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APPLICATION OF EPIDEMIOLGICAL INFORMATION SYSTEM (EPIS) IN THE SLOVAK REPUBLIC WITHIN THE SURVEILLANCE OF SALMONELLOSIS AND CAMPYLOBACTERIOSIS OUTBREAKS IN THE EUROPEAN UNION (2001–2010)

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Abstract

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The aim of the work was to analyze the changes in the epidemiology of salmonellosis and campylobacteriosis diseases in Slovakia over the past 10 years and evaluate them in the context of epidemiological changes comparing to the EU. Salmonellosis (A020) and campylobacteriosis (A045) belong to the diseases with the highest morbidity in Slovakia. For the period 2001–2010 was reported in Slovakia 109 304 salmonellosis cases in human and 3 327 cases of *Salmonella* carriage. The five-year EU-trend (2005–2009) showed a statistically significant decrease of salmonellosis disease (with a mean reduction of 12% per year). Campylobacteriosis remains a long time the most frequently reported zoonotic disease in humans in Slovakia as well as in EU. For the period of 2001–2010 25 574 campylobacteriosis cases was reported in Slovakia. Most diseases were reported in 2010 with the number 4 591 (84.63 morbidity/100 000 inhabitants). Increase in morbidity is evident since 2003 with an average annual increase of 22%. We focused on more in-depth epidemiological analysis of salmonellosis and campylobacteriosis cases in Slovak Republic in relation to the infection agens and the outbreak of disease transmission mechanism, age and gender, location and seasonality of disease.

salmonellosis, campylobacteriosis, changes in epidemiology, Slovak Republic, EPIS

Over the past 20 years, there has been a major change in the epidemiology of foodborne illness. Many factors have contributed to the change, including genetic factors, host susceptiblity, new foodborne zoonoses, antibicrobial resistance, and a substantial increase in international travel and in globalization of food trade. Zoonoses are diseases and disease agents that are transmitted between animals and humans in a natural way and they constitute a major part of the communicable disease burden. It appears that zoonoses represent the majority of emerging infectious diseases. Several transmission pathways exist for zoonoses, including those via food or drinking water, direct animal contacts or those mediated through insect or arthropod vectors, rodents or aerosols (Kangas *et al.*, 2007). The European Community system for monitoring and collection of information on zoonotic agents in foodstuffs and animals is based on the Zoonoses Directive 2003/99/EC, which obligates the European Union (EU) Member States to collect relevant and where applicable comparable data of zoonoses, zoonotic agents, antimicrobial resistance and foodborne outbreaks. The Member States (MSs) transmit to the European Commission, every year, a report covering the data collected. The European Food Safety Authority (EFSA) is assigned the tasks of examining the data collected and publishing the Community Summary Report. This Report is prepared in collaboration with the European Centre for Disease Prevention and Control (ECDC) and EFSA's Zoonoses Collaboration Centre (ZCC, in the Technical University of Denmark) (Lahuerta *et al.*, 2011). The latest findings published by European Food Safety Authority (EFSA) regarding zoonoses in the European Union (EU) in corroborate the fact that campylobacteriosis and salmonellosis remain the most frequently reported zoonoses in the EU (Pires *et al.*, 2009). Campylobacteriosis in humans is caused by thermophilic *Campylobacter* spp. *Campylobacter* spp. are obligate microaerophiles and most of them grow optimally at 42 °C. *Campylobacter jejuni* has the ability to survive refrigeration and freezing, which is of obvious relevance to food safety and public health (Palyada *et al.*, 2009). Thermophilic *Campylobacter* spp. are widespread in nature. The principal reservoirs are the alimentary tracts of wild and domesticated birds and mammals. They are prevalent in food animals such as poultry, cattle, pigs and sheep; in pets, including cats and dogs; in wild birds and in environmental water sources. The bacteria can readily contaminate various foodstuffs, including meat, raw milk and dairy products, and less frequently fish and fishery products, mussels and fresh vegetables. Raw milk and contaminated drinking water have been causes of larger outbreaks (Montserrat and Yuste, 2010). The species most commonly associated with human infection are *C. jejuni* followed by *C. coli*, and *C. lari*, but other *Campylobacter* species are also known to cause human infection (Hofreuter *et al.*, 2006). Campylobacteriosis usually occur during the summer months. The infective dose of *C. jejuni* is quite low: less than 100 organisms can cause disease. The incubation period in humans averages from two to five days and involves diarrhea (sometimes bloody), fever, and abdominal cramping as well as complications such as reactive arthritis, pancreatitis, meningitis, endocarditis, and Guillain–Barré syndrome (Ray and Bhunia, 2008). *Salmonella* has long been recognised as an important zoonotic pathogen of economic significance in animals and humans. More than 2500 serovars of zoonotic *Salmonella* exist and the prevalence of the different serovars changes over time (e.g. S. Typhimurium). Non-typhoidal *Salmonella enterica* infection is one of the leading causes of gastrointestinal illness, responsible for several million human cases and thousands of deaths worldwide each year (Clarkson *et al.*, 2010). The common reservoir of *Salmonella* is the intestinal tract of a wide range of domestic and wild animals which result in a variety of foodstuffs covering both food of animal and plant origin as sources of infections. Transmission often occurs when organisms are introduced in food preparation areas and are allowed to multiply in food, e.g. due to inadequate storage temperatures, inadequate cooking or cross contamination of ready-to-eat food (Montserrat and Yuste, 2010). Human salmonellosis infections can lead to uncomplicated enterocolitis and enteric (typhoid) fever, the latter being a serious disease that may involve diarrhea, fever, abdominal pain, and headache (D'Aoust and Maurer, 2007). Both spatial heterogenity and autocorrelation can be evaluated through the detection of clustering in disease frequency. Factors that might lead to the clustering of the risk of food-borne zoonotic agents, such as *Campylobacter* spp. and *Salmonella* spp., at the primary production level include those associated with farm management, biosecurity and animal trade (Bhopal, 2008). Developed countries have used for a long time systems of surveillance of food safety problems. However, many outbreaks of food poisoning are never recognized because known pathogens are not accurately diagnosed or reported, and other causative foodborne agents are unknown and therefore unreported. This causes underestimation of foodborne disease incidences. Furthermore, industries check their products but usually do not report positive findings (Todd, 2003; Dohoo *et al.*, 2009). This situation can be corrected through initiation of new and improvement of existing epidemiological monitoring programs. Tab. I shows current ECDC surveillance networks.

