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ORIGINAL RESEARCH

Community preparedness for highly pathogenic Avian influenza on Bali and Lombok, Indonesia

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ABSTRACT

Introduction: The Asia–Pacific region is the likeliest location for the next significant outbreak of highly pathogenic avian influenza (HPAI). Indonesia has experienced HPAI H5N1 outbreaks in poultry and humans each year since 2003 and has had the highest case fatality rate for human cases. The purposes of this study were to capture the knowledge of avian influenza and of poultry-raising practices in two regions of Indonesia and to evaluate the impact and extent of activities undertaken to 2010 through the National Strategic Plan for Avian Influenza Control at the village level.

Methods: A combination of quantitative and qualitative methods was used to investigate the multiple influences on behaviours, decisions and actions taken by poultry-raising households, and by villages and communities, regarding the threat of HPAI. Between June 2010 and May 2011 a structured survey of 400 households was conducted on Lombok and of 402 on Bali, inviting Sector 3 (small-scale independent commercial poultry farms) and Sector 4 (village household) poultry raisers to participate. Focus groups and in-depth interviews were convened with key stakeholders, including livestock and animal health and public health officials, community leaders and villagers.

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Results: From the focus group and in-depth interviews, it appears that the flow of information through the national HPAI control program has been efficient at the top levels (from national to provincial, then to districts and subdistricts). However, these findings show that effective transmission of information from subdistrict to rural village level and from village leaders to community members has been limited. The degree of community preparedness for HPAI on Bali and Lombok appears minimal. Knowledge of government activities was more extensive at Bali sites, while only limited government programs and activities occurred at the village level on Lombok. Activities conducted by government agencies from provincial to village level were limited in scope and need to be further developed to ensure safe poultry-handling practices and biosecurity measures. On both Bali and Lombok, community respondents knew the signs and symptoms of sick birds but did not differentiate well between HPAI and other bird diseases. On both islands, more than 60% of respondents were reluctant to report sudden deaths of poultry. The lack of a government compensation program for destroyed flocks contributed to this unwillingness to report.

Conclusions: While the Indonesian government's planning efforts for HPAI are commendable, the plan has not been effective, as it depends on the cooperative actions of people with small rural farms who have not been consulted in the development of the plan, have not been adequately instructed on the nature of the plan, and perceive no benefits to themselves from prevention efforts. Context-appropriate mechanisms for communicating zoonotic risk and options for risk mitigation that do not result in net loss to poor households are also needed.

Key words: Asia, community preparedness, highly pathogenic avian influenza, influenza, pandemic, poultry.

Introduction

The Asia–Pacific region is considered the likeliest location for the epicentre of the next significant outbreak of highly pathogenic avian influenza (HPAI)[1,2]. Reasons for this include the ideal conditions in the region for infectious disease emergence, particularly of zoonotic disease, such as population growth, mobility, urbanisation, livestock intensification and changes to land use, plus the close proximity of high-density human and animal populations and ecological conditions conducive to enhanced mutation/host adaptation of agents including limited regulation of drug use[3]. The public health and health service infrastructure of many countries in this region is presently deemed inadequate to provide an effective response[2,4]. Adequate, high-quality laboratory facilities[5] and surveillance systems[6] proximal to outbreak origin are needed. Resources to plan for and respond to a pandemic in the region are being developed[7], but these efforts are still in relatively early stages.

The magnitude of the next major pandemic, in epidemiologic terms of pathogenicity, infectivity and virulence, cannot be predicted with any degree of certainty[8]. The likely effectiveness of interventions to mitigate the severity of disease, including social controls, is not well known. While transmission of HPAI (including H5 and H7 viruses) from poultry to humans to date appears infrequent[9], exposure and infection risks are evident[10], although still poorly understood[11]. Previous research in Indonesia has suggested that areas with primarily household poultry raising have a higher risk of HPAI outbreaks[12]. Since HPAI viruses cause systemic infection in chickens and replicate in respiratory and intestinal tracts, handling and slaughter of birds poses risk for human exposure, making safe poultry handling and slaughtering practices essential to prevent exposure[12-14]. The recent development of easily transmissible laboratory mutants in the Netherlands is of real concern regarding the pandemic potential of these viruses[15]. The dynamics of viral genetic variability[16] and the close proximity of poultry and humans, particularly in Asia, provide potential for increased risk of human pandemics[11]. Safe poultry handling practices are essential.

