Food Safety
Key Issues and Challenges:

International, Including SAARC

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Outline

- Introduction
- Key Risk Areas
- Risk-based approach for food safety management
  - Illustrations
- Focus for SAARC

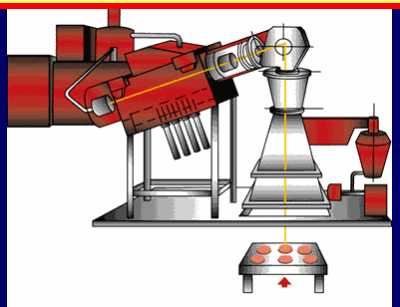
Global Foods in Local Markets

Out of Home Meals

Intensive Farming & Adulteration

Global Travel

Novel Food processing



Global Warming

Zoonoses – New patterns

Others

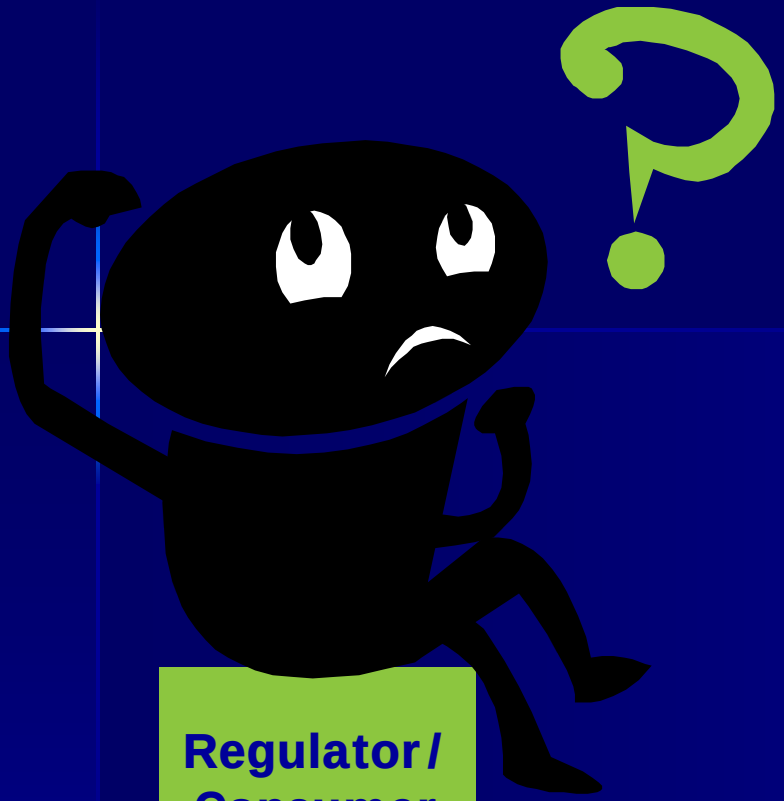
- Lower water & Land availability for cultivation
- Rising Food demand and costs
- Shrinking fishery resources
- Many other changes that are ….

- Rapid
- Widespread
- Affecting all
  - The world
  - Asia
  - SAARC
    - You and Me

& Have a bearing on FOOD SAFETY

How changes may influence outcomes – Some examples

- Irrigation water being a source of pathogens
  - Polluted/ Recycled waters may enhance the risk
- Pathogens survive in environments and can potentially contaminate foods
  - Global warming – higher temperatures increase survival opportunities and infective potential
- Consumer interest in exotic foods
  - Exposure to newer microbiological and toxicological risks
- Increasing travel and eating out
  - Global transmission of disease – Pandemics
    - SARS/ Bird Flu



Regulator / Consumer

So much Food
So many choices
So many issues
How to handle?
How to manage?

Nothing is absolutely safe

Whether a material will cause any adverse impact depends a number of factors

Risk Assessment

Risk Assessment

- Scientific evaluation of known or potential adverse effects resulting from human exposure to food-borne hazards.

It consists of

- Hazard Identification
- Hazard characterization
- Exposure assessment
- Risk characterization

Risk Management

Identify & Characterize hazards →

Epidemiology
Toxicology/ M obiology
Generate predictions

what biological, chemical and physical agents are ling with and with which foods is associated? what illness(es e caused, associated with which dose and for which p on?