I: *Current ECDC surveillance networks (http://ecdc.europa.eu)*

Short title	Full title	Former title
EISN	European Influenza Surveillance Network	former EISS
FWD-Net	European Food- and Waterborne Disease and Zoonoses Surveillance Network	former Enter-net
	European Network for STI Surveillance	
EU-IBD	European Invasive Bacterial Disease Surveillance Network	former EU-IBIS
	European HIV/AIDS Surveillance Network	former EuroHIV
	European Tuberculosis Surveillance Network	former EuroTB
EARS-Net	European Antimicrobial Resistance Surveillance Network	former EARSS
HAI-Net	Healthcare-associated Infections Network	former IPSE
ELDSNet	European Legionnaires' Disease Surveillance Network	former EWGLINET
EDSN	European Diphtheria Surveillance Network	former DIPNET

There is a need to institute and maintain effective surveillance and control programs, including reliable and sufficiently discriminative methods with rapid turn-around times, for providing epidemiological information on foodborne illness outbreaks and so reducing the prevalence of pathogens. This requires a collective effort by public health authorities (Sofos, 2008).

The aim of the work was to analyze the changes in the epidemiology of salmonellosis and campylobacteriosis diseases in Slovakia over the past 10 years and evaluate them in the context of epidemiological changes comparing to the EU.

MATERIALS AND METHODS

In line with the objectives the paper is focused on:

1. Epidemiological analysis of reported cases of salmonellosis and campylobacteriosis in the Slovak Republic for the period 2001 to 2010 in relation to the selected characters: etiological agens and an outbreak of disease transmission mechanism, age and sex, location and seasonality of infection.
2. Analysis and comparison of changes (trends) in the epidemiology of these diseases in Slovakia and in the European Union.
3. Importance of strengthening surveillance and reported infectious disease control.

The epidemiological analysis report is based on factual material that was obtained from the following sources:

- Scientific literature available in print and electronic form of the bibliographic database of the Slovak Agricultural Library in Nitra.
- The Epidemiological Information System (EPIS) in Slovakia.
- The European Surveillance System (TESS).
- The current ECDC surveillance networks: FWD - Net, resp. Former Enter – Net.
- The Community Summary Report on Trends and Sources of Zoonoses and zoonotic Agents in the European Union by EFSA.

Descriptive statistics and logical-cognitive methods and one-way analysis ANOVA were used in the evaluation and statistical analysis. Results were interpreted through the "p-values" (Tab. II). The effect is considered to be statistically significant, if the p-value is less than the selected significance level $\alpha = 0.05$.

II: *ANOVA analysis of the evaluated factors and achieved p-value*

Factor	p-value	
	salmonellosis	**campylobacteriosis**
Year	0.0000	0.0000
Month	0.0000	0.0000
Age	0.0000	0.0000
Region	0.2071	0.0000

Because of different frequencies were observed in the tested data, the Scheffe's test of 95% level was chosen among the Post Hoc methods. Exact calculations and testing were carried out in a specialized statistical software Statgraphics. Graphic processing and summary reviews of trends comparisons of individual factors during the decade were in absolute and relative terms processed in Microsoft Excel 2007 Microsoft Office in Windows Vista.

