

Public Health Institute Zrenjanin,
Center for Disease Prevention and Control, Zrenjanin¹
Institute of Public Health of Vojvodina,
Center for Disease Control and Prevention, Novi Sad²
University of Novi Sad, Faculty of Medicine Novi Sad
Department of Epidemiology³

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EPIDEMIOLOGICAL CHARACTERISTICS OF THE MOST COMMON ZOOSES IN THE CENTRAL BANAT DISTRICT OF VOJVODINA FROM 2002 TO 2016

EPIDEMIOLOŠKE KARAKTERISTIKE VODEĆIH ZOOZOZA U SREDNJOBANATSKOM OKRUGU VOJVODINE U PERIODU OD 2002. DO 2016. GODINE

Svetlana POPOV¹, Mirjana ŠTRBAC² and Mioljub RISTIĆ^{2,3}

Summary

Introduction. The aim of this study was to determine the epidemiological characteristics of the most common zoonoses in the Central Banat District of Vojvodina. **Material and Methods.** A descriptive epidemiological study was conducted using data of the Centers for Disease Control and Prevention of the Institute of Public Health of Vojvodina and Public Health Institute Zrenjanin. The data for this study were collected from January 1, 2002 to December 31, 2016. **Results.** Apart from Q fever, which showed a stable incidence, the trend of incidence rates of other two zoonoses decreased between 2002 and 2016. Q fever was three times more common in males than females, while the incidence of males and females was similar among patients with Trichinellosis and Salmonellosis. Regarding the age distribution, the highest average incidence rate (12/100,000) of Trichinellosis was reported in patients aged 20–39 years; Salmonellosis predominated among patients aged 0–19 years (64.6/100,000), and Q fever in the 20–39 age group (9.2/100,000). Pork products were the most common source of outbreaks of Trichinellosis, while cakes and cookies were the most common source of outbreaks of Salmonellosis. Out of 92 interviewed patients with Q fever, 50 (54.3%) had a direct daily contact with their domestic animals during the maximum incubation period. **Conclusion.** In order to improve evaluation of epidemiological characteristics of the most common zoonoses and consequently their control in a timely manner, efficient exchange of information between health sectors for humans and animals is necessary, along with continuous education of food handlers and the general population of the Central Banat District of Vojvodina.

Key words: Zoonoses; Epidemiology; Disease Outbreaks; Q Fever; Trichinellosis; Salmonella Infections; Public Health Surveillance

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Introduction

Zoonotic diseases (zoonoses) are infections that are spread between animals and people [1, 2]. Zoon-

Sažetak

Uvod. Cilj ove studije bio je da se odrede epidemiološke karakteristike vodećih zoonoza u Srednjobanatskom okrugu Vojvodine. **Materijal i metode.** Sprovedena je deskriptivna epidemiološka studija upotrebom podataka centara za kontrolu i prevenciju bolesti Instituta za javno zdravlje Vojvodine i Zavoda za javno zdravlje Zrenjanin. Podaci za ovu studiju prikupljeni su u periodu od 1. januara 2002. do 31. decembra 2016. godine. **Rezultati.** Osim *kju* groznice, koja je pokazala stabilan trend incidencije, trend incidencije za druge dve zoonoze u periodu od 2002. do 2016. godine bio je opadajući. *Kju* groznica je tri puta češće registrovana kod muškaraca u odnosu na žene, dok je učestalost obolavanja kod muškaraca i žena bila slična među obolelima od trihineloze ili salmoneloza. Što se tiče uzrasne distribucije, najviša prosečna stopa incidencije (12/100.000) trihineloze zabeležena je kod pacijenata uzrasta 20–39 godina, salmoneloza među pacijentima uzrasta 0–19 godina (64,6/100.000), a *kju* groznice u uzrastu 20–39 godina (9,2/100.000). Najčešće inkriminisane namirnice za trihinelozu bili su proizvodi od svinjskog mesa, dok su torte i kolači bili najčešći izvor infekcije za salmoneloze. Od 92 obolele osobe od *kju* groznice, ukupno 50 (54,3%) pacijenata je dalo podatak o svakodnevnom direktnom kontaktu sa domaćim životinjama tokom maksimalnog perioda inkubacije ovog oboljenja. **Zaključak.** Da bi se unapredila mogućnost procene epidemioloških karakteristika vodećih zoonoza, a time obezbedila i pravovremenost njihove kontrole, potrebna je brza razmena informacija između sektora za zdravstvenu zaštitu životinja i sektora za zaštitu zdravlja ljudi, uz kontinuiranu edukaciju osoba u prometu namirnicama i opšte populacije na teritoriji Srednjobanatskog okruga.

