

*Original Research*

# Zoonotic Health Hazards in the Practice of Emergency Medical Service Teams – a Three-Year Observation

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## Abstract

The study comprised a 3-year retrospective analysis of trips by the MRTs from the northern part of the Lubelskie Province. The data was taken from records functioning in the State Medical Rescue Service (SMRS) system. Analysis period: 1.01.2020- 31.12.2022. It is the analysis of emergency medical services calls justified by threat to health, life, or injury of the victim due to the action of insects, birds, reptiles, mammals as a result of direct contact with them (stinging, biting, scratching, hitting, kicking). Applying the inclusion and exclusion criteria, 72 emergency medical services trips representing 0.34% of the total interventions in local area. The population was divided according to the cause of the threat: insects n = 45, dogs n = 12, cattle (bull, cow) n = 15 Men statistically more often suffered injuries than women 61% vs 39% (p=0.048). A statistically significant influence of the type of threat on the time of intervention was demonstrated; for dog hazards 39±25 min, insects 40±17 min; cattle 56±15 min; P = 0.015. There was a statistically significant difference in the use of pharmacology compared to the procedures described by ICD 10 codes (P<0.001). The impact of the type of threat on the need to transport the patient to the Emergency Department was not demonstrated. Hymenopterous insects are the most common type of zoonotic hazard on an annual basis, with an increase for the spring-summer months. There was a statistically significant difference in age for each type of hazard, the youngest of those injured were harmed by dogs, while the eldest were by insects. There was no statistically significant effect of place of residence (urban-rural) on the type of zoonotic injury.

**Keywords:** Emergency Medical Service, health hazards, zoonotic injuries, stings, bites

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## Introduction

Emergency Medical Service (EMS) teams are responsible for providing medical rescue service to people in a medical emergency. A certain number of medical interventions relate to zoonotic health hazards, in the form of stings from hymenopterous insects, bites and scratches from mammals (domestic, wild and farm animals), or injuries suffered from larger animals. Among emergency number operators, this type of incident is defined as “a person battered by a large animal” (either farm animal or wild). The caller of medical teams is usually a family member of the injured person or a bystander to the incident [1].

In the case of insect stings, interventions involve a local reaction of the body (pain, itching, vascular edema, hives), or an anaphylactic reaction posing an immediate threat to the life of the sensitized person. Contact with insects is increased during spring and summer. For this reason, emergency services, state EMS teams, as well as fire protection units (FPU), are engaged to eliminate insect nests near public buildings and sensitive places for the public at large (educational institutions, playgrounds) [2, 3].

Injuries from contact with breeding cattle are a fairly common occurrence in agriculture, or the meat industry where animals arrive by wheeled transport and are carried out to the premises. Livestock is most often not aggressive, but it can become frightened and react unpredictably, which, combined with the animal's considerable weight, can cause significant injury to humans when kicked, cornered, stepped on or crushed against a building wall. Injuries resulting from contact with livestock are often referred to as being trampled or battered by an animal, and can affect any age group, as children living on farms with livestock are vulnerable to work-related injuries [4].

According to the World Health Organization (WHO) in its reports, zoonotic injuries depend on a given location, and have various causes, like scratches and bites by dogs, birds of prey, cats, or monkeys. In addition, there might be stings by hymenopterous insects and bites by reptiles, amphibians and venomous arachnids (snakes, scorpions, spiders). Most snakebites occur in Africa and Southeast Asia [5].

## Material and Methods

### Research Design

The study comprised a 3-year retrospective analysis of trips by the MRTs from the northern part of the Lubelskie Province. The data was taken from records functioning in the State Medical Rescue Service (SMRS) system:

- the dispatch order card (DOC)-filled out by the medical dispatcher (MD),

- a medical emergency response card (MERC)-filled out by the manager (leader) of the medical rescue team (MRT). The ambulance crew leader is:
- emergency physician - specialist team (S),
- paramedic or system nurse - basic team (B).

