A road traffic injury surveillance system using combined data sources in Peru

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ABSTRACT *A national hospital-based nonfatal road traffic injury surveillance system was established at sentinel units across Peru in 2007 under the leadership of the Ministry of Health. Surveillance data are drawn from three different sources (hospital records, police reports, and vehicle insurance reports) and include nonfatal road traffic injuries initially attended at emergency rooms. A single data collection form is used to record information about the injured, event characteristics related to the driver of the vehicle(s), and the vehicle(s). Data are analyzed periodically and disseminated to all surveillance system participants.*

Results indicated young adult males (15–29 years old) were most affected by nonfatal road traffic injuries and were most often the drivers of the vehicles involved in the collision. Four-wheeled vehicle occupants comprised one-half of cases in most regions of the country, and pedestrians injured in the event accounted for almost another half.

The system established in Peru could serve as a model for the use of multiple data sources in national nonfatal road traffic injury surveillance. Based on this study, the challenges of this type of system include sustaining and increasing participation among sentinel units nationwide and identifying appropriate prevention interventions at the local level based on the resulting data.

Key words Accidents, traffic; health surveillance; emergency medical services; external causes; Latin America; Peru.

The World Health Organization (WHO) World Report on Road Traffic Injury Prevention (1) recommends governments "implement simple and cost-effective information systems on road traffic deaths and injuries, appropriate to the skill levels of the staff using them, and consistent with national and international standards." However, many countries lack reliable data on road traffic crashes and resulting fatalities and injuries. In the Americas, road traffic injuries rank 10th among the leading causes of mortality and sixth among the leading causes of disability adjusted life years (DALYs) in low- and middle-income countries. Some of the highest rates of road traffic deaths in the world occur in Latin American countries, including El Salvador, Brazil, and Venezuela, where 42.2, 24.0, and 22.7 lives respectively per 100 000 are lost in road traffic accidents (1).

In Peru, a country with nearly 30 million people, the Ministry of Health (*Ministerio de Salud*, MINSA) estimated that in 2004 there were 3 166 road traffic-related deaths—11.5 per 100 000 population, and 242.5 per 100 000 vehicles (2). State mortality rates varied widely, from a low of 4.1 in Arequipa to a high of 22.6 in Puno (both per 100 000 population). Results by road user type indicated the highest rate of mortality occurred among occupants of four-wheeled vehicles. According to the police, 70% of factors contributing to road traffic injuries

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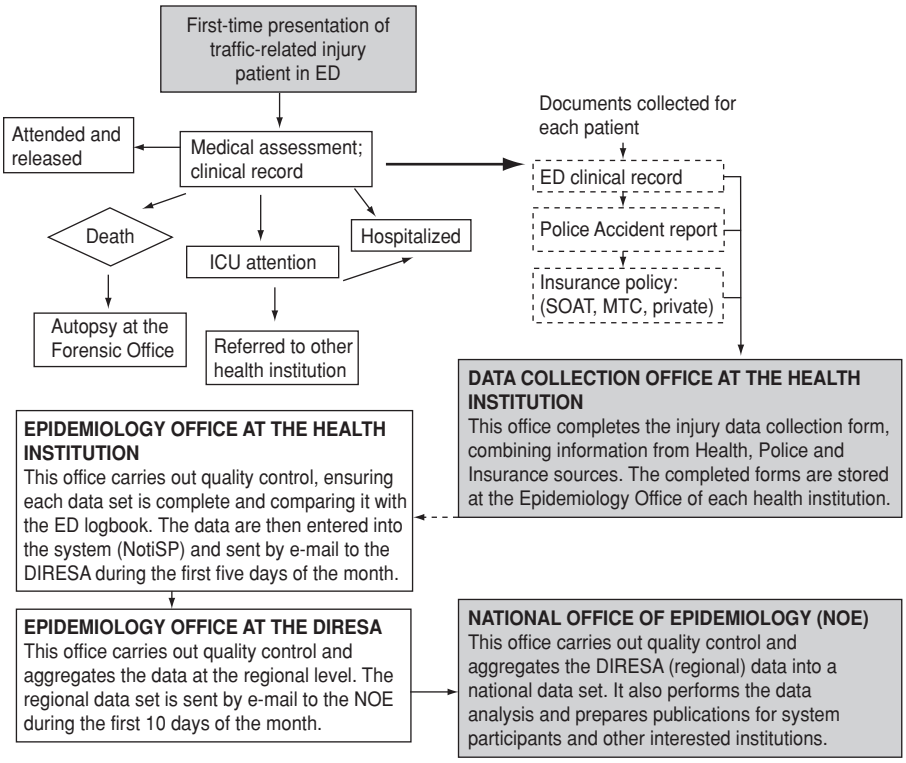
were driver-related (e.g., speeding, drunk driving, breaking traffic rules, etc.) (3). Another 10% was related to actions by pedestrians injured in the collision, almost 4% to mechanical problems of the vehicle involved, 2% to the physical environment, and 14% to other factors.

