

TBE in Slovakia*

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E-CDC risk status: endemic (data as of end 2022)

History and current situation

The former Czechoslovak Republic was one of the first countries in Europe where the tick-borne encephalitis virus (TBEV) was identified. This discovery was made in 1947, when Rampas and Gallia observed a high incidence of disease identified as “Czechoslovakia encephalitis”, and TBEV was isolated from *Ixodes ricinus*.¹

In 1951, for the first time ever, and again in Czechoslovakia, the alimentary transmission of TBEV from infected animals to humans was confirmed during a large outbreak in Rožňava. There were 271 hospitalized and serologically confirmed tick-borne encephalitis (TBE) patients. Blaškovič et al. found that most patients had drunk milk from the local dairy, which did not comply with basic sanitary requirements. The milk had not been pasteurized, but only stirred, equalized, and distributed. In addition, the goat milk that had been supplied to the dairy was also possibly infected.² During the examination of the tick-borne encephalitis TBE focus in Rožňava, the goats were found with high anti-TBEV titers.³

In the last few years, we have observed an increasing trend of TBE cases in Slovakia, for which there are several potential contributing factors. First, tick populations thrive because of extreme temperatures, high humidity, and the presence of snow cover during the winter, which acts as insulation. Early springs, as well as summers that are not too hot or dry, also may also be important positive factors for tick survival and reproduction success. Other factors are ecological, demographic, and socioeconomic conditions, for

instance, changes in land usage such as increased forestation or newly created gardens, and the growing popularity of outdoor pursuits such as hiking and fishing.⁴ Slovakia is well known in Europe for TBE alimentary outbreaks. Over the last few years, there has been a growing trend in the number of food-borne TBE outbreaks. Slovaks like to consume products made from raw goat and sheep milk. Moreover, raw goat milk has been recently promoted as a product to improve health and immunity in humans. In one case, a patient under immune-suppressive therapy in Slovakia drank raw goat milk in order to improve his health status, and he died from TBE.⁵

According to Decree No 585/2008 Coll. of the Ministry of Health of the Slovak Republic, which defines details on prevention and control of communicable diseases, TBE vaccination is compulsory for employees of virological laboratories working with TBE virus and TBE vaccination is recommended for occupationally exposed persons (forest workers, students of forestry schools, agriculture workers, etc.). Some insurance companies partially reimburse TBE vaccine in Slovakia.^{6,7}

**Note: Readers may also wish to review the accompanying chapter for the Czech Republic, given the geographic proximity and national history of these countries.*

