Food safety from a global perspective to a country perspective addressing challenges along smallholder pig systems in Vietnam

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Outline

• Global health from a food safety perspective
  – Trends over time and by region
• Food safety in Vietnam
• ILRI work along the pig/pork value chain in Vietnam
• Search for feasible interventions
Health constraints and causes in developing and developed countries

Measured as DALY (Disability Adjusted Life Years)

- Quantifying the burden of disease from mortality and morbidity
- Expressed in health statistics as the number of years lost due to ill-health, disability and early death

or

one lost year of healthy life
Leading causes of DALY in developed countries

<table>
<thead>
<tr>
<th>1990</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ischemic heart disease</strong></td>
<td><strong>Ischemic heart disease</strong></td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td><strong>Stroke</strong></td>
</tr>
<tr>
<td><strong>Back and neck</strong></td>
<td><strong>Back and neck</strong></td>
</tr>
<tr>
<td><strong>Road injury</strong></td>
<td><strong>Lung cancer</strong></td>
</tr>
<tr>
<td><strong>Lung cancer</strong></td>
<td><strong>Depression (MDD)</strong></td>
</tr>
<tr>
<td><strong>Depression (MDD)</strong></td>
<td><strong>COPD</strong></td>
</tr>
<tr>
<td><strong>COPD (Chronic obstructive pulmonary d.)</strong></td>
<td><strong>Diabetes</strong></td>
</tr>
<tr>
<td><strong>Self harm</strong></td>
<td><strong>Sense related diseases</strong></td>
</tr>
<tr>
<td><strong>Other musculoskeletal diseases</strong></td>
<td><strong>Self harm</strong></td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td><strong>Falls</strong></td>
</tr>
</tbody>
</table>

Health constraints and causes in developed countries

Only minor changes over 23 years:

• Cardiovascular including stroke diseases on top (16%*)
• Minor role of infectious diseases (HIV 0.52%*) including diarrhoeal diseases (0.12%*)

Risk factors for leading diseases:

• Lifestyle and dietary issues

*Percentage of total DALYs
Leading causes of DALY in developing countries

<table>
<thead>
<tr>
<th>1990</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower respiratory infections</td>
<td>Ischaemic heart disease (IHD)</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>Lower respiratory infections</td>
</tr>
<tr>
<td>Neonatal pre-term complications</td>
<td>Stroke</td>
</tr>
<tr>
<td>COPD</td>
<td>Back and neck</td>
</tr>
<tr>
<td>Malaria</td>
<td>Diarrhea diseases (3.5%*) (8.7%**)</td>
</tr>
<tr>
<td>Stroke</td>
<td>Neonatal pre-term complications</td>
</tr>
<tr>
<td>Protein energy malnutrition</td>
<td>HIV</td>
</tr>
<tr>
<td>TB</td>
<td>Road accidents</td>
</tr>
<tr>
<td>Neonatal encephalopathy</td>
<td>Malaria</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>TB</td>
</tr>
</tbody>
</table>

*Percentage of total DALYs
Some changes over 23 years others remain unchanged:
• Cardiovascular diseases has come up as the leading cause (1990 no. 10)
• No. 2 still: respiratory infections (often preventable by vaccine)
• Infectious diseases still a major cause
• Diarrhoeal diseases still among first 5

Risk factors for diarrhoeal diseases:
• Poor sanitation, poor food safety standards
Leading causes of DALY in central sub-Saharan Africa

<table>
<thead>
<tr>
<th>1990</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria (13%*)</td>
<td>Lower respiratory infections (11%*)</td>
</tr>
<tr>
<td>Lower respiratory infections (12%*)</td>
<td>Diarrhoeal diseases (11%*)(15%**)</td>
</tr>
<tr>
<td>Diarrhoeal diseases (11%*)(14%**)</td>
<td>Malaria</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>Neonatal pre-term complications</td>
<td>HIV</td>
</tr>
</tbody>
</table>

Almost no change over 23 years:
Lower respiratory infections and infectious diseases the major cause
Diarrheal disease and malnutrition unchanged but still highly ranked