Mandatory insurance for car owners in Peru (*Seguro Obligatorio de Accidentes de Tránsito*, SOAT) covers the expenses of road traffic injury victims (4). Health institutions such as hospitals have an office dedicated to the collection of information from the police report, and from the injured party's insurance policy (to obtain reimbursement for his/her health care expenses). Using data from these three sources (health facilities, police departments, and insurance companies), MINSA led the establishment of a national nonfatal road traffic injury surveillance system. This report describes the design, implementation, strengths, and limitations of the Road Traffic Injury Surveillance System (*Sistema de Vigilancia de las Lesiones de Tráfico*, RTISS) implemented nationwide in 2007.

At the national level, road safety in Peru is the responsibility of both the Ministry of Transportation and Communication (MTC) and the police, with the function of MINSA restricted to trauma care following road traffic crashes. However, two local injury surveillance systems have been established in Peru, each led by the health sector. The first was a road traffic injury surveillance system established in 1998 in Callao—a port city adjacent to the capital city of Lima—that comprised various institutions and sectors related to road traffic events. One of the unique components of this innovative program was its information system, which combined police department and health facility data (5). Strategies implemented in Callao as a result of the data generated by this system included 1) stricter seat belt enforcement by police officers, 2) increased traffic calming around schools, 3) more regulation of public transportation, and 4) better road safety education for drivers of government vehicles. From the launch of the system in 1998 to 2002, Callao's road traffic fatalities dropped from 110 to 60 cases. The second local system was established at Cayetano Heredia National Hospital in Lima, with the support of the Pan American Health Organization (PAHO). A pilot test of the system implemented from November 2003 to March 2004 revealed that 71% of all emergency room visits were due to road traffic injuries.[6]

FIGURE 1. Data collection process for nonfatal road traffic injury surveillance system, Peru, 2007



Note: ED: Emergency Department; ICU: intensive care unit; SOAT: mandatory insurance for car owners in Peru (*Seguro Obligatorio de Accidentes de Tránsito*); MTC: Ministry of Transport & Communication; DIRESA: regional health office (*Dirección Regional de Salud*); NotiSP: software program created specifically for the Road Traffic Injury Surveillance System; NOE: National Office of Epidemiology.

The national RTISS was established in 2005, led by MINSA's National Office of Epidemiology (*Oficina General de Epidemiología*, OGE). The objective was to produce timely and reliable information about the effects of traffic crashes on the health of Peruvian communities. A group of technical experts known as the Traffic Accident Prevention Team was formed at the OGE's Office of Disasters and Emergencies (*Oficina de Desastres y Emergencias*, ODE). In 2005, at a meeting of RTISS participants from different regions of the country, a training course on injury surveillance was conducted by the OGE with technical support from the U.S. Centers for Disease Control and Prevention (CDC) National Center for Injury Prevention and Control (NCIPC). The purpose of the training was to educate participants about the RTISS methodology.

The training was provided to all RTISS personnel, and a pilot test of the system was conducted in 2005. A national technical standard (*norma técnica* in Spanish) for management of road traffic injuries (6), originally issued in 2007, formally established the RTISS in sentinel hospitals nationwide (both public and private).

