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Lyme borreliosis – Epidemiological Analysis of Incidence in the Northern Region of Slovakia

Bochničková Mária[1], Szilágyiová Mária[2], Gardlík Roman[3]

[1]General Military Hospital Ružomberok, Slovakia
[2]Clinic of Infectology and Travel Medicine, Martin, Slovakia
[3]Institute of Molecular BioMedicine, Bratislava, Slovakia

SUMMARY

Lyme borreliosis is a contemporary public health problem. That's why we devoted our prospective and retrospective epidemiological study to the incidence of anthropozoonosis in the regions of Liptovský Mikuláš and Ružomberok. We created a group of 476 patients from the medical documentation of infectious units. These patients were treated for Lyme borreliosis from 1989 to 2010, 280 patients in the county of Liptovský Mikuláš, and 196 patients in the county of Ružomberok. Morbidity in different years was compared to national data. The number of ill patients (n = 476) compared to data about reported cases from The Regional Public Health Office in Liptovský Mikuláš (n = 221) confirmed the lack of a warning service. The actual incidence of Lyme disease in the Liptov region is twice higher. The average morbidity was 16.24 people per 100,000 of the population for the last 22 years. The highest morbidity from 476 treated patients (men 37.52 %, women 62.48%) was in the group aged from 45 to 54 years with an average annual morbidity 21.18/100,000. The study also confirmed the higher incidence of Lyme disease in the female population.
Key words: **Lyme borreliosis – Lyme disease – morbidity – incidence – report – age-specific morbidity.**

SÚHRN

Bochničková Mária, Szilágyiová Mária, Gardlík Roman: Lymská borelióza – epidemiologická analýza výskytu v severnom regióne Slovenska

Lymská choroba je aktuálnym verejnozdravotným problémom. Preto sme sa v prospektívnej aj retrospektívnej epidemiologickej štúdii venovali výskytu antropozoonózy v okresoch Liptovský Mikuláš a Ružomberok. Zo zdravotných dokumentácii infekčných oddelení sme vytvorili súbor 476 pacientov liečených počas rokov 1989–2010 pre uvedené ochorenie, 280 v okrese Liptovský Mikuláš a 196 pacientov v okrese Ružomberok. Chorobnosť v jednotlivých rokoch sme porovnávali s celoslovenskými údajmi. Počet všetkých chorých pacientov (n = 476) po porovnaní s údajmi o hlásených prípadoch z Regionálneho úradu verejného zdravotníctva v Liptovskom Mikuláši (n = 221) potvrdil zaostávanie hlásnej služby. Skutočný výskyt Lymskej choroby v regióne Liptova je dvojnásobne vyšší. Priemerná chorobnosť LB za 22 rokov výskytu bola 16,24/100 000 obyvateľov. Zo 476 liečených pacientov (ženy 62,48 %, muži 37,52 %) bolo najviac ochorení vo vekovej kategórii 45–54-ročných, s priemernou ročnou chorobnosťou 21,18. Štúdia potvrdila vyšší výskyt Lymskej choroby v ženskej populácii.
Kľúčové slová: **lymská borelióza – Lymská choroba – chorobnosť – incidencia – hlásenie – vekovo-špecifická chorobnosť.**

INTRODUCTION

Lyme borreliosis is the most common anthropozoonosis in Europe, as well as in Slovakia. Its actual incidence can only be assumed because there are some deficiencies in reporting the disease. The disease has an upward trend not only due to the development of diagnostic methods (reinvention of borreliosis), but in a great measure also global warming, economic, social changes and the public awareness. Lyme borreliosis is a contemporary public health problem due to its chronic process: it is necessary to deal with the disease in detail and to develop disease management. Anthropozoonosis manifests multi-body patient disability. For the great variability of clinical symptoms overlapping each other. Lyme disease is rightly regarded as the imitator of several diseases. Lyme disease agent is spirochete:

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Borrelia burgdorferi sensu lato, with phenotype and genotype of different genospecies: Borrelia garinii, Borrelia afzelii and Borrelia burgdorferi sensu stricto (B. burgdorferi s. s.). Among the newly isolated genospecies belong: B. spielmanii, B. lusitaniae, B. valaisiana, A14 S [1, 10]. The main vector of these spirochetes is the tick Ixodes.

