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Characterizing zoonotic disease detection in the United States: Who detects zoonotic disease outbreaks & how fast are they detected?

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Summary There have been many calls for improved detection of zoonoses; research has not yet characterized zoonotic disease detection in the United States, in humans or animals. This research reviewed ''who detects'' zoonotic disease outbreaks and ''how fast'' they are detected. Definitions were operationalized based on existing literature and current practice. An outbreak database was created from publicly available records: Morbidity and Mortality Weekly Reports and ProMed-Mail. Univariate and bivariate statistics—including chi-square tests, Kruskal—Wallis tests, and Dunn's method were used for analysis. From an $n = 101$, results showed that laboratories (human health) detected 32.7% ($n = 33$) of the outbreaks; physicians/clinicians (human health) detected 18.8% ($n = 19$). The median time to was 13 days; mean was 31.7 (range = 0—492). There was a relationship between the type of the entity (laboratory, practitioner, or state agency) and how fast the outbreak was detected; state agencies were slower in detection. There was also a significant relationship between how fast an outbreak was detected and whether the outbreak occurred in multiple regions. This research provides important empirical evidence regarding U.S. zoonotic disease outbreak detection, highlighting the difficulty in rapid detection of multi-state outbreaks and the need for rapid, sensitive diagnostic testing and astute practitioners.
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Introduction

Zoonotic diseases are a significant threat to public health; approximately half of the 1700 pathogens that are known to infect humans are zoonoses [1,2]. However, the different states in the United States have widely varying requirements and capabilities for zoonotic disease outbreak detection and reporting [3—5]. Both public and private stakeholders have argued that improved zoonotic disease outbreak detection is critically important, and a systematic, federal integration of veterinary and human disease surveillance and reporting should be considered [6—8]. The existing literature has not yet presented empirical evidence describing the current characteristics of disease outbreak detection in the United States specifically for zoonoses.

This research, which is based on a database of disease outbreaks constructed by reviewing the publicly available literature from 1998 to 2008, empirically analyzed the characteristics of zoonotic disease outbreaks in the United States. In particular, it focused on who detected these outbreaks, how fast they were detected, and the relationship between these variables. Similar research has been conducted [9—11], but prior analyses have not specifically focused on zoonotic diseases or described the relationship between who detected the outbreak and the speed of detection.

Because of the disconnect between animal health and public health disease detection systems [6—8], as well as capability and policy differences between the states in the United States [5], this type of information is critical to obtain a better understanding of the factors that may delay zoonotic disease outbreak detection and thereby potentially threaten public health. The results presented in this manuscript provide empirical descriptive and quantitative information about the actual practice of zoonotic disease detection in the United States, and the results may inform public policy.

Methods

Identifying zoonotic diseases of interest

To identify zoonotic diseases of interest, three primary lists were consulted: the U.S. Centers for Disease Control and Prevention (CDC) Nationally Notifiable Disease List (all diseases that affect humans); the World Organization for Animal Health (OIE) Reportable Disease List (all diseases that affect animals); and a U.S. Department of Agriculture (USDA) list of wildlife disease agents of concern (all diseases that affect wild animals). All non-zoonotic diseases were immediately removed from the potential pool.

Subsequently, the following process was followed. First, any zoonotic disease listed on both the CDC and the OIE list was included. Second, any zoonotic disease listed on the USDA list and the CDC list was included. Third, all zoonoses from the CDC Category A, B, and C Bioterrorism Agents/Diseases list were included [12]. Fourth, peer-reviewed literature was evaluated to capture additional relevant diseases from a public health security perspective (i.e., those with concerning transmissibility characteristics or mortality rates, such as Ebola). Fifth, zoonotic diseases that scientists agree are not a threat to public health (such as vesicular stomatitis) were excluded. Sixth, a physician with specific expertise in zoonoses from The George Washington University Medical Center reviewed the tentative list and recommended 13 additional diseases, 8 of which were from the CDC Nationally Notifiable Disease List, that should be included.

Forty-one zoonoses of interest were ultimately identified (Table 1); these diseases were considered to be the most relevant from a biological, health security, and policy standpoint. Although some of the diseases on the list had never been detected in the United States, because of rapid travel, trade, transport and the documented permeability of international borders, these diseases were included.

Creating an outbreak database

The database was created in Excel, and drop-down menus with discrete choices were used to prevent coding errors.

Data sources

The data were collected from publicly available literature dated from 1998 to 2008. This date range was selected for two reasons: first, an extended period was required to ensure a sufficient sample size for statistical analysis, and second, modifications occurred to the U.S. CDC National Outbreak Reporting System in 2009, which resulted in significant changes to the scope and level of enteric disease outbreak reporting [13]. As such, the date range was truncated at 2008 to improve the validity of the results.

Federal-level data were used because disease outbreaks may cross jurisdictions and state reporting requirements vary for animals and humans [3—5]. Outbreaks that originated outside the United

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