



Lyme Snap: a feasibility study of on-line declarations of erythema migrans in a rural area of France

P. Letertre-Gibert, Gwenaël Vourc'h, Isabelle Lebert, Magalie René-Martellet, V. Corbin-Valdenaire, D. Portal-Martineau, J. Beytout, O. Lesens

► To cite this version:

P. Letertre-Gibert, Gwenaël Vourc'h, Isabelle Lebert, Magalie René-Martellet, V. Corbin-Valdenaire, et al.. Lyme Snap: a feasibility study of on-line declarations of erythema migrans in a rural area of France. *Ticks and Tick-borne Diseases*, 2020, 11, 10.1016/j.ttbdis.2019.101301 . hal-02503295

HAL Id: hal-02503295

<https://hal.science/hal-02503295>

Submitted on 21 Dec 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

Lyme Snap: a feasibility study of on-line declarations of erythema migrans in a rural area of France.

P. Letertre-Gibert^{1,4}, G. Vourc'h², I. Lebert², M. Rene-Martellet², V. Corbin-Valdenaire¹, D. Portal-Martineau³, J. Beytout¹, O. Lesens^{1, 4}

¹ Service de Maladies Infectieuses et Tropicales, CHU de Clermont-Ferrand, France

² Institut national de la Recherche Agronomique, Theix, France,

³Département de Recherche Clinique, CHU de Clermont-Ferrand, France

⁴Laboratoire Microorganismes: Génome Environnement (LMGE) UMR 6023, Université Clermont Auvergne, Clermont-Ferrand, France

25 **ABSTRACT**

26 The incidence of Lyme borreliosis remains a matter of debate, but it can be estimated using
27 the incidence of erythema migrans (EM), which is pathognomonic of the first phase. The aim
28 of this prospective pilot study was to assess the feasibility of the on-line declaration of EM in
29 rural areas where the incidence of Lyme borreliosis was previously estimated at 85 per
30 100,000 inhabitants per year.

31 The study was limited to a rural area (Les Combrailles, Auvergne) of approximately 52,800
32 inhabitants and was preceded by an information campaign for the inhabitants and the
33 healthcare professionals. Patients who sent a photo of the suspected EM by email or MMS
34 message between April 2017 and April 2018 and who accepted to answer a questionnaire
35 were included in the study. Two physicians then evaluated the quality of the photographs and
36 the probability of EM. In parallel, the number of EM seen by physicians and pharmacists in the
37 area over the given period was recorded.

38 Out of the 113 emails and MMS messages received, 73 people were outside of the trial area
39 or period and 9 did not complete the questionnaire. The photos of the remaining 31 people
40 were analysed. The median age was 51.5 years old ([38-58] IQR) and 18 (58%) were women.
41 Seven people (25%) stated that they did not have a smartphone and in 9 cases (29%) the photo
42 was sent by a third party. The quality of the photos was considered very good in 22 (71%)
43 cases, good in 7 (23%) cases, and average in 2 (6%) cases. The probability of EM was
44 determined to be strong or possible in 12 (38%) cases, i.e. an estimated incidence of 22.7 per
45 100,000 inhabitants. Over the study period, 40 physicians and 20 pharmacists were contacted
46 on a monthly basis. A median of 5 physicians [3 ;7] and 4 pharmacists [3 ;7] answered each
47 month for a total of 18 and 36 declared EM respectively. The EM (strong probability/possible)
48 collected by on-line declaration and those declared by healthcare professionals were all sent
49 between April and October 2017. The total time spent on the information campaign and
50 collection has been estimated at 265 hours (divided between 10 people) for an overall cost of
51 10,669 Euros.

52 The incidence of EM recorded by on-line self-declaration in our study seems to be lower than
53 in previous studies, the under-reporting was probably linked to the low use of new
54 technologies in the rural areas. Increasing the human resources and finances appears difficult
55 to achieve in practice over a longer time period but the development of an application for the
56 automatic recognition of EM could be one method for a more exhaustive collection in the long
57 term and at lower cost.