Regarding future highly pathogenic influenza epidemics, some near-certainties can be anticipated. South-East Asia is an area enzootic for HPAI, with continuing potential for spread from birds to humans[17]. The causative organism will be a novel variant virus, probably sourced from birds, that acquires an ability to transmit efficiently in humans[18]. There will be a crucial time lag before an effective vaccine can be formulated, manufactured and distributed[19]. Human factors will affect the spread of infectious disease[20]. Finally, public health and healthcare systems in affected areas will be severely overloaded during the acute phase or phases of the pandemic[21].

In the ongoing HPAI H5N1 pandemic that has had an impact on poultry systems across several continents, Indonesia is a notable infected country, having experienced HPAI (*flu burung* in Indonesian) outbreaks in poultry and humans each year since 2003, with the highest case fatality rate for human cases, at 83.2%[22]. Several features of the poultry industry and of community and government practice contribute to the endemic infection cycle in Indonesia[23]. Transportation and management of birds at local and regional Indonesian markets have been shown to lack recommended biosecurity measures, such as use of gloves and masks or prevention of sick birds from being sold in marketplaces[24,25]. Illegal transport (smuggling) of birds from non-infected to infected provinces is common and poorly controlled[25]. Pigs, which can serve as asymptomatic intermediate hosts, often have contact with poultry in village settings[26]. Government control efforts have been viewed as ineffectual[2,23,25,27] but improving[28]. Outbreaks of HPAI are devastating to a local economy[29].

This study reports on knowledge of avian influenza and of poultry-raising practices in two rural island regions of Indonesia, Lombok and Bali. This evaluation was carried out by an international inter-professional team on the impact and extent of activities undertaken to 2010 through the National Strategic Plan for Avian Influenza Contro, a three-part plan of goals, targets and strategies for HPAI control in Indonesia. The present research focused on three of the 10 main strategies: protection of high-risk groups (Strategy 3); epidemiological surveillance on animals and humans (Strategy 4); and risk communication, information and public awareness (Strategy 6)[30]. The task of rolling out programs such as this in Indonesia is complex, partly due to the geography of the archipelago and partly because of funding and governmental infrastructural issues such as decentralisation.

Methods

Study site/population

As regional contextual issues of cultural diversity should inform modifications to program activities to ensure relevance for local settings, the authors sought to investigate the level of HPAI focused activities and the learning gained from these on two islands in eastern Indonesia. Bali and Lombok, geographically adjacent islands both with reliance on tourism, were chosen, as they offered interesting similarities and differences. The poultry industry on both islands consists of only Sector 3 farms and Sector 4 poultry-raising households[31], the poultry sectors that are the focus of national poultry HPAI surveillance activities and of reported poultry cases since 2003–2004. However for HPAI occurrence, Bali, with probably endemic poultry infection, has experienced few human cases compared to Lombok, which until 2011 had few poultry cases and no human cases. Whilst similar to most of Indonesia, village poultry ownership is extensive on both islands, providing economic and nutritional benefits. On Bali, chickens and ducks are particularly important in daily life for Hindu religious practices, with birds of certain colours needed for different ceremonies[2].

Poultry raisers in Indonesia fall into one of four sectors as delineated by the Food and Agriculture Organization of the United Nations (FAO) classification scheme[14]. Sector 1 consists of large-scale commercial producers, Sector 2 of large independent producers, Sector 3 of small-scale independent commercial poultry farms (the largest sector in Indonesia) and Sector 4 of village households keeping

poultry. The present research focused on Sectors 3 and 4 on Bali and Lombok, Indonesia.

Study design

Two study sites were selected purposively on each island to include one small rural community that had experienced HPAI outbreaks, human and/or poultry (the affected site) and one community that had few or no poultry outbreaks, in order to identify any differences in knowledge and attitudes that might be attributed to experience with an outbreak. On Bali, the sites selected were a community that had experienced many HPAI poultry outbreaks and a human case – Negara Subdistrict (Jembrana District) – and one that had very few poultry cases – Manggis Subdistrict (Karangasem District). On Lombok, the two sites were one that had experienced HPAI outbreaks in poultry – Pringgasela subdistrict (East Lombok District) – and one community with no poultry outbreaks – Pujut subdistrict (Central Lombok District). They are referred to throughout as the affected and non-affected sites.

This research was conducted by an international inter-professional team[32] with members from veterinary science epidemiology, public health epidemiology, medical anthropology, paediatrics and immunology, medical practice, medical academia, agriculture economics and rural development. A combination of qualitative methods (focus groups and in-depth interviews) was used to investigate the multiple influences on behaviours, decisions and actions taken by poultry-raising households, and by villages and communities regarding the threat of HPAI.

Pilot studies were carried out on both islands, results of which were used to amend and refine the questionnaires and fine tune interview and focus group methods.

