

# AGE-SPECIFIC INFECTION AND DEATH RATES FOR HUMAN A(H5N1) AVIAN INFLUENZA IN EGYPT

J P Dudley (joseph.p.dudley@saic.com)<sup>1</sup>

1. Science Applications International Corporation, Modeling and Analysis Division, Rockville, Maryland, United States

The age-specific infection and death profiles among confirmed human cases of influenza A(H5N1) infection in Egypt differ markedly from those recorded in other countries. The case fatality rate among human H5N1 cases in Egypt is 34%, versus an average of 66% in other countries. In Egypt, children younger than 10 years comprise 48% of reported cases, nearly twice the global average of approximately 25%, and no H5N1 fatalities have been confirmed among individuals in this age group as of 23 April 2009. Females outnumber males among confirmed H5N1 cases by a factor of nearly 2:1, and 90% of reported fatalities in Egypt have been females. The evident age and sex biases in morbidity and mortality among H5N1 cases in Egypt are phenomena that warrant further investigation and analysis.

### Introduction

The first cases of human infection with avian influenza type A(H5N1) were reported from Egypt in March 2006, and a cumulative total of 67 confirmed cases including 23 fatalities have been reported as of 23 April 2009 [1]. There are evident anomalies in the age distribution and sex ratio of human mortality from influenza A(H5N1) in Egypt relative to those reported from other countries that warrant detailed investigation and analysis.

### Methods

Published information on human H5N1 cases in Egypt was analysed to develop a first order comparative analysis of age-specific and sex-specific infection and mortality patterns between human H5N1 cases in Egypt and those in other areas of the world. The age and case history data of patients with confirmed influenza A(H5N1) infection in Egypt used in this analysis were derived from reports published by the United States Naval Medical Research Unit No. 3 in Cairo, Egypt [2] and the World Health Organization (WHO), available as of 23 April 2009 [1].

### Results

Human H5N1 cases in Egypt are most frequently reported among children younger than 10 years, and approximately 80% of all reported cases have occurred among individuals under the age of 30 years. In Egypt, children under the age of 10 years comprise 48% of all reported cases, nearly double the current global average of approximately 25% [3]. A median age of eight years has been reported for human H5N1 cases in Egypt between March 2006 and March 2009 [2], versus a median age of 18 years for WHO-confirmed human cases globally between November 2003 and November 2006 [4].

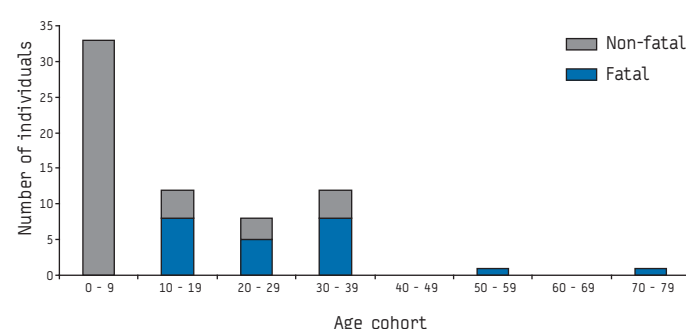
The age-specific infection and death profiles among confirmed human A(H5N1) cases in Egypt (Figure 1), differ markedly from those recorded in Asia and Indonesia when compared to cumulative data for countries worldwide other than Egypt, Nigeria, and Turkey (Figure 2). The case fatality rate from human H5N1 cases in Egypt confirmed as of 23 April 2009 is only 34% (23 of 67), versus an average of 66% among WHO-confirmed cases from all countries other than Egypt (234 of 354 cases as of 23 April 2009) [5].

Human mortality from H5N1 in Egypt is highly biased towards females (90%: 21 females, two males), with confirmed mortality only reported among individuals older than nine years. Although the sex ratio of cases in most countries is approximately 1:1, females outnumber males among confirmed cases in Egypt by a factor of nearly 2:1 (43 females:24 males). Although the average case fatality rate from H5N1 among children aged 0-9 years from all countries other than Egypt and Turkey is 59%, no confirmed fatalities among 33 children in this age cohort have been reported from Egypt as of 23 April 2009. A similar pattern is evident for H5N1 cases in Turkey during January 2006; although 11 of 21 confirmed H5N1 cases in Turkey were children in the age group 0-9 years, no confirmed fatalities were reported in this age cohort [6].

