



Short communication

Pilot study of the financial and practice protocol impacts of canine influenza virus (H3N2) outbreaks in example veterinary practices



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ABSTRACT

Since March 2015, canine influenza virus (CIV) H3N2 has caused widespread outbreaks in dogs across the USA. The effects of local H3N2 outbreaks on veterinary practices were investigated using an online interface and followed with phone calls to respondents when necessary. An outbreak was defined as confirmed diagnosis of H3N2 by either PCR or serology in at least four dogs. Of 30 practices invited to participate, five met the entry criteria: at least one documented H3N2 outbreak in the previous 12 months, a predominantly ($\geq 70\%$) small animal caseload, and adequate financial records to complete the survey. Respondents reported 1–3 H3N2 outbreaks/practice over the last 12 months, with 4–8 dogs diagnosed/outbreak. For each participating practice, self-reported direct financial impact data was collected from the single H3N2 outbreak that involved the most dogs. The two most substantial categories of self-reported financial loss occurred due to boarding facility closure (estimated cost per practice: median \$5000), and treatment costs borne by the practice (estimated cost per practice: median \$2850). Median extra biosecurity costs were \$300/practice. Median total direct costs of an H3N2 outbreak were \$8945/practice. Lost foot traffic included cancelled appointments, appointments redirected to other veterinary hospitals for the duration of the outbreak, and loss of revenue from ancillary services provided during usual business (calculated cost per practice: median \$450). Cost/practice normalized by the number of fulltime veterinarians in each practice was calculated and additional effects, such as interruptions to daily practice routine, reduced productivity, reputation loss and poor staff morale, were also reported. Vaccination against H3N2 was introduced as part of routine practice vaccination protocols or was made mandatory before boarding in three of five practices. In the remaining two practices, a focus on client education about canine infectious disease, especially H3N2, emerged in response to outbreaks. H3N2 outbreaks had substantial impacts on veterinary practice finances, daily routines and staff morale, and was associated with enhancements in vaccination, biosecurity and client education protocols.

1. Introduction

Evolution of the segmented genome of avian influenza viruses through viral mutation, recombination, and reassortment have been responsible for the emergence of novel viral variants, enabling species barriers to be crossed and resulting in epidemic waves in a broad range of susceptible new hosts (Su et al., 2015, 2017). Previously reported only in China, Thailand and South Korea, canine influenza virus (CIV) A H3N2 of avian origin was first identified in Chicago, IL, USA in March, 2015 (Newbury et al., 2016). Upper respiratory tract signs were initially identified in pet dogs that had been exposed to H3N2 in community settings such as veterinary hospitals, boarding facilities, day care and training facilities (Newbury et al., 2016). The virus spread rapidly throughout the Midwest and across the USA, and thousands of dogs have since been confirmed positive (AVMA, 2017; IDEXX, 2017).

This is the second CIV-A virus circulating in the USA, the first being H3N8 of equine origin, which was identified in racing greyhounds in 2004 (Crawford, 2005).

Recently, there have been widespread anecdotal reports of financial repercussions for veterinary practices affected by H3N2 outbreaks, but data have not been collected to quantify these effects. The objective of this study was to document and analyze the impacts on veterinary practices affected by H3N2 outbreaks using data collected from an online questionnaire.

2. Materials and methods

2.1. Questionnaire

Email invitations to participate in the study were sent to 30

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Table 1

Summary data describing practice size and size of associated boarding facilities at the time of the survey.

Practice #	Number of fulltime veterinarians	Approximate number of canine cases seen/week	Maximum boarding capacity
1	1	100	35
2	3	120	80
3	7	325	–
4	2	130	–
5	4	200	40

Table 2

Respondent-reported canine influenza virus (H3N2) data over the previous 12 months from veterinary practices studied ($n = 5$).