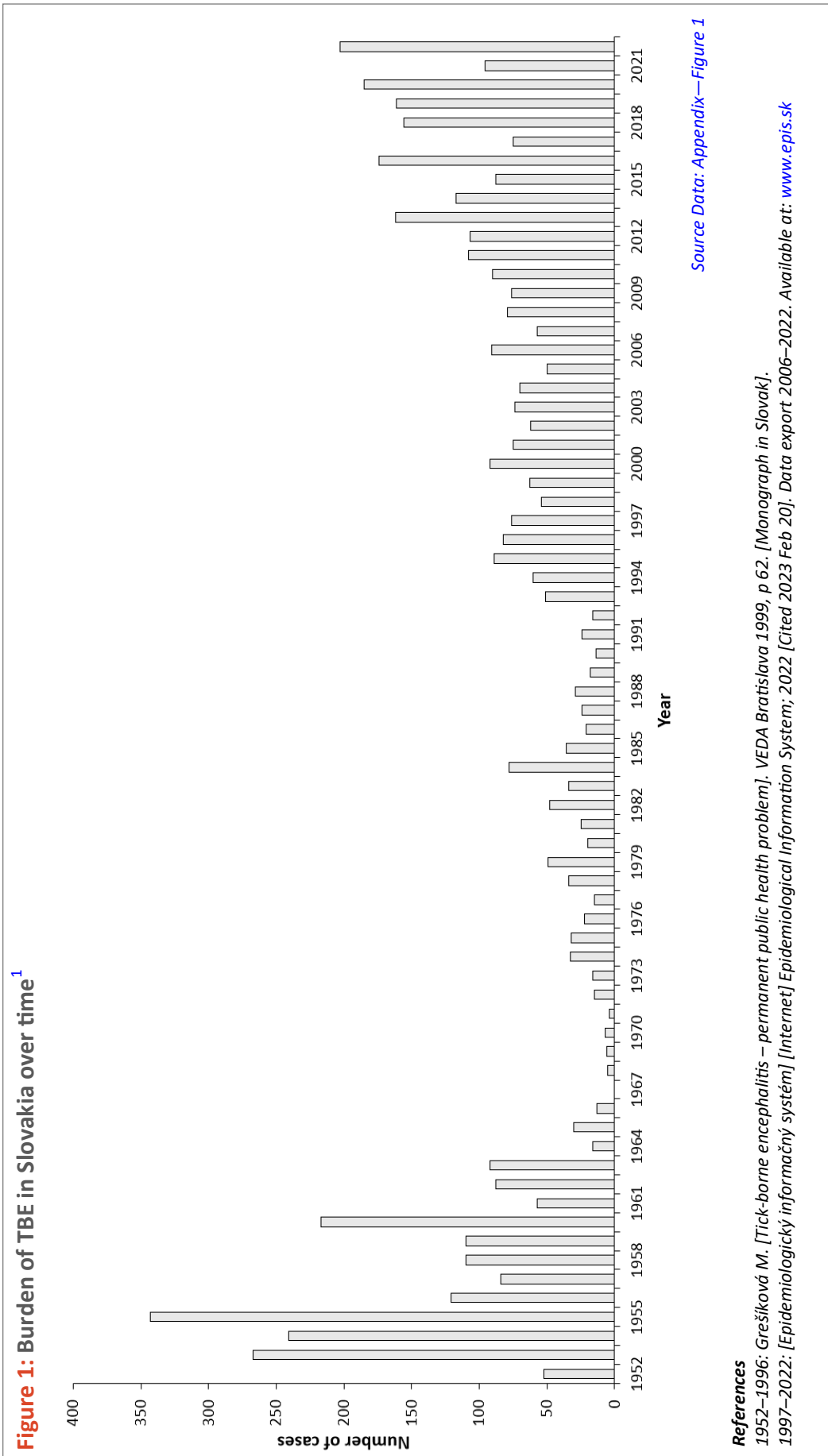
Overview of TBE in Slovakia

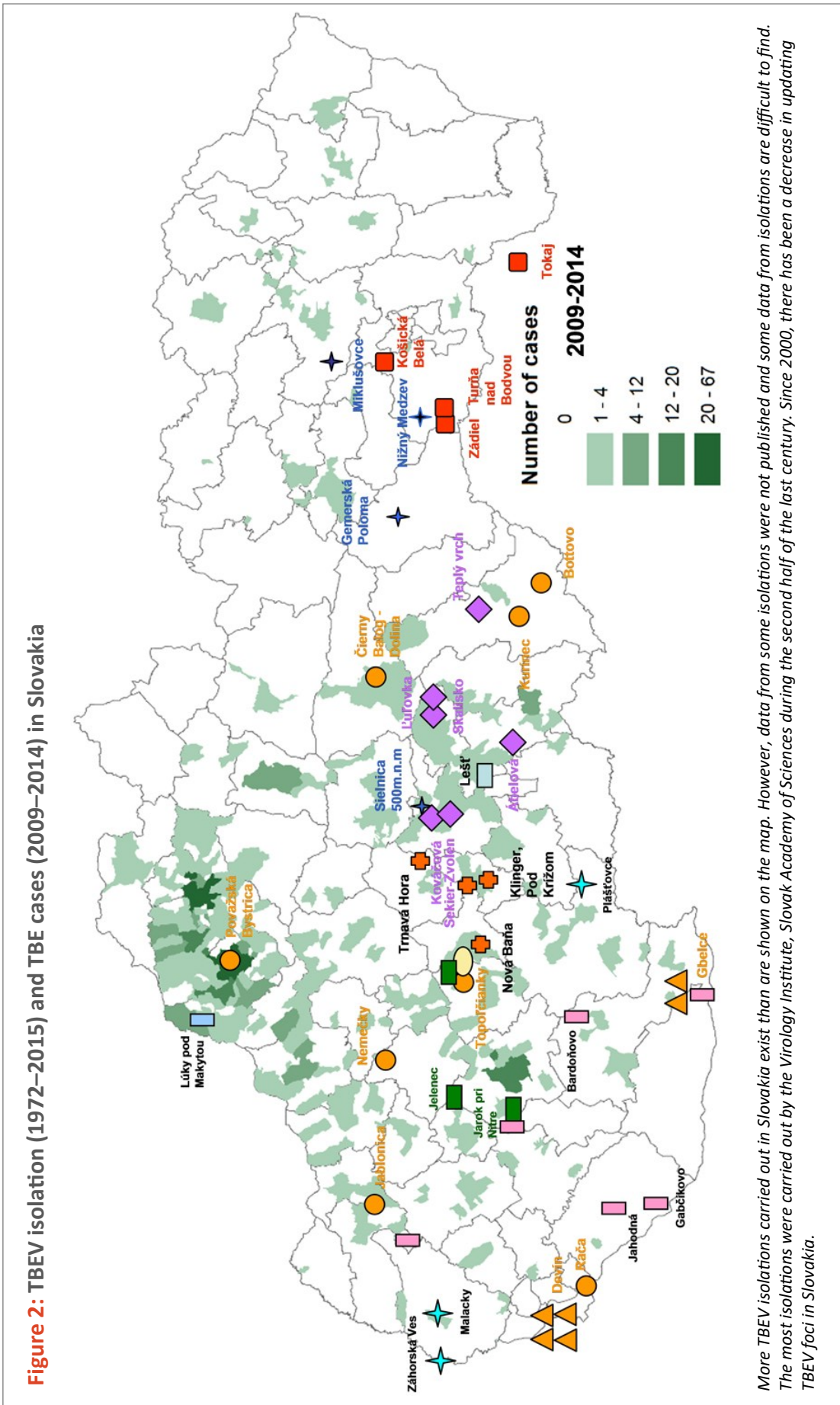
Table 1: Virus, vector, transmission of TBE in Slovakia

