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1 **Knowledge and vaccination practices among family physicians in northeastern France**  
2 **regarding tick-borne encephalitis virus.**

3

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25

26 **Abstract**

27 Tick-borne encephalitis (TBE) cases have been emerging in Europe. The Franche-Comte area,  
28 in northeastern France, borders Switzerland, but the two countries differ in their approach to  
29 TBE surveillance and prevention. Because family physicians (FPs) are in direct contact with  
30 the local population, at-risk of infected tick bites, they need to be well aware of TBE  
31 epidemiology and management. An observational survey was performed in 2019 in order to  
32 investigate Franche-Comte physicians' knowledge and vaccination practices with regard to  
33 TBE. Standardized online questionnaires were sent to a list of FPs practicing in Franche-  
34 Comte. The questionnaires included socio-demographic details, questions about TBE  
35 knowledge, symptomatology and vaccination. The response rate was 14.7%. FPs practicing in  
36 rural areas reported a significantly higher frequency of consultations for tick bites. While 81%  
37 of FPs indicated that they had some knowledge about TBE, only 20% were at ease with its  
38 clinical symptomatology. Thirty-one % of the FP participants performed TBE vaccinations. A  
39 general lack of knowledge about TBE and its clinical symptoms was observed in this survey.  
40 FPs play an essential role in screening and preventing TBE, especially those practicing in  
41 rural areas and in areas bordering Switzerland.

42

## 43 **Introduction**

44 Tick-borne encephalitis (TBE) is due to a virus of the *Flaviviridae* family, which is  
45 transmitted ~~immediately~~ during the tick blood meal of infected *Ixodes* spp. The *I. ricinus* tick  
46 species is the primary vector of TBE in Europe, and its geographic expansion has been  
47 documented both in latitude and in altitude (Suk and Semenza, 2014). This geographic  
48 expansion is associated with an increase of high-risk areas and the emergence of TBE foci  
49 (Michel et al., 2020). ~~Since TBE is a zoonosis, reservoirs of animals, including rodents, may~~  
50 ~~explain this geographic extension (Michel et al., 2020).~~ Three subtypes of TBE virus are  
51 circulating from Russia to Western Europe; the European subtype, present in France, was  
52 reported as the less virulent one (Lehrer and Holbrook, 2011).

53 The case fatality rate of TBE is low (less than 2%) but there is a considerable proportion of  
54 long-lasting sequelae (17-30%) (Bogovic et al., 2018; Velay et al., 2018). As no curative  
55 treatment is available for this viral infection, prevention depends on avoiding tick bites and  
56 receiving the TBE vaccination. Two licensed TBE vaccines are currently distributed in  
57 Europe (Erber and Schmitt, 2018).

58 Out of approximately 3000 TBE cases reported in Europe each year, approximately 300 are  
59 from Switzerland and only approximately 30 from France (Velay et al., 2019). In Switzerland,  
60 TBE case notification has been mandatory for several years. The recent increase of cases  
61 reported in 2018 led the Swiss authorities to promote vaccination for the entire Swiss  
62 population, especially for people who regularly engage in outdoor activities (OFSP-Bulletin  
63 16/19; [https://www.bag.admin.ch/bag/fr/home/das-bag/publikationen/periodika/bag-](https://www.bag.admin.ch/bag/fr/home/das-bag/publikationen/periodika/bag-bulletin.html)  
64 [bulletin.html](https://www.bag.admin.ch/bag/fr/home/das-bag/publikationen/periodika/bag-bulletin.html)).

65 TBE cases have increased in France in recent years, and particularly in areas located in  
66 northeastern regions bordering Germany (Beauté et al., 2018, Velay et al., 2018). In June

67 2020, the High Council for Public Health recommended that TBE case notification become  
68 mandatory  
69 (<https://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=856>).

70 Few TBE cases have thus far been reported in Franche-Comte, which is a heavily forested  
71 area in northeastern France (<https://inventaire-forestier.ign.fr>), bordering Switzerland.  
72 Serologic assays performed on non-vaccinated forestry workers in northeastern France  
73 showed a TBE seroprevalence of about 3.4% (Thorin et al., 2008). Every day, frontier  
74 workers, forestry workers and outdoor athletes cross the fictive line between Switzerland and  
75 France.

76 Several other factors may also account for an increase in TBE cases: increased abundance of  
77 ticks, increased range of *I. ricinus* tick, climate change, changes in human life-style such as  
78 the general increase of leisure outdoor activities (Lehrer and Holbrook, 2011; Velay et al.,  
79 2019).