Characterize risks →

Severity
Exposure
Susceptibility

how likely it is that an individu opulation will be exposed to a chemical/ biological hazard and what of the is likely to be ingested

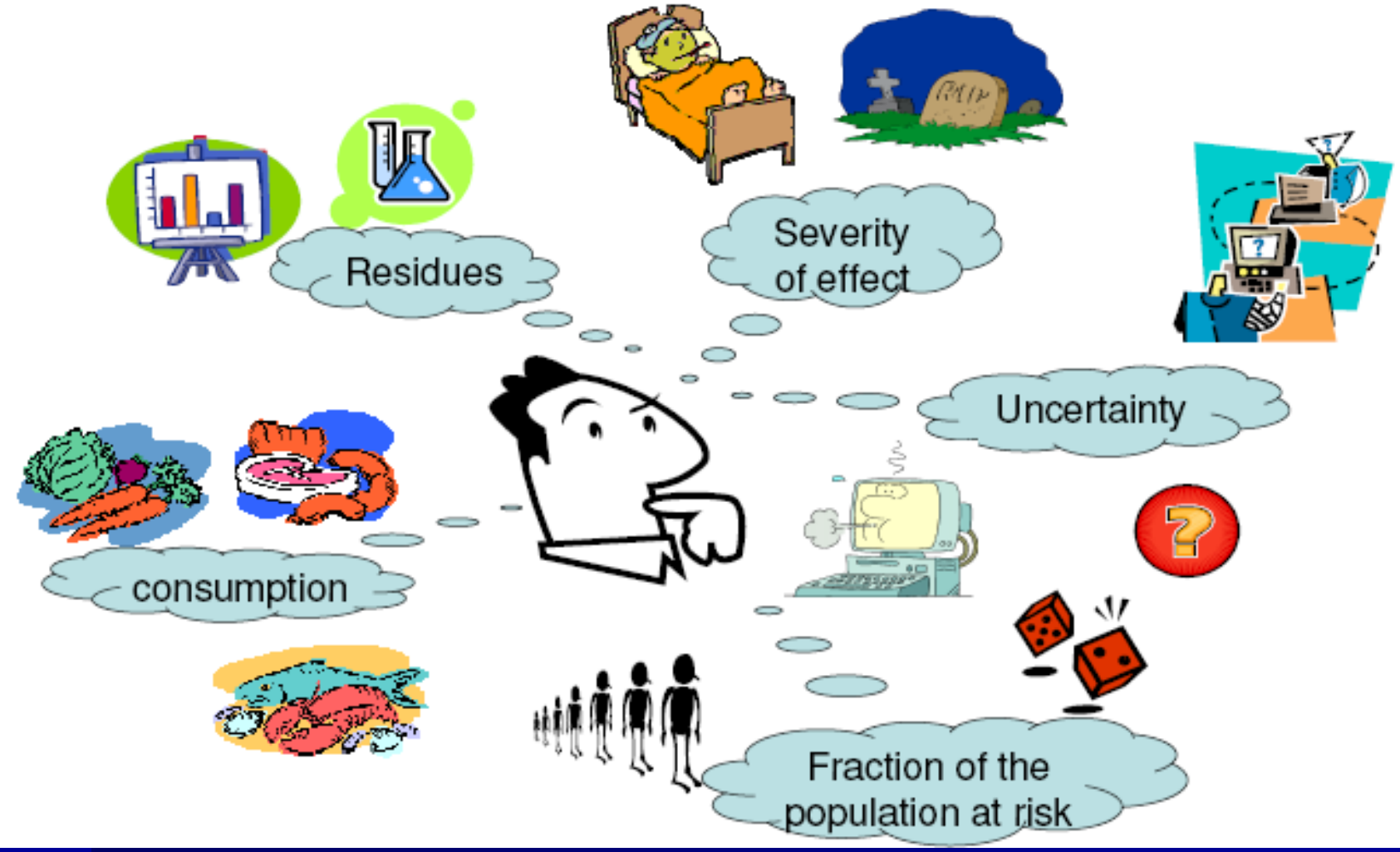
Integrate the resu gning probabilities and uncertainties

Manage ri →

Control measures (safety by design)
Regulation
Communication

Documented in a transparent manner!!

