Developing a Risk-Based Framework for Food Safety Decision-Making in Low and Middle Income Countries

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Food Safety is a Global Public Good

- Critical to food security, nutrition.
- Serious public health issue.
  - 600 million illnesses/year
  - Children bear most of burden
  - Associated with long-term health outcomes
- Significant economic impact.
  - Medical costs, lost productivity
  - Loss of consumer confidence
  - Reduced market access
  - Increased food loss and waste
Managing the Risks

The Well-Traveled Salad.
Do You Know Where Your Food Has Been?

As consumers, many of us fail to recognize that even our domestic and local food supplies are part of a global network. The daily activity of consuming food directly links our health as humans to the health of crops and produce, food animals, and the environments in which they are produced.
Failures in the System

Imported Baby Formula Tainted with Melamine

Possible Salmonella Contamination Response for Recalled Salsa Containing Serrano Pepper

E. coli O157:H7 Found at Area

RECALL

Melons

Source of Recall

All states

Recalled Products

15 oz., 24 oz., 32 oz., and 36 oz. containers

Reason for Recall

Potential for E. coli O157:H7 contamination

Consumers

Avoid consuming recalled products

Retailers

Withdraw products from sale

Distributors

Withdraw products from sale

Other Information

For more information, contact the company at 1-888-287-3704.
The Burden of Foodborne Disease

Every year foodborne diseases cause:

- almost 1 in 10 people to fall ill
- 33 million healthy life years lost

Foodborne diseases can be deadly, especially in children <5

- 420,000 deaths
- Children account for almost 1/3 of deaths from foodborne diseases

For more information: www.who.int/foodsafety

#SafeFood

Global Burden by Hazard Groups and by Subregion

AFR = African Region; AMR = Region of Americas; EMR = Eastern Mediterranean Region; EUR = European Region; SEAR = South-East Asia Region; WPR = Western Pacific Region

http://journals.plos.org/plosmedicine/article?id=info:doi/10.1371/journal.pmed.1001923
Food Safety Matters for Development

- Food safety largely neglected
- Developing countries bear most of burden but not well quantified
- Driven by intensification of agriculture, increased consumption of risk foods, lack of effective food safety systems
- Barrier to export markets
- Barrier for domestic markets
  - Informal markets dominate
  - Smallholder farms and women
- Major consumer concern
- Limited evidence on effective, sustainable, scalable interventions
The Assessment and Management of Risk from non-typhoidal Salmonella, Diarrheagenic Escherichia coli and Campylobacter in Raw Beef and Dairy in Ethiopia (TARTARE)

- Goal is to increase equitable consumption of a safe, affordable and nutritious diet by reducing morbidity and mortality from foodborne disease

- Focuses on three major food safety pathogens and two value chains (raw beef and raw dairy) in Ethiopia as a model for other countries
Goals and Outcomes

- **TARTARE will develop a risk-based framework to:**
  - Address important data and knowledge gaps in understanding the burden of foodborne disease
  - Develop and evaluate cost-effective, gender-sensitive and socio-culturally appropriate approaches for mitigating impact of foodborne disease
  - Providing models for improving food safety governance in low- and middle-income countries

- **Key outcomes:**
  1) Risk-based framework for collecting data, making decisions and allocating food safety resources using Ethiopia as model
  2) Increased in-country resources for implementing such an approach.
An Integrated Food Safety System

A Risk-Based Approach

- Proactive and data-driven
- Grounded in risk analysis
- Systematic and transparent
- Ranks risks based on public health impact
- Prioritizes allocation of resources to manage risk most effectively
- Considers other factors in decision-making (i.e. perception, cost, environmental/market impacts)
- Evaluates efficacy of risk management on continuous basis
- Involves all stakeholders

Source:
Assessing and Ranking the Risks
Assessing and Ranking the Risks

Source: Havelaar et al., Zoon Publ Health 2007;54:103-117
Burden of Disease

What are the public health burden and costs associated with non-typhoidal *Salmonella*, *Campylobacter* and diarrheagenic *E. coli* in Ethiopia?

- Estimate incidence of illness caused by three pathogens.
- Estimate health-related economic and public health burden of three pathogens.
The Challenge

What we know

- Small fraction of illnesses reported
- Foods contaminated by many agents
- Important proportion due to unknown agents
- Agents transmitted by food, non-food mechanisms
- Burden includes acute and chronic illness

What we need to know
Estimating the Population Burden

- **Confirmed Case**
  - Lab tests for pathogen
  - Stool sample obtained

- **Patient hospitalized**
  - Healthcare Worker Survey

- **Person seeks health care**

- **Person becomes ill**
  - Population Survey and Case-Control Study

- **Exposures in general population**

### Calculations

- Incidence of lab-confirmed cases in study
  - Extrapolate to number of lab-confirmed cases in country
  - Adjust for proportion of stool samples properly tested
  - Adjust for proportion of stool sample collected

- Adjust for proportion of patients who are hospitalized
  - Adjust for proportion of patients who seek health care

- Adjust for proportion of persons reporting symptoms

- Estimate of incidence of illness in country
  - Proportion of illnesses attributed to food
Mitigating Risk

What are cost-effective and socio-culturally acceptable approaches to mitigating public health risks associated with *Salmonella*, *Campylobacter* and diarrheagenic *E. coli* in raw beef and dairy products?