80 Family physicians (FPs) are in direct contact with the local population and should be well  
81 aware of the epidemiologic characteristics of infectious diseases present in the area where  
82 they work. Indeed, FPs play a major role in promoting appropriate preventive measures. ~~and~~  
83 ~~allowing early screening of the disease.~~

84 In this context, in 2019, an observational survey was undertaken in the Franche-Comte region  
85 to assess family physicians' knowledge and vaccination practices for TBE.  
86  
87

88 **Methods**

89 Over a 12-week period from September to December 2019, standard online questionnaires  
90 were sent to 544 FPs practicing in the Franche-Comte area. The questionnaire was designed  
91 to be short to encourage participation. It was made up of 10 questions: questions requesting  
92 sociodemographic details (number of years of practice, geographical area of practice, zip  
93 code, estimated number of consultations for tick bites per year), perception of their general  
94 knowledge about TBE, and questions concerning TBE vaccination practices (estimated  
95 frequency and circumstances of TBE vaccinations performed).

96 The FPs were asked to participate on a voluntary and anonymous basis. The inclusion criteria  
97 were: FPs working in Franche Comte with an e-mail address validated by the Regional Union  
98 of Health Professionals and /or by the Department of General Medicine.

99 The online R software was used for statistical analysis. Qualitative variables were tested using  
100 Chi-square test, with a  $p$ -value of less than 0.05 as the threshold of statistical significance.

101

102

103 **Results**

104 The response rate was 14.7% (80/544 questionnaires completed).

105 Most of participating FPs had been practicing for more than ten years (64%). A total of 77.5%  
106 (62/80) FPs reported seeing 10 to 50 consultations for tick bites per year (Figure 1).

107 Interestingly, of the 15% (12/80) of FPs reporting more than 50 consultations per year for tick  
108 bites (Figure 1), 83% were working in rural areas ( $p < 0.0001$ ,  $\text{Chi}^2$ ) and 92% were practicing  
109 in areas bordering Switzerland.

110 A total of 81% (65/80) of the participating FPs declared having some knowledge of TBE but  
111 only 20% (16/80) were at ease with its clinical symptomatology.

112 FPs with more than 10 years of practice indicated a lack of knowledge of TBE more often  
113 than the FPs with less experience (28% vs 3%,  $p=0.0081$   $\text{Chi}^2$ ).

114 A total of 31.3 % (25/80) reported that they performed the TBE vaccination. More precisely,  
115 in 32% of the cases, patients received the vaccination before travelling to Central Europe, in  
116 29% of the cases due to professional exposure, in 26% of the cases because of leisure outdoor  
117 activities and in 13% of the cases before travelling to Central Asia. Reasons for not  
118 performing TBE vaccinations are presented in Figure 2. A total of 68% (54/80) of the  
119 participating FPs did not propose the TBE vaccination to their patients either because they  
120 were not familiar with vaccine recommendations (46%) or with vaccine modalities (22%)  
121 (Figure 2).

122

123

124

125

126 **Discussion**

127 The aim of this observational survey was to investigate the knowledge and vaccination  
128 practices of FPs working in the Franche-Comte area of ~~N~~ northeastern France. The response  
129 rate of 14.7% was low, however, the sample was considered representative of the population  
130 for the Franche-Comte area based on their geographical distribution (area with or without  
131 common borders with Switzerland) and their age distribution (compared with the 2015-age  
132 pyramid).

133 On the whole, our study highlighted family physicians' lack of knowledge about TBE and its  
134 symptomatology. There was no significant correlation between better knowledge of TBE and  
135 rural medical practices with a high number of consultations for tick bites. This observation is  
136 alarming as rural areas in the northeastern part of France are particularly at risk of exposure to  
137 infected ticks. In areas bordering Switzerland, FPs reported a higher rate of consultations for  
138 tick bites (>50 per year), a finding which concurs with a French study performed from 2010  
139 to 2012 (Serre et al., 2017). FPs performing TBE vaccinations followed the official  
140 recommendation (professional exposure, travel in endemic areas) (Chrdle et al., 2016). ~~Those~~  
141 ~~not performing TBE vaccinations (68%) were unfamiliar with vaccine recommendations or~~  
142 ~~modalities.~~ FPs practicing in areas bordering Switzerland performed more TBE vaccinations.  
143 The difference in epidemiology between France and Switzerland is mainly due to the fact that  
144 TBE case notification has been mandatory for several years in Switzerland but not in France,  
145 although case notification will soon become mandatory: (High Council for Public Health  
146 recommendation June 2020 <https://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=856>).  
147 The difference ~~in~~ of incidence ~~the number of TBE cases reported in~~ between Switzerland and  
148 France could also be explained, at least in part, by eco-epidemiological factors ~~the~~  
149 ~~geographical location of Switzerland and its proximity to Germany and Austria.~~ The tick  
150 season lasts from March to November, and recent data from 2020 showed a general increase