<p>Viral subtypes, distribution</p>	<p>European subtype¹</p> <p>At present, there are around 50 known endemic TBE foci in Slovakia. A list of natural foci of TBE in Slovakia was developed by the Public Health Authority of Slovakia in 2002 directly on the basis of virus isolation data from ticks and reservoir animals in the years 1964–1997 from the Institute of Virology, Slovak Academy of Sciences in Bratislava as well as indirectly, by inference about the site of infection in patients with TBE as reported during 1972–2002.⁸</p> <p>In recent years, there has been a shift of natural TBE foci from the southern to the northern areas of the country.⁹ In the last few years, we have observed an increasing trend of TBE incidence.¹⁰</p>
<p>Reservoir animals</p>	<p>Tribeč region (Jarok pri Nitre, Jeleneč, Topoľčianky), 1965: Out of 46 blood and brain samples taken from moles (<i>Talpa europaea</i>), 7 positive isolations of TBEV were obtained. Therefore, moles can represent not only an important host animal, but may also be considered a reservoir of TBEV in elementary foci.¹¹</p> <p>Tribeč region, 1967: Isolation of virus from the blood of <i>Apodemus flavicollis</i>, <i>Clethrionomys glareolus</i>, and <i>Erinaceus roumanicus</i>¹²</p> <p>Tribeč region, 1967: 2 TBEV strains were isolated from <i>I. ricinus</i> collected on 2 <i>Turdus merula</i>¹³</p> <p>Lúky pod Makytou, 1981: 5 strains of TBEV isolated from ticks and organs of <i>Apodemus flavicollis</i> (in 15% infected)¹⁴</p> <p>Western Slovakia (6 localities), 1981–1986: 6 TBEV strains isolated from organs of <i>C. glareolus</i> (4), <i>Apodemus flavicollis</i> (1), <i>Sorex araneus</i> (1)¹⁵</p> <p>Záhorská Ves, 1990–1992: 8 TBEV isolates from organs of <i>C. glareolus</i> (6), <i>Apodemus flavicollis</i> (1), <i>Apodemus sylvaticus</i> (1)¹⁶</p> <p>Košická Belá, 2013: TBEV from the brain sample of <i>Buteo buteo</i>¹⁷</p>
<p>Infected tick species (%)</p>	<p>The number of infected ticks in endemic areas varies widely from 0.1% to 5% depending on the season and habitat¹⁸</p> <p>Tribeč, 1964: On average, 0.2% ticks were infected by TBEV in the entire Tribeč region. When only elementary foci were taken into account, this proportion increased to 0.4% (Topoľčianky) and 0.8% (Jeleneč)¹⁸</p> <p>Záhorská Bystrica, 1965: 1.7% female ticks infected by TBEV¹⁹</p> <p>Devín, 1973: 0.1% nymphs and 1.1% female ticks infected by TBEV²⁰</p> <p>Slovakia, 1981: In Slovakia there are 2 types of TBEV natural foci – Carpathian and Pannonian. In Carpathian natural TBEV foci, there were 2.6% ticks infected by TBEV. In the Pannonian natural TBEV foci, there were 0.1% ticks infected by TBEV²¹</p> <p>Kuríneč, 1982: 0.8% nymphs and 6% male ticks (<i>I. ricinus</i>) in south-central Slovakia²²</p> <p>Carpathian and Pannonian types of TBE natural foci, 1972–1982: The proportion of infected ticks in both types of natural foci was 1.7% in total. In Carpathian elementary foci (ranging from 0.4% to 4.1%; average 2.5% infected ticks). In Pannonian elementary foci (ranging from 0.07% to 6.0%; average 0.9% infected ticks)²³</p> <p>Western and Central Slovakia, 1980–1984: Western Slovakia, April–July 1980 (0.7%), May 1984 (0.1%), Central Slovakia April–May 1982 (0.2%)²⁴</p> <p>Western Slovakia, 1985–1990: In Slovakia surveillance of TBEV in ticks, carried out during 1985–1990 by the Virology Institute of the Slovak Academy of Sciences in Bratislava, showed that the TBEV distribution rates among ticks ranged from 0.30% (Jarok, Bardoňovo in 1987) to 0.38% (Malacky in 1990) in the 25 sites in the western region (data not published)</p> <p>Žiar nad Hronom, Banská Štiavnica a Žarnovica, 2002–2007: In the small sample of 142 ticks tested, there were 4.98% infected with TBEV²⁵</p>
<p>Dairy product transmission</p>	<p>During 2007–2016 we observed a growing trend in the number of TBE outbreaks. A total of 26 outbreaks (those with 2 or more people) were responsible for 142 TBE cases (13.9%) in the studied period. There were 13 family outbreaks with at least 2 linked TBE cases in a single outbreak. Larger outbreaks with 3 or more cases were recorded 13 times. The highest number of outbreaks (6) was recorded in 2013 (4 family outbreaks, 2 large outbreaks). In 2016, there was the largest number of TBE cases (44) reported in a single outbreak over the past 30 years.¹⁰</p> <p>The most probable and also confirmed common factor in the transmission of TBEV during outbreaks was goat milk and its products (61.5%, 16 outbreaks). Sheep's milk and products caused probably 7 outbreaks (26.9%) and cow's milk was the probable cause of 2 TBE outbreaks (7.7%). In one TBE outbreak, the probable TBE transmission factor was reported to be mixed goat and sheep milk.¹⁰</p> <p>In the majority of outbreaks (22) the probable transmission factor of TBEV was identified epidemiologically. Sheep cheese was considered as the TBEV transmission factor in the TBE outbreak with the highest number of TBE cases (44) over the past 30 years by retrospective case control study.²⁶ In 4 outbreaks TBEV was serologically confirmed in goats. In 3 outbreaks TBEV was tested directly in sheep milk. In 1 outbreak the sheep milk was TBEV positive, however it was not the milk from which the incriminated cheese was made. In another 2 outbreaks, TBEV was not found in the sheep milk.</p> <p>2018 again was a peak year for alimentary transmission: in 5 outbreaks altogether 21 TBE cases were recorded, 3x from consumption of sheep cheese, 1x from consumption of goat cheese, 1x from consumption of goat milk, in all cases the TBEV was detected in milk.</p>