The RTISS was first established in 2006 in sentinel units in Arequipa, Cajamarca, Callao, Cusco, Junín, La Libertad, Lambayeque, Lima, Loreto, and Piura. In 2007 the system was officially established in three more provinces (Ica, Puno, and Tumbes), and in 2008 another nine provinces were incorporated. By 2009, sentinel units in 23 of the 24 provinces in Peru (all except Ancash) were participating in the national surveillance system.

MATERIALS AND METHODS

Data collection for the RTISS is initiated when a patient with a nonfatal traffic-related injury seeks medical attention at a sentinel unit (a health facility participating in the sentinel system) (Figure 1). The sentinel unit's epidemiol-

[6] Cisneros G. Injury Surveillance System in Cayetano-Heredia Hospital. Lima, Peru. Paper presented at the Injury Surveillance Training Course in Lima, Peru. August 22–26, 2005.

ogy office prepares a binder for each road traffic injury patient. The binder contains the clinical record, which is prepared at the health facility; the police report describing the characteristics of the accident; the insurance affiliation card, which documents the insurance policy; and a blank surveillance data collection form.

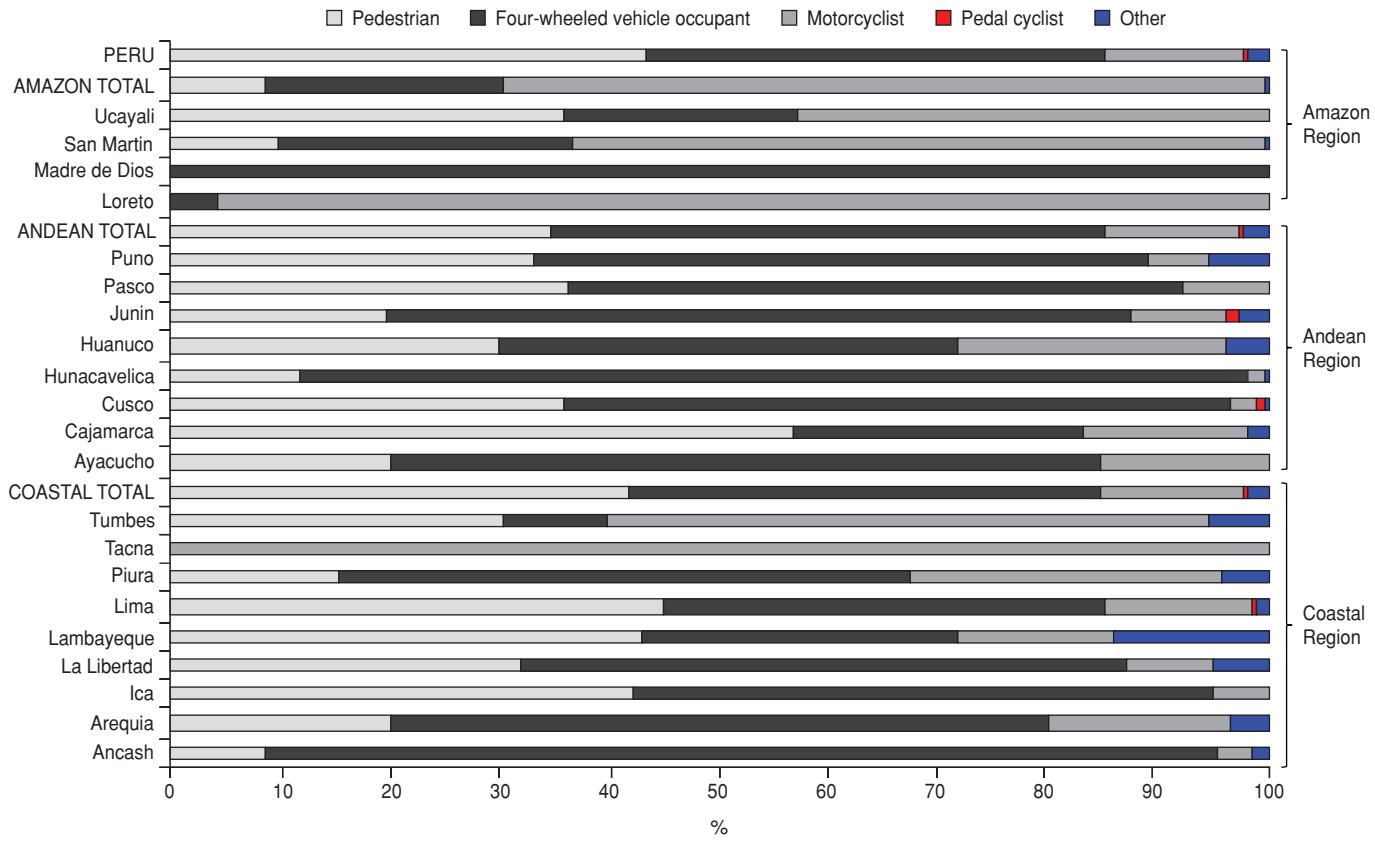
The surveillance data collection form combines the information from all three data sources (the health facility, the police department, and the insurance company) (Annex 1). The forms are completed, reviewed for quality control, and stored at the sentinel unit's epidemiology office. To identify missing cases, the forms are compared with the sentinel unit's emergency department registration logbook. Data entry is performed using NotiSP, a software program created specifically for the RTISS. During the first five days of each month, the information is forwarded by e-mail to the epidemiology office of the regional health office (*Dirección Regional de Salud*, DIRESA). At the DIRESA, further quality control is carried out and the data are aggregated at the state level. During the first 10 days of each month, the aggregated data are forwarded by e-mail to the OGE. The OGE is responsible for 1) conducting further quality control, 2) aggregating the data from the DIRESAS into a national data set, 3) coordinating the system at the national level, and 4) performing data analysis at the national level. Every three months, the OGE reports the results to the principal RTISS partners and participants (including the National Health Strategy for Road Traffic Injury Prevention Group [*Grupo de la Estrategia Nacional de Salud para la Prevención de Lesiones de Tránsito*], a special office created in MINSA as part of the Integrated Health Model [*Modelo Integral de Salud*, MIS]; each DIRESA; the epidemiology offices at the sentinel units; and decision-makers from the Road Security Council [*Consejo Nacional de Seguridad Vial*, CNSV], the institution in charge of national road safety).

