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AVIAN INFLUENZA A (H5N1)

FOCUS REPORT

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AVIAN INFLUENZA FOCUS REPORT

Introduction

Highly pathogenic avian influenza (HPAI) H5N1, a zoonotic disease caused by an influenza A virus, has been a persistent threat to global animal and public health for over two decades. While primarily circulating in avian populations, the virus has demonstrated the capacity for cross-species transmission, resulting in sporadic human infections and outbreaks in various mammalian species. The recent detection of HPAI H5N1 in dairy cows (Burrough et al., 2024) and the first reported human case in the United States underscore the continued importance of understanding and addressing this evolving threat.

This research aims to provide a comprehensive overview of HPAI H5N1, focusing on its virology, epidemiology, pathogenesis, clinical manifestations, diagnostic challenges, and control strategies. It will further explore the implications of the recent H5N1 outbreaks in mammals, including the potential risks to human health and food security. By integrating current knowledge and highlighting key research gaps, this study seeks to inform ongoing efforts to mitigate the impact of HPAI H5N1 and enhance preparedness for future outbreaks.

Methods

This report employed a comprehensive literature review methodology to investigate the landscape of highly pathogenic avian influenza H5N1 in the ASEAN region. Relevant data was sourced from established databases including PubMed, Embase, and Scopus, using a combination of keywords related to avian influenza, H5N1, and the ASEAN region. In addition, real-time information on disease burden, case definitions, preventive measures, and policy strategies was gathered from official reports and news articles detailing cases of vaccine-preventable diseases. This multi-pronged approach facilitated a thorough examination of current trends, patterns, and challenges in avian influenza management within the ASEAN region.

Case Definition and Clinical Features

Case Definition

Avian influenza is an infection caused by influenza viruses type A that primarily infect avian species, commonly referred to as bird flu (WHO, 2007). Influenza type A viruses are classified into subtypes based on surface proteins. When these viruses infect animals, they are named after the host species, such as avian, swine, equine, or canine influenza viruses. These animal influenza viruses are different from human influenza viruses and do not easily transmit to or among humans (WHO, 2023a).

Although avian influenza (AI) viruses are zoonotic, humans can occasionally contract the infection from infected animals through direct or indirect contact. Human infections may range from minor illnesses to fatalities. Domestic and wild birds (poultry and captive), as well as other mammalian species, play a significant role in the emergence, evolution, and transmission of various AI subtypes A (HxNy) to humans. The 18 subtypes of haemagglutinin (H1 through H18) and the 11 subtypes of neuraminidase (N1 through N11) on the viral surface are used to categorize the HxNy subtypes (Liu et al., 2020). HPAI H5N1 can be transmitted from wild birds to poultry by a fecal-oral route, oral–oral route, and indirectly by respiratory droplets and aerosols (Sturm-Ramirez et al., 2004; Jeong et.al., 2009).

Table 1. High-risk Groups (WHO, 2007)

High-Risk Groups	
Children playing with infected poultry, particularly asymptomatic infected ducks	Persons plucking and preparing of diseased birds in wet markets / backyard poultry / kitchens
Poultry handlers in live animal markets / wet markets	Consumption of undercooked poultry products
Cullers without proper PPE	Consumption of chicken or duck blood
Those handling fighting cocks	Hospital functionaries managing human cases of AI without proper PPE

The identification and classification of avian influenza cases are critical for effective monitoring and control measures. WHO categorizes avian influenza cases as suspected, probable, and confirmed as follows:

Table 2. Avian Influenza Case Classification (WHO, 2007)

Category	Criteria
Suspected Case	A person presenting with unexplained acute lower respiratory illness with fever (>38°C) and cough, shortness of breath, or difficulty breathing **AND** at least one of the following exposures within 7 days of symptom onset: 1. Close contact with confirmed H5N1 case 2. Exposure to birds/poultry/environments in regions with suspected/ confirmed cases within the last month 3. Consumption of undercooked poultry in regions with suspected/ confirmed cases 4. Close contact with verified H5N1-infected non-poultry/wild bird animal 5. Lab exposure to H5N1 virus
Probable Case	Meets suspected case criteria **AND**: Chest x-ray showing pneumonia/respiratory failure **OR** positive influenza A test without H5N1 confirmation, **OR** Dies from unknown acute respiratory illness with epidemiological link to confirmed/probable case
Confirmed Case	Meets suspected/probable case criteria AND one of the following positive laboratory tests: 1. Isolation of H5N1 virus 2. Positive H5 PCR test 3. Fourfold rise in H5N1 neutralizing antibody titer of an acute serum specimen with 1:80 or higher convalescent neutralizing antibody titer 4. High micro-neutralization antibody titer for H5N1 with additional positive serological test

Probable and confirmed cases of human infection with avian influenza A virus (H5N1), as defined above, should be reported to the WHO.

Clinical Presentation

Diagnosing human instances of avian influenza, clinical acquaintance with seasonal influenza signs and symptoms would be beneficial. Possible differences in clinical characteristics include a longer incubation period, early development of pneumonia, rapid progression to respiratory distress, and a high case fatality rate (CFR). Most of the patients studied in Thailand and Viet Nam had fever, cough, and dyspnea when they first arrived, and over half of them experienced diarrhoea, which is a rare symptom of seasonal influenza. The blood picture revealed abnormal liver function tests, significant thrombocytopenia, and persistent

lymphopenia. Radiographs of the chest were abnormal in more than 80% of the patients. Acute respiratory distress syndrome (ARDS) and multi-organ failure were the final outcomes in more than 50% of the cases that followed a rapid progression (WHO, 2007).

