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Clinical and epidemiological aspects of patients injured by stingrays in the state of Pará, Brazil

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ABSTRACT. The objective of this study was to outline the clinical-epidemiological profile of patients injured by stingrays from 2007 to 2021. A descriptive study was carried out through an epidemiological retrospective of ichthyism in 20 municipalities in Pará belonging to the Amazon Basin. Notified cases were obtained from the Notifiable Diseases Information System, where the following variables were investigated: socioeconomic profile, affected anatomical region, local and systemic clinical symptomatology. Treatment evolution regarding death and cure was also evaluated. Data were statistically evaluated using the chi-square test, at 5% significance level. A total of 737 cases of accidents caused by stingrays were reported during the period. Of these, 438 forms were not completed with the education data of the patients treated, followed by 158 forms not completed for the race item. Accidents caused by stingrays tend to happen to brown men, aged over 20 years, with incomplete secondary education, living in urban areas, with accidents occurring mainly on the region's beaches. The foot and leg were the most affected regions ($p<0.05$). Patients sought care in the first hours after the accident or only 24 hours ($p<0.05$) later. They presented local symptoms, such as pain and swelling. Some cases had systemic complications, mainly myolytic and neurological. This study reinforces the need to adopt strategies related to health and environmental education for people who visit risky areas to mitigate the occurrence of accidents caused by stingrays.

Keywords: Poisonous animals; Ichthyism; Stingrays; SINAN.

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Introduction

Ichthysm is defined as accidents caused by fish, being considered a public-health problem, with low lethality rates, but with high morbidity among humans. (Haddad Junior, & Lastoria, 2005; Garrone et al., 2005; Haddad Junior, 2007; Haddad Junior et al., 2012; Haddad Junior et al., 2014). Among the causes, trauma and poisoning cases also stand out. (Brasil, 2001; Haddad Junior, 2003).

There are different species of fish that can cause accidents in people who visit areas of rivers or streams. Ichthys tend to occur, in general, by the bites of different species of piranhas, electrical discharges emitted by the electric eel (*Electrophorus electricus*), perforations caused by thorns or stingers of different species of catfish and stingrays. For example, those from freshwater that can perforate and inoculate toxins produced by glands located at the base of the caudal thorn (Haddad Junior, Cardoso, & Neto, 2013), in addition to rarer cases, such as the candiru fish (*Vandellia cirrhosa*) that can enter the urethra of human beings.

In this context, the rates of ichthyism in the Brazilian territory are considered a neglected public health problem, with the Amazon region having the highest number of accidents. (Reckziegel, Dourado, Garrone Neto, & Haddad Junior, 2015). Specifically in Northern Brazil, poisoning from stingrays is the most frequent (Sá-Oliveira, Costa, & Pena, 2011; Monteiro, Bahia, Paiva, Sá, & Minayo, 2015). The stingray of the Potamotrygonidae family is considered the most commonly found in freshwater rivers in Brazil, having benthic habits (Garrone et al., 2007; Gualberto, Mendonça, & Santos, 2016; Fontenelle, Marques, Kolmann, & Lovejoy, 2021).

People who go to beaches, streams, or fish for animals, such as riverside dwellers, may have their health at risk due to accidents caused by fish of different species. In some cases these can be serious, causing sequelae

or scars on the body of the victims (Castro et al., 2016; Passos, Pimenta, Thomazi, Aires, & Turibio, 2016; Abati et al., 2017). In some cases, the victim may die, and this type of accident is common in the Amazon territory (Brisset, Schaper, Pommier, & Haro, 2006; Pimenta, Silva, Santos, Pelicice, &Brito, 2017; Carmo, Mota, & Manoel, 2018).

Faced with this scenario, fishermen and beachgoers are more susceptible to being affected by ichthyism, because of their exposure to the banks of rivers and creeks, where different specimens of stingrays, catfish, electric eels, and piranhas can shelter. In general, fishermen do not consider this a serious problem and end up not using personal protective equipment, which increases accident rates, as well as ignoring the possibilities of avoiding or treating them when they occur.