RESULTS

Treatment facility information

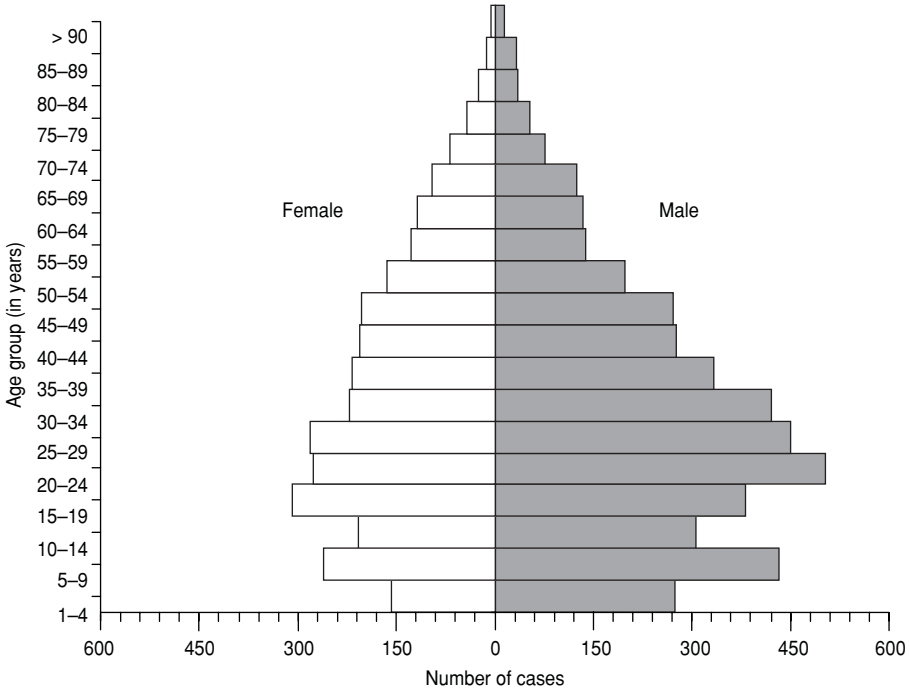
Nonfatal injuries by state. A total of 19 817 nonfatal injuries were recorded at RTISS sentinel units during 2007 and 2008, 56.7% of which were registered in Lima. There were an average of 900 injuries per province during the study period, ranging from three cases in Madre de Dios (in the Amazon region) to 11 252 cases in the Lima metropolitan area (data not shown). Across the three main regions of the country (coastal, Andean, and Amazon) there were differences in frequency of cases by type of road user (Figure 2). For example, in the coastal region, which comprises the capital city of Lima, four-wheeled vehicle occupants and pedestrians were most affected by nonfatal injuries, and represented more than one-half of all cases in the Andean region, whereas in the Amazon region motorcyclists accounted for 69.5% of cases.

