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SHORT REPORT
An outbreak of Q fever in a prison in Italy

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SUMMARY

We observed an outbreak of Q fever in a prison population. Overall, 65 of the 600 prison inmates developed the disease. The location of the prison cells had no apparent effect on the risk of infection. The outbreak was probably due to exposure to dust contaminated by a passing flock of sheep, which at the time of the outbreak was engaged in lambing. These findings highlight the possible emergence of Q fever in settings and populations not normally thought of as being at risk of exposure to the infection.

Q fever is a zoonotic disease caused by *Coxiella burnetii*, which is distributed globally [1]. Cattle, sheep, and goats are the most common reservoirs, although a broad range of arthropods and vertebrates can be infected [1–4] and potentially transmit the infection [5, 6]. Small outbreaks whose source had been initially unclear have been attributed to contact with pigeon faeces and ticks [3].

The infection is typically transmitted through the inhalation of aerosols or dust contaminated with the urine, faeces, milk, or birth products of infected animals, causing self-limiting outbreaks. Ingestion of contaminated unpasteurized milk products could also be a means of transmission for sporadic cases [1, 7]. *Coxiella burnetii*, because of its remarkable infectivity (i.e. an infectious dose of 1–10 organisms) and resistance to environmental conditions, has been considered as a possible biological war agent, although its virulence is not that high [8].

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Most of the large outbreaks of Q fever have occurred in rural settings and in most cases have been attributed to the breeding or passage of animals [9–11]. Outbreaks in urban areas are not uncommon and have been attributed to the transit of animals and farm vehicles along the road [12] or exposure to slaughterhouses [13]. In other words, Q fever is almost always associated with activities that involve direct or indirect contact with livestock [14, 15]. Herein we describe the results of an epidemiological study of a large outbreak of Q fever which occurred in a prison in northern Italy.

In the winter of 2003, the Local Health Authorities of the town of Como (northern Italy) received reports of 133 cases of Q fever, many of which were from a prison in a nearby semi-rural area [16]. The prison complex includes six main buildings within the prison walls (Fig. 1): two buildings containing prison cells for long-term inmates (one for men and one for women); one building for newly admitted inmates; one for inmates working outside the prison during the day; and two smaller structures serving multiple purposes (i.e. administrative offices, kitchen, etc.). The

