Animal diseases threatening food safety – Are we prepared?

Regional Symposium

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Agenda

- Introduction
- Foodborne animal diseases
  - Bacterial, Viral, Parasitic, Prions
  - Antimicrobial resistance
  - Non-animal foods
- Interventions
  - Preharvest, Processing, Postharvest
- Contingency Plans & Surveillance
- Advances in Science
- Conclusion

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Introduction

- Human exposed to zoonotic pathogens
- >200 known zoonoses
- Last 30 years, >70% emerging human infections are zoonotic
- Many zoonoses are foodborne – pose a threat to food safety & public health
- Foodborne illnesses/yr
  - worldwide >1.5 bil cases, >3 mil deaths
  - USA, ≈48 mil sick, 3,000 die

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Factors contributes to emergence of foodborne zoonoses

- Human demographics & behoviours
- Food production industry & technology
- Globalisation – international travel & trade
- Microbial adaptation
- Economics, political stability & breakdown in public health measures

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Foodborne Bacterial Zoonoses

- Many bact pathogens – known zoonoses, (Bovine TB, Brucellosis, Salmonellosis etc) while some only recently recognized (*VTEC*, Listeriosis, Campylobacteriosis etc)
- Several bacterial zoonoses – well controlled or even eradicated from domestic animal populations
  ➔transmission to human unlikely

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Mycobacteriium bovis & *Brucella abortus*

- **Meat inspection & pasteurization**
- **Virtually eradicated in devp'd countries, isolated incidence in human still occur**
- **Both organisms still exist in wildlife – risk of reintroduction to domestic herds**
- **Diseases exist in developing countries, greater risk to human health – more immunocompromised individuals**

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Verocytotoxin-Producing *E. coli* (VTEC)

- ***EC* - intestinal tract of man & animals**
- ***VTEC (EHEC)* - 1st recognised as cause of human illness in 1982, *O157:H7* predominant serotype in human infections**
- **Mild to severe bloody diarrhoea**
- **Serious infections in children/elderly**
- **Children - HUS & kidney failure**
- **Adults - thrombotic thromobocytopaenic purpura**
- **Infective dose very low (less than 10 cells)**

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Outbreaks In Man

- 1993 - USA, 732 people affected
  - Jack-in-the-Box hamburgers
- 1996 - Japan, 10,000 people, 11 died
  - 30 critically ill with HUS
- 1997 - Scotland, 409 people, 17 died
  - Cooked meat
- 1997 - O157:H7 in frozen beef patties
  - Biggest recall in USA
- 2006 - Spinach, 199 people ill, 3 died, 31 had HUS, 102 hospitalized in USA & Canada

Sources of Infection & Transmission

- Cattle main source of infection
- Faeces from infected livestock
- Faecal contaminated
  - meat & milk
  - fruits & vegetables
  - Cheese, sandwiches, apple juice
- Cross-contamination
  - raw foods to ready-to-eat foods
  - post-pasteurised milk
  - person-to-person

Control Strategy

- Heat sensitive & destroyed by cooking
- Min internal temp of 70°C/2 min or eqv
- Good manufacturing/catering practices
- QA programs in slaughterhouses
- Tests all imported patties & sausages, monitors vegetables & rejects +ve cases
- Requires adequate cooking of patties

Nipah Disease

- 1st Outbreak in Malaysia, 1998/99
- Since 1999, 12 outbreaks in India & Bangladesh
- New virus in Family *Paramyxoviridae*
- Now *Nipah virus*, a member of genus *Henipahvirus*

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Chronology of the Disease

- Outbreaks in late 1998 & early 1999
- Simultaneous epidemic in pigs & humans
- 3 clusters of cases
  - one in Perak & two in N Sembilan
  - primarily adult men in pig farms & abattoirs
  - some JE +ve
  - epidemiological picture not JE
  - 265 human cases with 105 died
  - virus identified by CDC similar to *Hendra virus* found in Australia in 94/95

