JOINT FAO/WHO FOOD STANDARDS PROGRAMME
FAO/WHO COORDINATING COMMITTEE FOR THE NEAR EAST
Tenth Session

CONFIRM AGAINST DELIVERED

If it is not safe
it is not food

Chemicals in food - the invisible challenge.

When do we need to be worried and what do we need to know?

Mark Feeley
Health Canada

OUTLINE

1. Food Safety Issues
2. Chemicals in food
3. How to assess food safety (chemical)
4. Examples of recent chemical contaminant assessments
5. Conclusions

FOOD

Food means any substance, whether processed, semi-processed or raw, which is intended for human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances used only as drugs.

"Food is fundamental to human health"

FOOD COMPOSITION

The "Good"

Fats, Protein, Carbohydrates, Fibre, Vitamins, Minerals and Water

The "Bad" (possibly)

Biological, chemical, radiological, physical

https://www.thelancet.com/gbd

Food Safety issues

Safe food saves lives

WHO has estimated 600 million foodborne illnesses and 420,000 deaths in 2010 could be attributed to unsafe food

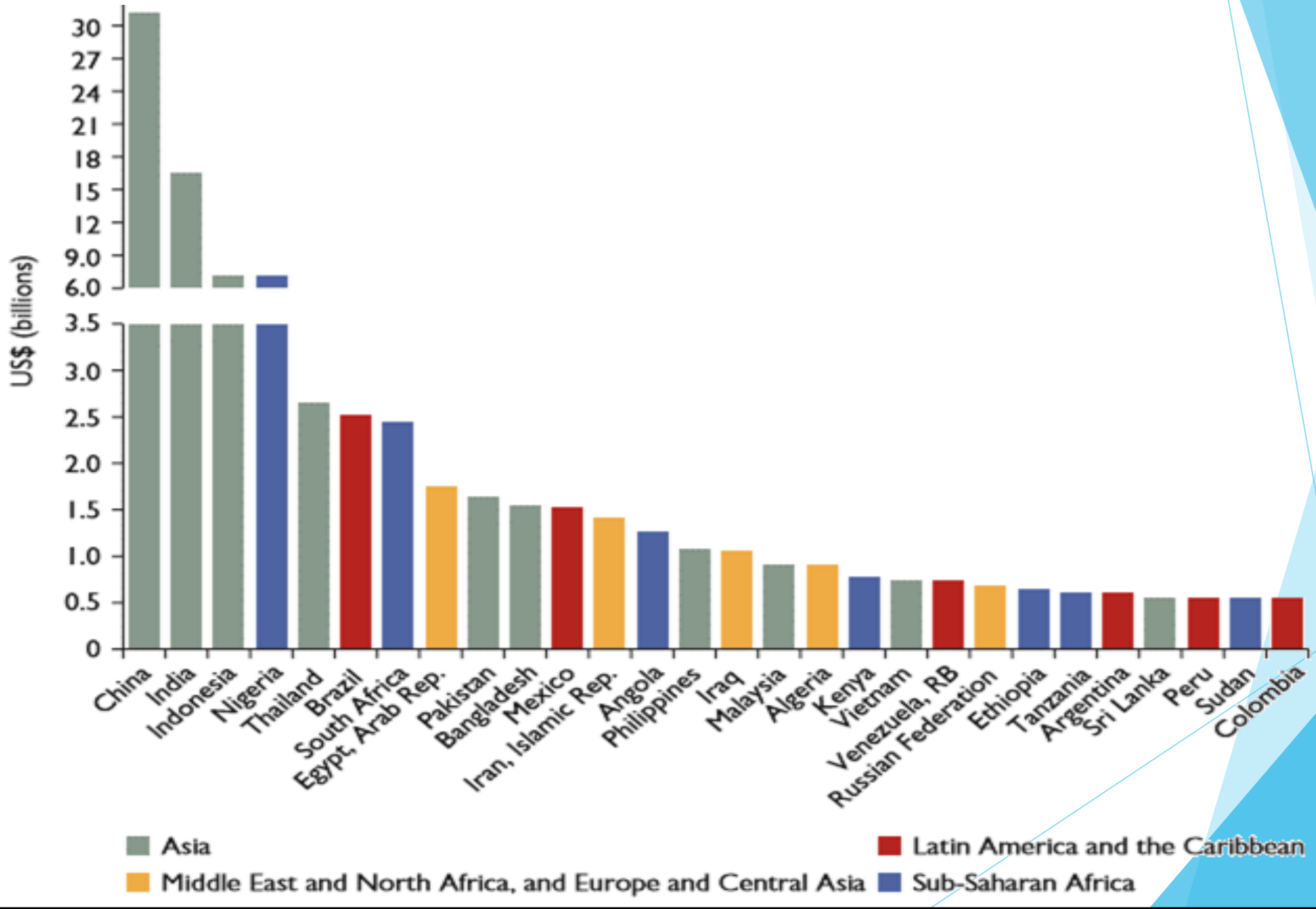
Safe food enhances individual and population health

Safe food improves economic growth in regions where food safety is practiced and enhanced