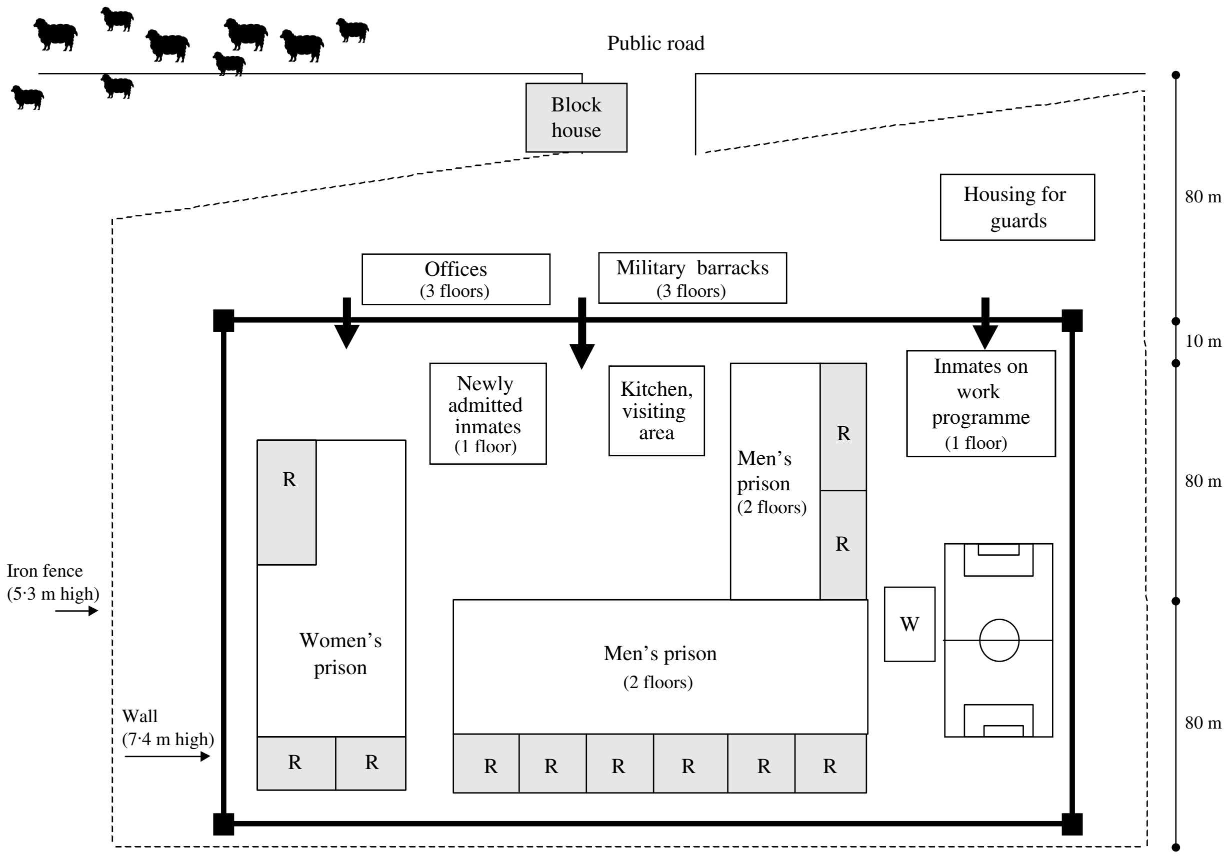

Fig. 1. Map of the prison of Como and its surrounding area. The sheep indicate the passage of the flocks. R, Outdoor recreational area; W, recreational workshops.

196 prison cells are grouped into 10 sections, each with an outdoor recreational area, where the inmates spend around 4 h a day. The complex is surrounded by a 7·4-m-high wall approximately 10 m from the buildings. Approximately 80 m from this wall, there is a public road that runs along the complex and which is situated somewhat above the level of the complex.

The epidemiological study was conducted among the 600 inmates (540 men and 60 women) who were present during the outbreak, which lasted from 3 January 2003 (i.e. the date of diagnosis of the first case) to 16 February 2003 (last case). A case of Q fever was defined as a prison inmate who, during the period from January 1 to the end of February, presented with fever (> 38 °C), headache, and non-productive cough and for whom the serological test for *C. burnetti* was positive [titre $\geqslant$164 (i.e. for IgM and IgG combined) using an immunofluorescence assay (IFA) with phase II antigen performed on convalescent-phase serum samples, in accordance with the cut-off established by the local laboratory]. A questionnaire was used to collect demographic and clinical data. Prison guards and administrative officers were excluded from the study, since the possibility of having acquired the infection outside the prison might not be ruled out.

The dates of the onset of symptoms were plotted to fit the epidemic curve. The attack rates and relative risks were compared taking the following features into consideration: gender (females *vs.* males); the position of the cell (i.e. window facing outwards *vs.* facing a courtyard; cell located on the ground floor *vs.* those located on the second and third floors; and cell located approximately 90 m from the prison's wall (i.e. ~170 m from the road). The cut-off of 90 m represents the approximate midpoint between the front and the back of the prison buildings). We also compared the attack rates and relative risks among the 10 sections. Statistical significance was assessed through the calculation of 95% confidence intervals (95% CI) of the relative risks and the use of standard tests (i.e. uncorrected and Yates' corrected χ^2 and Fisher's exact test).

