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# POTENTIAL EXPOSURE TO AUSTRALIAN BAT LYSSAVIRUS IN SOUTH EAST QUEENSLAND: WHAT HAS CHANGED IN 12 YEARS?

Megan K Young, Bradley J McCall

## Abstract

Public health measures have been targeting potential exposure to Australian bat lyssavirus (ABLV) since the first recognised human cases, more than a decade ago. The effect of these measures on the epidemiology of notifications of potential exposure has not been investigated since 2003. Trends in notifications of potential exposure to ABLV reported to the Brisbane Southside Public Health Unit between November 1996 and October 2008 were examined. During the study period notification rates declined among all population groups and potential exposures were notified more promptly. The proportion of female notifications and the proportion of notifications from volunteer bat carers and their families and professional groups decreased over time. These changes over 12 years may indicate success of public health measures, under-reporting of potential exposure or both. Intentional handling of bats by untrained members of the public continues to be an important source of potential exposure to ABLV and requires a sustained public health response. *Commun Dis Intell* 2010;34(3):334–338.

Keywords: lyssavirus, bats, Chiroptera, disease notification, Queensland, Australia

## Background

Australian bat lyssavirus (ABLV) is a member of the Rhabdoviridae family, which also includes European bat lyssavirus, and rabies virus. Classic rabies virus and ABLV possess marked similarity using both serotyping and molecular sequencing.<sup>1</sup> Like rabies, ABLV infection is lethal to humans. Two fatal cases of human ABLV infection have been reported in Australia, one in 1996 and the second in 1998.<sup>2,3</sup>

Bats are considered the natural host of ABLV. Natural infections have been recorded in both megachiropteran (flying fox) and microchiropteran (insectivorous bat) species.<sup>4</sup> The prevalence of ABLV infection in bats has been reported as <1%–7%.<sup>5</sup> Therefore, not all bat bites or scratches will result in human exposure to the virus.

Under current guidelines, all potential exposures require treatment (post exposure prophylaxis) with rabies vaccine and usually rabies immunoglobulin unless the bat involved is proven to be ABLV negative.<sup>6</sup> This requires that all available bats involved in potential human exposures are tested for ABLV. Detection of ABLV infection in bats requires examination of fresh brain impression smears.

Considering both human and animal welfare, it is desirable that potential exposure to ABLV is minimised. This is the objective of ongoing public health messages aimed at the general public.<sup>7</sup> Periodic examinations of notification data provide a measure of effect of these messages.

The epidemiology of potential exposure to ABLV in south east Queensland, Australia has been previously described.<sup>4,8</sup> Initial data showed that potential exposures were more likely to be the result of contact by people with some professional or volunteer interest in caring for bats than by members of the general public.<sup>4</sup> Between 1999 and 2003, the general public had a higher proportion of potential exposure than other groups, but absolute numbers of notifications had decreased.<sup>8</sup>

As no study had been conducted since 2003, population trends in potential exposure to ABLV reported to the Brisbane Southside Public Health Unit (BSPHU), in South East Queensland, between November 1996 and October 2008 were examined.