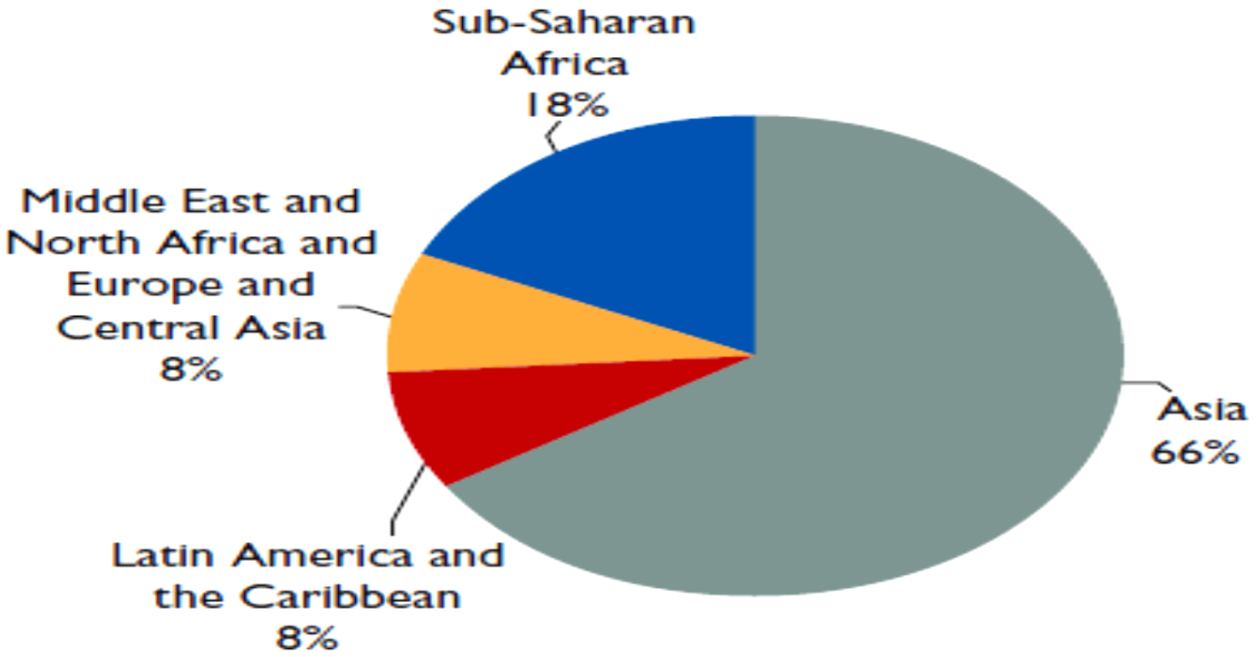
A safe food supply depends on both sound science and having an active food safety and security system

Unsafe food is a global health issue

Productivity Loss from Foodborne Disease - 2016



World Bank, 2019



Region	2016 human capital loss (current US$, billions)
Asia	63.1
Latin America and the Caribbean	7.4
Middle East and North Africa, and Europe and Central Asia	7.9
Sub-Saharan Africa	16.7
Total	**95.2**

World Bank, 2019


E. coli
toxins
mycotoxins
GMO
hormones
bacteria
allergens
Biological Hazards
Campylobacter
infection
parasites
factory contaminants
HACCP
Food Safety
infections
Staphylococcus
Physical Hazards
Salmonella
Clostridium perfringens
Shigella
virus
pesticides
intoxication
rotovirus
antibiotics
Clostridium botulinum
dioxins
foreign bodies
chemical residues
Listeria
heavy metals

2019 Eurobarometer on Food Safety in the EU

"Nowadays, food products are full of harmful substances" – 43% agree

Main concerns were:

- antibiotic, hormone or steroid residues in meat (44%)
- pesticide residues in food (39%),
- environmental pollutants in fish, meat or dairy (37%)
- food additives (colours, preservatives or flavourings) used in food (36%)

There are regulations in place to make sure that the food you eat is safe (43%)

EFSA, 2019

Food Safety and Quality Concerns – CCNE (CX/NE 19/10/3)

Chemical food contamination (aflatoxin, heavy metals, emerging pollutants, veterinary drug residues, pesticides residues, etc.) were identified as the greatest concern

WHO ESTIMATES OF THE GLOBAL BURDEN OF FOODBORNE DISEASES

Foodborne diseases are a major global public health concern

Foodborne diseases are caused by types of:


Bacteria


Viruses


Parasites


Toxins


Chemicals

Some of these are a public health concern across all regions
Others are much more common in middle- and low-income countries

But in a **globalized world** they can **spread quickly** along the food chain and **across borders**

FOODBORNE DISEASES ARE PREVENTABLE.
EVERYONE HAS A ROLE TO PLAY.

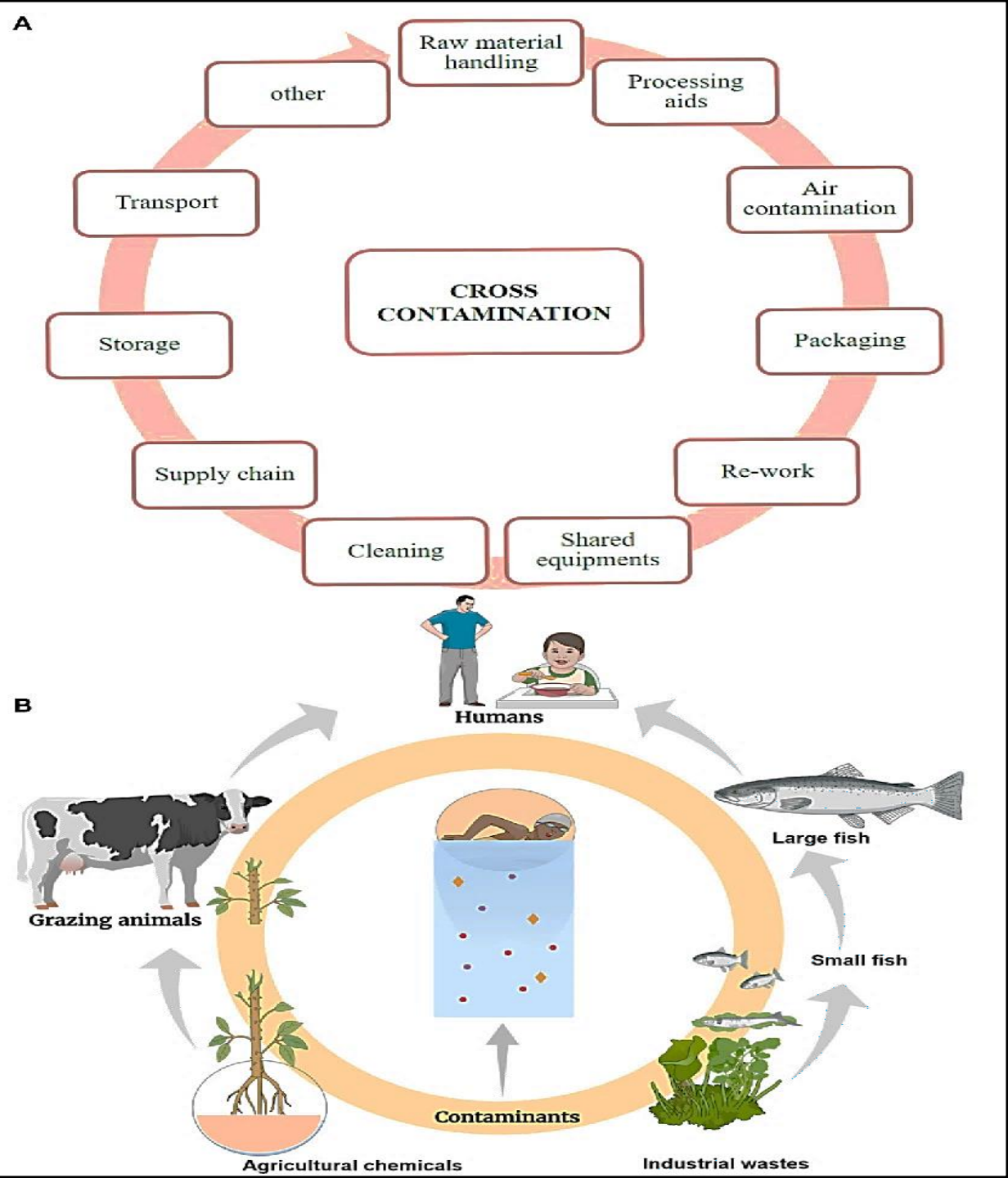
For more information: **www.who.int/foodsafety**
#SafeFood

