



# Antimicrobial Resistance Hub



## Advances in Risk Assessment for AMR

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# Outline

- Hazard and Risk
- Risk analysis frameworks for AMR?
- How we work with this

# Hazard

“What can go wrong?”

something that can cause adverse effects (harm)

biological agent which may have adverse effect (ie risk)

- presence of microbiological organisms in meat
- infectious disease agent in imported animals

hazard # risk

# Risk

- One unwanted outcome amongst several possible
  - it is usually uncertain which outcome will occur
- Likelihood of occurrence of unwanted outcome AND magnitude of consequences given its occurrence
  - probability plus consequences

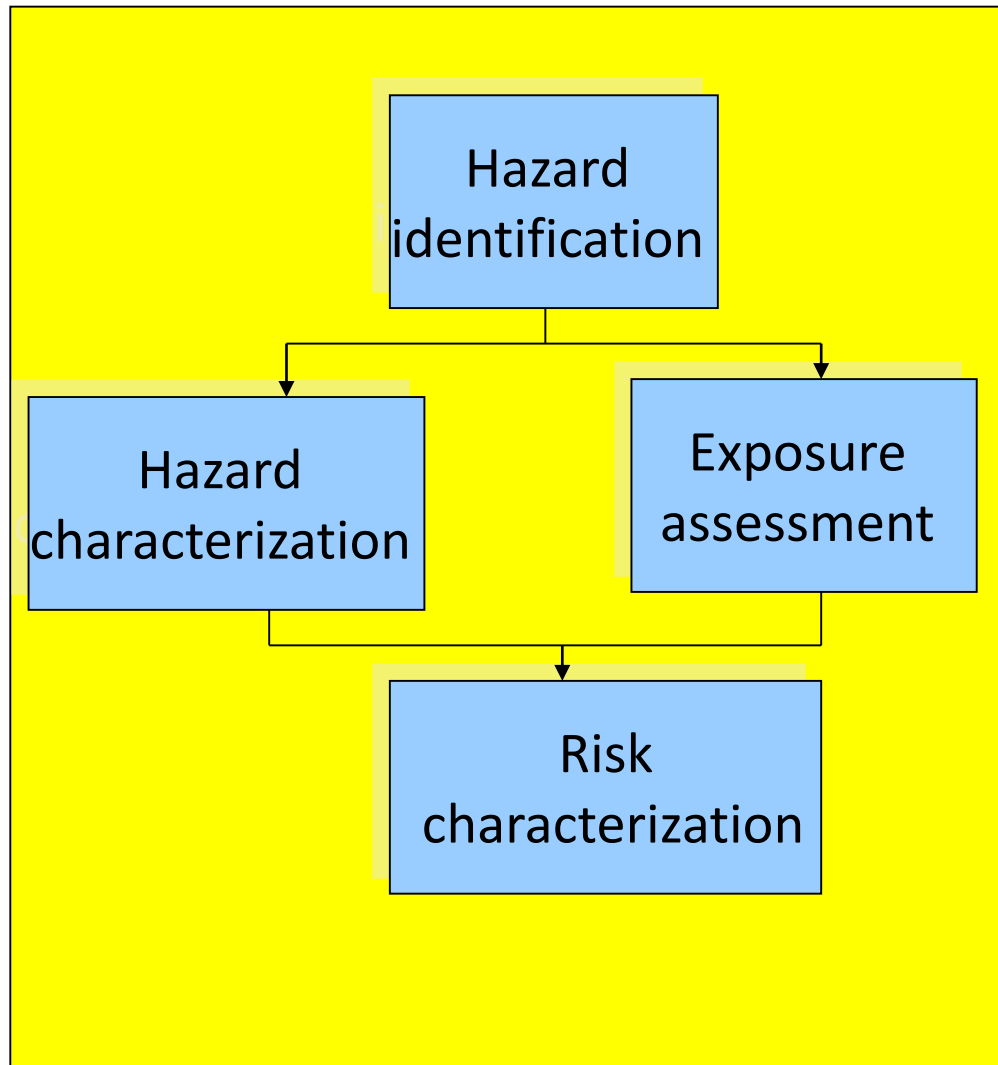