Data collection

Between June 2010 and May 2011 a structured survey was conducted of 400 households in Lombok and of 402 in Bali, inviting Sector 3 and 4 poultry raisers to participate. Two structured questionnaires were used: one for Sector 3 and one for Sector 4. Each questionnaire consisted of seven sections: participant demographics, poultry flock and management, management of sick/dead birds, slaughter of poultry, HPAI knowledge and perceptions, HPAI occurrence, and activities on HPAI. Surveys were administered by a team of trained surveyors during individual face-to-face interviews with the poultry carer in each randomly selected household. These structured surveys identified factors influencing the HPAI awareness and practices of poultry owners.

At each island's two study sites, four focus groups were conducted separately with community leaders, villagers who owned poultry, animal health agencies and human health agencies. Each focus group consisted of 8–10 participants and lasted 1–2 hours. In Lombok, there were 79 participants in the eight focus groups: 41 participants from the affected site and 38 from the non-affected sites. In Bali there were 77 participants in the eight focus groups: 42 from the affected site and 35 from the non-affected site.

Both men and women were encouraged to participate; however, there were fewer women participants than men because, in the group, community leaders and villagers (heads of households) women are not always represented. In Lombok, five of the eight focus groups had men and women participating; in Bali, six focus groups had women participating. The overall age range of all participants was 20–50 years.

In-depth interviews with 44 key informants from each of the above groups were conducted at each site to capture in more detail experiences of individuals, their sociocultural, economic and environmental views; and the needs, values, beliefs and everyday practices that constitute their response to HPAI. In total, 17 key informants were interviewed in Bali (including two women); in Lombok, 27 key informants were interviewed. Key informants included people who had lost birds or relatives due to HPAI infection or had birds identified as H5N1-infected, and local animal and human health employees charged with HPAI control activities. All

interviews were digitally recorded and transcribed for data analysis. All participants gave verbal consent for involvement and were informed that data would be de-identified prior to analysis.

Research team members trained Indonesian anthropology graduates in conducting focus group facilitation, in-depth interviews, audio recording, making observations and transcribing. All focus groups and in-depth interviews were conducted in Balinese, or Sasak (Lombok) and/or Indonesian language, recorded, and transcribed and translated where necessary into Indonesian. All quotations cited are English translations of the Indonesian.

Data analysis

Qualitative data were coded and analysed using a manual review of transcripts for theme and content. Dominant themes were identified with similar thematic content across both the focus groups and interviews. The same theme was often present across more than one focus group. Themes that supported appropriately the objectives of the research were then analysed for content along the lines of grounded theory[33] for coding, theme and content analysis. Coding continued until dominant themes were clearly identified. Several core themes in the qualitative data were consistent with findings in the quantitative data. Several core themes in the qualitative data were consistent with findings in the quantitative data[34]. Thus, the two bodies of data supported and enhanced each other.

This combination of methods, along with the interdisciplinary composition of the research team, was developed to enhance validity of the results through methodologic, investigator and data triangulation[35].

Ethics approval

Ethics approval was obtained from The University of Sydney Human Research Ethics Committee (no. 12885, 14 May 2010), the Ethical and Scientific Research Committee National Institute of Health Research & Development, Ministry of Health, Republic of Indonesia (No. LB.03.03/KE/036/2010, 6 January 2010), and the ethics committees of Universitas Udayana, Bali and Universitas Mataram, Lombok. Permission was also sought and received from the Animal Sector Ministry of Agriculture, Indonesia, for their employees to serve as respondents.

Results

Description of participants

Across the four sites, most of the 654 respondents from Sector 4 had only attended elementary (primary) school (38.5%), and a substantial number had never been to school (21.9%). Table 1 provides a description of people who participated in the structured household survey by gender and site.

HPAI activities, information sources and information flow

On Bali, from the survey, 103 of 188 (55%) of Sector 4 respondents in Negara (affected site) and 49 of 136 (36%) of Sector 4 respondents in Manggis (non-affected site) were aware of HPAI prevention activities in their village. For Sector 3 respondents, these figures were 11/14 (71%) and 41/64 (64%). On Lombok, only 9 of 330 (3%) of Sector 4 and 8/70 (11%) of Sector 3 respondents were aware of such activities.

Distribution of available information sources (brochures, posters, leaflets) was reportedly limited, according to the survey results. On Bali, in Negara, 46 of 188 (24.5%) of respondents reported seeing a poster and 2 (1.1%) being given a brochure or leaflet on HPAI. In Manggis, these figures were 46/136 (33.8%) for seeing posters and 18/136 (13.2%) for being given a brochure. On Lombok, 23 of 330 (7%) reported seeing either a poster or brochure.

