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AFRICA CDC
Centres for Disease Control and Prevention
Safeguarding Africa's Health

Detection for chemical hazards and public health – surveillance, analysis and poisons information

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Content

This session will present some introductory level content around:

- Introduction to detection
- methods for detection (including analysis) for chemicals
- common surveillance methods for identification of chemical issues of potential public health concern
- introduce the role of poison centres

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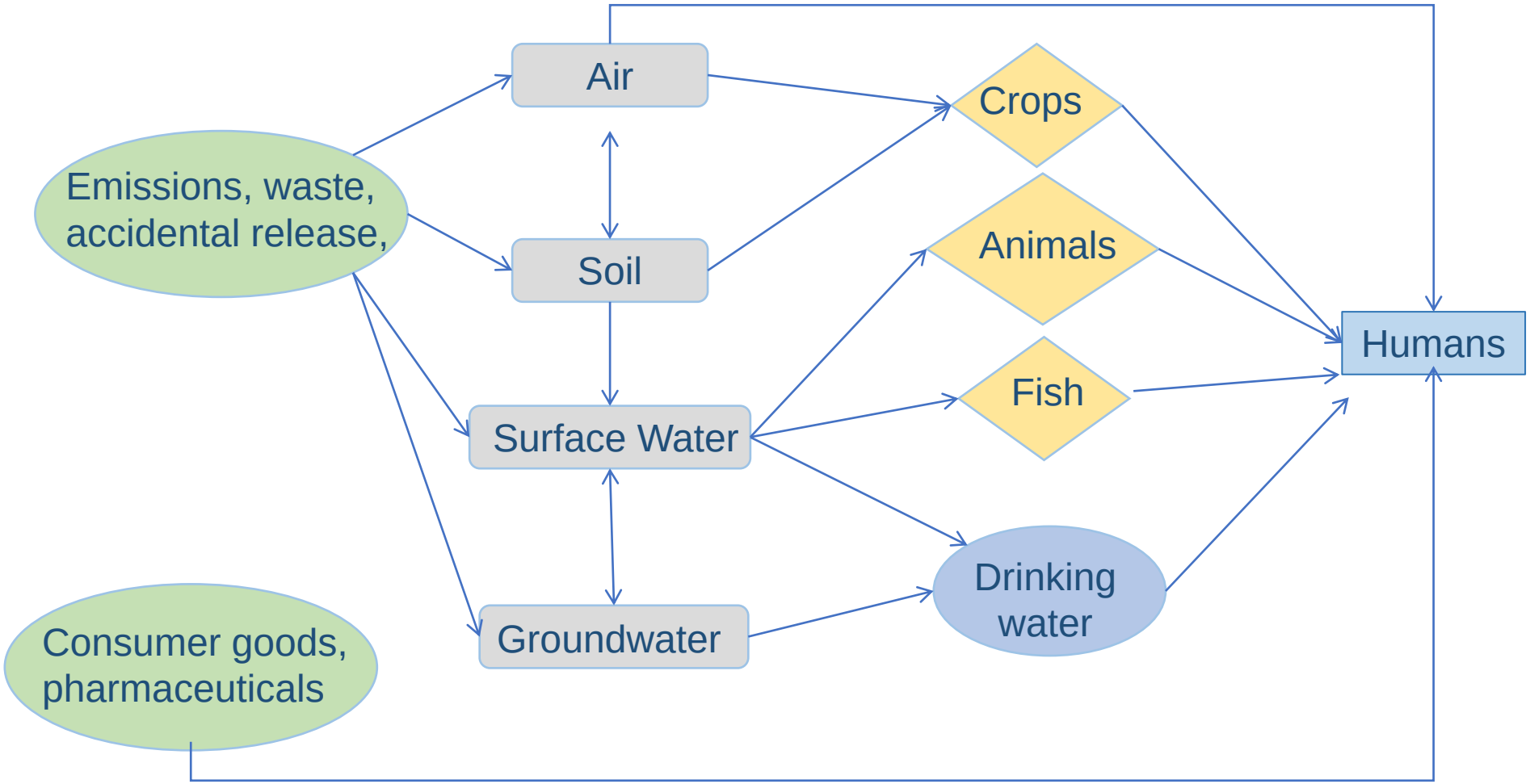
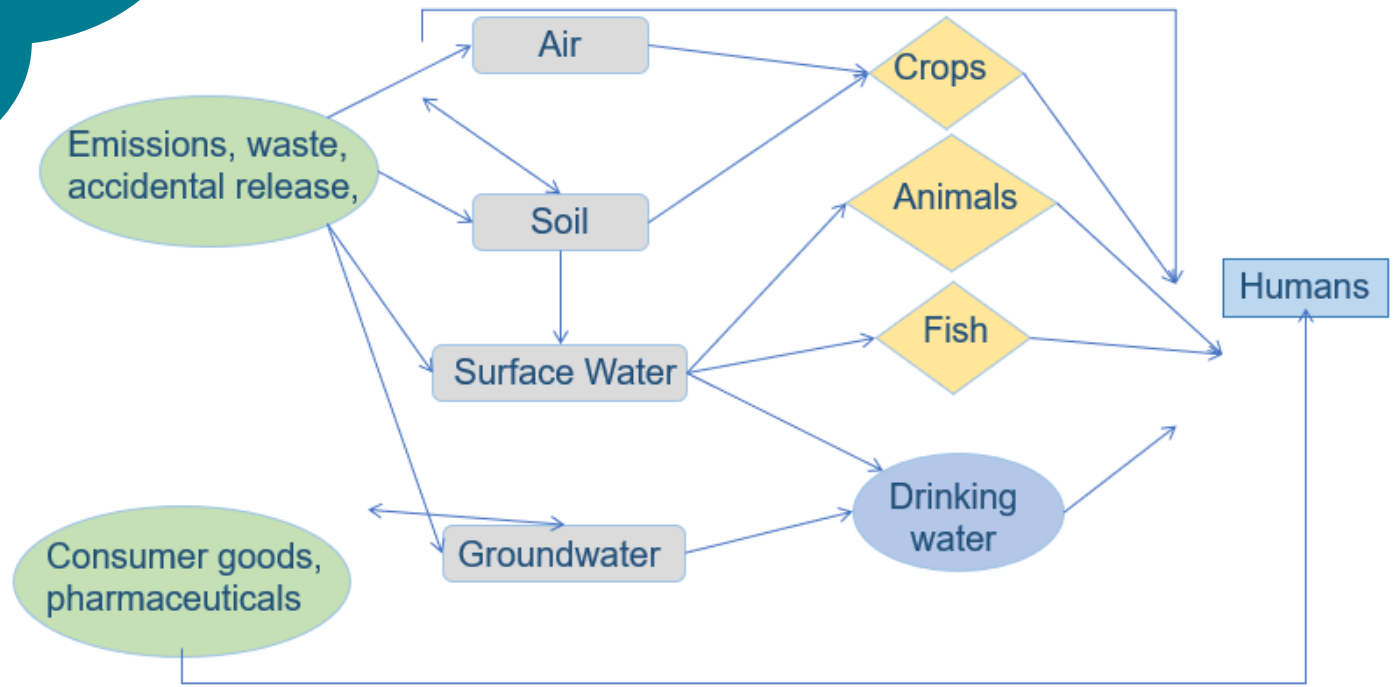
Introduction to detection

