EPIDEMIOLOGY OF AVIAN INFLUENZA

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Scientist

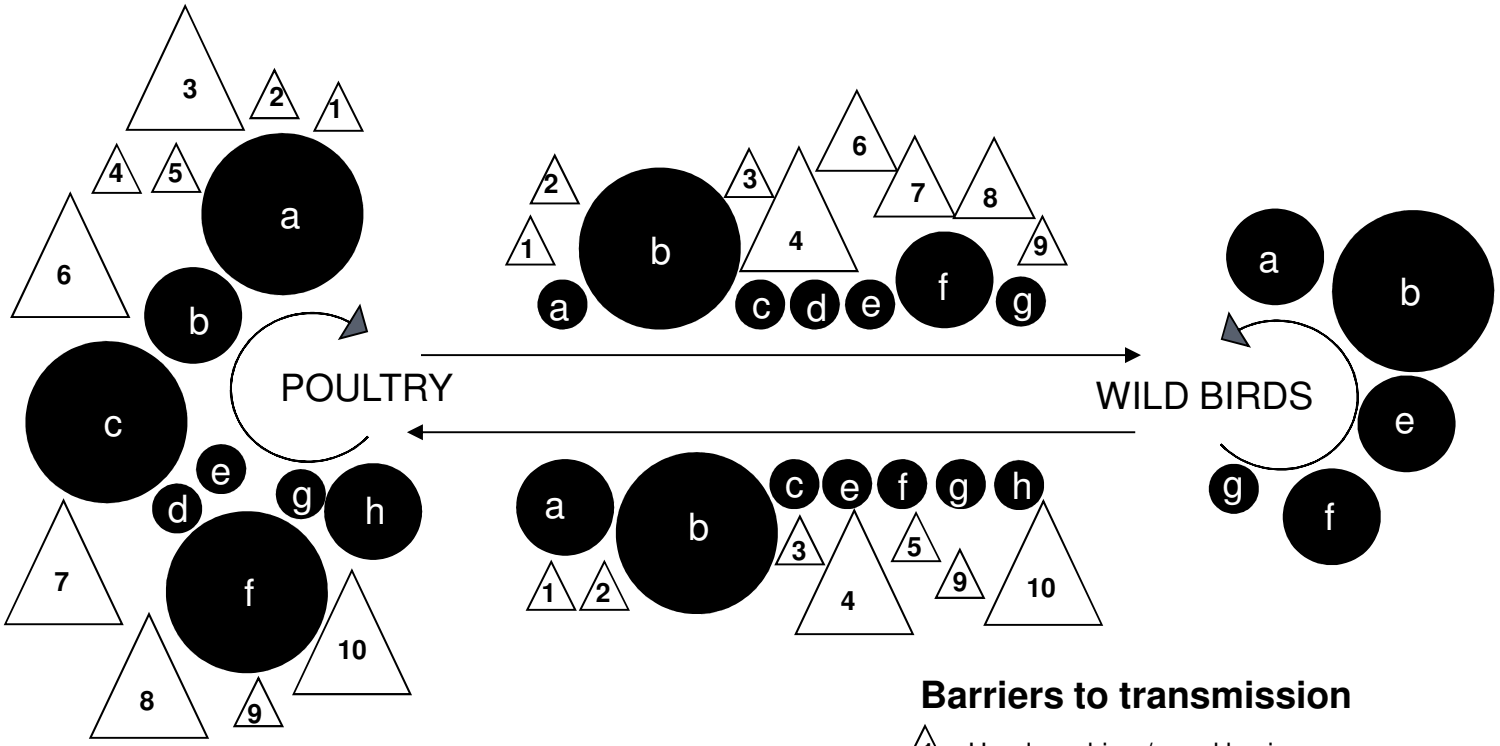
NIVEDI,Bangalore

INTRODUCTION

- *Orthomyxoviridae* family – Type A, B and C
- Influenza A viruses - variety of animals, including humans, pigs, horse, sea mammals and birds.
- Type B viruses affect human beings only
- Type C viruses affect human beings and pigs
- Type A influenza virus – H1 to H16 and N1 to N9 subtypes
- Notifiable form of AI is defined as ***an infection of poultry caused by any influenza A virus of the H5 or H7 subtypes or by any AIV causing at least 75% mortality or with an IVPI greater than 1.2.*** Notifiable AI viruses can be divided into **HPNAI and LPNAI**

H5N1 –GLOBAL OVERVIEW

- Since 2003, H5N1 has killed or forced the culling of more than 400 million domestic poultry and caused an estimated US$20 billion in economic damage across the globe before it was eliminated from most of the 63 countries infected at its peak in 2006.
- The H5N1 HPAI virus remains endemic in six nations.
- The period January to March is generally considered the peak of the H5N1 HPAI season, when outbreak numbers increase following an active period of disease events/reports (October to December)
- Effective control measures for outbreaks in poultry have been associated with a reduced incidence of human infections in several countries.



Sources of infection

- a Feces
- b Contaminated environment / body of water
- c Contaminated equipment / vehicles
- d Eggs & meat
- e Secretions
- f Carcasses / live infected birds
- g Pests (insects, rodents, cats, etc.)
- h Contaminated clothing / footwear

Barriers to transmission

1. Hand-washing / good hygiene
2. Personal protective equip. / dedicated clothing
3. Vehicle & equipment disinfection
4. Enclose birds / avoid attractants
5. Restricting movements on and off premises
6. Depopulation
7. Vaccination
8. Proper disposal of carcasses
9. Pest control
10. Avoiding contaminated environment / carcasses

HPAI in India

- H5N1 virus moved to south asia over himalayas,probably by migratory birds (Chen et al., 2005)
- First detected in poultry in India during Feb 2006 from Maharashtra.
- 50,000 birds died in Nandurbar district of western Maharashtra state and in Jalgaon district and in some poultry farms near Surat in Gujarat.
- Over 31,045 people were tested in Navapur town and an additional 23,925 people in the infective zone village, but none was found positive for H5N1 infection.
- Migratory birds may play a crucial role in spread and emergence of new strains of viruses. There are more than 173 migratory bird destinations in India.