# Risk Assessment Approaches

## Codex alimentarius

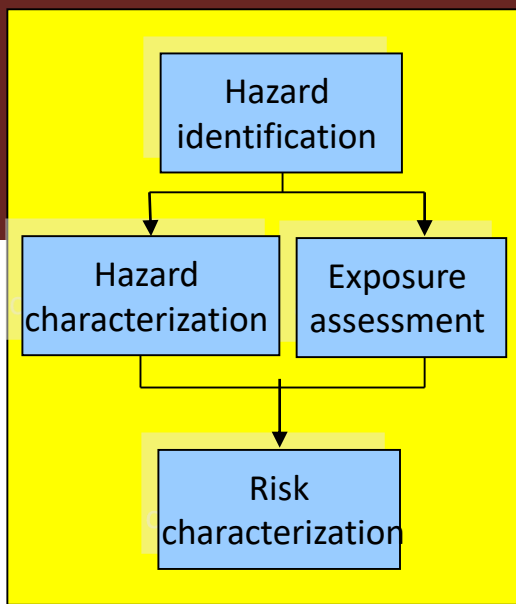
### □ 4 stages

- Hazard identification -> Hazard characterisation
- Exposure assessment -> Risk characterisation

# Why is there an issue with a risk assessment for AMR?



# Hazard identification



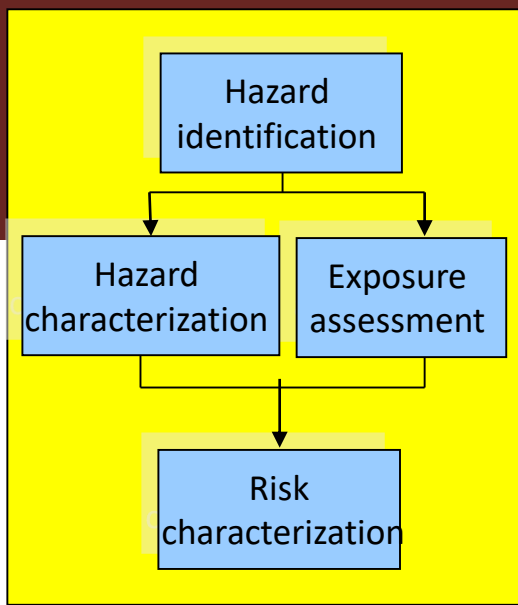
- The identification of biological, chemical, and physical agents –
- What is the hazard when we talk about AMR?
  - residues?
  - Pathogens?
  - Plasmid?
- and which may be present in a particular food or group of foods

# Hazard identification

## Process of Hazard Identification

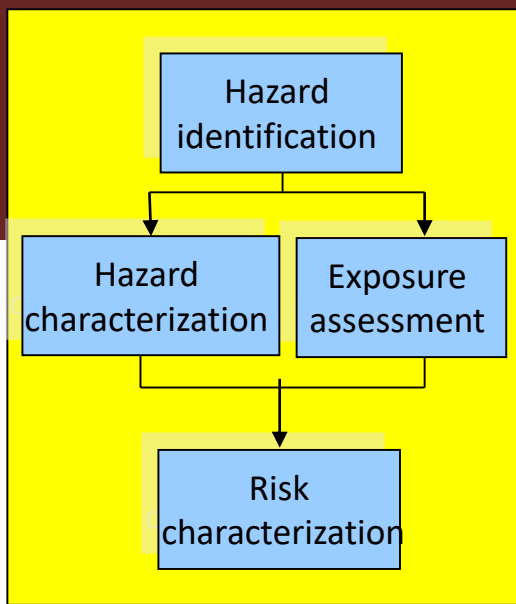
- The risk of consuming residues?
- The risk of consuming plasmids?