Table 1: Participants by site, gender and identity group

	Household survey				Focus group							
	Sector 3		Sector 4		Animal health staff		Public health staff		Community leaders		Villagers	
Gender	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Bali, Manggis Subdistrict, non-affected site												
Male	58	90.6	82	60.2	4	67	6	75	11	100	8	80
Female	6	9.4	54	39.7	2	33	2	25			2	20
Total	64		136		6		8		11		10	
Bali, Negara Subdistrict, affected site												
Male	12	85.7	124	66	7	64	9	90	8	89	12	100
Female	2	14.3	64	34	4	36	1	10	1	11		
Total	14		188		11		10		9		12	
Lombok, Pujut Subdistrict, non-affected site												
Male	33	82.5	65	40.6	6	75	7	70	10	100	10	100
Female	7	17.5	95	59·4	2	25	3	30	0			
Total	40		160		8		10		10		10	
Lombok, Pringgasela Subdistrict, affected site												
Male	26	86.7	91	53.5	6	75	2	20	11	100	8	80
Female	4	13.3	79	46.5	2	25	8	80	0		2	20
Total	30		170		8		10		11		10	

Several focus groups and in-depth interviews corroborated that attempts to disseminate written information were not only insufficient but also largely ineffectual because such materials were not retained. For example, as stated by a participant in the villager focus group discussions at the affected site in Lombok:

> *that's the problem with the brochures. … Sometimes when we give to the community they just put them in their pockets … sometimes they throw it away …*

Sometimes the materials are not read:

> *… we pasted some by the intersection, village offices are full of flu burung stickers, but willingness to read in our community is low …*

The need for more knowledge and information is poignantly demonstrated by one health worker when speaking about protection for personnel from infectious disease:

> *In my opinion what's needed is how the health staff protects themselves. Maybe that information is necessary, so before he handles the case he already understands what to prepare to protect himself so that he doesn't contract [flu burung]. Maybe that's very important so that if our staff go to the field or handle the case at this health clinic we are not worried. So it's similar to the AIDS in the past. All used to be afraid but after it was made clear that AIDS can be like this, can be prevented by this, the staff became calmer. The same with flu burung, don't let the staff unaware of how to manage it, he will become afraid.*

Animal health workers reported that an increase in rabies cases had resulted in diversion of effort from HPAI to rabies prevention efforts.

Poultry management

Housing: On Lombok, 159 of 330 (48%) of Sector 4 respondents reported keeping their chickens in cages or pens while 98/330 (30%) did not, with the remainder reporting that sometimes they kept the birds in the cages or pens while at other times not. This latter group of respondents explained that when the birds are still young (after hatching from the egg) they are kept in cages, and after the birds mature they are allowed to free range.

On Bali, the number of Sector 4 respondents that reported keeping their birds in cages was markedly lower, at 74/324 (22.8%). Here, too, there was a notable difference between the affected site and the unaffected site (26.9% in Negara, affected, vs 19.1% in Manggis, non-affected). Most birds scavenge around households, moving freely during the day and sleeping in trees at night. Sector 4 respondents expressed a concern that cages make the work of chicken thieves easier. As demand for birds of all types on Bali always exceeds supply, smuggling and theft are ongoing problems.

All Sector 3 respondents in all study sites reported keeping poultry in pens/cages.

Sick and dead bird management, consumption, and reporting: While community respondents on both Bali and Lombok knew the signs and symptoms of sick birds, they did not differentiate well between HPAI and other bird diseases such as Newcastle disease (*koyan*, *grubug* or *sasab*). In Lombok there was particular confusion between HPAI and other bird diseases, especially Newcastle disease (*koyan* or *manuk koyan* in East Lombok, *grubug* or *ende* (ND = Newcastle disease) in Central Lombok).

> *For the community, when there's a sudden death, that's koyan not flu burung, because the poultry has never been sick [with flu burung].*

On Lombok, a greater proportion of respondents reported willingness to sell or eat sick birds than on Bali (Table 2). A participant of the village focus group at the non-affected Lombok site supported this finding:

> *If there is a sick bird in the flock, then all chickens will be sold live. Or sometimes we slaughter for ourselves.*

The majority of respondents at each site, irrespective of sector, reported safe disposal of dead birds by burning or burying carcasses (Table 3). However, on Bali, 50/136 (36.8%) of Sector 4 respondents in Manggis and 95/324 (29.3%) in Negara reported sales to dead bird collectors. Low numbers of respondents did report discarding carcasses in waterways, consuming dead birds, feeding them to fish or dogs, and doing nothing with carcasses.