- The states affected with H5N1 AI outbreaks(from 2006-2012) were Maharashtra, Madhya Pradesh, Gujarat, Manipur, Assam, West Bengal, Tripura, Sikkim, Odisha, Meghalaya, Karnataka.
- Among the affected states, maximum number of outbreaks occurred in West Bengal (55) followed by Assam (18).
- Totally 16 districts affected in Westbengal, 9 districts in Assam, 4 districts in Tripura,2 districts in Orissa, and in others single district.
- Among the various districts affected, maximum number of outbreaks occurred in Murshidabad followed by Kamrup in Assam

- Outbreak frequencies were more during winter/cold season than any other seasons.
- Outbreaks were more common in January month which has very low temperature in most parts of India.
- 2008-2012
- Case fatality rate (CFR) was calculated for different states based on year wise data. CFR ranges from 37.16% - 100%.
- Apparent Morbidity rates were ranged from 0.15% -93.05%.Apparent mortality rates were ranged from 0.15% -92.4%.
- H5N1 AI Prevalence for different states ranged from 0.21 % to 13.53%. The overall prevalence was 1.68%.

Species	Year	State
Ducks	2008	West Bengal Assam
	2008,2011	Tripura
	2012	Odisha
Crows	2011	Jharkhand
	2012	Bihar,Maharashtra, Odisha
	2008	Assam
Goose	2008	Tripura
Turkeys	2012	Karnataka

LPAI viruses reported in India

- A duck influenza virus strain H4N2 was isolated from the cloacal swab of a domestic duck from Tirunelveli town, Tamil Nadu in 1978.
- Duck influenza virus strains H9N2 and H9N3 were isolated during an outbreak of respiratory distress with 15%–20% mortality at a duck farm in Kerala in 1985.
- Influenza virus strains similar to H2N2 and H3N2 isolated from avian species at Kasauli. Explosive outbreaks of equine influenza caused by H3N8 and H7N7 strains in horses have been reported from north and northwest India in 1987.
- Serological investigations from pigs, birds, horses, dogs, goats and bats by the National Institute of Virology, Pune.
- The study conducted on pig sera collected from different states of India between 1968 and 1973 demonstrated the prevalence of antibodies to human H3N2 strains and absence of infection with swine influenza H1N1 strain

- Similar studies conducted on pig sera collected from Pune in 1980, and Andaman and Nicobar islands in 1988 showed the prevalence of antibodies to human H3N2 and H1N1 strains and absence of infection with the swine influenza strain H1N1. Serological survey of equines from Pune between 1987 and 1989 showed the prevalence of antibodies to horse influenza strains H7N7 and H3N8.
- The study on dog sera showed the prevalence of antibodies to the human H3N2 and H1N1 strains, and bat sera to the human H1N1 strain.
- Bird and goat sera were tested to know the prevalence of antibodies against human influenza strains but were negative

AIV Outbreaks in poultry (India) from 2006 to 2013

YEAR	States	Total No. of Outbreaks (100)
2006	**Maharashtra, MP, Gujarat**	**7**
2007	**Manipur**	**1**
2008	**Assam ,West Bengal, Tripura**	**54**
2009	**Sikkim, West Bengal, Assam**	**15**
2010	**West Bengal, Tripura, Orissa**	**5**
2011	**Orissa, Maharashtra, West Bengal**	**4**
2012	**Meghalaya, Orissa, Tripura, Karnataka**	**8**
2013	**Bihar, Chattisgarh**	**3**

Massive Crow mortalities were in Jharkhand, Bihar, Odisha , Maharashtra in 2011-2012 due to H5N1

- Long distance migration of wild birds, poultry production and trade Advancements in transportation, coupled with the global food chain, enable the virus to be spread anywhere.
- Migratory birds, especially wild waterfowl such as Anseriformes and charadrillformes, are considered natural carriers of all avian influenza A viruses.
- Transmission of AIV via fecal contaminated water –oral route probably a major mechaniam of virus dissemination among aquatic birds.
- Birds infected with AIV excrete large amounts of virus in faeces and other secretions, which contaminate directly the environment such as soil, water, cages, tools and other fomites.



