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Critical control points for avian influenza A H5N1 in live bird markets in low resource settings

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ABSTRACT

Live bird markets can become contaminated with and become a source of transmission for avian influenza viruses including the highly pathogenic H5N1 strain. Many countries affected by the H5N1-virus have limited resources for programs in environmental health, sanitation and disease control in live bird markets. This study proposes five critical control points (CCPs) to reduce the risk of H5N1-virus contamination in markets in low resource settings. The CCPs were developed based on three surveys conducted in Indonesia: a cross-sectional survey in 119 markets, a knowledge, attitudes and practice survey in 3 markets and a microbiological survey in 83 markets. These surveys assessed poultry workflow, market infrastructure, hygiene and regulatory practices and microbiological contamination with the H5N1-virus. The five CCPs identified were (1) reducing risk of receiving infected birds into the market, (2) reducing the risk of virus spread between different bird flocks in holding cages, (3) reducing surface contamination by isolating slaughter processes from other poultry-related processes, (4) minimizing the potential for contamination during evisceration of carcasses and (5) reducing the risk of surface contamination in the sale zone of the market. To be relevant for low resource settings, the CCPs do not necessitate large infrastructure changes. The CCPs are suited for markets that slaughter poultry and have capacity for daily disposal and removal of solid waste from the market. However, it is envisaged that the CCPs can be adapted for the development of risk-based programs in various settings.

1. Introduction

In many countries, food markets are an integral part of the community – providing foods that reflect the local culture and traditions of the people as well as serving as a commercial and social centre. Food markets that offer bird carcasses as well as live birds either for sale or for slaughter are collectively referred to as live bird markets (LBMs) (World Health Organization, 2006b).

LBMs provide major contact points between people and animals, creating optimal conditions for the zoonotic transfer and evolution of infectious disease pathogens. LBMs are known to amplify and disseminate the highly pathogenic avian influenza A H5N1 (AI H5N1) virus (Kung et al., 2007). Studies have shown that AI H5N1 can be found in birds as well as on work surfaces in LBMs (Desvaux et al., 2006; Santhia et al., 2009; Wang et al., 2006). There is also evidence that humans have been infected with AI H5N1 in LBMs (World Health Organization, 2006a; Zhou et al., 2009). AI H5N1 virus infection in humans is of public health concern; the zoonotic disease has a high case fatality rate, and the virus has pandemic potential if it mutates into

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a form that transmits rapidly between humans (Kandun et al., 2006; Webster et al., 2005).

Most guidance on AI H5N1 recommends controlling the disease "at source" – that is, in the birds (Food and Agriculture Organization, 2009). Controlling AI H5N1 virus in LBMs is critical to prevent the dissemination of the virus back into farms and backyard bird holdings which can occur through movement of live birds, infective poultry by-products and fomites (Santhia et al., 2009). However, complete elimination of the virus from LBMs is not realistic if the farms supplying the LBMs continue to have outbreaks of AI H5N1 (Mullaney, 2003). Therefore, the goal in LBMs in areas endemic for the virus is to reduce the risk of contamination that may lead to human infection and continued circulation of the virus in birds.

Risk-based programs relate hazards to public health outcomes (Simjee et al., 2007). Risk-based programs have been used to control avian influenza viruses in LBMs (Kung et al., 2003; Mullaney, 2003). LBMs implementing such programs have been in high resource settings where there is good public health regulation and pre-requisite programs (PRPs) for general hygiene. PRPs are practices and conditions needed prior to and during implementation of risk-based programs such as good management, training and equipment (World Health Organization, 1999). In addition to PRPs, risk-based programs usually involve critical control points (CCPs) for managing hazards. CCPs are steps at which control can be applied and are essential to reduce, prevent or eliminate a hazard to an acceptable level (Codex Committee on Food Hygiene, 1997).

In high resource setting, risk-based programs in LBMs involve cleaning and disinfection activities as well as periodic rest days, for which impact is monitored through microbial surveillance (Kung et al., 2003; Mullaney, 2003; Trock et al., 2008). Risk-based programs would be difficult to implement in many countries affected by AI H5N1 due to limitations in resources and capacity, especially the availability of PRPs and an environment operating to good standards of hygiene. In such settings, disease control may be feasible if CCPs are not dependent on good infrastructure and capacity for PRPs.

Taking into account the limited capacity for PRPs, limited disease surveillance activities and low levels of public health regulation, this study aimed to identify CCPs for H5N1-virus control in LBMs in low-resource settings. The study was conducted in Indonesia – a low resource country that has been heavily affected by AI H5N1 (World Health Organization, 2010; World Organization for Animal Health, 2010).

1.1. Setting

There are an estimated 13,000 LBMs across the 17,000 islands of Indonesia (Raharjo, 2010). Many LBMs in Indonesia offer a variety of birds for slaughter and sale, including broilers, layers, village chicken, Muscovy ducks and geese. Birds coming into LBMs may be sourced from a variety of farms or backyard holdings, and may have travelled hundreds of kilometers from neighboring districts or provinces.

The bird area of an LBM in Indonesia generally has five zones: (1) bird delivery zone where trucks unload live birds, (2) bird holding zone which comprises cages or pens to house live birds, (3) bird slaughter zone where birds are killed, defeathered, eviscerated and dressed, (4) bird sale zone with display tables, and lastly, (5) waste management zone where remnants such as innards and feathers are discarded. In some LBMs, bird zones are combined. For example, small markets may have two or three bird vendors, where each operates a self-sufficient stall. In these stalls, live birds are held in cages placed under the work table, birds are killed on the floor or on the work table, a hot water barrel and a defeathering machine are used to scald and defeather the carcass and the internal organs are removed on a work table. The final products – whole bird carcasses or pieces of meat – are then displayed at the front of the stall on display tables made either of ceramic tiles, steel or wood covered with a plastic sheet.

2. Materials and methods

Since CCP identification relies on thorough knowledge of the workflow, the product and the hazard itself, three surveys were conducted. The three surveys assessed poultry workflow, infrastructure, regulatory practices and LBM contamination with the H5N1 virus. The findings from the surveys were then used to quantitatively summarize and synthesize the existing capacity for PRPs. The findings from the surveys and synthesis of PRP capacity in LBMs formed the basis of CCP identification. This multi-step process was critical to reduce the subjectivity associated with CCP selection. Methods for the (a) three surveys, (b) synthesis of PRP capacity, and, (c) CCP identification, are described in more detail below. Approval for the study was obtained from the Health Research Ethics Committee at the Indonesian Ministry of Health as well as the Australian National University Human Research Ethics Committee.

2.1. Cross sectional survey

A cross-sectional survey was conducted in 119 LBMs to assess infrastructure and hygiene practices. The 119 LBMs were selected from 17 districts in four provinces in Indonesia: Jakarta, West Java, Banten and South Sulawesi. Methods for selecting the 31 LBMs in Jakarta, 41 in West Java and 11 in Banten province have been described previously (Indriani et al., 2010). In South Sulawesi, all 36 LBMs in the provincial capital Makassar were included. The survey was conducted using a structured questionnaire with 33 close-ended questions. The questions were divided in five sections: (a) seven questions about general conditions in the market, (b) five questions about market infrastructure, (c) nine questions about poultry in markets, (d) five questions about poultry processing, and (e) seven questions about cleaning and disinfection. The interviews were conducted in Bahasa Indonesia by three interviewer teams who received one-day training in survey administration and documentation. Data were entered and descriptive statistics were calculated in Microsoft Excel® (Microsoft Corp., Redmond, WA, USA).