Gljučne reči: zoonoze; epidemiologija; pojave bolesti; Q groznica; trihinelozu; salmoneloza; nadzor javnog zdravlja

oses have a significant public health impact worldwide. Due to the lack of control strategies and education, zoonoses have a higher incidence rate in developing than in developed countries [3].

It is estimated that zoonoses account for 58% to 61% of all communicable diseases causing illness in humans worldwide [4]. The estimates showed that 60.3% of the emerging infectious diseases were zoonoses [5].

According to the annual reports, the most common zoonoses in the Autonomous Province of Vo-

Abbreviations

CBDV	– Central Banat District of Vojvodina
APV	– Autonomous Province of Vojvodina
EU/EEA	– European Union/European Economic Area
US	– United States

jvodina (APV) as well as in the Central Banat District of Vojvodina (CBDV) are Trichinellosis, Salmonellosis and Q fever [6].

Since 1966, when mandatory notification of Trichinellosis was introduced in the APV, this disease has been registered continuously with small or large outbreaks. The largest outbreak of Trichinellosis in the APV, with 907 human cases (the incidence rate of 45/100,000 inhabitants), was registered in 1985 [6].

A mandatory notification of Salmonellosis in the APV has been introduced since 1976. During the last 25 years of the XX century, there were several epidemics of human Salmonellosis that were registered mainly after eating improperly cooked contaminated foods [6, 7].

Q fever was the most common zoonotic disease in the APV until the 1990s, with the average annual incidence rate of 10.2/100,000 (incidence rate range: 3.8 - 20.4/100,000) [8]. After 1976, when 900 human Q fever cases were reported, which was the largest outbreak of the disease in Europe, Q fever remained an endemo-epidemic disease in the APV [9]. Until the 1990s, the disease showed a seasonal peak and it was registered mainly during the last winter months, as well as in the early spring months (during the lambing season) [10]. The CBDV was previously identified as a district with a potentially endemic area for Q fever [11].

The aim of this study was to determine the epidemiological characteristics of the most common zoonoses in the CBDV during 15 consecutive years (from 2002 to 2016).

Material and Methods

The study was conducted in the CBDV, one of seven administrative districts of APV, Serbia. It lies in the geographical region of Banat. According to the 2011 Census results, it has a population of 186,851 inhabitants. A retrospective, observational study was conducted during the period from January 1, 2002 to December 31, 2016. The data for this study were obtained from the communicable disease registries of the Centers for Disease Control and Prevention of the Institute of Public Health of Vojvodina and Public Health Institute Zrenjanin, which are responsible for the collection of passive surveillance data on the diseases for which notification is mandatory. Case inclusion criteria were based on the clinical signs specific for the analyzed zoonoses. The data on zoonoses in humans, collected as part of the routine system of infectious disease surveillance in the CBDV, included information on socio-demographic characteristics of patients, the date of disease onset, as well as the information related to the source and mode of transmission during the outbreak.

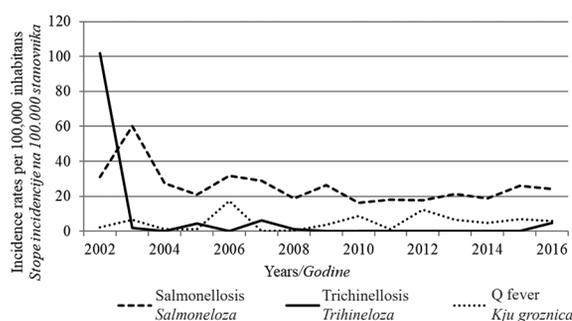
We used basic statistical indicators, general and specific incidence rates. Incidence rates were calculated using the annual number of registered human cases of zoonoses as the numerator and the number of inhabitants in the CBDV, according to the two Censuses in the Republic of Serbia (in 2002 and 2011) as the denominator, multiplied by 100,000 inhabitants per year.