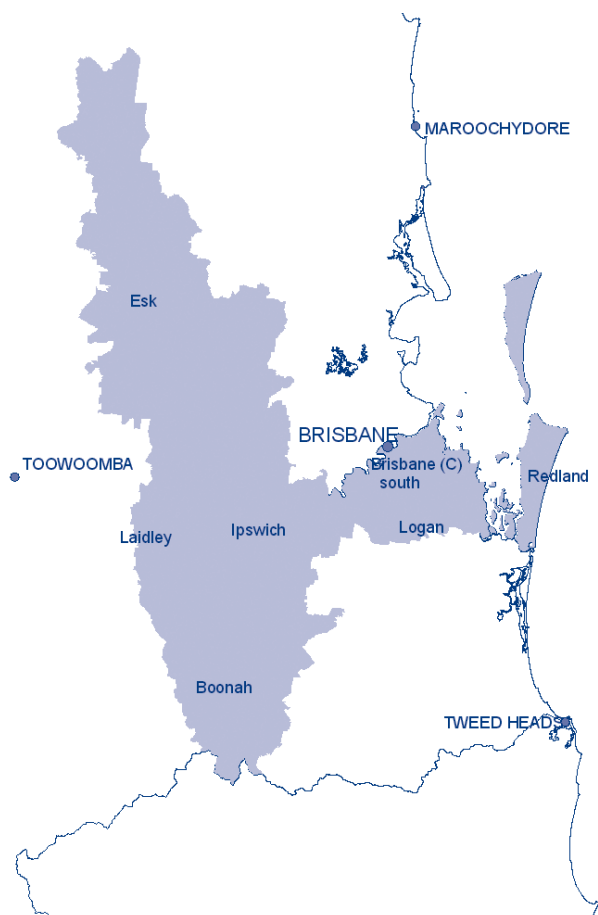
## Methods

Potential exposure to ABLV is a clinical diagnosis notifiable condition in Queensland. Enhanced surveillance of potential exposure to ABLV commenced at the BSPHU in November 1996. Since then, BSPHU staff have collected details of all potential human exposures to ABLV through completion of a standard telephone administered questionnaire, and in accordance with national guidelines<sup>6</sup> and Queensland Health policy, all available bats involved in potential human exposure have been tested for ABLV infection at the local reference laboratory. Further details of

the questionnaire, methods of study and results until 31 January 1999 have been described.<sup>4</sup> Of particular relevance to this study were the questions about the circumstances surrounding the potential exposure. The resulting data were categorised for analysis. Mutually exclusive categories were termed: General public, bat initiated contact (including cases where bats swoop upon or otherwise engage in human contact without provocation); General public, intentional bat handling (including where members of the public have attempted to rescue bats caught in fruit tree nets or fences); Volunteer bat carers and their families (including people recognised as bat carers by the Queensland Department of Environment and Resource Management); and Professional duties (including veterinarians or other people who handle bats as part of their profession).

The geographic boundaries of the area served by the BSPHU changed after 1999, but were then consistent for the rest of the study. This area (Figure 1) includes several local government areas with an estimated resident population of 1.2 million as at 30 June 2006,<sup>9</sup> increased from 920,680 as at 30 June 2000.<sup>10</sup> To allow comparison of data

**Figure 1: The geographical area covered by the Brisbane Southside Public Health Unit (shaded blue)**



across the entire study period, the original study data were restricted to those people who resided within the current BSPHU boundaries.

The trend in the number of notifications was examined using the curve estimation function in SPSS 16. Trend lines were modelled to determine which was the best fit for the data as indicated by the  $R^2$  value. As a number of retrospective notifications occurred in the early years of the study, this analysis was repeated after restricting the data to those notifications where exposure occurred within the study period, and then to those notifications with an interval of 3 months or less between exposure and notification.

Because the number of notifications in each year of the study was small, the dataset was then examined in 3 periods of 4 years. Chi-squared tests were used to assess the statistical significance of changes in proportions. Where the assumptions of chi-squared testing were not met, Fisher's exact test was used. ANOVA was used to assess the statistical significance of changes in means. Analysis was conducted in SPSS 16.

Ethics committee approval was not sought because enhanced surveillance was conducted in accordance with Chapter 3 of the (Queensland) *Public Health Act 2005*.

## Results

There were 385 notifications of potential exposure to ABLV over the 12 years of the study (November 1996 to October 2008), an average annual notification rate of 3.5 per 100,000 population. Notifications decreased over the first 4 years of the study and then seemed to plateau (Figure 2). The fitted line (Figure 2) accounted for 66% of the variability in the data ( $R^2$  0.657;  $P=0.001$ ). Restricting the data to notifications where exposure occurred within the study period ( $n=332$ ), and then to notifications with an interval of 3 months or less between exposure and notification ( $n=343$ ) did not appreciably alter this result ( $R^2$  0.482;  $P=0.012$  and  $R^2$  0.684;  $P=0.001$  respectively).