Four MRTs are stationed in the operational area under observation: 2 type S MRTs and 2 type B MRTs, and a district hospital with a hospital emergency department (ED).

### Research Setting

The database was prepared in Microsoft Excel using MS Office 2016 for Windows 10. Interventions meeting the inclusion criteria were entered into the database, taking into account: date and time of the intervention, length of the intervention (from the moment the ambulance leaves for the incident until the decision of the team - leaving at the scene or transferring to the ED), type of ambulance - B or S, age and sex of the patient, reason for the call, location of the incident - urban and rural division, rescue procedure, ICD-10 medical diagnosis, use of pharmacological agents.

### Ethical Considerations

In June 2022, consent to access medical records was obtained from the director of the unit executing trip orders in the operating area under study. Data on the injured, the composition of the Medical Rescue Teams and the collaborating services were not disclosed in the analysis, the cases described are fully anonymous in accordance with the Declaration of Helsinki, and therefore no approval was sought from the bioethics committee for the study.

### Statistical Analysis

Results concerning quantitative variables were presented as average values±standard deviation. A one-way analysis of variance (ANOVA) test were used in the comparative characteristics zoonotic injuries. Qualitative variables (age, sex) were presented as quantity (n) and percentage values of the whole group (%), while proportions in groups were assessed with a Chi-squared test. A student t-test was used in the comparative characteristics of age. Statistica 13 software (StatSoft Inc., Tulsa, OK) was used in the statistical analysis.  $P < 0.05$  was adopted as the significance level.

### Inclusion Criteria

Interventions meeting the two criteria established as having key importance to the work were included in the study:

1. Emergency medical services calls justified by threat to health, life, or injury of the victim due to the action of insects, birds, reptiles, mammals as a result of

direct contact with them (stinging, biting, scratching, hitting, kicking),

2. The dates of commencement of EMS interventions between 1.01.2020 0.00 a.m. and 31.12.2022 11.59 p.m.

Exclusion Criteria

- false calls to the emergency number;
- no patient at the place of call - while waiting for Emergency Medical Service unit, patient used his/her own means of transport to reach the nearest medical facility;
- health hazards caused by indirect participation of animate matter, for example;
- a motorcycle collided with a deer and driver sustained injuries, a car rolled after colliding with a moose, person fell off a horse while riding;
- zoonotic disease symptoms, allergies (to dander, feathers), transmissible and parasitic diseases contracted from animals (avian flu, Lyme disease).

Limitations

Observed health emergencies in line with the objective of the paper represent a small % of the emergency medical service interventions in the area, but these incidents are characterized by high dynamics, variability of the clinical condition and, as the analysis showed, can happen in any conditions (farm, workplace, school, office) posing a challenge to the units implementing pre-hospital rescue. The approval obtained covered only the records of the outbound teams, and no access was gained to the records of the patients' inpatient treatment.

Table 1. General characteristics of the intervention.

Variable- year	Overall events in the area	Included in the analysis	%
2020	7054	25	0.35
2021	7069	23	0.32
2022	6769	24	0.34
Total	20892	72	0.34

Table 2. Characteristics of patients' age by gender.

Variable	N	Min	Max	Mean	SD
Men	44	1	72	45.2	18
Women	28	6	84	53.5	21.1
Total	72	1	84	48.8	19.9

Results

Applying the inclusion and exclusion criteria, 72 emergency medical services trips representing 0.34% of the total interventions were selected for analysis (Table 1).

There were 6 underage patients in the analysis: male n = 4 and female n = 2: 1, 6, 7, 13, 16, and 16 years old.

Fig. 1 presents the most common ICD-10 medical diagnoses used in the analysis. 99 ICD-10 diagnoses were used with 72 interventions, meaning that in some incidents 2 or 3 diagnoses were entered. When there is a health risk associated with an injury, a given code for the circumstances of that injury is used, or in the case of multiple injuries, ICD-10 codes defining each injury separately are used [6, 7].

