

Observatory of the Americas

**A SYSTEM FOR OCCUPATIONAL INJURY
SURVEILLANCE IN PIRACICABA,
SOUTHEASTERN BRAZIL**

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ABSTRACT

This article describes the experience of developing the Occupational Injury Surveillance System in the city of Piracicaba, in upstate São Paulo, Brazil. The system has the following characteristics: the information entered into the system is obtained directly, in real time, where the injured individuals receive medical treatment; the system has universal coverage, including all accidents occurring on the job in Piracicaba regardless of the worker's employment status, workplace, and place of residence; the health monitoring and promotion actions are activated in response to the identification of sentinel events; and the analysis of spatial distribution of occupational injuries is a basic tool for elaborating strategies for treating the injured as well as policies for accident prevention. The system began operating on November 1, 2003. 10,777 occupational injuries had been identified by October 31, 2005, corresponding to an annual incidence proportion of 3.8% in the city. We present a brief description of a detailed investigation of one of the injuries.

In 2002, a multi-institutional initiative was launched in the city of Piracicaba, in southeastern Brazil, to develop the technology needed to prevent occupational injuries: the Project for the Diagnosis and Control of Occupational Injuries in Piracicaba (*Diagnóstico e Controle de Acidentes do Trabalho em Piracicaba*—DIATEP). This experience was recently reported on by Cordeiro and collaborators [1]. In this article, the coordinators of the DIATEP project describe the occupational injury information management system.

Occupational accidents constitute the greatest safety and health problem for Brazilian workers [2]. Despite what the name suggests, they are not accidental or fortuitous events [3], but rather socially determined phenomena that are predictable and preventable. They occur under specific work conditions and are determined by the relations established in the production process. They are events influenced by factors related to the immediate working conditions, such as machinery, job tasks, and technical or material means, as well as organization of work and work relations in a broader context [4].

Since 1970, when systematic record-keeping was initiated on a national level, more than 30 million accidents have been reported in Brazil, causing 100,000 preventable deaths among young and productive Brazilians. An obstacle to planning and implementation of occupational injury prevention policies in the country is the questionable validity of the information available, which has been contested by various authors [5].

Official Brazilian statistics on occupational injuries are produced by the Ministry of Social Insurance and Assistance with the exclusive aim of monitoring compliance with health insurance regulations. Only a segment of the workers formally employed in the country, approximately 25% of the economically active population, is covered by this information system. Even for this limited population, the system suffers from under-reporting of occupational injuries [6].

The under-reporting of injuries among formal workers is only one aspect of the difficulty of obtaining valid information about occupational injuries in Brazil. Added to this is the complete lack of knowledge regarding what occurs in the informal sector of the Brazilian economy. There is no information system that includes this sector, which comprises more than 50% of the economically active population [7] and continues to grow. Taking into consideration the total number of workers, it is estimated that for every ten occupational injuries that occurred in Brazil, only one is reported [8].

Notification of workers' health injuries has been the object of concern of health policymakers in Brazil since the 1980s, when a new constitution was enacted, as illustrated by state and municipal initiatives to create programs and referral centers for occupational health. Such experiences have sought to respond to the deficient interventions on the part of federal institutions as well as the medical services provided by companies. These initiatives proposed a more integral action related to work-related morbidity and mortality, linking care to monitoring activities and counting on worker participation [9].

As a result of a historical process of mobilization of Brazilian civil society to achieve universal health care coverage, the *Sistema Único de Saúde—SUS* (Unified Health Care System) was enacted as part of the Federal Constitution of 1988. The system is composed of a set of activities and health services provided by federal, state, and municipal agencies and institutions or affiliated organizations. Occupational health surveillance was incorporated into public health policy through specific regulations for the SUS included in the Organic Health Law (Laws no. 8.080 and no. 8.142, 1990). It became possible only when it was agreed upon, within the health sector and in all of Brazil, that occupational health is a non-debatable duty of the public health sector that should be addressed by a set of public policies aiming at preventing health injuries in the Brazilian workforce. From that point on, occupational health also became the responsibility of public health professionals, conferring upon them the prerogative of conducting workplace surveillance, which had previously been the exclusive duty of the Ministry of Labor and Employment.

Occupational health surveillance requires an organizational network that is larger than individuals and their representative organizations, such as unions, and includes research and human resource development, as well as provision of health care and rehabilitation for workers. The formulation of public policies to address this issue requires reliable information about the distribution, characterization, and determinants of work-related injuries.