FIGURE 2. Aggregated data on nonfatal road traffic injuries for 23 provinces, by road user type and province (location of sentinel unit), Peru, 2007–2008



Note: pedestrian: person injured while walking; four-wheeled vehicle occupant: injured driver and/or passenger of vehicle; motorcyclist: injured driver and/or passenger of motorcycle and/or motorcar; pedal cyclist: person injured while riding bicycle; other: person injured as occupant of animal-drawn vehicle, animal cart, train, water transport, etc.

FIGURE 3. Aggregated number of nonfatal road traffic injuries recorded by sentinel units in 21 provinces, by age group and sex, Peru, 2007–2008



Source: Road Traffic Injury Surveillance System, Ministry of Health, Peru.

Nonfatal injuries by age, sex, diagnosis, and length of stay. The highest number of cases occurred among males 20 to 34 years old and 5–9 years old. Among females the higher frequency was registered in the group 15 to 29 years old and 5–9 years old (Figure 3). Analysis of MINSA data on road traffic deaths for 2007 revealed a similar pattern for men, with a higher number of cases in the group 20–29 years old.

The most common clinical diagnosis for nonfatal road traffic injuries was polytraumatism (23%). The average length of stay for cases that required hospitalization was 7.7 days (ranging from 1 to 297 days) (data not shown).

Insurance policy information

Characteristics of transport to care and insurance coverage. The method of transport to care was recorded for 87% of cases. Data indicated that only 4% of cases were transported by ambulance, with the rest transported by nonmedical personnel, including the driver of a vehicle involved in the crash (23%), the police (23%), relatives of the injured (15%), firefighters (9%), the injured themselves (6%), and bystanders (7%). Data from insurance policies indicated most cases were covered by SOAT (87%), with only 4% of cases covered by a private source.

Police report data

Characteristics of car driver. Information from the police report indicated that 1) 98% of car drivers involved in nonfatal road traffic injuries were male; 2) most were in the 20–39 year age group; and 3) 22.1% (4 388) had a driver's license, 9.2% (1 824) did not, and for 68.6% (13 605) the information was not recorded. According to general data from the police, the overall percentage of drivers with a license is 93%, but there are significant differences by state (i.e., in Tumbes, in the coastal region, only 42% of drivers have a driver's license).

DISCUSSION

Various types of injury surveillance systems have been implemented in Latin America in recent years. Most are based on health facility records, while others aggregate data from police and hospital records. These systems initially focused on the collection of mortality data, but eventually incorporated nonfatal injury data. Some use combined data from health, police, forensic medicine, and transportation authorities (7–11)[7] to improve the quality and scope of their information. Studies that have collected and compared information from the health sector and the police have revealed differences in mortality, morbidity, and severity of injury by data source (12–14).

With the support of PAHO, the CDC, the Institute for Peace Promotion and Injury/Violence Prevention (*Instituto de Investigación y Desarrollo en Prevención de Violencia y Promoción de la Convivencia Social*, CISALVA), and other organizations, regional, hospital-based, nonfatal injury surveillance systems have been established in Central America (El Salvador and Nicaragua) and some cities in Colombia (Cali, Santander de Quilichao, and Pasto) (15–17).[8] Nevertheless, Latin American surveillance of nonfatal road traffic injuries using combined data, remains uncommon. The RTISS system implemented in Peru is the first to collect nonfatal road traffic injury data at the national level, combining three different data sources, and led by the Ministry of Health.