Results

Structure and distribution of the most common zoonoses in the CBDV, 2002–2016

Throughout 2002–2016, the highest incidence rate (101.7/100,000) of Trichinellosis was registered during 2002 (212/249; 85.1%); Salmonellosis during 2003 (60/100,000), and Q fever during 2006 (17.3/100,000). Apart from Q fever, which showed a stable trend of incidence, the trend of incidence rate of other two zoonoses in the CBDV decreased between 2002 and 2016 (**Graph 1**).

The average annual incidence rates of the three most common zoonoses with gender distribution are shown in **Graph 2**. The average annual incidence of Trichinellosis among males was 9.8/100,000, and 6.3/100,000 among females. The prevalence of Salmonellosis in males and females

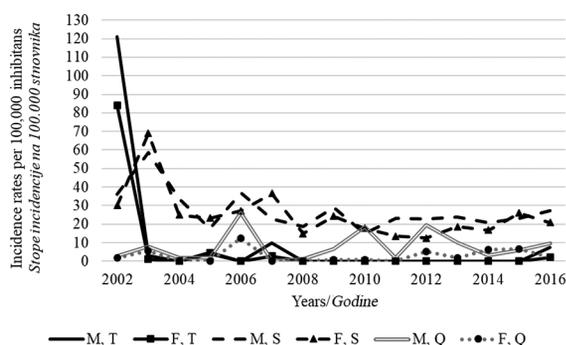


Graph 1. Incidence rates of the most common zoonoses in the Central Banat District, 2002–2016

Grafikon 1. Učestalost vodećih zoonoza u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

was nearly equal (51% vs. 49%), while Q fever was three times more frequently recorded in males than in females, with the average annual incidence rates of 7.9/100,000 and 2.9/100,000, respectively.

With regard to the age distribution, the highest average incidence rate (12/100,000) of Trichinellosis was reported in patients aged 20–39 years, while the lowest one was among patients aged 0–19 years (4.3/100,000). Human Salmonellosis predominated among patients aged 0–19 years (64.6/100,000), while the lowest average incidence rate was recorded among the oldest population (13.7/100,000). During 2002–2016, the majority of Q fever cases (81.2%) were reported in patients aged 20–59 years, with the highest average incidence rate (9.2/100,000) in the 20–39 age group (**Graph 3**).

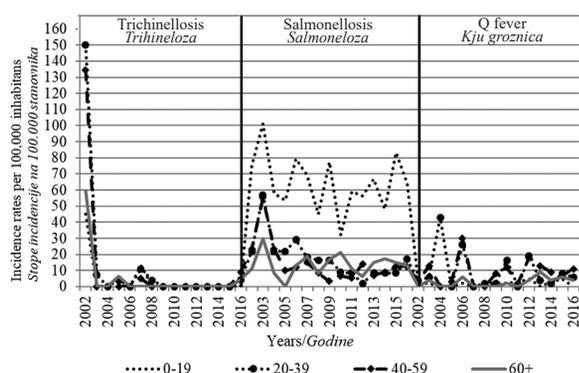


Graph 2. Gender-specific incidence rate of the most common zoonoses in the Central Banat District, 2002–2016

Grafikon 2. Rodno specifična distribucija vodećih zoonoza u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

Legend: M, T = males, *Trichinellosis*; F, T = females, *Trichinellosis*; M, S = males, *Salmonellosis*; F, M = females, *Salmonellosis*; M, Q = males, *Q fever*; F, Q = females, *Q fever*

Legenda: M, T = muškarci, *trihineleza*; F, T = žene, *trihineleza*; M, S = muškarci, *salmoneloze*; F, M = žene, *salmoneloze*; M, Q = muškarci, *kju groznica*; F, Q = žene, *kju groznica*



Graph 3. Age-specific distribution of the most common zoonoses in the Central Banat District, 2002–2016

