

No evidence of infection with avian influenza viruses among US poultry workers, Delmarva Peninsula

Jessica H. Leibler¹, Ellen K. Silbergeld¹, Andrew Pekosz², and Gregory C. Gray³

¹ Department of Environmental Health Sciences; ² Department of Molecular Microbiology and Immunology, Johns Hopkins Bloomberg School of Public Health

³ Department of Epidemiology and International Programs, College of Public Health University of Iowa

Abstract

Industrial poultry workers may be at elevated risk of avian influenza infection through occupational pathways due to intense contact with poultry and limited use of personal protective equipment. We sought to determine if poultry workers in the Delmarva Peninsula, one of the densest regions of poultry production in the United States, had evidence of seroconversion to avian influenza viruses circulating in poultry. We analyzed serum samples from 24 poultry workers and 75 community members in the Delmarva Peninsula for antibodies to avian influenza strains H4N6, H5N2, H6N2, H7N2 and H9N2 using microneutralization assays. Serum samples were also analyzed with hemagglutination inhibition assays for antibodies to human influenza A H1N1 and H3N2 viruses. No evidence of seroconversion to the avian influenza subtypes included in our study was found. We observed high rates of seroconversion to human influenza subtypes in both poultry worker and community groups, with no significant difference in seroconversion rates between the two populations. The lack of infection among industrial poultry workers in the Delmarva Peninsula suggests inefficient viral transmission from poultry to humans or the absence of virus in these premises at the times preceding our sample collections.

Introduction

While much research on avian-to-human influenza transmission focuses on small-scale poultry producers, evidence of risk among the industrial poultry workforce is inconclusive. Studies of avian influenza (AI) transmission between poultry and workers in industrial facilities are limited, due in part to the perception that industrial poultry facilities are biosecure. Some studies indicate that industrial poultry workers are not infected during the course of work [1] and that background AI seroprevalence is low [2]. Other studies have found that working in industrial poultry is an important risk factor for human infection with AI, both following reported outbreaks in poultry [3] and independent of reported outbreaks [4]. While outbreaks of low pathogenic AI (LPAI) occur periodically in the US, little is known about AI exposure or seroconversion among poultry workers in the United States.

The Delmarva Peninsula is one of the densest regions of broiler production in the US, with five counties among the top 50 in the country for sales in 2007 and home to the county with the highest production in the US, Sussex County, DE. Four major integrators (Perdue, Tyson, Mountaire and Allen Family Foods) operate 10 processing plants in Delmarva and contract with over 1,500 growers. Market value of poultry produced in Delmarva exceeds \$2.7 billion in 2007 (USDA Census of Agriculture).