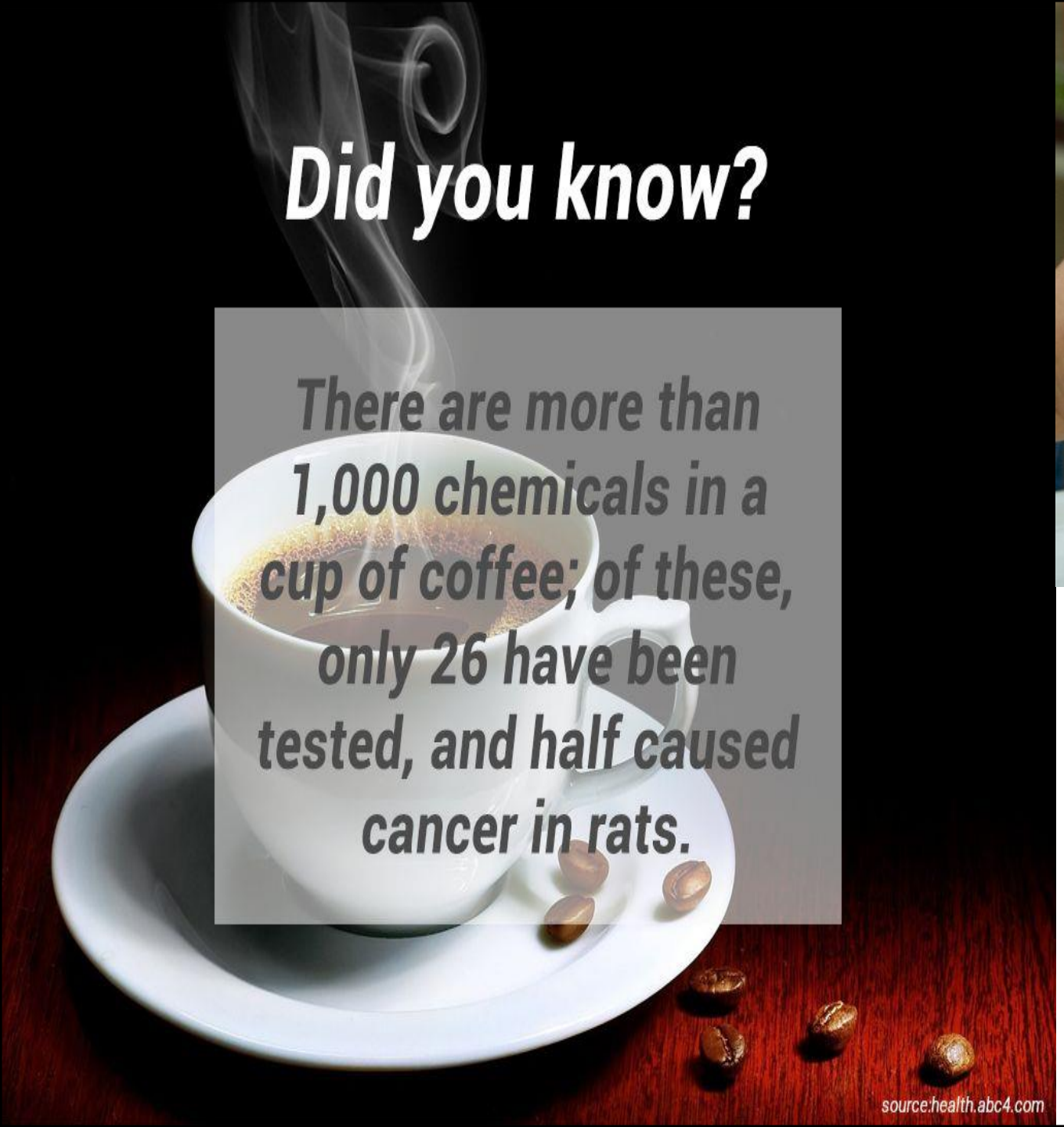
World Health Organization

CHEMICALS IN FOOD

All food contains chemicals

Main sources are those deliberately added and unintentional (NIAS)