Objectives

Comparison of the number of only reported cases of Lyme borreliosis to the number of all treated patients in the regions: Liptovský Mikuláš and Ružomberok.

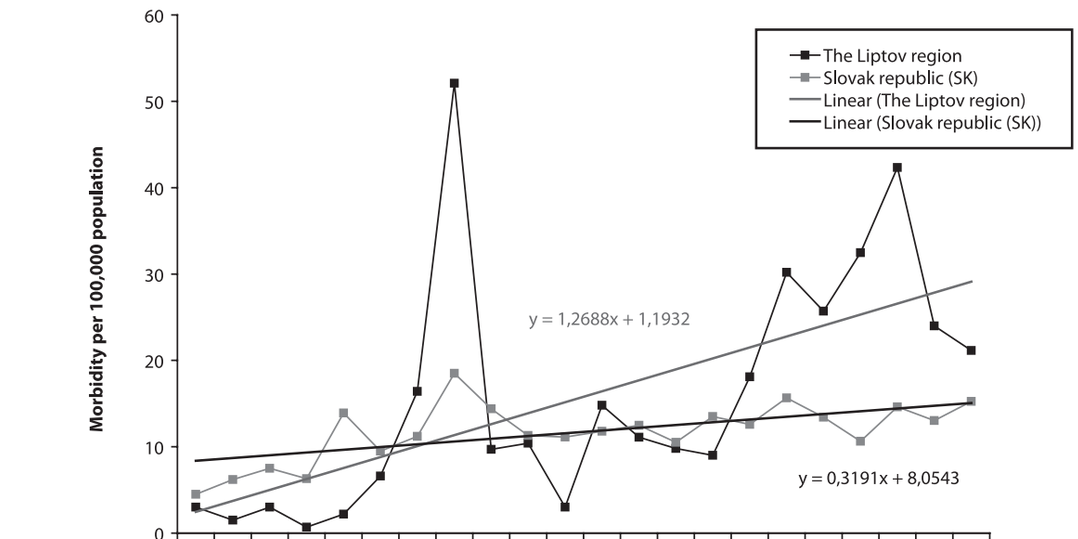
MATERIAL AND METHODS

The total population in both Ružomberok and Liptovský Mikuláš regions is about 140,000. The subject research is the group of patients with the diagnosis of Lyme borreliosis in two districts: Liptovský Mikuláš and Ružomberok. We obtained this number after data processing from medical documentation, from patients of the Infectious Department of Central Military Hospital in Ružomberok, from the Department of Infectology at the hospital in Liptovský Mikuláš – abolished in 2004, and lastly from the Infectology Clinic in Liptovský Mikuláš. Ethic committee approval was issued in both hospitals. The diagnosis of Lyme borreliosis was established on the basis of the comprehensive assessment of epidemiological history, clinical symptoms of disease, and serological tests for antibodies against antigen: Borrelia burgdorferi by using the immunofluorescent method (1989–2005) and later by using the method ELISA.

We compare the number of all patients diagnosed with Lyme disease (data from medical reports) with the number of reported cases according to the annual reports of Regional Public Health Office in Liptovský Mikuláš. The patients with Lyme disease diagnose were divided according to these characteristics: gender and age. The data processed into graphs was subject to statistical processing, to determine the incidence of the disease in the region and for specific morbidity in the regions of Liptovský Mikuláš and Ružomberok. The morbidity in these two districts was compared to national data. The trend in time series values shows the regression line in a graphic presentation of results. It reflects the dependence of overall morbidity on time by using the linear regression method, while assuming linear dependence on changes in the dependent variable (morbidity) on changes in the independent variable (1989–2010).