**What do we want to study?**



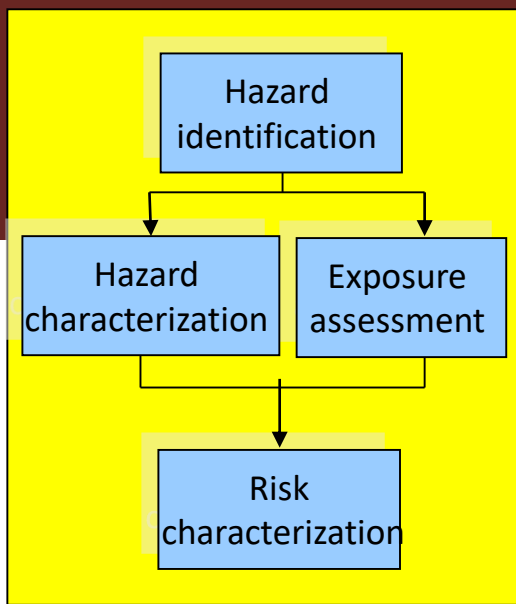


# Exposure assessment



- Based on potential extent of **food** **contamination** by a particular agent or its toxins, and on **dietary** information
- Assessment should specify the **unit of food** that is of interest, i.e., the portion size in most/all cases of acute illness

# Exposure assessment

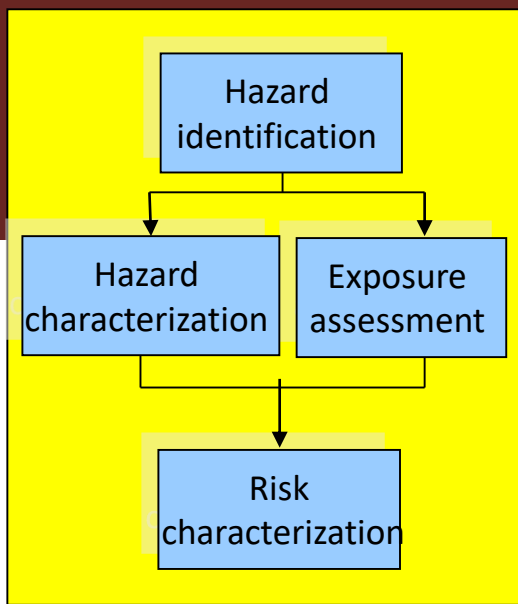


## Factors that must be considered in exposure assessment

- Frequency of consumption of foods by the age groups and its level in those foods
- Patterns of consumption
  - socio-economics
  - Cultural background
  - Ethnicity
  - Seasonality
  - Age
  - Consumer preference and behavior

**We can do this!**

# Hazard characterization



- Qualitative or quantitative description of the severity and duration of adverse effects that may result from the ingestion of a microorganisms or its toxin in food
- A **dose-response** assessment should be performed if the data are obtainable

# Hazard characterization

## Dose-response assessment

- Determination of the relationship between the magnitude of exposure to a chemical, biological or physical agent and the severity and/or frequency of adverse health effects (response)

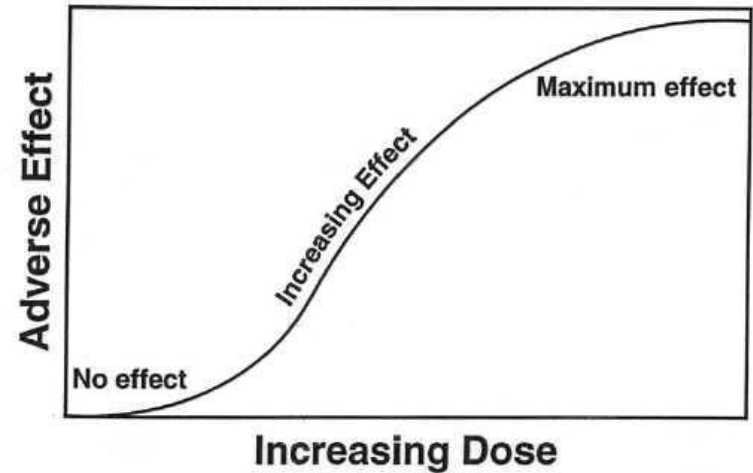


FIGURE 3.1. Adverse response as a result of increasing dose.