RESULTS AND DISSCUSSION

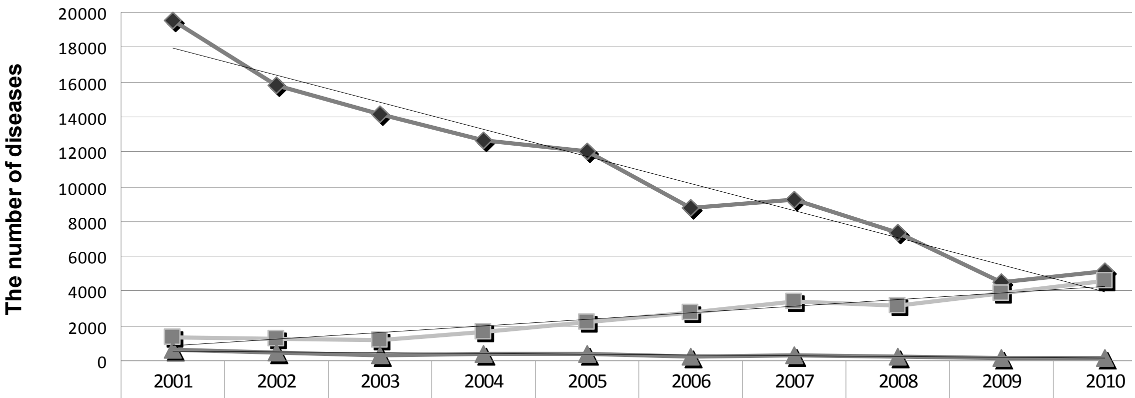
The Slovak Republic is actively involved in Early Warning Response System (EWRS) in the case of emergency epidemiological situation in the EU. The aim of the system is a rapid exchange of information on the incidence of infectious diseases and epidemics that have the potential to spread beyond countries where they start respectively, or may be a threat to the population of the EU or are rare and interesting in professional view. Slovak Republic cooperates in international activities in the area of foodborne diseases and zoonoses with WHO, EFSA, and also in particular the European Centre for Disease Prevention (ECDC) in Stockholm at the European level. In addition to sending data to TESS (The European Surveillance System) is managed as the tasks under a special program of the European Food and Waterborne Diseases (FWD). Based on the FWD program European network of special Epidemiological Information System (EPIS, since 2006) for the FWD was established in Slovakia. EPIS network is involved in the solutions of so-called "urgent inquires," what is a signal of a possible threats of an international epidemics. ECDC teams distribute the data to the all member states including Slovakia. FWD monitors the surveillance of 6 priority diseases (salmonellosis, campylobacteriosis, VTEC-*E. coli*, yersiniosis, listeriosis and shigellosis) and partially 10 of other diseases (botulism, brucellosis, Creutzfeldt-Jacob disease, cryptosporidiosis, echinococcosis, gardiosis, VHA, non-virus infection, toxoplasmosis and trichinellosis).

Certain pathogens occur ubiquitously or are rapidly spread over Europe as a result of the expansion of travel and/or trade within the EU or with third countries. This challenges the efficacy of the various national programs to control zoonoses. Only in European Union countries are affected about 350 000 people annually by zoonoses. In Slovakia with 5 424 925 inhabitants (as reported in 31. 12. 2009), the epidemiological situation in the incidence of zoonoses is relatively favourable, but still is necessary very close collaborations between human and veterinary health authorities (Halánová *et al.*, 2010).

Salmonellosis (A020) belongs to the diseases with highest morbidity in the Slovak Republic. For the period 2001–2010 there was reported 109 304 salmonellosis diseases and 3 327 cases of *Salmonella* carriage (A02N) in the Slovak Republic. The most cases were reported in 2001 with the number 19 511, representing a morbidity 361.14/100 000 inhabitants. In other years it was observed a gradual decline in reported cases (Fig. 1). Their occurrence in 2010 (94.58 morbidity/100 000) is 73.48% lower than in 2001 and 38.3% lower than the 5-year average (2005–2009). Number of registered carriers also gradually declined from 604 cases in 2001 to 164 in 2010. The gradual reduction in salmonellosis cases during the decade is in the results of statistical analysis visible if comparing the years 2001–2003 to 2010, when it was scored with a statistically significant difference between the reported number of diseases.

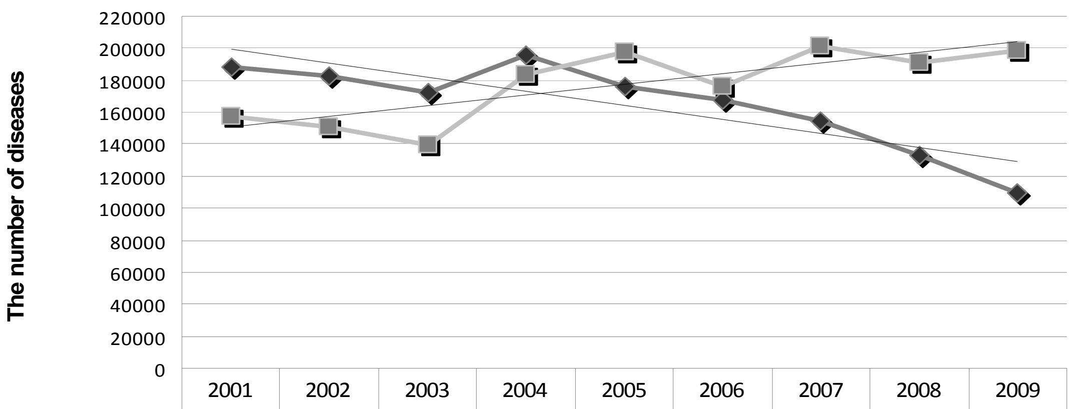
It can be assumed that the significant decrease of human salmonellosis cases were affected by: the entry of Slovakia into the EU (in 2004), gradual harmonization of legislation within the EU and its application in food practice and the field of health protection and promotion, active international cooperation SR with the EU, WHO, EFSA and ECDC and Slovakia's participation in EWRS.

