

Health information systems and pesticide poisoning at Pernambuco

Sistemas de informação em saúde e as intoxicações por agrotóxicos em Pernambuco

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ABSTRACT: *Introduction:* Understanding the epidemiologic profile of a particular disease is key to undertake health actions. To that end, information systems that present quality data help in the decision-making process and demonstrate the impact of the problems. *Objective:* To analyze the contribution of health information systems for the characterization of pesticide poisoning through SINAN, CEATOX and SIM in the State of Pernambuco. *Method:* In this study, the completeness and consistency of the data were assessed, as well as the epidemiological profile of pesticide poisoning in Pernambuco in the period from 2008 to 2012, based on the following Health Information Systems: Center for Toxicological Assistance of Pernambuco (CEATOX), Notifiable Diseases Information System (SINAN) and Mortality Information System (SIM). *Results:* The data revealed incompleteness and inconsistencies in information. Regarding the profile, females are more affected in the morbidity profile, and men have a higher mortality rate. Poisoning was more frequent in young adults with low educational level. With regard to the circumstances, most of the cases were suicide attempts, unique acute cases and not related to work. Despite suggesting underreporting, the data showed that persons engaged in agriculture are most commonly affected. *Conclusion:* The strengthening of these systems is necessary for the generation of consistent information that support health policies for the population groups involved.

Keywords: Pesticides. Poisoning. Public health surveillance. Health information systems. Health Profile. Disease notification.

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RESUMO: *Introdução:* Conhecer o perfil epidemiológico de um determinado agravo é fundamental para realizar ações de saúde. Para tanto, os sistemas de informação que apresentam dados de qualidade auxiliam a tomada de decisão e evidenciam os impactos dos problemas. *Objetivo:* Analisar a contribuição dos Sistemas de Informação em Saúde na caracterização das intoxicações por agrotóxicos por meio do SINAN, CEATOX e SIM em Pernambuco. *Método:* No presente estudo, foi avaliada a completude e consistência dos dados, bem como o perfil epidemiológico de intoxicações por agrotóxicos em Pernambuco no período de 2008 a 2012 com base nos seguintes Sistemas de Informação em Saúde: Centro de Assistência Toxicológica de Pernambuco, Sistema de Informação de Agravos de Notificação e Sistema de Informação sobre Mortalidade. *Resultado:* Os dados revelaram incompletude e inconsistências nas informações. Com relação ao perfil, os casos acometem com mais frequência pessoas do sexo feminino no perfil de morbidade e os homens apresentaram maior letalidade. As intoxicações apresentaram-se mais frequentes em adultos jovens e de baixa escolaridade. Com relação às circunstâncias, a maioria dos casos foram tentativas de suicídio, casos agudos únicos e não relacionados ao trabalho. Apesar de sugerir subnotificação, os dados mostraram que pessoas ocupadas na agricultura são mais comumente acometidas. *Conclusão:* O fortalecimento destes sistemas é necessário para que sejam geradas informações consistentes que subsidiem políticas de saúde para os grupos populacionais envolvidos.

Palavras-chave: Praguicidas. Envenenamento. Vigilância em saúde pública. Sistemas de informação em saúde. Perfil de saúde. Notificação de doenças.

INTRODUCTION

Studies highlighting the environmental and public health problems caused by pesticides are numerous in the literature and, recently, several of them were systematized in the dossier of the Brazilian Public Health Association¹.

In Brazil, starting in the 1970s, the Green Revolution boosted the conservative modernization of agriculture², which conditioned the rural credit to the use of inputs (fertilizers, pesticides, soil correctors, improved seeds, liquid fuels) and industrial machinery (tractors, harvesters, implements, irrigation equipment)³. These productive clusters formed, later, the so-called agribusiness strategy, which dominates the agricultural policy of the Brazilian State.

