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System, Report Sensitivity and Data Quality of the Injury Surveillance System, Ratchaburi Province, Thailand

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Abstract

Since 1993 when an injury surveillance system was established in Thailand, the central Ratchaburi Province has been consistently ranked high for traffic injuries. This study aimed to describe the operation and usefulness of the injury surveillance system at Ratchaburi Provincial Hospital, and assess the sensitivity and quality of the surveillance data. The study was carried out among the injured people who visited the emergency room and/or were admitted to Ratchaburi Hospital in 2011, including those who died upon or before arrival at the hospital. Data were collected from log books, the hospital database and interviews with key informants. The sensitivity of reports in the system revealed as 93.2% for injured patients, 71.3% for deaths upon arrival, and 67.7% for deaths before arrival. Of 33 variables assessed for data accuracy, 24 (72.2%) did not pass the standard of 90%, including age, systolic and diastolic blood pressure, pulse rate, respiratory rate, blunt/penetrating injury, diagnosis, region of injury, and severity of injury. The data were used for planning purposes and to conduct a trauma audit conference. In summary, the injury surveillance system at Ratchaburi Hospital was deemed to have a high sensitivity for detecting injured patients, yet low sensitivity for those dying before being assessed. To improve the sensitivity of reporting dead cases and quality of data, the hospital was recommended to provide annual trainings for personnel working for the surveillance system.

Keywords: injury, sensitivity, quality, accuracy, surveillance, Thailand

Introduction

An injury is the physical damage resulted when a human body is suddenly or briefly impacted with intolerable level of energy.[1] Signs and symptoms include pain, blood loss or bleeding, deformity, and organ dysfunction. Injuries can be categorized into intentional such as homicide or suicide, and unintentional like drowning, fall, burn or traffic accidents.[2]

The Bureau of Policy and Strategy in Thailand reported that during 2003-2010, the second highest fatality rate was recorded as injuries, following those of tumors and malignancies.[3] The average fatality rate for injuries in the past eight years was 56.7 per 100,000 population, with no sign of a decreasing trend. In 2014, traffic accidents were the highest cause of disability-adjusted life years (DALYs) among males and ranked sixth among females.[4]

An injury surveillance system with accurate and comprehensive data and trends is important for developing the effective strategies to reduce injuries in the population. Hence, a national injury surveillance system was established in Thailand during 1993 by the Bureau of Epidemiology, and the Regional Offices of Disease Prevention and Control under the Ministry of Public Health. The objectives of this system are to utilize the national injury data for improving services and referral system, and reducing injuries at the provincial and national levels.[5]

One of the methods for quality control of injury data is evaluation of the injury surveillance system. A general surveillance evaluation composes of assessing sensitivity, positive predictive value, data accuracy, completeness, timeliness, acceptability, simplicity, flexibility, stability and usefulness.[6]

Ratchaburi, a province in the western region of Thailand, was ranked second for the highest morbidity rate in 2007 with 14,749 injuries.[7] In 2011, the number decreased to 9,204 injuries, still making it the third highest in the western region.[8]

The injury surveillance is a complex system as more than 100 variables are collected and recorded, which need coding by the skillful officers. Although evaluation of the injury surveillance system could explain the magnitude and cause of problems, it had not been conducted in Ratchaburi Provincial Hospital for the past 10 years. Thus, the Ratchaburi Hospital was selected by comparing with standard values in the national guideline for evaluation of the injury surveillance system[9]. This evaluation was expected to highlight the critical flaws in the system which could then be targeted for further improvement.

The objectives of this study were to evaluate the injury surveillance system at Ratchaburi Hospital by describing the operation and usefulness of the system as well as assessing sensitivity, accuracy and completeness of the reports.

Methods

This surveillance evaluation was a descriptive study conducted between December 2012 and March 2013, and composed of both quantitative and qualitative assessments.

Qualitative Data Collection for Processes, Flow and Usefulness

Data collection forms and a semi-structured questionnaire were designed for interview with key informants, including nurses in emergency room and surgery intensive care unit, the chief of orthopedics department, the director of Ratchaburi Hospital, and a statistician. Contents of the questions were related to processes of the system, data collection and analysis, distribution and feedback of data to executives and officers, knowledge, workload, tools, policy, budget, usefulness of the system in terms of prevention and control[10], first aid, referral system, treatment, trauma audit, and problem solving. In addition, key informants were interviewed about co-operation among public health, local and other related organizations, obstacles, and recommendations. Data were analyzed using a content analysis method.

Quantitative Assessment for Sensitivity, Accuracy and Completeness of Data

The study population included people who had injury, visited the emergency room (ER) and/or were admitted to Ratchaburi Hospital during 1 January to 31 December 2011. People who were dead upon or before arrival during the same period were also included in the study. Among those who visited ER or hospitalized more than once, only first visit was selected for analysis.