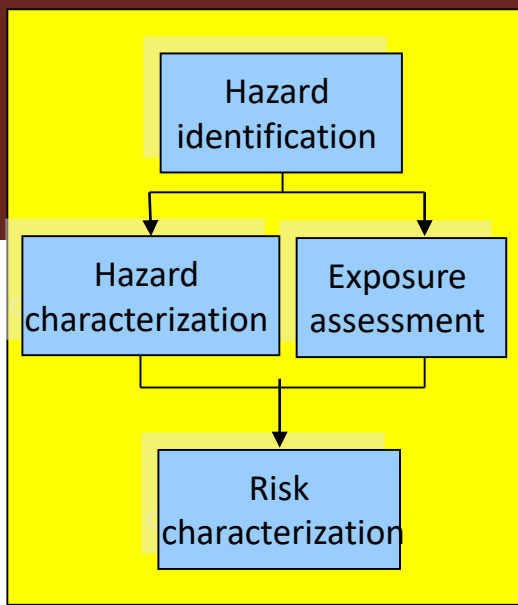
- Representative dose-response relationships

– P =  $1 - \left(1 + \frac{\lambda}{\beta}\right)^{-\alpha}$

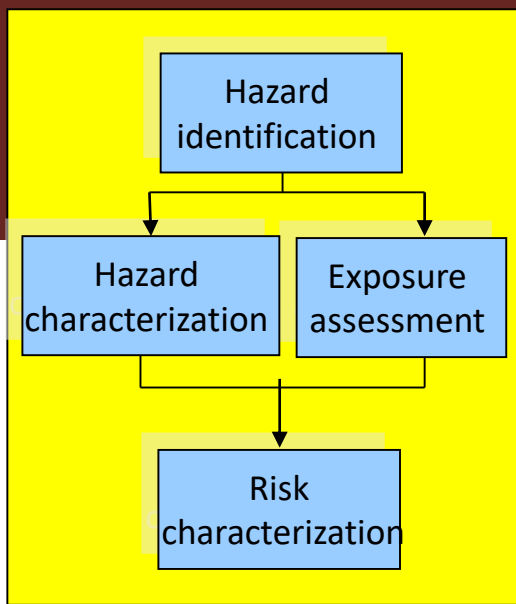
– Exponential model  
 $P = 1 - e^{-\lambda p}$

P: probability of illness;  
 $\lambda$ , D: the number of microorganism;  
 $\alpha, \beta, a, b$ : parameter obtained by experiments or outbreak investigations;  $\exp(A) = e^A$

**We do not have this for residues nor resistance genes!**



# Risk characterization



- Integration of previous three steps to obtain a **Risk estimate**
- Degree of confidence: **uncertainty and variability**
- Influence of the estimates and assumptions by **sensitivity and uncertainty analyses**

# Risk characterization

## Uncertainty and variability

- **Uncertainty: Lack of knowledge**

- Associated with data themselves

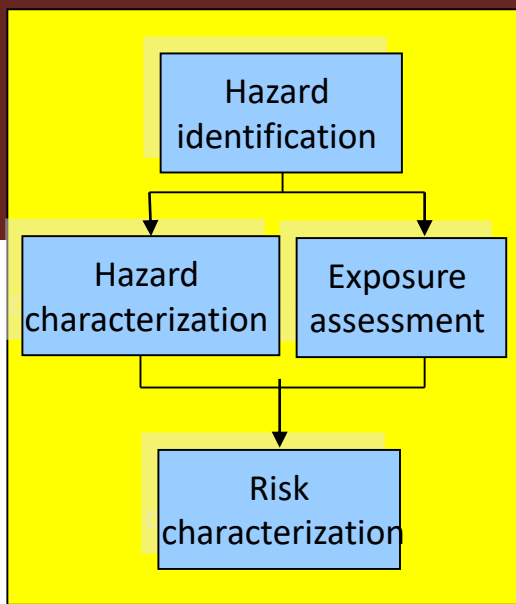
- Data uncertainty might arise in the evaluation and interpretation of information obtained from epidemiological, microbiological and laboratory animal studies