Agribusiness was responsible, in 1991, for earning 8.8 billion dollars more for the national trade balance. In 2012, this figure rose to 79.4 billion dollars⁴. Between 2000 and 2008, the global market for pesticides grew 45.4%, while the Brazilian grew 176.0%⁵.

Pernambuco adopted this model of chemical-dependent development, and agribusiness focuses on the production of sugarcane in the Zona da Mata region and irrigated fruit production in Vale do São Francisco Valley, with the agricultural sector accounting for 4.8% of the State's Gross Domestic Product⁶.

The problems arising from the use of pesticides are more intense in what are considered emerging countries in globalized capitalism, where, annually, 70,000 cases of acute and chronic poisoning progressing to death and at least seven million non-fatal acute and chronic diseases are accounted due to pesticides⁷. Surveys conducted in Brazil showed results above these estimates.⁸⁻¹³.

Although the estimates indicate a serious situation, several studies suggest underreporting of poisonings¹⁴⁻¹⁹. Among the cases reported, there are different problems in the health information systems (HIS), such as failing to identify chronic cases, incomplete and inadequate data and information that are not able to support actions^{15,19-21}.

In Pernambuco, pesticide poisoning cases may appear in the Notifiable Diseases Information System (SINAN)²², in the Center for Toxicological Assistance of Pernambuco (CEATOX)²³ and Mortality Information System (MIS)²⁴.

CEATOX has the task of recording calls and providing data for the production of epidemiological information²³. The center acts providing support by telephone for all health units of Pernambuco, and its information is consolidated through a proprietary instrument. SINAN records pesticide poisoning cases in an exogenous intoxication record since 2007. From 2011, the notification of this disease has become compulsory in all health units of Pernambuco²⁵. SIM provides important information for research of the characterization of the mortality profile according to the International Classification of Diseases (ICD-10)²⁴.

The Interagency Network for Health Information (Ripsa)²⁶ points out that, for the HIS, the following quality attributes are important: integrity or completeness (complete data) and internal consistency (consistent and non-conflicting values).

This study aimed to analyze the contribution of the HIS in the characterization of pesticide poisoning through SINAN, CEATOX and SIM in Pernambuco.

METHOD

A cross-sectional study was conducted in Pernambuco in the period from 2008 to 2012 based on SINAN, CEATOX and SIM.

Were considered pesticide poisoning cases in SINAN and CEATOX that rated the toxic agent into five groups (agricultural pesticides, household pesticides, public health pesticides, or even pesticides in rodenticides and products for veterinary use); agents which, by legal definition²⁷, are considered pesticides. A similar strategy was adopted by Faria, Fassa and Facchini¹⁵. In SINAN, only the cases whose final classification was "confirmed poisoning" and "single treatment" were selected, as adopted by Malaspina, Lise and Bueno¹⁴.

In SIM, cases selected were those that showed the cause of death identified by ICD-10 as X48 (Accidental poisoning by exposure to pesticides), X68 (Intentional self-poisoning by pesticide exposure), X87 (Assault by pesticides) and Y18 (Poisoning by exposure to pesticides, undetermined intent).

The results presented were divided into mortality and morbidity profiles. For all data sources, variables were classified into two groups: those related to the individual (gender, age, education and occupation); and related to the intoxication (circumstances, type of exposure, place of exposure and poisoning related to work).

Not all variables are registered in all information systems. In CEATOX, you cannot evaluate the variables education, occupation, type of exposure, place of exposure and poisoning related

to work, as they are not consolidated in this database. In SIM, you cannot identify the variables related to poisoning because there is no record of this information in the death certificate.

In the occupation variable, were considered employed in agriculture cases that had marked their activity as general agricultural worker, temporary agriculture worker, agricultural caretaker and multipurpose agricultural producer.

In the education variable, subjects were divided into illiterate, low education (from the first year of incomplete primary education to complete primary education for SINAN, and from one to seven years of studies completed for the SIM), average schooling (incomplete high school for SINAN, and eight to eleven years of studies completed for SIM) and higher education (complete high school or more for SINAN; and twelve or more years of studies completed for SIM).