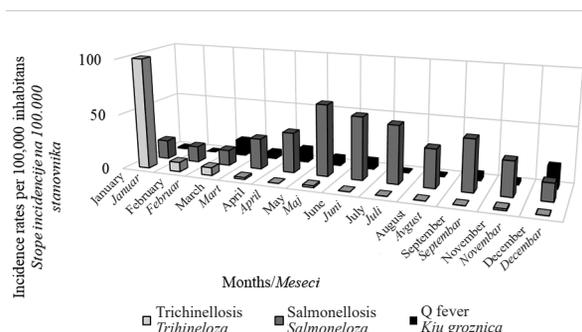
Grafikon 3. Uzrasno specifična distribucija vodećih zoonoza u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

Legend: Black vertical lines separate values of different zoonoses
Legenda: Crne vertikalne linije odvajaju vrednosti za različite zoonoze

Table 1. Distribution of patients affected in epidemic outbreaks and sporadic cases of the most common zoonoses in the Central Banat District, 2002–2016

Tabela 1. Distribucija pacijenata u epidemijama i distribucija sporadičnih slučajeva u tri vodeće zoonoze u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

Zoonosis/Zoonoza	No of outbreaks Broj epidemija	Cases in epidemic Broj obolelih u epidemijama		Sporadic cases Sporadični slučajevi		Total Ukupno	
		N	%	N	%	N	%
Trichinellosis/ <i>Trihineleza</i>	5	247	99.2%	2	0.8%	249	100%
Salmonellosis/ <i>Salmoneloze</i>	28	114	14.6%	666	85.4%	780	100%
Q fever/ <i>Kju groznica</i>	6	70	45.2%	85	54.8%	155	100%



Graph 4. Seasonal distribution of the most common zoonoses in the Central Banat District, 2002–2016

Grafikon 4. Sezonska distribucija vodećih zoonoza u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

Regarding the seasonal distribution, the majority of cases with *Trichinellosis*, *Salmonellosis* and *Q fever* were registered during January (84%); between June and August (42%), and during December, March and May (58%), respectively (**Graph 4**).

Outbreak occurrence, probable sources and modes of transmission according to available data after epidemiological investigation of the most common zoonoses in the CBDV, 2002–2016

From 2006 to 2016, there were 5, 28 and 6 outbreaks of *Trichinellosis*, *Salmonellosis* and *Q fever* in humans, accounting for 99%, 15% and 45% of the total number of human cases within the three observed zoonoses, respectively (**Table 1**).

According to the available data, pork products were the most common source of outbreaks of *Trichinellosis* (89%; 222/249), while cakes and cookies were the most common sources of outbreaks (36/114; 31.6%) of human *Salmonella* infections. Interestingly, two patients provided information that they had consumed quail eggs before the onset of *Salmonellosis* symptoms. Out of 92 interviewed patients with *Q fever*, 50 (54.3%) had a direct daily contact with their domestic animals during the maximum incubation period, while every fourth patient did not have any contact with animals (**Table 2**).

Table 2. Probable sources and modes of transmission of the most common zoonoses in the Central Banat District, 2002–2016**Tabela 2.** Verovatni izvori i putevi prenošenja vodećih zoonoza u Srednjobanatskom okrugu u periodu od 2002. do 2016. godine

Zoonosis <i>Zoonoza</i>	Probable source or mode of transmission <i>Verovatni izvor ili put prenošenja</i>	No of cases <i>Broj slučajeva</i>	% of total cases <i>% od ukupnog broja</i>
Trichinellosis <i>Trihineloz</i> N = 249	Pork products, bacon, sausages <i>Proizvodi od svinjskog mesa, slanina, kobasice</i>	222	89.1
	Grilled pork meat/ <i>Svinjsko meso sa roštilja</i>	13	5.2
	Homemade smoked pork sausages <i>Domaće dimljene kobasice od svinjskog mesa</i>	10	4.1
	Unknown/ <i>Nepoznato</i>	4	1.6
	Cakes and cookies/ <i>Torte i kolači</i>	36	31.6
Salmonellosis <i>Salmoneloze</i> N = 114*	Ice cream/ <i>Sladoled</i>	20	17.5
	Chicken eggs/ <i>Kokošija jaja</i>	19	16.7
	White sausage/ <i>Bela kobasica</i>	8	7.0
	Baked chicken wings/ <i>Pečena pileća krilca</i>	3	2.6
	Mayonnaise/ <i>Majonez</i>	3	2.6
	Quail eggs/ <i>Prepeličja jaja</i>	2	1.8
	Unknown/ <i>Nepoznato</i>	23	20.2
Q fever <i>Kju groznica</i> N = 92*	Contact with animals/ <i>Kontakt sa životinjama</i>	50	54.3
	Livestock in the neighbourhood/ <i>Uzgoj stoke u komšiluku</i>	19	20.7
	No contact with animals/ <i>Bez kontakta sa životinjama</i>	23	25.0