*Percentage of total DALYs  **< 5 years
## Leading causes of DALY in Vietnam & Laos

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>War</td>
<td>Stroke</td>
<td>Diarrhoeal diseases</td>
<td>Lower respiratory infections</td>
</tr>
<tr>
<td>Pre-term birth complication</td>
<td>Road accidents (6.1%*)</td>
<td>Lower respiratory infections</td>
<td>Preterm birth complication</td>
</tr>
<tr>
<td>Stroke</td>
<td>Back and neck</td>
<td>Pre-term birth complication</td>
<td>IHD</td>
</tr>
<tr>
<td>Measles</td>
<td>Sense organ diseases</td>
<td>Measles</td>
<td>Stroke</td>
</tr>
<tr>
<td>Drowning</td>
<td>Lower respiratory infections</td>
<td>Tetanus</td>
<td>Diarrhoeal diseases</td>
</tr>
</tbody>
</table>

*Percentage of total DALYs

**Considerable changes over 23 years:**

- Cardiovascular and/or stroke but also road injuries (Vietnam) jumped up
- Diarrhoeal disease, depends on country
Health constraints and causes in developing and developed countries

- Clear differences between developed and developing countries
- Cardiovascular related diseases main cause in developed countries
- Infectious diseases including diarrhoeal diseases still a major problem in developing countries with regional and country differences
WHO report: Global estimates of foodborne diseases

• First ever estimates of the global burden of foodborne diseases
• For the global estimates, 31 foodborne hazards causing 32 diseases were included, being diarrhoeal disease agents, invasive infectious disease agents, helminths and chemicals
• Estimated global burden of foodborne disease by these 31 hazards was 33 million DALYs in 2010
• Demonstrated that almost 1 in 10 people fall ill every year from eating contaminated food and 420,000 die as a result
- Children under 5 years of age from low-income countries are at particularly high risk
- Highest burden observed for Africa (East and Central) followed by Southeast Asian region
Food safety – global perspective

• Diarrhoeal diseases responsible for more than half of the global burden of foodborne diseases, with 230,000 deaths every year.

• Major causes of diarrhoea: norovirus, Campylobacter, non-typhoidal *Salmonella* and pathogenic *E. coli*.

• Others causes of foodborne disease related to *Salmonella typhi*, *Taenia solium*, hepatitis A virus and aflatoxins.

http://www.who.int/foodsafety/publications/foodborne_disease/fergreport/en/
Food safety – Vietnam

• Limited number of food safety studies
  • Focus on assessment of hazards and often focusing on slaughter process

• Lack of
  • Value chain approach
  • Investigating the related risk for consumers, impact and intervention studies

• Risky consumption habits are common
  • Raw pork sausage, blood pudding, common in slaughterhouse workers

• Increasing consumer concerns on animal diseases and food safety
  • Disease in pigs, hormones, antibiotics and grow promoters and slaughter hygiene
Food safety Vietnam
Consumer preferences for purchasing pork

Pork purchasing sources

Proportion of purchased pork types by consumer groups

ILRI PigRISK Unpublished results
Food safety – Vietnam

Legal framework

• Various ministries involved, MoH (VFA), MoA (Nafiqad)
  • New single institutional body needed?
• Food safety law from 2010, currently revised, 2016 amendment expected
• Enforcement limited
  • Mainly based on importer demands
  • Very limited or absence in small-scale sector
Food safety Vietnam

• Majority of pork distributed through informal market chains
  – traditional processing, and retail practices (e.g. wet markets, temporally and/or permanent)
  – escape effective health and safety regulation (lack of regular inspection)
  – affordable, accessible, addressing local demands (e.g. fresh pork, meat pie, blood pudding)

• Approximately 30,000 small-scale pig slaughter units
  – Implementation of existing food safety law a challenge
  – Regular inspections (if any) focus on medium to large scale slaughterhouses
Background - pigs in Vietnam

- Pork is an important component of the Vietnamese diet
  - More than 70% of consumed meat is pork
  - More than 80% supplied by small scale sector
  - Preference for chilled pork provided by traditional market chains (90%)

- Strong dominance of smallholders in pig production, significant contribution to household income
Background - pigs in Vietnam