Variables equally recorded in the three information systems and the variables that indicate the case's relationship to work were selected, since estimates suggest more cases involving workers^{7,12,28,29}.

To evaluate the completeness, the complete filling of the data relating to each of the variables in all databases, or the number of records with non-zero values, were observed.

For consistency analysis, three SINAN variables were used: "Place of exposure", "The exposure/contamination resulted from the job/occupation?" and "Communication of Work Accident (CAT)". The degree with which related variables can have consistent and not contradictory values was considered³⁰.

Two relations were assessed for consistency in the notifications. "Place of exposure" versus "The exposure/contamination resulted from the job/occupation?". To be considered as exposure related to work, poisoning must have occurred in the work environment or in the way to or back from work. The second, "Communication of Work Accident (CAT)" versus "The exposure/contamination resulted from the job/occupation?". The issuance of the CAT applies only when the poisoning is related to work and the worker is insured. If the case is not related to work, regardless of employment, the option stating that the filling of the CAT is not applicable shall be marked. Thus, the following were considered inconsistent:

1. cases that reported that no CAT was issued and that it was unrelated to work (in these cases, filling of the CAT is not applicable); and
2. cases that reported that a CAT was issued, but it was not related to work.

This study was examined and approved by the Research Ethics Committee of Centro de Pesquisas Aggeu Magalhães, with no conflicts of interest, and the data were requested to the Pernambuco State Health Department.

RESULTS

MORBIDITY PROFILE

The characteristics of poisoning cases were organized in Table 1 and show that the majority are women, concentrated in the economically active population (15 – 59 years),

Table 1. Morbidity profile according to the characteristics of poisoning cases.

Characteristics	SINAN		CEATOX	
	n = 2970	%	n = 2449	%
Sex				
Female	1,575	53.0	1,301	53.1
Male	1,395	47.0	1,146	46.8
Ignored	0	0	2	0.1
Blank	0	0	0	0
Age group				
< 1 year	61	2.1	11	0.4
1 – 9 years	361	12.2	320	13.1
10 – 19 years	590	19.8	474	19.3
20 – 39 years	1,370	46.1	1,141	46.5
40 – 59 years	467	15.7	375	15.3
> 60 years	121	4.1	97	4.0
Ignored	0	0	31	1.3
Blank	0	0	0	0
Education				
Illiterate	26	0.9	NR	NR
Low educational level	314	10.6	NR	NR
Average educational level	64	2.2	NR	NR
High educational level	94	3.2	NR	NR
Not applicable	392	13.2	NR	NR
Ignored	1,509	50.8	NR	NR
Blank	571	19.2	NR	NR
Occupation				
Employed in agriculture	144	4.8	NR	NR
Student	131	4.4	NR	NR
Homemaker	45	1.5	NR	NR
Retired	13	0.4	NR	NR
Other occupations	86	2.9	NR	NR
Ignored	29	1.0	NR	NR
Blank	2,522	84.9	NR	NR

Sources: Information System for Notifiable Diseases and Center for Toxicological Assistance of Pernambuco
 NR: Not registered in the information system; SINAN: Sistema de Informação de Agravos de Notificação (Notifiable Diseases Information System); CEATOX: Centro de Assistência Toxicológica de Pernambuco (Center for Toxicological Assistance of Pernambuco).

mainly among young adults (20 – 39 years). The data for education presented a high number of missing information and blank cases; however, those that were registered reveal a larger number of cases among individuals with low education. Regarding occupation, it is observed that most people are engaged in agriculture, despite the large number of notifications with this field left unfilled (84.9%).

With regard to poisoning, most cases were suicide attempts with acute (single) exposition, which occurred in the individuals' residences and showed no relation with work, according to the results presented in Table 2. In CEATOX, cases related to work accounted for only 1.3% of registered cases.