Question	Answer (number of practices; % all practices surveyed)
How many times did you experience an H3N2 outbreak over the last 12 months?	1 ($n = 3/5$) 2 ($n = 1/5$) 3 ($n = 1/5$)
In the most severe H3N2 outbreak your facility experienced over the last 12 months, how many dogs were affected?	8 ($n = 1/5$) 5 ($n = 3/5$) 4 ($n = 1/5$)
Were there any fatal cases of H3N2?	Yes ($n = 2/5$) No ($n = 3/5$)
If fatalities occurred, how many were there?	1 ($n = 2/5$)
How many cats were affected the H3N2 outbreaks you experienced?	0 ($n = 5/5$)

veterinary practices, each located within a 50-mile radius of major US cities that had experienced cases of H3N2. A 41-question confidential, online questionnaire (Qualtrics™; Appendix A, Supplementary material) was administered by a market research company (IPSOS Insight). The company targeted email invitations to practices in their veterinary panel located within a 50-mile radius of the following confirmed H3N2 outbreak areas: Atlanta GA, Chicago IL, and Austin, TX. Based on H3N2 outbreak maps (Cornell, 2017), invitations were also sent to veterinary panels in the following areas: Minneapolis MN, Charlotte NC, Cincinnati OH, and Philadelphia PA.

Once acceptances to our email invitations had been received, eligibility criteria for participating practices were applied as follows: (1) experienced an outbreak of H3N2 in dogs presented to the practice in the last 12 months; and (2) a predominantly ($\geq 70\%$) small animal caseload; and (3) the survey respondent was willing and able to provide practice financial data. An outbreak was defined as confirmed diagnosis of H3N2 by either PCR or serology in at least four dogs presented to the practice. The duration of each outbreak was defined as the time

Table 3

Direct self-reported impacts of canine influenza virus (H3N2) outbreaks in veterinary practices studied ($n = 5$).

	Number of practices affected	Cost range (\$)	Mean cost/practice (\$)	Median cost/practice (\$)	Mean cost/practice normalized by # fulltime veterinarians in each practice (\$)	Median cost/practice normalized by # fulltime veterinarians in each practice (\$)
Estimated lost foot traffic revenue ^a	2/5	200–700	450	450	364	364
Boarding facility closure ^b	3/5	2450–7500	4983	5000	2067	2450
Biocontainment costs	5/5	100–2500	768	340	336	50
Wage costs for overtime and additional staff	2/5	200–400	300	300	64	64
Treatment costs borne by practice	2/5	2700–3000	2850	2850	1838	1838
Total direct costs			9351	8940	4669	4766

^a Estimated lost foot traffic revenue included losses from cancelled appointments, appointments redirected to other veterinary hospitals during the outbreak, and reduced income from ancillary services.

^b Three of the 5 practices included in the study had boarding facilities.

between the initial identification of clinical signs, confirmation of diagnosis by PCR and/or serology and clinical resolution in all affected dogs. If there were multiple H3N2 outbreaks over time in a single practice, respondents were asked to confine their answers to the single H3N2 outbreak that involved the most dogs. Respondents were instructed to consider financial impact over a 21 day period from the start of the outbreak. Follow up phone interviews were conducted with hospitals as necessary to verify financial data and estimates.

Effects of H3N2 outbreaks were divided into: (1) direct financial impacts - costs of lost revenue, biocontainment, additional wages, and costs borne by the practice that were associated with the treatment of sick dogs; (2) indirect impacts - perceived effects of the outbreak that had potential financial effects that were not quantified numerically e.g. interruptions to daily practice operations, reputation loss, effects on staff morale and productivity; and (3) protocol responses - development of biosecurity and outbreak prevention protocols in response to an outbreak. For each participating practice, direct financial impact data was collected from the single H3N2 outbreak that involved the most dogs. For numeric data, summary statistics (n , %, range, mean, median) were calculated and for indirect effect data, written comments were reviewed and summarized.

3. Results

3.1. Eligible practices

Of 30 facilities invited to complete the online survey, 13 (43%) responded, representing veterinary practices in Atlanta GA, Chicago IL and Charlotte NC. Of those 13 practices, five met the study entry criteria; four were within 50 miles of Chicago IL (Practices #1, #3, #4 and #5) and one within 50 miles of Atlanta GA (Practice #2). Summary data about practice size and the size of associated boarding facilities (Practices #2, #3 and #5) are presented in Table 1. Table 2 shows summary H3N2 outbreak data from the five eligible practices. The duration of each outbreak was approximately 10 days.