Sample Size and Sampling

The sample size was calculated using the Cochran's formula, assuming the expected sensitivity, data accuracy and completeness of 0.9, and adding 10%. The final sample size was 189 cases. We stratified records into three groups: group 1 with injured patients who were discharged from ER or hospital; group 2 with patients who visited ER or hospitalized and later died from the injury, and group 3 with patients who died before arrival at the hospital. Patients in group 1 were selected using the systematic random sampling method[11,12]. Given that there were 365 days in the study period and the average daily number of injured patients who visited ER or hospitalized was 13, the days for data collection was calculated as 15 (189/13) days with an interval of 24 (365/15) days. The first date of data collection was selected by simple random sampling from the first 25 days of 2011. Data of all cases in 15 sampled days were included in the study.

Data of patients who were dead upon or before arrival were collected for every patient from the registration log book and the injury surveillance system during the same period.

For accuracy and completeness, we excluded those died before arrival (group 3) as their diagnoses were not specifically recorded in the system. The patient's medical records were matched with those in the surveillance system using hospital number and compared to determine the accuracy of the surveillance reports.

Three data collection forms were used to collect data from the ER log book, medical records and the injury surveillance system.

Data Analyses

The sensitivity values for all three groups were calculated separately based on the correct values of three variables: hospital number, injury date and cause of injury. Overall sensitivity was calculated using a weighted average of all three groups. An acceptable level of sensitivity was based on the national guideline for evaluation of the national injury surveillance from the Bureau of Epidemiology, 2010, including 90% for reporting injury patients and 80% for reporting deaths from injuries either upon or before arrival at the hospital.[9]

Data were analyzed for accuracy using 33 variables in 18 variable groups. The variable groups included hospital number, age, date of hospital visit, systolic and diastolic blood pressure, pulse rate, respiratory rate, (total) Glasgow coma score, status during the

injury (driver/passenger/pedestrian), vehicle, cause by 10th edition of international statistical classification of diseases (ICD-10) code[13], characteristics of injury, treatment result, discharge status, diagnosis[14], injury severity score (ISS), body region (BR), and severity of injury based on the abbreviated injury scale (AIS)[15]. The acceptable level of completeness was 90% of reports in the injury surveillance system having information of that variable[16].

This study was approved by the Human Research Ethical Committee of Mahidol University, Thailand (228/2555).

Results

Processes and Usefulness in Ratchaburi Hospital

Process of the injury surveillance system began when an injured patient visited ER of the hospital. An administrative clerk recorded information into the form during 08:30-16:30 on weekdays. Otherwise, injury surveillance forms were completed by ER nurses. The recorded forms were then checked and signed by nurses at ER. An officer from the Planning and Information Department of the hospital collected the completed forms every Monday, Wednesday and Friday, and entered the data into the injury surveillance program for both out-patients and in-patients. Afterwards, a medical statistician entered data of BR and AIS in the program for out-patients. For in-patients, diagnoses are based on ICD-10 code and were completed upon discharge. Data from the injury surveillance system were utilized for discussion in the monthly executive meetings in the hospital. Every three months, data from the injury surveillance system were sent to the Bureau of Epidemiology.

In Thailand, there are the "7 Dangerous Days Campaign" during the New Year and other related campaigns for specific festivals for traffic accident prevention. Data from the injury surveillance system in Ratchaburi Hospital were also sent to the Ministry of Public Health for the campaigns according to the national regulation. However, the officers who work for this surveillance system did not receive any feedback. During 2006 and 2010, data from the injury surveillance system were used in the annual trauma audit conference to search for service problems and make improvements. However, the trauma audit conference was not conducted since 2010 as the responsible doctor moved to another department.

Quantitative Assessment

Number of injury patients and sensitivity of reports during 2011 were presented in the figure 1. The sensitivity of the injury surveillance were 93.2% for patients visiting ER and/or admitted to the hospital, 71.3% for patients who died upon arrival at ER, and 67.7% for patients who died before arrival (Table 1). The overall weighted sensitivity was 89.3%.

On review of the medical records, 17 patients who died upon or before arrival at ER were incorrectly reported in the surveillance system. Of these, 13 showed the same hospital number and incorrect date of arrival at ER or cause of injury (Table 2). Four patients were not reported in the system based on the hospital number.