MORTALITY PROFILE

When analyzing the SINAN data, it was observed that 87.0% of the deaths occurred by suicide. In SIM, this portion represented 78.6% of reported cases; and in CEATOX, 96.5%. The mortality data are shown in Table 3.

The characteristics of poisoning cases in the mortality profile showed that in both information systems, most were males and concentrated in the economically active population (15-59 years), mainly among young adults (20-39 years). Regarding occupation, the number of blank notifications for this variable is relevant; however, among cases that completed this field, many of the individuals were employed in agriculture.

CONSISTENCY ANALYSIS

Of the 2970 cases reported in SINAN in the period, 359 (17.1%) had inconsistent information between "Place of exposure" versus "The exposure/contamination resulted from the job/occupation?".

Regarding the consistency between "Communication of Work Accident (CAT)" versus "The exposure/contamination resulted from the job/occupation?", 786 (25.96%) presented inconsistent information.

DISCUSSION

According to the guidelines of the World Health Organization (WHO)³¹, data collected are different from information generated; that is, it is only considered information when it subsidizes decision-making. A large number of variables that were ignored or left blank was observed, indicating that the data collected do not generate information.

A comparison of the morbidity profile of SINAN and CEATOX revealed no significant differences in the proportions of each variable. However, the amount of records in SINAN

Table 2. Morbidity profile according to the characteristics of the poisoning.

Characteristics	SINAN		CEATOX	
	n = 2970	%	n = 2449	%
Circumstance				
Suicide attempt	1,960	66	1,839	75.1
Accidental	520	17.5	509	20.8
Violence/murder	34	1.1	15	0.6
Other	249	8.3	48	2.0
Ignored	191	6.4	38	1.6
Blank	16	0.5	0	0
Type of exposure				
Acute–single	2,221	74.8	NR	NR
Acute–repeated	101	3.4	NR	NR
Chronic	7	0.2	NR	NR
Acute over chronic	6	0.2	NR	NR
Ignored	536	18.0	NR	NR
Blank	99	3.3	NR	NR
Place of exposure				
Residence	1,884	63.4	NR	NR
Work environment	143	4.8	NR	NR
Outdoor environment	48	1.6	NR	NR
Way to or from work	6	0.2	NR	NR
Other	45	1.5	NR	NR
Ignored	739	24.9	NR	NR
Blank	105	3.5	NR	NR
Related to work				
No	2,180	73.4	NR	NR
Yes	171	5.8	NR	NR
Ignored	570	19.2	NR	NR
Blank	49	1.6	NR	NR

Sources: Information System for Notifiable Diseases and Center for Toxicological Assistance of Pernambuco
 NR: Not registered in the information system; SINAN: Sistema de Informação de Agravos de Notificação (Notifiable Diseases Information System); CEATOX: Centro de Assistência Toxicológica de Pernambuco (Center for Toxicological Assistance of Pernambuco).

Table 3. Mortality profile according to the characteristics of poisoning cases.

Characteristics	SINAN		SIM		CEATOX	
	n = 237	%	n = 552	%	n = 201	%
Sex						
Male	141	59.5	311	56.3	121	60.2
Female	96	40.5	241	43.7	78	38.8
Ignored	0	0	0	0	2	1.0
Blank	0	0	0	0	0	0
Age group						
< 1 year	2	0.8	0	0	0	0
1 – 9 years	7	3.0	4	0.7	5	2.5
10 – 19 years	28	11.8	99	17.9	23	12.0
20 – 39 years	108	45.6	253	45.8	81	40.3
40 – 59 years	67	28.2	141	25.5	55	27.3
> 60 years	25	10.5	55	9.9	34	16.6
Ignored	0	0	0	0	2	1.0
Blank	0	0	0	0	0	0
Education						
Illiterate	5	2.1	45	8.2	NR	NR
Low educational level	23	9.7	224	40.6	NR	NR
Average educational level	3	1.3	96	17.4	NR	NR
High educational level	4	1.7	35	6.3	NR	NR
Not applicable	7	3.0	0	0	NR	NR
Ignored	0	0	123	22.3	NR	NR
Blank	195	82.3	29	5.3	NR	NR
Occupation						
Employed in agriculture	28	11.8	111	20.1	NR	NR
Student	13	5.5	86	15.6	NR	NR
Homemaker	4	1.7	53	9.6	NR	NR
Retired	4	1.7	36	6.5	NR	NR
Mason	2	0.8	6	1.1	NR	NR
Other occupations	10	4.2	145	26.3	NR	NR
Ignored	8	3.4	1	0.2	NR	NR
Blank	169	71.3	114	20.7	NR	NR

