

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.



LETTUCE

Canada, Chile, Dominican Republic, Mexico, Peru, USA



CUCUMBERS

Canada, Honduras, India, Mexico, Spain, USA



FETA CHEESE

Canada, Denmark, Egypt, Germany, Greece, Israel, Italy, Turkey, UK, USA



VINAIGRETTE

Argentina, Brazil, Canada, Chile, China, France, Germany, Greece, India, Indonesia, Italy, Mexico, Morocco, Peru, Portugal, Spain, Thailand, Tunisia, Turkey, USA, Vietnam



OLIVES

Greece, Israel, Mexico, Spain, USA



SPROUTS

Argentina, Australia, Bangladesh, Canada, China, Egypt, France, India, Morocco, Nepal, Pakistan, South Africa, Spain, Turkey, USA



CROUTONS

Argentina, Australia, Brazil, Canada, China, France, India, Mexico, Netherlands, Poland, Russia, Switzerland, Uruguay, USA, Vietnam



TOMATOES

Canada, Dominican Republic, Holland, Israel, Italy, Mexico, USA



ONIONS

Canada, China, Germany, India, USA



MANDARIN ORANGES

Israel, Mexico, Morocco, South Africa, Spain



Failures in the System

Imported Baby Formula Tainted with Melamine

Attempts to boost the nitrogen content

Possible *Salmonella*
Contamination Respons
for Recalled Salsa
Containing Serrano Pepp

E. coli O157:H
Found at Area

RECA

The Burden of Foodborne Disease

Every year foodborne diseases cause:

almost
 **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

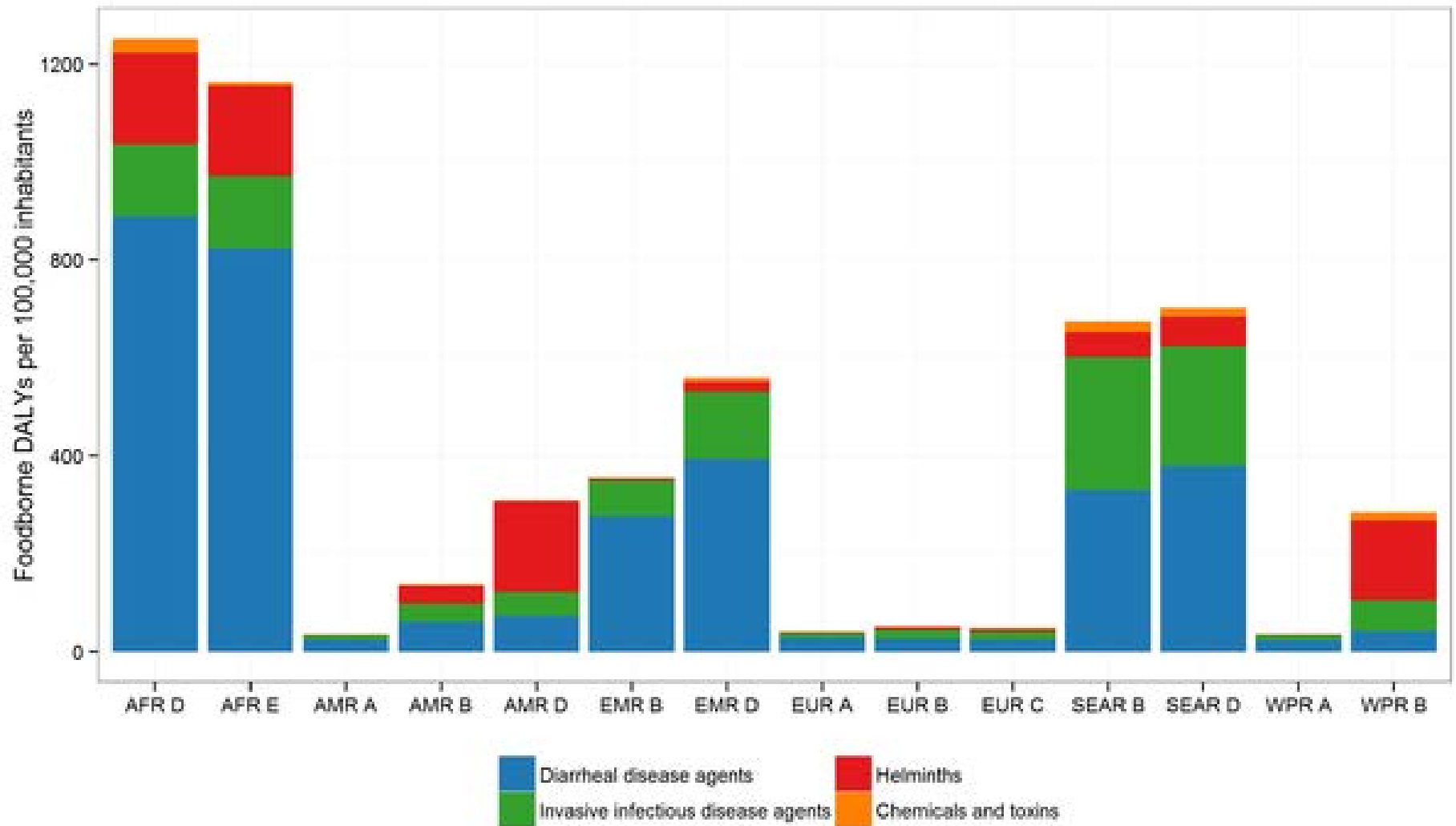
#SafeFood

Source: WHO Estimates of the Global Burden of Foodborne Diseases, 2015.