• Various challenges to increase production of smallholders from an animal health perspective
  
  • Limited biosecurity, poor on-farm hygiene
  • Poor reproductive management
  • Very limited resources of farmers to change
  • Pig diseases are common, wide range of notifiable diseases are endemic
  • Vaccines available but efficacy often not clear
  • Limited surveillance and response capacity
  • Pig vets rather used by large-scale sector
## Food safety issues along the pork value chain

### Pork-related foodborne hazards

<table>
<thead>
<tr>
<th>Category</th>
<th>Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parasitic</td>
<td>Cysticercosis, Trichinellosis, Toxoplasmosis</td>
</tr>
<tr>
<td>Bacterial e.g.</td>
<td><em>Bacillus cereus</em>, <em>Brucella suis</em>, <em>Campylobacter spp.</em>, <em>Salmonella spp.</em>, <em>Streptococcus suis</em>, <em>Shiga toxin producing E. coli</em>, <em>Yersinia enterocolitica</em></td>
</tr>
<tr>
<td>Chemical</td>
<td>Antibiotic residues, Aflatoxins, Steroids/growth promoters, Heavy metals</td>
</tr>
</tbody>
</table>

Source: PigRISK Project proposal
ILRI food safety research related pig systems in Vietnam
- an overview

- Pig risk project (2012–17)
  - ACIAR-funded
- Cross-CGIAR Research Program (2014–15)
  Scoping study to evaluate the potential of indigenous pig systems
- Lab diagnostic review (related to pork)
- Evaluation of large scale interventions related to food safety along the pork value chain (LIFSAP)
PigRISK project (2012–17)

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

Key components:
Assessment (qualitative/quantitative risk assessments) and intervention

Integrated approach
- Interdisciplinary team: vets, public health, economics, animal science, modeller
- Data collected along entire pork value chain
**Risk assessment (RA):**

- *Salmonella* risk pathways developed for producers, slaughterhouse and consumers
- Quantitative risk assessment (risk for consumer) currently finalised
PigRisk: Selected key results on food safety

Sampling for biological hazards \textit{(Salmonella spp.)}

- Overall **1275 samples** (farm, slaughterhouse, market) over 12 months
  - Increasing prevalence along chain – final product, **meat for sell: 45%**
- Quantitative risk assessment completed
- Systems dynamic model (potential interventions ex-ante evaluated) completed

\textit{Streptococcus suis} in slaughter pigs (N=147):

- Presence of \textit{S. suis} type 2
- Potential risky behaviour ‘Tiet canh’
  - common in slaughterhouse workers (43%)

Chemical hazards

- **Presence of banned substances** (e.g. chloramphenicol and the growth promoter salbutamol in pig feed and sold pork)
## PigRIsk - Results of microbial analysis

<table>
<thead>
<tr>
<th>Actor</th>
<th>Sample type</th>
<th>Pos/Total</th>
<th>Prev (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer</td>
<td>Drink-FA</td>
<td>14/72</td>
<td>19.4</td>
</tr>
<tr>
<td>Producer</td>
<td>FloSwab-FA</td>
<td>26/72</td>
<td>36.1</td>
</tr>
<tr>
<td>Producer</td>
<td>WasteW-FA</td>
<td>28/72</td>
<td>38.9</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>CarcassSwab</td>
<td>58/149</td>
<td>38.9</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Feces</td>
<td>50/149</td>
<td>33.6</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Mesenteric LN</td>
<td>53/149</td>
<td>35.6</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>SwabFlo-SH</td>
<td>11/49</td>
<td>22.4</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Water-SH</td>
<td>10/49</td>
<td>20.4</td>
</tr>
<tr>
<td>Market</td>
<td>Pork</td>
<td>97/217</td>
<td>44.7</td>
</tr>
<tr>
<td>Market</td>
<td>Pork-Gr</td>
<td>33/80</td>
<td>41.3</td>
</tr>
<tr>
<td>Market</td>
<td>CutSwab</td>
<td>55/217</td>
<td>25.3</td>
</tr>
<tr>
<td>Market</td>
<td>Overall</td>
<td>435/1275</td>
<td>34.1</td>
</tr>
</tbody>
</table>
PigRisk - Results of microbial analysis