Although the RTISS is relatively new, it has already provided evidence of the advantages of using different types of road traffic injury data (e.g., health facility, police department, and insurance company) collected for different purposes (e.g., health facility data on injury diagnoses versus police department data on injury victims' method of transport to care). This system is the first step toward a better understanding of the large number of road traffic injuries in Peru that fall outside the realm of fatalities and are therefore not included in traditional surveillance. The key methodological innovation of the system is the process in which it combines three data sources (health, police, and insurance) to produce a unique data set (nonfatal road

[7] Espitia V, Guerrero R, Gutierrez M, Concha-Eastman A, Espinosa R. Ten years of a fatal injury surveillance system using linkage data. Cali, Colombia, 1993–2002. Abstract presented at the 7th World Conference on Injury Prevention and Safety Promotion, Vienna, 6–9 June 2004.

[8] Mascarenhas MD, da Silva MM, Malta DC, Gawryszewski VP, de Moura L, Costa VC, et al. Building a violence and injury surveillance system: the Brazilian approach. Abstract presented at the 9th World Conference on Injury Prevention and Safety Promotion, Merida, Yucatan-Mexico, March 2008.

traffic injuries registered in sentinel units in the country). By incorporating data normally collected only by police departments and insurance companies (e.g., information on the driver of the vehicle, including his/her age, driver's license status, and insurance policy), the RTISS results can be used to guide various prevention strategies, such as those targeting age groups frequently involved in road traffic injuries.

RTISS data indicate that adult males 15–29 years old accounted for the highest number of nonfatal road traffic injuries and were most often the drivers of the vehicle(s) involved in the collision. The data also showed that in regions other than the Amazon, occupants of four-wheeled vehicles comprised one-half of the cases, with pedestrians accounting for almost another half. Despite these statistics, interventions specifically targeting these high-risk groups remain lacking. In the Amazon region, the most commonly injured road users were motorcyclists and occupants of three-wheeled vehicles known as "moto-taxis" or "moto-cars." Although Peru has a national helmet law, according to WHO, actual use of helmets—and enforcement of the law—is very low (18).

The RTISS data also indicate a need for improvement in pre-hospital care. According to police reports, only 5% of road traffic injury patients are transported to health facilities by ambulance. For areas where there is no pre-hospital trauma care system, the provision of basic training in first-aid techniques to interested community members is one of the recommendations of WHO (19). These unofficial "first responders" could be taught to recognize an emergency, call for help, and provide treatment until the arrival of formally trained health care personnel. As recommended by WHO, it may be possible to identify particularly motivated or well-placed members of the community, such as taxi drivers, or community leaders, and target them for more comprehensive training. In addition to learning a more extensive range of first-aid skills, this group could be taught the basic principles of safe rescue and transport. With this level of training, a kit of simple equipment and supplies, and access to a suitable vehicle, these individuals could provide an acceptable level of trauma care while transporting an injured person to an appropriate health care facility.

This type of training was tested in Ghana, between 1998 and 2000, when a total of 335 commercial drivers participated in a first-aid program designed to provide pre-hospital care training at an appropriate educational level. It relied heavily on demonstrations of care, active learning, and practice sessions rather than on didactic lectures and written material. The efficiency of the course was assessed by comparing self-reports on the process used for pre-hospital care provided before the course with self-reports of the process of care provided after the course. The follow-up evaluation indicated 61% had provided first aid since taking the course, and there was considerable improvement in the type of first aid they had provided. In one evaluation two years after the course, nurses scored the drivers' actions on a scale from 0 (potentially harmful) to 10 (perfect). Scores for the first aid provided by 50 trained drivers were notably higher (median = 7) than those for a comparison group of 19 untrained drivers (median = 3). The actual financial cost of the course was US$ 4.00 per driver (19). In Peru, similar first-aid training could be designed for police personnel and firefighters, who transported 30% of the country's road traffic injury victims.

Limitations of the RTISS include the following staff-related deficits: insufficient number of staff, and frequent turnover; lack of motivation and inadequate data analysis skills; and low interest in using the data collected by the system. In addition, as a sentinel system the RTISS is not population based and is not implemented at all health facilities nationwide. Therefore, the data generated by the system may be better suited for informing local versus national strategies.