Incidents involved: 1 diagnosis - 46 interventions, 2 diagnoses - 25 interventions, 3 diagnoses - 1 intervention. The three most common ICD-10 diagnoses were related to contact with hymenopterous insects: W57 (bite or sting from a non-venomous insect), T78 (anaphylactic shock), X23 (contact with hornets, wasps and bees).

In the analysis, there were 3 types of contact with health risk effect which were grouped (Table 3). Health hazards after direct contact were caused only by dogs, hymenopterous insects and livestock cattle.

A significant proportion of injuries involve the head. Of the 72 incidents selected for analysis, as many as 28 times the interventions involved the head as the spot of the injury/contact. The number may be higher, but in 9 hymenopterous insect incidents, the call involved

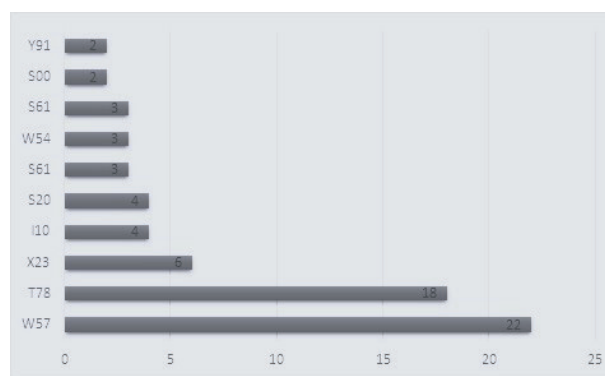


Fig. 1. Diagnoses according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) for n>1 in observed group

Table 3. Characteristics of the causes of health hazards.

Variable- cause	N	Type of injury: N
Hymenoptera insects	45	Sting - 45
Cattle	15	Kick - 3 Horn hit - 3 Mauling - 9
Dogs	12	Bite - 12

multiple body areas, with no specific spot being described.

Men were statistically more likely to suffer injuries, i.e. 61% vs 39% ( $P = 0.048$ ), (Table 4). There was a statistically significant effect of the type of hazard on the intervention time ( $P = 0.015$ ), which is presented in Fig. 3. There was a statistically significant difference in age for each type of hazard, with the youngest being harmed by dogs and the eldest by insects ( $P < 0.001$ ), (Fig. 4). There was no statistically significant effect of place of residence (urban-rural) on the type of hazards ( $P = 0.102$ ). The impact of a given type of hazard on the need to transport the patient to the ED was also not indicated.

There was a statistically significant difference in the use of pharmacology versus procedures described by ICD 10 codes ( $P < 0.001$ ).

### Discussion

Among the reasons for calling EMS in the own study project, there were a lot of calls related to insects with the information: stung by bees, stung by wasps, stung by insects. The authors point out that the emergency

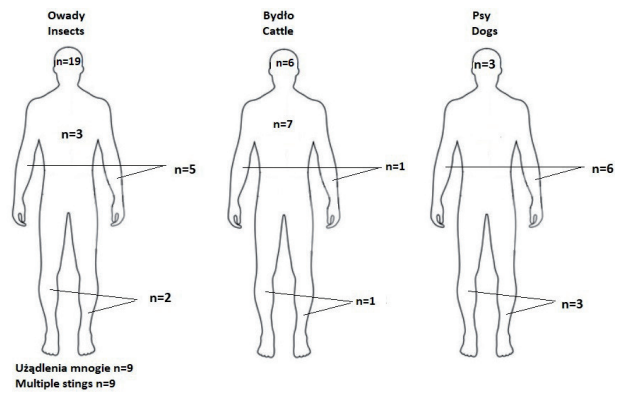


Fig. 3. Analysis of intervention time according to the reason for the call.

caller acts under the influence of emotions (stress), time pressure, and does not necessarily have specialized knowledge, hence the different synonyms in the naming of insects.