INTRODUCTION

Lyme borreliosis (LB), caused by *Borrelia burgdorferi* sensu lato in Europe and transmitted by ticks of the genus *Ixodes*, has become a public health problem. The controversy surrounding the disease is notably fuelled by a debate concerning its actual incidence. Although the infections linked to tick bites are probably an emerging problem, the uncertainty regarding the incidence of LB is an obstacle to the knowledge of its evolution over time and of its importance in terms of public health (Paules et al., 2018; Rosenberg et al., 2018). Moreover, knowledge of the areas at risk is an important element in the diagnosis, which is based on a clinical, biological and epidemiological triad (Shapiro and Wormser, 2018). It also allows better targeting of preventative actions.

The assessment of the incidence of LB in France is currently based on the National Reference Centre as well as the Sentinelles network (voluntary report by general practitioners), which is coordinated by the Institut de Veille Sanitaire (InVS), and has been active since 2009. The diagnosis of LB is based on the EUCLB clinical and biological criteria (Stanek et al., 2011). A significant increase in the French national incidence was seen in 2016, with a median of 84 cases [40-79] per 100,000 inhabitants, up to 105 in Auvergne, the region of our study (Fournier et al., 2018; Septfonds et al., 2019). This increase could be attributed to the start of the national plan against LB, with awareness-raising measures for the general public and healthcare professionals (Ministère des Solidarités et de la Santé, 2016). However, it cannot be excluded that the incidence is truly increasing.

The rise in the number of smartphones and the development of telemedicine (Boiteux et al., 2016; Gossec et al., 2017; Gilmore, 2018) makes it possible to consider collection of EM by self-declaration, based on the sending of digital photographs. This self-declaration is also used in other epidemiological follow-ups ("Signalement tiques", ongoing study being carried out by INRA, Institut National de la Recherche Agronomique). However, the efficacy of this method can meet with several difficulties, such as reduced diffusion of information and digital tools in rural areas. The quality of the photography may also prove to be an impediment when trying to make a confident diagnosis.

We therefore wanted to evaluate the feasibility of an on-line declaration of EM for estimating the incidence of LB via the sending of a digital photo, in a rural area of France (Les Combrailles, Auvergne), known for having a significant part of the tick population carrying *Borrelia burgdorferi* s.l. (Boyard et al., 2011).

MATERIALS and METHODS

This was a prospective, non-interventional study evaluating the feasibility of a diagnostic method, carried out as part of a local Hospital Clinical Research Program (PHRC) and led by both University Hospital of Clermont-Ferrand and INRA. It received ethics committee approval within the framework of category 3 of article L.1121-1 given by the decree of February 23, 2017 (registration number 2016-A02068-43). The study was limited to the Combrailles area of the Puy-de-Dôme department, a rural area of approximately 52,800 inhabitants in the center of France. It took place over a period of one year, from 1st April 2017 to 31st March 2018.

To raise awareness of the study, an information campaign for the inhabitants and the healthcare professionals was carried out beforehand, in February and March 2017. It consisted of repeated letters (paper and electronic) to the general practitioners, pharmacists and paramedical staff in the area, 3 briefings (2 for the healthcare professionals, 1 for the local population), posters and flyers in the local shops in the area, articles in the locally printed press as well as reports on local radio and television (France Bleu Pays d'Auvergne and France 3 Auvergne-Rhône-Alpes). Furthermore, an information website dedicated to the study was hosted on the INRA website (<https://www6.ara.inra.fr/lyme-combrailles>).