The decreasing trend in the notification rate of salmonellosis cases in humans (Fig. 2) continued in last year while salmonellosis still remained the second most commonly reported zoonotic disease in the EU. The total number of reported human salmonellosis cases in the EU has decreased steadily by several thousand cases annually since 2001, from 188 269 cases in 2001 to 109 844 cases in 2009 (decrease 41.66%). The epidemiologic report mapping the year 2010 is still not reported and published in annual Community Summary Report, which covers 15 diseases. It can be assumed that the number of human salmonellosis cases in the EU reported via BSN (Basic Surveillance Network) has decreased since 2004. The five-



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
A020	19511	15840	14186	12657	12055	8784	9241	7336	4519	5175
A045	1351	1267	1197	1689	2206	2797	3422	3147	3907	4591
A02N	604	471	342	419	382	270	301	239	135	164

1: *The trend in the total number of salmonellosis and campylobacteriosis diseases in Slovakia (2001–2010) (own processing)*



	2001	2002	2003	2004	2005	2006	2007	2008	2009
A020 (EU)	188269	182424	172700	196042	176395	167240	154099	133258	109844
A045 (EU)	157631	150332	139581	183480	197363	176013	200889	190820	198582

2: *The trend in the total number of salmonellosis and campylobacteriosis diseases in European Union (2001–2009) (own processing)* year EU-trend (2005–2009) showed a statistically significant decrease (with a mean reduction of 12% per year). However, there were member states specific variations in trend. Although ten countries showed a significant decreasing trend (the greatest average annual decline of 28% was observed in the Czech Republic), there was still one MS, Malta that showed a significant increasing trend. Trends were not significant in the rest of the 14 countries that reported data on *Salmonella* for the five consecutive years.

Campylobacteriosis (A045) have been concerned one of the leading position regarding the incidence of foodborne diseases in the last 5 years in Slovakia. This situation correlates well with other members states forward, where campylobacteriosis is one of the often foodborne disease following salmonellosis. For the period of 2001–2010 has been reported 25 574 campylobacteriosis cases in Slovakia. Most diseases were reported in 2010 with the number 4591 (84.63 morbidity/100 000 inhabitants), what represents an increase over 2009 of 17.5%. Increase in morbidity is evident since 2003 with an average annual increase of 22% (Fig. 1). Analysing the reported cases of campylobacteriosis during the decade it can be found three homogeneous groups of years with the statistical significant differences between the beginning and the end of the decade.

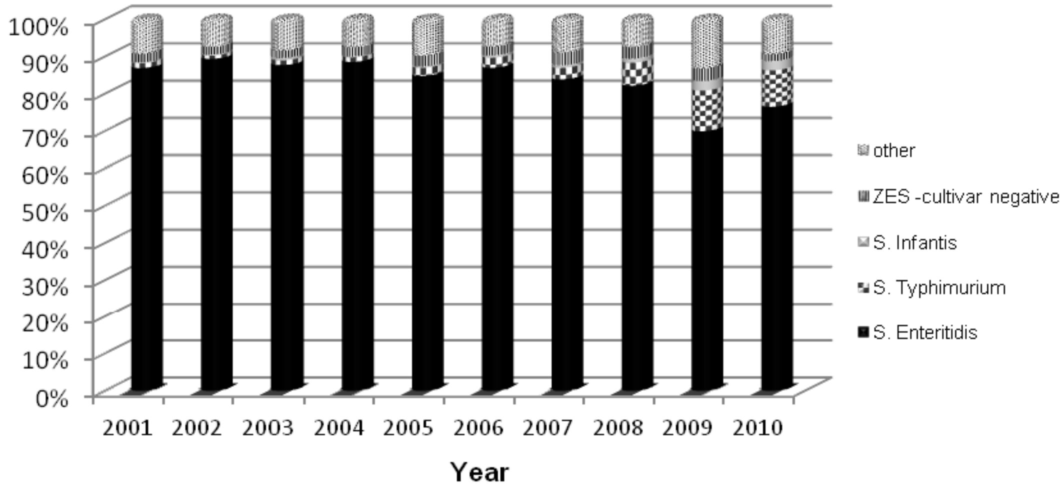
Campylobacteriosis remained the most reported zoonotic disease in humans within EU, showing a slight increase with 198 252 cases in 2009 compared to 190 566 in 2008 The case fatality rate was 0.02%, which is lower than for salmonellosis. The number of reported cases during the period of 2001–2010 varies between 139 581 total cases in 2003 to 200 889 in 2007. It is interesting that 2003 both, in Slovakia and the EU was reported the lowest number of campylobacteriosisdiseases. The trend of campylobacteriosis in the EU can be considered as a lineary slightly upwarding (Fig. 2).

Monitoring and surveillance schemes for some zoonotic agents are not harmonised between MSs, and findings must, therefore, be interpreted with care. The data presented may not necessarily derive from sampling plans that are statistically designed, and may not accurately represent the national situation regarding zoonoses. Results are generally not directly comparable between MSs and sometimes not even between different years in one country.

Concurrently in some year no surveillance system has been existed in some country. The total number of reported human salmonellosis and campylobacteriosis cases in the EU is influenced by the expanding of the EU (Estonia, Latvia, Lithuania, Poland, Czech Republic, Hungary, Slovakia, Slovenia, Malta and Cyprus in 2004 and Romania and Bulgaria in 2007).