### Discussion

There is increasing concern that undetected H5N1 cases may be occurring in Egypt, given the evident anomalies in observed age-specific and sex-specific case incidence and fatality rates. Although there appears to be no compelling evidence for human-to-human

**FIGURE 1**  
Human influenza A(H5N1) cases by age and outcome, Egypt, March 2006 - April 2009 (n=67)



transmission of H5N1 in Egypt, family clusters have been observed in Egypt, and H5N1 clusters involving highly probable human-to-human transmission have been documented in China, Thailand, Vietnam, Indonesia, and Pakistan [7].

The most characteristic presentation of humans with fatal H5N1 virus infections is severe lower respiratory disease accompanied by hypercytokinaemia of the alveolar tissues. The pathology of most fatal H5N1 cases resembles those of fatal human severe acute respiratory syndrome (SARS) infections, and a suspected SARS case in China during November 2003 was subsequently confirmed as a fatal H5N1 case [8].

The existing anomalies with regard to age and sex may be attributable in part to the existence of undetected fatal or non-fatal atypical or asymptomatic human H5N1 infections. Although human infections with the H5N1 virus are typically associated with respiratory symptoms, the clinical spectrum of H5N1 infections in humans is extremely broad, and H5N1 virus has been recovered from lung, brain, large intestine, small intestine, cerebrospinal fluid, kidney, spleen, liver, pharynx, blood, and placental tissues [9]. Fatal atypical human H5N1 infections involving only gastrointestinal and neurological symptoms have been documented from patients in Vietnam and Thailand [10]. Asymptomatic human infections with H5N1 have been reported from China, Vietnam, Japan, Thailand, and Korea [11].

Clinically mild illness from highly pathogenic avian influenza (HPAI) H5N1 virus infection has been reported from children in most countries, but the early detection and treatment of possible cases may be a factor in the overall lower case fatality rate reported for H5N1 cases in Egypt. Although a median time of four days from symptom onset to hospitalisation has been reported for H5N1 cases worldwide [4], nearly 50% of confirmed cases in Egypt are admitted to hospitals within 24 hours after the first onset of symptoms, and approximately 70% are hospitalised within 72 hours after symptom onset [2].

### Conclusions

The evident age and sex biases in the incidence of infection and mortality among H5N1 cases from Egypt are phenomena

that have not been fully explained, and merit further in-depth investigation and analysis. Further research is needed to understand the immediate and long-term health risks of avian influenzas for human populations, and to identify those members of exposed populations who are at greatest risk of infection and serious disease from avian influenza viruses. Although most cases in Egypt can be linked to contact with diseased poultry, increasing numbers of confirmed human H5N1 cases with no evident history of direct exposure to diseased poultry or birds are being reported from China and Indonesia. Efforts need to be made to evaluate potential background rates of asymptomatic and mild cases of human avian influenza in communities where human H5N1 clusters have been documented, and to evaluate potential instances of human-to-human transmission of H5N1 in Egypt.