Stobecki, et al [8] describes that tests to confirm sensitization include the determination of specific IgE for insect venom. A given insect can be identified in this way. In pre-hospital medical rescue, the clinical condition of a given patient caused by the sting is important. Medical teams at this stage do not identify the species of the insect. More important is the recognition of allergy symptoms leading to anaphylaxis, defined as specific adverse reactions that depend on a secondary immune response to contact with a foreign allergen.

Kleszczyński [9] reports that EMS teams have far more calls for anaphylactic shock in the months of May through September, during warmer days when people's clothing is lighter and body parts are more exposed.

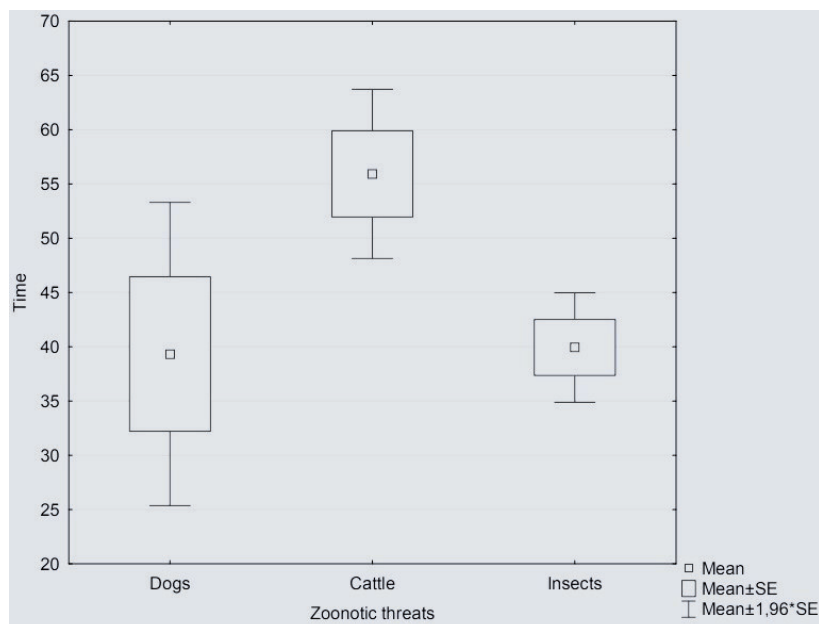


Fig. 2. Contact / injury site characteristics in each group.

Table 4. Univariate comparison of zoonotic threats.

Zoonotic threats	Dogs	Cattle	Insects	All	P
N	12	15	45	72	
Time, min	39±25	56±15	40±17	43±19	0.015
Age, y	28±19	49±16	54±18	48±20	<0.001
Sex, male, n (%)	6 (50)	13 (87)	25 (56)	44 (61)	0.048
Pharmacology, n (%)	0 (0)	9 (60)	41 (91)	50 (69)	<0.001
S MRTs, n (%)	7 (53)	7 (47)	28 (62)	42 (58)	0.571
City, n (%)	5 (42)	1 (7)	11 (24)	17 (24)	0.102
Transfer to ED, n (%)	11 (92)	13 (87)	29 (65)	53 (74)	0.072
Season					<0.001
Spring, n (%)	2 (17)	4 (27)	3 (7)	9 (13)	
Summer, n (%)	2 (17)	2 (13)	27 (60)	31 (43)	
Autumn, n (%)	4 (33)	5 (33)	15 (33)	24 (33)	
Winter, n (%)	4 (33)	4 (27)	0	8 (11)	
Intervention code					0.012
Code 1, n (%)	1 (8)	3(20)	22 (49)	26 (36)	
Code 2, n (%)	11 (92)	12 (80)	23 (51)	46 (64)	

Abbreviations: S MRTs- Specialist medical rescue teams; ED- Emergency department, Code 2- the dispatch time in emergency mode (code 1 – up to 60 seconds, urgent (code 2 – up to 120 seconds

In addition, the author cites statistics on the causes of anaphylaxis, i.e. food is the most common cause of anaphylactic reactions (56%), and then come drugs (5%) and insects (5%). The causes of the remaining anaphylactic reactions have not been determined. Our own study points, that the majority of emergency

medical services interventions after a sting fall during the summer (60%).

