Twenty-first Century disease threats, epidemiology and One Health

Fred Unger
International Livestock Research Institute

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Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya, Indonesia
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Presentation outline

• 21\textsuperscript{st} century disease threats
• History of Epidemiology
• Basic concepts of Epidemiology
• New concepts: Participatory Epidemiology
• Related areas: One Health
• Case studies
Human health in the 21st century

• 7 billion people
  – 1 billion hungry;
  – 2 billion with hidden hunger;
  – 1.5 billion overweight or obese – increasing trend

• 55 million die each year
  – 18 million from infection
  – 1.2 million from road traffic accidents
  – 20,000 from extreme weather events
Historical and current health constraints and causes in developed countries

<table>
<thead>
<tr>
<th>1990</th>
<th>2013</th>
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<tbody>
<tr>
<td>Ischaemic heart disease</td>
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<td>Stroke</td>
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<td>Back and neck</td>
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<td>Road injury</td>
<td>Lung cancer</td>
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<td>Lung cancer</td>
<td>Depression (MDD)</td>
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<td>COPD</td>
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<td>COPD</td>
<td>Diabetes</td>
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<td>Self harm</td>
<td>Sense</td>
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<td>Other musculoskeletal diseases</td>
<td>Self harm</td>
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<tr>
<td>Diabetes</td>
<td>Falls</td>
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Only minor changes over 23 years

Risk factors for main diseases: Lifestyle and dietary issues
### Historical and current health constraints and causes in developing countries

<table>
<thead>
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<tbody>
<tr>
<td>Lower respiratory infections</td>
<td>Ischaemic heart disease</td>
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<td><strong>Diarrhoeal diseases</strong></td>
<td>Lower respiratory infections</td>
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<td>Neonatal pre-term complications</td>
<td>Stroke</td>
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<td>Protein energy malnutrition</td>
<td>HIV</td>
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<td>Tuberculosis</td>
<td>Road accidents</td>
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<tr>
<td>Neonatal encephalopathy</td>
<td>Malaria</td>
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<td><em>Ischemic heart disease</em></td>
<td>Tuberculosis</td>
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**Some changes over 23 years others remain unchanged:**

- Cardiovascular diseases have come up
- Infectious diseases still a major cause
Where do we get our diseases?

• Most are earned
  – Degenerative diseases: heart failure, stroke, diabetes, cancer
  – Allergies, asthma, autoimmune diseases
  – Sexually transmitted infections such as HSV-2, gonorrhea

• Many are “souvenirs”
  – Around 60% of human diseases shared with animals
  – 70% of emerging/re-emerging infectious disease are zoonotic
    • 30 to 50% among these are foodborne
21st century disease threats

Emerging and Reemerging infections - 70% vector-borne or zoonotic
History of human diseases

• **Paleolithic baseline** (up to about 10,000 years ago)
  – Mankind existed in *small, isolated groups as hunter-gatherers* where population size and density remained low

• **1st epidemiological transition**
  – mankind became *less nomadic, and settled into larger population* clusters
  – *domestication of animals* brought other disease (zoonoses): *Anthrax*, *TB*
  – 16th Century New world – small pox & old world – Syphilis

• **2nd epidemiological transition** (roughly 200 years ago)
  – *Industrial revolution*, railways & steam ships
  – new – *chronic, non-infectious* were added
  – 20th Century First World War – Spanish flu

• **3rd epidemiological transition** (began early 1980s …) (??)
  – *newly emerging* infectious diseases, re-emerging diseases carried over from the 2nd transition, *antimicrobial resistant* pathogens
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- Related areas: One Health & ecohealth
- Case studies
400 BC Hippocrates

Greek physician, known as the father of medicine

Tried to **explained disease occurrence from a rational standpoint.**

**First person known** to have **examined the relationships between** the occurrence of **disease and environmental** influences.

He believed **sickness of the human body** to be caused by an **imbalance of the four humors** (air, fire, water and earth "atoms").

The cure = balance the 4 humors of the body.
History of epidemiology

1662

John Graunt, a London councilman
Published a **landmark analysis of mortality** data in 1662. This publication was the first to quantify patterns of birth, death, and disease occurrence, noting disparities between males and females, high infant mortality, urban/rural differences, and seasonal variations.