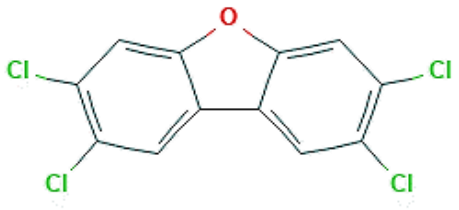


TEST RESULTS: 168 BABY FOODS

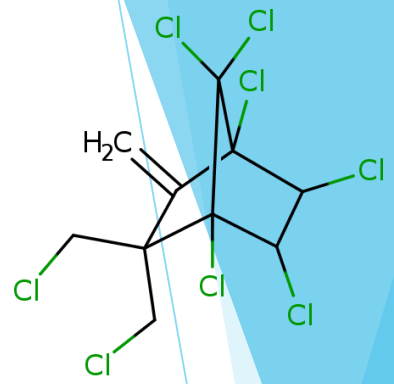
"95 percent of baby foods tested contained one or more toxic heavy metals"

Lead - 94%
Cadmium - 75%
Arsenic - 73%
Mercury - 32%

HBBF, 2019



CHEMICALS IN FOOD



Should we be worried?

Most chemicals are found in food at levels which do not represent a health risk.

Chemicals with toxic properties deliberately used in food production are typically subject to pre-market controls (safety evaluation, risk management).

Issues with intentional chemicals more related to deliberate or accidental misuse

Chemicals unintentionally present in food represent a greater health risk.

"All things are poison, and nothing is without poison, the dosage alone makes it so a thing is not a poison."

Main Chemicals Intentionally Present in Food

Deliberate addition/use of chemicals for specific purposes

Ex. food additives, pesticides and veterinary drugs

Maximum residue limits (MRLs) are established for vet drugs and pesticides; maximum levels (MLs) set for food additives

Residues found in food must be safe for consumers and must be as low as possible

Tolerances/limits set for “intention” chemicals in food all are established based on a risk assessment

Typically a dose is established which is considered unlikely to represent a human health risk (HBGV)

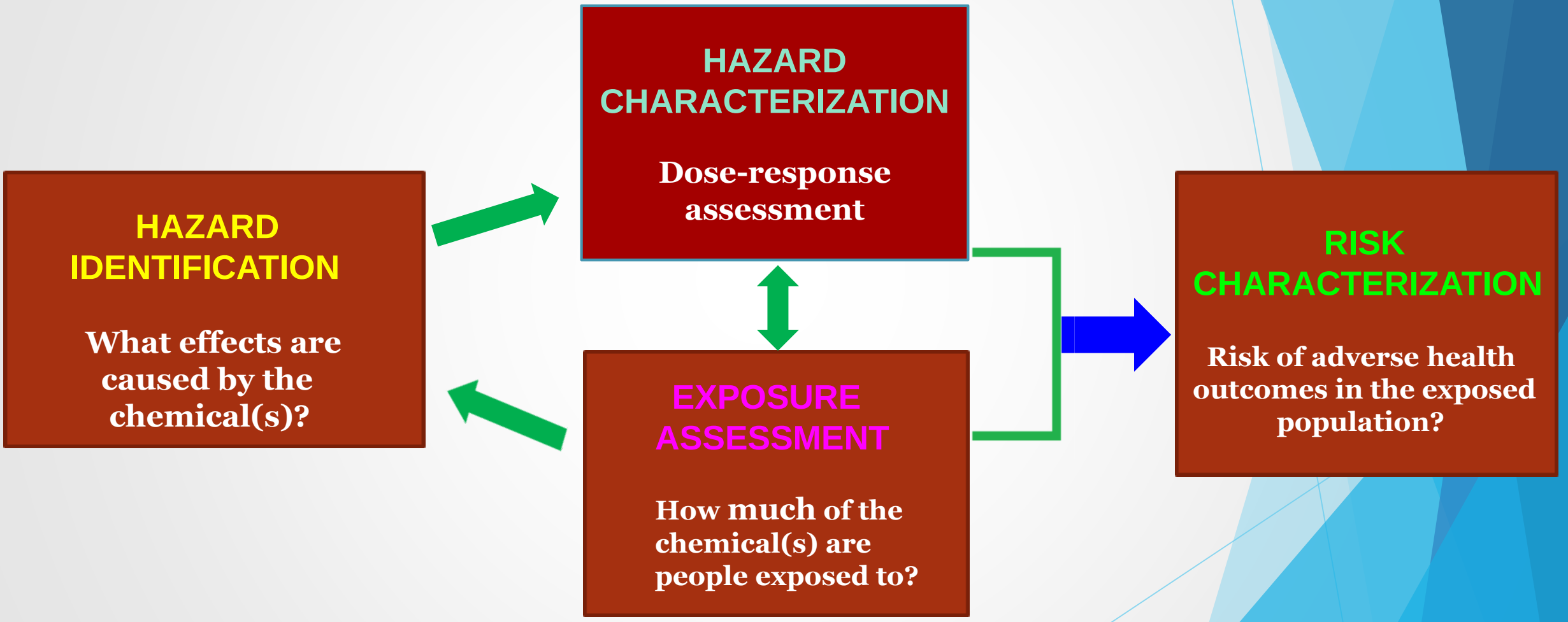
MRLs are based on the highest amount of residues expected in food when the chemical is used in accordance with GAP/GMP.

MRLs are not safety limits, and are always set below levels that would present a risk to consumers.

Consider both short term and long term exposure to the chemical

International harmonization of MRLs???

How to determine if chemicals in food are a health risk?