Table 3. Clinical Features of Avian Influenza Infection in Human (WHO,2007)

Clinical Features of Avian Influenza	
• Onset after 2-8 days of exposure to sick / dying poultry • Fever >38ºC • Difficulty in breathing after 5-7 days of onset of Diarrhoea	• Onset similar to seasonal influenza • Cough • Primary viral pneumonia • Rapid deterioration to ARDS and multi-organ failure

Infrequent features include vomiting, abdominal pain, chest pain, bleeding from the nose and/or gums, and, in rare cases, encephalopathy may occur among AI patients.

Clinical Diagnosis

Both clinical and epidemiological requirements must be fulfilled to diagnose a human case of avian influenza in a primary healthcare setting during the pandemic alert phase. While the epidemiological criteria are mainly used for case identification, referral, and reporting, the clinical presentations are used for case management (WHO, 2007).

Epidemiological Criteria

In the seven days preceding the start of symptoms, one or more of the following exposure categories are used to epidemiologically connect a suspected case to a known AI case (WHO, 2007):

- Close contact (within one metre) with a person (e.g., caring for, speaking with or touching) who is a suspected, probable or confirmed AI case;
- sustained exposure (e.g., handling, slaughtering, plucking, butchering or preparing for consumption) to poultry or wild birds or their remains or to environments contaminated by their faeces in an area where AI infections in animals or humans have been suspected or confirmed in the last month;
- consumption of raw or undercooked poultry products in an area where AI infections in animals or humans have been suspected or confirmed in the last month;
- close contact with a confirmed avian influenza-infected animal other than poultry or wild birds (e.g., cat or pig);
- handling samples (animal or human) suspected of containing avian influenza virus in a laboratory or other setting.

Direct contact with poultry is defined as:

- Touching birds (well-appearing, sick or dead);
- Touching poultry faeces or surfaces contaminated with faeces;
- Consuming uncooked poultry products (including blood) in an affected area;
- Close contact with a person from an infected area with confirmed or suspected novel influenza is defined as being within three feet (one metre) of that person during their illness.

Epidemiology

Global Situation of Avian Influenza

HPAI H5N1 virus has been a public health concern due to its ability to cause severe respiratory illness. The first HPAI H5N1 viruses in humans originated from a 1996 detection in geese from Guangdong Province, southern China. The initial human cases occurred in Hong Kong in 1997, resulting in six deaths out of 18 recorded cases (Hatta et al., 2001).

Since its first reported pandemic in 2003, avian influenza, specifically subtype H5N1, has been a significant global health concern (WHO, 2023a). By 2005, the HPAI H5N1 virus had spread to Indonesia, China, Malaysia, Africa, Europe, the Pacific, and the Middle East, and continues to circulate in poultry and humans (Poovorawan et al., 2013).

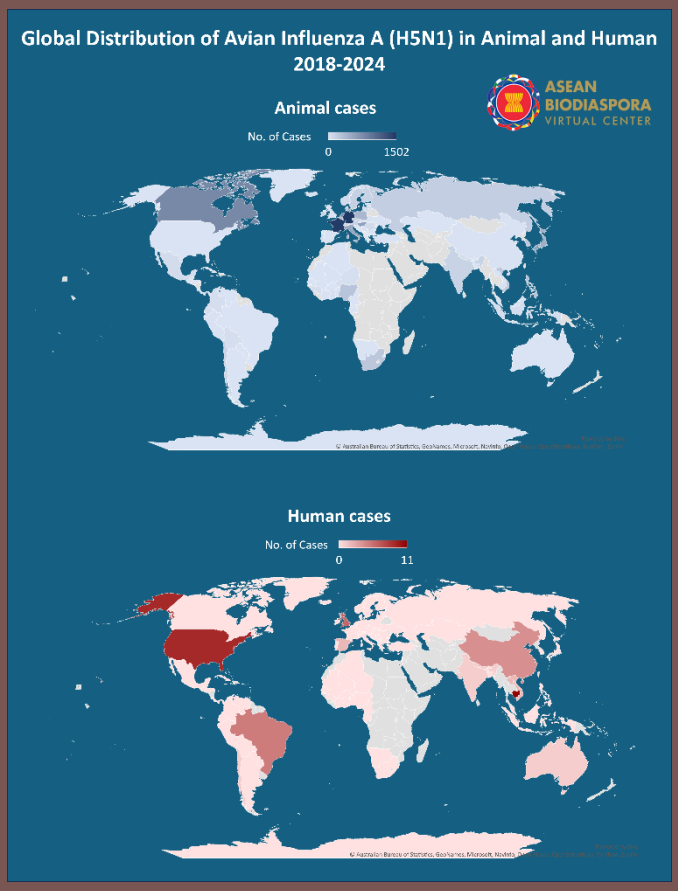

Figure 1. Global distribution of Avian Influenza type A (H5N1) in animal (top) and human (bottom) (Source: FAO (https://empres-i.apps.fao.org/), Bluedot (https://portal.bluedot.global/), last accessed July 5, 2024)

Since January 2018, a total of 13,359 HPAI H5N1 cases on animal have been reported worldwide, with the majority from Europe (8,592 cases), followed by the Americas (2,366 cases), Asia (1,727 cases), Africa (667 cases), and Antarctica (7 cases) (FAO, 2024).

There is a concerning trend in annual global H5N1 cases in animal reported between 2018 and 2024. While the number of cases fluctuated throughout this period, there was a significant increase overall, reaching a worrying high of 6,269 in 2022. This significant increase in reported cases underscores the need to continue to investigate and possibly take stronger preventive measures.

