Combating zoonoses in India: need for ‘disciplinary’ convergence

Manish Kakkar MD MPH
Public Health Foundation of India
February 2009, North Carolina
Key issues

• Distribution and trends of major zoonoses in India
• Factors that make India more vulnerable
• Possible mechanisms for inter-sectoral collaboration
• Opportunities to move ahead
Why zoonoses need special focus?

• **Dual burden** of human and animal diseases

• >58% of the human pathogens are zoonotic
  – 20 of 27 infectious diseases in WHO’s GBD DALY¹

• **Under diagnosed and under-reported**

• ‘Spill over’ and ‘pathogen pollution’ to and from wildlife (BSE, SARS, nipah, hanta) - How many other new agents are lurking in our wildlife?

• **Global climate change** and its effect on vector bionomics and disease prevalence

¹Source: Coleman, 2002
Why zoonoses need special focus?

- Tend to affect poor families in poor and marginalized communities; livestock contribute to livelihoods of at least 70% of world’s rural poor
- Major changes in global food consumption patterns; shift from a resource (feed availability) driven system to a demand driven system (LIVESTOCK REVOLUTION) thus greatly increasing human-animal contact
- Limited capacity: training, research, response
Distribution and trends of major zoonoses in India
Emerging and re-emerging diseases in India in recent past

<table>
<thead>
<tr>
<th>Disease/ agent</th>
<th>Year of emergence/ re-emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibrio cholerae O139 (West Bengal)</td>
<td>1992</td>
</tr>
<tr>
<td>Nipah virus  (West Bengal)</td>
<td>2001, 2007</td>
</tr>
<tr>
<td>?SARS</td>
<td>2003</td>
</tr>
<tr>
<td>Chandipura virus disease</td>
<td>2003 (Maharashtra, Andhra), 2004 (Guj)</td>
</tr>
<tr>
<td>Scrub typhus</td>
<td>2003, 2005</td>
</tr>
<tr>
<td>Dengue (Sikkim)</td>
<td>2004</td>
</tr>
<tr>
<td>Trypanosomiasis (T evansi)</td>
<td>2004</td>
</tr>
<tr>
<td>Leptospirosis pulmonary (Mumbai)</td>
<td>2005</td>
</tr>
</tbody>
</table>
Distribution and trends of major zoonoses in India

• Epidemic prone:
  – Large outbreaks
    • Avian influenza (H5N1)
    • Chikungunya
    • Japanese encephalitis
    • Leptospirosis
  – Focal outbreaks
    • Anthrax
    • Scrub typhus
    • Chandipura
    • Nipah
    • Trypanosmiasis

• Neglected zoonoses:
  – Rabies
  – Brucellosis
  – Bovine tuberculosis
  – Cysticercosis
Chikungunya re-emergence, India (2006-07)

Epidemics reported
1963 (Kolkata), 1965 (Pondicherry, Tamil Nadu, Andhra Pradesh, in Madhya Pradesh, Maharashtra) 1973 (Barsi in Maharashtra)

Sporadic cases
1983 and 2000: Yawat in Maharashtra

2006-07 epidemic
1.4 million cases; 13 states (including NCT of Delhi), 210 districts; no deaths
Japanese encephalitis, India (2001-05)

Outbreaks reported from 25 states

Cumulative human cases, JE endemic districts, 2001-05 (<11 to >1650 cases)

Average CFR: 20% - 40%

High mortality in piglets, reproductive failure in adult pigs, decline in meat production & encephalitis in equines (Nageelavathi et al, 2008)

Socio-economic significance of piggeries, particularly in the NE

Source: NVBDCP
Spread of Avian Influenza (H5N1), India (2006-2009)

<table>
<thead>
<tr>
<th>Year</th>
<th>State</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2008</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>2009</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>8*</td>
<td>33</td>
</tr>
</tbody>
</table>

* 2 separate outbreaks in West Bengal

Estimated economic loss: US$ 2 billion (Business Standard, 2008)

Source: www.oie.int
Leptospirosis in India (1984-2008)

Seropositivity
- Domestic animals: 57%
- Wild animals in captivity: 73%

Loss of productivity in cattle

States reporting human outbreaks

States reporting sporadic human cases
Zoonoses in India

Rabies
• 50% of global mortality; 20,000 (APCRI, 2003);
• National Rabies Control Program absent
• National mass canine vaccination program absent
• Rabies deaths -1.74 million DALYs lost/ year in Asia & Africa and US$ 583.5 million (Knobel et al, 2005)