Furthermore, more in-depth epidemiological analysis of salmonellosis and campylobacteriosis cases in relation to the infection agens and the outbreak of disease transmission mechanism, age and gender, location and seasonality of disease were done.

The incidence of salmonellosis in Slovakia is not different from those in other European countries. The current situation is due to a strong activity of *S.* Enteritidis (Fig. 3), which dominates in the etiology of salmonellosis and the number of cases has increased since the beginning of the last decade. In the Slovak Republic in the analysed period 2001–2010 *S.* Enteritidis accounted for 86% of the salmonellosis diseases. The second most frequently occurring serotype of *S.* Typhimurium accounted for 3% and *S.* Infantis was 1%. Other serotypes occurred only sporadically and usually represent only a fraction of a percentage of a total (8%). As already mentioned, the number of salmonellosis illnesses since 2001 is gradually declining, but new serotypes of *Salmonella* are still isolated. While in 2001 there were 35, in 2010, epidemiologists have



3: *The overview of Salmonella serotypes in Slovakia (2001–2010) (own processing)* identified 52 new serotypes and phage types. In the group of salmonellosis were reported only 2 deaths in 2010. In recent years, death hasn't been reported.

The number of sallmonellosis epidemic cases varies in the range from 22 in 2010 to 72 in 2007. The most common causes of epidemics, the number of which is under surveillance in Slovakia since 2005, was the use of contaminated ingredients in the preparation of food, non-compliance with the right technology in the preparation of food, especially the lack of heat treatment and weaknesses in the storage of raw materials and finished products.

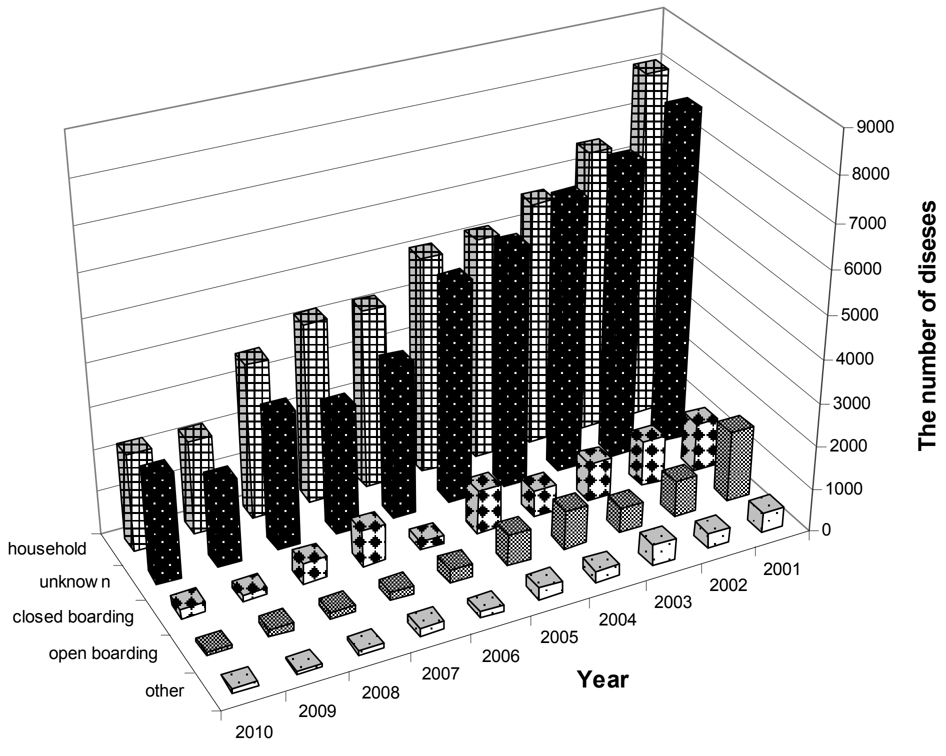
The most common factors of transmission were: eggs, home and business networks, egg products inadequately treated, unpasteurised milk, water from individual sources, blended food, confectionery, cheese and poultry. Transfer factor has been proven by laboratories, but also by epidemiological investigation.

The analysis of single epidemics determined by the place reported that the most of their occurrence is in private (usually within the family celebrations) but also in firm, school and open forms of catering (Fig. 4).