**World Health
Organization**

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

Havelaar AH, Kirk MD, Torgerson PR, Gibb HJ, Hald T, et al. (2015) World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. PLoS Med 12(12): e1001923. doi:10.1371/journal.pmed.1001923
<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**

TARTARE



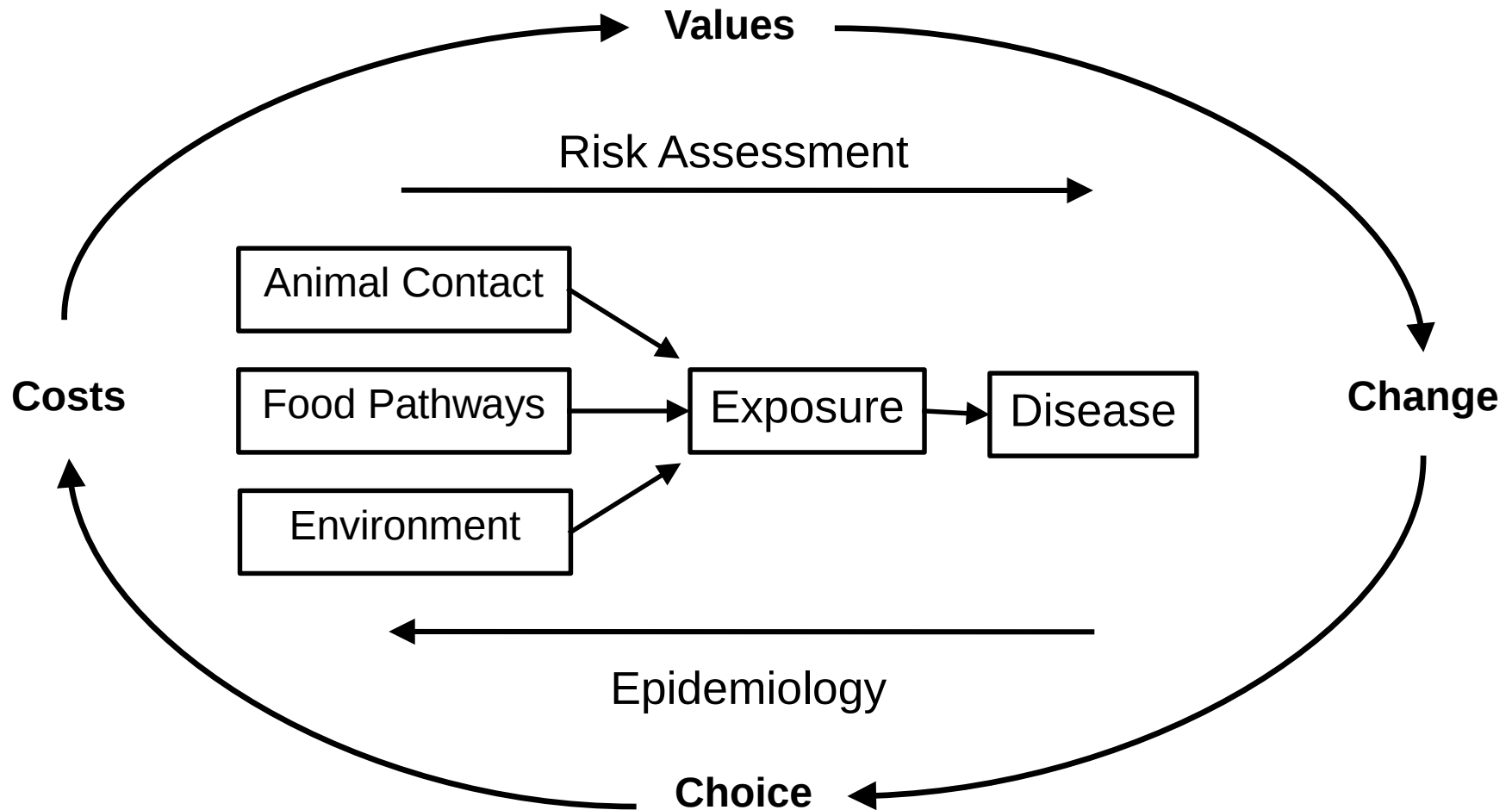
The Assessment and Management of Risk from non-typhoidal *Salmonella*, Diarrheagenic *Escherichia coli* And *Campylobacter* in Raw Beef and Dairy in Ethiopia (TARTARE)

- **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



Source: Modified from Havelaar AH, Braunig J, Christiansen K et al. Towards an Integrated Approach in Supporting Microbiological Food Safety Decisions. *Zoonoses Public Health* 2007; 54:103-117.