- **Variability: Variation in a system**

- Biological variation: difference in virulence that exist in microbiological populations

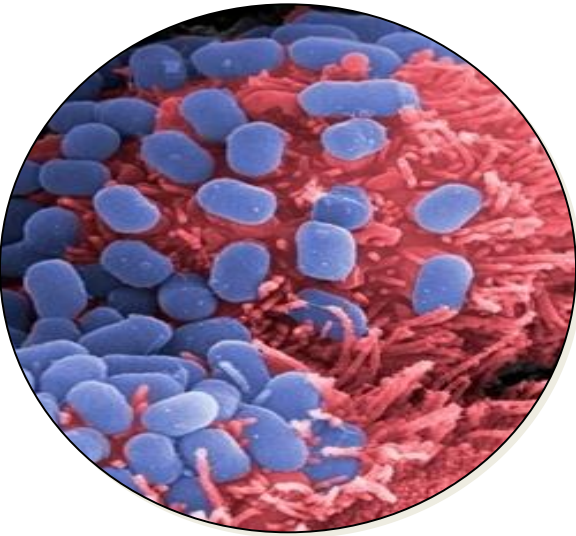
- Variability in susceptibility within the human population and particular subpopulations

*We can't do this....*



# Risk communication

What you worry about and what kills you are not the same



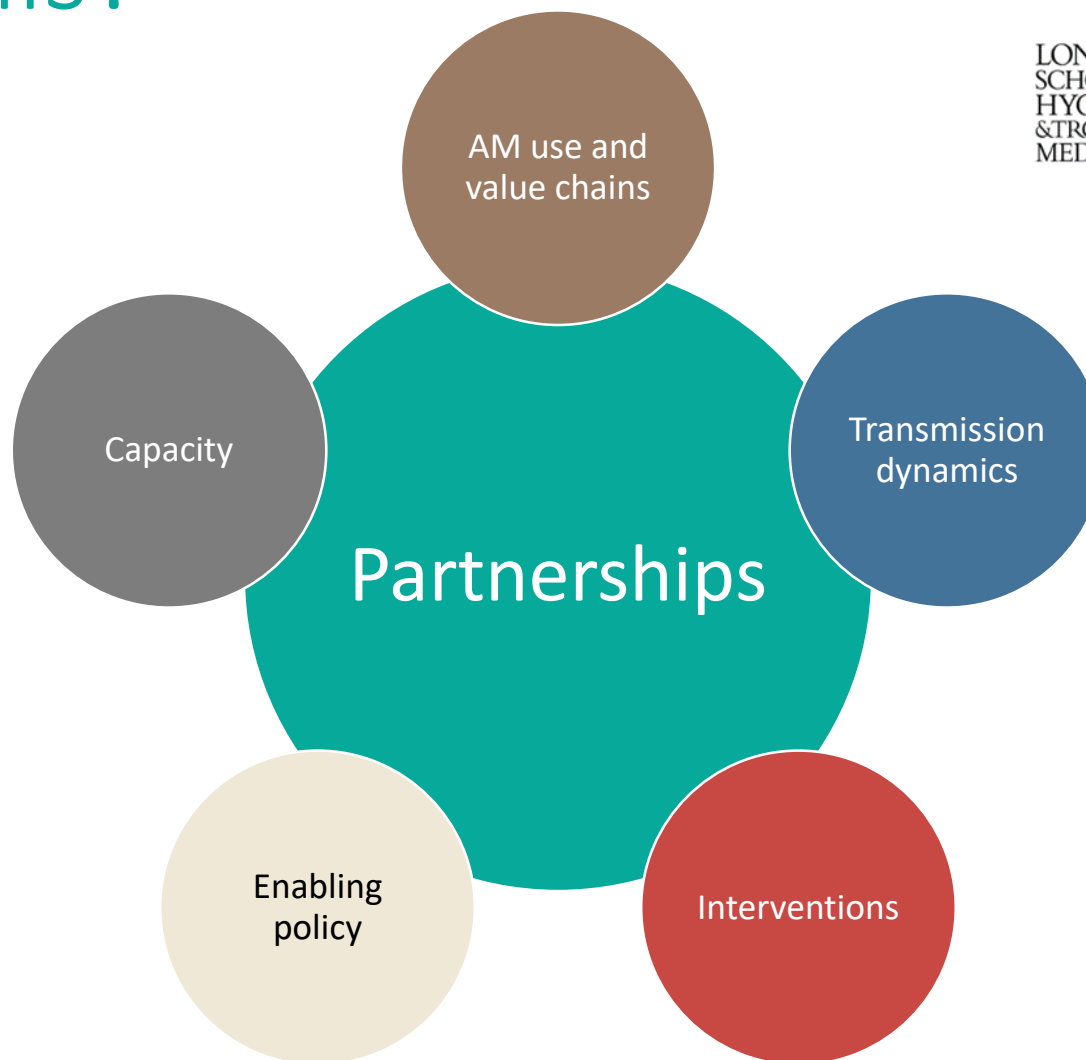
High concern about chemicals  
Low concern about microbes