Chemical Exposure Pathways

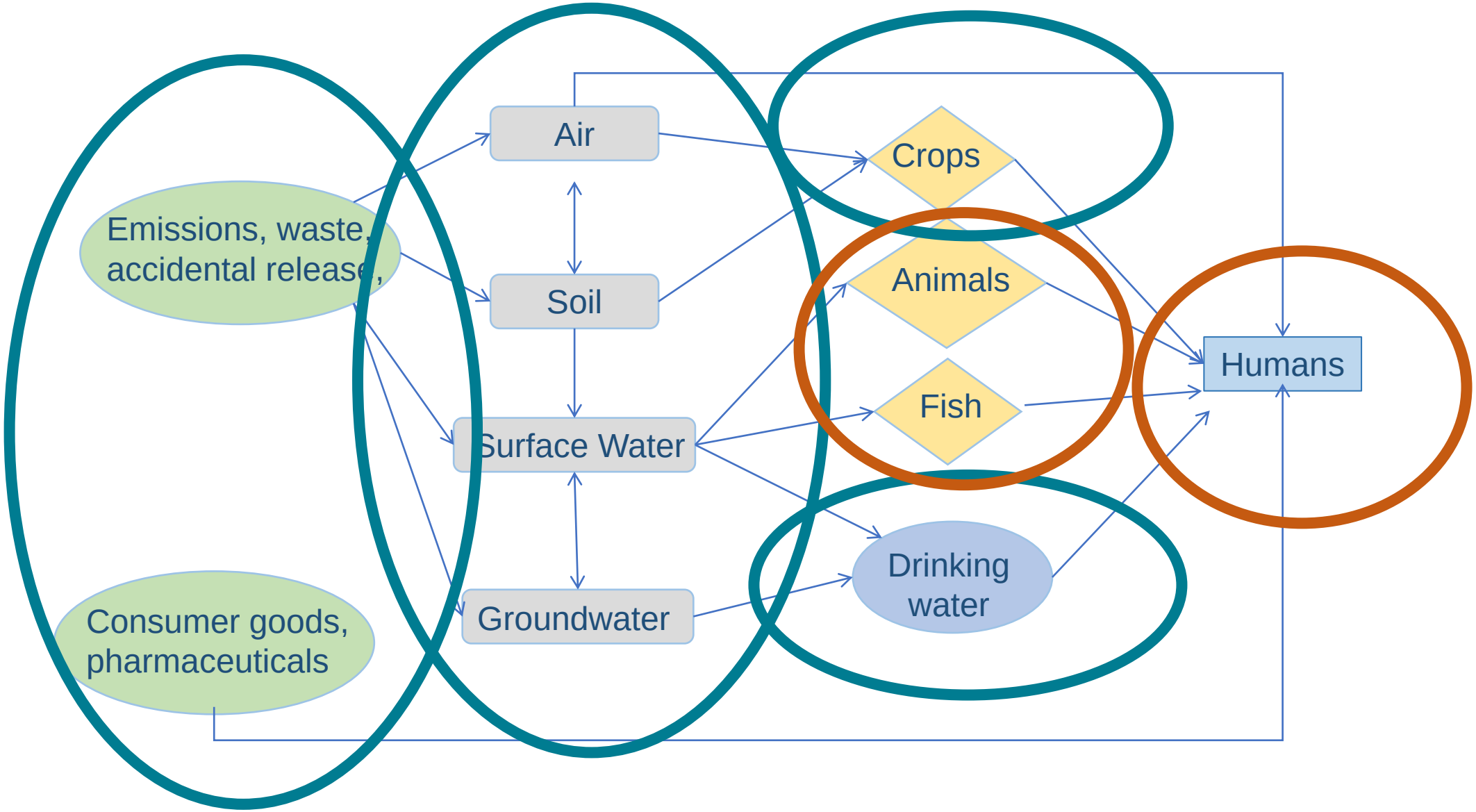


Chemical Exposure Pathways

What are the exposure pathways of particular concern in your country? Are there any missing?