The Disease In Pigs

- Severe, acute vasculitis affecting lungs & brains
- Mortality low, morbidity high
- Many asymptomatic
- Clinical signs
  - mild to severe, explosive dry cough
  - dyspnoea
  - neurological signs - incoordination convulsions & death

The Disease In Man

- Fever, severe headache, myalgia, pnuemonia, encephalitis/meningitis
- Fatal cases, neurological signs
  - Behaviour changes, mild blurred vision
  - Coma, respiratory failure, unstable blood pressure, high spiking fevers, & finally rapid progression to death
- Incubation 1 - 3 weeks

Emergence of NiV in Malaysia

- Pigs primary source of NiV for human infection, direct contact with sick pigs/secretion/urine/tissue (droplet, oral & thru conjunctiva)
- Fruit bats (*Pteropus spp*) primary reservoir
  - Sero evidence & culture of Nipah virus
- Bats migrate out P Tioman to pig growing areas in Ipoh, non-fruiting due to haze, pigs pick up fruits bitten by bats & contact with bat urine
- Sero +ve dogs, cats, horses & goats found in affected areas in Malaysia

Transmission in South Asia

- Consumption of fruits or fruit products (raw date palm juice) contaminated with saliva or urine of infected bats (Pteropus giganteus)
- Human-to-human spread
  - 75% of cases among hospital staff/visitors in Siliguri, India
  - ≈ 50% reported cases in Bangladesh
- Mortality rate 73% (145/199 cases)

Control Strategy

- **Malaysia**
  - Stamping out - pigs culled within 3 km of affected areas, later penisular-wide test & slaughter
- **Singapore**
  - Banned imports of pigs & mammals
  - Closed abattoirs for disinfection
- **South Asia**
  - Prevent bat access to date palm sap, boil sap, wash & peel fruits
  - Use PPE in handling infected person

Zoonotic foodborne Parasites

- Helminths (roundwroms, tapeworms & flukes) & protozoa – thrive under various conditions, but control measures successful & limit transmission opportunities
- Today, v few foodborne zoonotic parasites in domestic food supply of developed countries
- Taeniasis – rare except developing countries in S America, Asia & Africa; T solium – risk of neurocysticercosis
- *Trichinella spiralis* – meat from wild pig, bear, walrus
- *Fasciola hepatica* – rare in human, from wild watercress or other fresh water plants

Zoonotic foodborne Parasites 2

- *Clonorchis sinesis, Opisthorchis viverri*ni & *O. felineus* - >20 mil people infected, esp NE Thailand, 90% prevalence – eating raw/undercooked fish
- *Toxoplasma gondii* – eating raw/undercooked meat of livestock & games; particular risk to pregnant women è fetus suffers cerebral malformation, mental retardation
- *Crytosporidium parvum* – reported in 79 spp of mammals, severe diarrohea in turkey 1955, calves 1971 & human 1976. Mostly waterborne, largest outbreak in 1993, 403,000 cases in Milwaukee, USA

Prions - Bovine Spongiform Encephalopathy In Cattle

- First diagnosed in 1986 in UK
- Causative agent - prion
- Resist heat sterilization & evoke no immune or inflammatory responses
- In brain tissue, spinal cord & retina, dorsal root ganglion, distal ileum & bone marrow,
- Incubation 2 - 8 years
- 181,123 cattle, 62% dairy herds affected
- Jan 93 - peak 1000 new cases/wk
- 2009-Now - 20 cases

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Prions – v Creutzfeldt-Jakob Disease In Man

- **CJD**
  - rare disease in man, 1-2 cases/mil people
- **vCJD**
  - 20 Mar 96 - SEAC announced 10 cases
  - unusual clinical course with psychiatric problems & different lesions in brain tissues
  - Early age of onset
  - Rapid clinical course
  - Different lesions in brain tissues
  - linked to exposure to BSE – consumption of infected beef (mainly burgers)

Emergence of BSE

- Rendered protein feed from scrapie-infected sheep carcass
- Scrapie endemic in UK for centuries
- Early 80's - lower temperature & removal of solvent extraction process from rendering
- Prion recycled & adapted in cattle
- Acquired through consumption of infected meat & bone meal