Hymenopterous insect stings as a reason for EMS calls during spring are also reported by Sowizdraniuk [10]. Hymenopterous insect venom consists of many substances that can allergenize humans (proteins and

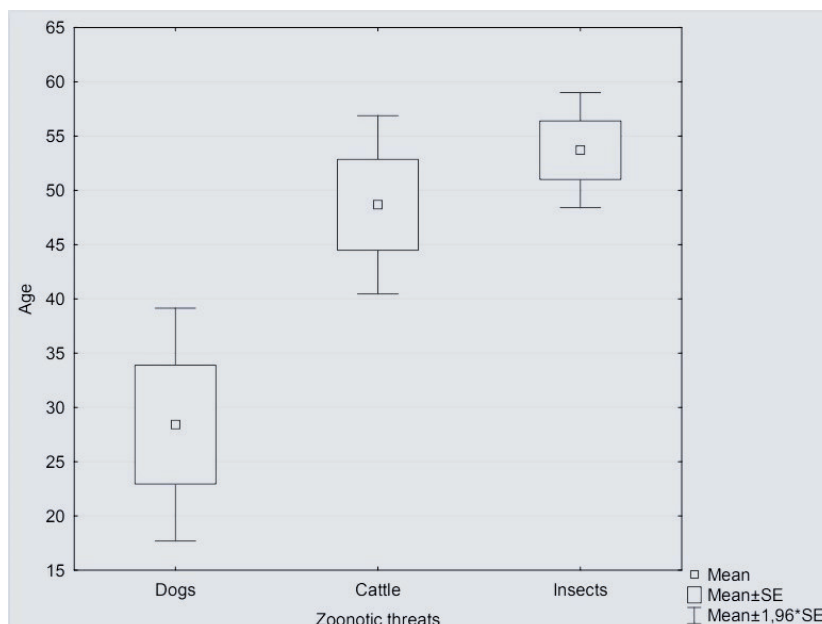


Fig. 4. Analysis of the patient's age according to the reason for the call.

Table 5. The use of pharmacology vs. group of diagnoses ICD-10.

ICD-10	Pharmacology-NO	Pharmacology-YES	Total
S, n (%)	11 (50%)	4 (8)	15
W, n (%)	3 (14)	23 (46)	26
T, n (%)	3 (14)	15 (30)	18
X, n (%)	2 (9)	3 (6)	5
I, n (%)	0	3 (6)	3
Other, n (%)	3 (14)	2 (2)	5

Other- less frequently used codes: L50, R04, I10, R42, S01, Z00, Y91 (the effect of alcohol determined by the degree of intoxication; smell of alcohol from the mouth). It concerns a patient bitten by a dog.

peptides). The drug of choice for anaphylaxis is 0.5 mg of epinephrine intramuscularly. Administration of the drug in anaphylactic shock is important and affects the effectiveness of treatment and significantly reduces mortality. The indicated dose applies to people over 12 years of age. In own study, epinephrine was used in 11 patients after contact with insects (the age range of these patients was 16-79) [11].

The World Allergy Organization (WAO) classifies epinephrine (adrenaline) as the primary drug for the treatment of anaphylaxis regardless of age criteria. Some of the patients in own study had a site reaction, while some developed symptoms of anaphylactic shock in the form of weakness, dizziness, fading of the skin, excessive sweating, a feeling of shortness of breath, hoarseness during speech, and a feeling of swelling in the mouth. Stings to the head and neck

region are particularly dangerous (n = 19) in our own study. European Resuscitation council (ERC) guidelines recommend administering epinephrine for anaphylactic reactions via the intramuscular route without dilution at a total dose of 0.01 mg/kg or an age-dependent dose [12, 13].