1800

William Farr built upon Graunt’s work by systematically collecting and analyzing Britain’s mortality statistics. Farr is considered the **father of modern statistics and surveillance**. He identified **urbanisation** and population density as public health issues.
History of epidemiology

Jon Snow, mid-1800s “father of field epidemiology.”

Twenty years before the development of the microscope, Snow conducted studies of cholera outbreaks both to discover the cause of disease and to prevent its recurrence.

1854, when an epidemic of cholera erupted in the Golden Square of London. He began his investigation by determining where in this area persons with cholera lived and worked. He marked each residence on a map of the area. He hypothesized correctly water as the source of infection for cholera.
History of epidemiology

**Developed a spot map** showing pumps and households with cases of cholera.

**More case** households clustered Around **Pump A**, than Pump B or C.

Residents who lived in the area stated that they avoided Pump B & C because grossly contaminated or too inconveniently located.

**In a subsequent step he related water suppliers** to specific pumps.
History of epidemiology

Mid- and late 1800s, epidemiological methods began to be applied in the investigation of disease occurrence of infectious disease

1930s and 1940s, epidemiologists extended their methods to non-infectious diseases. Also behaviour, knowledge and attitudes (e.g. lung cancer and heart disease)

1960s and early 1970s health workers applied epidemiologic methods to eradicate naturally occurring smallpox

1990s/2000s, molecular/genetic epidemiology and participatory epidemiology were added
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Epidemiology - definition

The word epidemiology comes from the Greek words:
- *epi*, meaning on or upon
- *demos*, meaning people,
- and *logos*, meaning the study of.
In other words, the word epidemiology has its roots in the study of what befalls a population.

Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.

Veterinary epidemiology deals with the investigation of animal diseases, productivity and animal welfare in populations.
Epidemiology
– a few basic considerations

**Temporal patterns of disease** broadly categorized into:

- **Sporadic**, single cases or clusters of cases of disease
- **Epidemic**, disease occurrence which is **higher than expected**
- **Endemic**, usual frequency of disease or **constant presence** of disease
- **Pandemic** widespread epidemics affecting a large proportion of the population and possibly many countries.

Presented graphically as epidemiological curves
- Vertical axis: new cases
- Horizontal axis: time
- Shape of curve used to conclude on cause or disease characteristics
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What is participatory epidemiology?

- An relatively **new approach to epidemiology** develop in response to poor performing veterinary services, a common problem in developing countries.
- Participatory epidemiology (PE) is flexible, and **adaptable to changing situations**.
- PE is founded on **equal partnership with mutual respect and trust** to enable community empowerment.
- Method to improve understanding of animal diseases, and to **design solutions to disease problems with livestock keepers**.
Somalia

• Used to achieve **eradication of rinderpest** in Somalia
• Last foci detected and eradicated using PE

Indonesia (later also Egypt)

• Participatory Diseases Surveillance and Response (PDSR)
• Initiated in 2005
• Thousands of PDSR officers have been trained
• Evaluate the feasibility of a suite of control interventions for highly pathogenic avian influenza

• PE component: Participatory impact assessment of Interventions
  • Proportional pilling
  • Participatory mapping (mortality events, duck flocks, markets, etc.)
  • Seasonal calendars (link certain historical events with mortality e.g. last flood, Ramadan, village wedding)
Further readings

Links:
PENAPH.net
PE website
http://www.participatoryepidemiology.info

Materials:
http://www.fao.org/docrep/003/X8833E/X8833E00.HTM

Conference: 2nd regional PENAPH conference, Khon Kaen, 10-12 January 2018
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Ecohealth and One Health

Driven in response to emerging disease threats along the 3rd epidemiological transition
Ecohealth

Originated in biological Ecology/land conversation

Complexity focus/systems
Communicable/non-communicable diseases

Pioneered from IDRC and outside traditional health
(heavy metal toxicity in communities and related to mining)

‘Bottom Up’
Vets, medical doctors, epidemiologists, ecologists, social scientists, philosophers, indigenous perspectives etc.