3.2. Direct financial impacts

Table 3 presents details of the self-reported direct costs of the most severe H3N2 outbreak experienced in each eligible practice. Of the five eligible practices, three had boarding facilities. These three veterinary practices made the decision to close their boarding facilities during the outbreak. One of the three practices where boarding facilities were closed in response to an outbreak was closed to boarding intake for 3 weeks (total reported lost revenue potential \$5000).

The cost of biosecurity interventions covered a variety of inputs, including the purchase of protective clothing (gloves, gowns, supplies, specialized suits), clean up (waste disposal, footbaths/disinfectants)

Table 4
Self-reported indirect effects of canine influenza virus (H3N2) outbreaks in veterinary practices surveyed ($n = 5$).

Answer	Number of practices affected/number of practices surveyed
Interruption of daily practice operations	5/5
Vaccination against H3N2 instituted as a core vaccination or mandatory before boarding	3/5
Heightened awareness of H3N2 resulting in increased client education	2/5
Damage to reputation	1/5
Staff morale	1/5
Staff turnover	0/5
Reduced staff productivity because of longer appointment times and increased demands for client communication/phone calls	2/5
Expressed concern regarding capacity to contain and resolve outbreak and unforeseen consequences	1/5
No indirect effects perceived/reported	0/5

and the creation of H3N2 isolation wards and treatment areas. There were also instances where practices repurposed other parts of the practice for the management of CIV cases. For example, in one clinic, the intensive care unit was converted into an isolation ward, in another, affected pets were boarded in isolation and had separate food and water bowls from the rest of the practice, with attending technicians required to wear protective clothing, gloves and shoe covers which had to be disposed of separately after use. Facility adaptation and protocol changes were also implemented in other ways, such as repurposing existing infectious disease containment areas and instituting new biosecurity protocols.

One practice paid for non-critical care treatment of four client-owned dogs and critical care treatment for one clinic dog; the second practice paid for non-critical care of eight client-owned dogs. Both practices had boarding facilities. Respondents from the first practice reported that critical care costs were approximately \$1200 for the clinic dog. In these practices, treatment duration was approximately 3 days for non-complicated cases of CIV and the costs of materials were estimated at \$125/case.

3.3. Indirect impacts

Survey responses to the question ‘*What were the indirect impacts of the H3N2 outbreak?*’ are summarized in Table 4. All practices reported interruption of daily practice operations and 2/5 practices reported reduced staff productivity because of longer appointment times and increased demands for client communication/phone calls. Other indirect impacts reported included reputation loss, reduced staff morale and concerns regarding the capacity of the practice to contain and resolve outbreak and unforeseen consequences of the outbreak. Increased staff turnover was not reported.

3.4. Protocol responses

The most common protocol responses to H3N2 outbreaks reported by survey respondents included increased awareness of H3N2; increased recommendation and use of vaccination against H3N2, including requirement for H3N2 vaccination for boarding dogs; and more frequent discussion of H3N2 and CIV with dog owners during routine visits. Of the five practices studied, three changed their vaccination protocols after the outbreak and two expressed heightened awareness of the H3N2 risk to their practice. Two of the three practices that changed their vaccination protocols instituted vaccination against H3N2 as a core vaccination (i.e. recommended for all dogs meeting label requirements for the vaccine) for all canine patients, and the other practice discontinued allowing dogs to enter their boarding facility

until a full primary series against H3N2 had been completed. In the two practices that reported increased awareness of H3N2 risk, respondents reported that more time was spent on educating clients about risks, clinical signs and prevention of CIV.

4. Discussion

This study was designed to rapidly estimate the self-reported financial and indirect impacts of real-life H3N2 outbreaks on veterinary practice. Bearing in mind that the sample was small, yet diverse, the range and scale of the self-reported financial impacts described in this study reveal important new information. Our study quantified self-reported financial losses and then described financial impacts and occasional financial benefits (without quantifying them) attributable to an infectious disease outbreak, as seen from the perspective of a veterinary practice. Importantly, an awareness of the potential for disease outbreaks to affect veterinary practice finances could help veterinarians and practice managers manage financial risk by prioritizing prevention strategies, such as infection control and routine vaccination protocols.