Table 2: TBE reporting and vaccine prevention in Slovakia











Mandatory TBE reporting	<p>According to Slovak legislation, physicians, hospitals, national reference centers, and laboratories are obliged to report TBE cases comprehensively via paper-based forms, e-mails, or by phone (more urgent) to the individual Regional Public Health Authorities, which passes the information to the Epidemiological Information System (EPIS), or they can report TBE cases directly to EPIS.^{6 (§ 4)}</p> <p>The TBE case definition set by Commission Implementing Decision (August 8, 2012) was adopted in Slovakia at the end of 2012.²⁶</p> <ul style="list-style-type: none"> • <i>Possible case</i>: not applicable • <i>Probable case</i>: any person meeting the clinical criteria (fever, aseptic meningitis/encephalitis) and the laboratory criteria for probable case - OR- any person meeting the clinical criteria with an epidemiological link • <i>Confirmed case</i>: any person meeting the clinical criteria (fever, aseptic meningitis/encephalitis) and laboratory criteria for case confirmation
Other TBE surveillance	No data available
Special clinical features	<p><i>Note: In the TBE search interface, EPIS offers the following categories: meningeal form (includes biphasic form, but also encephalitis), febrile form, and neurological form (paresis). If greater specification is desired, each case must be reviewed individually for details such as course of disease, which is quite complicated given the large number of cases.</i></p> <ul style="list-style-type: none"> • Meningeal form (including encephalitis): 68.5%¹⁰ • Febrile form: 21.8%¹⁰ • Other neurological form: 8.8%¹⁰ • Asymptomatic form (during outbreak): 0.2%¹⁰ • Unspecified report: 0.7%¹⁰ <p>The meningeal form of the disease was observed in almost the same ratio after alimentary transmission and tick-borne transmission (66.3% vs 69.1%). The febrile form affected 24.9% patients after consumption of TBE infected milk products and 20.9% tick-bitten patients.</p> <p>Most TBE cases were recorded among retired persons (19.7%). High-risk occupations were identified in 15.3%, including general workers (111), foresters (17), farmers (12), field workers (9), and railway workers (7).¹⁰</p> <p>Other groups affected by TBE: students (9.1%), unemployed persons (8.0%), and children (6.6%). Other professions (e.g., women on maternity leave, food producers, health professionals, educators, social workers and others) were affected by the disease in 33.1% of cases.¹⁰ In most TBE cases (85.9%) a recovery was observed. In 6 cases, permanent consequences (palsy, neurological complications) were recorded. Three cases resulted in death (0.3% mortality). In 2 cases, an infectious cause was involved; in 1 case death was from another cause. In 13.2% of cases the impact of the disease was not specified.¹⁰ In a study, we have diagnosed post-encephalitic syndrome in 27.2% of patients who most often reported headache, tremor of upper limbs, fatigue, and lack of concentration.²⁸</p>
Available vaccines	FSME-IMMUN; FSME-IMMUN junior
Vaccination recommendations and reimbursement	<p>According to the law, employees of the virology laboratories in Slovakia that work with TBEV must be vaccinated^{6 (§ 8, section 5)} Vaccination is recommended in persons who are professionally exposed to increased risk of selected diseases such TBE. Physicians usually vaccinate subjects who are forestry and water management (including students of forestry schools) employees, agricultural workers, surveyors, geologists, tourist hiking guides, employees of the mountain hunts and lifts, employees of recreation facilities, members of police forces and customs officers, professional soldiers and reserve soldiers called for extraordinary service, and employees performing work associated with the operation and maintenance of the tracks.^{6 (§ 10, section 2)}</p> <p>Some insurance companies partially reimburse TBE vaccine in Slovakia.⁷</p>
Vaccine uptake by age group/risk group/general population	<p>TBE immunization data on the Slovak population are not available, but according to numbers of sold vaccine doses and child immunization control, the estimated vaccination coverage in Slovakia is 1% (1.3/100 000).¹⁰</p> <p>None of the TBE patients seen in the country during the period 2007–2016 had all 3 vaccine doses. Most cases were not vaccinated (98.8%). In 9 (0.9%) cases, a vaccination record was not found or was not available. Partial vaccination was recorded in 3 cases.¹⁰</p>
Name, address/ website of TBE NRC	<p>NRC for arboviruses and hemorrhagic fevers Public Health Authority of Slovakia Trnavská cesta 52 826 45 Bratislava, Slovakia elena.ticha@uvzsr.sk</p>





More TBEV isolations carried out in Slovakia exist than are shown on the map. However, data from some isolations were not published and some data from isolations are difficult to find. The most isolations were carried out by the Virology Institute, Slovak Academy of Sciences during the second half of the last century. Since 2000, there has been a decrease in updating TBEV foci in Slovakia.