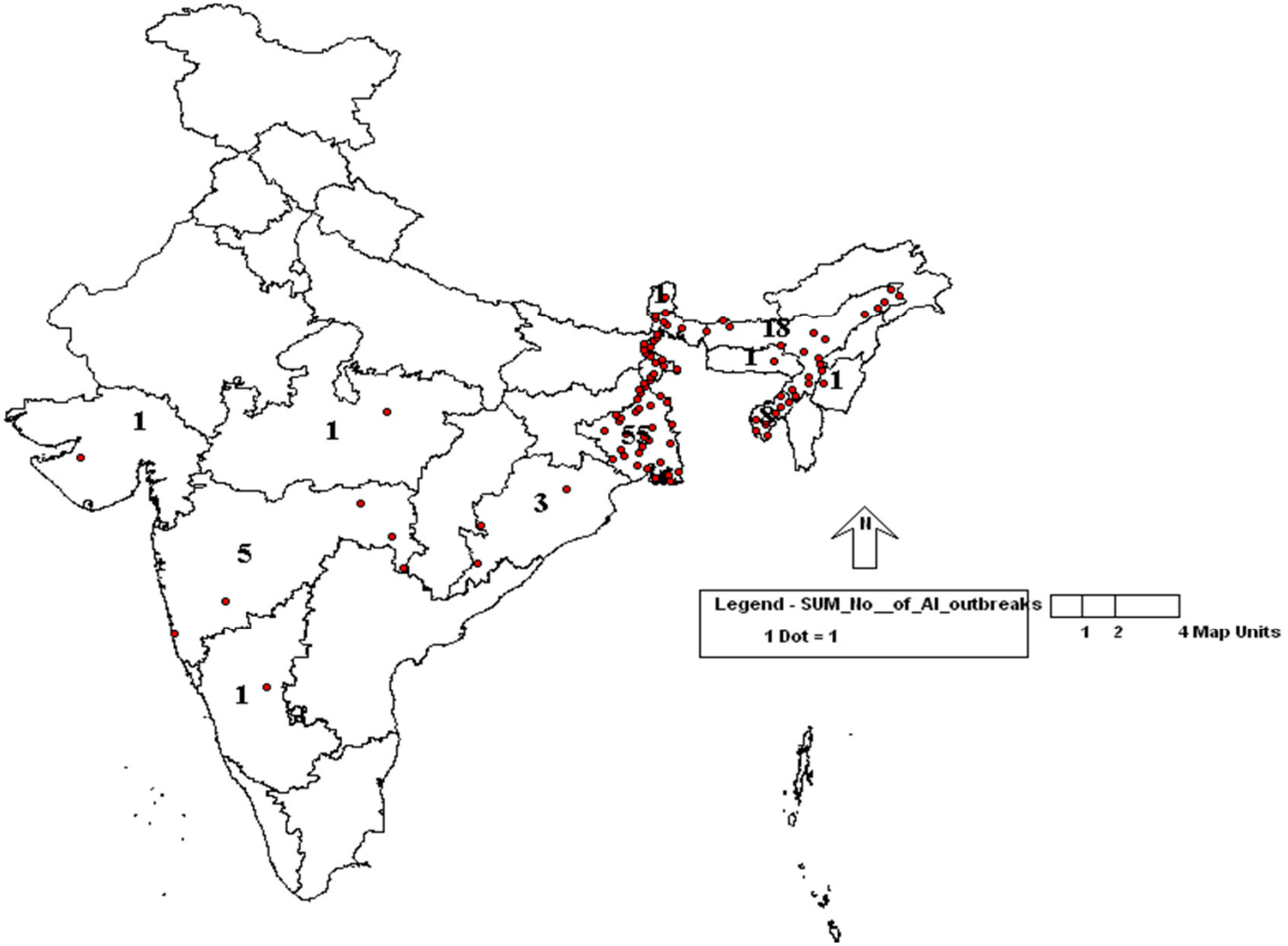
- Human transmission occurs through direct contact with birds or contaminated fomites.
- AIV may remain infectious in soil, water or contaminated equipments for weeks to months depending on the temperature and humidity
- It is proposed that HPAI viruses emerge in chickens only after the viruses had crossed from feral birds (Perdue et al.1998).

- Previously, an assortment of different classification systems was used to designate branches of evolutionarily distinct strains of H5N1.
- The current system is made up of 10 distinct clades with further subclades designated by decimal points to indicate additional sequence divergence from ancestral viruses.
- Phylogenetic studies have been conducted to determine the clade and subclades of previously and currently circulating H5N1 viruses capable of infecting humans in several countries and regions,

- The first strain of H5N1 to emerge in 1997 is of clade 0 origin,
- the 2003–2005 human outbreaks in Vietnam and Thailand are attributed to clade 1 viruses,
- clade 2.1 viruses are responsible for Indonesian outbreaks.
- The most geographically widespread H5N1 strain, the clade 2.2 viruses, has spread from Qinghai Lake in China throughout parts of western Asia, Europe,
- clade 2.3 viruses are predominantly isolated in southern China, clade 7 viruses are similarly predominantly isolated in China
- Since 2008, the currently circulating clades of H5N1 infecting humans are 2.3.2 (China),2.3.4 (China and Vietnam), 2.2 (Egypt), 2.1 (Indonesia),1 (Cambodia) and 7 (China)