To overcome these limitations, periodic training should be established and conducted by the DIRESA epidemiology offices, emphasizing the importance of proper data collection, implementation of the system's methodology, and data analysis as well as the usefulness of the results. Monthly reports at both the national and regional level should be prepared and disseminated to system participants as well as decision-makers. Police and insurance personnel should be involved in planning prevention strategies based on the results of the data analysis.

The RTISS data contain valuable information about road traffic injuries treated in hospitals. This information can be used to help inform prevention strategies at the local and national level. The following recommendations can be used as guidelines for developing appropriate data sets:

- Monitor registered cases at each health facility to identify high-risk groups;
- Identify the human and material resources required to treat road traffic injury patients at each health facility at both the regional and national level;
- Analyze trends in road traffic injuries by municipality and region, illustrating differences across regions;
- Monitor prevention strategies applied at all levels (local, regional, and national);
- Provide timely and reliable information to decision-makers in different sectors involved in the system (health, police, insurance, and transportation authorities);
- Provide the following information to university researchers and other investigators seeking information on this topic: 1) analysis of injuries of car drivers versus those of other road users in terms of part of the body affected, cost, type of accident, severity, etc.; 2) number of young male drivers injured versus number and age of car passengers involved in the event; 3) type of vehicles most frequently involved in pedestrian injuries in the Lima metropolitan area; 4) pre-hospital care for injured persons, by region and type of road user; 5) analysis of road traffic injuries in car passengers under 12 years old, and any correlation with child prevention measures.

The RTISS established in Peru could serve as a model for other low- and middle-income countries that wish to take advantage of the availability of multiple sources of information on national road traffic injuries. While the system is not population based, it is the first step toward attaining a better understanding of the plethora of road traffic injuries treated at health facilities nationwide. What makes the system unique is its innovative methodology combining information from three data sources—health facilities, police departments, and insurance companies—to create a rich set of data on nonfatal road traffic injuries occurring nationwide.

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Disclaimer. The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention (CDC) or the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR).

ANNEX 1. Data collection form used in nonfatal road traffic injury surveillance system, Peru, 2007

I. Source of payment: SOAT (Car insurance) ☐ MTC ☐ Private ☐

II. Related to the injured person *(Clinical record)*

1. # of Emergency Clinical Record _____ 2. # of Admitted Clinical Record _____
2.1. Referred from EESS ☐ Name of the EESS _____
3. Full name of injured person _____
4. DNI ___ ___ ___ ___ ___ ___ ___ ___ 5. Age_____ 6. Sex 6.1 ☐ Male 6.2 ☐ Female
7. Resident's address: 7.1 Ave/Street/ _____
7.2 District _____ 7.3 Province _____ 7.4 State _____
8. Date of presentation at the hospital ____ ____ /____ ____ /____ ____ 9.Time ____: ____ (hour/minutes)
10. Medical diagnosis: Dx. 1: _____ ICD 10 codes
Dx. 2: _____ ____ ____ ____
Dx. 3: _____ ____ ____ ____
11. Discharged date: __ __ /__ __ /__ __
12. Discharged status: 12.1 Alive ☐ 12.2 Died ☐ 12.3 ☐ Referral to: _____
12.4 Require rehabilitation: Yes ☐ No ☐

III. Related to the accident *(Police report)*

13. Date of accident: ____ ____ /____ ____ /____ ____ 14. Time ____: ____ (hour/minutes)
15. Place of occurrence: 15.1 Ave/Street/ _____
15.2 District _____ 15.3 Province _____ 15.4 State _____
16. Street where accident occurred 17. Type of accident
16.1 ☐ Streets/boulevard 17.1 ☐ Pedestrian
16.2 ☐ Avenues 17.2 ☐ Crash 17.2.1 ☐ Mobile object 17.2.2 ☐ Fixed object
16.3 ☐ Roads 17.3 ☐ Roll over
16.4 ☐ Highway 17.4 ☐ Vehicle occupants ejected 17.5 ☐ Other _____