151 of reported cases: 704 cases for Germany (Epid. Bull 9-2021) and 455 cases for Switzerland  
152 ([https://www.bag.admin.ch/bag/fr/home/zahlen-und-statistiken/zahlen-zu-  
153 infektionskrankheiten.exturl.html/aHR0cHM6Ly9tZWxkZXN5c3RlbWUuYmFnYXBwcy5ja  
154 C9pbmZyZX/BvcnRpbmcvZGF0ZW5kZXRhaWxzL2YvZnNtZS5odG1sP3dlYmdy/YWI9a  
155 Wdub3Jl.html](https://www.bag.admin.ch/bag/fr/home/zahlen-und-statistiken/zahlen-zu-infektionskrankheiten.exturl.html/aHR0cHM6Ly9tZWxkZXN5c3RlbWUuYmFnYXBwcy5jaC9pbmZyZX/BvcnRpbmcvZGF0ZW5kZXRhaWxzL2YvZnNtZS5odG1sP3dlYmdy/YWI9aWdub3Jl.html)). These recent data tend to confirm the forecasts for 2019 and 2020 of  
156 increased incidence for Germany, Switzerland and Austria proposed by Rubel and Brugger  
157 (2020).

158 In comparison, the incidence of Lyme Bborreliosis (LB), due to *Borrelia burgdorferi* sensu  
159 lato was estimated in France in 2018 to be approximately at 104 cases per 100,000 inhabitants  
160 (Septfons et al., 2019). This incidence is similar to that of bordering countries (Germany,  
161 Belgium and Switzerland) (Septfons et al., 2019). As reporting LB is not mandatory in all  
162 these countries, data may be less reliable than for TBE. In France, the difference between LB  
163 and TBE is that French FPs are more aware of LB, which is monitored by a sentinel network  
164 and is systematically screened in the presence of suggestive symptoms after a tick bite.

165 All in all, TBE seems to be well known by health professionals in Switzerland, thus  
166 facilitating its screening and detection, but there are also differences in the ways that TBE is  
167 diagnosed and reported in France and Switzerland. In Switzerland, reporting TBE cases is  
168 mandatory and TBE serology assays are widely prescribed in case of fever, neurologic  
169 symptoms and a history of tick bites. In Switzerland, cases with fever and positive TBE IgM  
170 are reported as probable TBE cases (although serological cross-reactions or non-specific  
171 reactions cannot formally be ruled out in this context); serology screening is usually  
172 performed early in the diagnostic approach. In contrast, in France, only cases with  
173 neurological symptoms have been reported as TBE cases, generally with positive TBE IgG,  
174 suggesting that serology screening is performed later in the diagnostic approach (Velay et al.,  
175 2018).

176

177 **Conclusion**

178 A lack of knowledge about TBE and its symptomatology was observed in the present survey  
179 of FPs practicing in Franche-Comte. Efforts should be made to provide up-to-date specialized  
180 information about TBE to family physicians, especially those working in rural areas and areas  
181 bordering Switzerland. For this reason, a flyer summarizing the results of the study and  
182 including reminders about TBE epidemiology, clinical symptoms, prevention, and vaccination  
183 was sent to all the participating FPs.

184

185 **References**

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235

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238

239 **Figure legends**

240 **Figure 1.** Distribution of the participants according to the number of patients consulting for

241 tick bites per year.

242 **Figure 2.** Reasons for not performing TBE vaccinations.

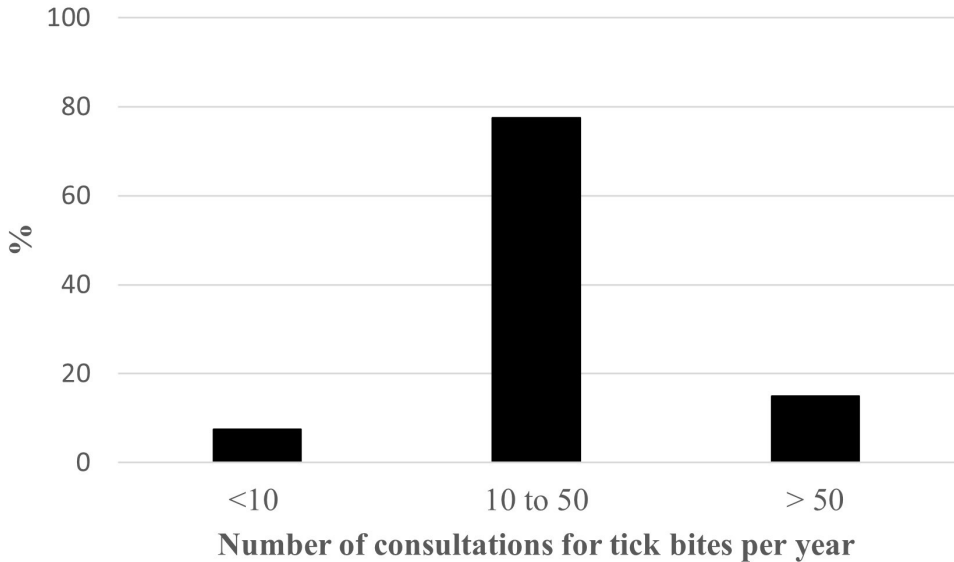
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**Reasons for not practicing TBE vaccination**