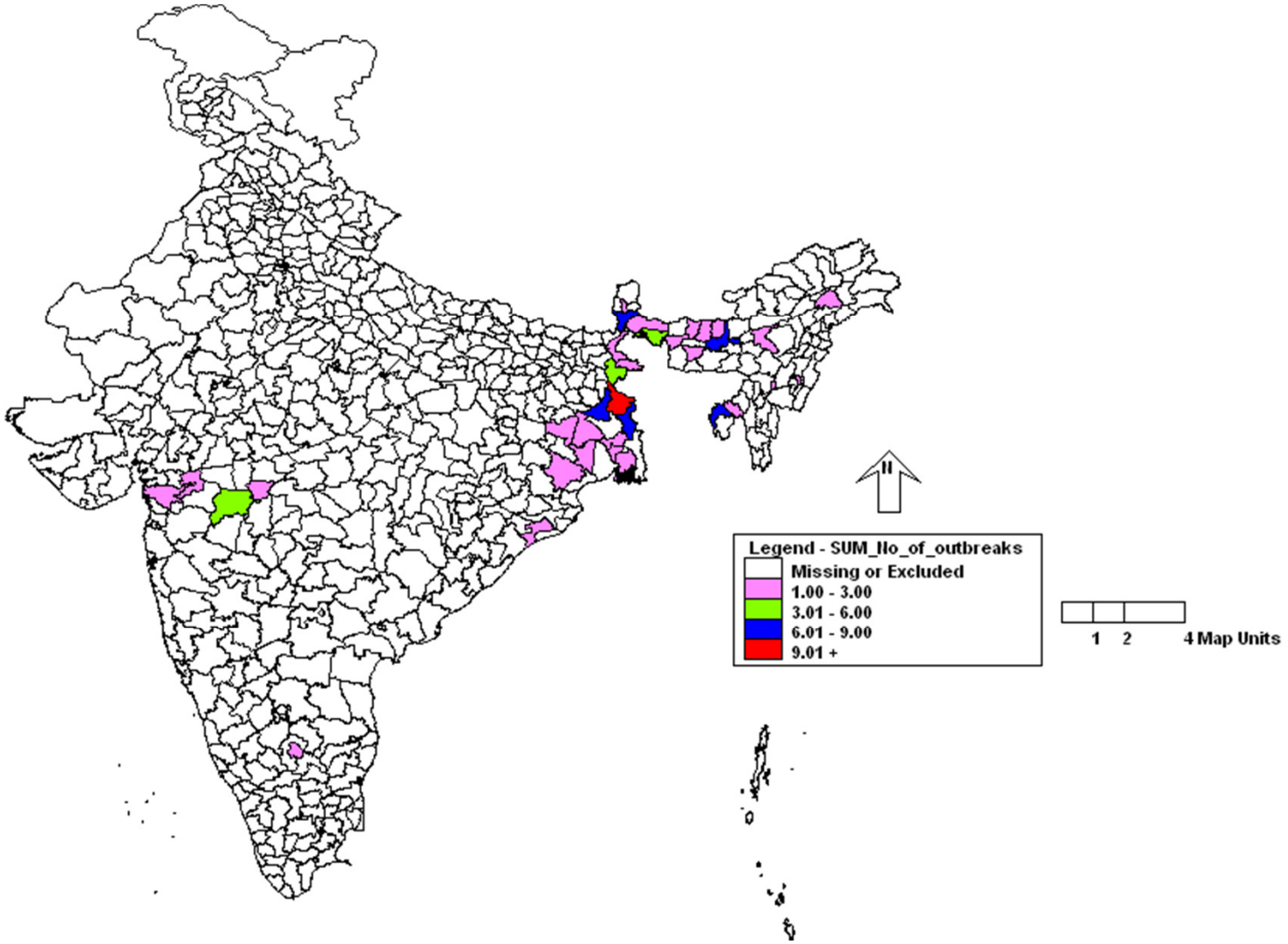


H5N1 AI OUTBREAKS IN DIFFERENT STATES FROM 2006-2012

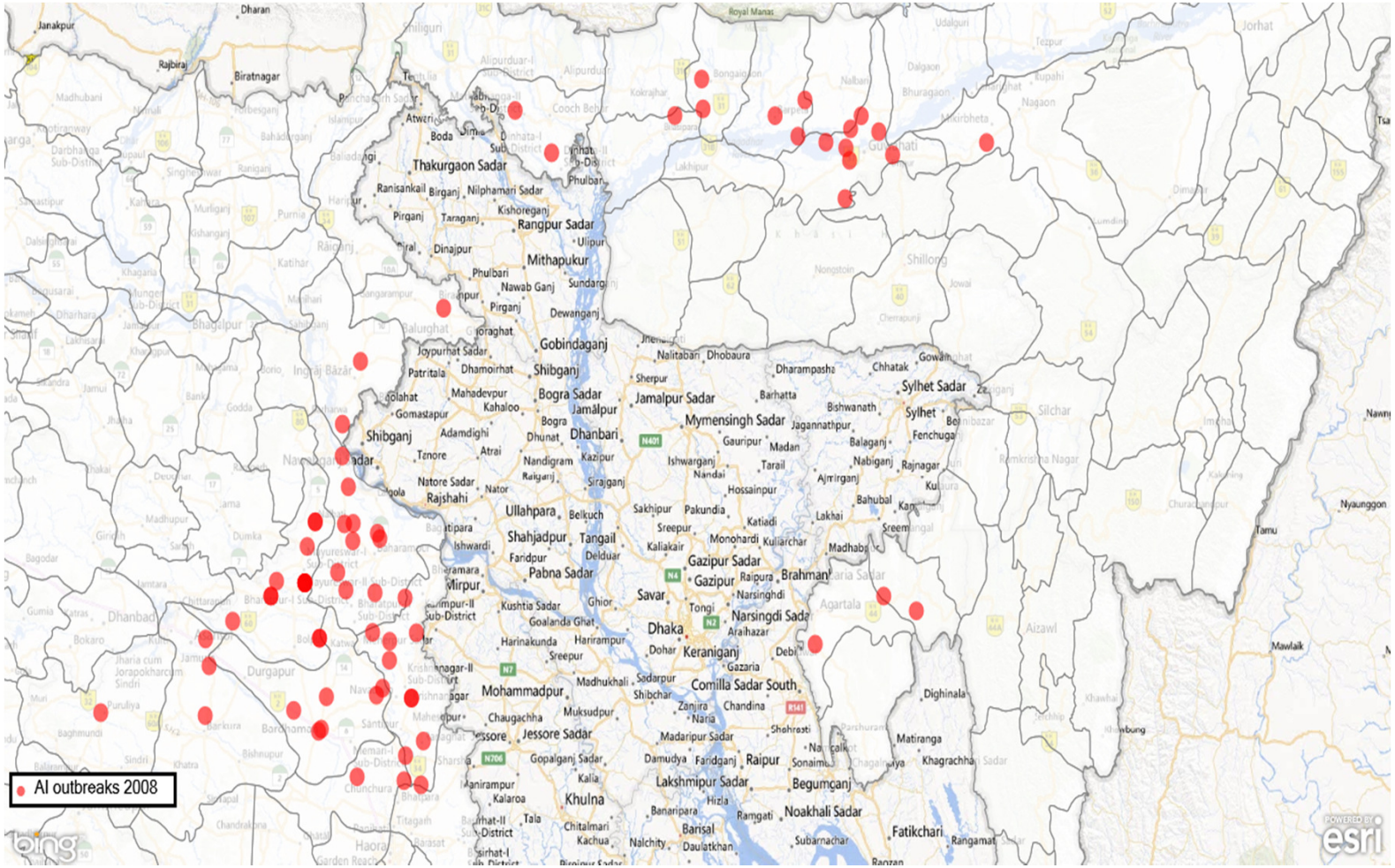