In the literature there is a shortage of scientific information about accidents caused by fish in Pará. Especially when it comes to the municipalities of Santarém, Alenquer, Almerim, Aveiro, Belterra, Curuá, Faro, Itaituba, Juruti, Jacareacanga, Mojuí dos Campos, Monte Alegre, Novo Progresso, Óbidos, Oriximiná, Prainha, Placas, Rurópolis, Terra Santa and Trairão. Furthermore, this study is justified by the need to know the epidemiological aspects of patients affected by ichthyism, to support strategies capable of mitigating the occurrence of these accidents among people who frequent rivers and streams.

Based on this information, the objective of this study was to outline the clinical-epidemiological profile of patients injured by stingrays in the municipalities of Santarém, Alenquer, Almerim, Aveiro, Belterra, Curuá, Faro, Itaituba, Juruti, Jacareacanga, Mojuí dos Campos, Monte Alegre, Novo Progresso, Óbidos, Oriximiná, Prainha, Placas, Rurópolis, Terra Santa and Trairão, from 2007 to 2021.

Material and methods

Study location and data collection

A descriptive study was carried out, through an epidemiological retrospective of the prevalence of accidents by stingrays in 20 municipalities of the Amazon Basin, all of them belonging to the state of Pará.

Of these, 15 are part of the Baixo Amazonas mesoregion, namely: Santarém, Alenquer, Almerim, Belterra, Curuá, Faro, Juruti, Mojuí dos Campos, Monte Alegre, Óbidos, Oriximiná, Prainha, Placas and Terra Santa.

The other 5 municipalities studied belong to the Sudoeste Paraense mesoregion, i.e.: Aveiro, Itaituba, Jacareacanga, Novo Progresso, Rurópolis e Trairão.

All these municipalities are under the management of the 9th Health Regional, of the Pará State Department of Public Health (SESPA). For this reason, the data used in this study were provided by the 9th Regional Health/SESPA, which authorized the use of information on reported cases of accidents due to ichthyism during the period from 2007 to 2021.

The population for this study was identified through probabilistic linkage of records from the Notifiable Diseases Information System (SINAN). Data were collected from the Individual Notification Form (FIN), which is completed by the care units for each patient. When necessary, data were also collected from the Individual Investigation Form (FII), which is an investigation guide that allows the identification of the source of infection and the mechanisms of transmission of the disease.

Variables

A quantitative and qualitative analysis of reported cases of patients affected by ichthyism was carried out. Missing data were characterized by the unfilled field in the patient's file. After identifying these data, they were excluded from subsequent analyzes of other variables. Therefore, the following variables were considered, divided into categories:

Regarding the profile, gender (male and female), age, education (Incomplete Elementary School – IES, Complete Elementary School – CES, Incomplete High School – IHS, Complete High School – CHS, Incomplete Higher Education – IHE and Complete Higher Education – CHE), Race (White, Black, Brown, Indigenous), Pregnant Woman (yes or no) and Area of residence (rural or urban).

Data from the largest number of cases per municipality and per year were analyzed, as well as the anatomical region affected (foot, leg, hand, toe, forearm, trunk, head, finger) and the time from accident to care (0-1h, 1-3h, 3-6h, 6-9h, 9-12h, 12-24h, >24h).

For data on local clinical symptoms, pain, edema, ecchymosis, necrosis were considered. In the systemic clinical symptomatology, the neurological, vagal, myolytic and renal cases. The rates of patients who died and who presented evolution to cure were also evaluated.

Statistical analysis

Data were tabulated and organized in Microsoft® Excel spreadsheets. The inferential analysis of the variables was performed using Pearson's chi-square test at 5% significance and for comparison between years, the Post-Hoc test. All statistical analyzes were performed using RStudio Desktop 1.3.1093 software.

Ethical aspects

The data used in this study were free, secondary and the names or any other personal characteristic that would allow the identification of the patients involved in the study were not revealed, using only the variables mentioned above, respecting, therefore, the ethics set forth in Resolution nº 510 of the National Health Council, of April 7, 2016, therefore, approval by the Research Ethics Committee is not necessary.

Results

Among the 1,375 files involving cases of ichthyism, 737 cases of accidents caused by stingrays were identified. It is noteworthy that the other forms did not specify the popular names or the species of fish that caused the accidents.

The number of data that remained to be completed in the files of patients treated for ichthyism was alarming, with 438 files identified that were not filled in with the patients' education data, followed by 158 files not filled in for the race item, as well as 51 files not filled in for age and 13 for area of residence. However, there was no missing data for gender and pregnant women.