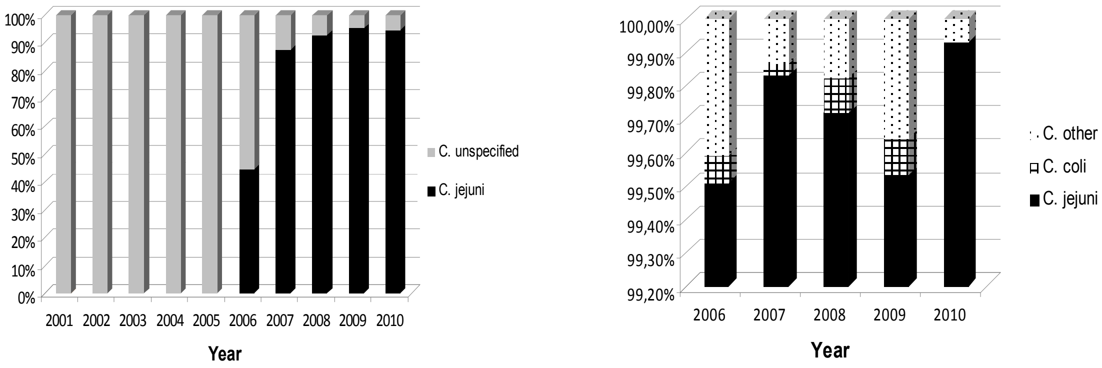
Salmonella spp. is an enteric pathogen associated with animal and slaughter hygiene. In the EU, eggs and egg products are the most frequently implicated sources of human salmonellosis. Meat is also an important source, with poultry and pork implicated more often than beef and lamb (EFSA Journal, 2008). The two most common *Salmonella* serotypes are Typhimurium and Enteritidis. In human salmonellosis, *S.* Typhimurium is the most frequent serotype. *S.* Enteritidis is associated primarily with poultry and eggs. It has been observed that *Salmonella* spp. usually persist during chilling (Voetsch, 2004). Overall, in the EU, S. Enteritidis and S. Typhimurium are the serovars most frequently associated with human illness. Human S. Enteritidis cases are most commonly associated with the consumption of contaminated eggs and poultry meat, while S. Typhimurium cases are mostly associated with the consumption of contaminated pig, poultry and bovine meat. *Salmonella* was rarely detected in other foodstuffs, such as dairy products, fruit and vegetables. Products non-compliant with EU *Salmonella* criteria were mainly observed in minced meat and meat preparations as well as in live molluscs.

The major etiologic agens in campylobacteriosis was *C. jejuni*, but it should be noted that the specification of the species occurred since 2006. Overview of different *Campylobacter* species is shown in Fig. 5. The most common transferfactors included the lack of heat treated poultry meat and milk from milk machines.

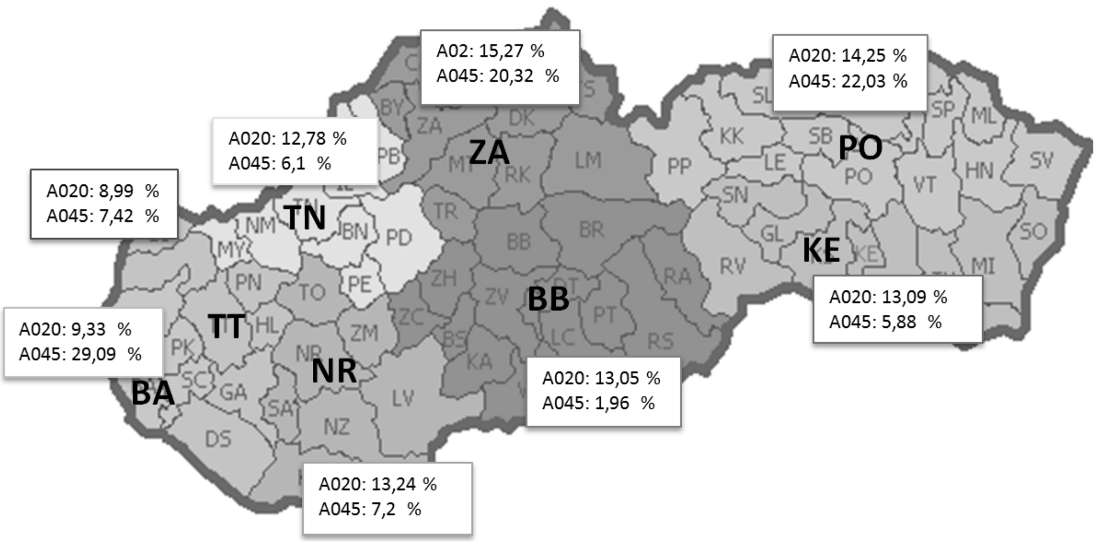
The most commonly reported species in EU was *C. jejuni* followed by *C. coli*. The Community incidence increased, but no common trend within the MS was evident. MS provided information on the origin (domestic vs. imported) of the infections and the situation varied considerably between the MS. In foodstuffs, the highest proportion of *Campylobacter*-positive samples was reported for



4: *The incidence of salmonellosis in Slovakia by location (2001–2010) (own processing)*



5: *The overview of Campylobacter species in Slovakia by location (2001–2010) (own processing)*



6: *Regional expansion of salmonellosis (A020) and campylobacteriosis (A045) in Slovakia (2001–2010) (own processing)*
Note. The percentages show the proportion of the number of diseases in various regions to the total number observed in Slovakia. Regions: BA – Bratislava; TT – Trnava; NR – Nitra; TN – Trenčín; BB – Banská Bystrica; KE – Košice; PO – Prešov; ZA – Žilina

fresh broiler meat where, on average, 29.03% of samples were positive (2007–2009). *Campylobacter* was also commonly detected from live poultry, pigs and cattle (EFSA Journal, 2011). During the analysed period salmonellosis were reported for 53 199 men and 56 105 women. In the period of 2001–2010 13 609 men and 11 955 women has been reported on campylobacteriosis. The opposite trend comparing to salmonellosis can be observed. Non of these results were statistically significant if comparing men and women. Based on these, it can be assumed that slovak consumers still prefer meat dishes (especially poultry) andoften due to the insufficient heat treatment can indigestion or an infection be observed what is main cause of the infections in both sexes.