A Risk-Based Approach

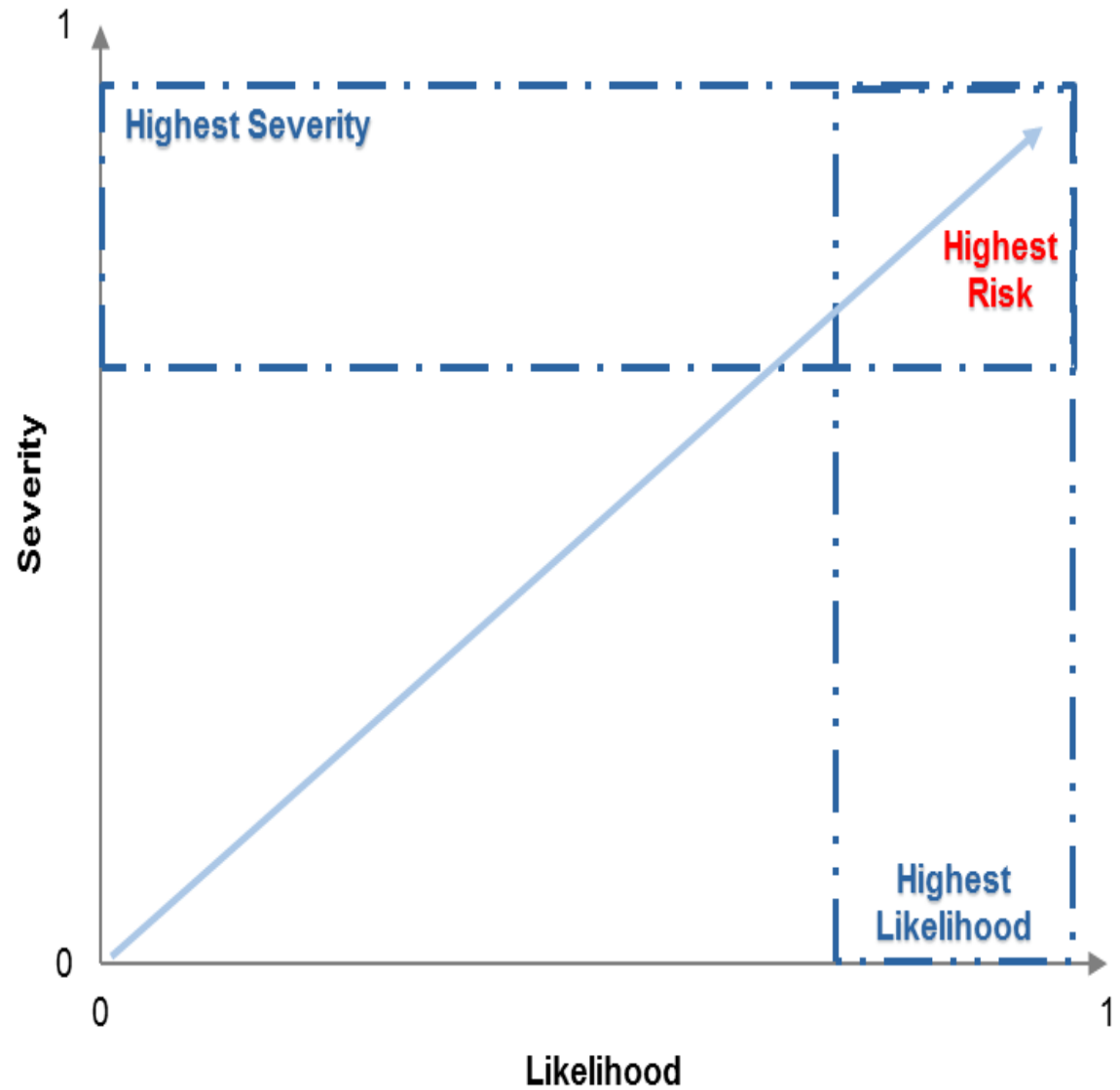
- Proactive and data-driven
- Grounded in risk analysis
- Systematic and transparent
- Ranks risks based on public health impact
- Prioritizes allocation of resources to manage risk most effectively
- Considers other factors in decision-making (i.e. perception, cost, environmental/market impacts)
- Evaluates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