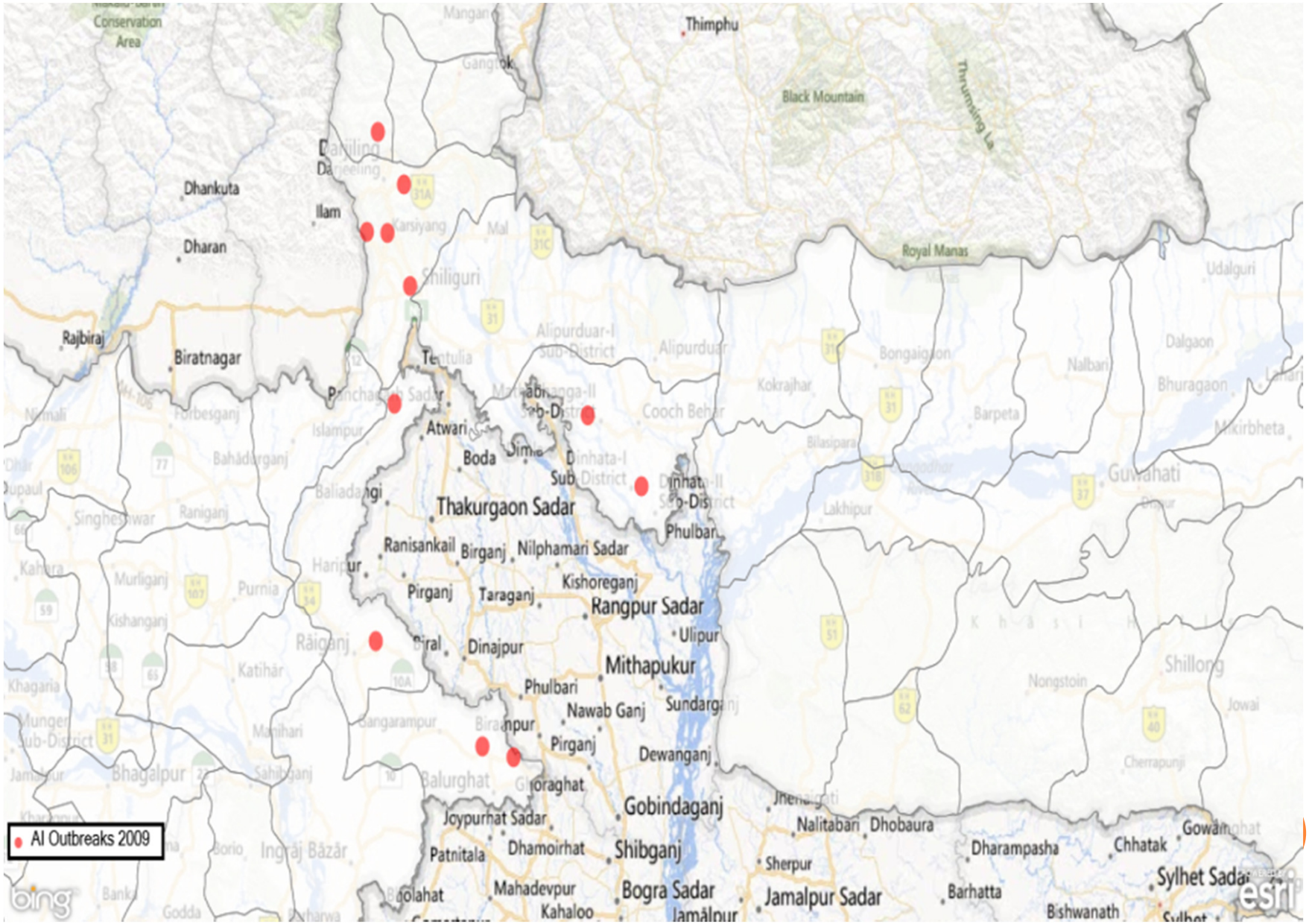
District wise H5N1 outbreaks

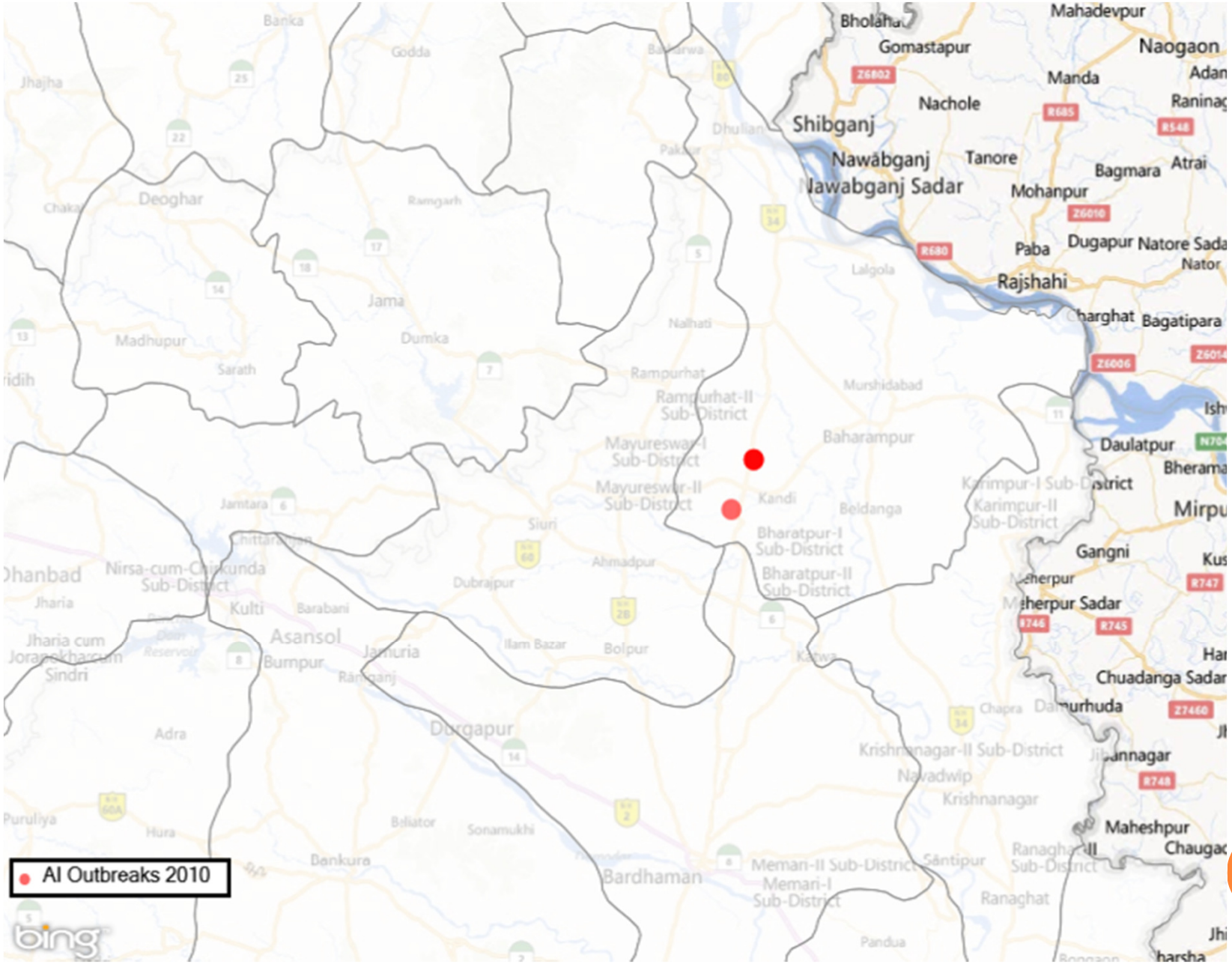