Salmonella prevalence

<table>
<thead>
<tr>
<th></th>
<th>Mesenteric LN</th>
<th>Feces</th>
<th>CarcassSwab</th>
<th>Pork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter house</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

The graph shows the prevalence of Salmonella across different samples from a pig slaughter house and market.
Selected risk factors for *Salmonella* contamination

**Slaughterhouse**

- Urban and peri-urban versus rural
- Hot season versus cold season
- Using of hot water kettle for scalding versus open hot water basin
- Not washing floor after each pig
- Hand, knife freely washed in open water tank
- Floor slaughter versus elevated

**Market**

- Hot season versus cold season
- Wipe hand on cloth using for wipe pork/equipment
- Shop is next to the sewerage or presence of stagnant water
Pig Risk - Best bet selection – Value chain approach
Placed at specific actor along value chain based on RA results

From farm to fork
Randomized control trials: Pilot and RCT Feb 2016 onwards
Consideration:
• Based on evidence
• Investment cost
• Feasibility/compliance
• Effect on specific actor or entire chain
• Effect can be measured
• LIFSAP experience (USD 80 million World Bank)
• Adoption rate and time and after 6 months
• Systems dynamic model used to test effect of intervention
• Incentives (cash, social recognition)

Challenges:
• Lack of enforcement of regulations
• Behaviour change required
• What are the incentives to change current practice
• No prime price for ‘safer’ pork
Intervention development: Pig slaughterhouse

Investment USD 700 – 800

Source: Sinh, Handlos and Unger (2014)
Intervention development: Pig slaughterhouse

Pilot trial to practical test:

- LIFSAP table not accepted by workers as too high to handle a pig alone

Source: Unger (2016)
Grit has to have sufficient size to allow to handle 2 pigs and adapted to the existing slaughterhouse structure.

Investment USD 400

Source: Unger (2015)
Intervention development: Pig slaughterhouse

Source: Unger (2015)
Pig slaughterhouse: challenges observed
Behaviour/practice change is needed

Source: Unger (2016)
Market – challenges

Source: Unger (2016)
Market – trader

Source: Unger (2016)
Interventions – final reflections

We aim for:
• Feasible interventions towards ‘more hygienic’ pork with intervention at slaughterhouse, markets, and consumers
• Means not hazard free; possible develop a store brand

Slaughterhouse:
• Avoid floor slaughter (implemented and scientific evidence)
• Water source (planned)
• Dirty versus clean zone (greatest challenge)

Market:
• Avoid use of towel to dry pork (planned)
• Storage place for knife with cleaning/disinfection (planned)
• Reduce number of flies

Consumer:
• Meat auction survey (what do they relate to safe pork)(planned)
• Test of dissemination options (poster, video, flyer, photos)(planned)
Scoping study on indigenous pig systems (2014–15)
Central Highlands of Vietnam

Source: Unger, 2015
Scoping study to evaluate the potential of integrated indigenous pig systems to improve livelihoods and safe pork consumption for poor ethnic minority smallholders in the Central Highlands of Vietnam.

Integrated focus
• Components:
  • Market access/opportunity study
  • Value chain study
  • Breeding component
  • Gender study
  • Food safety
• Economist, vets, public health, breeding, crop/livestock system experts

Source: Unger (2015)
Free range versus pen use, among HH with indigenous pigs (N=262)

Knowledge of targeted zoonotic parasitoses (N=262)

Among those 10% none of them aware about mode of transmission from pig to human
Conclusions

• Food safety an important concern, in particular in developing countries (and highest in children under 5 years) but also for Vietnamese consumers
• Presence of various hazards along the pork chain shown in Vietnam but related risk and impact unclear
• Various challenges found in Vietnam (all levels including policy)
• Intervention development must consider feasibility questions but also requires a behaviour change of all involved actors
• Suitable incentives: greatest challenge is how to find in a resource-poor context
Scientific evidence (2015): 8 journal articles, 27 presentations at international fora

better lives through livestock

ilri.org

HP2, healthy pigs, healthy people