Regarding the profile of the interviewees (Table 1), it was found that the majority were men (83.03%), with incomplete secondary education (14.11%), mixed race (69.19%) and residents of the urban area (63.30%). Of the total number of women, only two were pregnant (0.27%).

Table 1. Profile of patients injured by stingrays.

Epidemiological aspects	Description	Number of cases	%
Gender	Men	612	83,03
	Women	125	16,97
Education	IES	91	12,34
	CES	33	4,47
	IHS	104	14,11
	CHS	51	6,91
	IHE	8	1,08
	CHE	12	1,62
Race	White	26	3,52
	Black	38	5,15
	Brown	510	69,19
	Indigenous	5	0,67
Pregnant	Yes	2	0,27
	No ou NA	735	99,73
Zone	Rural	306	41,51
	Urban	415	63,30

Incomplete Elementary School – IES, Complete Elementary School – CES, Incomplete High School – IHS, Complete High School – CHS, Incomplete Higher Education – IHE and Complete Higher Education – CHE; NA = not applicable.

The age of patients injured by stingrays was very diverse. However, most cases were concentrated above 20 years. However, cases have also been reported in children aged less than 10 years old and elderly individuals aged over 70 years old.

Regarding the patients' city of origin, most were registered in Santarém, with 74.49%, followed by Oriximiná, with 13.70%. The other case distributions are shown in Figure 1.

The highest rate of notifications by stingrays was in 2012 (Figure 2), with 109 cases ($p<0.05$), that is, 14.78%. On the other hand, the smallest was registered in 2007, with only 0.4%, equivalent to 3 cases ($p<0.05$). When evaluating the last five years, there was a gradual increase (7.34%) in cases from 2017 to 2020, with a reduction in 2021.

The most affected anatomical regions (Figure 3 A) were the foot ($p<0.05$) and the leg ($p<0.05$). The time elapsed from the accident to the patient's care was quite variable. Most patients took between 0 and 1 hour ($p<0.05$) and over 24 hours ($p<0.05$) to be seen (Figure 3 B).

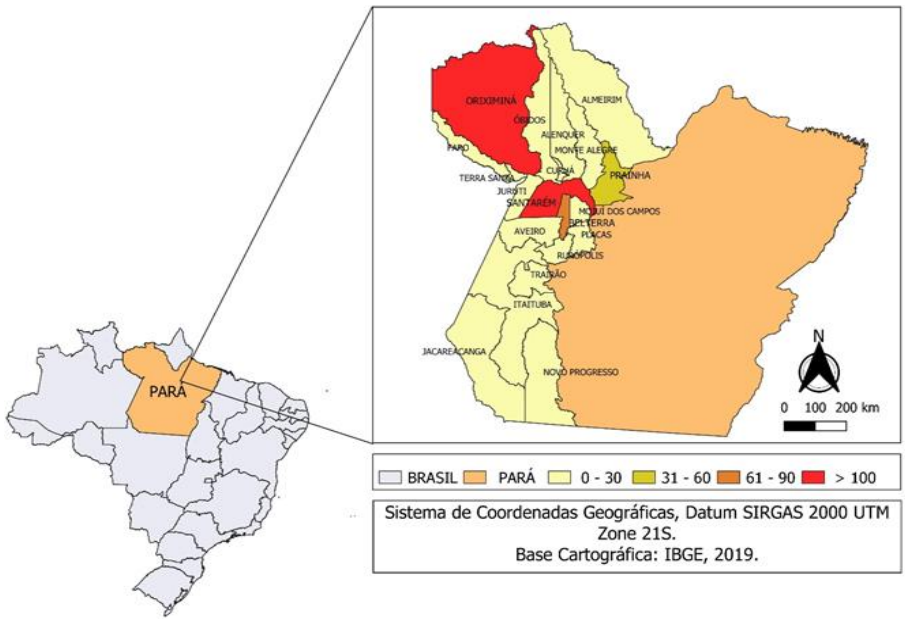

Figure 1. Number of cases due to ichthyism in the municipalities of the 9th Health Region/SESPA, Pará, Brazil (2007-2021).