2006-2012



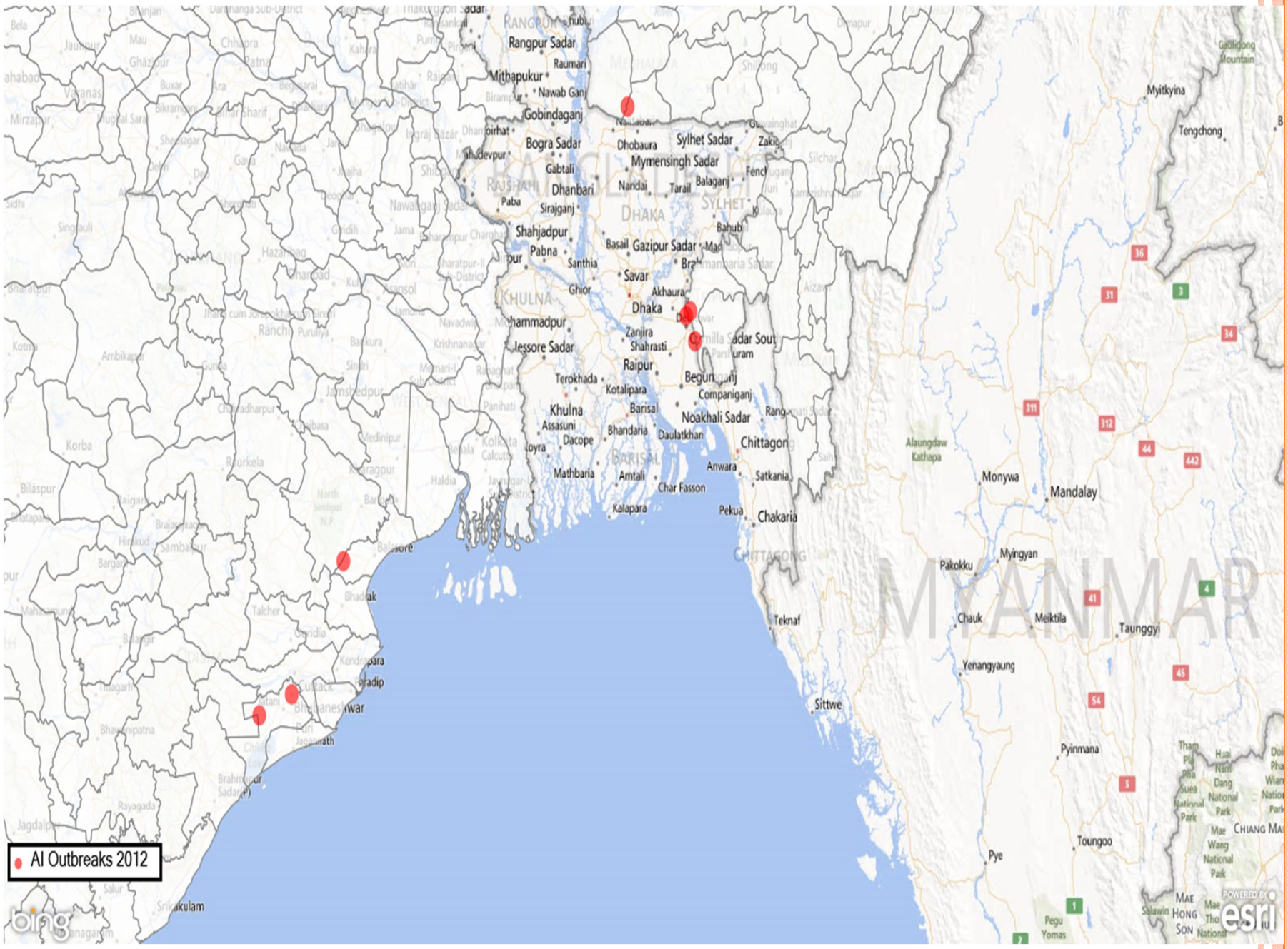
Spatio-temporal mapping of H5N1 AI outbreaks