Analyses of geographical localizations of infections shows that salmonellosis is reported in the all regions of Slovakia (Fig. 6), but in none of them has been reported higher infection growth compared to the other regions. It should be noted however that a slightly higher incidence of salmonellosis has beed reported in the Eastern Slovakia that is due to the more traditional rural way of life of local residents. An example is the preference of eggs originated from local farms, which are used for food preparation (potato salad) and confectionery products. The verification of the differences between the levels of the factor Region by the Sheffe's analysis we observed homogeneous groups with statistically significant differences.

Campylobacteriosis infections were reported from each region of the Slovakia (Fig. 6) during the analysed period and the highest morbidity was observed in the Bratislava region (29.09%) what significantly exceeds the morbidity of Slovak republic. Regional disparities in Slovakia can be explained by specific eating habits, which are in relationships also with te socio-economic aspects.

Salmonellosis infections were reported in each age group (Tab. III), while the highest number of 21 374 was recorded for 1–4 year olds (age-specific

III: *Salmonellosis and Campylobacteriosis in Slovakia (2001–2010). Disease and morbidity by age group (own processing).*

Year	A 020					A 045				
	Number of infections in the age group			Total in Slovakia	Morbidity/100 000	Number of infections in the age group			Total in Slovakia	Morbidity/100 000
	0–24	25–54	55 +			0–24	25–54	55 +		
2001	11 807	5 741	1 961	19 511	361.14	1 055	228	68	1 351	25.01
2002	9 169	4 935	1 736	15 840	294.48	975	225	69	1 267	23.55
2003	8 262	4 341	1 583	14 186	263.72	916	212	69	1 197	22.25
2004	7 598	3 619	1 442	12 657	235.26	1 248	351	90	1 689	31.39
2005	7 239	3 344	1 772	12 055	223.87	1 581	464	161	2 206	40.97
2006	5 190	2 407	1 187	8 784	163.13	2 066	523	208	2 797	51.94
2007	5 289	2 703	1 249	9 241	171.33	2 591	598	233	3 422	63.45
2008	4 389	1 876	1 071	7 336	135.83	2 344	559	244	3 147	58.27
2009	2 609	1 134	776	4 519	83.50	2 957	639	311	3 907	72.19
2010	3 189	1 186	756	5 131	94.58	3 411	803	377	4 591	84.63

IV: *Verification of differences in the incidence of salmonellosis in Slovakia (2001– 2010) for the factor Month with Scheffe's analysis in the level of 95% (own processing)*

Month	Number (2001–2010)	Average of salmonellosis cases	Groups homogenity			
Februar	10	373.70	X			
December	10	419.40	X	X		
March	10	460.10	X	X	X	
Januar	10	592.50	X	X	X	X
April	10	667.80	X	X	X	X
November	10	803.50	X	X	X	X
May	10	1 022.40	X	X	X	X
October	10	1 103.20	X	X	X	X
Jun	10	1 344.60		X	X	X
July	10	1 354.00		X	X	X
September	10	1 373.30			X	X
August	10	1 413.40				X

*LSD critical level: 941.481

morbidity 990.05/100 000) and 6 395 infections in 0-year old children (1 160.91/100 000). The most significant proportion of consumers to 1–4 annual incidence of salmonellosis was recorded in 2010 (24.55%). In determining the existence of differences between age groups were created two homogeneous groups. We found that the age range 1–4 were not statistically significantly different from all of the other categories except two 25–34 and 5–9. The results confirmed that the formation of salmonellosis is higher in risk groups (newborns, infants and people with lower immunity as well as with decreased gastric acidity.

In EU the highest notification rate for human cases was for age groups 0 to 4 years and 5 to 14 years and in age group of 25–44 in the 2005.

Campylobacteriosis infections are reported in each age group (Table III), while the highest number of 7 431 was within the group of 1–4 year olds (age-specific morbidity 346.79/100 000) and lowest (1830 cases) for seniors over 55 years of age-specific morbidity 298.04/100 000). We also have found that the age range of 1–4 years were not statistically significantly different from all of other categories.

In 2007 in EU children under the age of five had the highest notification rate 120 cases per population of 100 000 in 2007 and 128 cases per 100 000 population in 2005. Other age groups varied between ca. 32 to 53 cases per population of 100 000.

Salmonellosis occurred throughout the whole year with a peak incidence from May to September over the period of 2001–2010. We found that in these months, the incidence of salmonellosis ranged from 54% (2009) to 65.07% (2010). Very interesting is the year of 2008, when most infected were in February and March what was associated with rapid warming and favorable conditions for multiplication of microorganisms. The existence of differences in the incidence of salmonellosis in different months of the year we analysed using the Scheffe's test (Tab. IV). The four homogeneous groups were found, while the three were confirmed

V: *Verification of differences in the incidence of campylobacteriosis in Slovakia (2001–2010) for the Factor Month with Scheffe's analysis in the level of 95% (own processing)*

Month	Number (2001–2010)	Average of campylobacteriosis cases	Groups homogenity	
Februar	10	93.20	X	
Januar	10	114.30	X	
December	10	122.80	X	
March	10	123.40	X	
April	10	142.50	X	
November	10	200.80	X	X
October	10	252.80	X	X
May	10	267.80	X	X
September	10	271.60	X	X
August	10	290.10	X	X
July	10	318.20	X	X
Jun	10	378.50		X

*LSD critical level: 229.218

with statistically significant differences: a) from February to August b) from December to September c) March – (June, July). In a homogeneous group, "January, April, November, May and October" there were no statistically significant differences.

