



www.esaunggul.ac.id

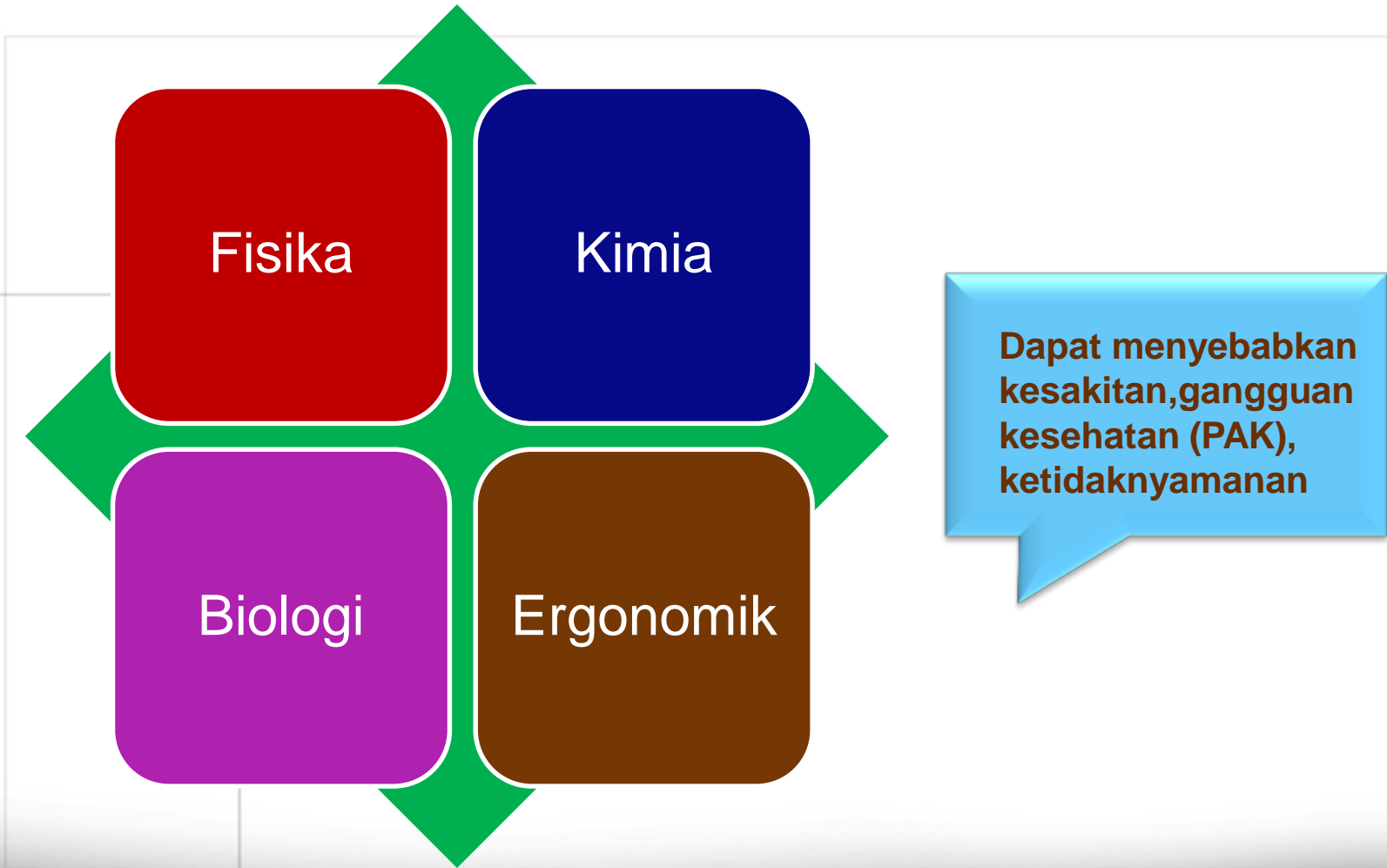
**BAHAYA KESEHATAN KERJA &
KAJIAN PAJANAN
PERTEMUAN KE 7
FIERDANIA YUSVITA
KESMAS, FIKES, UEU**

Kemampuan yang Diharapkan...