- Evaluate effectiveness, gender sensitivity and sociocultural acceptability of selected intervention strategies for mitigating risk in raw beef and dairy products.

- Estimate public health impact and cost-effectiveness of the selected intervention strategies.
Intervention Studies

- Training Intervention Studies
  1. Meat Hygiene and Safety Training of Trainers
  2. Dairy Producer Training

- Processing Intervention Studies
  1. Validate jerky processing procedure
  2. Validate fermented dairy products procedure
Estimating Public Health Impact & Cost Effectiveness

Data Needs
- Incidence of illness
- Health outcomes
- Burden of Disease
- Dose-response
- Population Sensitivity
- Probability of contamination
- Prevalence/load of pathogens
- Pathogen growth or die-off potential
- Consumption patterns

Risk Assessment
- Hazard Identification
  Does the agent cause the adverse effect?
- Hazard Characterization
  What is the relationship between does and disease?
- Exposure Assessment
  What is the magnitude of exposure currently experienced or anticipated?

Risk Characterization
- What is the estimated incidence of adverse effect in given population?

Risk Management
- Development of risk management options
  - Evaluation of public health consequences of options
    - Economic, social and political factors
  - Decisions and Actions
Where should resources be allocated nationally to effectively reduce FBD risk from all causes in Ethiopia?

- Map current governance systems for food safety of animal-based food products in Ethiopia
- Engage stakeholders in risk ranking exercise
- Engage stakeholders in prioritization process to determine where to focus future food safety efforts
- Develop roadmap for risk-based food safety systems
From Data to Decision

- Raw Material → Processing → Distribution and Storage → Consumption → Disease

**Bottom-up Approach**

Risk Assessment

- Stakeholder opinions and values

Cost-Benefit Analysis

**Multi-criteria Decision Analysis**

- Probability of illness
- Severity of Illness
- Ease of implementation
- Burden of disease
- Economic growth
- Vulnerable populations
- Budget impact
- Cost-effectiveness

- Rank ordering
  1. Probability of illness
  2. Severity of Illness
  3. Ease of implementation
  4. Burden of disease
  5. Economic growth
  6. Vulnerable populations

Decision-maker

**Top-Down Approach**
Capacity Building

- Increasing food microbiology laboratory capacity
  - Equipment
  - Facility improvements
  - Training and mentoring

- Increasing human capacity
  - Predoctoral fellows
  - One Health Summer Institute
  - CDC Ethiopia Field Epidemiology Training Program

- Improving risk-based decision making
TARTARE Project Team

- The Ohio State University
  - College of Food, Agricultural and Environmental Sciences
  - College of Veterinary Medicine
  - College of Public Health
  - College of Education and Human Ecology
- OSU Global One Health – Ethiopia
- University of Florida
- International Livestock Research Institute (ILRI)
- Addis Ababa University
- University of Gondar
- Haramaya University
- Ethiopia Public Health Institute
Collaborating Projects

- **TARTARE**
- **Foodborne Disease Epidemiology, Surveillance and Control in African LMIC (FOCAL)**
  - PI: Tine Hald, Technical University of Denmark (DTU)
- **Ensuring the Safety and Quality of Milk and Dairy Products Across the Dairy Value Chain in Ethiopia (ENSURE)**
  - PI: Ashagrie Zewdu, Addis Ababa University (AAU)
- **Urban Food Markets in Africa – incentivizing food safety (Pull-Push Project)**
  - PI: Delia Grace, International Livestock Research Institute (ILRI)
An integrated, holistic, systems approach to food…

- proactive, preventive and anticipatory;
- addresses human, animal and environmental health needs (One Health); and
- delivers sufficient, safe and nutritious food to all.
References/Resources

- Grace, D. 2015a. Food safety in developing countries: An overview. Hemel Hempstead, UK: Evidence on Demand. [Link](https://cgspace.cgiar.org/handle/10568/68720)


“As for the future, your task is not to foresee it, but to enable it.”

- Antoine de Saint-Exupery
French Writer, 1900-1944

Thank You!
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- Guiseppe Arcimboldo