*According to the available data after the epidemiological investigation/*Prema dostupnim podacima, nakon epidemiološkog ispitivanja*

Discussion

To our knowledge, this is the first study about the epidemiological characteristics of Trichinellosis, Salmonellosis and Q fever which are the three most common zoonoses in the CBDV.

Although these zoonoses are mainly clinically presented as mild diseases with minor complications, some of them can lead to development of severe complications with a potentially fatal outcome [3, 4].

Trichinellosis

Trichinellosis is a very common zoonotic disease across the world. Infection with *Trichinella* spp. has been documented in domestic animals as well as in wildlife worldwide. Globally, reporting of human Trichinellosis varies greatly. According to the analysis conducted between 1986 and 2009, a total of 56,912 cases of human Trichinellosis were registered in Europe. In addition, the highest ranges of the incidence rate per 100,000 inhabitants were registered in the following countries: Bosnia and Herzegovina, 4.1; Bulgaria, 2.4–2.9; Croatia, 1.7–4.8; Latvia, 1.1–1.3; Lithuania, 1.2–6.6; Romania, 2.9–8.5; and Serbia, 5.0 [12]. With regard to the annual epidemiological reports from the 29 European Union (EU)/European Economic Area (EEA) countries, Bulgaria, Lithuania and Romania accounted for 63% of all confirmed cases in 2015 [13]. Our results showed that the average incidence of human Trichinellosis was 8/100,000, which is much higher than the average incidence registered in the APV during the same pe-

riod [6], or the incidence registered in the EU/EEA countries during 2015, but it was close to the average incidence of the human Trichinellosis documented in Romania [12, 14]. Moreover, Romania was considered as one of the most affected countries in Southeastern Europe and in the world during 2004 [15]. With regard to the age and gender of patients, available data from clinical reports show that Trichinellosis is primarily a disease of adults, occurring almost equally in both genders. The results of a retrospectively reviewed Trichinellosis outbreaks, conducted worldwide during 1986–2009, showed the highest incidence among subjects aged 20–50 years in both genders [12]. Our findings showed that the highest incidence rate of Trichinellosis was detected in adults aged 20–39 years, which is consistent with the results obtained from the EU/EEA region [13]. A possible explanation for Trichinellosis predominance in adults may lie in food related behavior. Some previously published studies have reported that improperly cooked or prepared meat dishes may be more commonly eaten at adult-oriented events, particularly if alcohol is consumed [12, 15, 16]. Contrary to the age-specific distribution of human Trichinellosis obtained from several EU/EEA countries as well as from our findings during 2015, Lithuania and Romania were the countries in which almost all cases were reported among children and young teenagers (0–14 years of age) [13]. Similar to the results from the study conducted in Belgrade [17], and the previously published data in the APV [6], there was no significant difference regarding the gender of patients.

Multiple studies have reported a Trichinellosis outbreak in Europe among people who had consumed wild boar sausages [18]; bacon bought at the market [19]; homemade ground meat products after home slaughter [20]; infected pork salami [21]; raw pork meat and meat products produced by a meat processing plant and sold in shops [22]; ham produced from a pig slaughtered without veterinary inspection [23]; horse meat [24]; bear meat [25]; smoked wild boar ham [26]; grizzly bear meat [27]. We found evidence that almost all cases of registered human Trichinellosis were after eating some pork products. Hence, our results were supported by the findings from the latest described outbreak of human Trichinellosis in the CBDV where 309 cases were recorded which led to the highest incidence rate of Trichinellosis in 2002 (101.7/100.000) compared with other years. Smoked pork sausages produced by a slaughterhouse near Zrenjanin were the common source of this largest outbreak in the CBDV [28]. On the other hand, a total of 114 human cases were detected in the latest outbreak of human Trichinellosis in Serbia. This time wild boar (*Sus scrofa*) meat products were the source of the outbreak. Interestingly, this is the first case of *Trichinella britovi* confirmed in food samples linked to human Trichinellosis [29].