References for Figure 2

	1964 Tribec region (Topoľčianky, Jelenec)	Ticks <i>I. ricinus</i>	Grešíková M, Nosek J.	Isolation of Tick-borne Encephalitis Virus from <i>I. ricinus</i> Ticks in the Tribec region. <i>Bull Wld Hlth Org.</i> 1967;36 Suppl. 1:67-71.
	1965 Tribec region (Jarok pri Nitre, Topoľčianky, Jelenec)	Blood and brain samples from <i>Talpa europaea</i>	Kozuch O, Grulich I, Nosek J.	Isolation of Tick-borne Encephalitis Virus from <i>I. ricinus</i> Ticks in the Tribec region. <i>Bull Wld Hlth Org.</i> 1967;36 Suppl. 1:67-71.
	1967 Tribec region (Topoľčianky – 2 TBEV strains isolated from <i>Ixodes ricinus</i> collected on 2 <i>Turdus merula</i>)	Ticks <i>I. ricinus</i> collected on the birds	Grešíková M, Nosek J.	Isolation of Tick-borne Encephalitis Virus from <i>I. ricinus</i> Ticks in the Tribec region. <i>Bull Wld Hlth Org.</i> 1967;36 Suppl. 1:67-71.
	1972–1983 Pannonian TBE focus type (most of the southern part of Slovakia – Devín, Gbelce)	Ticks <i>I. ricinus</i>	Grešíková M. Gresíková M, Kozuch O, Sekeyová M, Nosek J.	[Tick-borne encephalitis – permanent public health problem]. VEDA Bratislava 1999. 100 p. [Monograph in Slovak]. Studies on the ecology of tick-borne encephalitis virus in the Carpathian and Pannonian types of natural foci. <i>Acta Virol.</i> 1986;30 (4):325-31.
	1982 (Kuríneč – 4 TBEV strains)	Ticks <i>I. ricinus</i>	Grešíková M, Palanová A, Pötheová A, Teplan J, Sekezová M, Kohutová V.	[Contribution to harnessing natural foci of tick-borne encephalitis in south central Slovakia]. <i>Bratisl Lek Listy.</i> 1983;80, No 4:385-512. [Monography in Slovak].
	1973–1984 Carpathian TBE focus type (Carpathian mountains – Rača, Jablonica, Bottovo, Topoľčianky, Čierna Dolina, Nemečky, Kuríneč)	Ticks <i>I. ricinus</i>	Grešíková M. Gresíková M, Kozuch O, Sekeyová M, Nosek J.	[Tick-borne encephalitis – permanent public health problem]. VEDA Bratislava 1999. 100 p. [Monography in Slovak]. Studies on the ecology of tick-borne encephalitis virus in the Carpathian and Pannonian types of natural foci. <i>Acta Virol.</i> 1986;30 (4):325-31.
	1973 (Devín – 2 strains Bratislava 188, Bratislava 204)	Ticks <i>I. ricinus</i>	Grešíková M.	[Isolation of tick-borne encephalitis strains Bratislava from ticks <i>I. ricinus</i> collected by Devín pathway]. <i>Bratisl Lek Listy.</i> 1975;64, No 1: 1-128. [Article in Slovak].
	1981 (Lazy pod Makytou – 5 TBEV strains from <i>Apodemus flavicollis</i>)	Ticks <i>I. ricinus</i>	Nosek J, Kozuch O, Grešíková M, Lysý J, Labuda M, Teplan J, et al.	[Uncovering natural foci of tick-borne encephalitis in Central Slovakia]. II. Synecology of tick-borne encephalitis virus in Central river Váh area. <i>Bratisl Lek Listy.</i> 1982;77, No 3:257-263. [Article in Slovak].
	1981–1986 (Western Slovakia – 6 TBEV strains: Plavecký Mikuláš – 2x <i>C. glareolus</i> , 1x <i>A. flavicollis</i> , Gabčíkovo – 1x <i>C. glareolus</i> , Gbelce – 1x <i>C. glareolus</i> , Jahodná – 1x <i>S. araneus</i> .)	Tissues of animals	Kozuch O, Labuda M, Lysý J, Weismann P, Krippel E.	Longitudinal study of natural foci of Central European encephalitis virus in West Slovakia. <i>Acta Virol.</i> 1990;34(6):537-44.
	1987 (Bardoňovo, Jarok)	Ticks <i>I. ricinus</i>	Cannot find publication	