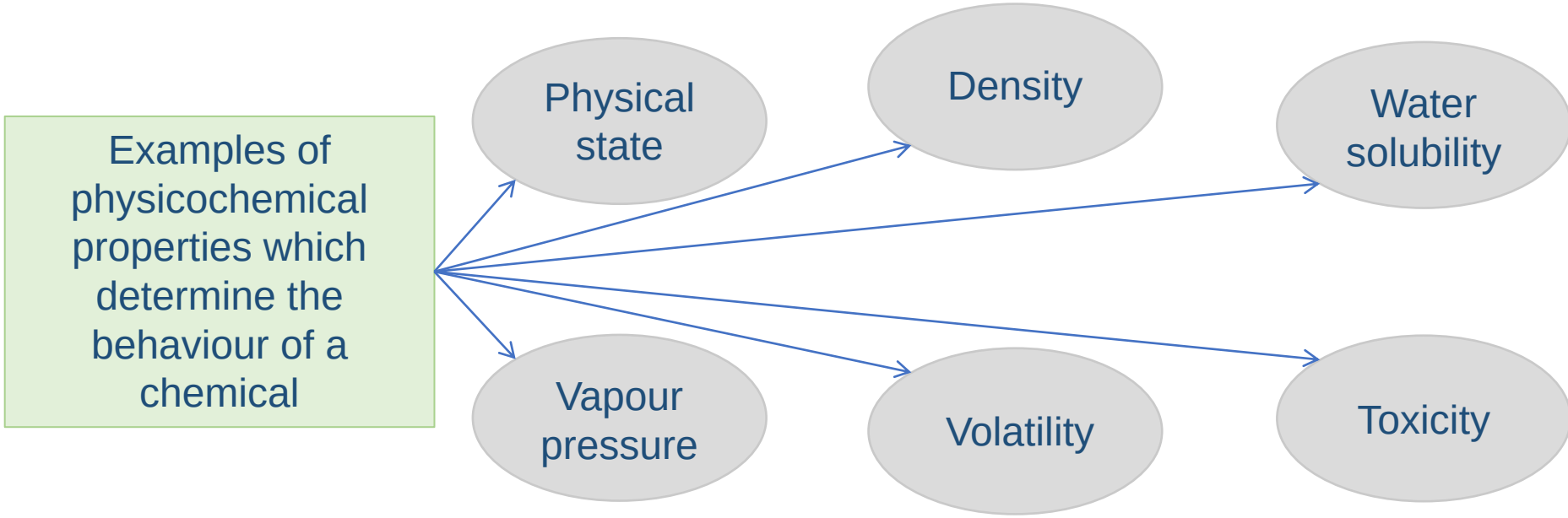


Chemical Exposure Pathways



Physico-chemical Properties

It is important to understand that chemicals can behave very differently to one another, due to their differing properties



e.g. if a chemical involved in an incident is liquid BUT has a high vapour pressure, it is more likely to form vapours which can spread more easily and may lead to the exposure of more people

Detection and Alert Scenarios

1. Environmental contamination	2. Health effects following known exposure	3. Health effects of unknown aetiology
		

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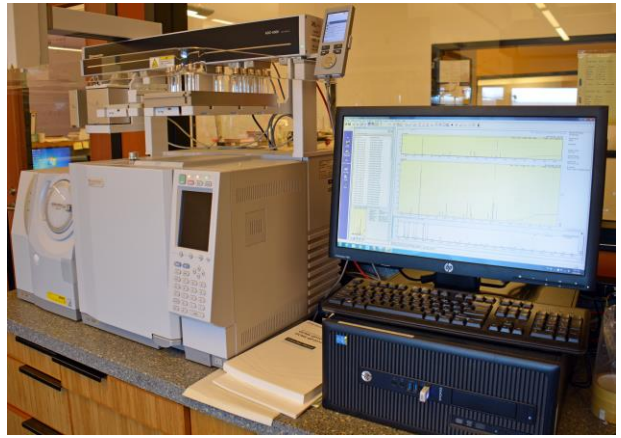
Methods of Detection

Field and mobile laboratory analysis

Mobile field techniques

- Immediate indication of chemicals in the field
- Chemical test kits, organic vapour analysers and other portable monitoring devices
- Quick turnaround
- Leak detection, confined space entry, HazMat response, personal exposure level etc.

Static laboratory techniques

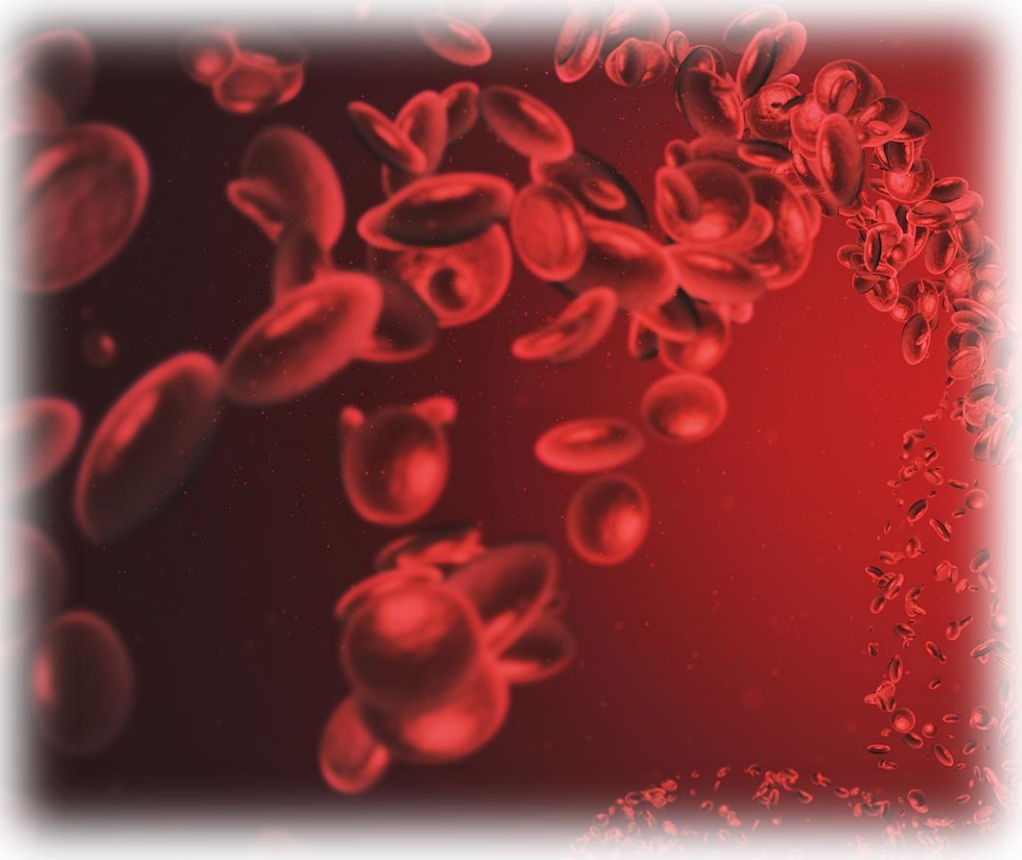


- Sample collection followed by analysis in laboratory
- Compliance with government regulations in accredited laboratories
- More precise and high quality results, measurement of highly toxic compounds etc.