**We still have to do this!**



FRANKENCOW

# AMR in the CGIAR: How to work with this?



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# Antimicrobial use, behaviour and value chains

We research behaviour around antimicrobials used, the distribution networks of veterinary drugs, and the role of formal and informal markets in perpetuating cycles of inequity.

## Outputs:

- Metrics for AM use in different systems
- Better understanding of systems influencing AM use behaviour



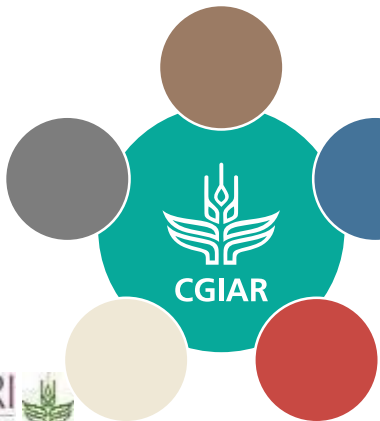
## Transmission dynamics, AMR residues

To better understand AMR risks for people, we study the biology, ecology, and epidemiology of resistant microbes at the animal, human and environment interface.



### Outputs

- adequate study designs for genotyping research
- evidence on the extent of antimicrobial-resistant bacteria and antimicrobial residues found in livestock, fish, humans, the environment, water and food
- transmission and genetic mechanisms of resistance in agriculture and health implications





## Interventions and incentives

Based on One Health approaches, we design, test and evaluate interventions and incentives that lead to behavioural change and reduce agriculture-associated AMR.

### Outputs

- Typologies of interventions
- Decision support tools to identify best-bet interventions
- Gender sensitive interventions to manage drivers of AM use
- Cost and benefits of interventions from a One Health perspective





## Enabling policy environment

We translate evidence into convincing arguments to engage policymakers and other stakeholders in the AMR discussion. Accepted and feasible policies are key for sustainable solutions that achieve impact.

### Outputs

- Synthesized evidence for policy makers
- Advocacy materials
- Integrated policy approaches towards One Health solutions



# Capacity development

Capacity development is a key enabler on the pathway to impact. An important area of research is how solutions can be brought to scale. We capitalize on a network of AMR experts to support capacity building on researching AMR issues and to facilitate access to international AMR research for professionals and institutions in LMICs.

## Outputs

- Guidance for scaling of interventions
- Training, mentorship and exchange programs
- Training materials







# Antimicrobial Resistance Hub

[www.amr.cgiar.org](http://www.amr.cgiar.org)

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