It is a known fact that some parts of APV have an endemic occurrence of human Trichinellosis. For comparison, in Serbia between 2005 and 2009, 62.8% of total human Trichinellosis cases were registered in the APV [30, 31]. Contrary to the fact that human Trichinellosis was permanently registered in the APV, outbreaks of this parasitic zoonosis in the CBDV occurred sporadically, with up to 24% of hospitalized cases [28]. In line with local customs, we found that most human cases of Trichinellosis were registered during January. This finding can be explained by increased pig slaughter for local consumption during Christmas and winter, and particularly due to consumption of pork sausages, salami and smoked meat [28]. Similar seasonal distribution of human Trichinellosis was described in Romania and Bulgaria, probably because of food behavior and customs similar to those in Serbia [13].

Salmonellosis

Salmonella is a significant public health concern worldwide and *Salmonellosis* in humans are a leading bacterial cause of acute gastroenteritis, both in children under 5 years of age and in the general population [32]. Previous estimates from four developed countries showed that the incidence of diarrheal disease ranged from 0.44 to 0.99 episodes per person-year, which possibly means that each year up to 2.8 billion cases of diarrheal diseases should be detected globally, and *Salmonella* infections account for around 3% of them [32, 33]. Global estimates of *Salmonellosis* are difficult to calculate because many countries, particularly the developing ones, have insufficient surveillance data [32]. However, the estimates for *Salmonella* infections in the

27 EU countries in the 2005–2009 period showed that about one out of every 80 inhabitants was affected by *Salmonella* spp. each year [34].

According to the data of the global population divided into 21 regions, the highest estimation of the *Salmonella* gastroenteritis per 100.000 person-years was detected in East Asia (3,980/100.000 person-years), and the lowest was detected in regions of Central Asia and Asia-Pacific (40/100.000 person-years). Interestingly, in the European region, the highest incidence rate of *Salmonella* gastroenteritis was registered in Central Europe (2.390/100.000), and the lowest in Western Europe (240/100.000) [32].

Similar to the results of recently published data for 37 European countries [35], we found a decreasing trend of *Salmonellosis*. In the rest part of the APV, there was a decreasing trend in the period between 1998 and 2008, but since 2009 the trend of *Salmonellosis* in the APV has been stable [6]. Although the reason for decrease of *Salmonellosis* in the CBDV remains unclear, experiences from the 37 European countries suggest that implementation of comprehensive veterinary control programs, particularly in poultry, may contribute to reduction in *Salmonella* infections in humans [35]. Similar to the reports from the European countries [36] and the United States (US) [37], there was no difference in the overall rates between males and females. The results of the reports mentioned above [36, 37] strongly suggested that most *Salmonellosis* cases were detected among children aged 0–4 years. This phenomenon can be explained by a higher proportion of symptomatic *Salmonellosis* in children and increased likelihood that parents will take their children to see a doctor who will then recognize and report the disease in this age group [36]. In support of the aforementioned facts, the highest incidence rate of *Salmonellosis* in the CBDV was registered in patients under 19 years of age. However, for a better evaluation of the age distribution of *Salmonella* infections in humans in a certain territory, a seroprevalence study should be implemented [38].

Regarding the seasonal pattern of *Salmonellosis*, we found that more than 40% of all cases were registered between June and August. Similar experiences were described in some European countries as well as in the US [36, 37], and this could be explained by particular or specific seasonal human behaviors as well as by variation in host susceptibility. Higher ambient temperature during summer months can itself be a risk factor for transmission because it drives bacterial survival and growth [39]. Other risk factors for *Salmonellosis* in humans include gastric hypoacidity, recent use of antibiotics, and different immunosuppressive conditions [40].

Homemade cakes and cookies consumed among family members were the most prevalent source of infection in the 28 outbreaks of human *Salmonellosis* in the CBDV. This is quite similar to the findings of the Belgrade study where 63.4% out of total outbreak cases of human *Salmonellosis* were registered after some family celebrations [41], as well as to the results obtained from other parts of APV [7].