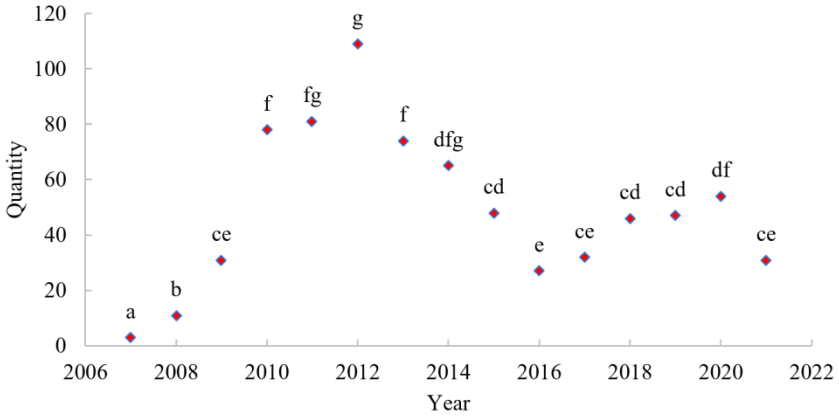

Figure 2. Number of cases of ichthyism per year. Note: different letters indicate statistical difference (p<0,05).

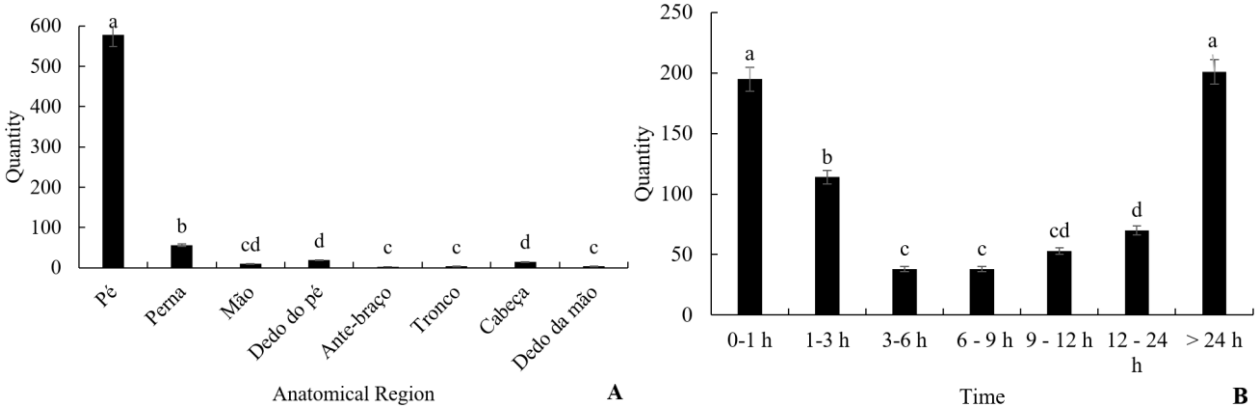

Figure 3. Patients treated for ichthyism. A. Anatomical regions affected by stingray sting. B. Time elapsed from accident to care. Different letters indicate statistical difference (p<0,05).

Local clinical signs in some patients evolved into systemic clinical complications. Pain and edema were observed in most systemic manifestations in the body. However, ecchymosis was more evident in patients who had vagal and myolytic symptoms.

Local necrosis was present in a patient with neurological and vagal problems. Patients with renal complications had conditions associated with myoitis and manifested pain and swelling at the site of the sting (Figure 4). Most cases evolved to cure, as only one case of death was recorded.