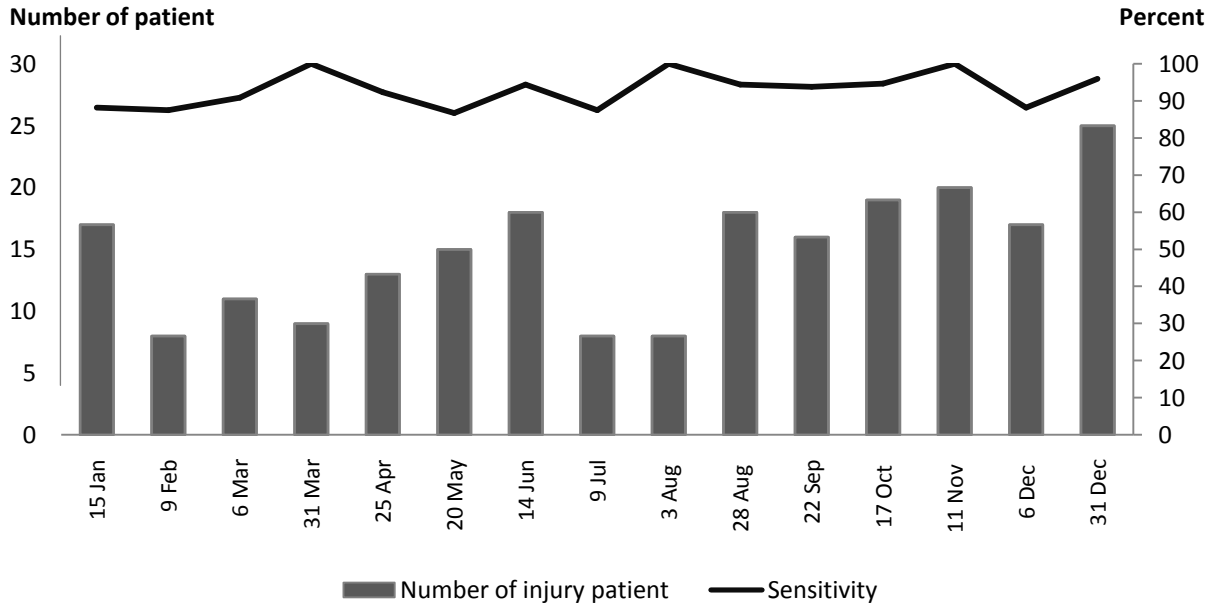

Figure 1. Injury patients visiting the emergency room and/or admitted to the provincial hospital and sensitivity of reports in the injury surveillance system during 15 sampled days, Ratchaburi Province, Thailand, 2011

Table 1. Sensitivity of injury surveillance reports by type of patient in Ratchaburi Hospital, Thailand, 2011

	Admitted	Died upon arrival	Dead before arrival
Number of injury patients recorded in the injury surveillance system	207	19	21
Number of injury patients registered in the log book of emergency room	222	26	31
Report sensitivity (%)	93.2	71.3	67.7
Evaluation criteria (%)	90.0	80.0	80.0
Interpretation	Pass	Fail	Fail

Table 2. Summary of injured patients who died upon or before arrival but were incorrectly reported in the IS system, Ratchaburi Hospital, Thailand, 2011

Description			Died upon arrival	Dead before arrival	Total
Hospital number	Visiting date	Cause of injury			
Same	Same	Different	3	3	6
Same	1 day different	Same	2	4	6
Same	>1 day different	Same	1	0	1
Not found in the system	-	-	1	3	4
Total			7	10	17

Of 33 variables assessed for accuracy, only nine passed (≥90% accurate). Apart from diagnosis, body region and abbreviated injury scale, completeness of all other variables was 100%. Of six possible diagnoses that were assigned to each patient, including severity of injury and body region, only the first diagnosis passed the completeness assessment (≥90% complete) (Table 3).

Discussion

Records of the injured patients who visited ER and/or were admitted to Ratchaburi Hospital were randomly selected and compared with the injury surveillance reports in the electronic database. The sensitivity of the injury surveillance reports (89.3%) was comparable to two hospitals in Canada which were reviewed by the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP)[17]. In our study, the data collection process at ER was found to have affected the sensitivity of the reports. Our sensitivity of 68-93% for the injury surveillance system in Ratchaburi Province was higher than that of the chikunganya surveillance system in Chonburi Province[18] and the dengue hemorrhagic fever surveillance system in Kampangphet Province of Thailand[19], which each had a sensitivity of 31% and 15% respectively. However, the latter two evaluations used data from the national notifiable disease surveillance system, for which many characteristics were needed to report and differed from those variables in the national injury surveillance system.

The sensitivity of reports for patients who died before arrival was lower than 90% as recommended by the national guideline. That might be due to our evaluation method which required information being similar for all hospital number, ER registered number and record number in the surveillance system. Twelve out of 17 records had incorrect date of visit or cause of injury though the hospital number was the same. Using a more flexible definition (same hospital number and either same cause of injury or same date of visit) with a reviewer's judgment, this sensitivity increased from 70% (40/57) to 91% (52/57).