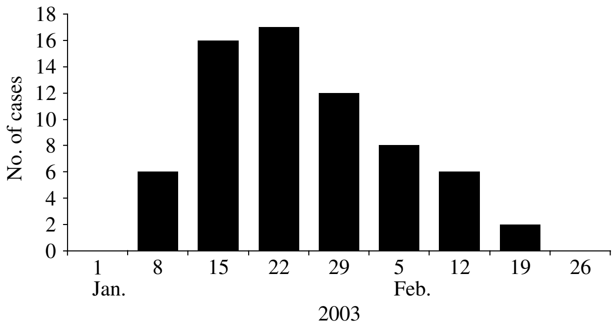

Fig. 2. Epidemic curve of Q fever cases in the prison of Como, northern Italy (January to February, 2003).

The epidemic curve is shown in Figure 2. Between 3 January and 16 February 2003, 67 cases of Q fever were diagnosed: 65 among inmates (two of whom were women) and two among prison guards. The median age of cases was 36·6 years (range 21–53 years). The attack rate among inmates was 10·8 %, and it was almost four times higher among male inmates, compared to female inmates; however, the 95 % CI of the relative risks included one, and the uncorrected χ^2 was marginally significant ($P=0·049$), whereas the Yates' corrected χ^2 was not significant ($P=0·079$). The attack rate was similar when comparing inmates in terms of cell position (Table). Although the attack rates ranged from 3·3 % to 17·3 % among the 10 sections, the differences were not statistically significant (data not shown in the Table).

According to Local Health Authorities, between December and January two flocks of sheep and goats had grazed on pastures near the prison. One of these flocks, which consisted of around 750 animals, was found to have had a high proportion of sheep infected with *C. burnetii* (Communication of the Local Health Authority, and ref. [16]), and around the Christmas holidays this flock was seen to have engaged in lambing near the prison and to have walked along the nearby road, which, as previously mentioned, is above the level of the prison complex (Fig. 1).

Dust contamination from the infected flock of sheep was the probable cause of this outbreak. As reported in other outbreaks, ecological factors, such as wind frequency and direction [17], dry weather [10], and lambing [9], which are known to increase the risk of Q fever outbreaks, may have facilitated air contamination and the dispersion of *C. burnetii* beyond the wall of the prison. Although we do not have accurate information on the wind conditions in the period in which the flock was near the prison, we do know that it was dry and windy, conditions that favour the dispersion of dust.

Table. *Attack rates and relative risks with 95 % confidence intervals (CI) of Q fever among prison inmates, by gender and location of the prison cell*

	Attack rate	Relative risk (95 % CI)
Gender*		
Female	3·3 % (2/60)	1
Male	11·7 % (63/540)	3·50 (0·88–13·94)
Cell position		
Facing outwards	8·5 % (23/270)	1
Facing a courtyard	12·7 % (42/330)	1·49 (0·92–2·42)
$<$90 m from the wall	8·3 % (17/204)	1
$>$90 m from the wall	12·1 % (48/396)	0·69 (0·41–1·16)
Ground floor	10 % (9/90)	1
2nd floor	10·5 % (30/286)	1·05 (0·52–2·13)
3rd floor	11·5 % (26/225)	1·16 (0·56–2·37)

* χ^2 uncorrected, $P=0·049$; Yates' corrected, $P=0·079$.

The finding that the attack rates did not significantly differ when comparing inmates located in different areas of the prison suggests that the infection was probably acquired in common open spaces and that the contaminated dust had travelled a distance of up to 200–250 m (i.e. from the road to the recreational areas situated at the back of the buildings). Whether the lower attack rates among female inmates compared to male inmates could be explained by the location of recreational areas (i.e. some areas possibly more protected from dust than others) or whether it arose by chance, as suggested by the marginal significance or lack of significance, remains undefined.

To the best of our knowledge, this is the first outbreak of Q fever reported in a prison population. It was not possible to determine whether inmates acquired the infection while in their cells or during outdoor recreation periods. Although we have previously described outbreaks of Q fever in a confined population (i.e. a population of drug users living in a residential community), the infection was attributed to sheep-breeding and farming in pastures contained within the boundaries of the community [18]. The occurrence of this large outbreak confirms that the Q fever agent is highly infectious and that it constitutes a potential threat even to persons not in direct contact with infected animals.

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