Cichocka Jarosz, et al. [14] also describes Hymenoptera insect bites in the head and neck region as a common risk factor for systemic reactions. However, clinical data on this problem are scarce.

Castagnoli, et al. [15] states that hymenopterous insect stings are generally well tolerated and usually cause limited local reactions. Researchers have described a variety of reactions after hymenopterous insect stings: immediate hypersensitivity reactions, delayed reactions, local and systemic, reactions with unusual sting locations, and reactions with unusual signs and symptoms.

In another study, Cichocka-Jarosz, et al. [16] describes an assessment of the impact of allergy to hymenopterous insect venom in children and adolescents on their parents' quality of life, taking into account their sociodemographic characteristics. Own analysis was based only on the outbound records of the Emergency Medical Service, with no additional tools for people with allergies to examine their quality of life.

The epidemiology of deaths related to anaphylactic reaction was studied by Vikrant, et al. [17]. Most Hymenoptera-related deaths are the result of immediate hypersensitivity reactions causing anaphylaxis to one or more stings. Multiple stings in a short period of time are particularly dangerous. Most deaths occur in tropical countries and are caused by snakebite, scorpion stings and anaphylactic reactions to insect stings (mainly Hymenoptera).

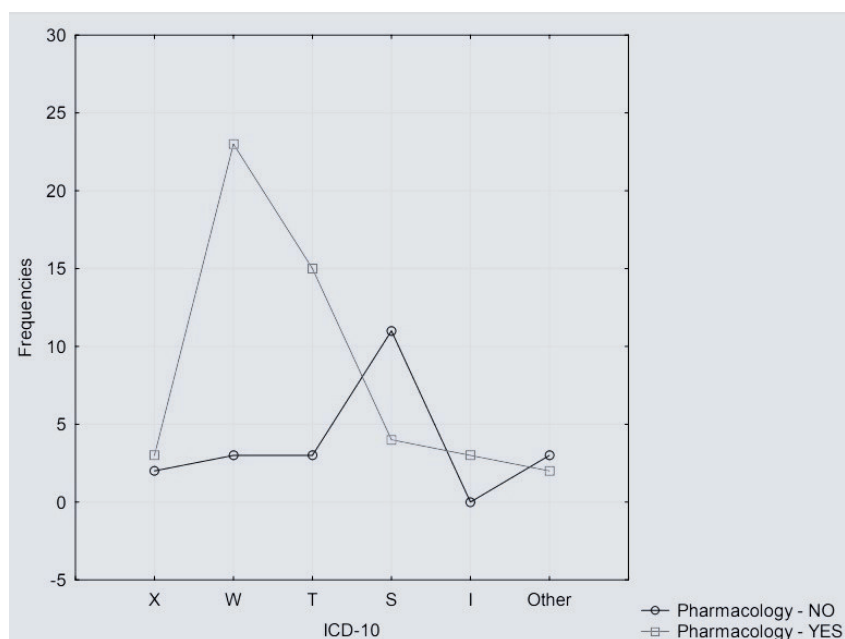


Fig. 5. Interactions of counts between pharmacotherapy use and ICD-10 groups.