Sources: Information System for Notifiable Diseases, Center for Toxicological Assistance of Pernambuco and Mortality Information System.

NR: Not registered in the information system; SINAN: Sistema de Informação de Agravos de Notificação (Notifiable Diseases Information System); CEATOX: Centro de Assistência Toxicológica de Pernambuco (Center for Toxicological Assistance of Pernambuco); SIM: Sistema de Informação Sobre Mortalidade (Mortality Information System).

should be much higher, since CEATOX only records cases in which care was sought by phone, while SINAN must compulsorily register suspected cases of exogenous intoxication in all health facilities since 2011²⁵.

London and Bailie³², as well as Koh and Jeyratnam³³, concluded that basing surveillance actions on data from an information center, which captures acute cases, may underestimate occupational cases and overestimate the importance of suicide attempts.

Morbidity results regarding the individuals' sex disagreed with other studies that presented a higher occurrence in males (53.0¹⁴; 51.2¹⁶ and 54.3%¹⁷). Oliveira³⁴ evaluated two information systems in the state of Mato Grosso and also found higher incidence in males, which accounted for 58.6% in one information system and 63.6% in the other. He results found were similar to those presented by Lima et al.³⁵, who identified more cases in females (50.5%). Moreira et al.⁸, when performing laboratory investigations, found that the female sex is 4.12 times more likely to have pesticide poisoning in a rural community. Mortality data also showed an inversion in the proportions. This difference between the profiles of morbidity and mortality with respect to the predominant sex may be related to suicide, as it is the most common circumstance in all information systems. Studies^{36,37} showed that suicide attempts are more common in females, and successful suicide attempts are more common in males.

Cases of poisoning recorded were found to be acute, contrary to estimates by the International Labour Organization⁷, which suggests a higher incidence of chronic poisoning. Other studies^{15,38,39} mention as factors for the absence of records of chronic cases the difficulty of definition/identification of cases by health professionals; the lack of training for diagnosis and notification; low or no laboratory capacity; and the distance of health services in rural areas.

Cases of exposure in the workplace (4.8%) and work-related cases (5.8%) found represent a low percentage among all cases reported in Information Systems. Due to the directly handling of pesticides, a higher proportion of cases related to work is expected. The figures revealed underreporting, but suggested that the population engaged in agriculture is the most vulnerated, both in the morbidity and in the mortality profiles. According to Schramm⁴⁰, vulnerated and vulnerable have different concepts: the first refers to the condition of those who are already wounded, and the second, to a potential (can be injured). That is, the entire population is vulnerable (potential situation) to poisoning, but individuals involved in agriculture represent a group whose exposure context determines the occurrence of pesticide poisoning (concrete situation). The results also corroborated the study by Meneghel et al⁴¹, who observed a higher occurrence in men employed in agriculture. Faria et al.⁴² found correlation between socioeconomic factors such as low education and suicide, but did not support the hypothesis of a specific role by agricultural practices.

Some pesticides have neurotoxic capacity and can lead to mental disorders and depression, culminating in suicide⁴³. Freire and Koifman⁴⁴ They conducted a review of literature in studies dealing with exposure to pesticides, depression and suicide, and concluded that

there are studies that suggest the correlation between these factors. However, they emphasize the need for further prospective epidemiological studies.