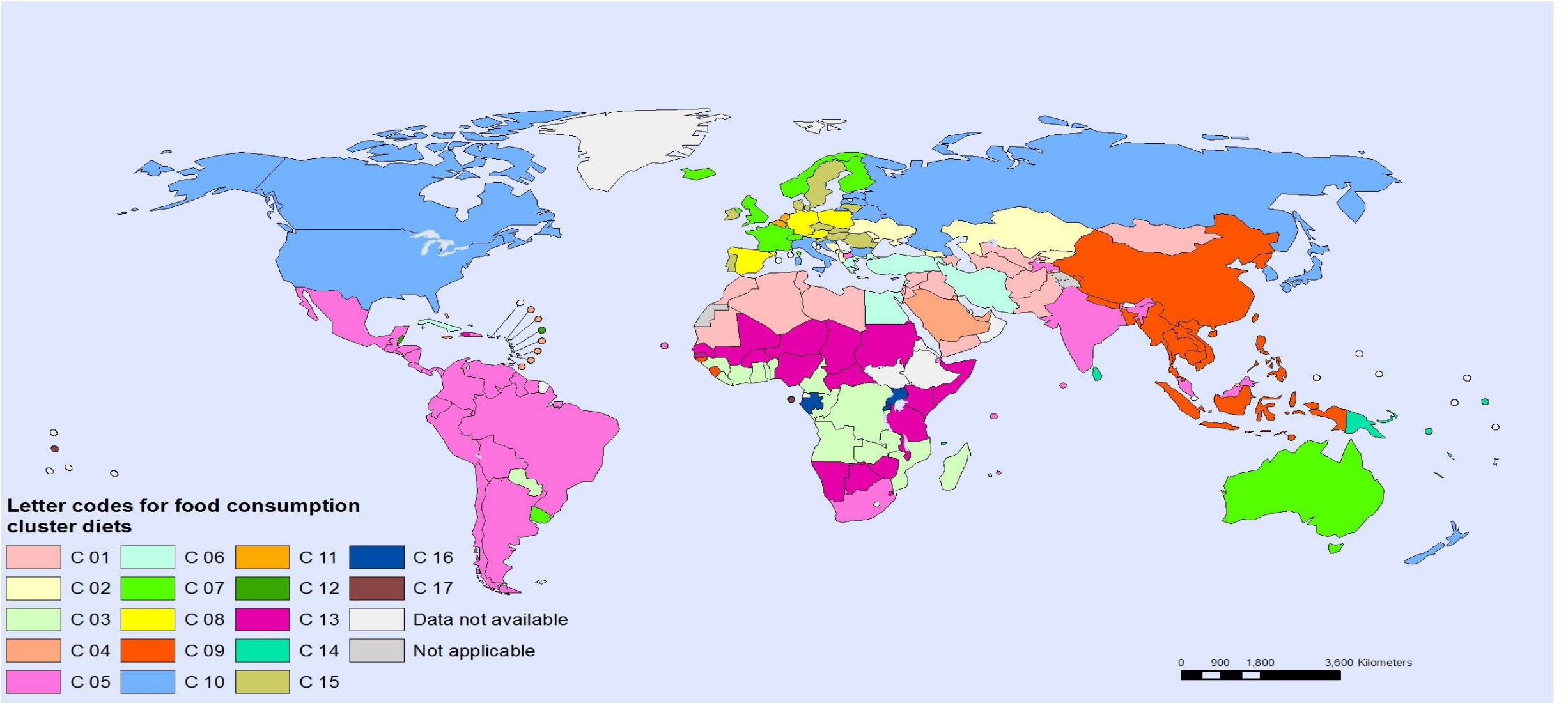



0422013

Exposure Assessment

- presence in food(s) of dietary significance
- presence in food that are widely consumed
- presence in feed and feed components
- food intake data for average and most exposed/high consumer groups
- results from total diet studies
- calculated contaminant intake data from food consumption models
- data on intake by susceptible groups
- data on intake by food producing animals