RESULTS

The morbidity curve of reported cases of Lyme borreliosis in Slovakia and concretely in the regions



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
The Liptov region	3	1,5	3	0,7	2,2	6,6	16,4	52,1	9,7	10,4	3	14,8	11,1	9,8	9	18,1	30,2	25,7	32,5	42,3	24	21,2
Slovak republic (SK)	4,5	6,2	7,5	6,3	13,9	9,5	11,2	18,5	14,4	11,3	11,1	11,8	12,5	10,5	13,5	12,6	15,7	13,4	10,6	14,6	13	15,2

Fig. 1. Morbidity in the Liptovský Mikuláš and Ružomberok districts and across Slovakia from 1989 to 2010

Graf 1. Lymská borelióza – chorobnosť na 100 000 obyvateľov v SR a v okresoch Liptovský Mikuláš a Ružomberok v rokoch 1989–2010

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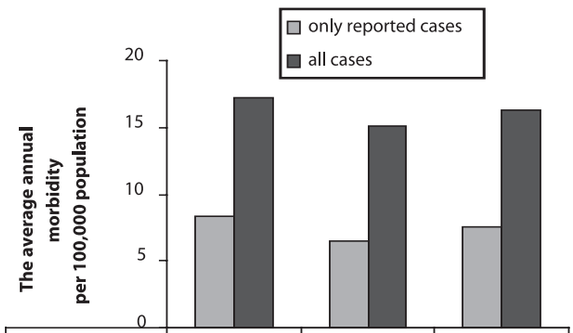
of Ružomberok and Liptovský Mikuláš had a slight upward trend during the period 1989–2010. In the Slovak Republic the morbidity has moved from 4.50 : 100,000 population in 1989 to the highest morbidity 18.50 : 100,000 in 1996. The second significant increase in disease on the national scale was in 2005, in the Liptov region in 2004–2006 and from 2007 to 2009. In the districts Liptovský Mikuláš and Ružomberok the morbidity exceeded the national value according to all treated cases of Lyme disease in 1995, 1996, 2000, 2004–2010 (Fig. 1).

During this period the morbidity of Lyme borreliosis in the area of Liptovský Mikuláš was 7.50 patients per 100,000, meanwhile it was 11.72 per 100,000 in Slovakia. Morbidity in the region of Liptovský Mikuláš in 1996 was three times higher than morbidity in the whole country, and the situation in 2007–2009 was very similar (see Fig. 1).

Average annual morbidity in 1989–2010 based on reported cases was 8.37 per 100, 000 in Liptovský Mikuláš district and 6.43 : 100,000 in Ružomberok district. According to the number of patients (not only reported cases) the morbidity in Liptovský Mikuláš ranged in the value 17.2 per 100,000 inhabitants, and in Ružomberok in value 15.04 : 100,000 for about the last 22 years. An average morbidity value in the region of Liptovský Mikuláš was 7.5 : 100,000 (reported cases) and 16.24 : 100,000 (all patients with diagnosis of Lyme borreliosis) (Fig. 2).