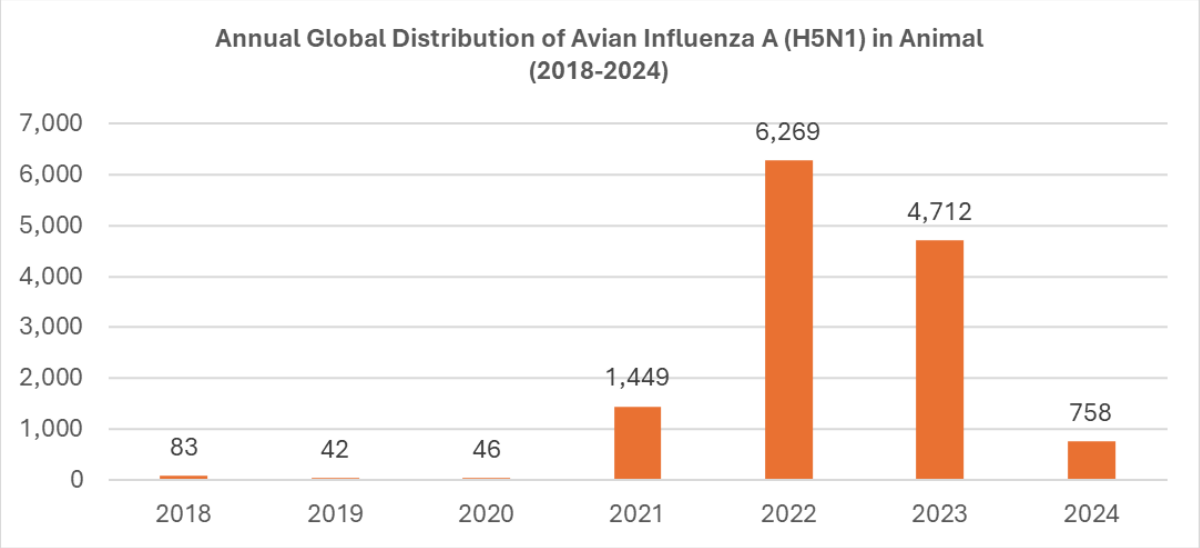

Figure 2. Annual Global distribution of Avian Influenza type A (H5N1) in Animal (Source: FAO (https://empres-i.apps.fao.org/), Bluedot (https://portal.bluedot.global/), last accessed July 5, 2024)

Of the reported cases, 50 human infections were reported with a total of 10 deaths (CFR=20%). During the period, Cambodia accounted for the highest number, with 11 infections and 5 deaths. The United States reported 10 infections with no death, followed by the UK (8 infections), Brazil (5 infections), China (4 cases, 2 deaths), Lao PDR (3 cases, 1 death), Spain (3 cases), India and Nepal (1 case, 1 death), Australia and Chile each reported 1 infection (Bluedot, 2024).

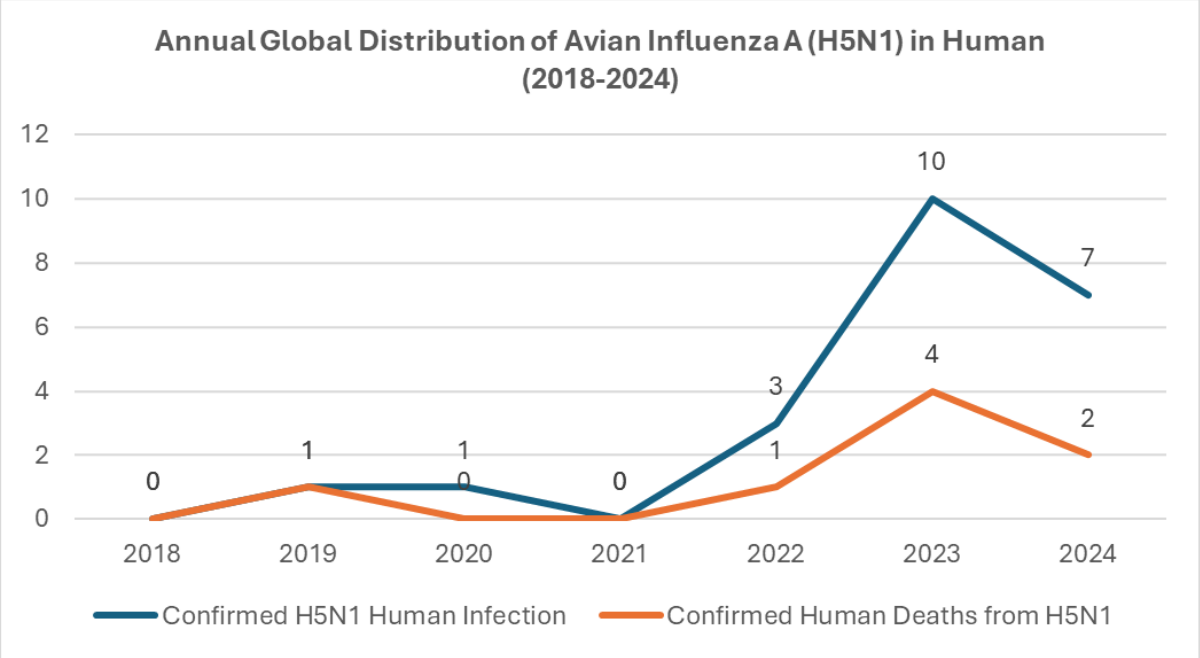

Figure 3. Annual Global Human Infections of Avian Influenza type A (H5N1) (Source: FAO (https://empres-i.apps.fao.org/), Bluedot (https://portal.bluedot.global/), last accessed July 5, 2024)