Laboratory analysis

- The types of laboratories: diagnostic, clinical, toxicological, environmental, forensic, food safety and research laboratories
- Quality assurance
- Pre-analytical considerations
- Analytical considerations
- Post-analytical considerations

Biomonitoring



- The measurement of the body burden of toxic chemical compounds, elements, or their metabolites or by-products, in the body
- **Blood, urine**, hair, serum, saliva, exhaled air, breast milk, feces – specimens of choice
- Detection window:
  - Blood – hours & urine – days
- Potential to correlate internal dose with observed health effects

Role of routine environmental monitoring

- provide data on ***background levels*** of chemicals in environmental media;
- demonstrate any ***normal variation*** in those levels;
- act as ***a warning*** when a sudden increase in chemical concentration is detected;
- ***enable comparison*** with levels following a chemical incident; and
- ***determine restoration*** to background levels.

Portable survey detectors

Colorimetric technologies

- Detector tubes available for measurement of over 200 gases/vapours

Ion mobility spectroscopy (IMS)

- The most commonly deployed detectors, predominately used for the field detection of explosives, illicit drugs and chemical agents

Photo ionisation detection (PID)

- Commonly used instrument for field detection of total VOCs (ppm)

Infra-red spectroscopy (IR)

- Detection of vapours, liquids and solid hazardous materials

Raman spectroscopy

- A distinct chemical fingerprint - can be used to very quickly identify the material, or distinguish it from others
- Solids, powders, liquids, gels, slurries and gases

Personal monitors

- Carbon Monoxide / Hydrogen Sulphide etc.
- Commonly used by emergency services to clear an area as safe before entering and for worker safety
- High level alarms
- Dust / particulate matter
- Often used in worker safety but can also be used in epidemiology
- Sample collection – laboratory analysis required

Analysis

What chemical analysis is undertaken in your country? And who is responsible for this?

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Surveillance

What is Surveillance

Information to Action

- to guide immediate public health actions
- planning and implementation of rational intervention programs to prevent and control disease.
- monitor changes or trends in health factors
- burden of disease and inform service delivery

What is Surveillance

Prevention – risks understood, assessment and mitigation measures implemented. SOPs.

Preparedness – data capture put in place to test risk mitigation measures e.g. monitoring and action to be taken by who.

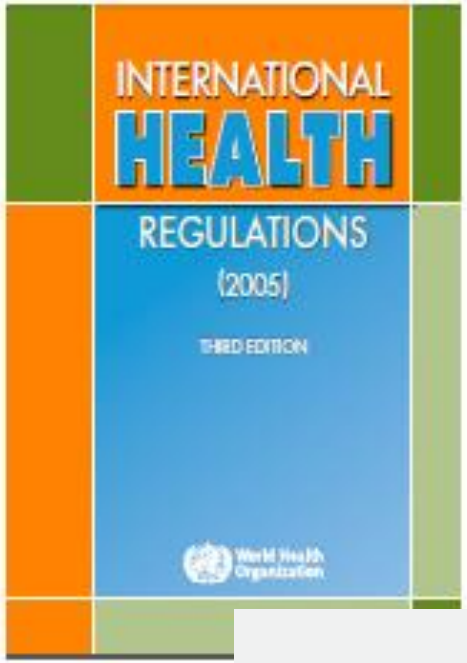
Detection & Alert – mechanisms in place for detection and alerting to employer, public health, poison centre etc. Surveillance stage.

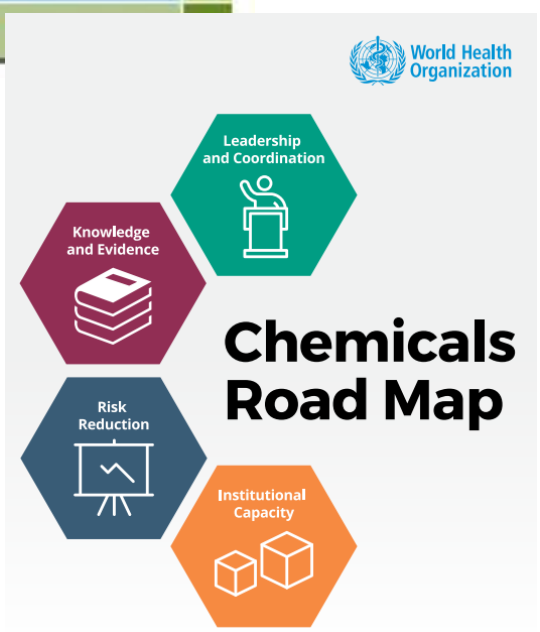
Response – Action to be taken on surveillance to protect health if immediate risks or mitigate if chronic risk

Recovery – health monitoring, health and wellbeing recovery, physical recovery. After action review to feed into prevention and preparedness.

Why do it?

- International Health Regulations (IHR)
- Sustainable Development Goals (SDGs)
- WHO Chemical Road Map
- Strategic Approach to International Chemicals Management (SAICM)