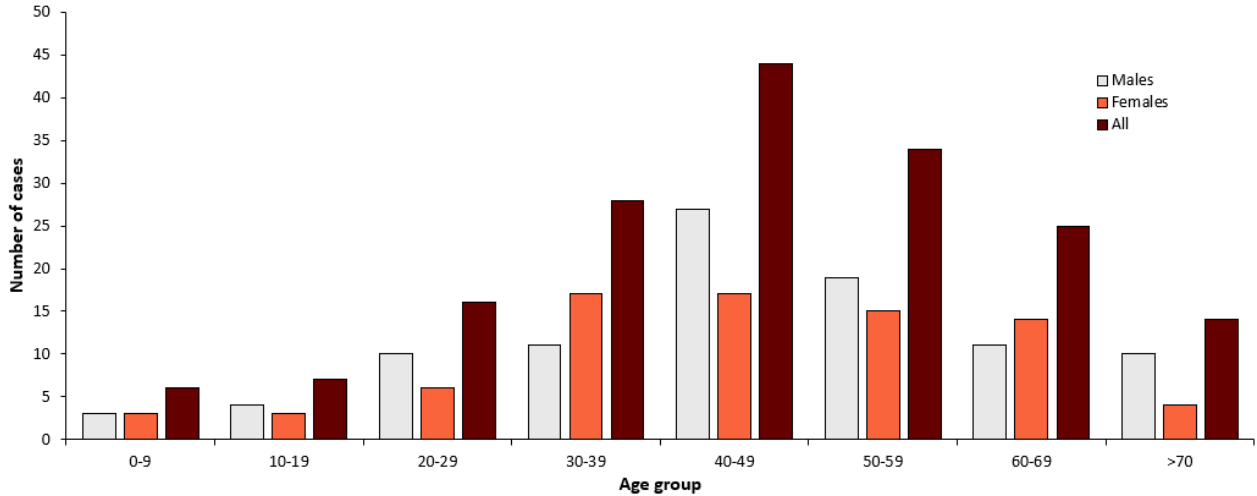
	1980 (Plášťovce – strain 114) 1990 (Záhorská Ves from <i>Myodes glareolus</i> – strain CGI223, Malacky – strain 285)	2 strains (285, 114) from ticks <i>I. ricinus</i> and 1 strain (CGI223) from the brain of <i>Myodes glareolus</i>	Frey S, Essbauer S, Zöler G, Klempa B, Dobler G, Pfeffer M.	Full genome sequences and preliminary molecular characterization of three tick-borne encephalitis virus strains isolated from ticks and a bank vole in the Slovak republic. <i>Virus Genes</i> . 2014;48:184-8.
	1990–1992 (Záhorská Ves - 8 TBEV isolates: 6 from tissues of <i>Clethrionomys glareolus</i> , 1 from <i>Apodemus flavicollis</i> , 1 from <i>Apodemus sylvaticus</i>)	Tissues of animals	Kožuch O, Guryčová D, Lysý J, Labuda M.	Mixed natural focus of tick-borne encephalitis, tularemia and haemorrhagic fever with renal syndrome in west Slovakia. <i>Acta Virol</i> . 1995;39:95-8.
	1996–1997	Ticks <i>I. ricinus</i>	Labuda M, Elecková E, Licková M, Sabó A.	Tick-borne encephalitis virus foci in Slovakia. <i>Int J Med Microbiol</i> . 2002;291 Suppl 33:43-7.
	2002–2007	Ticks <i>I. ricinus</i>	Košťanová Z.	We searched for one, we discovered more and what's next? <i>Zoonoses – Protection of public and animal health reviewed abstracts from the 5th scientific congress</i> . Slovak Medical University, Bratislava, 2016. 322 p. [online] http://www.sevs.sls.sk/images/public/Reviewed_Abstracts_Zoonoses_2016.pdf
	2006	Ticks <i>I. ricinus</i>	Koči J, Taragelová V, Derdáková M, Selyemová D, Cíglerová I, Lenčáková D, et al.	[Tick seasonal dynamics and prevalence of tickborne pathogens in Slovakia.] <i>Labudove dni 2009: Proceedings of extended abstracts</i> . Bratislava: Virological Institute SAS, 2009. [Abstract in Slovak].
	2012–2013	Ticks <i>I. ricinus</i>	Csank T.	Not published
	2013 Košická Belá	From one brain sample of <i>Buteo buteo</i>	Csank T, Bhide K, Bencúrová E, Dolinská S, Drzewnioková P, Major P, et al.	Detection of West Nile virus and tick-borne encephalitis virus in birds in Slovakia, using a universal primer set. <i>Arch Virol</i> . 2016;161:1679-83.
	1972–2002	Ticks <i>I. ricinus</i>	Not published in print, present on the website of Public Health Authority of Slovak Republic	[Natural foci of tick-borne encephalitis in Slovakia] [Internet] Public Health Authority of Slovak republic; 2017 [Cited 2017 Jan 9]. Available at: http://www.uvzsr.sk/index.php?option=com_content&view=article&id=395:prirodne-ohniska-klieovej-encefalitidy-na-slovensku&catid=68:epidemiologia&Itemid=76 . [In Slovak].
	2015	Ticks <i>I. ricinus</i>	Kerlik J, Avdičová M., Musilová M., Dobler G., Molčányi T., Csank T, et al.	Presence of tick-borne encephalitis virus in ticks from selected locations in Slovakia. <i>Zoonoses – Protection of public and animal health reviewed abstracts from the 5th scientific congress</i> . Slovak Medical University, Bratislava, 2016. 322 p. [online]. http://www.sevs.sls.sk/images/public/Reviewed_Abstracts_Zoonoses_2016.pdf .

Figure 3: Age and gender distribution of TBE in Slovakia in 2016



Source Data: Appendix—Figure 3

Reference

[Epidemiologický informačný systém] [Internet] Epidemiological Information System; 2017 [Cited 2017 Jan 5]. Data export 2015. Available at: www.epis.sk [In Slovak].

Figure 4: TBE trend in Slovakia, 2003–2022

(A84.1) Výskyt kliešťovej encefalitídy .
Trend za 20 rokov.
Rok 2022. SR.