ASEAN Regional Situation of Avian Influenza

A wave of HPAI H5N1 infections were first reported in Southeast Asia in 2003, affecting Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Thailand, and Viet Nam. In Indonesia, H5N1 outbreaks in poultry began in December 2003. The disease was first detected in poultry in Lao PDR in 2003. In Viet Nam, the virus was introduced from China in late 2003, with poultry outbreaks first reported in 2004, followed by several human cases. Human infections were continuously reported throughout 2004-2005. Vaccination of poultry against the H5 virus began in August 2005 using inactivated H5N1 and H5N2 vaccines. In Thailand, the H5N1 virus was first reported in January 2004; during the period, the first confirmed outbreak of HPAI H5N1 in poultry was also reported in Cambodia. Malaysia's first outbreaks in poultry occurred in August to September 2004. Myanmar reported its first poultry outbreak of H5N1 in March 2006 (Gutiérrez et al., 2009). In the Philippines, H5N1 was first identified in July 2005 in ducks on an isolated farm in Bulacan Province (CIDRAP, 2005).

During the period of 2018 to 2024, a total of 617 HPAI H5N1 cases have been reported in ASEAN Region with the majority from the Philippines (295 cases), followed by Viet Nam (226 cases), Indonesia (56 cases), Cambodia (27 cases), Malaysia (7 cases), and Lao PDR (6 cases) (FAO, 2024).

Figure 4. Distribution of Avian Influenza type A (H5N1) in animal (top) and human (bottom) in ASEAN (Source: FAO (https://empres-i.apps.fao.org/), Bluedot (https://portal.bluedot.global/), last accessed July 5, 2024)

Despite the implementation of control strategies, cases of human infection have been reported in the region. Since 2018, a total of 14 human infections with 6 deaths have been reported (CFR=43%). During this period, Cambodia had the highest number with 11 cases and 5 deaths, followed by Viet Nam (2 cases and 1 death) and Lao PDR (1 case).

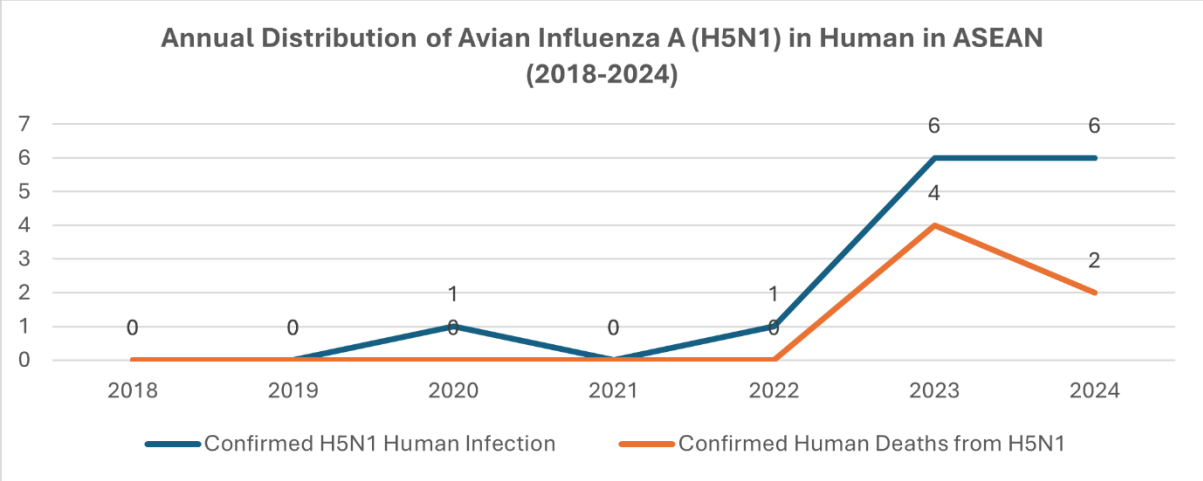

Figure 5. Annual Human Infections of Avian Influenza type A (H5N1) in The ASEAN Region (Source: FAO (https://empres-i.apps.fao.org/), Bluedot (https://portal.bluedot.global/), last accessed July 5, 2024)

Table 4. Annual Human Cases od Avian Influenza A (H5N1) in ASEAN Region

AMS	2019		2020		2021		2022		2023		2024	
	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death
Brunei Darussalam	0	0	0	0	0	0	0	0	0	0	0	0
Cambodia	0	0	0	0	0	0	0	0	6	7	5	1
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0
Lao PDR	0	0	1	0	0	0	0	0	0	0	0	0
Malaysia	0	0	0	0	0	0	0	0	0	0	0	0
Myanmar	0	0	0	0	0	0	0	0	0	0	0	0
Philippines	0	0	0	0	0	0	0	0	0	0	0	0
Singapore	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	0	0	0	0	0	0	0	0	0
Viet Nam	0	0	0	0	0	0	0	0	1	0	1	1

Burden of Avian Influenza in ASEAN Region

Since its first reported outbreaks in 2003, seven ASEAN member states have reported H5N1 confirmed cases, both on animal and human, namely Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, and Viet Nam.

Brunei Darussalam

There have been no reported HPAI H5N1 infections in humans or animals in Brunei Darussalam since its first reported cases in ASEAN. Despite the absence infections, the country had implemented numerous preve-ntive measures (ASEAN Secretariat, 2010). Ongoing efforts include:

1. maintain active surveillance of commercial and backyard farms since the ASEAN outbreak in 2003;
2. develop specific procedures covering public awareness, emergency response, zoning of infected areas, standard operating procedures for quarantine and stamping out, animal movement control, and disease surveillance with laboratory methods;
3. promote biosecurity programs among farmers and establish compensation schemes for affected farmers; and
4. implement mitigation measures to prevent cross-border spread (quarantine regulations with ASEAN neighbors, regular bilateral meetings with Malaysia on border issues).