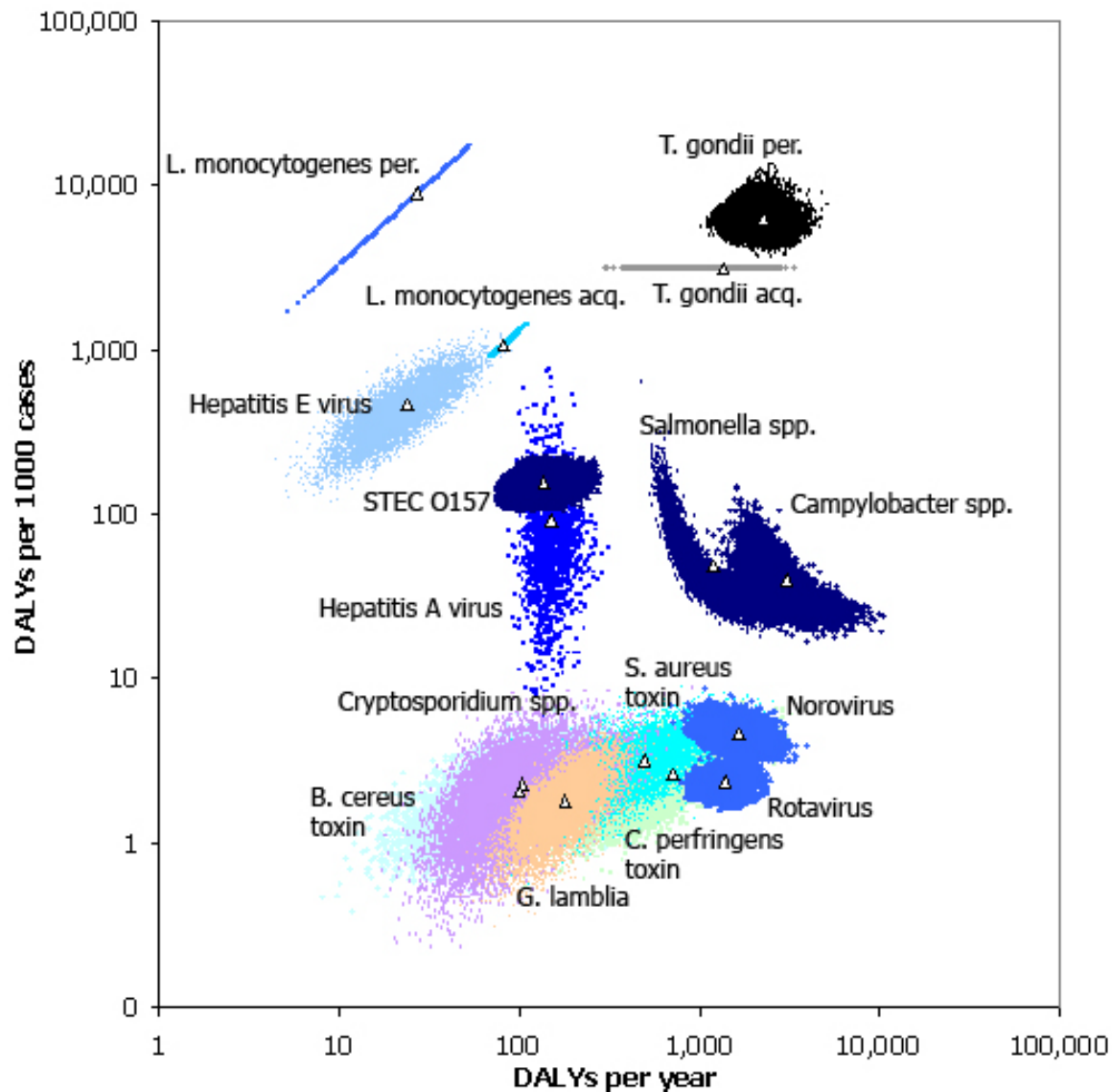
Source:

<http://www.nationalacademies.org/hmd/Reports/2010/Enhancing-Food-Safety-The-Role-of-the-Food-and-Drug-Administration.aspx>

Assessing and Ranking the Risks



Assessing and Ranking the Risks



TARTARE Results Framework

Strategic Goal: Increase equitable consumption of a safe, affordable, nutritious diet year-round

Efficiently and sustainably reduce morbidity and mortality from foodborne disease (FBD)

Improved in-country resources for implementing risk-based approaches in food safety

Roadmap for implementing risk-based decision-making around food safety in Ethiopia that can be adopted in other LMIC with similar food systems

Increased national capacity in food safety

Increased availability of quality food safety data and evidence

Improved understanding of FBD Burden (Obj 1.1, 1.2)

Identified cost-effective approaches for mitigating impact of FBD (Obj 2.1, 2.2)

Established risk-based priorities in food safety (Obj 3)

Women, dairy producers and abattoir workers trained in food safety risk mitigation

Improved in-country collaborations with OSU, UF, ILRI, WHO, FAO, US-CDC, others

Ethiopian stakeholders experienced in risk-based research around food safety

Four Ethiopian PhD's trained in food safety

Estimates of incidence of illness caused by NTS, STEC, CAMPY in 2 regions of Ethiopia (Obj 1.1)

Burden of illness models developed

Case-control study conducted

Surveys conducted

Descriptive Epidemiology study conducted

Estimates of cost of illnesses attributed to NTS, STEC, CAMPY in 2 regions of Ethiopia (Obj 1.2)

Benefit-cost analysis and cost-effective analysis conducted for each intervention strategy

Public health impact estimated for each intervention strategy

QMRA Models developed

Estimated public health impact and cost-effectiveness for identified intervention strategies (Obj 2.2)

Effectiveness evaluated for interventions (Obj 2.1)

Dairy Intervention studies conducted

Beef intervention Studies conducted

Government officials engaged in risk ranking

Risk ranking approach developed and implemented

Trainings in risk ranking/prioritization

Situation analysis conducted

Stakeholders engaged in risk prioritization

Gender and vulnerable communities, Comprehensive communication plan for disseminating results (integrated across all activities)