Brucellosis
• 5% of cattle & 3% of buffaloes infected with brucellosis¹; up to 24% in some populations²
• Estimated annual loss: Rs. 350 million
• True incidence of human brucellosis not known; 25X reported incidence; Sero-prevalence of up to 8.5% in occupational groups

Zoonoses in India

Anthrax

- Actual incidence not known
- Transmission to humans is low; animal-to-human transmission ratio is 20/1
- 95% Cutaneous anthrax
- Wildlife constantly threatened

Bovine Tuberculosis

- Little information on transmission & impact on human health.
- **Mixed infection** in humans (8.7% samples) & in cattle (35.7% samples); potential **zoonosis** & **reverse zoonosis** (Prasad et al, 2005)
- Isolation in cattle: M.tb 8.7%; M.bovis 25% (Srivastava et al, 2008)
Cysticercosis, India

Humans:

• 8.7-50% of patients recent onset of seizure.
• Prevalence of taeniasis: 0.5-18.6%; up to 38% in pig-rearing community (Prasad et al, 2007)

Porcine:

• Prevalence of porcine cysticercosis: 7-26% (Prasad et al, 2002)
# Zoonoses in India

## Reported attacks (cases) in animals

<table>
<thead>
<tr>
<th>Year</th>
<th>Anthrax</th>
<th>Rabies</th>
<th>Brucellosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>839</td>
<td>47</td>
<td>24</td>
</tr>
<tr>
<td>2004</td>
<td>519</td>
<td>152</td>
<td>46</td>
</tr>
<tr>
<td>2005</td>
<td>668</td>
<td>84</td>
<td>13</td>
</tr>
<tr>
<td>2006</td>
<td>616</td>
<td>43</td>
<td>551</td>
</tr>
</tbody>
</table>

Source: Department of Animal Husbandry, GoI (www.dahd.nic.in)
Why makes India more vulnerable?

Why special focus on India?
Why special focus on India?

EMERGING INFECTIONOUS DISEASES ‘HOTSPOTS’

Source: Jones et al (2008)
Why special focus on India?

Pathogens reported by global location via ProMED (2007-08)

Source: ProMEDmail.org
Demographic factors

Decadal population growth (1951-2010)

Urbanization (1901-2001)
International travel

Growth in International Air Traffic, India (2003-2010)

- 40% of India's trade by value, and 95% of international travel to and from India
- International passenger traffic growth: 8.4% annually (2005-2009)

Source: Ministry of Civil Aviation, GoI, 2006
Socio-cultural-economic factors

- 80% population lives in close contact with domesticated animals & poultry; there is also an abundance of vectors

- 70% livestock market owned by 67% of small and marginal farmers and by the land less

- Farming is unorganized and backyard

- 53% of world buffalo population; 15% of world cattle population; 5th rank in sheep population

- 1st in milk production (100.9 million tonnes, 2006-07)

- 3rd in egg production (51 billion, 2006-07)

- 2.3 million tonnes of meat annually (2006-07); animals slaughtered for meat rose from 66 million in 1980 to 106 million in 2000 (2x)
Tropical livestock unit density
Sub-Saharan Africa & South Asia

Source: Emerging Technologies to Benefit Farmers in Sub-Saharan Africa and South Asia, NAP, 2008
V cholerae O139
Dengue
Nipah
Avian flu (H5N1)
Chikungunya
‘hotspot’
Environmental factors

Forest Cover, India (1990-2005)

- **1990**: 64 million ha
- **2000**: 67.5 million ha
- **2005**: 67.7 million ha

**Annual Change**:
- 1990 to 2000: 0.57%
- 2000 to 2005: 0.04%
Carbon Emissions, India and China

Energy consumption by fuel, India (2005)

>2000 million MT by 2030
Public health, veterinary, wildlife surveillance & response capacity

Public Health
• Zoonoses not an organized effort in national program
• Mainly follows major outbreaks/ disasters
• Not enough laboratory capacity for diagnosis & monitoring

Veterinary
• Commodity surveillance does not exist
• No regular detection of disease; only following events of disease morbidity/ mortality

Wildlife
• Mainly conceptual & amateur
• Census reporting and disaster type reporting
• No mechanism for surveillance of animal diseases
Capacity building efforts