In order to participate, a photo of a suspected EM skin lesion had to be sent (by the person themselves or by a third person) by email or MMS message during the study period. The patients then had to complete a questionnaire (by email or telephone interview) reporting the characteristics of the erythema, the possible clinical signs associated and epidemiological and demographic data. The photos were then embedded in the questionnaire. The inclusion criteria were the appearance of erythema during the study period with compatible exposure during the previous month in the Pays des Combrailles area. Patients were not included if they presented an erythema before the 1st April 2017 or after the 31st March 2018, or if they had not stayed in the Combrailles area. After the photo and questionnaire had been received, two doctors (an infectious disease specialist and a dermatologist) determined the quality of the photograph and the probability of EM.

In parallel to the collection from the general public, the number of EM seen by doctors and pharmacists in the area (31 physicians and 20 pharmacists) during the study period was collected by an INRA scientist. Case report forms were provided to these healthcare professionals and a monthly reminder was sent by email to collect the number of EM identified. The sending of a photo was not required. An initial delivery of the questionnaire was made at the start of the month and a reminder was sent at the end of the month to the doctors and pharmacists that had not replied. Finally, an evaluation of the cost and the time required for the information campaign and the collection was carried out.

RESULTS

At the end of the study, 113 emails or MMS messages had been received, including 30 photographs of erythema that appeared in the area and period of the study (Figure 1). Thirty patients with a median age of 51 years [IQR: 35-58] were included in the study. Their characteristics are summarised in Table 1.

All participants except 2 considered the sending of the photograph to be easy. However, in 8 cases (27%) the photo was sent by a third party (4 by family members, 2 by a pharmacist, 1 by a nurse and 1 by a doctor). The quality of the photographs was determined to be very good in 22 cases (73%), good in 6 (20%) and average in 2 cases (7%). The results of the joint analysis of the photograph and questionnaire are summarised in Figure 1. Erythema migrans probability was determined to be strong or possible in 40% of cases.

In the 12 probable or possible cases, 10 (83%) appeared in June and July 2017, 2 people did not notice the tick and in the 10 others, the erythema appeared within a median of 2 days ([1 ;7] IQR) after the bite. Ten people received an antibiotic therapy (6 with amoxicillin, 2 with doxycycline and 2 could not remember the name).

Concerning the questionnaire for professionals, 45 replies were received from 10 different physicians (out of 40). A median of 5 physicians replied per month [3-7] (participation rate of 10%), for 18 declared cases of EM during the all study. Forty-three replies were received from 8 different pharmacists (out of 20). A median of 4 pharmacists replied per month [3-7] (participation rate of 20%), for 36 declared EM during the all study. Only 6 of these patients seen by professionals stated that they were participating in the Lyme Snap study, the information was missing for the other ones.

No EM were declared by the population nor the healthcare professionals after October 2017. The photographs received were mainly from the north of the Combrailles area.

The incidence of EM in the year (probability considered as strong/probably based on the photos, i.e. 12 per 52,800 inhabitants) was estimated at 22.7 per 100,000 inhabitants per year.

The time spent in the briefings, the poster advertising and the information for the healthcare professionals was estimated at 183 hours (8 people involved), and the time required for the collection of the information and the classification of the EM (4 people involved) was estimated at 82 hours. The total cost in terms of human resources amounted to 8,061 Euros. The cost (travel and material) for the information campaign amounted to 2,608 Euros. The overall cost was 10,669 Euros.

DISCUSSION

In this study we investigated the feasibility of self-declaring EM in rural areas by sending a digital photograph of a skin lesion. This method of collecting EM by on-line declaration is certainly attractive but it faces the problems of feasibility.

A study carried out in the same rural area in 2005 and 2006 found an incidence of EM (declared by the doctors) of 66 to 104 per 100,000 inhabitants (Beytout et al., 2007), which is 3 to 4 times higher than the incidence estimated from the self-declarations in our study. Likewise, in our study, the number of EM reported by physicians and pharmacists in the same period was greater than those collected by self-declaration, despite a low rate of participation of healthcare professionals. However, the diagnoses of EM declared by healthcare professionals were not verified by our team, which may have resulted in an over-declaration on their part.