Burden of Disease

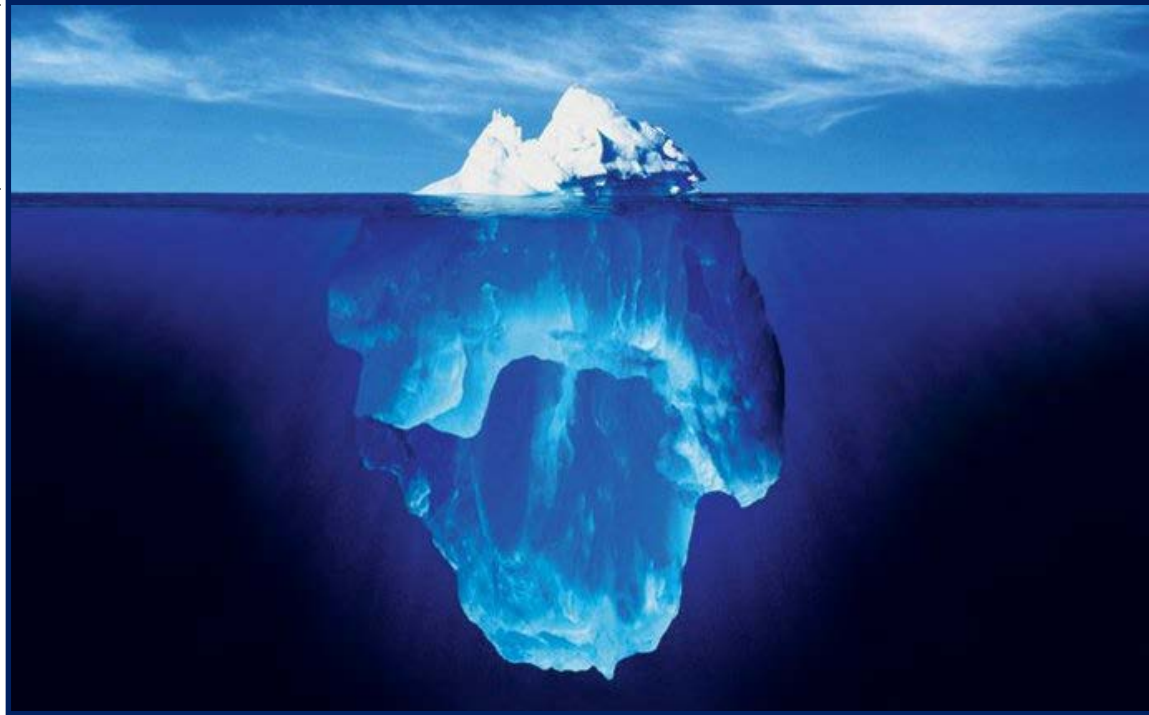


What are the public health burden and costs associated with non-typhoidal *Salmonella*, *Campylobacter* and diarrhegenic *E. coli* in Ethiopia?

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

The Challenge

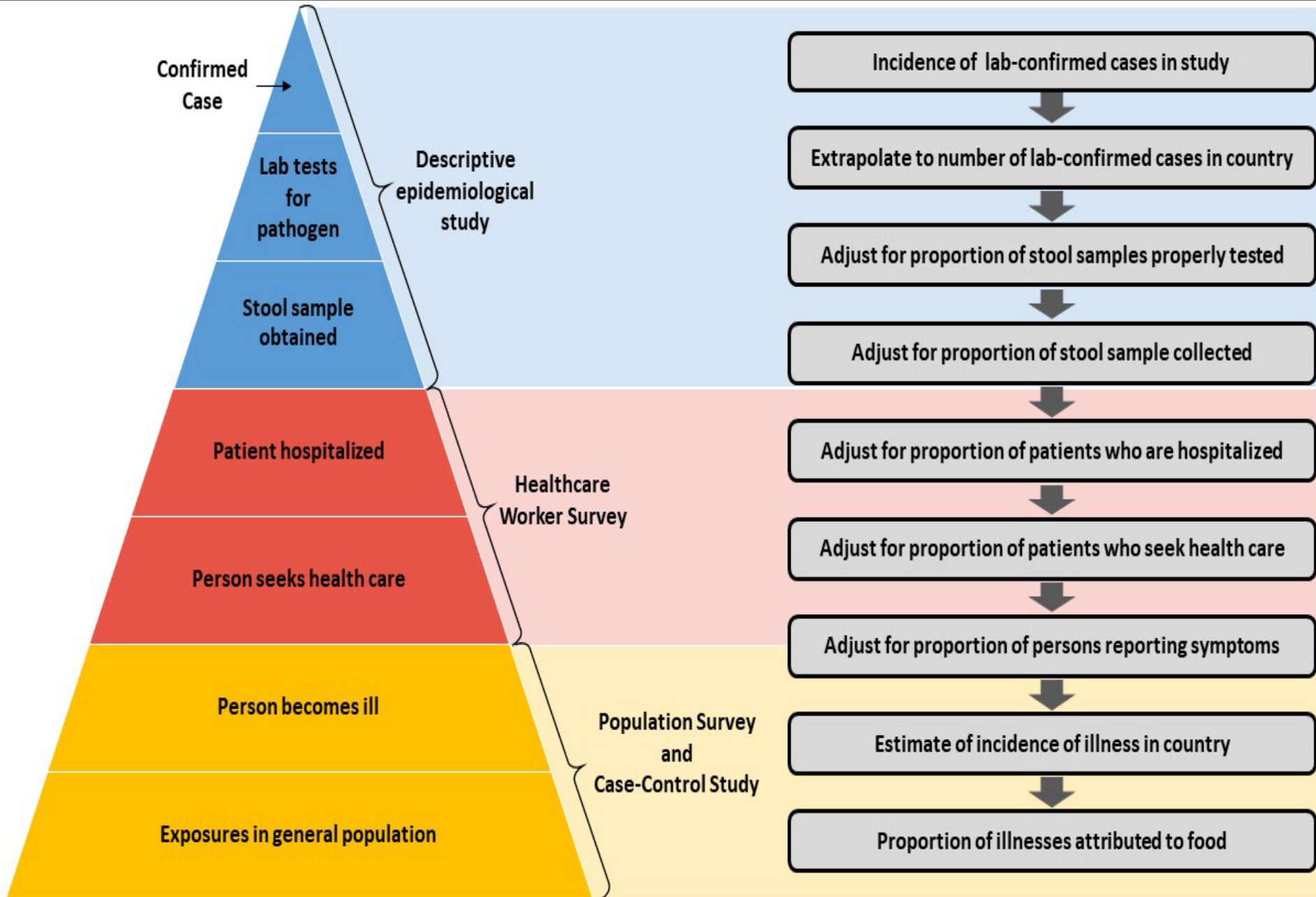
What we
know



What we
need to
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

Estimating the Population Burden



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 dose 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?