**Veterinary education**
- 33 veterinary colleges in 23 states versus 192 medical colleges
- VPH focuses on animal health
- Few post graduate
- Companion-animal practice preferred over public health
- Veterinarians not well conversant with sociological aspects

**Medical education**
- Zoonoses disjointed in disciplines
- Ecology of micro-organisms not emphasized
- Onus of zoonoses on veterinarians
- Typical physician doesn't inform clients of the risks; 'that's for veterinarians.
- Public health professionals not well conversant with role of animal health professionals or control strategies
Inter-sectoral and inter-disciplinary coordination

• Only 2 broad mechanisms exist:
  – National Joint Working Group on avian influenza (MoH, DAH, MoEF)
  – National standing committee on zoonoses under chairmanship of DGHS

• No effective coordination mechanism at state and district level

• Recent efforts in IDSP following Avian Influenza (H5N1)
Current approaches to Zoonoses prevention and control: ‘Divided Constituencies’

- **HUMAN**
  - Surveillance
  - Prevention
  - Control

- **VETERINARY**
  - Surveillance
  - Prevention
  - Control

- **ZOOONES TRANSMITTED**
  - Leptospirosis
  - Anthrax
  - Intestinal parasites

- **COMMODITY**
  - Farm animals/livestock
  - Wildlife

- **POPULATIONS**

PUBLIC HEALTH FOUNDATION OF INDIA
What are the options in large and diverse country like India?
The changing paradigm: approaches for multi-sectoral collaboration

- ‘One health’ Integrated approach:
  - Coordinated public and animal health action on an equal partner basis

- ‘Separable cost’ approach for sector-wise spending
  - Cost sharing maximizing benefits to all sectors

- Shift from organism and sector focus to ‘population’ and ‘commodity’ focus

- Shift from disease reduction to RISK reduction

- Not perfect but more efficient; sensitive versus specific; prevention versus control
Comparative advantages of integrated approach

Non-monetary benefits:
- DALYs averted

Monetary benefits:
- Improved productivity
- Animal treatment savings
- Human treatment saving
- Loss of income saved for patient and caretakers
Experience from other region
(approaching integration)

EXPERIENCE: Transforming dual burden into dual benefit

Brucellosis control in Mongolia using ‘separable costs’ approach

• 16% infectivity in herdsman and other animal workers

• Using ‘separable costs’ approach, if monetary costs of brucellosis were shared between health and veterinary sectors proportionately to monetary benefits, controlling brucellosis would be profitable for both sectors

• Cost per DALY averted in human health sector would be only US$ 19 (WHO band of highly cost effective intervention, costing US$ 25 or less per DALY averted)
Prevention and control of zoonoses:
INTEGRATED Paradigm

Occupational groups

Age groups e.g. children, women

Rural/ urban populations

Farm animals/ livestock

Leptospirosis
Anthrax
Brucellosis
Campylobacteriosis
Listeriosis

Salmonellosis
Staph infections
Cryptosporidiosis
Intestinal parasites
Echinococcosis
Toxoplasmosis
Trichinellosis
Pseudocowpox, Orf

Prevention and control of zoonoses
INTEGRATED Paradigm
How and where to begin?
Prevention and control of zoonoses
INTEGRATED RESEARCH

Detection & control
Targeted intervention; ‘Control packages’ or ‘commodity based approach’; Surveillance designs/ tools in detection & source attribution; GIS

Risk research
Risk assessment (hazard identification, risk management, risk communication); Cost-benefit analyses

Host-micro interactions research
Biological factors; microbial ecology; Vector bionomics; Environmental/ climatic factors; Social factors; Sustainable Development

Epidemiological research
Disease burden; Epi databases - methods for linkages; Disease data modeling

Occupational groups
Age groups e.g. children, women
Rural/ urban populations
Farm animals/ livestock

Level of Intervention (s)
Inter-disciplinary capacity building

- Need-based and client-based.