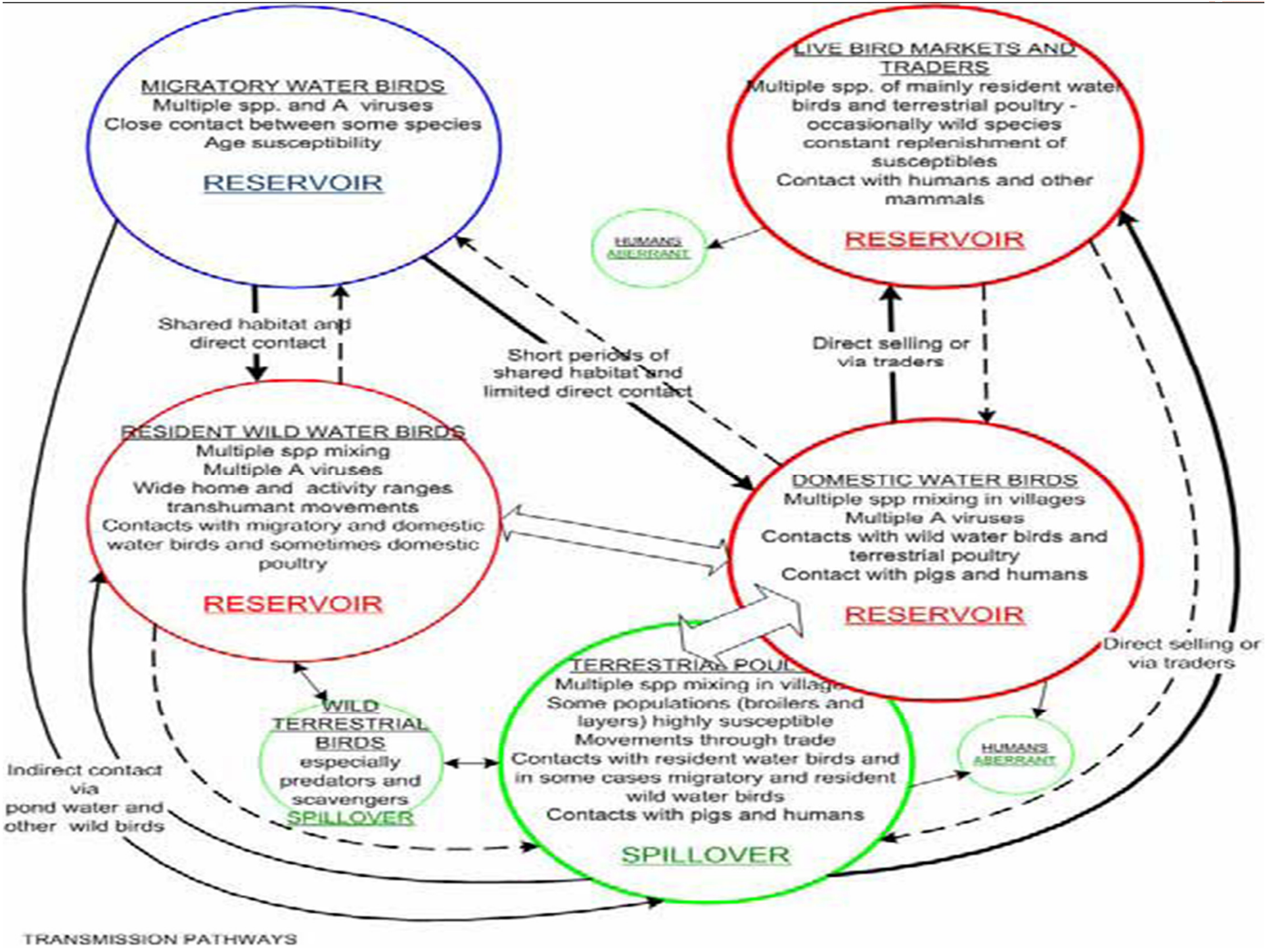

AI Outbreaks 2009
Thimphu
Black Mountain
Thrumsing La
Royal Manas
Conservation Area
Dhankuta
Ilam
Dharan
Rajbiraj
Biratnagar
Siliguri
Kharsiyang
Alipurduar-I Sub-District
Alipurduar
Cooch Behar
Kokrajhar
Bongaigaon
Nalbari
Dalgaon
Udalguri
Bhuragaon
Barpeta
Guwahati
Lakhipur
Bilasipara
Atwari
Boda
Thakurgaon Sadar
Ranisankail
Birganj
Nilphamari Sadar
Kishoreganj
Pirganj
Taraganj
Rangpur Sadar
Ulipur
Dinajpur
Mithapukur
Phulbari
Nawab Ganj
Sundargan
Dewanganj
Gobindaganj
Joypurhat Sadar
Patnitala
Dhamoirhat
Shibganj
Bogra Sadar
Mahadevpur
Kahaloo
Jamalpur Sadar
Sherpur
Barhatta
Nalitabari
Dhobaura
Dharampasha
Chhatak
Sylhet Sadar
Bishwanath
Shillong
Nongstoin
Jowai
Cherrapunji
Bhagalpur
Balurghat
Katihar
Purnia
Murliganj
Kishanganj
Raniganj
Singheshwar
Forbesganj
Bahadurganj
Islampur
Phulbari
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AI Outbreaks 2010
Mahadevpur
Naogaon
Gomastapur
Manda
Nachole
Shibganj
Nawabganj
Tanore
Bagmara
Atrai
Nawabganj Sadar
Mohanpur
Paba
Dugapur
Rajshahi
Bagatipara
Daulatpur
Gangni
Chuadanga Sadar
Maheshpur
Deoghar
Jama
Madhupur
Dumka
Rampurhat-II Sub-District
Mayureswar-I Sub-District
Mayureswar-II Sub-District
Baharampur
Kandi
Beldanga
Bharatpur-I Sub-District
Bharatpur-II Sub-District
Karimpur-II Sub-District
Nirsa-cum-Chirkunda Sub-District
Kulti
Asansol
Durgapur
Adra
Bardhaman
Memari-II Sub-District
Memari-I Sub-District
Krishnanagar-II Sub-District
Krishnanagar
Navadwip
Ranaghat
Santipur
Bolpur
Dubrajpur
Sonamukhi
Bankura
Puruliya
Jharia
Dhanbad
Jharia cum Jorapokharcum Sindri
Jamuria
Burnpur
Barabani
Ilam Bazar
Pandua
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AI Outbreaks 2011
Janakpur
Dharan
Biratnagar
Darjilin
Darjeelin
Rangpur Sadar
Raumari
Mithapukur
Nawab Ganj
Gobindaganj
Bogra Sadar
Gabtali
Dhanbari
Paba
Sirajganj
Shahjadpur
Pabna
Santhia
Ghior
Jessore Sadar
Terokhada
Khulna
Assasuni
Dacope
Mathbaria
Kalapara
Raipur
Kotalipara
Barisal
Bhandaria
Amtali
Char Fasson
Dhobaura
Sylhet Sadar
Mymensingh Sadar
Nandai
Tarail
Balaganj
Gazipur Sadar
Basail
Savar
Akhaura
Dhaka
Zanjira
Shahrasti
Begum
Companiganj
Noakhali Sadar
Daulatkhan
Chittagon
Anwara
Satkania
Pekua
Chakaria
Alaungdaw Kathapa
Royal Manas
Thrumsing La
Mountain
BHUTAN
RANGPUR
RAJSHAHI
DHAKA
KHULNA
BARISAL
SYLHET
MEGHALAYA
BANGLADESH