Quantifying Risks - Modeling



Chemical (Tox.) v/s Microbiological

Chemicals:

- Levels unchanged
- May not be destroyed cooking
- Often homogeneous distribution
- Not transmitted
- Consumer has less responsibility for safety
- Mostly chronic exposure

Microorganisms:

- Can change in concentration
- Many destroyed by cooking
- Heterogeneous distribution
- Person-to-person transmission important
- Role of the consumer in ensuring safety is essential
- Mostly acute

Toxicity Endpoints

Toxicology studies how external chemicals interact with your body's chemicals to cause damage or illness

- Carcinogenicity
- Mutations
- Altered immune function
  - Food Allergy
- Teratogenicity
- Altered reproductive function
- Neuro-behavioral toxicity
- Organ-specific effects
- Ecological effects (wildlife, environmental persistence)

Appropriate Hazard Data

- Choose most sensitive endpoint for effects

1. sub-chronic study,
2. reproduction/development study,
3. neurotoxicity,
4. lifetime exposure (thresholded tumours)

- Determine the NOEL (no observed effect level) or
  the NOAEL (no observed adverse effect level)

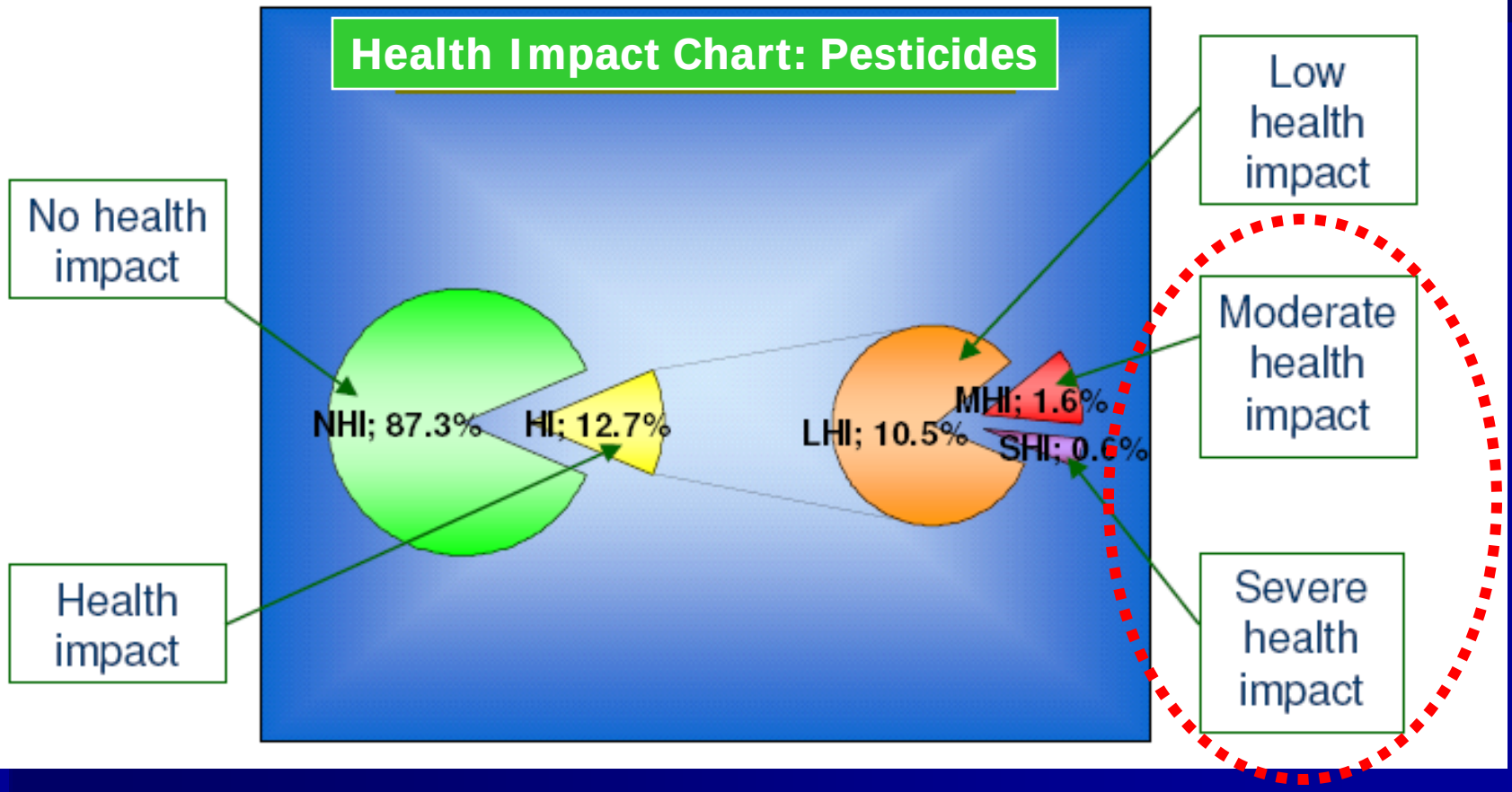
Input to risk-based decision making

No-observable Adverse Effect Levels (NOAELs)