The possible under-reporting may be linked to several factors: (a) the possible low use of new technologies in the rural areas could have been the cause of the low number of self-declared cases. (b) A geographical effect exists with fewer photos received from the southern area, an area less accessible, with fewer healthcare professionals and with a lower population but also with a lower known density of ticks. (c) A temporal effect also existed during the study with a maximum number of photographs received during the 7 first months (April-October). However, it is difficult to know if this was due to the fact that the information drive was not repeated (the study then being forgotten), or simply because *Ixodes* ticks are known to be less active during this period. The information campaign should probably have been repeated during the study, but with a more significant spending and human mobilisation. A larger scale study would require repeated information drives and more resources.

It is important to note that the majority of the exposures to ticks were due to gardening activities, an activity usually sparsely highlighted in the prevention strategies, which mostly targets hikers. However, the people who sent the photographs were mainly inhabitants of the area and rarely tourists, who would have been less informed of the study.

Several factors that could contribute to feasibility issues, particularly in a large-scale study, have been identified. Firstly, we received many messages and emails that were not related to EM (mainly chronic aspecific symptoms). Although they underline the need to inform the public, these messages interfere with the study and significantly increase the workload. Then again, in the context of a larger study, the human resources needed to sort out and reply to these inappropriate declarations would be considerable. Furthermore, the call-back for suspected cases in order to obtain the clinical history data, essential for the analysis of the photographs, was very time-consuming; And even when the message contained a photograph of the skin lesion, over half were not EM. The questionnaire was a key element for classifying the probability of EM based on the significance of the history but effectively required additional time. This method of collection for the estimation of the incidence of EM is probably not the most appropriate due to the low number of EM collected, despite the significant

human and financial resources. Nevertheless, to date, no other collection method appears to be satisfactory (Cartter et al., 2018).

Since the quality of the photographs received during the study was very good, it is possible to envisage an automatic recognition application for EM combined with a few short questions in order to assess the probability of EM. This technique, which has already been validated for the diagnosis of melanoma, could help with diagnosis but also with an epidemiological collection while limiting, after the implementation phase of the application, the financial and human cost.

REFERENCES

Beytout J., George J.C., Malaval J., Garnier M., Beytout M., Baranton G., Ferquel E., Postic D., 2007. Lyme borreliosis incidence in two French departments: correlation with infection of *Ixodes ricinus* ticks by *Borrelia burgdorferi* sensu lato. Vector Borne Zoonotic Dis. 7, 507-17. <https://doi.org/10.1089/vbz.2006.0633>.

Boiteux M.C., Rey P., Cadiou F., Chauvet C., 2016. Cardiauvergne is a remote monitoring and care coordination service for patients with severe heart failure. Soins. 61, 45-47. <https://doi.org/10.1016/j.soin.2016.09.009>.

Boyard C., Barnouin J., Bord S., Gasqui P., Vourc'h G., 2011. Reproducibility of local environmental factors for the abundance of questing *Ixodes ricinus* nymphs on pastures. Ticks Tick Borne Dis. 2, 104-10. <https://doi.org/10.1016/j.ttbdis.2011.02.001>.

Cartter M.L., Lynfield R., Feldman K.A., Hook S.A., Hinckley A.F., 2018. Lyme disease surveillance in the United States: Looking for ways to cut the Gordian knot. Zoonoses and Public Health. 65, 227-229. <https://doi.org/10.1111/zph.12448>.

[dataset] Fournier L, Roussel V, Couturier E, Jaulhac B, Goronflot T, Septfonds A., 2018. Épidémiologie de la borréliose de Lyme en médecine générale, France métropolitaine, 2009-2016. Bull Epidemiol Hebd 19-20. 383-8. http://beh.santepubliquefrance.fr/beh/2018/19-20/2018_19-20_1.html

Gilmore S.J., 2018. Automated decision support in melanocytic lesion management. PLoS One. 13, e0203459. <https://doi.org/10.1371/journal.pone.0203459>.