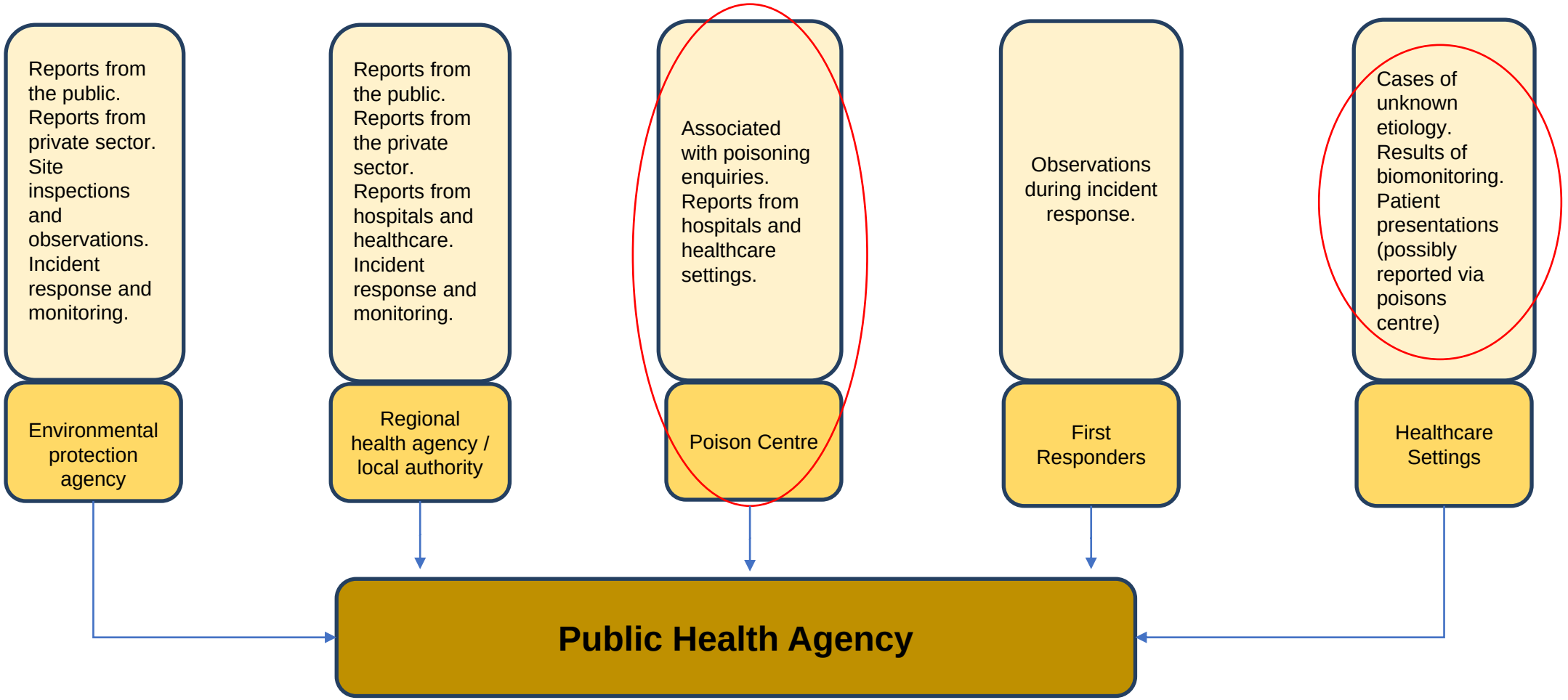


Health Surveillance - occupational

- Outside of the remit of the UK Health Security Agency as worker safety falls under our health and safety authority – the Health and Safety Executive…however, HSE define worker health surveillance as:

Health surveillance is a scheme of repeated health checks which are used to identify ill health caused by work. Health and safety law requires health surveillance when your workers remain exposed to health risks even after you have put controls in place. This is because control measures may not always be reliable, despite appropriate checking, training and maintenance. Health risks which require health surveillance include noise, vibration and substances hazardous to health.

Case of potential or actual public health exposure to chemicals



Integrating Surveillance

- Event Based Surveillance
- Poisoning surveillance
- Indicator Based Surveillance
- Syndromic Surveillance

Integration into existing surveillance / data collection roles may be most effective.

Toxidromes

Toxidrome	Mechanism of action	Syndrome[a]	Poisons and environmental chemicals
Anticholinergic	Muscarinic receptor antagonism	Agitation, confusion, dry mouth, dry skin, hyperthermia, mydriasis, paralytic ileus, tachycardia and urinary retention	Antihistamines, antimuscarinics, antipsychotics, atropine, *Inocybe* mushrooms, Jimson weed (*Datura stramonium*), tricyclic antidepressants
Antimitotic	Cytotoxic to dividing cells	Alopecia, bone marrow suppression, diarrhoea, mucositis, vomiting	Arsenic, colchicine, chemotherapy agents, immunosuppressants, ionizing radiation, podophylline, thallium
Cardiac glycosides	Inhibition of Na^+/K^+-ATPase pump Increased vagal tone	Arrhythmia, confusion, hypotension, nausea, vomiting, xanthopsia	Digoxin, foxglove (*Digitalis* spp), lily of the valley (*Convallaria majalis*), oleander, ouabain, red squill
Cholinergic	Muscarinic and/or nicotinic receptor agonist Acetylcholinesterase inhibition	Bradycardia, diaphoresis, dyspnoea, lachrymation, loss of sphincter control, miosis, muscle fasciculation, muscle paralysis, vomiting and wheeze	Carbamates, chemical warfare nerve agents (sarin, soman, taban, VX, fourth-generation novichoks), hemlock, *Inocybe* mushrooms, laburnum, nicotine, organophosphates
Corrosives	Direct chemical irritation or reaction with tissues	Drooling, dysphagia, dyspnoea, haematemesis, melaena, localized pain, vomiting, blisters, skin burns	Acids, alkalis, copper sulfate, hydrofluoric acid, iron salts, paraquat
Hydrocarbons	Central nervous toxicity (volatile hydrocarbons) or aspiration pneumonitis	Arrhythmia, coma, confusion, cough, dyspnoea, gastrointestinal upset	Benzene, diesel, gasoline, kerosene, toluene
Toxic metals and metalloids	Oxidation–reduction reactions	Arrhythmia, confusion, hypotension, gastrointestinal disturbance, metal fume fever, peripheral neuropathy	Arsenic, chromium, iron, cobalt, lead, thallium

Surveillance

What chemical surveillance are you aware of in your country?