Cambodia

In 2018, Cambodia documented seven cases of H5N1 infection on animals. Following a two-year interval with no reported cases, the country observed one instance of infection with the H5N1 strain in 2021, which subsequently resulted in the reporting of 10 additional cases in 2023. As of June 2024, the country has documented nine confirmed animal cases. During this time frame, there have been 11 confirmed human infections, resulting in five deaths.

The Cambodia Ministry of Health's national and sub-national rapid response teams, with support from the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of Environment, have been actively investigating the avian influenza outbreak in Prey Veng and Siem Reap Provinces (WHO, 2024). Ongoing efforts include:

1. thorough investigations to identify sources and modes of transmission in both animals and humans.
2. continuous effort to find suspected cases and contacts to prevent further transmission.
3. Sample collection and testing of poultry as part of ongoing surveillance and control measure

Indonesia

Up to 2017, Indonesia reported a total of 200 H5N1 human cases with 168 deaths (CFR=84%) since its first reported cases in 2003 (Kemenkes RI, 2017). In 2018 and 2019, there were documented animal cases of H5N1 (47 and 8, respectively). Following a three-year period with no reported cases, one case was documented in 2023. No further human infections are reported.

Following a circular issued by the Directorate General of Animal Husbandry and Animal Health, Ministry of Agriculture, regarding the detection of the H5N1 Clade 2.3.4.4.b virus through PCR and sequencing in May 2022, the Ministry of Health issued an official circular regarding surveillance activities as follows (Kemenkes RI, 2023; Kementan RI, 2023):

1. Implement comprehensive surveillance measures to monitor for avian influenza outbreaks;
2. Perform active monitoring of poultry populations and human cases ensures early detection of the virus; and
3. Report each H5N1 case through the evidence-based surveillance system and early warning and report system to the District Health Office

Lao People's Democratic Republic

Lao PDR reported a total of 6 H5N1 cases between 2018 and 2021, with 1 case in 2018, 3 cases in 2020, and 2 cases in 2021. Since 2022, no cases have been reported by the country.

The Government has implemented the following surveillance, prevention and control measures as detailed in the Joint National Preparedness and Contingency Plan for Avian Influenza A(H7N9) and A(H5N1) (WHO, 2020):

1. Case management and isolation of cases and close contacts
2. Testing of close contacts
3. Coordination of Provincial Health Department and the Provincial Department of Agriculture and Forestry to perform the rapid response
4. An epidemiological investigation performed by veterinarians from the Provincial Department of Agriculture and Forestry
5. Risk communication initiated for the public and healthcare workers
6. Strengthened surveillance and disinfection of the surrounding environment, including the patient's residence and suspected exposure areas
7. Collaboration in performing laboratory samples with the WHO Collaboration Centre

Malaysia

In 2018, Malaysia reported 7 cases of H5N1 on poultry without any human infection. No further cases have been reported since 2019. To combat the spread of the disease numerous preventive measures had been implemented (ASEAN Secretariat, 2010):

1. Implementation of a National HPAI and A/H1N1 Surveillance Programmes across all 14 states, focusing on poultry and wild birds, including clinical and virology surveillance. Data collected from these surveillance programs is collated and analyzed by the Animal Disease Information Centre (ADIC).
2. Development of an early warning system for animal diseases is in place using a short messaging system (text messaging) to alert relevant authorities promptly.
3. Maintain central monitoring of animal and product movements between states through an e-permit system, ensuring controlled and traceable movements to prevent disease spread.
4. Production of an electronic based information system to improve animal disease reporting and managing the disease situation by monitoring its progress both at the state and central level, in a timely manner.

Myanmar

Myanmar reported its first HPAI (H5N1) outbreak in March-April 2006, followed by four other waves of HPAI (H5N1) outbreaks up to 2011 (Mon *et al,* 2012). The country had implemented systematic strategies to tackle the HPAI H5N1 outbreak through the National Strategic Plan for Prevention and Control of Avian Influenza and Human Influenza Pandemic Preparedness and Response (Ministry of Health Union, 2006). Several measures were implemented during the interpandemic phase, when the disease was transmitted only between birds and animals:

1. Strengthening surveillance of wild and migratory birds;
2. Strengthening surveillance of avian influenza outbreak in poultry and investigation and control of outbreak at source;
3. Surveillance of poultry farm workers and people who are in contact with birds;
4. Strengthening advocacy and implementation of good poultry farming practice in accordance with FAO and OIE guidelines;

5. Strengthening of laboratory facilities and human resource development; and
6. Intensify national and international networking especially with FAO, OIE, and WHO.

The country reported 1 human infection with no death in 2007 through routine surveillance after a poultry outbreak in November 2007 (WHO, 2007; WHO, 2023b). The positive H5N1 results were confirmed by laboratories in Yangon, Thailand, and Japan. The Ministry of Health, in collaboration with Livestock and Fisheries and WHO Country Office, discovered a poultry die-off near the case's home the week before the illness onset. No further human infections were found during surveillance, and no additional cases have been reported since then.

Philippines

In 2022, the Philippines reported its first cases of H5N1 avian influenza, with 208 cases detected in poultry. The number of cases declined in subsequent years, with 76 cases reported in 2023. As of June 2024, the country has reported 11 cases. No human infections have been reported.