In ER, senior nurses trained the junior ones about the injury surveillance reports. Apart from the nurses, there was another officer responsible for collecting data for the injury surveillance during daytime. Injury cases were very often easier to record than infectious or communicable disease surveillance reports since most injury cases were associated with easily identifiable causes. Therefore, the sensitivity of an injury surveillance system should be higher than those of other surveillance systems. Nonetheless, the sensitivity of reports of those dying upon or before arrival at ER resulted less than 80%. It might be due to the fact that those with the same hospital number, date of hospital visit, and cause of injury in both ER

logbook and reports in the injury surveillance system was classified as the same case. In fact, reports with date of hospital visit differing for one day could be the same case as well.

Accuracy of patient's age was less than 90%, probably because nurses collected the age from the screening page of medical records, which was provided directly by the patients. Age should be calculated from patient's date of birth, which was documented on the first page of medical records. Data accuracy of blood pressure level, pulse rate and respiratory rate were also less than 90%, which might be due to incorrect recording, rounding error, or high workload (service first and record later). When nurses were busy, another officer recorded information in the surveillance record forms only after the medical records were returned to the storage room. Thus, the data might not be as accurate as they could be.

The accuracy of all six diagnoses was less than 90% and ranged from 15% (diagnosis 4) to 77% (diagnosis 1). Incorrect diagnoses might be due to missing or incomplete diagnosis by the attending ER doctor or

Table 3. Accuracy and completeness of data in the injury surveillance reports by variables recorded, Ratchaburi Hospital, Thailand, 2011

Variable	Number of case	Evaluation			
		Accuracy (%)	Interpretation	Completeness (%)	Interpretation
Hospital number	186	100	Pass	100	Pass
Age	186	88.2	Fail	100	Pass
Date of hospital visit	186	96.2	Pass	100	Pass
Systolic blood pressure	186	81.2	Fail	100	Pass
Diastolic blood pressure	186	82.8	Fail	100	Pass
Pulse rate	186	86.6	Fail	100	Pass
Respiratory rate	185	82.2	Fail	100	Pass
Glasgow coma score	182	92.9	Pass	100	Pass
Status of patient	186	98.9	Pass	100	Pass
Vehicle	186	97.3	Pass	100	Pass
Cause	186	92.5	Pass	100	Pass
ICD-10 cause	186	87.6	Fail	100	Pass
Characteristics of injury	186	84.9	Fail	100	Pass
Treatment result at the emergency room	186	98.4	Pass	100	Pass
Diagnosis 1	186	76.9	Fail	97.8	Pass
BR 1	186	93.5	Pass	97.8	Pass
AIS 1	186	78.0	Fail	97.8	Pass
Diagnosis 2	105	41.9	Fail	56.2	Fail
BR 2	105	55.2	Fail	56.2	Fail
AIS 2	107	45.7	Fail	56.2	Fail
Diagnosis 3	47	21.3	Fail	27.7	Fail
BR 3	47	25.5	Fail	27.7	Fail
AIS 3	47	23.4	Fail	27.7	Fail
Diagnosis 4	20	15.0	Fail	15.0	Fail
BR 4	20	10.0	Fail	15.0	Fail
AIS 4	20	15.0	Fail	15.0	Fail
Diagnosis 5	9	22.2	Fail	22.2	Fail
BR 5	9	11.1	Fail	22.2	Fail
AIS 5	9	22.2	Fail	22.2	Fail
Diagnosis 6	4	25.0	Fail	25.0	Fail
BR 6	4	25.0	Fail	25.0	Fail
AIS 6	4	25.0	Fail	25.0	Fail
Status at hospital discharge	185	96.8	Pass	98.4	Pass

ICD-10 = International Classification of Disease version 10, BR = Body region, AIS = Abbreviated injury scale

code error. The coder might record it into a wrong code in the injury surveillance data using ICD-10 codes, without reviewing medical records. Nurses might record wrong diagnosis in the surveillance record form as well. Low accuracy of diagnosis also affected the accuracy of the severity of injury which was used to calculate the probability of survival[5] in the trauma audit conference. For completeness, most variables showed values more than 90% and many were 100% complete. One possible reason for this result was that nurses in ER set a high priority for recording data in the paper record forms for the injury surveillance.

The trauma audit conference could be resumed and continued if officers perceived the usefulness of the injury surveillance system. In addition, data accuracy should be improved in order to estimate the survival probabilities more accurately.

In 2012, a specialist ER doctor was assigned to conduct the regular trauma audit conferences in Ratchaburi Hospital.

Recommendations

Annual training should be conducted in the hospital for all recorders in the injury surveillance on recording data correctly and in a standardized way. The trauma audit conferences should be set as a key performance indicator of hospitals in 2014. There should be an internal discussion between doctors and officers about calculation of survival probabilities, followed by organizing a meeting about the survived patients with a low probability of survival.

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