On both Bali and Lombok, approximately half of respondents were reluctant to report sudden deaths of poultry (Table 4). The lack of a government compensation program for destroyed flocks contributed to this unwillingness to report. For example, one person from an affected site focus group said:

> *When farmers report, they are only given advice to destroy the animal because there is no compensation to cull birds.*

Thus the social and economic cost to an individual poultry farmer or a householder who has lost birds during an HPAI outbreak is considerable.

People living at the study site where a human case of HPAI had occurred in Bali were more aware of HPAI prevention programs than those in villages where no human HPAI had occurred. For example, according to the participants in the focus group of the human health office, nearly all villages in Jembrana District had active *desa siaga* ('alert village') programs. One public health staff participant of the focus group of the affected site in Bali said they had established a team for tackling *flu burung* and then continued with:

> *Because we, for example, go to monitor desa siaga. We ask everyone. We ask what is established, especially in the village context. Is this still functioning or not, is it still effective or not?*

Table 2: Sick bird management across affected and non-affected sites on Bali and Lombok[†]

Bali

Manggis, non-affected site	**Sector 3, *n*=64**		**Sector 4, *n*=136**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	28	43.8	48	35.2
Sell at low price	0	0	1	0.7
Kill and sell meat	0	0	0	0
Kill and burn	0	0	1	0·.
Kill and bury	0	0	3	2.2
Kill and discard into river/waterways	0	0	0	0
Kill and eat	0	0	0	0
Nothing	0	0	35	25.7
Other – give medicine	51	79.6	67	49.3
Negara, affected site	**Sector 3, *n*=14**		**Sector 4, *n*=188**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	11	78.6	45	23.9
Sell at low price	0	0	1	0·5
Kill and sell meat	0	0	0	0
Kill and burn	0	0	6	3.2
Kill and bury	1	7.1	7	3.7
Kill and discard into river/waterways	0	0	0	0
Kill and eat	1	7.1	1	0.5
Nothing	0	0	60	31.9
Other – give medicine	6	42.8	77	41.0

Lombok

Pujut, non-affected site	**Sector 3, *n*=40**		**Sector 4, *n*=160**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	29	72.5	28	17.5
Sell at low price	3	7.5	45	28.1
Kill and sell meat	3	7.5	4	2.5
Kill and burn	0	0	1	0.6
Kill and bury	2	5	1	0.6
Kill and discard into river/waterways	0	0	0	0
Kill and eat	6	15.0	49	30.6
Nothing	0	0	32	20.0
Other – give medicine	20	50.0	37	23.1
Pringgasela, affected site	**Sector 3, *n*=30**		**Sector 4, *n*=70**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	24	80	51	30
Sell at low price	1	3.3	0	0
Kill and sell meat	0	0	7	4.1
Kill and burn	0	0	0	0
Kill and bury	0	0	1	0.6
Kill and discard into river/waterways	0	0	1	0.6
Kill and eat	2	6.77	72	42.4
Nothing	1	3.3	32	18.8
Other – give medicine	9	30.0	33	19.4

[†] Multiple responses included

Table 3: Dead bird management across affected and non-affected sites on Bali and Lombok[†]

Bali

Manggis, non-affected site	**Sector 3, *n*=64**		**Sector 4, *n*=136**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	11	17.2	10	7.4
Sell to neighbour in the village	0	0	0	0
Sell to dead bird collector	0	0	50	36.8
Burn	47	73.4	87	64
Bury	26	40.6	5	3.7
Discard into river/waterways	0	0	0	0
Consume	0	0	0	0
Nothing	4	6.3	3	2.2
Negara, affected site	**Sector 3, *n*=14**		**Sector 4, *n*=188**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	0	0	0	0
Sell to neighbor in the village	0	0	0	0
Sell to dead bird collector	0	0	45	23.9
Burn	10	71.4	130	9.0
Bury	9	64.3	17	9
Discard into river/waterways	0	0	1	0.5
Consume	0	0	1	0·.
Nothing	0	0	4	2.1

Lombok

Pujut, non-affected site	**Sector 3, *n*=40**		**Sector 4, *n*=160**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	0	0	0	0
Sell to neighbour in the village	0	0	1	0.6
Sell to dead bird collector	5	12.5	1	0.6
Burn	26	65.0	121	75.6
Bury	5	12.5	31	19.4
Discard into river/waterways	0	0	0	0
Consume	0	0	1	0.6
Nothing	10	25.0	14	8.8
Pringgasela, affected site	**Sector 3, *n*=30**		**Sector 4, *n*=170**	
Action:	***n***	**%**	***n***	**%**
Separate from healthy birds	0	0	1	0.6
Sell to neighbour/dead bird collector	1	3.3	0	0
Burn	4	13.3	1	0.6
Bury	21	70.0	155	91.2
Discard into river/waterways	0	0	7	4.1
Eat	0	0	0	0
Nothing	0	0	0	0
Other (feed to fish, dogs)	7	23.3	11	6.5