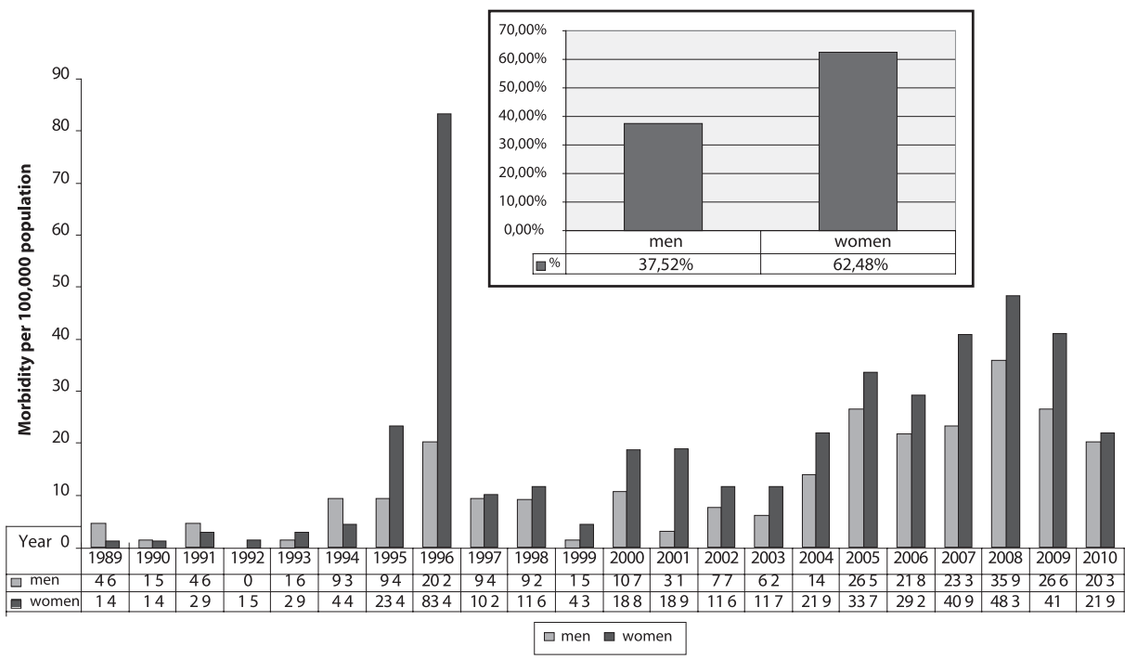


District	LM	RK	Liptov region
only reported cases	8,37	6,43	7,5
all cases	17,2	15,04	16,24

Fig. 2. The average annual morbidity of Lyme borreliosis according to all cases and only reported cases in the Liptovský Mikuláš and Ružomberok districts from 1989 to 2010

Graf 2. Lymská borelióza – priemerná ročná chorobnosť na 100 000 obyvateľov podľa všetkých diagnostikovaných prípadov a len hlásených prípadov ochorenia v okresoch Liptovský Mikuláš a Ružomberok v rokoch 1989–2010

The morbidity in Liptovský Mikuláš region in 1989–2010 ranged from 1.3 to 77.6 per 100,000 and in Ružomberok region from 0 to 45.73 : 100,000 (see Fig. 1). The first case of Lyme disease



Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
men	46	15	46	0	16	93	94	202	94	92	15	107	31	77	62	14	265	218	233	359	266	203
women	14	14	29	15	29	44	234	834	102	116	43	188	189	116	117	219	337	292	409	483	41	219

Fig. 3. Morbidity according to gender in the Liptovský Mikuláš and Ružomberok districts from 1989 to 2010

Graf 3. Lymská borelióza – chorobnosť na 100 000 obyvateľov podľa pohlavia v okresoch Liptovský Mikuláš a Ružomberok v rokoch 1989–2010

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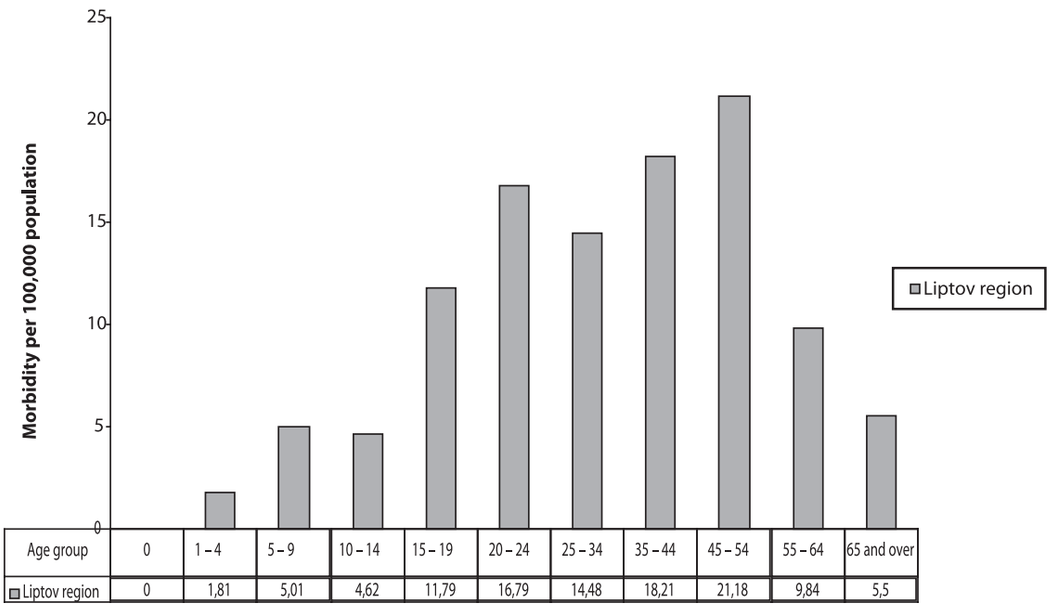