In an official statement⁴⁵, the Brazilian Association of Generic Pesticides stated that believing that pesticides predispose to suicide is believing that windows, cars and the gun in the drawer do the same, showing their total lack of commitment to the health of the population and the regulation of the industry.

Currently, most of the pesticides are sold without the legal requirement of agronomical prescriptions and the smuggling rate is high⁴⁶, reinforcing the need for a more severe regulation and control of the sales of these substances.

A higher concentration of cases is observed in the economically active population, results similar to those found in other studies^{14,16,17,34}. Since it affects much of the young adult population, poisoning cases constitute an economic problem.

The high proportion of cases missing or left blank in SINAN (70.0%) is noteworthy. Most cases, of both morbidity and mortality, and concentrated in individuals with a low educational level. Although state law prohibits the use of pesticides by illiterate people⁴⁷ deaths were recorded in this population both in SINAN (2.1%) and in SIM (8.2%). Pernambuco has a 16.7% illiteracy rate among the population aged 10 years or over⁴⁸, and it is also important to consider functional illiterates, who are considered literate, but cannot understand the instructions and the risks indicated in the agronomic prescription and in the products' written materials⁴⁹. Oliveira-Silva et al.⁹ identified that a low educational level increases risk of poisoning by pesticides, as was also observed by Moreira et al.⁸.

The mortality data in Information Systems revealed large differences in the number of reported cases, with SIM (552) having more than twice the number of cases than SINAN (237) and CEATOX (201).

Some fields related to work, place of exposure and completion of the CAT are not common in other reporting tools. When analyzing the consistency of the information in these fields, one can see difficulties among health professionals to recognize the relationship with work, that is, cases that occur in the work environment or on the way to or back from work. The high number of inconsistencies between the case's relationship to work and the completion of the CAT suggested that health professionals need to learn more about this instrument by the Ministry of Social Security. The instructional material on how to fill the exogenous intoxication form provided by the Ministry of Health on the Internet⁵⁰ needs to contain more detail to explain the different fields of the notification form, especially the CAT.

By defining exogenous intoxication as a disease of compulsory notification in SINAN²⁵, the Ministry of Health chose this disease as a priority throughout the national territory. In addition to exogenous poisoning, 44 other diseases were defined in the list of notifiable diseases, which probably raises doubts among health professionals when learning about all the specifics of each notification.

CONCLUSION

The study found underreporting of cases of poisoning. The majority of reports are acute conditions (suicide attempts), while the estimates of the International Labour Organization show that most cases of poisoning are chronic. Although they are underreported and there is a database limitation, the epidemiological profile shows that workers employed in agriculture is an important group affected.

The three information systems presented incompleteness of the data needed for monitoring and surveillance of the population exposed to pesticides, related to the characteristics of the cases of poisoning (occupation, education) and intoxication (relationship to work, place of exposition).

The two inconsistencies highlighted in SINAN (“Place of exposure” versus “The exposure/contamination resulted from the job/occupation?”; “Communication of Work Accident (CAT)” versus “The exposure/contamination was due to the work/occupation?”) reveal the lack of knowledge by health professionals about the interaction of these variables and their importance for the identification of diseases related to occupational health.

Data generated on pesticide poisoning, in addition to not being able to subsidize actions, reveal a lack of interest by the health sector in facing this environmental and public health problem.

A greater control over the marketing of pesticides is necessary, with greater demand for agronomic prescriptions, and fighting smuggling, hindering people’s access to these substances and, consequently, reducing suicide attempts and cases of poisoning.

Actions aiming to reinforce the fulfillment of exogenous poisoning reporting forms are urgently needed to qualify the database for information generation, improving information completeness and consistency. Besides the increase in quality, actions are needed to increase the number of reported cases. An active search of cases and continuing education actions with health professionals for the correct diagnosis of chronic poisoning are strategies that can generate increase in notifications.

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