A. Related to injured person

18. The injured person was in:
18.1.1 Motorcycle ☐ 18.2.1 Bicycle ☐
18.1.2 Motorcar ☐ 18.2.2 Horse car ☐
18.1.3 Automobile ☐ 18.2.3 Airplane ☐
18.1.4 Microbus ☐ 18.2.4 Helicopter ☐
18.1.5 Omnibus ☐ 18.2.5 Boat with motor ☐
18.1.6 Truck/trailer ☐ 18.2.6 Boat without motor ☐
18.1.7 Train ☐
19. Place of injured person:
19.1 Passenger ☐
19.2 Driver ☐
19.3 Pedestrian ☐
20. Who transported the injured person
20.1 Involved person ☐ 20.4 Guard ☐ 20.7 Firefighter ☐
20.2 Relative ☐ 20.5 Private ☐ 20.8 Ambulance
20.3 Alone ☐ 20.6 Police ☐

B. Related to involved person

21. Type of vehicle
21.1.1 Motorcycle ☐ 21.1.1 Bicycle ☐
21.1.2 Motorcar ☐ 21.1.2 Horse car ☐
21.1.3 Automobile ☐ 21.1.3 Other ☐
21.1.4 Microbus ☐ 21.1.4 Airplane ☐
21.1.5 Omnibus ☐ 21.1.5 Helicopter ☐
21.1.6 Truck/trailer ☐ 21.1.6 Boat with motor ☐
21.1.7 Train ☐ 21.1.7 Boat without motor ☐
22. Type of vehicle involved ☐
22.1 Private owner ☐
22.2 Public ☐
22.3 Government ☐
22.4 Private company ☐

IV. Related to the driver of vehicle involved *(Insurance and Police report)*

23. Full name of vehicle's driver _____
24. Age_____ 25. Sex ☐ 25.1 Male ☐ 25.2 Female ☐
26. # Driver license: 26.1 ☐ Yes # _____ 26.2 No ☐ 26.3 Unknown ☐
27. Denounce Police office_____ 27.1 State_____ 27.2 Province _____ 27.5 District _____

V. Related to vehicle involved *(Insurance policy)*

28. No. insurance police (SOAT) _____ 29. Vehicle tag_____
30. Name of insurance police owner (SOAT) _____
31. Insurance company: 31.1 Rimac ☐ 31.2 Pacifico seguros ☐ 31.3 La Positiva ☐ 31.4 General Peru ☐
31.5 Mapfre Peru ☐ 31.6 Latino seguros ☐ 31.7 Other _____

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RESUMEN

Sistema de vigilancia de traumatismos por accidentes de tránsito con fuentes de datos combinadas en el Perú

Con el liderazgo del Ministerio de Salud, en el 2007 se estableció un sistema hospitalario nacional de vigilancia de traumatismos no mortales por accidentes de tránsito en unidades centinela de todo el Perú. Los datos de vigilancia se extraen de tres fuentes diferentes (registros hospitalarios, informes policiales e informes del seguro del vehículo) e incluyen los traumatismos no mortales por accidentes de tránsito atendidos inicialmente en las salas de urgencia. Se usa un único formulario de recopilación de datos para registrar la información sobre los heridos, las características del hecho relacionadas con el conductor o los conductores de los vehículos y del vehículo o los vehículos involucrados. Los datos se analizan periódicamente y se comunican a todos los participantes del sistema de vigilancia.

Los resultados indicaron que los hombres adultos jóvenes (de 15 a 29 años) fueron los más afectados por traumatismos no mortales por accidentes de tránsito y con mayor frecuencia eran los conductores de los vehículos que participaron en la colisión. Los ocupantes de vehículos de cuatro ruedas representaron la mitad de los casos en la mayoría de las zonas del país y los peatones lesionados en el hecho representaron prácticamente la otra mitad.

El sistema establecido en el Perú podría servir de modelo del uso de múltiples fuentes de datos para la vigilancia a nivel nacional de traumatismos no mortales por accidentes de tránsito. Según los resultados de este estudio, los retos de un sistema de este tipo consisten en mantener y aumentar la participación de las unidades de vigilancia de todo el país y determinar las intervenciones de prevención adecuadas en el nivel local según los datos obtenidos.

Palabras clave Accidentes de tránsito; vigilancia sanitaria; servicios médicos de urgencia; causas externas; América Latina; Perú.