Age group	0	1 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 and over
Liptov region	0	1,81	5,01	4,62	11,79	16,79	14,48	18,21	21,18	9,84	5,5

Fig. 4. Average age-specific morbidity in the Liptovský Mikuláš and Ružomberok districts from 1989 to 2010

Graf 4. Lymská borelióza – priemerná vekovo-špecifická chorobnosť v okresoch Liptovský Mikuláš a Ružomberok v rokoch 1989–2010

in the Liptov region was diagnosed in 1989. There were 280 patients treated at the Infectious Department in Liptovský Mikuláš or in the Infectology Clinic to 2010. There were 196 patients treated for Lyme disease in the Infectious Department in Ružomberok. The diagnosis of Lyme borreliosis was established on the basis of the comprehensive assessment of epidemiological history, clinical symptoms of disease, and serological tests for antibodies against antigen: Borrelia burgdorferi by using immunofluorescent method (1989–2005) and later by using the method ELISA. We excluded 195 patients from the original group of patients because of the possible cross-positivity of antibodies. Morbidity according to gender was higher among women than men. Women accounted for 62.48 % and men only 37.52 % from the total number of diseases. Average morbidity in proportion MEN-WOMEN was:

- In Liptovský Mikuláš region 10.96 – 30.84 : 100,000
- In Ružomberok region 12.85 – 17.12 : 100,000

In the area of Liptovský Mikuláš the average morbidity of men was 9.00 per 100,000 and the average morbidity of women was 16.3 : 100,000 (Fig. 3).

The age-specific morbidity analysis for 1989 till 2010 shows that the most exposed groups were 45 to 54 year old and 35 to 44 year old adults. The average annual morbidity was 21.1 and 18.21. The lowest morbidity was among 0 to 4 years old children (Fig. 4).

In the region of Liptovský Mikuláš the average morbidity in the age category of 45 and 54 years old was 21.68 : 100,000 and in the region of Ružomberok 20.6 per 100,000 population.

DISCUSSION

There were 476 diagnosed cases of Lyme borreliosis and the average morbidity was 16.24 : 100,000 over 1989 to 2010 in the district Ružomberok and Liptovský Mikuláš. The average morbidity for both regions (Liptovský Mikuláš and Ružomberok) was 7.5 patients per 100,000 according to reported cases. The real incidence of disease (all diagnosed cases) is two times higher than the number of reported cases. In comparison to national data (11.72 : 100,000), the average morbidity in the Liptov region is much higher. The incidence of disease in the Liptovský Mikuláš district is higher than in the Ružomberok district, the average morbidity is 17.20 and 15.04 per 100,000. The number of reported cases has increased from the initial 7 cases in Slovakia in 1987 to hundreds per year with the maximum in 1996 [2]. In comparison with our western neighbour, the incidence of Lyme borreliosis in the Czech Republic from 25 to 36 patients : 100,000 [3].

The first case of this disease in the Czech Republic was described in 1984, in the Slovak Republic in 1987, and in the Liptov region in 1989 [7]. Lyme disease occurs in forested areas in

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Europe. It occurs in every European region except for hot south (Sicily and south Spain) and cold north (northern Russia). The European incidence of Lyme borreliosis ranges from 14 to 190 : 100,000 [10]. The highest incidence in Europe is in Slovenia – 193 : 100,000, and differences are also within own graphic areas [5]. There is a correlation between the increasing incidence of the disease and much wildlife in these regions (especially deer and fallow deer), although their role in the cycle of infection transmission is not classified [9]. There is an upward trend of incidence since 1989 to 2010, i. e. from the beginning of monitoring Lyme disease in Slovakia and the Czech Republic, this fact also confirms disease surveillance in the area of Liptovský Mikuláš [2, 6]. In 1996 it was warm winter, and consequently more wintered infected ticks. Studies led by Assoc. Peťko confirm the presence of ticks at higher altitudes than 15 years ago [8]. This shift is due to global warming, but also not maintaining meadows and mountain pastures. On a national scale this fact was influenced by several factors: improving doctors' awareness of the disease, the warning service improvement and the introduction of new diagnostic methods. The increase of newly diagnosed cases in our region was influenced by introducing serological diagnosis in 1996 at Department of Microbiology in Liptovský Mikuláš and Western blot later.