Gossec L., Cantagrel A., Soubrier M., Berthelot J.M., Joubert J.M., Combe B., Czarlewski W., Wendling D., Dernis E., Grange L., Beauvais C., Perdriger A., Nataf H., Dougados M., Servy H.,

238 2017. An e-health interactive self-assessment website (Sanoia®) in rheumatoid arthritis. A 12-
 239 month randomized controlled trial in 320 patients. Joint Bone Spine. 85, 709-714.
 240 <https://doi.org/10.1016/j.jbspin.2017.11.015>.

241 Ministère des Solidarités et de la Santé, 2016. Plan national de lutte contre la maladie de
 242 Lyme et les maladies transmissibles par les tiques. . [https://solidarites-](https://solidarites-sante.gouv.fr/IMG/pdf/plan_lyme_180117.pdf)
 243 [sante.gouv.fr/IMG/pdf/plan_lyme_180117.pdf](https://solidarites-sante.gouv.fr/IMG/pdf/plan_lyme_180117.pdf) (accessed 09.11.19)

244 Paules C.I., Marston H.D., Bloom M.E., Fauci A.S., 2018. Tickborne diseases – Confronting a
 245 growing threat. NEJM. 379, 701-703. <https://doi.org/10.1056/NEJMp1807870>.

246 Rosenberg R., Lindsey N.P., Fischer M., Gregory C.J., Hinckley A.F., Mead P.S., Paz-Bailey G.,
 247 Waterman S.H., Drexler N.A., Kersh G.J., Hooks H., Partridge S.K., Visser S.N., Beard C.B.,
 248 Petersen L.R., 2018. Vital Signs: Trends in Reported Vectorborne Disease Cases - United States
 249 and Territories, 2004-2016, MMWR Morb Mortal Wkly Rep. 67, 496-501.
 250 <https://doi.org/10.15585/mmwr.mm6717e1>.

251 Septfonds A., Goronflot T., Jaulhac B., Roussel V., De Martino S., Guerreiro S., Launay T.,
 252 Fournier L., De Valk H., Figoni J., Blanchon T., Couturier E., 2019. Epidemiology of Lyme
 253 borreliosis through two surveillance systems: the national Sentinelles GP network and the
 254 national hospital discharge database, France, 2005 to 2016. Euro Surveill. 24, 1800134.
 255 <https://doi.org/10.2807/1560-7917.ES.2019.24.11.1800134>

256 Shapiro E.D., Wormser G.P., 2018. Lyme Disease in 2018: What Is New (and What Is Not).
 257 JAMA. 320, 635-636. <https://doi.org/10.1001/jama.2018.10974>.

258 Signalement Tiques, ongoing study. Institut National de Recherche Agronomique.
 259 http://ephytia.inra.fr/fr/P/159/Signalement_TIQUE (accessed 09.11.2019).

260 Stanek G., Fingerle V., Hunfeld K.P., Jaulhac B., Kaiser R., Krause A., Kristoferitsch W., O'Connell
 261 S., Ornstein K., Strle F., Gray J., 2011. Lyme borreliosis : clinical case definitions for diagnosis
 262 and management in Europe. Clin Microbiol Infect. 17, 69-79. [https://doi.org/10.1111/j.1469-](https://doi.org/10.1111/j.1469-0691.2010.03175.x)
 263 [0691.2010.03175.x](https://doi.org/10.1111/j.1469-0691.2010.03175.x)