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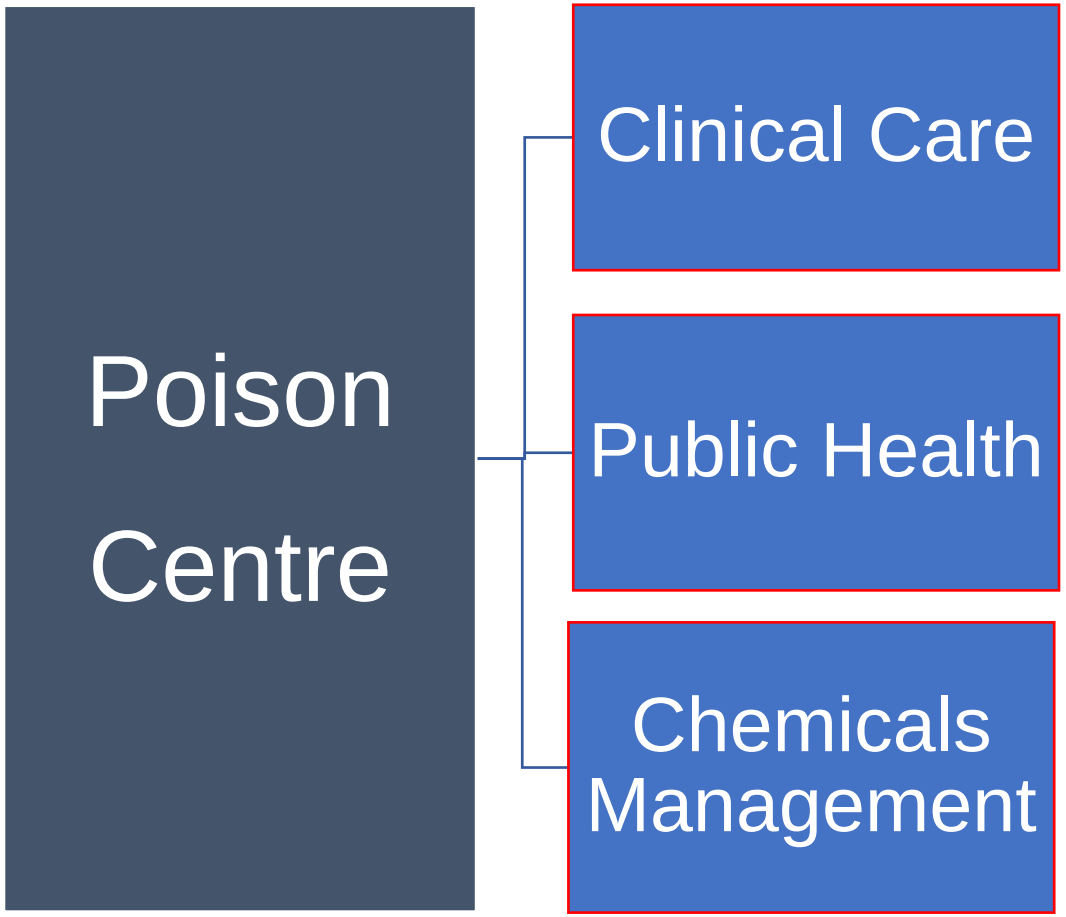
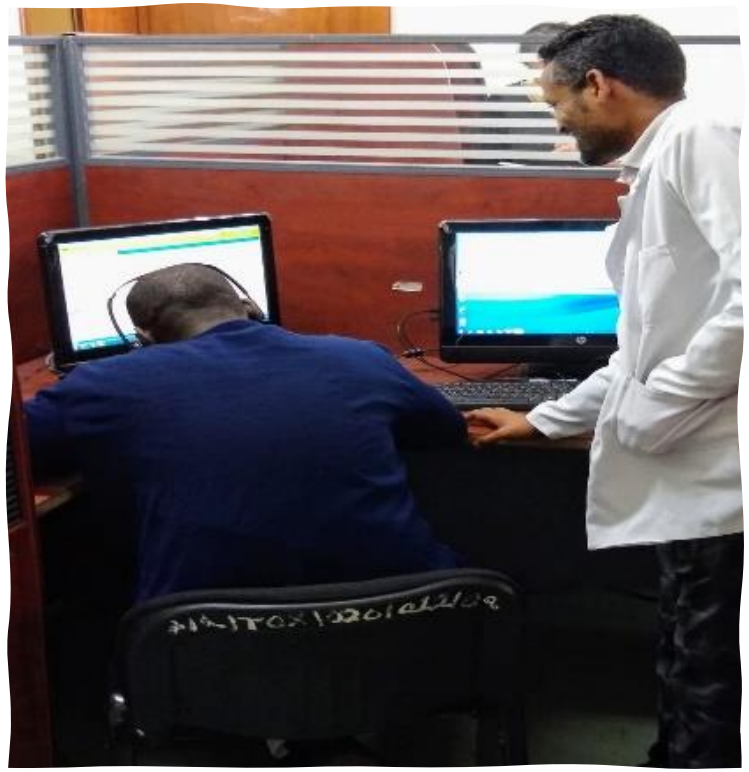
Poison Centres