Surprisingly, only 15% out of total human Salmonellosis cases were detected during the outbreak occurrence and the majority of Salmonellosis infections were classified as sporadic cases. Other authors have reported similar results [42]. Possible reasons for this might be a lack of consistency during the outbreak investigation or the fact that human Salmonellosis cases were registered mostly in families without a large outbreak appearance in the general population of CBDV. Additional reasons may be in the fact that a lot of patients with milder clinical presentation of disease symptoms did not consult a physician and/or specific etiology was not diagnosed. In accordance with the facts mentioned above, we believe that the number of cases reported during the study period represents only the “tip of the iceberg” of human Salmonellosis in the CBDV.

Most cases of Salmonellosis are caused by ingestion of contaminated food items such as eggs, dairy products, meat, even peanut butter [40]. It is noteworthy that previous investigations have established that a shell egg was the most important vehicle for the epidemic of human Salmonellosis in the US [43]. Although our results are consistent with the reports obtained from different European countries where either eggs or egg products were the most commonly identified sources of human Salmonella infections during summer months [34], findings of other authors also highlighted that barbecue and gardening were recognized as a specific source or mode of Salmonellosis transmission which was particularly noticed during June or July [39]. Similar to the findings in several European countries as well as the US [36, 37, 43], Salmonella Enteritidis was the most common serotype (96%) of Salmonella among the reported human Salmonellosis in the CBDV.

Q fever

With regard to Q fever, we provided evidence that the average incidence rate of Q fever was 5.2/100.000 which is higher than the average incidence rate of Q fever in the APV (1.4/100.000) in the 2008–2017 period. The analysis of all seven districts of APV during 2017, a higher incidence of Q fever was registered only in the Srem District (7.0/100.000) in comparison with the CBDV (3.7/100.000) [6]. Although only two large outbreaks of Q fever were registered in the CBDV during 2006 and 2010, a large number of sporadic human Q fever cases were registered in 2012, as well. The results of the study conducted by Ristić M. et al. [11] showed a strong positive correlation between the increase in Q fever cases and the increase in wind speed in the CBDV, which could potentially explain an endemo-epidemic character of human Q fever in this district.

Our results showed that human Q fever cases were more frequently registered among males than

females, predominantly affecting the 20–59 age group. Furthermore, we found that the incidence of human Q fever was higher in December, March and May, and that more than one half of all patients had a direct daily contact with their domestic animals before the onset of the disease. If anything, most of the data presented above are in good agreement with the previously published data and their explanations in the study of Q fever conducted in the APV [11].

It is a known fact that the predominant mode of Q fever spreading is inhalation of aerosols generated from infected placenta, body fluids or contaminated dust resulting from contaminated manure and desiccation of infected placenta and body fluids [44]. In accordance with this, we believe that the aforementioned modes of transmission were presented in the majority of patients in our study. Findings of other authors across European countries also confirmed these observations [45].

In the latest largest community outbreak of Q fever ever reported in the literature in the Netherlands during 2007, 2008 and 2009, there were 168; 1,000 and 2,357 cases, respectively [46]. Findings of the aforementioned study highlighted that abortion waves in dairy goat farms were the primary source of infection in humans primarily affecting people living near these farms (within 5 km). It was noteworthy that one of the potential reasons for an obviously large number of human cases of Q fever was partly explained by an increased awareness of Q fever among general practitioners, specialists and medical microbiological laboratories, especially in the region where the 2007 outbreak firstly occurred. Similar to the results of the recently published systematic review in Galicia (north-west Spain) [47], we provided evidence that most human Q fever cases were sporadic, which additionally suggests that there was an endemic area of Q fever in Vojvodina. In accordance with the fact that Q fever in humans is often presented as an influenza-like illness and not correctly classified as Q fever, it can be assumed that the true number of persons with Q fever exceeds the number of reported cases [44]. In line with this, the implementation of a seroprevalence study in the CBDV should be considered.

Conclusion

The most common zoonoses in humans in the Central Banat District of Vojvodina are Trichinellosis, Salmonellosis and Q fever. In order to improve evaluation of epidemiological characteristics of these zoonoses and consequently the timely manner of their control, prompt exchange of information between health sectors for animals and humans, along with continuous education of food handlers and the general population in the Central Banat District of Vojvodina are needed.

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