One Health

Schwabe’s One Medicine
One world/One Medicine (Zinsstag)

More quantitative focus
(animal/human/wildlife)

Communicable diseases, zoonoses

Vets, medical doctors, some ecologists or epidemiologists

Currently institutionalized (FAO, OIE, WHO)

Modified after IAEA (2014)
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Case study: Optimizing rabies control in Bali
Combined epidemiological surveys with a transdisciplinary approach
Case study 1: Optimizing rabies control in Bali
ILRI EcoZD 2010 to 2012

The problem

• Rabies emerged since its introduction
• **Conventional control measures show limited success**
• **Prominent role of dogs** in Bali society
  – Initial mass culling faced strong obligations (local and international)
  – Obligations against general population control measures

Classical vet approach
Vaccination in dogs and sterilisation if applicable
Case study 1
Optimizing rabies control in Bali: An ecohealth approach

Combination of epidemiology with a Eco Health perspective

• Transdisciplinary research team
• Behaviour and attitudes:
  – Socio-cultural relationship between dogs and the Balinese community using participatory epidemiological tools
• Classical epidemiological approach:
  – Dog population and its dynamics
  – Dog ecology, estimate contact rates between dogs and with humans
• Selected results:
  – Free-roaming (2–3) and juvenile dogs (10–70) have a higher risks to be unvaccinated
  – 79% of owners applied free-roaming dog practices
  – Discarding of unwanted female puppies remains an issue
Case study 2: Food safety along pork chains (since 2012)

To assess impacts of pork-borne diseases on human health and the livestock and identify control points for risk management.

Interdisciplinary team: Vets, public health specialists, economists, animal scientists

Why it matters:
Food safety ranked by Vietnamese equal or higher than education and health

Why pork:
Majority of consumed animal protein is pork
Distributed mainly via informal value chains
Case study 2: Food safety along pork chains (since 2012)

**Epidemiological tools**
- Qualitative and quantitative risk assessment (*Salmonella*)

**Participatory epidemiology tools**
- Proportional pilling, participatory mapping, observational checklists

**Value chain assessment** along the entire pork chain
- People’s living around slaughter houses (IDI)
- Pork consumers (KII)
- Community vets
- Community health workers (KII)
- Slaughterhouse workers (FGD)
- Pork sellers (FGD)
- Local authorities, party committee (KII)
Case study 2: Exiting results from participatory epidemiology study of pork sellers

1. Use of cloths to dry pork, clean equipment, hands or tables: some consumers related “wet” looking meat to low meat quality

2. Use of cupboards at market stools: same reason as under 1

3. Use of masks: in response to buyer/consumer perception that sellers may have a health problem.


Results from participatory epidemiology helped to understand practices which were not in line with regulations

Quantitative risk assessment: 1 to 1.5 over 10 consumers face a Salmonella-related infection annually
The problem

- **Parasitic zoonoses** are often neglected disease but endemic in the Laos e.g. trichinellosis, cysticercosis and liver fluke
- Some characteristics of **animal production and food consumption habits** in Laos likely promote zoonoses spread:
  - both human and animal populations live in close proximity
  - abattoirs and wet markets operating with rudimentary hygiene
  - widespread consumption of raw meat/fish

- **Approach**
  - Serological survey in pigs and humans
  - Participatory epidemiology
Case study 3: Laos synthesis of selected results

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<thead>
<tr>
<th>Participatory rural appraisal</th>
<th>Questionnaire</th>
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<td><strong>Interview question</strong></td>
<td><strong>Likert scale</strong></td>
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<tr>
<td>Very limited knowledge on cause and prevention</td>
<td>Perception that worms are not harmful for humans (85% agreement)</td>
</tr>
<tr>
<td>Worms are common for villagers but not considered as health issue</td>
<td></td>
</tr>
<tr>
<td>Very limited knowledge on cause and prevention</td>
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<tr>
<td>Only 1.5%, link raw pork consumption to PFBD</td>
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Seroprevalence for *Trichinella* in pigs: 17%

Main constraints ranked by farmers: Flood, water access, no market access, health
Final reflections

- New emerging and reemerging disease threats
- Epidemiology of increasing importance
  - New approaches such as participatory epidemiology
- One Heath and ecohealth evolved over the recent decade; supporting approaches to epidemiology
- Need to understand why people adopt certain practices
- What are potential incentives for behaviour change
- Regulations alone will not help
Special thanks to:
Delia Grace (ILRI), ComAccross (Lao) and EcoZD team (CIVAS)

better lives through livestock

ilri.org

On dogs, people, and a rabies epidemic: results from a sociocultural study in Bali, Indonesia
Maria Digna Winda Widyastuti et al. 2016. Infectious Diseases of Poverty, 20154:30

Determinants of Vaccination Coverage and Consequences for Rabies Control in Bali, Indonesia