This article describes the surveillance system for serious and fatal occupational injuries under development in the city of Piracicaba, in upstate São Paulo, which seeks to inform the discussion about public policies related to monitoring and prevention of these injuries, and contribute to the improvement of occupational injury information systems in Brazil.

IMPLEMENTATION OF THE SYSTEM

The city of Piracicaba, with a population of approximately 350,000, has a complex, diversified industrial park that includes businesses from the metallurgical, mechanical, paper and cardboard, food, and energy (ethanol production for fuel) sectors [10]. The economically active population in the city was estimated to be 138,913 workers in 2003: 86,542 in the formal labor market and 52,370 in the informal labor market of the economy [11].

In January 2002 the city launched a multi-institutional project involving local universities, the municipal government, and the Ministry of Labor and Employment, with the general objective of producing information and, above all, technology for action that would be useful for the planning and implementation of an effective policy to prevent occupational injuries in Piracicaba.

One of the activities of this project was the implementation of the Work-Related Injury Monitoring System (*Sistema de Vigilância de Acidentes do Trabalho—SIVAT* Piracicaba), which has the following characteristics:

- 1) the information entered into the system is obtained directly, in real time, where the injured individuals receive medical treatment;
- 2) the system has universal coverage extending to *all* occupational injuries *occurring* in Piracicaba, regardless of the formality of the worker's employment status, work site, and place of residence;
- 3) the health monitoring and promotion actions are activated in response to the identification of sentinel events [12, 13];
- 4) the analysis of the spatial distribution of occupational injuries, as well as the occupational risks associated with them, is a basic tool for developing strategies to care for the injured and policies for injury prevention.

In Piracicaba, workers who demand medical care for occupational injuries are cared for at eight different locations: five municipal emergency care facilities, two private hospitals, and one philanthropic hospital. As a result of a municipal government initiative, since 2002 these health care facilities have been required to report the delivery of care to any worker injured on the job, regardless of the worker's employment status.

The reporting has been carried out by filling out a form called the Injured Worker Care Delivery Report (*Relatório de Atendimento ao Acidentado do Trabalho—RAAT*). This document includes fields to collect personal data for the injured worker, occupational data, type of work activity, company data, address where the accident occurred, description of the accident, and clinical data. The form is filled out by the person at the reception desk together with the nurses and the attending physician. As a result of training provided to the teams that work in the emergency care health facilities in the city, the key question asked when an injured person arrives in the emergency room is: *What were you doing at the time of the accident?* Based on the response, the accident is characterized as work-related or not.

The RAAT forms are collected daily from the eight health care sites and the information is entered into a computer system especially designed to store and manage the data. The system automatically assigns the zip code as well as the standardized Brazilian occupational classification [14] and the economic activity [15] codes.

The system's user interface has four components that correspond with the RAAT forms: *Care Provided*, *Patient*, *Injury*, and *Medical Report*. Analysis of the consistency of the information is carried out at the moment it is entered, when the respective codes of the Brazilian Occupational Classification (CBO) and National Classification of Economic Activities (CNAE) related to the injured worker are assigned, as well as the other data recorded on the RAAT forms. The data on the workers and the companies that are already registered in the system remain available to be used again in future entries. The system makes it possible to carry out diverse consultations and perform groupings according to

type and severity of the accident, company, occupation, type of activity, and other characteristics.

From these data, the system identifies serious injuries to be investigated, selected when one of the following conditions is present:

- fatal injury
- multiple trauma
- crushing
- amputation
- perforation with loss of body fluids
- head injuries
- spinal fracture
- lesion of the spinal medula
- trauma with visceral lesion
- 2nd or 3rd degree burns
- occupational injury involving a minor (under 16 years of age)

The injuries selected according to the above criteria are investigated at the site of the accident, aiming at identifying the causes and preventive measures needed to avoid similar occurrences.

For these investigations, the system emits a RAAT form with a space reserved to fill in the information collected, which is later fed into the database. During the on-site inspections, a standardized protocol is followed, with photographic documentation and interviews (whenever possible) of the injured worker and his/her co-workers, using the Causal Tree Method [16], when necessary. The cases are investigated by professionals from the partner organizations involved in the project. All of the information produced in these investigations is stored and managed by a computerized system that generates periodic reports.