	90 day rat NOAEL (mg/kg/day)	90 day dog NOAEL (mg/kg/day)	1-year dog NOAEL (mg/kg/day)	2-year rat NOAEL (mg/kg/day)	Lowest NOAEL (mg/kg/day)
2,4 D	15	1	1	5	1
Acetochlor	80	10	2	10	2
Atrazine	1	6	5	3.5	1
Carbaryl	125	1	3.1	10	1

Health Impact Categorisation

Risk Prioritization: Health Impact in the population



Microbiological Risks

A systems approach to food safety.

DRIVERS	SOURCES	PATHWAYS			OUTCOMES
	Pathogens	Farms	Processing/distribution	Preparation/Consumption	Public health
Economy					
Globalization	**Reduced geographical barriers to spread (of new variants)**	**Inadequate sanitation: higher pathogen loads Global sourcing Intensified contact structures**	**Long and complex supply chains Varying hygiene levels**	→	**Increased risk**
Food price/income level		**Less profit margins; decreased investment in food safety**		Preference for cheaper alternatives (e.g. less meat and butter; discounters; home brands)	Risk not clear
Science and technology and industry					
Minimal processing	**Adaptation**		Less kill steps	→	**Increased risk if not well controlled**
Innovation		**New food animal species**	Step change food innovation *Smart packaging Bacteriophages*	*Smart labels*	Risk not clear
Laboratory methods	**Discovery of new pathogens or variants Omics approaches**				**Increased observed risk**

More Natural
Minimally Preserved

Sustainability:
Lower Processing

Microbial Resilience
Food-Microbe Interaction

Emerging Pathogens - Common Features

- Many (75%) have an animal reservoir
- Many can infect multiple hosts
- Do not often cause disease in host animals
- Rapid spread, on a global basis
- Many have antibiotic resistance capabilities
- Some have low infectious dose
- Sharing of virulence genes
- Some cause severe illness
- We don’t have much knowledge about ecology and methods for detection/enumeration and control

Why have new food-borne diseases emerged ?

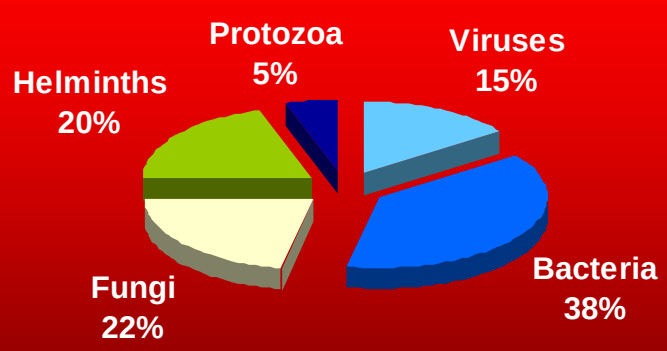
Rank	Driver
1	Changes in land use or agricultural practices
2	Changes in human demographics and society
3	Poor population health (e.g. HIV, malnutrition)
4	Hospitals and medical procedures
5	Pathogen evolution
6	Contamination of food sources or water supplies
7	International travel
8	Failure of public health programmes
9	International trade
10	Climate change

Woolhouse and Gowtage-Sequeria, 2005, Emerg. Infect. Dis., 11, 1842-1847

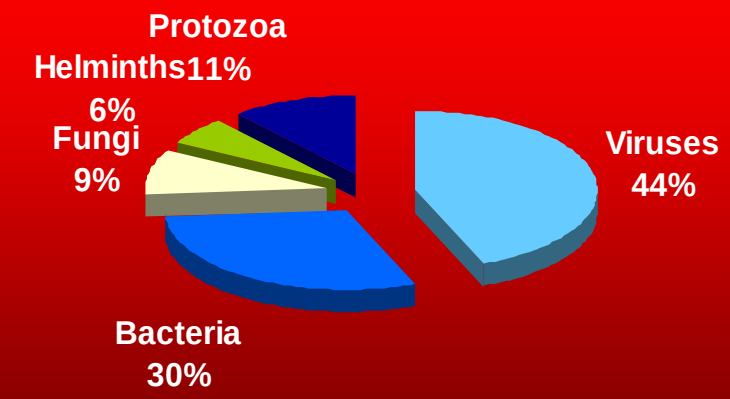
What should we be worried about ?