### References

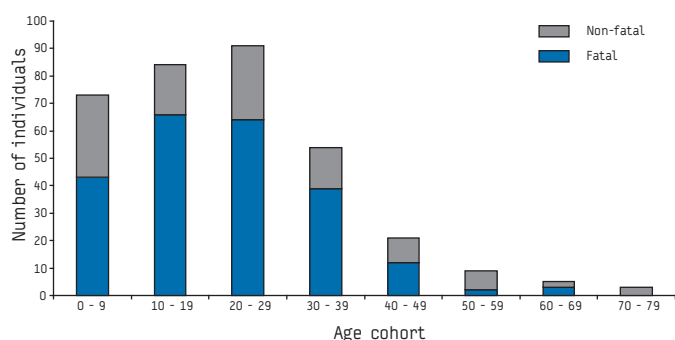
- World Health Organization. Epidemic and Pandemic Alert and Response (EPR). Disease outbreaks by country. Egypt. Geneva: World Health Organization; 2009 Apr 23. Available from: [http://www.who.int/csr/don/2009\\_04\\_23a/en/index.html](http://www.who.int/csr/don/2009_04_23a/en/index.html)
- United States Naval Medical Research Unit No. 3. Influenza Activities Report. February–March 2009. Egypt. Available from: [http://www.geis.fhp.osd.mil/GEIS/SurveillanceActivities/Influenza/Reports/NAMRU3\\_March\\_2009.pdf](http://www.geis.fhp.osd.mil/GEIS/SurveillanceActivities/Influenza/Reports/NAMRU3_March_2009.pdf)
- World Health Organization Western Pacific Regional Office. Avian Influenza A(H5N1) Cases by Age Group and Outcome. Geneva: World Health Organization Western Pacific Regional Office; 2009 Mar 23. Available from: <http://www.wpro.who.int/NR/rdonlyres/FD4AC2FD-B7C8-4A13-A32C-6CF328A0C036/0/Slide4.jpg>
- Peiris JSM, de Jong MD, Guan Y. Avian influenza virus (H5N1): a threat to human health. *Clin Microbiol Rev.* 2007;20(2):243-67. Available from: [http://cmr.asm.org/cgi/content/full/20/2/243#Transmission\\_and\\_Epidemiology](http://cmr.asm.org/cgi/content/full/20/2/243#Transmission_and_Epidemiology)
- Epidemic and Pandemic Alert and Response (EPR). Cumulative Number of Confirmed Human Cases of Avian Influenza A(H5N1) Reported to WHO. Geneva: World Health Organization; 2009 Apr 23. Available from: [http://www.who.int/csr/disease/avian\\_influenza/country/cases\\_table\\_2009\\_04\\_23/en/index.html](http://www.who.int/csr/disease/avian_influenza/country/cases_table_2009_04_23/en/index.html)
- World Health Organization. Epidemic and Pandemic Alert and Response (EPR). Disease outbreaks by country. Turkey. Available from: [http://www.who.int/csr/don/2006\\_01\\_18/en/index.html](http://www.who.int/csr/don/2006_01_18/en/index.html)
- Nicoll A. (Yet) another human A/H5N1 influenza case and cluster – when should Europe be concerned? *Euro Surveill.* 2008;13(15):pii=18833. Available from: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=18833>
- Zhu QY, Qin ED, Wang W, Yu J, Liu BH, Hu Y, et al. Fatal infection with influenza A (H5N1) virus in China. *New Engl J Med.* 2006;354(25):2731-2. Available from: <http://content.nejm.org/cgi/content/full/354/25/2731>
- Ng WF, To KF. Pathology of human H5N1 infection: new findings. *Lancet* 2007;370(9593):1106-8.
- de Jong MD, Hien TT. Avian influenza A (H5N1). *J Clin Virol.* 2006;35(1):2-13. Available from: [http://www.prbo.org/cms/docs/birdflu/deJong\\_and\\_Hien\\_2006\\_J%5B1%5D\\_Clinical\\_Virology.pdf](http://www.prbo.org/cms/docs/birdflu/deJong_and_Hien_2006_J%5B1%5D_Clinical_Virology.pdf)
- Dudley JP. Public health and epidemiological considerations for avian influenza risk mapping and risk assessment. *Ecology and Society* 2008;13(2):21. Available from: <http://www.ecologyandsociety.org/vol13/iss2/art21/>

This article was published on 7 May 2009.

Citation style for this article: Dudley JP. Age-specific infection and death rates for human A(H5N1) avian influenza in Egypt. *Euro Surveill.* 2009;14(18):pii=19198. Available online: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19198>

FIGURE 2

### Human influenza A(H5N1) cases by age and outcome world total, November 2003 - March 2009 (n=340)\*



\*WHO data as of 23 March 2009, world total excluding cases in Egypt, Nigeria, and Turkey [3].