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AI Outbreaks 2012
Rangpur Sadar
Mithapukur
Nawab Ganj
Gobindaganj
Bogra Sadar
Dhobaura
Sylhet Sadar
Mymensingh Sadar
Gabtali
Dhanbari
Nandai
Tarail
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Char Fasson
Anwara
Satkania
Kalapara
Pekua
Chakaria
Teknaf
Sittwe
Myitkyina
Tengchong
Alaungdaw Kathapa
Monywa
Mandalay
Myingyan
Pakokku
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Gabtali
Dhanbari
Nandai
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Shahjadpur
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Dacope
Chittagong
Mathbaria
Amtali
Char Fasson
Anwara
Satkania
Kalapara
Pekua
Chakaria
Teknaf
Sittwe
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TRANSMISSION PATHWAYS

Species-specific infection information for poultry and other owned birds

In the AREAS with mixed populations of birds, village chickens and ducks were the principal focus of clinical disease.

although a range of other species were also involved.
Outbreaks appear also to be predominantly in smaller flocks.

A notable feature is the apparent under representation of outbreaks from larger scale commercial flocks.



Survival of influenza viruses in the environment

Influenza A viruses have exceptionally long survival times outside tin a favourable environment.

When excreted by water birds they can survive in lake water for many months at 17 ℃, and for even longer at 4℃.

Infectivity of this virus for hosts is variable, depending on strain and environmental factors. In less favourable environments,in faecal material survives 24 to 48 hours.

very significant issue for transmission within wild bird populations, where water contamination may continue to provide a source of infection for extended periods, especially in the northern breeding grounds

Under village conditions in India virus survival in the environment can also be important, but its role depends on temperature, the nature of fomites which may carry virus, and density of birds.

Maintenance of infection in wild and domestic bird populations is considerably more important than environmental sources in spreading infection to new locations.

Exposure of people to virus occurs through direct handling of infected birds and consumption of raw products or contamination of fomites with virus from uncooked poultry.

THANK YOU