GEMS/Food Consumption Cluster Diets



Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

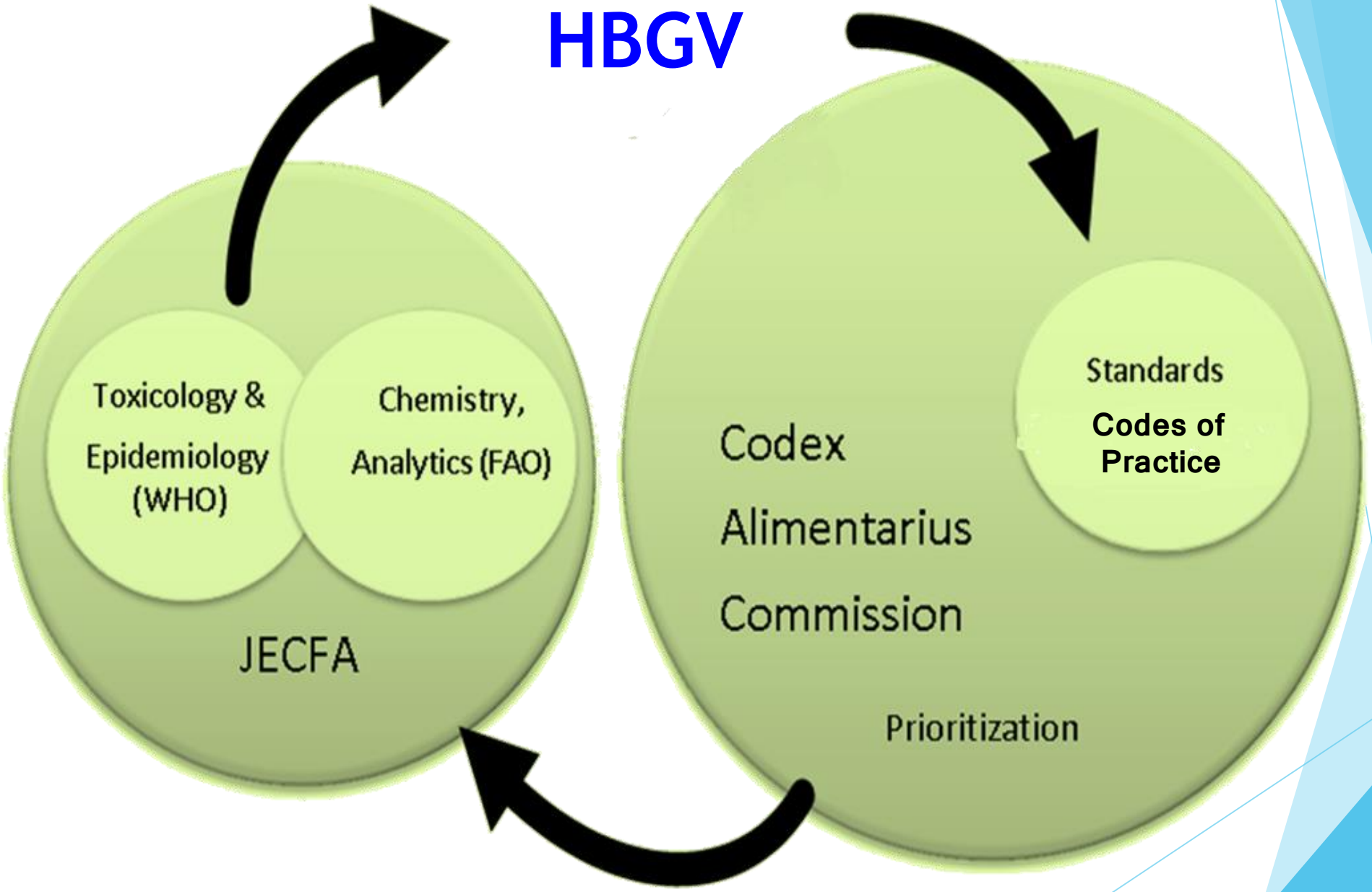
World Health Organization

“Intentional” Chemicals

JECFA	Food additives	CCFA/CCCF
JMPR	Pesticides	CCPR
JECFA	Veterinary drugs	CCRVDF

Risk Assessment → **Risk management** → **Risk Communication**

HBGV


Toxicology &
Epidemiology
(WHO)
Chemistry,
Analytics (FAO)
JECFA
Codex
Alimentarius
Commission
Standards
Codes of
Practice
Prioritization

"Unintentional" Chemicals

Classes of chemicals with documented adverse health effects in humans from food exposure

METALS: As, Cd, Hg, Pb (cancer, neurodevelopment, cardiovascular, reproduction, immunotoxicity, death)

MYCOTOXINS: aflatoxins, OTA, Fusarium toxins, patulin (cancer, growth suppression, GI tract and organ damage)

POPs: PCBs, dioxins, OC pesticides (neurological disorders, developmental effects, immumotoxicity, cancer (?))

WHO Global Burden of Foodborne Disease Project

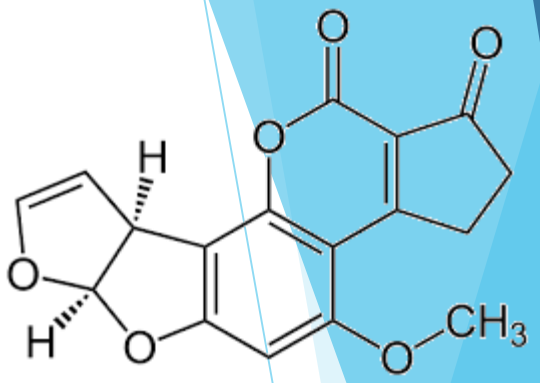
An initiative to generate the first ever estimates of the global burden of foodborne disease

Considered chemicals from each of the major classes

(aflatoxins, arsenic, dioxins)

https://www.who.int/foodsafety/areas_work/foodborne-diseases/ferg/en/

Aflatoxins



Fungal metabolites associated with *Aspergillus* spp.

Aflatoxins are among the most potent carcinogenic substances known

Described as a “global health concern” (humans and livestock)

Typically detected in cereals (wheat, rice, maize, sorghum), peanuts, tree nuts and spices; estimated greater than 5 billion people world-wide are at risk

Liver cancer in humans is considered the critical endpoint

Up to 19,000 deaths per year world-wide attributed to aflatoxin exposure

JECFA Assessments

Average dietary exposure estimates approx. < 10 ng/kg bw/day for all GEMS cluster diets with 90th% at 30-40 ng/kg bw/day; highest intakes in sub-Saharan African countries due to sorghum and maize.

1 ng/kg bw/day aflatoxins = an increased cancer risk of 0.01 cancers per 100000 per year (HBV-); risk for HBV+ is approx. 30 fold greater.

For countries with the highest dietary intakes, overall risk was between 0.21-3.94 additional liver cancer cases per year per 100000.

Dietary exposure to Aflatoxins should be reduced to the lowest practicable levels, so as to reduce the potential risk as far as possible.

EFSA latest assessment - draft

Liver cancer still considered to be the pivotal effect for the risk assessment

Lifetime exposure to 0.4 µg/kg bw per day AFB1 results in a 10% increase in liver cancer in experimental animals

Dietary exposure ranges from 0.08-7.5 ng/kg bw/day (median 3.2)

Suggests a cancer risk of approximately 80 cases per 100000.

Codex has developed MLs for Aflatoxins in:

Almonds, Brazil nuts, Hazelnuts, Pistachios and Dried figs = **10 ppb**

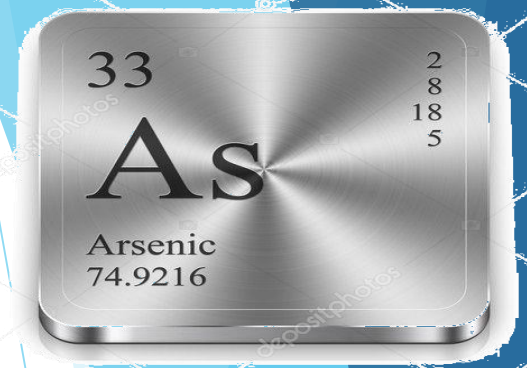
Future work will also look at establishing MLs for peanuts, spices, cereals (maize, rice, sorghum) and cereal-based foods for infants and young children.