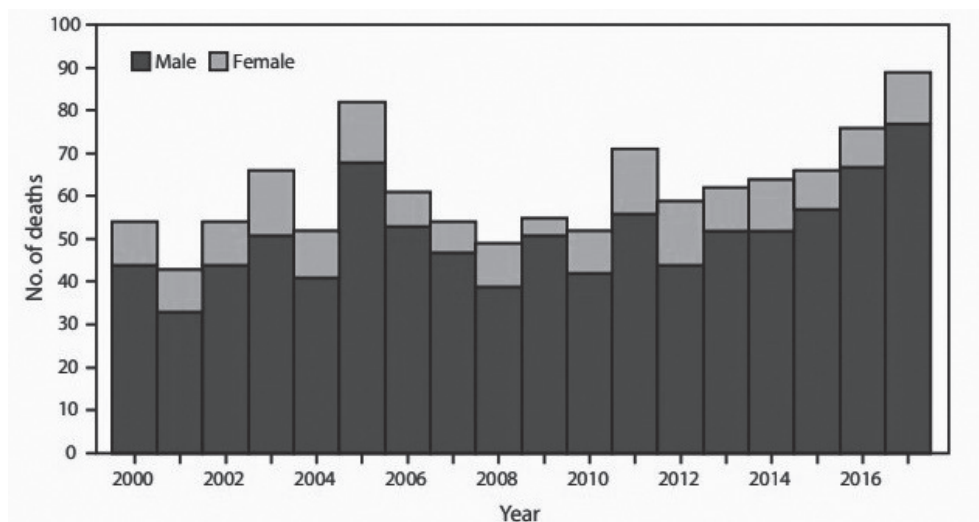


Fig. 6. U.S. mortality from hymenopterous insect stings.

In our own study, there were no deaths caused by anaphylaxis, as well as no anaphylactic reaction after contact other than with a Hymenoptera insect.

Vikrant, in his other study [18], points to animal toxin poisoning as a serious health hazard in the tropics. Approximately 5 million snakebites, scorpion bites and anaphylactic reactions to insect stings occur annually worldwide, causing >100,000 deaths per year, and the majority of deaths following stings by hymenopterous insects have occurred in rural areas. 76% of the Emergency Medical Service's interventions to patients after a sting in our own study also involved rural areas, as is confirmed by the data from that study.

Epidemiology of Hymenoptera-related deaths in Europe based on the WHO database was described by Feas, et al. [19]. Mortality associated with ICD-10 code (cause of death code: X23), analysis for 1994-2016, with a mortality rate for Eastern Europe of 0.35/1,000,000 population, with differential participation by both sexes. The figures for Poland were below the European average of 0.1-0.19/ 1,000,000 per year.

The figures shown in Fig. 6 also apply to mortality from hymenopterous insect causes, but for the US.

The hazards of owning a dog were described by Cinciara [21]. Owning a dog or spending time with a dog has many advantages, but it also comes with the risk of being bitten or attacked. Researchers determined the frequency of dog bite victims in Poland between 2006 and 2020 with W54 (ICD-10) code as the cause of hospitalization. In our study, this code was used in 6 interventions.

Other researchers note that dogs are a common cause of hospitalization for bites [22]. In the observation of deaths from dog bites in 1995-2016, the number of deaths is increasing, and this increase cannot be explained by an increase in the human or dog population [23].

Ricardi [24] points to rabies, which is a zoonotic disease with a significant mortality burden worldwide.

Our own analysis did not involve zoonotic infectious diseases, although dogs involved in incidents cannot be excluded as carriers. The authors do not have such knowledge and tools to study the above relationship.

Ghaffari, et al [25] examined the location of bites, showing the majority of bites to legs and feet (65%), and dogs being responsible for 92% of bites. Own study shows a small percentage of limb bites.

According to Janatolmakan, thousands of animal bite cases around the world each year represent a large financial burden on the health and economy of many countries [26]. It is necessary to develop intervention programs, such as curbing stray dogs, vaccinating dogs and raising public awareness.

## Conclusions

(1) Hymenopterous insects are the most common type of zoonotic hazard on an annual basis, with an increase for the spring-summer months; (2) there was a statistically significant difference in age for each type of hazard, the youngest of those injured were harmed by dogs, while the eldest were by insects; (3) there was no statistically significant effect of place of residence (urban-rural) on the type of zoonotic injury; (4) the majority of injured patients required transport to the ED (65% - 92%); (5) the most common livestock-related incidents were head and chest injuries due to kicking or hitting; (6) the results obtained are necessary to better understand zoonotic injury factors.

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### Conflict of Interest

The authors declare no conflict of interest.

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