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Control Strategy

- **UK**
  - BSE as notifiable disease
  - Prohibit meat & bone meal in feed
  - Prohibit cattle >30 months old as food
  - Destroy/incinerate BSE animals
  - Removal of SRMs, stunning & splitting methods
- **Singapore**
  - Ban beef import from UK & BSE-affected sources
  - Exporting countries - BSE free for 6 yrs
  - Risk assessment - <30 mths, boneless beef safe

Antimicrobial Resistance

- Antimicrobial resistant microbes still present in animal products even after withdrawal period to prevent antibiotic residues
- Antimicrobial resistance can spread from animals to humans thru 2 routes:
  - Zoonotic infection
  - Transfer of resistance patterns within bacterial populations

  eg identical fluqroquinolone-resistant *C jejuni* identified in both retail poultry products & human clinical cases

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Non-animal foods

- a new area of concern
- intensification of production systems ➔ contamination of environment & non-animal foods – eg lettuce, sprouts, spinach, tomatoes & various fruits
  - eg *E coli O157:H7* outbreak in Sep 2006 in 26 US states & Canada – spinach from California, growing areas within 1 km of a cattle farm, feral pigs frequent both cattle grazing areas & spinach fields & waterway – outbreak strain *EHEC* cultured from cattle, feral pig feces & surface water

Non-zoonotic animal diseases

- **Animal diseases which are not zoonotic can still threaten food safety –**
  when slaughtered, sick animals have poor bleeding & depleted muscle glycogen for conversion to lactic acid during rigor mortis, hence pH of carcase remains close to neutral, making meat highly susceptible to rapid spoilage & unfit for consumption

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Interventions

Ensurig food is safe from zoonotic agents requires controls along entire continuum from farm to fork:

- Reduce pathogen in reservoir (increase biosecurity, vaccination, etc)
- Prevent contamination during processing
- Inhibit/destroy pathogens (pasteurization, sterilization, cooking, irradiation etc)
- Educate consumers on safe food handling

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Preharvest Interventions

- Biosecurity – animals, feed, equipment, visitors
- Vaccination – raise immunity
- Probiotic – promote enteric health
- Isolation of sick animals, adequate disinfection prevent spread of disease, maintain herd health
- Modern farming practices developed to control disease transmission – eg keep pigs indoors w no access to rodents, refuse – effective control of Taenia, Trichinella & Toxoplasma. Demand f free range animals risk reintroducing old pathogens

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Preharvest Interventions 2

- Proper animal waste & dead stock management prevent infection of wildlife – if disease develops in wildlife, a permanent source of reinfection
- Good transport – reduce stress, overcrowding etc predispose latently infected animals to shed pathogens at higher rate
- Clean & healthy stock reduces contamination of abattoir environment

Interventions at Processing

- Traditional meat inspection - effective to detect & eliminate meat from visibly diseased animals
- Today, its effectiveness is limited in detecting hidden hazards from carriage of zoonotic pathogens by clinically healthy animals
- ∴ good hygiene during processing - most important factor in consumer protection
- prevent contamination, include treatment to destroy/inhibit pathogens

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Postharvest Interventions

- Most public - far removed from production & processing of their food but still interested in the safety of their food
- No production/processing system in the world today will create zero-risk food
- Consumer education on acceptable food handling, storage, and cooking procedures continues to be crucial

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Contingency & Response Plans

- Responsibility for responding to foodborne disease outbreaks is usually shared among various govt agencies at different levels.
- Contingency & incident response plans are established in many countries to facilitate effective response - requires cooperation & coordination among partners to ensure timely mitigation of risk & prevention of further illnesses.