Role of Poison Centres



Toxicology laboratory



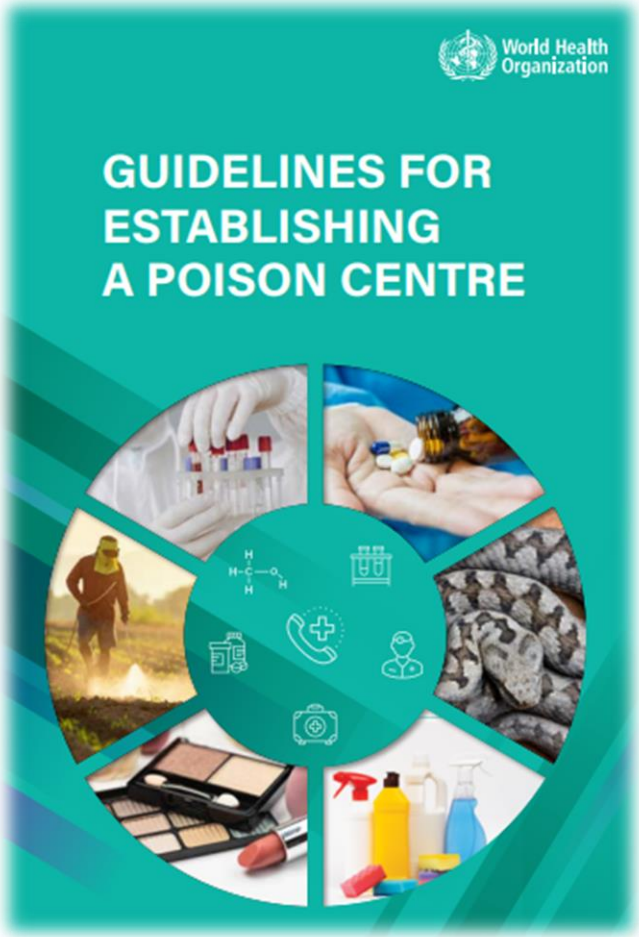
Poisons information service

Clinical treatment unit

Poison Centre Models

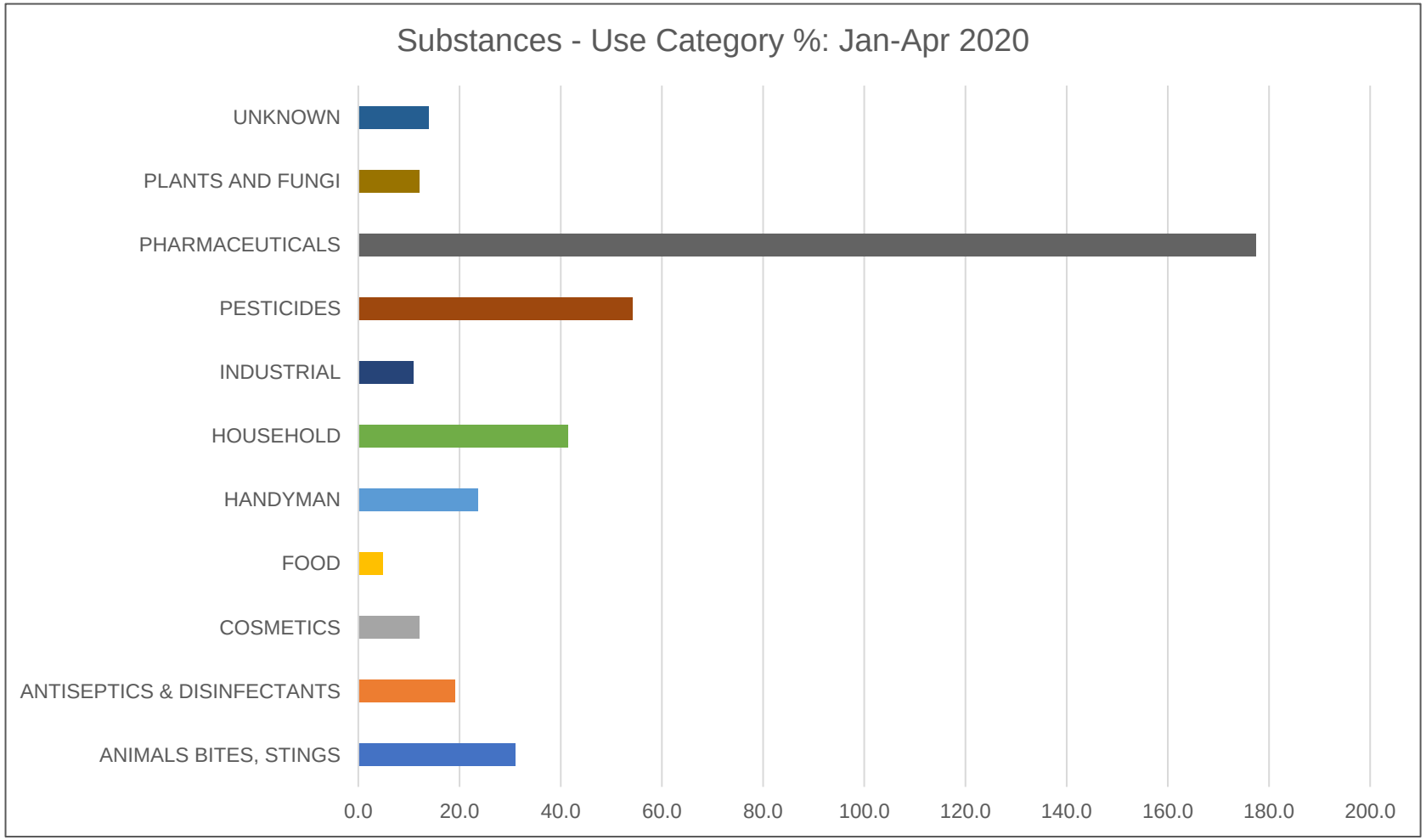
WHO global perspective on poisoning

- Unintentional poisoning
- Intentional poisoning
- Snakebite



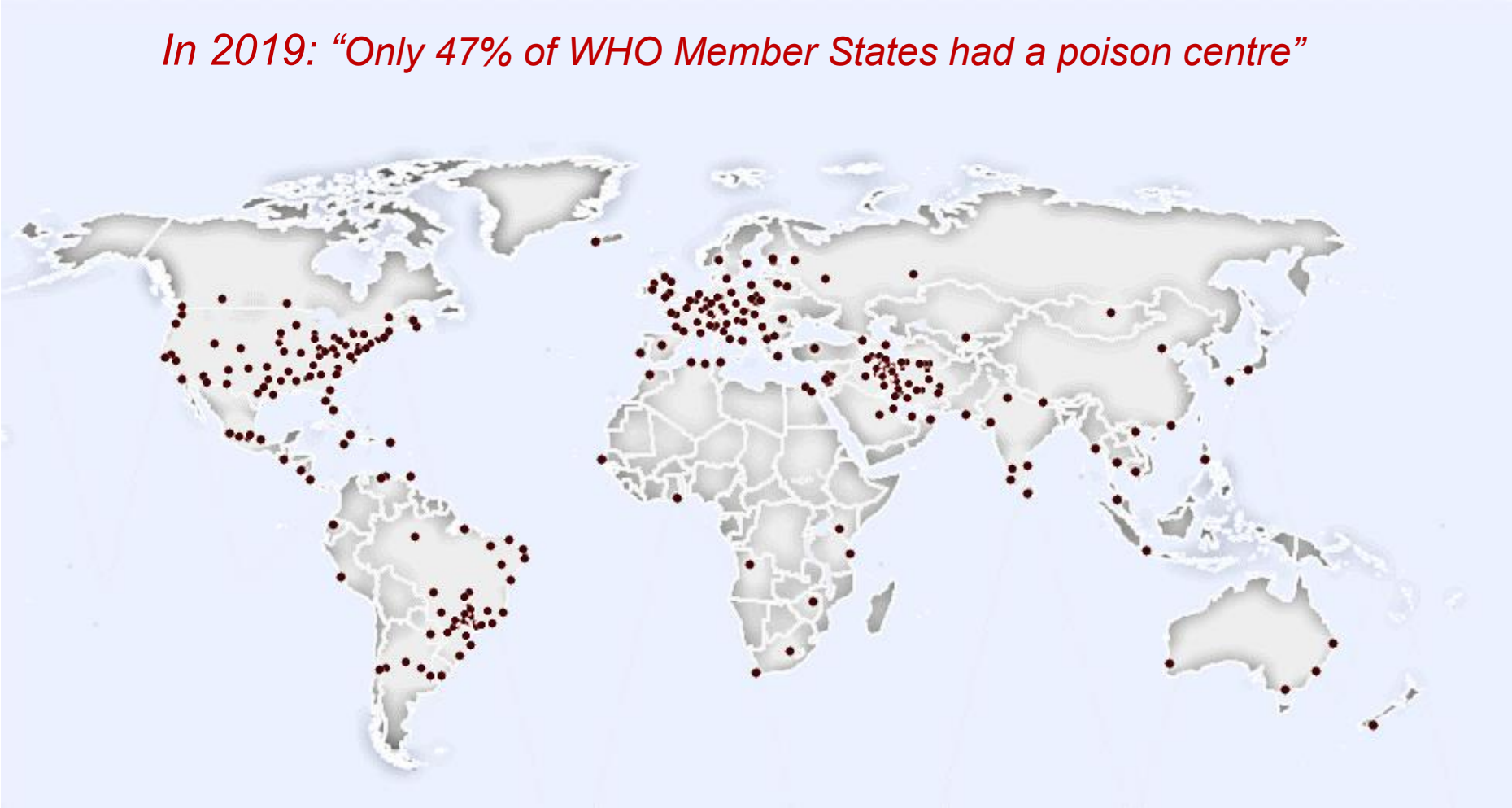
https://www.who.int/publications/i/item/9789240009523

What Poisons Centres get called about?



WHO directory of Poison Centres

In 2019: "Only 47% of WHO Member States had a poison centre"



Health and economic benefits

- Reduces hospital admissions / emergency department attendances
- Reduces time patients spend in hospitals
- Reduces unnecessary treatments
- Has benefits in the prevention of poisoning, not just treatment
- Saves the healthcare system (i.e. Ministries of Health) money overall