[†]Multiple responses included

Vaccination and biosecurity: Government policy in Indonesia is that vaccines for poultry must be purchased by owners – the government does not supply vaccine for any diseases. While bird owners may vaccinate against some bird diseases, they do not necessarily vaccinate against HPAI. On Bali, 92% of Sector 3 respondents and 34% of Sector 4 respondents in Manggis reported that they vaccinated their birds, while 64% of Sector 3 and 23% of Sector 4 in Negara reported doing so. Thus, vaccination rates were actually lower in the subdistrict that had experienced a human HPAI case. On Lombok, Sector 3 respondents who reported vaccinating their birds varied from 10% (Pujut Subdistrict) to 90% (Pringgasela subdistrict) and in Sector 4 from 33% (Pujut) to 25% (Pringgasela) (Table 2).

Table 4: Willingness to report sudden death of poultry (% responding) across affected and non-affected sites on Bali and Lombok

Bali

Manggis, non-affected site	**Sector 3, *n*=64**		**Sector 4, *n*=136**	
Action:	***n***	**%**	***n***	**%**
Yes	23	35.9	31	22.8
Maybe	5	7.8	7	5.1
No	36	56.3	98	72.1
Negara, affected site	**Sector 3, n=14**		**Sector 4, *n*=188**	
Action:	***n***	**%**	***n***	**%**
Yes	11	78.6	85	45.2
Maybe	1	7.1	7	3.7
No	2	14.3	96	51.1

Lombok

Pujut, non-affected site	**Sector 3, n=37**		**Sector 4, *n*=103**	
Action:	***n***	**%**	***n***	**%**
Yes	29	78.4	25	24.3
Maybe	0	0	2	1.9
No	8	21.6	76	73.8
Pringgasela, affected site	**Sector 3, *n*=25**		**Sector 4, *n*=101**	
Action:	***n***	**%**	***n***	**%**
Yes	17	68.0	18	17.8
Maybe	0	0	3	3.0
No	8	32.0	80	79.2

The logistics of vaccinating non-commercial flocks is also problematic in that flocks are not confined in pens, but are free-ranging. As one key informant villager from the affected site in Lombok said:

> *Nowadays it is very difficult to do vaccinations for kampong [free-ranging village] chickens because the chickens run free and are hard to catch, [and] the community's perception [is] that their chickens are in a healthy condition and there is no need to be vaccinated.*

This was reiterated across many other Sector 4 participant groups. There is also a prevalent belief in some (but not all) communities that vaccination kills poultry, as told by a veterinarian in the animal health focus group at the affected site in Lombok:

> *Sometime ago when we did vaccinations there was a complaint from the community that their ducks died.*

There is also a belief that vaccination of poultry would cost owners money:

> *… they thought that it [vaccination] was not free … that is one of our obstacles.*

Respondents' knowledge of prevention of bird-to-human transmission is presented in Table 5.

Cultural and religious differences between the islands Bali (mainly Hindu) and Lombok (mainly Muslim) provide potential to enhance HPAI transmission in one respect. Both cultural/religious groups sacrifice poultry for ritual purposes and feasting. However, the extent and scale of Balinese rituals and feasting occurs on a much larger scale compared to that on Lombok. Because of these cultural practices, Bali receives live chickens and ducks in large numbers from other Indonesian islands, many of which enter illegally without regard for the quarantine ban on all live birds, with the exception of day-old chicks, thus further jeopardising biosecurity measures.

Discussion

This study was conducted on two islands in sites both affected and non-affected by human cases of HPAI in poultry. Bali had experienced a human fatality in the affected site. Several differences became clear between the islands and also between the two kinds of sites explored. For example, there was a difference in the extent of vertical information flow of the national HPAI control program through the various levels of administrative governance – from national to provincial, then to districts, subdistricts, villages and subvillages. On Lombok, this flow was very limited beyond the subdistrict level.

One major difference between Bali and Lombok is the good collaboration between public health and animal health agencies that have helped disseminate HPAI information between subdistrict and village and subvillage levels on Bali. This collaboration does not exist in Lombok; neither does dissemination of HPAI information below the subdistrict level.