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Contingency & Response Plans 2

- **National Food Incident Response Protocol, Australia –** guidelines to member agencies for responding to a range of national food incidents in a timely , appropriate, consistent & coordinated manner. Does not override States' own response system.
- **Food Standards Agency, UK – Incident Response Protocol –** aids to responsible agencies & food industry to prevent & deal efficiently with food incidents if they occur.
- **Food Safety Authority of Ireland – CP on Food Incidents & Food Alerts –** manage food incidents
- **AVA Singapore – All-Hazards Incident Management System (AIMS) –** Prevention, preparedness & response plan to manage major outbreaks of animal/zoonotic diseases & food incidents.

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Improved Surveillance & Early Warning

- **Surveillance of diseases**
  - assesses risk posed by any one pathogen
  - monitors any level of food chain
  - alerts authorities to issues in food safety
  - provides mechanism to assess control measures
  - Surveillance of a multitude of pathogens needed to protect consumers
- **International organisations, national & regional authorities - have in place various systems to carry out surveillance of foodborne diseases & zoonotic diseases**
- **Trends in data generated by surveillance - provide indications of emergence of certain pathogens**
- **Early detection of emerging risks averts foodborne outbreaks & prevents spread of disease**

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National surveillance systems

- **US CDC, State PH Labs & other Fed agencies**
  - **PulseNet – employ PFGE of 7 food pathogens –** *Salm enterica*, *Shigella* **spp,** *L monocytogenes*, *VTEC O157* *Campylobacter* **spp,** *Cl perfringens*, *V cholerae*,
  - **cooperates w several laboratory networks in Europe, Canada, Japan and other countries**
- **US CDC, FDA and USDA**
  - **Foodborne Disease Active Surveillance Network (FoodNet) - actively collects foodborne disease in 10 sites covering 13% of American population**
  - **National Antibiotic Resistance Monitoring System for Enteric Bacteria (NARMS-EB) - tracks antibiotic resistance in foodborne pathogens**

Regional surveillance system

- **EU's Rapid Alert System for Food and Feed (RASFF)**
  - **enables quick and effective exchange of information among Member States and the European Commission when risks to human health are detected in the food and feed chain**

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International surveillance systems

- WHO's International Food Safety Authorities Network (INFOSAN), 2000
  - authorities in member states exchange information on routine and emerging foodborne diseases
  - Rapid alert or outbreak situations of international public health importance reported in 'real time' through its computerized Global Outbreak Alert and Response Network (GORAN)
- OIE(World Animal Health Organisation) Notification System
  - veterinary authorities of member states have to notify the OIE thru an electronic system the occurrence of notifiable animal diseases, including diseases of food safety importance such as BSE
- OIE, FAO and WHO's Global Framework for progressive control Transboundary Animal Diseases (GF-TAD)
  - facilitates exchange of information among these organisations, national and regional organisations
  - enables early warnings & intervention measures to mitigate the threat at its source
- FAO's Emergency Prevention System for Food Safety (EMPRESS Food Safety)
  - international system to assist in prevention & management of global food safety emergencies, including early warning, emergency prevention and rapid response

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Advances in Science & Diagnostic Technologies

- Science & diagnostic technologies - huge advances in last 2 decades
  - better understanding of pathogens, microbiology, pathogenesis, epidemiology, risk factors, mathematical modeling & health impacts
- Molecular biology & microelectronic - great strides in DNA technologies & diagnostic capabilities
  - Rapid & accurate id of causative agents
- Accumulated knowledge & new technologies –
  - permit scientific interventions targeted at pathways of transmission to optimize effective prevention & control measures

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Conclusion

- Foodborne zoonotic hazards continue to threaten food safety
- Better animal hlth & husbandry, effective meat inspection, hygiene practices throughout processing & greater awareness on safe food handling/cooking safeguard consumer health
- Advances in science & diagnostic technologies, improved surveillance, wider international cooperation in reporting & early alert systems, enhanced vigilance, the world today is better prepared to combat foodborne zoonoses
- Microbes evolve & adapt to changing environment, new pathogens emerge & old ones increase virulence
- Concerted efforts to better understand pathogens, virulence, factors for emergence, implications on food safety & devise effective control measures to mitigate risk of infections

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Thank You

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