Every injured worker included in the system has four addresses associated with him/her: location where the accident occurred; place(s) of work; location of the health care facility where services were provided; and home address. For the analysis of the spatial distribution of injury risk, the data are sent (together with all the other co-variables associated with each injury) to the Geographic Information System (GIS) of the SIVAT-Piracicaba. This GIS consists of a digital cartographic base geo-referenced in the municipality containing information on the streets, plazas, and all the approximately 102,000 urban lots in the city.

The GIS automatically identifies the four locations mentioned above on the cartographic base. These locations can be visualized and analyzed according to any attribute contained in the RAAT forms. This feature makes it possible to estimate the spatial distribution of risk of occupational injuries in the streets, which is particularly important for the informal workers, by applying spatial statistical techniques [17]. The information can also be used to study the best routes for emergency vehicles and transportation of workers who suffer accidents on the job or while commuting.

RESULTS FROM THE FIRST TWO YEARS OF OPERATION OF SIVAT

Planning of the SIVAT-Piracicaba began in 2001. During 2002 and the first half of 2003, the necessary partnerships were established and training was delivered to all teams involved. The system started operating on November 11, 2003, and is still in operation to date. The data presented here refer to the period from November 1, 2003 to October 31, 2005, the first two years of operation. During this period, 10,777 workers who were victims of occupational injuries were treated in the eight emergency health care facilities in Piracicaba; 9,574 (88.8%) were victims of typical occupational injuries, and 1,203 (11.2%) suffered injuries while commuting. This distribution allowed us to estimate the annual incidence proportion of occupational injuries that required medical care as 3.9%.

Of the injured, 868 (8.1%) were female and 9,909 (91.9%) were male, yielding an estimated incidence proportion of 0.8% and 5.9% for female and male workers, respectively, a difference which is statistically significant ($\alpha = 05$).

Of the workers treated for injuries, 8,339 (77.4%) suffered mild injuries, 2,170 (20%) moderate injuries, and 268 (2.5%) serious injuries, of which 10 (0.1%) died during hospitalization, which yields an estimated incidence proportion of 7.2 fatal work-related accidents per 100,000 workers/year in Piracicaba. It should be emphasized that this estimate was made based only on the data of workers who were treated for injuries prior to their death, and could therefore be an underestimation. The male:female odds ratio was 6.9:1, 8.5:1, and 13.6:1 for mild, moderate, and serious occupational injuries, respectively. All of the fatal injuries involved male workers.

Of the workers treated, 3,888 (36.1%) did not need to leave work to undergo treatment, 6,200 (57.5%) went on leave for 1 to 15 days, 418 (3.9%) required leaves of 16 to 30 days, and 271 (2.5%) had to miss work for more than 30 days as a result of the occupational injury.

In 8,535 cases (79.2%), the injured workers were formally employed. Based on the National Classification of Economic Activity of the companies where the injured workers were employed, the Basic Metallurgical (CNAE 27) and Construction (CNAE 45) sectors accounted for 2,220 accidents (20.6%).

Table 1 presents the distribution of occupational injuries according to the immediate causes of the accidents suffered, emphasizing that one-third were caused by machines or falling objects.

Table 2 presents the distribution of occupational injuries according to the body part affected by the accident, highlighting that about 2/3 had their upper or lower extremities affected.

Table 3 presents the distribution of occupational injuries according to the diagnosis of the lesion, showing that slightly more than half were diagnosed with contusions or cut-contusion wounds.

Table 1. Distribution of Immediate Causes of Occupational Injuries in Piracicaba, Brazil, 2003-2005

Immediate cause	Percent	Cumulative frequency
Others	35.7	35.7
Machines/equipment	22.2	57.9
Falling objects	11.1	69.0
Transport vehicle	9.5	78.5
Fall from heights	9.0	87.5
Strains/loads	5.8	93.3
Physical agents (heat, noise, radiation)	1.8	95.1
Chemical/biological agents	1.8	96.9
Hot substances	1.2	98.1
Poisonous animals/plants	1.0	99.1
Explosion/fire	0.7	99.8
Electrical shocks	0.2	99.9

Table 2. Distribution of the Parts of the Body Affected by Occupational Injuries in Piracicaba, Brazil, 2003-2005

Part of the body affected	Percent	Cumulative frequency
Hand	31.7	31.7
Lower extremity	14.0	45.7
Upper extremity	12.6	58.3
Eye	9.7	68.0
Foot	8.5	76.5
Head	6.5	83.0
Other	6.2	89.2
Spinal column	4.5	93.7
Thorax	2.3	96.0
Back	2.2	98.2
Neck	0.8	99.0
Abdomen	0.6	99.6
Entire body	0.4	100.0