On Bali, the flow of information seems to have extended to village and subvillage levels in both sites through the effective collaborations of public health and animal health agencies and the strong subvillage administrative organisation known as the *banjar* system, unique to Bali. In Lombok there was very little collaboration between animal and human health agencies. Nevertheless, people in the affected sites on both islands appear to have absorbed more information than those in non-affected areas, probably because of previous HPAI infection and contact with government agencies.

Survey results and focus groups were also consistent in finding that knowledge of government activities was more extensive at Bali sites and that only limited government programs and activities occurred at village level on Lombok to promote community changes in knowledge, attitudes, skills and practices on HPAI. Probably as a result, Lombok Sector 4 survey respondents reported less disease prevention activity in their flocks. There was also a difference in disease-prevention activity between affected and unaffected sites.

The degree of community preparedness for HPAI on Bali and Lombok is minimal. It was found that activities conducted by government agencies from the provincial to the village levels are limited in scope[36] and largely ineffectual[2,25,27,37] in engendering safe poultry-handling practices and biosecurity measures. Participatory District Surveillance Response (PDSR) officers (Animal Health) appear to have focused principally on households keeping small numbers of often free-range chickens. As a result, the small commercial poultry producers have relied on supply companies for information on HPAI control and prevention. Villagers in the present study learned about HPAI mostly from national television programs, primarily news broadcasts, not official government publications or programs.

Unsafe poultry management practices are still in place, especially with Sector 4. Participants generally did not apply recommended biosecurity measures to protect their birds from infection. Most Sector 4 respondents did not vaccinate their birds, regularly disinfect or even clean cages and pens, use masks and hand gloves in handling sick birds, or apply disinfectant for cleaning the bird pen if there was one.

Vaccination is viewed with great scepticism, as others have found[38]. Vaccination rates were higher in Bali amongst both Sector 3 and 4 households than in Lombok. Most Sector 4 respondents in Lombok did not vaccinate their birds, but some did in Bali. Several animal health agents concurred that there are logistical difficulties in capturing Sector 4 free-ranging birds for vaccination. Interview data revealed that there have been negative results from some vaccinations (ie poultry have died). Where vaccinations did occur in poultry, they were for other poultry diseases and not HPAI. The major reason for this lack of compliance is economic. In contrast, Sector 3 farmers across both islands and all sites were mostly contracted to commercial poultry companies that ensured biosecurity measures are followed by providing appropriate technical services. Commercial and profit motives appear to drive better compliance. Large-scale vaccination efforts have not demonstrated effectiveness as a control measure[39], and were stopped in Indonesia in 2007, as they were seen as a source of spread of virus by vaccination teams[23].

Table 5: Reported actions taken by households to protect poultry from diseases across affected and non-affected sites on Bali and Lombok[†]

Bali

Manggis, non-affected site	**Sector 3, *n*=64**		**Sector 4, *n*=136**	
Action:	***n***	**%**	***n***	**%**
Clean pen/cage every day	23	35.9	14	10.3
Disinfect pen/cage on regular basis	49	76.6	5	3.7
Vaccinate birds	59	92.2	46	33.8
Separate new birds	20	31.3	5	3·7
Purchase healthy birds	23	35.9	16	11.8
Nothing	0	0	49	36.1
Negara, affected site	**Sector 3, n=14**		**Sector 4, *n*=188**	
Action:	***n***	**%**	***n***	**%**
Clean pen/cage every day	11	78.6	43	22.9
Disinfect pen/cage on regular basis	9	64.3	15	8.0
Vaccinate birds	9	64.3	43	22.9
Separate new birds	2	14.3	1	0.5
Purchase healthy birds	4	28.6	17	9
Nothing	0	0	97	51.6

Lombok

Pujut, non-affected site	**Sector 3, *n*=40**		**Sector 4, *n*=160**	
Action:	***n***	**%**	***n***	**%**
Clean pen/cage every day	7	17.5	30	18.8
Disinfect pen/cage on regular basis	17	42.5	*1*	0.6
Vaccinate birds	36	90	53	33.1
Separate new birds	3	7.5	1	0.6
Purchase healthy birds	3	7.5	15	9.4
Nothing	1	2.5	58	36.3
Pringgasela, affected site	**Sector 3, *n*=30**		**Sector 4, *n*=170**	
Action:	***n***	**%**	***n***	**%**
Clean pen/cage every day	7	23.3	50	29.4
Disinfect pen/cage on regular basis	13	43.3	3	1.8
Vaccinate birds	27	90	3	1.8
Separate new birds	0	0	1	0.6
Purchase healthy birds	2	6.7	14	8.2
Nothing	0	0	37	21.8

[†] Multiple responses included

Symptoms of various bird diseases are similar and indistinguishable without laboratory testing, Because bird mortality from all causes has always been high, it is understandable that respondents aren't viewing HPAI as different or more serious than the bird morbidity and mortality they are used to.