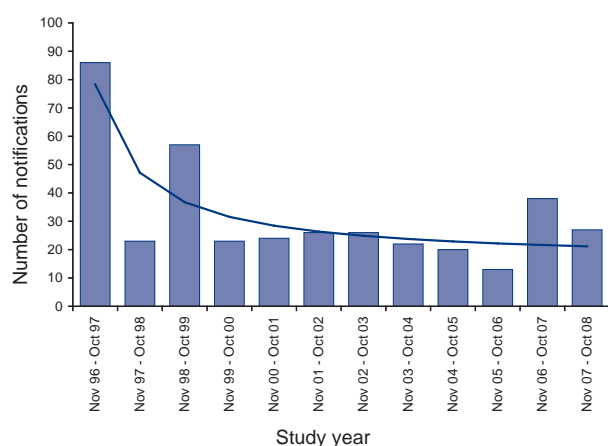
The mean age of those potentially exposed was 40 years, with equal proportions of males and females (Table 1). Of notifications where the circumstance of potential exposure was recorded, the majority (52%) occurred because members of the general public intentionally handled bats (Table 2). Volunteer bat carers and their families were the next most commonly notified group (27% of potential exposures). The majority of potential exposures were associated with bite injuries (55%;

n = 212). Two hundred and seventy-three notifications (71%) received post-exposure prophylaxis, although 17 of these notifications did not complete prophylaxis as the bat tested ABLV-negative.

There were 189 notifications of potential exposure to ABLV over the first 4 years of the study (November 1996 to October 2000 – period 1), 98 notifications over the second 4 years (November 2000 to October 2004 – period 2) and 98 notifications over the last 4 years (November

2004 to October 2008 – period 3). Accounting for population growth, the average annual notification rates were 5.1 per 100,000 (period 1), 2.7 per 100,000 (period 2), and 2.0 per 100,000 (period 3) ( $P < 0.001$ ). The mean age of those notified was not different across the 3 periods of study ( $P = 0.09$ ). There was significant difference in the ratio of males to females ( $P = 0.018$ ) across the periods of study, with more females being notified in period 1 (58%) and more males being notified in periods 2 and 3 (58% and 55%) (Table 1).

**Figure 2: Notifications of potential exposure to Australian bat lyssavirus to the Brisbane Southside Public Health Unit, November 1996 to October 2008**



The interval between potential exposure and notification was significantly different across the periods of study, decreasing from a mean of 228 days in period 1 to a mean of 3 days in period 2 and a mean of 22 days in period 3 ( $P < 0.001$ ). Of those notifications where the circumstance of potential exposure was recorded (n = 376), these varied significantly across the periods of study ( $P < 0.001$ ) (Table 2), although, in all periods, intentional bat handling by members of the general public was the most common circumstance. Both the number and the proportion of notifications from volunteer bat carers and their families showed the largest decline during the study (Table 2). Of female notifications, volunteer bat carers and their families accounted for 52% (n = 56) in period 1; 20% (n = 8) in period 2 and 30% (n = 13) in period 3. This was the largest decline in both numbers and proportion of female notifications across the study.

**Table 1: Gender of notifications of potential exposure to Australian bat lyssavirus to the Brisbane Southside Public Health Unit**

Gender	Nov 96–Oct 00		Nov 00–Oct 04		Nov 04–Oct 08		Entire study period	
	%	n	%	n	%	n	%	n
Male	42	80	58	57	55	54	50	191
Female	58	109	42	41	45	44	50	194
Total	100	189	100	98	100	98	100	385

**Table 2: The circumstances of potential exposure to Australian bat lyssavirus of notifications to the Brisbane Southside Public Health Unit**

Circumstance	Nov 96–Oct 00		Nov 00–Oct 04		Nov 04–Oct 08		Entire study period	
	%	n	%	n	%	n	%	n
General public, bat initiated contact	5	9	18	17	17	16	11	42
General public, intentional bat handling	43	79	64	61	59	57	52	197
Volunteer bat carers and families	41	75	11	10	19	18	27	103
Professional duties	12	22	7	7	5	5	9	34
All circumstances	101*	185	100	95	100	96	99†	376†

\* Percentages do not add to 100 due to rounding error.