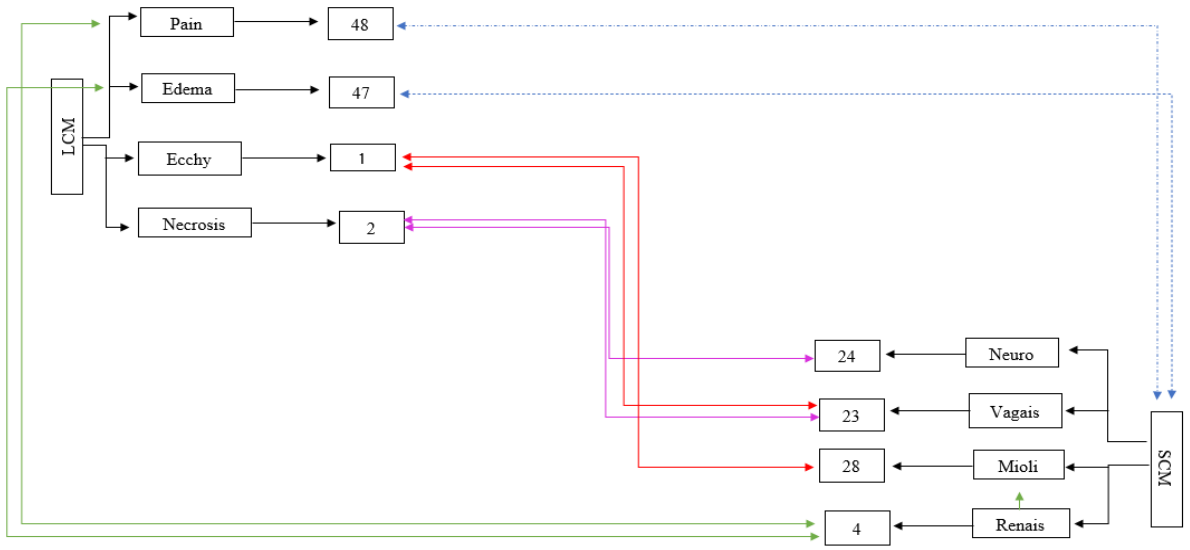

Figure 4. Flowchart of local complications that progressed to systemic symptoms.LCM = local clinical manifestations; Ecchy = ecchymosis; SCM = systemic clinical manifestations; Neuro = neurological; Mioli = Miolitic.

Discussion

The factors responsible for the undercompletion of sociodemographic variables, such as education, race, age and area of residence, reinforce the understanding on the part of managers and professionals that these variables are not fundamental. In this condition, the SINAN notification forms are sent to the units of origin so that rectification can be carried out only in situations where there is specific information about the condition. On the other hand, in cases of non-completion of sociodemographic information, it is not possible to carry out the rectification (Brasil, 2009; Pedraza, 2012; Braz, Oliveira, Reis, & Machado, 2013; Santos et al., 2013; Guimarães&Cunha, 2020).

The low deficit in filling out the notification forms may also be associated with the unwillingness of health professionals who fill out the forms, the non-recognition by the interviewees of the information collected, inadequacies in the infrastructure, medical records with missing data and perception filling bureaucracy (Jorge, Laurenti, &Gotlieb, 2007; Guerra, Llerena, Gama, Cunha, & Theme Filha, 2008; Costa&Frias, 2009; Mascarenhas&Gomes, 2011). In this way, the complexity of the variables demands joint work from managers to professionals responsible for completing consultations in basic health units (Silvestrin, Buriol, Silva, & Goldani, 2018).

Regarding the male gender being the most affected, this can be explained by the fact that he develops more activities related to fishing than the female gender. Therefore, they would be more exposed to the risk of stings (Sá-Oliveira et al., 2011; Hønge et al., 2018). A similar result was also identified for other areas of the Amazon biome, such as Acre (Silva, Poscai, & Casas, 2020) and Amazonas (Sachett et al., 2018).

This study agrees with the results obtained by Haddad Junior et al. (2013). For this team, accidents with stingrays generally occur in patients aged over 20 years old. Silva, Santos, Costa, Silva, and Serruya, (2022), evaluating pregnant women affected by ichthyism, also showed higher rates in patients aged over 20 years old.

The level of education shown here can be explained by the fact that this group frequents beach environments more often and because this is a school level compatible with most fishermen (Silva et al., 2022). The brown race was more evident as a result of being the most predominant in the state of Pará (IBGE, 2022). This fact is also evidenced by Cunha et al. (2021) in Tocantins. On the other hand, the fact that most of the victims are from the urban area may be related to the greater flow of people going to the region's beaches.

The municipalities of Santarém and Oriximiná had the highest rates of cases. Possibly because they are places of greater accessibility to victims of accidents and have more structured hospitals to serve the population of neighboring municipalities. Thus, these municipalities end up notifying more cases in the region. The highest rate of cases that occurred in 2012 does not have a specific justification for this occurrence.

The increase observed between 2017 and 2020 may have occurred due to greater ease of access to health services, as well as the modernization of health systems and the services they offer. In this respect, the greater capillarity of the assistance network in municipalities that are not within the metropolitan areas, together with the better structuring of the assistance network in municipalities in the interior, deserves special mention.