  - US: In 2012, report on cost–effectiveness of US poison centres, which found a near 1:14 benefit for each US$ spent, equivalent to $1.8 billion per year
  - Brazil: Patients where poison centre was consulted stayed an average of 3.42 days fewer than those not discussed with the poison centre

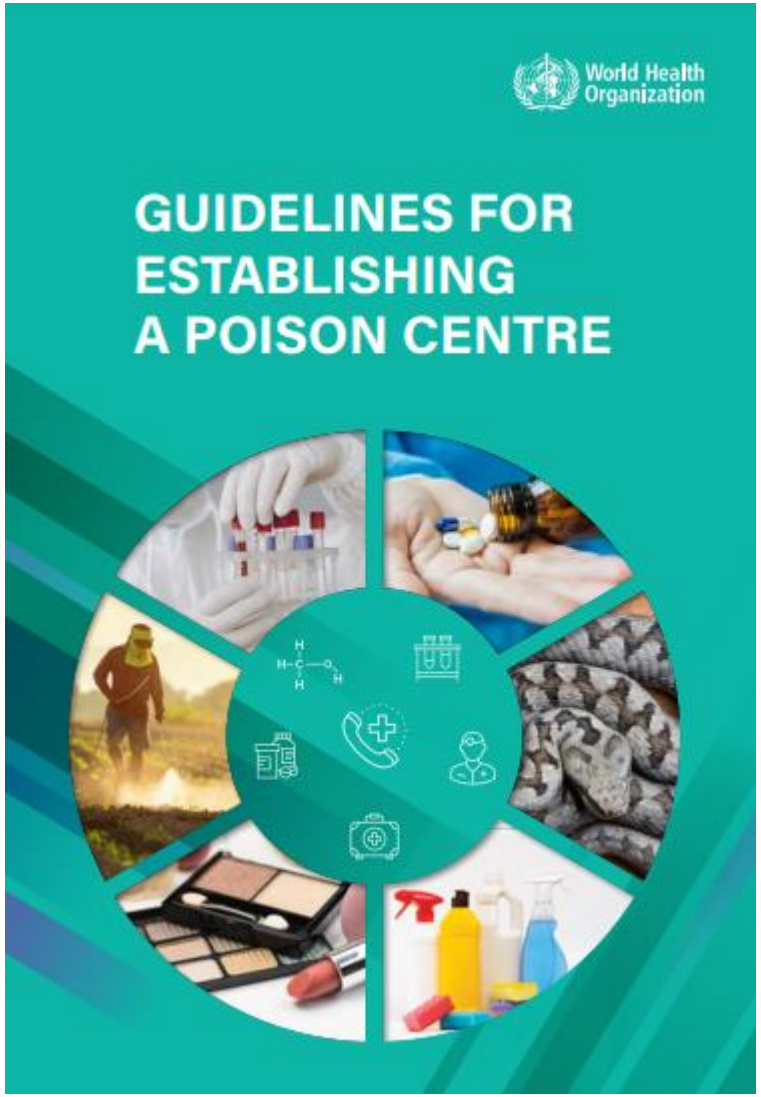
Analytical toxicology labs

- Emergency qualitative and/or quantitative assays for common poisons, especially when may influence treatment

URGENT	LESS URGENT
Carboxyhaemoglobin	Cholinesterase
Methaemoglobin	Lead
Iron	Mercury
Lithium	Methotrexate
Toxic alcohols (methanol, ethanol, ethylene glycol)	Thalium
Paracetamol	General toxicology screen
Salicylate	
Paraquat	

Poisons and toxicology

Do you have access to a poison centre or clinical toxicology in your country?




Thank You!
Any questions?