- Helminths - complex, with complex life cycles, long generation times, not extremely virulent/pathogenic
- Viruses - difficult to prevent spread, high mutation rates, generation times short, quicker to evolve/adapt, RNA viruses more easily transmissible across species/orders
- Bacteria - somewhere in between

All human pathogens (1415)



Emerging human pathogens (175)



Cleaveland et al, Phil, Trans. R. Soc Lond. B 2001, 356, 991-995

Salmonella

- Easy to kill
  - Thermal*
    - Easily inactivated

Bacteria	Time (min.)	Temp°C
Salmonella	4.3	60

***Thermal death time** is a concept used to determine how long it takes to kill a specific bacteria at a specific temperature.

- *Salmonella*
  - Can survive for months to years in low moisture foods
    - nonfat dry milk, peanut butter, chocolate
  - Small numbers of this bacterium can produce illness when consumed in high-fat foods
    - chocolate (< 1 *Salmonella*/g), peanut butter, cheese

Hypotheses:

1) Entrapment of Salmonella within hydrophobic lipid micelles protection against the bactericidal action of gastric acidity

2) Rapid emptying of fat based gastric contents.

Thermal Inactivation of *Salmonella* in Peanut Butter[a]

Internal Temperature (°C / °F)	Mean maximum time (min) 3-log reduction	5-log reduction	7-log reduction
71 / 160	107	402	965
77 / 170	62	197	423
83 / 181	33	110	227
90 / 194	21	49	120

[a] Commercial, creamy-style peanut butter; a_w = 0.45, pH = 5.1

Ma et al., J. Food Protect. July 2009

Bacteria	Time (min.)	Temp°C
Salmonella	4.3	60

Equivalence in Food Safety Management

- New Technologies for food processing
  - Ultrasonic waves
  - Pulse field
  - High Pressure
  - Radio Frequencies

- Equivalent level of risk reduction needs to be ensured

SAARC – Reported Gaps

- **Strengthen health surveillance systems**
  - **Poor assessment of health issues linked to foods**
- **Strengthen to conduct detailed risk assessment**
  - **lack of exposure assessment data**
  - **laboratory infrastructure**
  - **know-how to analyze a wide range of contaminants**
  - **Focus on easily measurable target**
    - **e.g. Bacterial pathogens. What about viruses/ other types of pathogens in foods?**

- Adequacy of in-house controls
  - Hazard Analysis and Critical Control Points (HACCP) system
    - science-based, systematic, Food Safety management system
  - Establishment of
    - Traceability and recall systems
    - Understanding of hazard analysis
    - Pest control and proofing
    - Water treatment system maintenance
    - Staff hygiene facilities

How Do We Go About

- Recognize - Food-related illnesses have a significant impact not only on health but also on development
- Put food safety high on national priorities E.g. Establishment of FSSAI in India
- Identify critical gaps in technical expertise
- Make available Financial resources and infrastructure to address gaps and implement food safety policies
- Support the development of risk-based, sustainable, integrated food safety systems
- Devise science-based measures along the entire food production chain
  - prevent exposure to unacceptable levels of microbiological agents and chemicals in food
- Assess and manage risks and communicate information, in cooperation with other sectors and partners.

- **Utilize & Exploit excellent intellectual resources already available**
  - **Knowledge on behavior of microorganisms in foods**
  - **Toxicological endpoints**

- **Interdisciplinary network of experts**
  - **Mathematics/ Microbiology/ Toxicology/ Epidemiology ++**
  - **Country/ Regional**

- **R&D to generate new knowledge enabling scientific risk assessment**
  - **E.g. Ethnic foods**
  - **Hazards '*creeping in*' on account of evolving supply chain**

- Food MicroModel http://www.leatherheadfood.com
- Sym'previus http://www.symprevius.net/

✓ Freeware packages:

- Pathogen Modeling Program (PMP) http://www.arserrc.gov/mfs/pathogen.htm
- Growth Predictor (GP) http://www.ifr.ac.uk/Safety/GrowthPredictor/
- Seafood Spoilage & Safety Predictor (SSSP) http://www.dfu.min.dk/micro/sssp/

THANK YOU