Table 3. Distribution of the Diagnoses in Occupational Injuries in Piracicaba, São Paulo, 2003-2005

Diagnosis	Percent	Cumulative frequency
Contusion	28.8	28.8
Cut-contusion wound	26.7	55.5
Others	20.4	75.9
Sprain	7.8	83.7
Fracture	6.2	89.9
Burn	4.2	94.1
Perforation	1.6	95.7
Multiple traumas	1.6	97.3
Crushing or squishing	0.7	98.0
Amputation	0.7	98.7
Head injuries	0.5	99.2
Intoxication/poisoning	0.5	99.7
Wmsds	0.2	99.9
Infection	0.1	100.0
Respiratory disorder	<0.1	100.0
Lesion of the spinal cord	<<0.1	100.0
Visceral trauma	<<0.1	100.0

Analysis of the RAAT forms filled out during this period shows that 268 serious injuries were identified and investigated, according to the criteria previously outlined. A summary of one such investigation follows.

COLLECTIVE ACTIONS RESULTING FROM SIVAT

The SIVAT identified three serious accidents in 2004 in the baking industry; two caused by the handling of cylinders and bread dough mixers. The other serious accident involved an unregistered, underage worker, thus considered an informal worker, who crushed his hand and lost four fingers from his right hand while operating a sugar cane grinder in a bakery. These three workplace injuries were investigated at the work site and led to joint actions between the Ministry of Labor and other government agencies. They also led to negotiations between the Bakers' Association of Piracicaba, the Food Industry Worker Union

of Piracicaba and Surrounding Area, and with representatives of the Ministry of Labor and Employment, the Occupational Health Referral Center of Piracicaba, the National Industrial Learning Service, the Municipal Sanitary Inspectorate, and two local universities. Emphasis was given to the need to adopt preventive measures and changes in the sector.

An additional development resulting from this process was the creation of the Food Safety Committee (FSC), on December 14, 2004, charged with implementing a program to improve the sector, which included improvement of management, food hygiene and sanitation conditions, work premises, waste treatment, worker training, and workplace health and safety.

The first activity of the FSC was an assessment of the bakeries in the city to identify priorities for actions in the area. The preliminary assessment was conducted by the Food Safety Committee with four thematic teams in ten bakeries in Piracicaba. The findings of this assessment were:

- The bakeries are predominantly small and medium-sized, employing on average, 17 workers each, with a high rate of turnover (32% per year).
- There is little investment in worker training.
- The majority are family businesses (70%).
- Hygiene during food processing is deficient at 75% of the sites visited.
- Out of eleven bread dough mixers analyzed, nine had no safety system to protect operators from the mixing paddles, creating a risk for injuries; of the nine bread dough cylinders inspected, five had no protection in the zones of convergence, creating a risk of catching workers' fingers and hands. Improvised electrical installations were identified, presenting a risk of electrical shock and fire.
- It was found that only 35% of the businesses studied met half or more of the requirements of current legislation; the others met less than half.

Following the assessment, the First Food Safety Forum was held with the participation of 70% of the 188 bakery owners. The assessment was presented in this forum and each owner was given a Term of Notification containing demands and deadlines for the correction of irregularities.

Monthly meetings of the Food Safety Committee are currently held in which actions to correct irregularities are monitored and other actions are planned, including training, hearings, and so forth. We could observe the adherence of the baking industry to the proposals of the committee and the first advances in the improvement of operational and safety conditions. We carried out a new assessment of the same businesses at the end of June 2006 and did observe a significant improvement in protecting workers who handled dangerous equipment, such as cylinders and mixers, in sanitary conditions, and workplace safety, confirming the importance of collective processes and inter-sectoral actions.

DISCUSSION

An important characteristic of the SIVAT Piracicaba is the reporting of employees' occupational injuries by the emergency health care facilities in the city. It is estimated that 80% of injured workers in Brazil receive care in the public emergency health services [6]. These services, together with the private health care facilities, are the strategic locations chosen to house the SIVAT Piracicaba, and are an aspect that differentiates it from the official system of the Ministry of Social Insurance and Assistance.