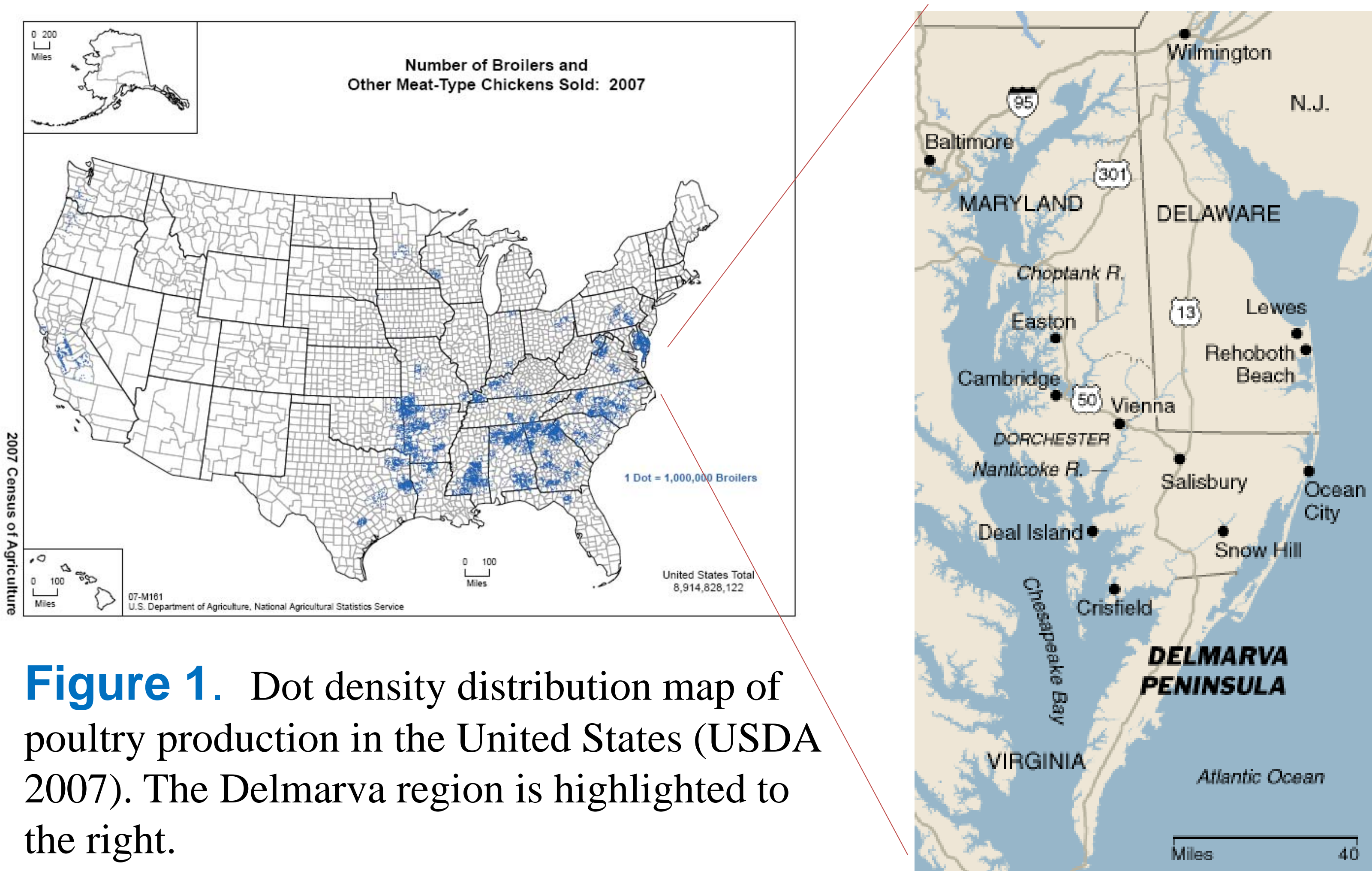


Figure 1. Dot density distribution map of poultry production in the United States (USDA 2007). The Delmarva region is highlighted to the right.

Methods

Study design: This study was a convenience sample of poultry workers and community residents in the Eastern Shore region of Maryland and Virginia in 2003 and 2005. Self-identified poultry workers completed a face-to-face questionnaire about the nature of poultry work [5]

Serology: Hemagglutination inhibition assays were used to analyze serum samples for antibodies to human influenza A viruses A/New Caledonia/20/99 (H1N1) and A/Panama2007/99 (H3N2). Microneutralization assays adapted from Rowe et al. (1999) [6] were used to detect antibodies to AI strains believed to be representative of those circulating in poultry the US: A/Duck/Cz/1/56 (H4N6), A/Chucker/MN/14591-7/98 (H5N2), A/Turkey/MA65 (H6N2), A/Turkey/VA/4529/02 (H7N2), and A/Turkey/MN/38391-6/95 (H9N2).

Fertilized eggs were used to grow AI viruses for microneutralization assays. Sera were screened at a dilution of 1:10, under the expectation of low titers.

Results

No evidence of seroconversion among poultry workers or community residents to the AI subtypes included in our study was observed. No individual within our sample had titers to any of the AI subtypes at dilutions greater than 1:10, implying a lack of infection with these viruses.

We observed high rates of seroconversion to human influenza subtypes in both the poultry workers and community residents with no differences in seroconversion rates to the human influenza viruses between these subgroups (Table 1).

Table 1. Number and percentage of subjects with observed antibody titers to human influenza A viruses, by strain and titer level*

	Human H3N2 (Influenza A/Panama2007/99) (%)	Human H1N1 (Influenza A/ New Caledonia/20/99) (%)
Poultry workers (n=24)		
Geometric mean titer	1:40	1:40
Community residents (n=75)		
Geometric mean titer	1:40	1:80

* No titers were observed among any subjects at levels higher than 1:5 for avian influenza viruses A/Duck/Cz/1/56 (H4N6), A/Chucker/MN/14591-7/98 (H5N2), A/Turkey/MA65 (H6N2), A/Turkey/VA/4529/02 (H7N2), and A/Turkey/MN/38391-6/95 (H9N2). No statistically significant differences were observed between poultry workers and community residents in terms of human influenza titers.

Table 2 Select demographic and socioeconomic characteristics of study population

	Number of subjects (N=99)	Mean age (min, max)	Number of men (%)*	Non-white (%)*	High school education or less (%)	No health insurance (%)
Poultry workers	n=24	45 (29,60)	22 (91.6)	18 (75)	19 (79.2)	7 (29.2)
Non-poultry workers	n=75	45 (18,60)	33 (44.0)	40 (53.3)	42 (56.0)	24 (32.0)
Total	N=99	45 (18,60)	55 (55.0)	58 (77.3%)	61 (61.6)	31 (31.1)

* Statistically significant differences between poultry workers and non-poultry workers at p<0.05.

Discussion

Our findings indicate that poultry workers and community residents in the Maryland and Virginia areas of the Delmarva Peninsula were not infected with AI viruses prior to our sample collections in 2003 and 2005.

The most likely explanations for our results are that the workers in our study were either not exposed to AI viruses because none were present in their occupational environments, or that the viruses to which they were exposed were incapable of infecting humans.

It is feasible that the workers were not exposed to AI viruses because there was no AI virus present in the poultry houses prior to serum collection. Our knowledge of AI outbreaks before 2006 is limited due to weak reporting requirements in the US, so we are unable to document the presence of virus in poultry houses at times preceding our study.

Due to low levels of reported use of protective equipment, it is improbable that the use of safety equipment prevented infection following exposure.

It is possible that slight antigenic differences between the AI viruses used in the HAI assay and the viruses circulating in the poultry (antigenic drift variants) could result in false negative readings, although this explanation is unlikely.

Greater and continued attention to the serological status of poultry workers is of vital importance. Prospective studies of industrial poultry worker populations are required to monitor this critical animal:human interface in the United States, and therefore should be a central component of pandemic prevention strategies.