A seasonal peak in the number of cases during the summer and autumn was generally observed in all MSs within the EU.

Campylobacteriosis is also among the diseases with a peak incidence in the months of May to September. Its incidence varies between 55.42% (2006) to 73.42% (2004). We can say that the months of the years 2001–2010 contributed to campylobacteriosis with 62.67%. Using the Scheffe's test, we have seen two homogeneous groups, where only the first confirmed statistically significant differences (for the month of June to December, January, February, March and April). In a homogeneous group, other months were not with statistically significant differences (Tab. V).

Regarding the EU situation, there was a distinct seasonal variation in the human cases, with a peak in the number of cases reported during the summer months. The number of reports of human campylobacteriosis was stable over the five-year period, but the incidence was always higher during the summer months. This could be due to a seasonal effect that has not been addressed through traditional *Campylobacter* control programmes for food and animals (Lahuerta *et al.*, 2011).

Increased ambient temperature may lead to increased foodborne illness for several reasons. First, under certain conditions some bacteria, such as *Salmonella* spp., multiply in food in direct proportion to temperature, within the range 7.5–37 °C. In the absence of any control measures increased ambient temperatures may therefore increase bacterial reproductionat various points along the food chain, making the consequences of any subsequent ingestion more severe (Tam *et al.*, 2003). Second, ambient temperature may influence people's behaviour, which in turn may affect the chance of a foodborne illness occurring. Finally, warmer temperatures may lead to increased outdoor recreational activity which may make it more likely that people will be exposed to environmental sources of the relevant gastrointestinal pathogens. Although these illnesses are not strictly'foodborne', routine surveillance data cannot readily distinguish between these illnesses and those which are foodborne (Adak *et al.*, 2002). The results presented in research of Lake *et al.* (1999) indicate that temperature still plays an important role in foodborne infections, but in England and Wales, the impact of temperature upon foodborne illness is decreasing over time. Food poisoning, campylobacteriosis, salmonellosis, *Salmonella* Typhimurium infections and *Salmonella* Enteritidis infections were positively associated ($p < 0.01$) with temperature in the current and previous week. Only food poisoning, salmonellosis and S. Typhimurium infectionswere associated with temperature 2–5 weeks previously ($p < 0.01$). There were significant reductions also in the impact of temperature on foodborne illnesses over time.

When specific control programs are carried out, variations in the progress of these programmes might follow a geographic pattern, leading to spatial heterogenity. However, climate may affect maintenance and transmission of *Campylobacter* and *Salmonella*, and wildlife may act as a source of infection. Under these circumstances, and considering that information on geographical location isavailable, spatial analysis can be considered as a key step in epidemiology. The objectives include generating hypotheses on the risk factors and on processes underlying the transmission of infections (Nabila *et al.*, 2010).

SUMMARY

The primary objective of food-borne zoonotic pathogen control is to reduce the incidence of human disease. Ideally, this is achieved by elimination of the pathogen at the most appropriate stage(s) in the food chain. Where this is not feasible the alternative is to incrementally reduce the risk at various stages of production by introducing 'hurdles', i.e. taking measures that limit growth of or partially eliminate pathogens. Obviously, the latter should be combined with consumer information on the residual risks prevailing and how to manage these. We recommend continued surveillance and ongoing analysis of these trends over time. Even though the pathological consequences of campylobacteriosis and salmonellosis in most cases are relatively minor for the individual, the social costs can be high.
The decreasing trend in the notification rate of salmonellosis cases in humans continued in last year while salmonellosis still remained the second most commonly reported zoonotic disease both in Slovakia and EU. For the period 2001–2010 was reported in Slovakia 109 304 salmonellosis cases in human and 3 327 cases of *Salmonella* carriage. The five-year EU-trend (2005–2009) showed a statistically significant decrease of salmonellosis disease (with a mean reduction of 12% per year). Campylobacteriosis remains a long time the most frequently reported zoonotic disease in humans in Slovakia as well as in EU. For the period of 2001–2010 25 574 campylobacteriosis cases was reported in Slovakia. It is assumed that the observed reduction of salmonellosis and campylobacteriosis cases is mainly attributed to successful implementation of national *Salmonella* and *Campylobacter* control programs in fowl populations; but also other control measures along the food chain may have contributed to the reduction.
The aim of surveillance of foodborne diseases is in our opinion:

- reducing of morbidity, mortality, and after these diseases and thus achieve improving the quality of life,
- improving the surveillance and control of these diseases,
- to educate the population in the areas of transmissible disease.

Slovakia became a part of the European Union network for surveillance of infectious diseases. Development and introduction of EPIS in Slovakia led to a strengthening of surveillance of infectious diseases, increased operational capacity of epidemiologists in the area of control of transmissible diseases, epidemics, management and control of emergency situations, speeding up and ensuring the quality, what is a prerequisite for rapid adoption of effective antiepidemic steps and actions for the health protection.

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