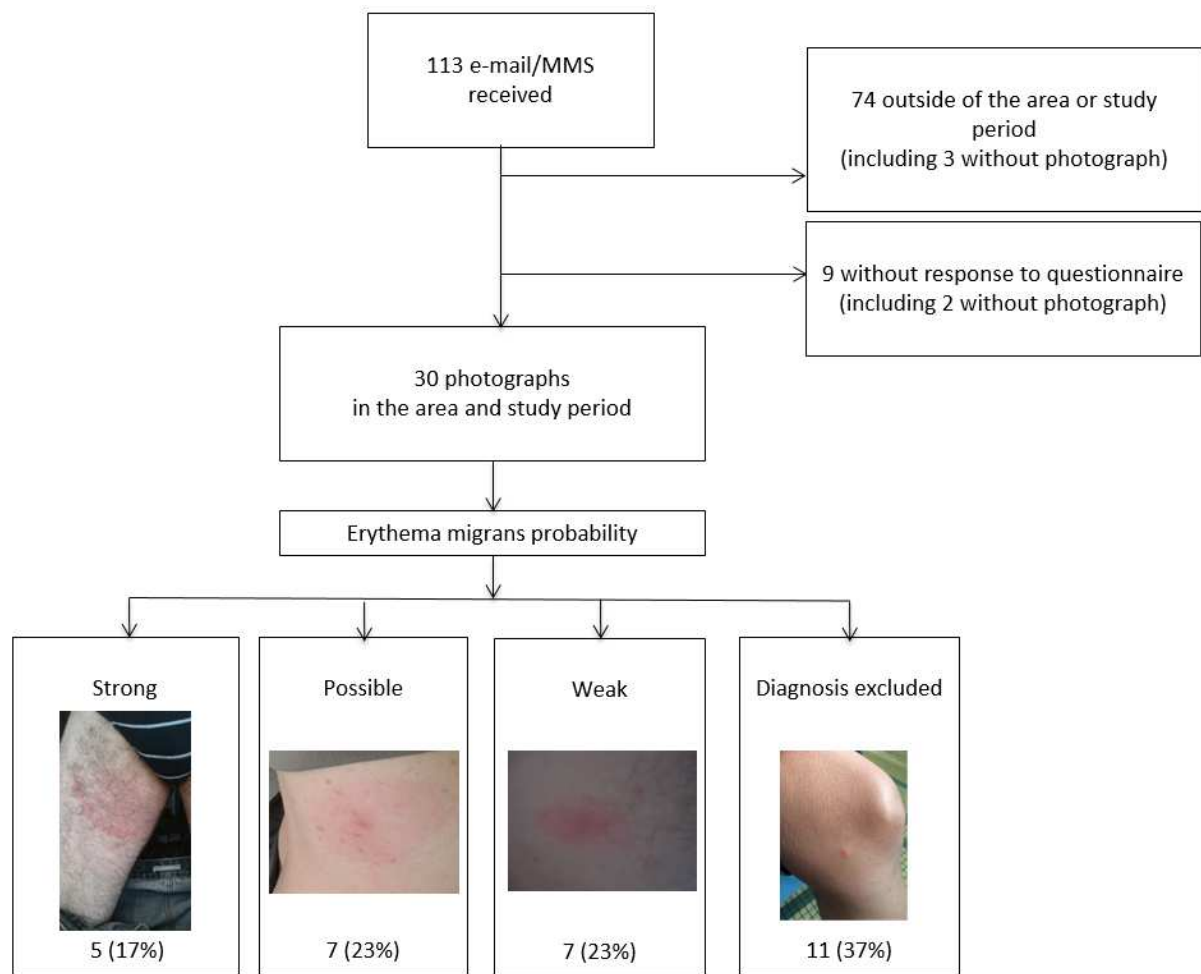


Figure 1. Study workflow.

Characteristics	Number (%)
Women n (%)	18 (60%)
Link with the Combrailles area n (%)	
Home	28 (94%)
Strictly professional	1 (3%)
Leisure/tourist	1 (3%)
Activity at the time of the bite n (%)	
Gardening	18 (61%)
Hiking/biking	6 (20%)
Animal care	2 (6 %)
Unknown	4 (13%)
Owned a smartphone n (%)	26 (87%)
Photograph sent by a third party n (%)	8 (27%)

269

270 Table 1. *Characteristics of the included patients (n=30)*

271

272

273

274

275