In March 2014, a person in their eighties who was diagnosed with extensive cellulitis due to toxigenic Corynebacterium ulcerans died from multiple organ failure. Environmental investigation also isolated C. ulcerans in biological samples from two stray cats in contact with the case. This finding provides further evidence that pets can carry toxigenic C. ulcerans and may be a source of the infection in humans.

In March 2014, the French Institute for Public Health Surveillance (Institut de Veille Sanitaire, InVS) was informed that a toxigenic C. ulcerans was confirmed by a multiplex PCR [2]. The NRC detected the presence of the tox gene by end-point PCR [3] and the production of diphtheria toxin by the isolate using the modified Elek test [4]. The isolate was sensitive to a large spectrum of antibiotics (among others: penicillin, amoxicillin, gentamicin, erythromycin, clindamycin, azithromycin, cotrimoxazole, ciprofloxacin) but not fosfomycin. Multilocus sequence typing (MLST) was performed using the MLST methodology used for C. diphtheria [5].

Microbiological investigation

One culture from each of the three soft tissue samples was sent to the National Reference Centre (NRC) and the identification of C. ulcerans was confirmed by a multiplex PCR [2]. The NRC detected the presence of the tox gene by end-point PCR [3] and the production of diphtheria toxin by the isolate using the modified Elek test [4]. The isolate was sensitive to a large spectrum of antibiotics (among others: penicillin, amoxicillin, gentamicin, erythromycin, clindamycin, azithromycin, cotrimoxazole, ciprofloxacin) but not fosfomycin. Multilocus sequence typing (MLST) was performed using the MLST methodology used for C. diphtheria [5].

Veterinary investigation

A follow-up investigation was conducted by the local health authorities. Two delivery drivers were identified who had been in close vicinity to the patient, but they were not considered as close enough contacts to be sampled. The patient had two pet cats and was taking care of three stray cats. At the end of March, all five cats were taken away by the veterinary services. Throat and ocular samples were taken from each animal. In addition, conjunctival swabs were systematically taken, even if the cats were asymptomatic. One of the stray cats had a wound on its neck which was also sampled.
The samples were sent to the NRC for culture. *C. ulcerans* carrying the *tox* gene was isolated from the ocular sample of the stray cat with the wound and from the throat sample of another stray cat. The isolates were characterised using the same methods used for the human isolate. The modified Elek test was positive for both isolates. The samples of the third stray cat and the two pet cats tested negative for *C. ulcerans*.

After the patient's death, the cats were taken to an animal shelter. The Direction for the protection of populations of Yvelines decided to start antibiotics treatment of the infected cats. They were treated with amoxicillin for 10 days and a post-treatment sampling control was performed. These cultures showed the persistence for 10 days and a post-treatment sampling control of *Yvelines* decided to start antibiotics treatment of the infected cats. They were treated with amoxicillin for 10 days and a post-treatment sampling control was performed. These cultures showed the persistence for 10 days and a post-treatment sampling control of a *C. ulcerans* bearing the *tox* gene in the pharynx of one infected cat despite antibiotic treatment. The other post-treatment cultures were negative, including those for the cat that previously had *C. ulcerans* isolated from an ocular sample.

**Discussion**

From 2002 to 2013, 28 autochthonous cases of diphtheria due to toxigenic *C. ulcerans* were reported in mainland France [6]. The affected patients were mostly women (18/28) over 60 years of age with comorbidity [6]. The vaccination status was known for only six cases, and only two had received a diphtheria booster in the 20 years before the event. In veterinary investigations performed on pets owned by 14 cases only two dogs tested positive for toxigenic *C. ulcerans* (*tox*+), one of them carrying an identical ribotype as the *C. ulcerans* isolated from the owner of one of these dogs [7].

For the present case, seven housekeeping genes were compared by MLST, and all alleles from the human and animal isolates were found to be identical and belonged to sequence type ST325. This number is deduced from the *C. diphtheriae* database (http://pubmlst.org/cdiphtheriae/) and only provisional because there is presently no MLST scheme for *C. ulcerans*.

Nevertheless, this result strongly suggests that transmission of *C. ulcerans* tox+ occurred from a stray cat. Few studies have described toxigenic *C. ulcerans* in domestic cats [8-10]. Transmission from animal to human or from a common unknown source of infection cannot be formally ruled out as several recent studies have mentioned *C. ulcerans* carriage in different mammalian species [11,12].

**Conclusion**

The clinical course of events (sepsis and multiple organ failure) and the possible zoonotic transmission suggest that the infection by *C. ulcerans* probably led to the death of the patient. The discovery of the bacteria in the stray cats reinforces the need to strengthen the links between animal and human health research, to better characterise the circulation of the bacteria in animals. Despite national recommendations on the use of diphtheria antitoxin and vaccination boosters, severe and lethal infections due to *C. ulcerans* tox+ have been observed in France among elderly people who were in contact with cats and dogs [13].

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**Conflict of interest**

None declared.

**Authors’ contributions**

All the authors contributed to the acquisition of data, analysis or interpretation; drafting the paper (or revising it critically) and approve the final version.

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