On November 3, 2023, the Philippine Department of Agriculture issued Memorandum Circular No. 49, which introduces Guidelines on Targeted Vaccination for Avian Influenza Control in the Philippines as follows (DA, 2023):

1. A vaccination program to reduce virus spread, eradicate it, and prevent bird flu outbreaks in vulnerable regions, reducing economic losses and human exposure.
2. Poultry raisers have the discretion to use inactivated, vectored, and combination vaccines for AI control, as these options are permitted but not mandatory.
3. The AI vaccination program prioritizes groups based on their risk of virus exposure, offering protective emergency vaccination in areas with notable HPAI cases, and preventive vaccination in regions at high risk of HPAI outbreaks.
4. Eligible avian species for vaccination include commercial layer chicken, layer breeder, broiler breeder, colored/free-range breeder, grandparent broiler breeder, small-hold layer/native chicken, duck, game fowl, turkey, and goose.
5. Ineligible species for vaccination are commercial broiler chicken, small-hold broiler, quail, pigeon, and exotic birds.

Singapore

There have been no reported HPAI H5N1 infections in humans or animals in Singapore since its first reported cases in ASEAN. Despite the absence of infections, the country has implemented numerous preventive measures (Ministry of Health, Singapore, 2023):

1. Animal Health Efforts: Ensuring animals and animal products are only imported from disease-free zones or compartments;
2. Border Inspections: Screening live bird consignments at border checkpoints for avian influenza and conducting joint operations with the Immigration and Checkpoints Authority (ICA) to detect bird smuggling;
3. Biosurveillance Programmes: Monitoring local animal populations and migratory birds through both animal-based and environmental sampling, given Singapore's location along major migratory bird flyways;
4. Contingency Plans: Collaborating with multiple agencies to prepare plans that minimize the spread of disease in case of an outbreak, protecting the local at-risk population.

Thailand

In January 2004, HPAI subtype H5N1 was first confirmed in poultry and humans in Thailand (Gutiérrez et al., 2009). As of 2006, the country reported a total of 25 human infections with 17 deaths (CFR=68%). Since 2018, there have been no further reports of H5N1 infections in humans or animals in Thailand. The country has successfully implemented its national strategic plan for emerging infectious disease preparedness, prevention and response, such as:

1. Safe animal husbandry, including improvements in biosafety, adherence on international standards, poultry movement control in-country and cross-border, back-tracing practices in commercial poultry industry, as well as compensation and funding support for affected farmers;
2. Disease surveillance, prevention and control in animals and humans;
3. Preparedness for influenza pandemic
4. Multi-sectoral and international cooperation

Viet Nam

Viet Nam continuously reported H5N1 cases from 2018 to 2024. The country reported 1 case in 2018, 9 cases in 2019, 12 cases in both 2020 and 2021, and 69 cases in 2022. The peak occurred in 2023 with 120 reported cases. As of June 2024, Viet Nam has reported 9 H5N1 cases. To address the issue, the Government has taken the following public health response measures (WHO, 2024b):

1. Conducting epidemiolocal investigation, and disinfection of the patient's residence and suspected exposure areas.
2. Contact tracing, isolation, testing and monitoring for close contacts of the patient.
3. Testing of samples from chickens and ornamental birds near the patient's residence. All samples collected from these birds have tested negative for influenza A(H5) viruses.
4. Issuing an official letter requesting the Provincial Department of Health of Khanh Hoa province to prepare drugs (Oseltamivir), and other supplies, to timely support the local hospitals and authorities in patient management and containment of potential outbreaks.

Case Management and Prevention

Case Management

In the event of a suspected zoonotic influenza case, the relevant health authorities should be promptly notified and appropriate clinical case management initiated. This should include, but not be limited to, testing, triage, a clinical assessment for disease severity classification, an assessment of risk factors for severe disease, and isolation and treatment (for example, with antivirals and supportive care). It is of the utmost importance that patients with influenza are managed properly in order to prevent severe illness and death (WHO, 2007).

Treatment

WHO established a multidisciplinary panel to provide rapid advice on human H5N1 on pharmacological management. The guidelines were developed using the GRADE (Grading Recommendations, Assessment, Development and Evaluation) approach to ensure a transparent and evidence-based process (Schünemann et al., 2007). Oseltamivir administration is recommended for the treatment and prophylaxis of H5N1 cases following the recommended dose as follows:

Table 5. Recommended dose and duration of treatment and prophylaxis management of human infection of avian influenza A (H5N1) virus

Oseltamivir	Duration	Age groups (year)	
		1-12	>12
Treatment	5 days	Weight adjusted doses: 30 mg twice daily for ≤15 kg 45 mg twice daily for >15-23 kg 60 mg twice daily for >23-40 kg 75 mg twice daily for >40 kg	75 mg twice daily
Prophylaxis	Begin as soon as exposure identified and continue for 7–10 days after last known exposure	Dose varies by child's weight as for treatment once daily	75 mg/day

Additionally, the CDC recommends that the greatest clinical benefit is observed when treatment is initiated early, particularly within 48 hours of symptom onset. Hospitalized patients who have been confirmed, are suspected, or are probable cases of human infection with the H5N1 virus should begin antiviral treatment with oral or enterically administered oseltamivir immediately, regardless of the time since illness onset. The administration of treatment should not be postponed while waiting for laboratory test results (CDC, 2024).