† Nine notifications did not have circumstance of exposure recorded and these have been excluded from the calculation of percentages.

There was a similar decline in the proportion of volunteer bat carers and their families among the male notifications, but the decrease in numbers was not as large (period 1: 24%,  $n = 19$ ; period 2: 3.6%,  $n = 2$ ; period 3: 9%,  $n = 5$ ).

The proportion of notifications where bats were available for testing varied significantly across the study periods from 32% ( $n = 60$ ) in period 1, to 51% ( $n = 50$ ) in period 2, to 42% ( $n = 41$ ) in period 3 ( $P = 0.008$ ). Of notifications where bats were available for testing, the proportion with ABLV-positive bats decreased over time (20% ( $n = 12$ ) in period 1; 6% ( $n = 3$ ) in period 2; nil in period 3 ( $P = 0.002$ ). A total of 6 bats tested positive over the 12 year study; four in period 1 and two in period 2. Fifteen people were exposed to ABLV-positive bats and provided with post exposure prophylaxis (in accordance with public health recommendations<sup>6</sup>). No new cases of human ABLV infection have been reported to date.

## Discussion

Notification rates significantly decreased during the 12 years of enhanced surveillance, seeming to plateau in the latter part of the study. Changes in the distribution of notifications in various groups occurred. Notifications from the general public increased in proportion, but decreased in absolute numbers across the study period. The proportion of females notified decreased across the study period.

These results seem to support continuing effectiveness of public health messages about the importance of not handling bats. It is also possible that the observed reduction in notifications from the general public is due to a decline in community awareness about the risks associated with potential exposure.

The trend in notification numbers and rates was not linear. With only 12 data points, the fitted line gives a general picture of trend, showing that notifications decreased substantially over the first 4 years of the study and then seemed to plateau. The change in notification rates across the 3 periods of the study support the same conclusion. Retrospective notifications did not influence this general trend.

The change in gender of notifications during the study seems related to a reduction in reporting among volunteer bat carers as this group had the largest decline in numbers and proportion of female notifications. This conclusion is also supported by the fact that the majority of carers (62/84, 74%) in the largest volunteer bat care group in south east Queensland are female (personal communication R. Larkin, Department of Environment and

Resource Management, 21 April 2010). Concerns remain about the potential for under-reporting of non-bite exposures among this group.

The notifications included some retrospective potential exposures associated with publicity about human cases during period 1. In recent years, with the exception of 1 delayed report in period 3, the interval between potential exposure and reporting has remained short. Reporting from medical practitioners has been consistently prompt. The overall improvement in reporting times suggests that those people who sought medical attention for a potential exposure were aware of the importance of prompt medical assessment for a bat related injury, if not the importance of avoiding intentional handling. Public health messages should continue to emphasise that members of the public can be of most help to orphaned or injured bats by contacting a trained, vaccinated bat handler.

The decline (from period 2 to period 3) in the proportion of notifications where the bat was available for testing is important because of the resultant increase in the need for post-exposure prophylaxis, especially rabies immunoglobulin, which is in short supply. However, public health messages should continue to reinforce that people should not risk potential exposure (or further potential exposure) in order to detain a bat for testing.

Reported potential and confirmed exposures to ABLV declined during the study. Further research is required to determine whether this is a genuine reduction in potential exposures, under-reporting, or a combination of the two. The plateau of notifications more recently and the lethality of the infection demand ongoing public health measures to improve and sustain public awareness of the potential for exposure to ABLV.

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