As a result, there is the offer of qualified medical care to perform outpatient and even surgical procedures, reflecting in a greater number of people assisted in the municipality where the accident occurred, according to the report by Silva, Filho, Pardal, Ferreira, & Diaz, (2019) and Silva et al. (2022).

Most stingray accidents occurred in Alter do Chão district, made up of different beaches, considered one of the most visited tourist spots in the western region of Pará, as described by Silva et al. (2022).

The anatomical regions that suffered the greatest number of occurrences in this investigation corroborate the studies by Haddad Junior (2003); Garrone Neto and Haddad Junior (2010); Sá-Oliveira et al. (2011); Monteiro, Seibert, Araújo, Bertolin, and Marques,(2014), Passos et al. (2016), Abati et al. (2017) and Sachett et al. (2018), which indicate that the most affected body parts are the lower limbs, especially the foot and leg.

This finding can be justified because of the benthic lifestyle of these fish. However, records were found in the region of the trunk, head, forearm, hand, fingers, which may indicate that the accidents may not be related only to stingrays, but to other non-benthic animals that cause similar injuries.

Due to the precarious socioeconomic conditions combined with the low level of education, it is common for victims not to seek medical support or to postpone this search. The accident often happens in places farther from the health units or the injured person prefers to use folk medicine as the first therapeutic option.

However, when there are local complications, such as necrosis and secondary infections, victims seek medical-hospital care (Monteiro et al., 2014; Torrez, Quiroga, Said, Abati, & França, 2015; Monteiro et al., 2016). This fact may explain the higher number of people seeking care in the first hours (0-1h) and 24 hours after the accident.

It is worth noting that what was described by Antoniazzi et al. (2011) and Hønge et al. (2018) the immediate search after the accident (0-1 hour) can minimize the symptoms subsequent to the accident, preventing the emergence of secondary infections.

Accidents caused by stingrays are rarely fatal, however, they present uncomfortable sensitivity (Holanda et al., 2019). The pain appears followed by the sting, initially at the site of the wound and then affecting the entire injured limb. Thus, the pain can be characterized as intense and disproportionate to the size of the lesion (Halstead, 1970; Garrone Neto and Haddad Junior, 2010; Lameiras, Costa, Santos, & Duncan, 2013), and may last for more than 48 hours (Sadhasivam, Muthuvel, Pachaiyappan, & Thangavel, 2013; Silva Jr., Ferreira, Pinto, & Aird, 2015).

During the first hours, the pain is considered unbearable (Santos, Seibert, Araújo, Bertolin, & Marques, 2014). Other early symptoms are edema and erythema (Silva Jr. et al., 2015), the latter not being seen in the patients studied.

It is worth mentioning that depending on the severity of the case, the stinger can fragment or come loose during the accident, allowing it to be retained in the lesion (Haddad Junior, 2003; Garrone Neto & Haddad Junior, 2010), which can result in necrosis, vasculitis, slow-healing ulcerations, pain-induced muscle contractures, and secondary infections (Sadhasivam et al., 2013; Fino, Onesti, Felli, & Scuderi, 2015; Torrez et al., 2015; Silva Jr. et al., 2015).

Silva Jr. et al. (2015) identified an accident caused by *Potamotrygon motoro* in which the patient had persistent intense pain (even using different analgesics), edema, necrosis, vasculitis, infection, even with therapeutic interventions and assistance from health professionals. Symptomatology like that presented by the patients in this study. On the other hand, the observed systemic signs may be associated with the time elapsed from the accident to the assistance. In addition, local complications can trigger the appearance of these symptoms.

Conclusion

Accidents caused by stingrays in the municipalities studied tend to occur in brown men, aged over 20 years old, living in urban areas. They take place mainly on the beaches of the region, with emphasis on those belonging to Alter do Chão district.

Mostpatients sought care in the first hours or just 24 hours after the accident. Most of the time, patients had local symptoms, such as pain and swelling. In some cases there were systemic complications, the most common being myolytic and neurological.

Thus, this study reinforces the need to adopt strategies linked to health education, in order to reduce the number of cases, as well as the need for trained professionals to care for injured patients and adequately fill out clinical forms.

Regarding the observed limitations, this research pointed out failures during the procedure for filling out the ichthyosis injury notification forms.

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