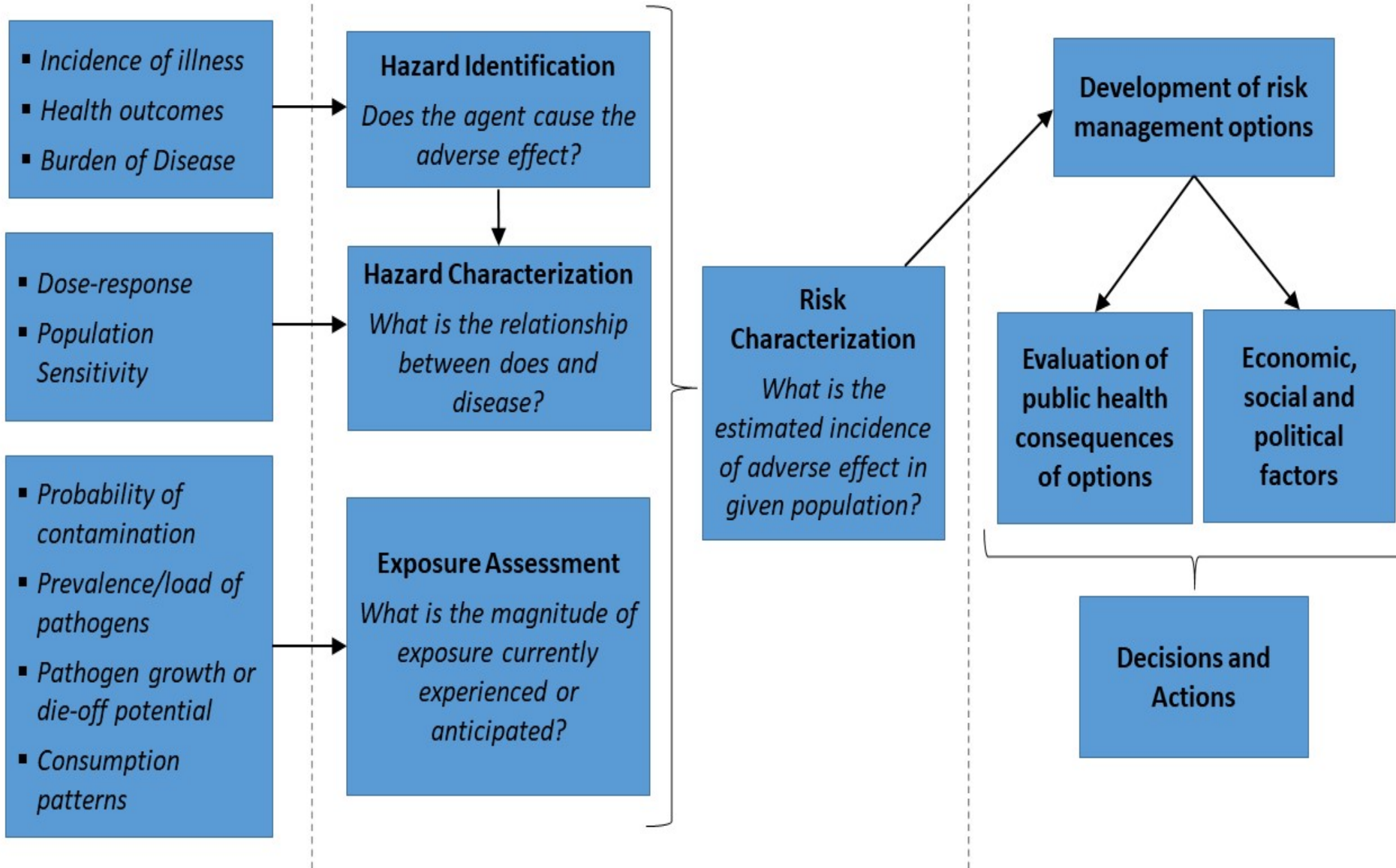
Risk Management

Development of risk management options

Evaluation of public health consequences of options

Economic, social and political factors

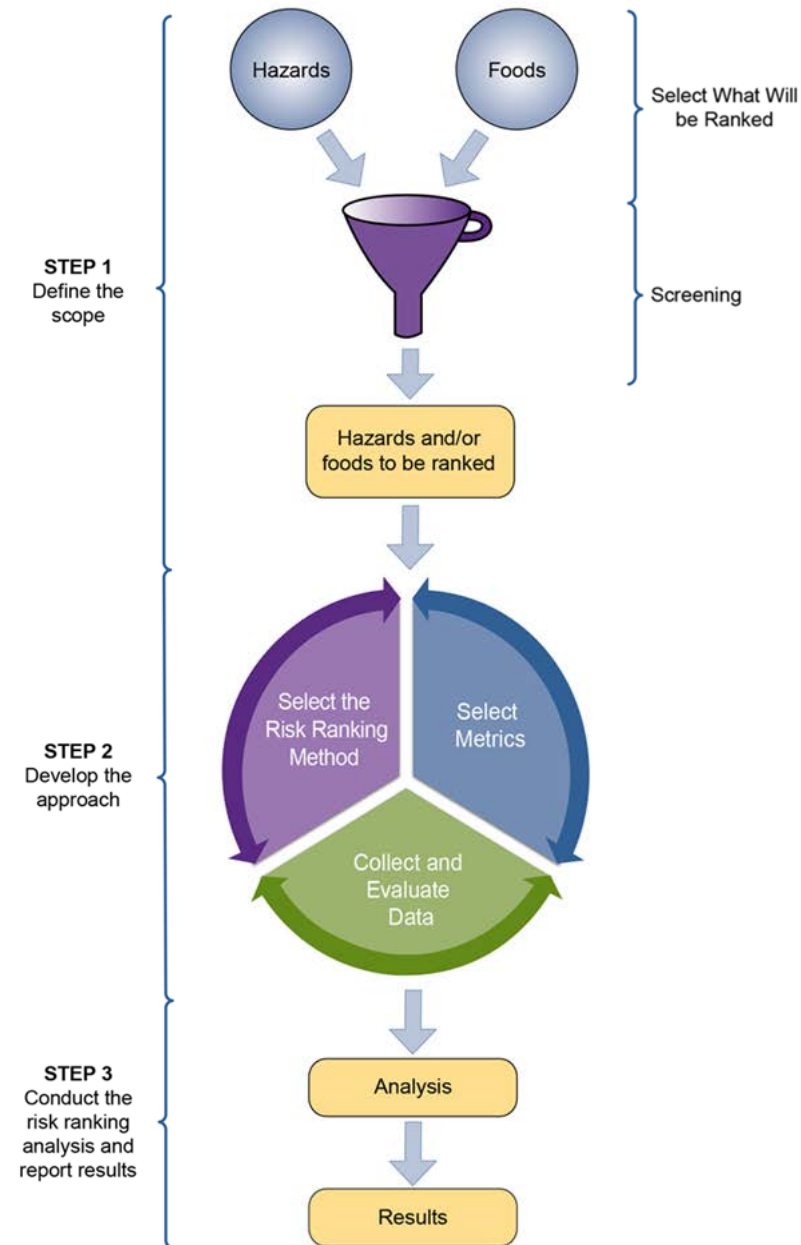
Decisions and Actions



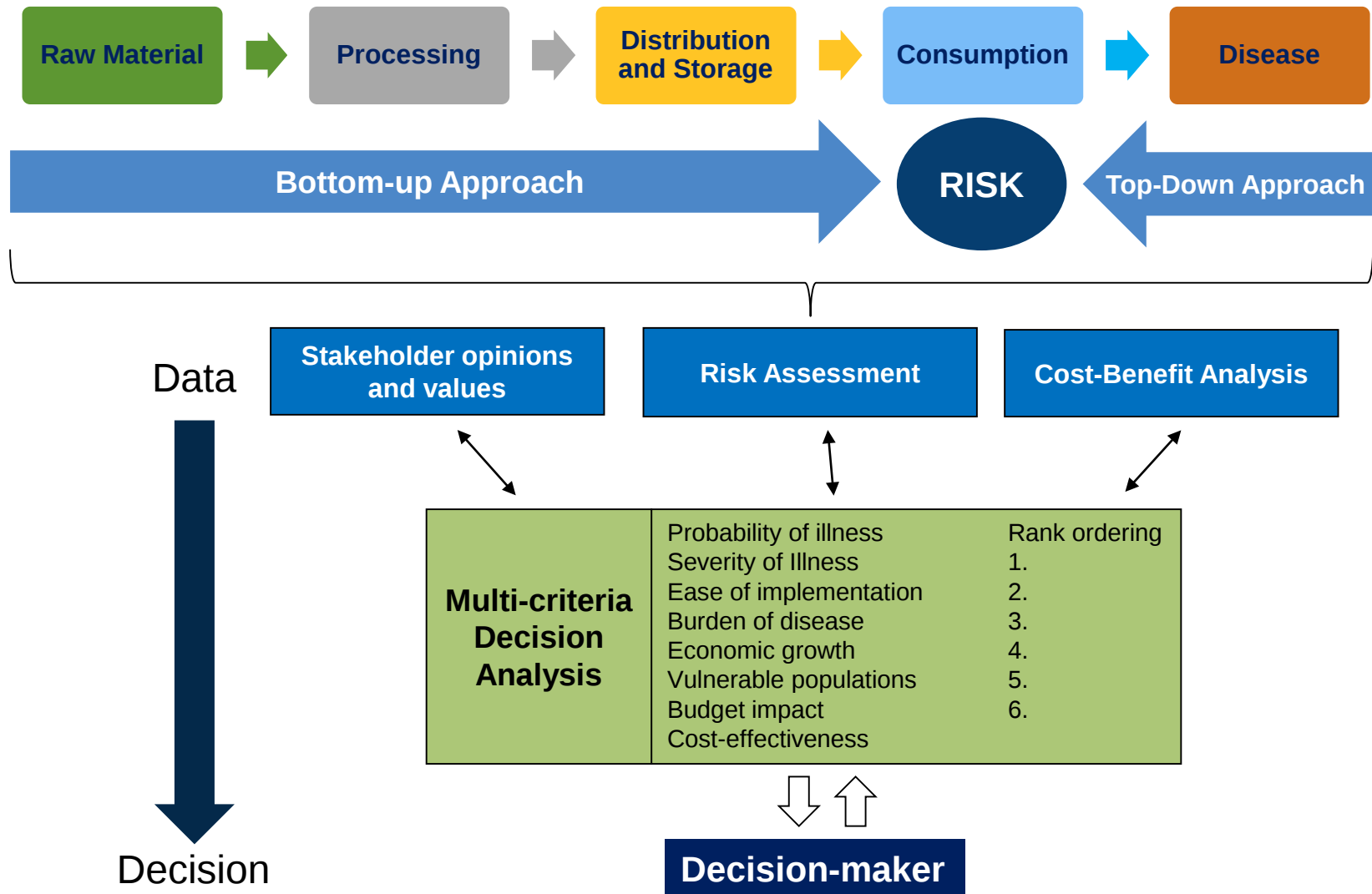
Ranking and Prioritizing Risks

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



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**