In addition to decreasing under-reporting, locating the generation of information within the emergency health services contributes to broadening the coverage of the SIVAT Piracicaba, since the health services network in the city serves workers without discrimination, regardless of the formality of their work status, place of work, or place of residence. Thus, the SIVAT Piracicaba also distinguishes itself from the official Brazilian system, which covers only a portion of formal workers.

A comparative study of the incidence of occupational injuries reported by the Communication of Occupational Injuries (*Comunicação de Acidentes de Trabalho—CAT*) statistics produced by the National Institute of Social Insurance with data generated by the RAAT system in Piracicaba identified a rate of under-reporting of 16.2% in the CAT for the year 2002. The authors concluded that the RAAT is a more reliable instrument for the identification of occupational injuries than the CAT, with the potential to become an important source of information for the city [18].

The approach adopted by the SIVAT Piracicaba of implementing corrective actions based on sentinel events had been officially proposed in Brazil in 1998 when the Ministry of Health announced interventions in work environments guided by epidemiological criteria obtained in the most serious and significant cases investigated. A similar system was implemented in the United States in 1987 (Sentinel Event Notification System for Occupational Risks—SENSOR) [13].

The implementation of the Occupational Injury Surveillance System of Piracicaba has made possible [10]:

- Improved understanding of existing risks via epidemiological criteria with systematic collection of information and reports;
- The combination of information originating from the RAAT, the CAT, and the forms used in the emergency health care system, thus widening the information sources to include occurrences in the informal labor market that had previously been practically ignored;
- Initiation of actions of impact or collective reach, based on the selection of the most significant events, in such a way as to intensify preventive measures jointly with companies and the economic sector, with social oversight;

- Integration, intensification, and broadening of actions by various institutions involved (municipal government, Ministry of Labor and Employment, universities, hospitals, etc.) leading to mutual strengthening and improved performance in the exercise of their duties, overcoming fragmented inspection and random fines that still predominantly characterize the occupational health field;
- The development of collective actions and negotiations leading to more in-depth knowledge about and prevention of risks in certain sectors of economic activity, or according to geographical criteria, based on the cases that present themselves.
- The development of collective actions stimulated by and including the active participation of public organizations, contributing to the construction of an environment that is favorable for prevention, to the extent that this participatory process facilitates the involvement of diverse segments and organizations representing civil society.

The implementation of SIVAT requires systematic effort, however, to maintain the quality of the reporting using the RAAT forms, as the professionals in the emergency health services are confronted daily with critical situations in caring for patients. The implementation of the reporting system requires permanent training and supervision to assure the maintenance of the quality of the system. In the initial phase of the implementation, the project benefited from the part-time dedication of research assistants to train and monitor the filling out of the forms. Currently, the Occupational Health Referral Center (CEREST-Piracicaba) supervises the quality of the RAAT reports weekly. Even with this supervision, resistance to filling out the reports on the part of professionals was still found; as an example, one hospital was fined for failing to fill out a RAAT form.

Our intention in the next phase is to computerize and automate the emission of the RAAT forms, since the filling out of various forms at the reception desks of the emergency care services has been an obstacle to participation in reporting activities. Another difficulty has been the systematic monitoring of actions in response to the occurrence of serious and fatal injuries due to the limited number of professionals in the surveillance teams. In addition to the investigation of the causes of serious and fatal injuries, which is very time-consuming, the negotiation processes following the sentinel actions are slow and demand initiative and communication with representatives of the organizations that represent the sectors involved.

PERSPECTIVES FOR CONTINUATION OF THE PROJECT

The SIVAT Piracicaba represents an attempt to overcome the traditional gap that exists between sanitary inspection and epidemiological surveillance, because the information and action are directly associated as components of the same

system. From the perspective presented here, the occupational health surveillance carried out by the SIVAT Piracicaba consists of continuous and systematic actions to detect, learn about, research, and analyze factors that determine and condition work-related health problems, with the aim of planning and evaluating interventions to eliminate them [19].

The SIVAT Piracicaba is an experience that is in a phase of consolidation. It is too early to evaluate whether it has contributed to decreasing the incidence of occupational injuries in the city. Nevertheless, we believe that publicizing the development of this system, its characteristics, potential, and obstacles while still in its initial phase, can contribute to the debate about the development of public policies to safeguard and promote the health of Brazilian workers. It is a possibility whose continuation will depend on the maintenance of inter-sectoral, multi-professional efforts, breaking away from the isolation of institutions and, fundamentally, the action of individuals who share the common aim of promoting the health and defending the lives of Brazilian workers.

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