Prevention

Influenza viruses, including H5N1 cannot be eradicated, and zoonotic infections will continue to occur. To reduce public health risks, it is essential to conduct quality surveillance in both animal and human populations, investigate each human infection thoroughly, and develop pandemic planning on risk assessment (WHO, 2023). It is also necessary to improve public awareness and behavior as follows:

1. Minimize contact with animals in high-risk areas like farms and live animal markets
2. Avoid surfaces potentially contaminated with animal faeces
3. Prevent high-risk groups (children, elderly, pregnant / postpartum women, immunocompromised) from handling poultry or slaughtering activities (e.g., collecting eggs, assisting with slaughtering, or preparing food)
4. Report sick or dead animals to wildlife/veterinary authorities
5. Practice frequent hand hygiene and good food safety habits (separating raw meat from cooked or ready-to-eat foods, keeping clean and washing hands, cooking food thoroughly, and handling and storing meat properly)

Individuals travelling to countries or residing in countries with reported outbreaks of avian influenza are advised to avoid contact with poultry farms, live animal markets, and areas with potential for poultry slaughter. Individuals who have travelled to regions affected by avian influenza should report any flu-like symptoms they may develop upon their return (WHO, 2023).

Policy and Recommendation

WHO Response to Avian Influenza Outbreak

WHO consistently monitors avian and other zoonotic influenza viruses thoroughly via its Global Influenza Surveillance and Response System (GISRS). In collaboration with the World Organisation for Animal Health (WOAH) and the Food and Agriculture Organization of the United Nations (FAO), WHO conducts surveillance at the human-animal interface, evaluates associated risks, and coordinates responses to zoonotic influenza outbreaks and other public health threats (WHO, 2023a).

Regional Disease Control and Prevention Policy & Strategy

Strengthening ASEAN's capacity to prevent, detect, and respond to zoonotic diseases using the One Health approach is essential to avert future pandemics. On October 4, 2023, during the 45th ASEAN Ministers on Agriculture and Forestry (AMAF) meeting, three policy and technical frameworks were adopted with support from FAO ECTAD and the Government of Australia. These frameworks aim to enhance cooperation for the sub-region's preparedness, prevention, and control of zoonotic and transboundary animal diseases (Putri, 2023).

The Post-2020 Avian Influenza Control Framework in ASEAN provides a comprehensive strategy to address avian influenza, building on the achievements of the HPAI-Free ASEAN Community Roadmap by 2020, emphasizing collaborative efforts to mitigate the disease's impact on poultry and public health (ASEAN, 2023b). The Policy Brief on Mitigating Risk of Zoonotic and EID points proactive strategies to identify risk factors along the livestock value chain to reduce disease risk effectively (ASEAN, 2023c).

The Assessment Tool for Regional Strategic Framework for Veterinary Epidemiology offers guidelines for evaluating and enhancing epidemiology capacities at regional and country levels, promoting harmonized initiatives and improved animal health management (ASEAN, 2023a).

The post-2020 framework focuses on three strategic goals:

1. Maintaining Free Status: Ensuring that Member States already free from avian influenza (AI) remain so.
2. Strengthening Control: Enhancing the ability of Member States experiencing occasional AI outbreaks to quickly control and recover from them.
3. Reducing Impact: Ensuring that Member States with a sustained presence of AI can mitigate its effects on the poultry industry and reduce the risk to human health.

To effectively achieve the strategic goals, key technical elements are essential. Implementation should consider the country's context and regional agreements. The technical elements and their implementation approaches are:

Table 6. Technical Elements and Implementation Approaches (ASEAN, 2023b)

No	Technical Elements
1	**Surveillance and monitoring**
	• **Systematic Collection:** Collect relevant health information systematically and timely. • **Continuous Collection:** Maintain ongoing or continuous data collection from populations or subpopulations. • **Practicable Methods:** Use methods that are uniform and rapid, though not necessarily completely accurate. • **Data Analysis and Communication:** Analyze, interpret, and communicate collected data. • **Dissemination:** Share surveillance results to inform evidence-based actions such as vaccination programs and guidelines.
2	**Laboratory capacity**
	• **Systematic Collection:** Collect relevant health information systematically and timely. • **Capacity Planning:** Develop detailed plans to enhance laboratory testing capacity to support surveillance and ensure an effective response during emergencies. • **Adequate Resources:** Ensure sufficient staffing, equipment, and supplies are available. • **Regular Training:** Conduct regular training for laboratory personnel as needed. • **Rapid Diagnosis:** Ensure rapid and definitive disease diagnosis in well-equipped laboratories with trained personnel. • **Technical Expertise:** ALDF could recommend creating a pool of experts for technical consultation and maximizing the role of ASEAN Reference Laboratories and centers. • **Framework Support:** Link the Regional Framework for Laboratory Capacities Building and Networking and its monitoring and evaluation (M&E) tool to support the implementation of this framework.
3	**Capacity building**
	• **Systematic Training:** Design and implement a systematic training program at regional and national levels. • **Familiarization:** Ensure trainees understand the clinical, pathological, and epidemiological features of AI. • **Disease Investigation Training:** Provide training on disease investigation techniques, reporting responsibilities, surveillance methods, and laboratory diagnosis. • **Training Opportunities:** Utilize various training methods such as: sending staff to other countries for gaining first-hand experience during major outbreaks, participating in international training opportunities, conducting national emergency disease training workshops, and academic education.
4	**Regionalization/ Zoning**
	• **Investment in Strategy:** Explore further investments in zoning and compartmentalization strategies. • **Certification System:** Develop a certification system based on zones and compartments. • **Cross-Border Checkpoints:** Maintain and determine critical checkpoints, strengthening the capacity of personnel managing borders.