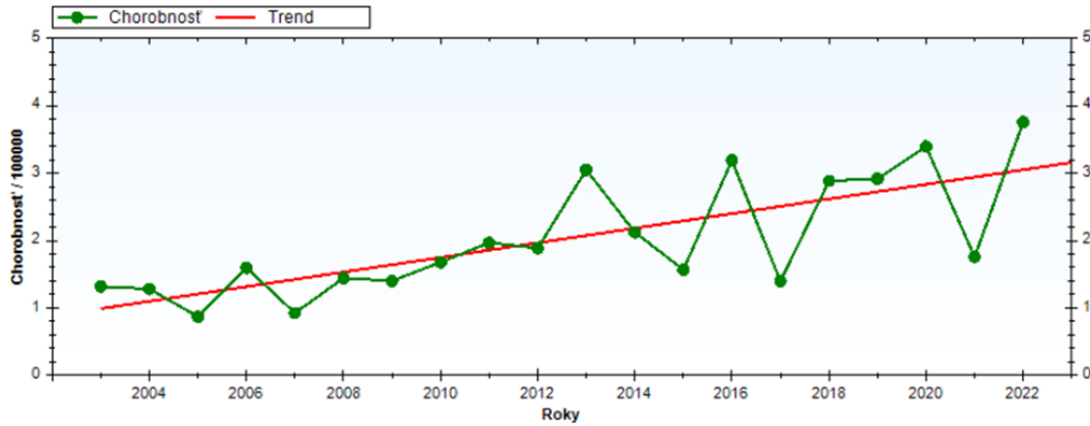


Figure 5: TBE age-specific morbidity in Slovakia, 2022

(A84.1) Výskyt kliešťovej encefalitídy .
Vekovošpecifická chorobnosť.
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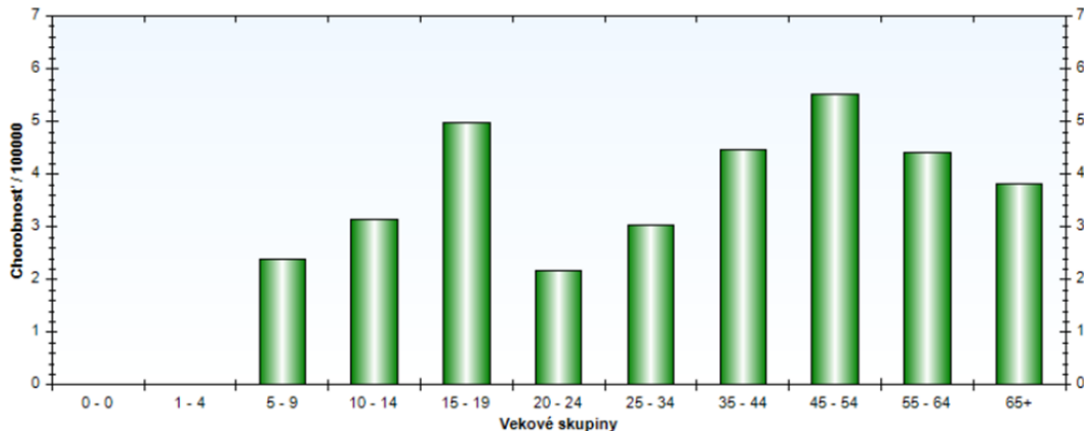


Figure 6: Number and trend of TBE alimentary outbreaks in Slovakia, 2005–2022

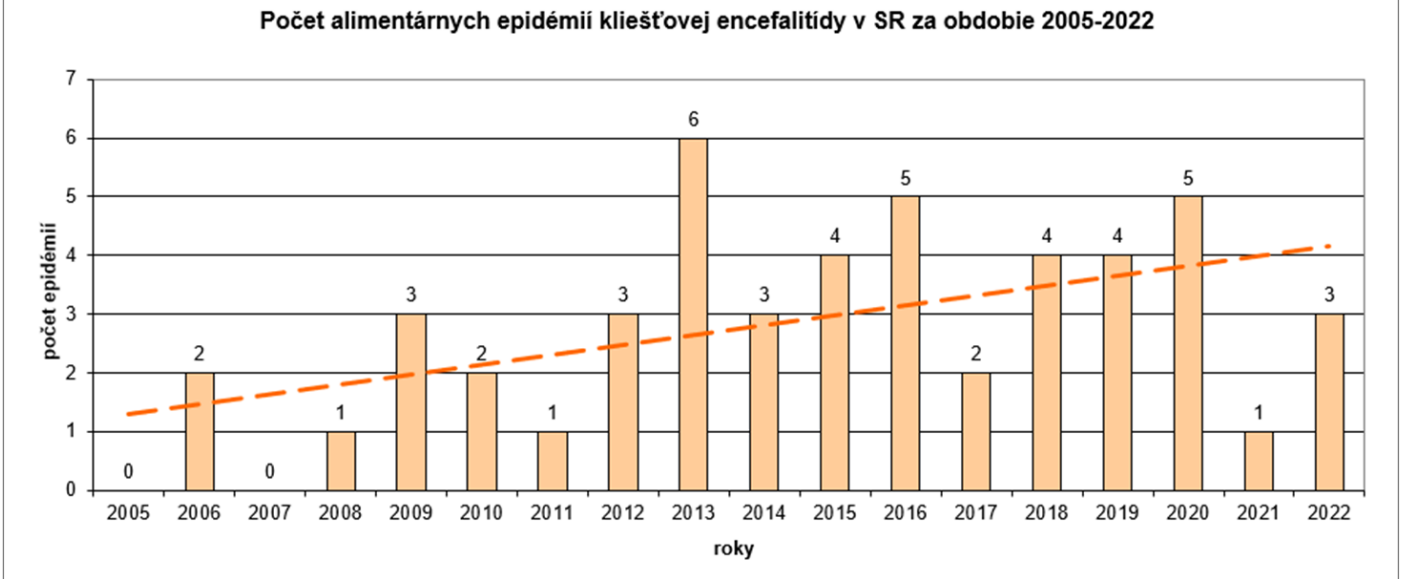
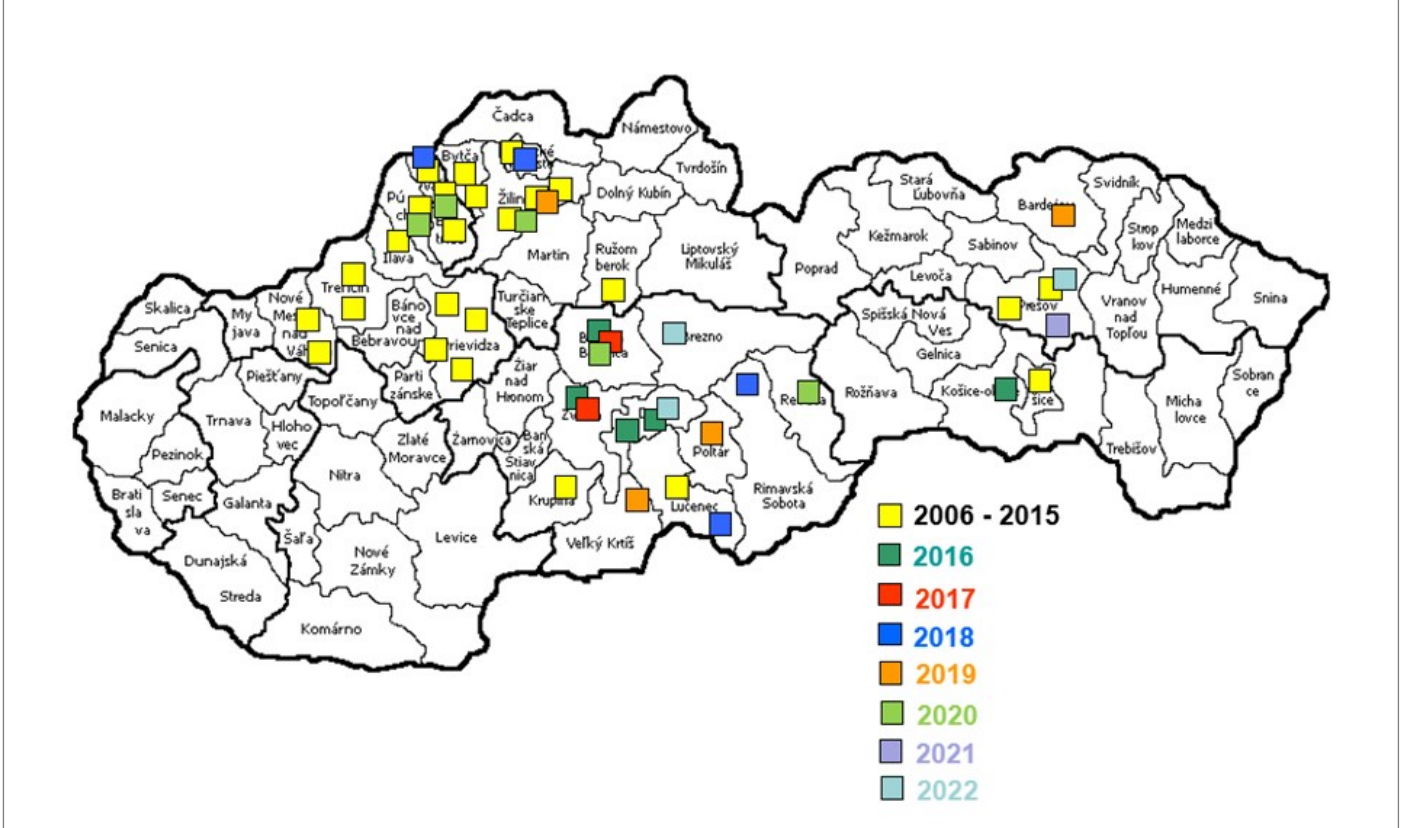


