Between herd reproduction ratios (R_H) and time to intervention during the 2001 foot-and-mouth disease epidemic in Argentina

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Abstract

A major epidemic of foot-and-mouth disease occurred in 2001 in Argentina. Reproduction ratio between herds (R_H) and time to intervention were estimated before, during, and after the end of the first round of vaccination. Control activities were significantly ($P<0.05$) associated with reduced disease transmission (median R_H 2.4, 1.2 and <1, respectively). Time to intervention before vaccination was significantly ($P<0.01$) longer (median: 8) than during (median: 4) or after (median: 3) vaccination. Similarly to other epidemics, the period before effective application of control strategies was probably crucial in determining the progress of the epidemic.

Introduction

A major epidemic of foot-and-mouth disease (FMD), including 2126 infected herds, occurred in Argentina between February 24 and December 3, 2001. The index outbreak was identified on March 12. Control was achieved by vaccination and movement restrictions. Vaccination of contact herds was imposed following detection of the first outbreak. In early April 2001, a national mass vaccination campaign began. This first round of mass vaccination ended in July. The aim of this study was to assess the variation in the basic reproduction ratio and time to intervention during the 2001 foot-and-mouth disease epidemic in Argentina.

Material and Methods

Time to intervention was calculated as the lag between when the herd was infected (estimation based on age of lesions) and when the outbreak reported. Reproduction ratio between herds (R_H) was estimated as

$$R_H = 1 + (D/t_d)\ln 2,$$

where D is the duration of herd infectiousness and t_d is the time period in which the number of cases (herds) are doubled. D was estimated by time to intervention.

The change in R_H and D over time (Table 1) was assessed by estimating values before the index case occurred and vaccination started, during the vaccination period, and after the end of vaccination. Median values of R_H and D during the three assessed

periods were compared using a Kruskall-Wallis test. Median time to intervention was also estimated for the first week of the epidemic.

Table 1: Duration and number of herds affected before, during and after the end of the mass vaccination campaign in the foot-and-mouth disease epidemic in Argentina in 2001.

Period	Duration	Herds infected
Before index case	2 weeks	33
During mass vaccination	5 months	1968
After end of mass vaccination	4 months	112

Results

Time to intervention before vaccination was significantly (Kruskall Wallis test, $P<0.01$) longer than during or after vaccination. During the first week of the epidemic, median time to intervention was 12 days.

Control activities were significantly (Kruskall Wallis test, $P<0.05$) associated with reduced disease transmission (Table 2). After the first round of mass vaccination was completed, the reproduction ratio between herds was estimated only once (1.0), since the epidemic finished before the number of outbreaks was doubled for a second time. Thus, median R_H was assumed <1.

Table 2: Reproduction ratio (R_H) and time to intervention before, during and after the end of the mass vaccination campaign in the 2001 foot-and-mouth disease epidemic in Argentina.

	Period		
Variable	Before index case	During mass vaccination	After end of mass vaccination
Time to intervention			
Minimum	1	0	0
Median	8	4	3
Maximum	21	30	7
R_H			
Minimum	2.4	1.0	…
Median	2.4	1.2	<1
Maximum	3.8	1.5	…

Discussion

The index case was detected 15 days after the primary case occurred. Similar to other major epidemics (Yao et al., 1999, Gibbens et al, 2001), the period between the first outbreaks of FMD and effective application of control strategies was probably crucial in determining the progress of the epidemic. After the detection of the index outbreak, median time to intervention decreased, indicating an increase in the

capability of the veterinarian services to detect affected herds and/or to initiate control.

The estimated value of the reproduction ratio before the detection of the epidemic (2.4) in Argentina was similar to that (2.6) reported in The Netherlands (Bouma et al., 2003). The association between vaccination and reduction in the reproduction ratio may indicate that this strategy was effective in controlling the epidemic. High serological titers were developed by 85% of the vaccinated cattle during the FMD epidemic in Argentina (SENASA, 2001). Incomplete vaccine protection may be responsible for the residual occurrence of cases after the end of mass vaccination (112 herds affected in 4 months).

The decision to vaccinate during an FMD epidemic is always controversial. Analysis of the time between primary infection and index case detection and the number and distance between outbreaks during this period is key. If evidence suggests that a slaughter policy will be insufficient to control the epidemic, then vaccination should be considered (Leforban, 2002). The time between the end of mass vaccination and effective control of this epidemic and the number of outbreaks that occurred during this period, suggests that imposition of mass vaccination during the 2001 FMD epidemic in Argentina was an appropriate decision.

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