Participants offered ideas for additional education efforts that might have more chance of penetrating the communities. These included information disseminated through local leaders, through mosques, and through cadre forums (groups of voluntary or poorly compensated health workers recruited from villages).

While the Indonesian government's planning efforts for HPAI are commendable, the plan is not presently effective, as it depends on the cooperative actions of people with small rural farms who have not been consulted in the development of the

plan, have not been adequately instructed on the nature of the plan, and perceive no benefits to themselves from prevention efforts. The present study found, as have others, that compensation mechanisms are problematic (2,23} and amounts offered by the government for culled birds are considered far too low[36,38]. Risk-based culling may reduce the number of birds that need to be killed while still reducing human infections[40]. Better collaboration between public health and animal health agencies is essential[11].

Bali, especially, has a large international and national tourist industry. One of the complexities of the zoonotic disease profile, and its containment, is that local officials may be reluctant to acknowledge an outbreak for fear of the resultant economic distress that reduced tourism numbers would bring[41,42].

This study supports previous findings that effective health promotion and disease prevention efforts are complicated when the distance – geographically, culturally, and socially – between government agencies and rural, indigenous people is great[43,44] and when people are required to give up a valuable asset to meet a goal that they can't appreciate[45]. Such measures are likely to be less effective than would be expected in the best of times[46]. It also confirms that a bureaucratic, formulaic approach to disease prevention, especially when such an approach comes from a centralised governmental body, will be insufficient, and that an effective approach will need to be interdisciplinary[47] and involve community people in development and decision-making[14,23,27,28,48,49]. With so many other causes of morbidity, mortality and social distress prevalent, HPAI barely registers as a matter of concern[2].

In contrast to findings of others investigating HPAI prevention efforts[2,43], study respondents on Bali (but not Lombok) reported a good relationship between public and animal health agencies at all administrative levels in promoting HPAI control and education programs.

A potential limitation of this research is that the research team worked across cultures. This holds the potential for mistranslation and for perceptions of miscommunication implicit in developed world researchers working with indigenous participants[50]. The authors tried to control for this by training local people to work with them on participant recruitment and data collection.

The authors consider the interdisciplinary and international nature of the research team as a potential strength. This project brought together the disciplines of medical anthropology, epidemiology, public health disease prevention practice, vaccinology and veterinary science. Collaborations such as this one, particularly between the human and animal health sectors, are essential for risk assessment, surveillance and the development of effective control strategies[11].

Another strength is the mixed methods study design. Results were triangulated across the quantitative and qualitative data collection arms, with results from one supporting those obtained through the other[51]. Another is that primary data rather than surrogate measures[52] were collected.

Conclusions

On the basis of these findings, the authors recommend the following further actions:

1. More effective communication is needed between subdistrict levels and village/community levels, and could be improved through field agents trained in communication techniques with village people.
2. A participatory approach is needed, with village level people consulted in all phases of development and delivery of prevention strategies.
3. Communication should take place at places where owners of poultry meet and feel at ease to ask field officers questions about HPAI. This should be in addition to mass media communication.
4. The formation of cooperatives/associations/ networks of small farms might also contribute to more effective promotion of behavioural changes at

the community level and to articulate the concerns and interests of small farmers to the government.

5. Development of school programs that focus on living with animals, including information about diseases of animals and zoonotic diseases and the environmental factors surrounding the management of sick and dead poultry, could instil a prevention ethos. Children at primary, elementary and high school could be taught about safe handling of poultry and the hygiene practices necessary in keeping their poultry or pets and themselves healthy (eg cage and pen cleaning, handwashing and changing clothes).
6. Operational research is needed to identify best approaches or models in disseminating information on HPAI that results in improving people's attitudes, skills and practices within current household structures. It is unlikely that a single such model could be devised that would work for the whole of the country. Rather, priority must be given to community/village participation on their terms. Existing *desa siaga* programs, which already operate in in many villages on Bali and some on Lombok, can work well for a number of village-based activities.

For Sector 4 poultry raisers on Bali and Lombok, and for many around the world like them[10], flocks are their livelihoods, primary sources of food, important social/cultural totems (especially on Bali) or primary sources of income. Most of these people are fairly poor. Chickens are often their only ready cash assets. From their perspective, it is an entirely rational decision to deal with sick birds by converting them to something useful (revenue or a meal) as quickly as possible.

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