Because of the variability in both practice size and location represented by our survey practices, our report focused on the most commonly reported areas of impact. For this reason, compelling accounts such as absorption of treatment costs as reported by one practice, and gains in revenue as reported by another were excluded in reporting the self-reported practice level financial impacts. However, follow up interviews did provide more nuanced insights into the financial effects of H3N2 outbreaks. This feedback supported our methodology, which combined an online questionnaire and in-person telephone interviews, and yielded an interpretable picture of the impact of H3N2 outbreaks on veterinary practices.

The indirect impacts of H3N2 outbreaks appeared primarily driven by staff concerns about interruptions to the daily practice routine, with accompanying reductions in perceived productivity and reputation loss. Respondents also expressed anxiety about balancing the need to examine increasing numbers of suspect cases with the associated risks to biosecurity, and their capacity to cope if the outbreak escalated. While some veterinary hospitals limited their risk by choosing not to treat CIV cases as inpatients, others instituted strict biosecurity protocols. Respondents reported that these indirect impacts of H3N2 outbreaks undermined staff morale, but it is perhaps noteworthy that none reported associated staff losses. However, situations that are perceived by staff to be temporary, even if their effects are severe, such as infectious disease outbreaks, are probably unlikely to precipitate changes such as resignation from the practice.

It was clear that the H3N2 outbreaks as experienced by the veterinary hospitals surveyed led to process changes, such as the development of new biosecurity and vaccination protocols. Further, there was a renewed focus on client education about infectious disease control, especially H3N2. It could be argued that while these changes may be costly in the short-term, they may bring about long-lasting improvements in the quality of care and service provided to both patients and pet owners.

5. Study limitations

In this study, an outbreak was defined as confirmed PCR or serologic diagnosis of H3N2 in at least four dogs. Since not every clinical case presented to veterinary practices receives confirmatory diagnostic testing, outbreaks might not always have been recognized, and when they were recognized, their magnitude might have been underestimated. This could have led to under-estimates of the effects of H3N2 outbreaks on practice finances. This pilot study also had a relatively small sample size, which limited its generalizability. Additionally, limitations were associated with the retrospective nature of data collection and the reliance in on self-reported financial estimates, especially regarding lost foot traffic and increased wages to cope with

increased workload/reduced productivity. To reduce the chance of inaccuracies in these estimates, we conducted follow-up phone interviews with each practice to verify them, but they remain self-reported estimates. Additionally, because annual revenue data was not available in this pilot study, the scale of financial impact on an individual practice financial level could not be calculated. However, data reflecting practice size was collected, such as number of fulltime veterinarians, number of canine cases seen/week and maximum boarding capacity for those with boarding facilities, and financial data was normalized by number of fulltime veterinarians in Table 3, to enable some scaling of financial impacts. While collection of total practice revenue data is recommended for future studies, so that financial effects can be calibrated against practice size, this initial report is the first to provide an insight into the potential costs of an infectious disease outbreak in small animal veterinary practice. It is also possible that there were unrecognized and unrelated factors that affected practice finances during the outbreaks, such as seasonal income fluctuations, which could have acted as potential confounders. Larger comprehensive prospective studies investigating veterinary practice gross financial trends and relating them to demographics (e.g., veterinarian:staff ratios, veterinary team:client ratios and local market share), seasonal variations, practice growth and changes in management protocols, using quantitative and qualitative impact analysis tracking, are necessary to accurately understand the financial impacts of infectious disease outbreaks on veterinary practices.

6. Conclusions

This study demonstrated that an H3N2 outbreak can have a substantial effect on veterinary practice finances. Perceived reputation loss was manifested as client concerns about the potential risk of exposure to H3N2, resulting in cancelled appointments and avoidance of elective or ancillary services typically offered by the veterinary practice. Additionally, costs were incurred in essential outbreak responses, such as biosecurity materials and protocols, provision of quarantine and isolation areas, and extra wage costs to handle increased caseload.

Business was lost (at least in part) because of temporary redirection of clients to other veterinary practices and closure of boarding facilities. Outbreak responses included expanding vaccination protocols to include vaccination against CIV and increased emphasis on client education about CIV.

Conflict of interest

The authors are both fulltime employees of Zoetis LLC. They declare that they have no other financial or profession conflicts of interest that might inappropriately influence this paper.

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