Figure 7: Geographical distribution of TBE alimentary outbreaks in Slovakia, 2006–2022



Appendix

Source data: Figure 1

Year	Number of cases	Incidence / 10 ⁵	Year	Number of cases	Incidence / 10 ⁵	Year	Number of cases	Incidence / 10 ⁵
1952	52	1.5	1976	22	0.5	2000	92	1.71
1953	267	7.4	1977	15	0.3	2001	75	1.39
1954	241	6.6	1978	34	0.7	2002	62	1.15
1955	343	9.2	1979	49	1	2003	74	1.38
1956	121	3.2	1980	20	0.4	2004	70	1.3
1957	84	2.2	1981	25	0.5	2005	50	0.93
1958	110	2.8	1982	48	1	2006	91	1.69
1959	110	2.8	1983	34	0.7	2007	57	1.06
1960	217	5.4	1984	78	1.5	2008	79	1.46
1961	57	1.4	1985	36	0.7	2009	76	1.4
1962	88	2.1	1986	21	0.4	2010	90	1.66
1963	92	2.1	1987	24	0.5	2011	108	1.99
1964	16	0.4	1988	29	0.6	2012	107	1.98
1965	30	0.7	1989	18	0.3	2013	162	2.99
1966	13	0.3	1990	14	0.3	2014	117	2.16
1967	not available	not available	1991	24	0.5	2015	88	1.62
1968	5	0.1	1992	16	0.3	2016	174	3.21
1969	6	0.1	1993	51	1.07	2017	75	1.38
1970	7	0.2	1994	60	1.1	2018	156	2.87
1971	4	0.1	1995	89	1.6	2019	161*	2.95
1972	15	0.3	1996	82	1.5	2020	185**	3.39
1973	16	0.4	1997	76	1.4	2021	96***	1.76
1974	33	0.7	1998	54	1	2022	203****	3.74
1975	32	0.7	1999	63	1.17			

*According to ECDC classification, Slovakia is in 2/3 areas endemic. There were 161 TBE cases last year.

There were 4 alimentary outbreaks: 2 cases - goat milk; 2 cases - goat milk (cheese); 3 cases - goat milk; 7 cases - goat milk (cheese)

There were 9 sporadic cases, where the transmission mechanism was ingestion of milk/cheese of goat and sheep origin.

**There were 5 family alimentary TBE outbreaks (4 - milk and products of sheep origin, 1 - milk and products of goat origin; 11 cases)

***There was 1 alimentary TBE outbreak (1- milk and products of goat origin; 5 cases)

****Total of 207 TBE cases reported of which 4 were imported.

Source data: Figure 3

Age group	Males	Females	All
0-9	3	3	6
10-19	4	3	7
20-29	10	6	16
30-39	11	17	28
40-49	27	17	44
50-59	19	15	34
60-69	11	14	25
>70	10	4	14

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