	• **Bilateral/Zonal Cooperation:** Institutionalize cooperation mechanisms among neighboring countries to control AI and other transboundary animal diseases (TADs) .
5	**Border Control/ Animal Movement Management**
	• **Movement Management Protocols:** Develop regional protocols aligned with the certification system, indicating and accessing health information of animals. • **Good Animal Husbandry Practices (GAHP):** Adopt GAHP for poultry, especially layers and broilers, aligning with ASEAN GAHP on Broiler and Layer. • **Stakeholder Organization:** Involve key private sector stakeholders in industry-wide working groups or consultative bodies to ensure participation and buy-in for the system.
6	**Compensation**
	• **Incentive for Reporting:** Emphasize that compensation is an incentive to encourage rapid disease reporting, not to cover all losses. • **Policy Review:** Regularly review and ensure timely compensation to support control efforts. • **Alternative Means:** Explore alternatives like insurance or privately managed funds to support the compensation program.
7	**Farm Biosecurity**
	• **Attitudes and Behaviors:** Promote attitudes and behaviors that reduce risk in activities involving birds and their products. • **GAHP Importance:** Highlight biosecurity as crucial for Good Animal Husbandry Practices (GAHP), and elevate it through accreditation systems for farms and markets. • **Basic Principles:** Follow the basic principles of biosecurity, namely segregation, cleaning farm fixtures and materials, and disinfection • **Implementation Steps:** review existing measures, develop biosecurity plans, and establish audit system
8	**Vaccine and Vaccination**
	• **Early Availability:** Ensure the availability of the required type and quantities of vaccines at an early stage. • **Decision on Supply:** Decide whether to establish local vaccine production and an antigen bank or source vaccines externally via governmental or private links. • **Collaboration:** Collaborate with vaccine manufacturers, international organizations, and research institutions to ensure sufficient, safe, and effective vaccines. • **Deployment Planning:** Plan vaccine deployment, including the cold chain, targeted species, vaccination teams, and communication with local authorities and producers. • **Identification and Monitoring:** Implement permanent identification of vaccinated animals and conduct serological monitoring before and after vaccination to evaluate coverage and efficacy.
9	**Contingency Plan**
	• **Customized Plans:** Develop a contingency plan tailored to the country's unique circumstances and requirements for managing a disease emergency. • **Written Plan:** Ensure the plan is written so all involved know their roles, points of contact, and actions, which are clearly laid out and harmonized.
10	**Simulation**
	• **Purpose:** Use simulation exercises to test and refine contingency plans and standard operating procedures (SOPs) in advance of any disease emergency. • **Team Building:** Utilize simulations to build emergency response teams and train individual staff.

	• **Realistic Scenarios:** Create realistic scenarios using real data where possible. • **Training Components:** Provide comprehensive training for government veterinarians, private veterinarians, and livestock keepers on epidemiology and disease recognition
11	**Recovery Plan**
	• **Objective:** Develop a plan for the safe recovery and restoration of normal activities, possibly with modified procedures and practices based on outbreak experiences. • **Verification Programmes:** Implement verification programmes to demonstrate disease control and/or regained disease freedom to the international community. • **Community Recovery:** Plan for the recovery and rehabilitation of affected communities, including restocking and providing technical and financial support • **Shift in Focus:** As disease control measures diminish (e.g., stopping vaccination), shift the focus towards active disease surveillance, such as ongoing visits and sample testing, to detect any residual infection.

Several gaps and challenges were identified in implementing the Roadmap for an HPAI-free ASEAN Community by 2020 (ASEAN, 2023b):

1. **Laboratory Issues:**
   There is a need for upgraded equipment, inter-laboratory proficiency testing, biosafety level 3 (BSL3)-accredited laboratories, and technical support for AI tests. Furthermore, the lack of experts for laboratory diagnosis and facility use is also a concern.
2. **Surveillance Issues:**
   Technical support for passive and active surveillance, as well as wildlife surveillance and collaboration are strongly needed.
3. **Regional Collaboration Issues:**
   There is a need for sustainable resourcing and mechanisms, as well as enhanced wildlife surveillance. Early alert systems and rapid data sharing among ASEAN Member States (AMS) are crucial for supporting vaccination programs. Additionally, bilateral agreements should be guided by WOAH mechanisms on compartmentalization to ensure effective collaboration.
4. **Administrative and Legal Issues:**
   There are slow procurement processes and challenges in accessing emergency funds. Effective legislation for disease control is needed. Human resource limitations are evident, with the same personnel handling multiple diseases, highlighting the need for new recruitment.
5. **Other Issues:**
   There are concerns about biosecurity at farms and live bird markets, and current compensation mechanisms do not match the value of animals. Movement and border control issues, including undocumented trade, pose additional challenges. Increasing awareness to encourage the reporting of cases is also essential.

Lessons Learned

1. **Comprehensive Surveillance:** Active and continuous surveillance of poultry and human populations is critical for early detection and control of H5N1 outbreaks.
2. **Inter-agency Collaboration:** Effective collaboration between health, agriculture, and environmental ministries, along with international organizations, enhances outbreak response.
3. **Public Awareness and Biosecurity:** Promoting public awareness and biosecurity measures among farmers can prevent the spread of H5N1.
4. **Vaccination Programs:** Targeted vaccination programs in high-risk areas can reduce the spread of avian influenza and protect economic interests.
5. **Preparedness and Contingency Planning:** Preparedness plans, including early warning systems and rapid response teams, are essential for managing outbreaks.
6. **Cross-border Cooperation:** Regular bilateral meetings and quarantine regulations with neighbouring countries help prevent cross-border spread of the virus.

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