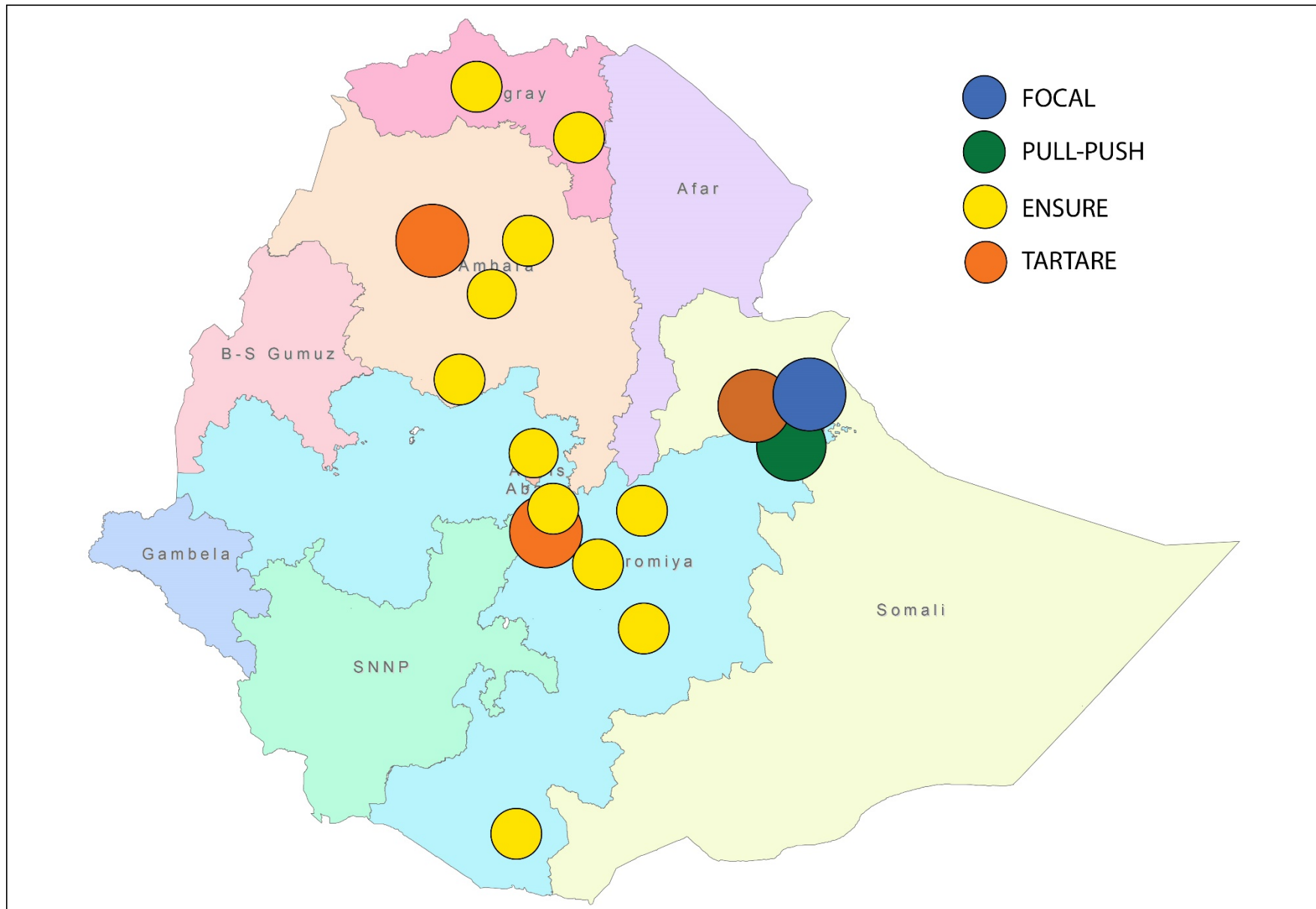


BILL & MELINDA
GATES *foundation*

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)

Areas of Focus



Our Destination



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.
<https://cgspace.cgiar.org/handle/10568/68720>
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- Havelaar, A.H., Kirk, M.D., Torgerson, P.R., Gibb, H.J., Hald, T., Lake, R.J., Praet, N., Bellinger, D.C., Silva, N.R. de, Gargouri, N., Speybroeck, N., Cawthorne, A., Mathers, C., Stein, C., Angulo, F.J. and Devleesschauwer, B. on behalf of World Health Organization Foodborne Disease Burden Epidemiology Reference Group. 2015. World Health Organization global estimates and regional comparisons of the burden of foodborne disease in 2010. PLOS Medicine 12(12): e1001923.
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Questions?



**“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