An important factor is also the improvement in public awareness about the knowledge of Lyme borreliosis, but this does not reach the level of educational activities in the neighborning of the Czech Rebulic. The peak of the dynamic curve recorded in 1993 in Slovakia was not recorded in our region. The morbidity curve continuously pointed to the peak of maximum incidence in 1996 when there was recorded the highest morbidity recorded in our region – 52.1 per 100,000 also in Slovakia. This value exceeded about three times the morbidity in Slovakia in 1996 – 18.5 per 100,000. In the Czech Republic peak morbidity was recorded a year later [6]. The increase in the number of cases of Lyme disease is attributed to global warming, climatic changes, and human intervention in the ecosystem: the result is the overgrowth of ticks and the increase of zoonosis [4].

Long-term monitoring of the disease shows the cyclical nature of the incidence of this disease, which evidently correlates with the cyclical nature of tick infestation [8]. This fact was also confirmed in the study in the area of Košice, where the increased prevalence of B. burgdorferi in ticks correlated with the dynamics of seroprevalence of borrelia antibodies of urban dogs with the dynamics of reported cases of Lyme borreliosis in Slovakia [8]. There were a higher number of newly diagnosed cases in the Liptov area in 2000–2001 and from 2004 to 2006 (about a 4-year cycle) except for morbidity culmination in 1995 and 1996 and 1996 across Slovakia and Czech [2, 6]. A dominant epidemiological marker is the tick Ixodes ricinus in which the borrelia infestation varies between different localities [1, 9]. The age-specific morbidity in our region confirmed the highest morbidity in the category 45 to 54-years-old people, the second is the age group of 30 to 34-years-old people. Higher morbidity of these groups of patients can be caused by young adults' leisure time activities such as nature visits, and also by spare-time activity of some people, especially women, working with the land [6, 9]. The difference in the number of diseases between women and men can have several reasons. Higher morbidity in the female population in several studies [7, 12] shows that there is another way of infection than transmission by insect, for example by working with arable soil contaminated with rodent urine.

CONCLUSION

1. The comparison of the number of reported cases and treated patients in both districts – Liptovský Mikuláš and Ružomberok – confirmed twice more patients with diagnosed disease than reported cases and also inadequate warning service.
2. The morbidity according to gender was higher in the female group of patients than in the male population.
3. The analysis of age-specific morbidity confirmed the highest risk of infection in the age bracket 45 to 54-years-old.

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Kontaktní adresa:
MUDr. Mária Bochničková, MPH
Janoškova 1
031 01 Liptovský Mikuláš
Slovenská republika
e-mail: mbochnickova@gmail.com

Reakce zahraničí na článek uveřejněný v EMI

V časopise Epidemiologie, mikrobiologie a imunologie č. 4/2012 byl uveřejněn článek „Isolation of *Cronobacter* spp. (formerly *Enterobacter sakazakii*) from Nostrils of Healthy Stable Horse – short communation" autorů Holý O., Matoušková I., Koukalová D., Chmelař D. První autor Mgr. Ondřej Holý působí v Ústavu preventivního lékařství Lékařské fakulty UP v Olomouci a je zároveň postgraduálním studentem na tomto pracovišti, kde se zabývá problematikou nozokomiálních nákaz a *Enterobacter sakazakii* (*Cronobacter* spp.). Po uveřejnění článku jej kontaktoval pan prof. Steve Forsythe z prestižní School of Science and Technology, Nottingham Trent University a nabídl Ondřejovi Holému spolupráci při výzkumu *Enterobacter sakazakii* a rovněž i stáž na svém pracovišti v Nottinghamu, kterou by měl absolvovat v letošním roce během letních měsíců. V současné době se začíná rozbíhat velmi slibná spolupráce mezi mateřským pracovištěm Ondřeje Holého a panem prof. Forsythem.

Redakční rada EMI Ondrovi Holému gratuluje k jeho úspěchu a přeje mu hodně zdaru při spolupráci s pracovištěm environmentální mikrobiologie School of Science and Technology, Nottingham Trent University.

MUDr. Jana Vlčková
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