Codes of Practice: define the production, processing, manufacturing, transport and storage practices for individual foods or groups of foods that are considered essential to ensure the safety and suitability of food for consumption.

Code of Practice for the Prevention and Reduction of Aflatoxin Contamination in:

Peanuts (CXC 55-2004)
Tree Nuts (CXC 59-2005)
Raw Materials and Supplemental Feedingstuffs for Milk Producing Animals (CXC 45-1997)
Dried Figs (CXC 65-2008)
Cereal grains (CXC 51-2003)
Spices (CXC 78-2017)

Arsenic (inorganic)



Naturally occurring chemical widely distributed throughout the environment and found in almost all foods and groundwater

Main exposure sources include drinking water and various foods (cereal grains, vegetables)

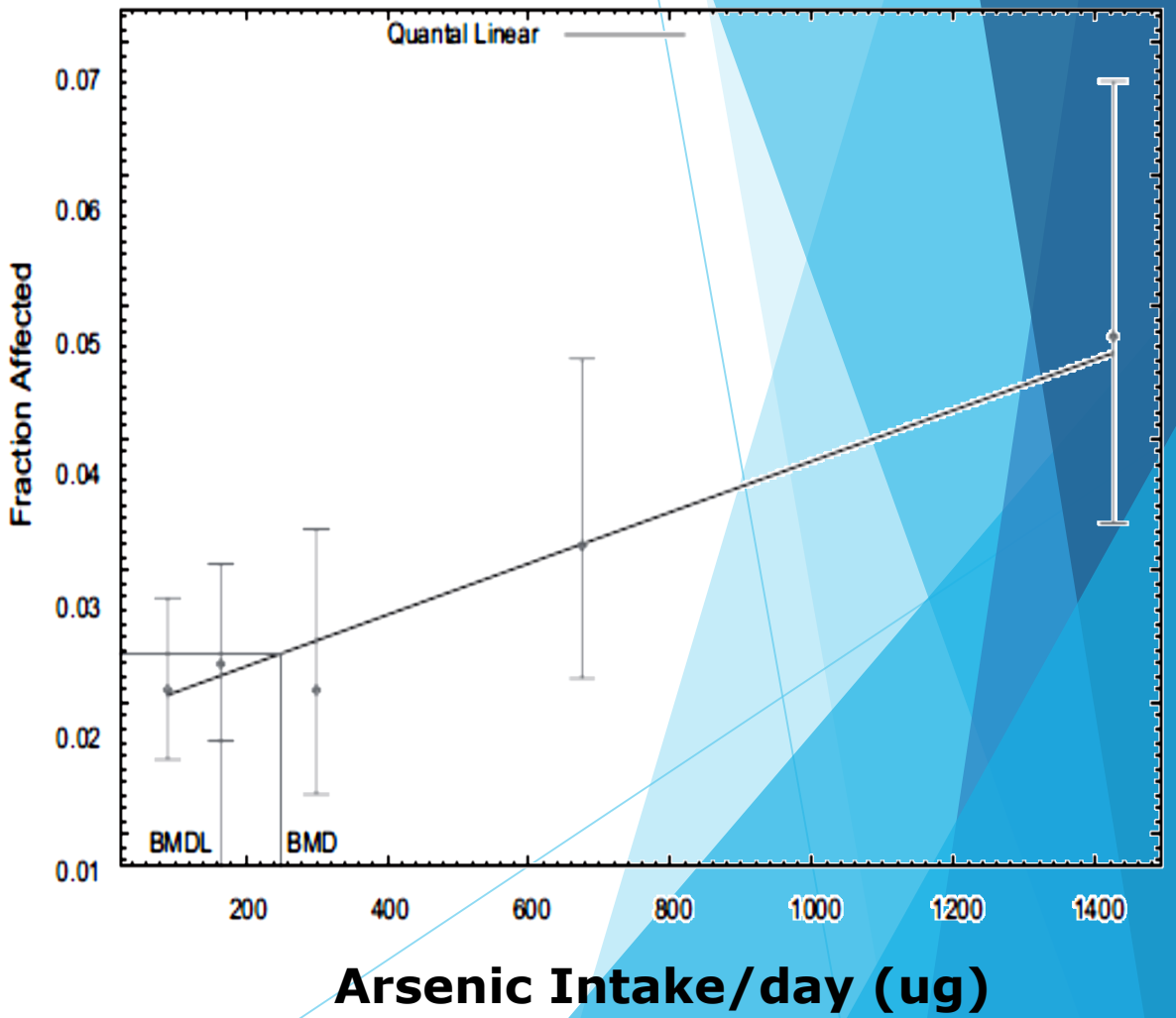
The main adverse effects in humans associated with long-term ingestion are:

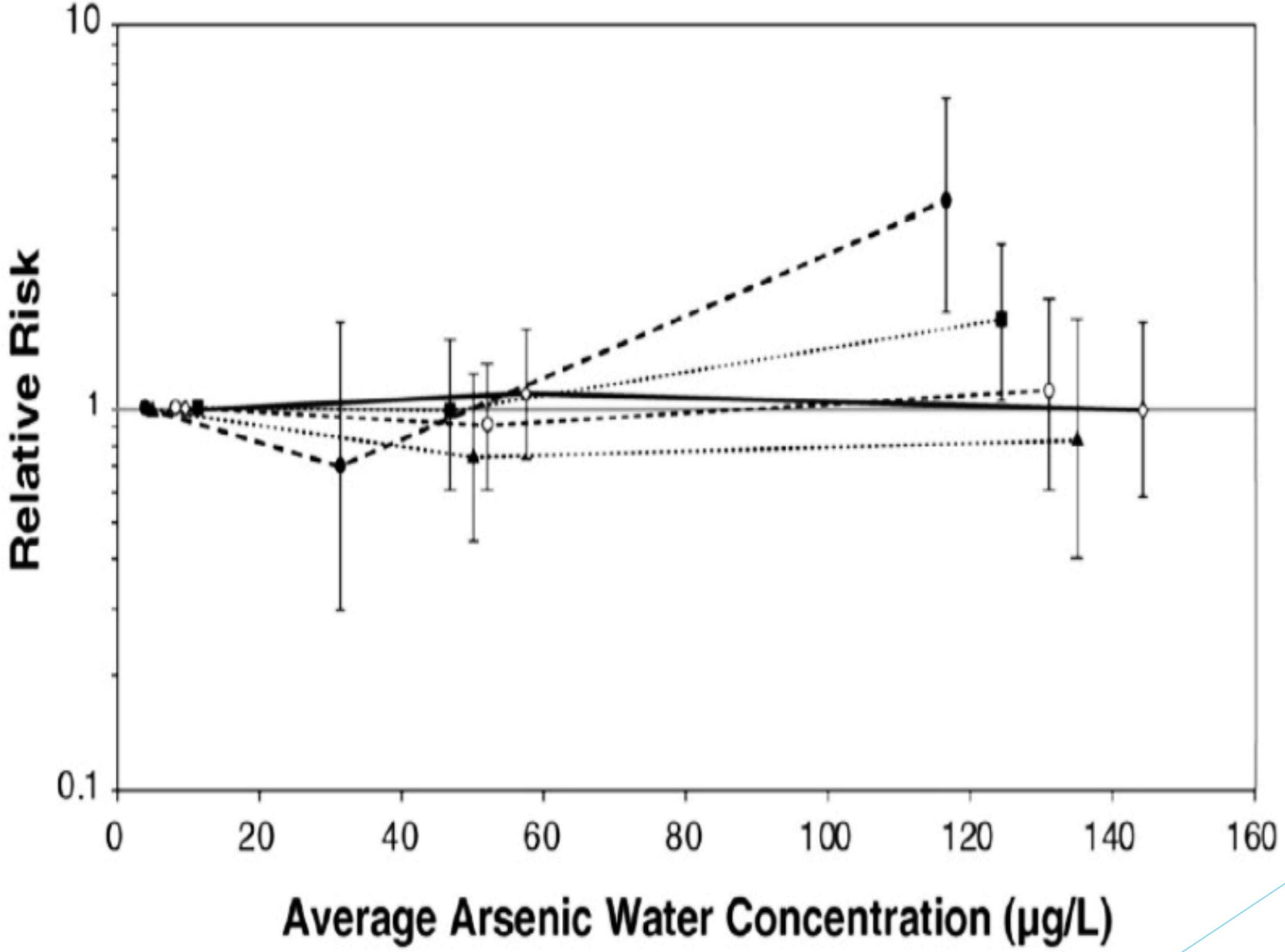
cancer, skin lesions, developmental effects, cardiovascular disease, neurotoxicity and diabetes.

JECFA Assessments

Table 3.2. Association of Lung Cancer with Arsenic Exposure in Northeastern Taiwan (in person-years)

Inorganic Arsenic in Water Category range (µg/L)	Inorganic Arsenic Concentration in Well Water[a] (µg/L)	Unadjusted RR[b]	Adjusted RR[b]	*N*	Unadjusted Cases	Adjusted Cases[c]
< 10 (referent group)	2.1	1.00	1.00	2288	48	48.0
10 – 49.9	26.9	1.16	1.10	2093	51	48.3
50 – 99.9	74.6	1.05	0.99	907	20	18.8
100 – 299.9	162.4	1.47	1.54	909	28	29.4
≥ 300	836.3	2.14	2.25	691	31	32.6





Tsuji et al, 2019

Increased risk of lung cancer

iAs Drinking water	**RR (95% CI)**
10 ug/L	1.02 (1.00-1.03)
50 ug/L	1.10 (1.04-1.15)
100 ug/L	1.20 (1.08-1.32)

Yuan et al., 2018

What does this mean??

Epidemiologic studies with drinking water [iAs] >50 ug/L provide the strongest support of adverse effects in humans

At 10-50 ug/L, there is a possibility that adverse effects could occur as a result of exposure to inorganic arsenic from water and food, but these would be at a low incidence

Previous JECFA HBGV no longer considered protective and was removed

Minimizing arsenic exposure may be of public health importance

Risk Management

Achieve drinking water [iAs] of < 10 ppb

Identify foods which contribute to iAs intake from the diet

Update risk assessment with non-cancer endpoints

CODEX Activities

Cereal grains, specifically rice, have been identified as making significant intake contributions for a number of GEMS cluster diets

MLs have been set for both polished (0.2 ppm - 2014) and husked rice (0.35 ppm - 2016)

CoP for the Prevention and Reduction of Arsenic Contamination in Rice – CXC 77-2017

CONCLUSIONS

Food chemical safety begins with knowledge of possible risks

Dietary exposure information used to identify risks and, if required, priorities for risk management

Effective communication with stakeholders about control measures being developed

Food safety is a shared responsibility

The End

- Thanks for your time

Appendix 1

AFB1 ground nuts Risk Assessment

Dietary exposure = $f_c \sum$ ([AFB1] in food x food consumption rate)/bw

= (55 ng/g AFB1 x 30 g/day/60 kg

= 27.9 ng/kg bw/day

Estimated population risk (cases/100,000 persons/year) of AFB-induced HCC

HBV- = 0.27
HBV+ = 8.44
HBV+ (12%) = 1.2

Total population (20×10^6) = 240 cases per year.

Appendix 2

iAs in cereals Risk Assessment

Dietary exposure = fc $\sum$ ([iAs] in food x food consumption rate)/bw

= (9 ng/g iAs x 229 g/day/76 kg

= 27 ng/kg bw/day

Estimated population risk of iAs-induced Lung Cancer

Risk= (0.005÷$BMDL_{0.5}$) x Exposure = 4.5 x 10^{-5}%

Total population ($5x10^6$) = 3 cases per year