- Shift focus from knowledge based education to competency based human resource development:
  - **Core competencies**: epidemiology, research, surveillance operation, outbreak investigation, laboratory engagement and leadership & communication
  - **Desired competencies**: food safety, bio-security, environmental health management

- Short-term and long term
Opportunities for inter-disciplinary collaboration

SURVEILLANCE
• Integrated Disease Surveillance Project (IDSP)
• Involvement of veterinarian & wildlife officers at district level in IDSP
• International Health Regulations (2005)
• Livestock health
  • Central & Regional Disease Diagnostic laboratories (RDDLs and CADRAD)

RESEARCH
• Network of ICMR (28 centers) and NICD (8 branches)
• Network of ICAR (78 national centers/ bureaus), agri universities (41), IVRI
• Network of Wildlife Institute of India (WII)
Opportunities for inter-disciplinary collaboration

CAPACITY BUILDING
• New District Epidemiologists (600+ districts)
• Field Epidemiology Programs (NIE, NICD)
• PHFI’s Indian Institutes of Public Health (7-8)
• Veterinary Schools and WII

COMMUNITY INVOLVEMENT
• National Rural Health Mission (NRHM)
• National Rural Employment Guarantee Scheme (NREG)

INTER-SECTORAL COORDINATION
• National Standing Committee on Zoonoses (GoI)
• Road Map to Combat Zoonoses in India (RCZI) Initiative
PHFI-NCSU-UNC-RTI ‘Road Map to Combat Zoonotic infections in India’
‘Road Map to Combat Zoonotic infections in India’
June 2008

• National level multi-disciplinary endeavor on research, capacity building and advocacy/health promotion

• Active technical support of 23 national & international institutions/agencies, Govt. & NGOs

• Unique platform of PHFI for leading national and international academic and research institutions to converge and create a hub of ‘one medicine one health’
**PHFI Leadership**

- Autonomous public – private partnership, launched by the Honourable Prime Minister of India, Dr. Manmohan Singh in March 2006 at New Delhi.

- Eminent and actively engaged Governing Board, including –

<table>
<thead>
<tr>
<th>International and National Academia</th>
<th>Government Representatives</th>
<th>Civil Society Representatives</th>
<th>Industry Leaders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Amartya Sen</td>
<td>Dr. Montek Singh Ahluwalia</td>
<td>Ms. Mirai Chatterjee</td>
<td>Mr. Rajat K. Gupta</td>
</tr>
<tr>
<td>Nobel Laureate</td>
<td>Deputy Chairman, Planning Commission of India</td>
<td>Coordinato, SEWA</td>
<td>Chairman, PHFI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Senior Partner, McKinsey &amp; Company</td>
</tr>
<tr>
<td>Dr. Lincoln C. Chen</td>
<td>Mr. T. K. A. Nair</td>
<td>Dr. Ravi Narayan</td>
<td>Mr. Shiv Nadar</td>
</tr>
<tr>
<td>President, China Medical Board</td>
<td>Principal Secretary – to the Honorable Prime Minister of India</td>
<td>Community Health Adviser (SOCHARA)</td>
<td>Founder, HCL</td>
</tr>
</tbody>
</table>
PHFI Mandate

PHFI is working towards –

a) Establishing a network of 8 **schools of public health**, the IIPHs.

b) Assisting **growth** of existing institutions.

c) Establishing a strong national **research** network

d) Developing a vigorous national **advocacy** platform.

e) Facilitating creation of an independent **accreditation** body.
World Class, India Relevant Education

United States of America
- Association of Schools of Public Health (ASPH)
- Over 15 schools have direct partnerships, including
  - Harvard
  - UNC, Chapel Hill
  - Johns Hopkins
  - Emory
  - UCLA, Berkley

United Kingdom
- 10 schools have committed support
  - London School of Hygiene & Tropical Medicine
  - University College, London
  - Edinburgh
  - Oxford
  - Cambridge

Europe
- Over 6 schools in mainland Europe, including
  - National Public Health Institute, Finland
  - Centre for International Health, Norway
  - Royal Tropical Institute, Netherlands

Australia
- Discussions to set up partnerships with 4-5 schools in Australia, with confirmations from
  - University of Sydney
  - University of Melbourne

ACTIVE NETWORK OF INTERNATIONAL SPHs.
Way forward

• Multitude of factors make India a ‘hotspot’ for emerging infectious diseases including zoonoses. Efforts can be coordinated into a strategic approach for to combat the threat of zoonoses

• There is adequate strength and ample opportunity within country that can be supported by international partners. PHFI-NCSU-UNC-RTI ‘s RoadMap to Combat Zoonoses in India (RCZI) is a uniquely positioned multi-disciplinary platform to create a ‘one health’ movement in India
THANK YOU