- Mahasiswa mampu menguraikan bahaya kesehatan dan proses analisis pajanan bahaya di lingkungan kerja

BAHAYA KESEHATAN KERJA & KAJIAN PAJANAN

Bahaya Kesehatan Kerja



Physical hazards

- Berupa Energi/hazardous energi
- Meliputi :
 - Bising
 - Getar
 - Temperatur ekstrim
 - Tekanan (udara) ekstrim
 - Radiasi ion
 - Radiasi non-ion

Chemical hazards

- Kontaminan udara yang berlebihan (inhalasi)
 - Kabut
 - Uap
 - Gas
 - Padatan dalam bentuk debu atau asap
- Selain bahaya inhalasi, sebagian bahan-bahan tersebut dapat menyebabkan iritasi kulit atau mungkin beracun karena penyerapan melalui kulit.

Ergonomic hazards

- Disain yang tidak sesuai :
 - Tools
 - work areas
 - work procedures
- Ketidak sesuaian dalam:
 - Lifting
 - Reaching
 - Kondisi visual conditions
 - Gerakan berulang
 - Posisi janggal

Biological hazards

- Merupakan organisme hidup atau bagian dari makhluk hidup atau dihasilkan oleh makhluk hidup yang membahayakan kesehatan manusia



KAJIAN PAJANAN

Latar belakang

- Merupakan bagian dari sejarah peradaban manusia, berawal dari risiko yang muncul akibat makanan dan kondisi lingkungan yang boleh atau yang harus dihindari.
- Pada zaman romawi dan perbudakan, juru masak istana diharuskan mencicipi makanan sebelum dihidangkan kepada raja (*emperor*).
- *Exposure assessment* bertujuan untuk mencegah (*prevention*)

Latar belakang

- Bernardino Ramazzini (1633-1714) mempunyai pendekatan lebih scientific, yang mencoba mengkaitkan antara pekerjaan, exposure, dan penyakit.
- John Snow (1813-1858) di London tahun 1850 mencatat kejadian yang terkait antara sumber air minum dengan kejadian kolera.
- Pada akhir abad ke-19 dan awal abad ke-20 para ahli kesehatan sudah mulai mempertimbangkan keterkaitan antara faktor-faktor lingkungan dengan kejadian penyakit.

Latar belakang

- *Exposure assessment* adalah hal yang krusial/penting untuk identifikasi, evaluasi, dan pengendalian risiko-risiko di tempat kerja sama pentingnya dengan exposure assessment di general environment.

Environmental exposure vs Occupational exposure

- *Concentration of pollutants are usually much lower in the general environment than in the occupational environment, which requires more sensitive measurement techniques*
- *In the occupational setting, there are usually well-defined groups of people who are exposed, often healthy male workers, while the general population includes children, the elderly and people with different diseases, who may be more susceptible to exposure and effects*
- *In the occupational setting there is generally a limited set of hazardous agents to be considered, while in the general environment there is often a variety, and a mixture, of potentially hazardous agents to be examined*

Environmental exposure vs Occupational exposure

- *Worker are exposed within a reasonably well-defined occupational setting, while the general population is exposed in different environmental settings with various concentrations, outdoors and indoors, in urban and rural areas, and at home, school or work, etc.*
- *The general population is exposed intermittently throughout a whole lifetime, over periods of days, months, years, or decades, whereas a worker is exposed during working hours. Of course, the worker is also a member of the general population*

Differences between occupational and environmental exposure assessment.

Issue	Occupational	Environmental
Exposure prevalence	Confined to specific occupational settings	Often commonly occurring, but not specific
Exposure range	Wide range of exposures within an industry is relatively common	Limited range of exposures, that is “high exposure” is not very different from “low exposure”
Exposure characteristics	Single (or a few) exposure common	Often multiple exposures (complex mixtures) but usually only a single exposure included in study

Differences between occupational and environmental exposure assessment.

Issue	Occupational	Environmental
Individual exposure data	Often lacking, but data from representative work places may be good surrogates	Often lacking, group or community based data may be less good surrogates
Public health importance	Limited	Large populations often exposed, and therefore the impact of low excess risks may be important

Definitions of exposure

- The key word in the definition of exposure is *contact*.
- Exposure does not result only from the presence of a harmful agent in the environment.
- There must be contact between the agent and the outer boundary of the human body, such as the airways, the skin and the mouth.
- Exposure may be defined as “the contact of a chemical, physical, or biological agent with the outer boundary of an organism”.
- Exposure is often defined as a function of concentration and time.

4 important aspects (main characteristic) to determination of exposure

1. The nature of the agent (chemical, physical, and biological properties)
 2. The intensity of exposure (how much [concentration] of the agent)
 3. The duration of exposure (for how long a time)
 4. The frequency of exposure (How often)
- *Exposure is quantified as the concentration of an agent in contact with the human body, averaged or integrated over time (duration) of contact.*

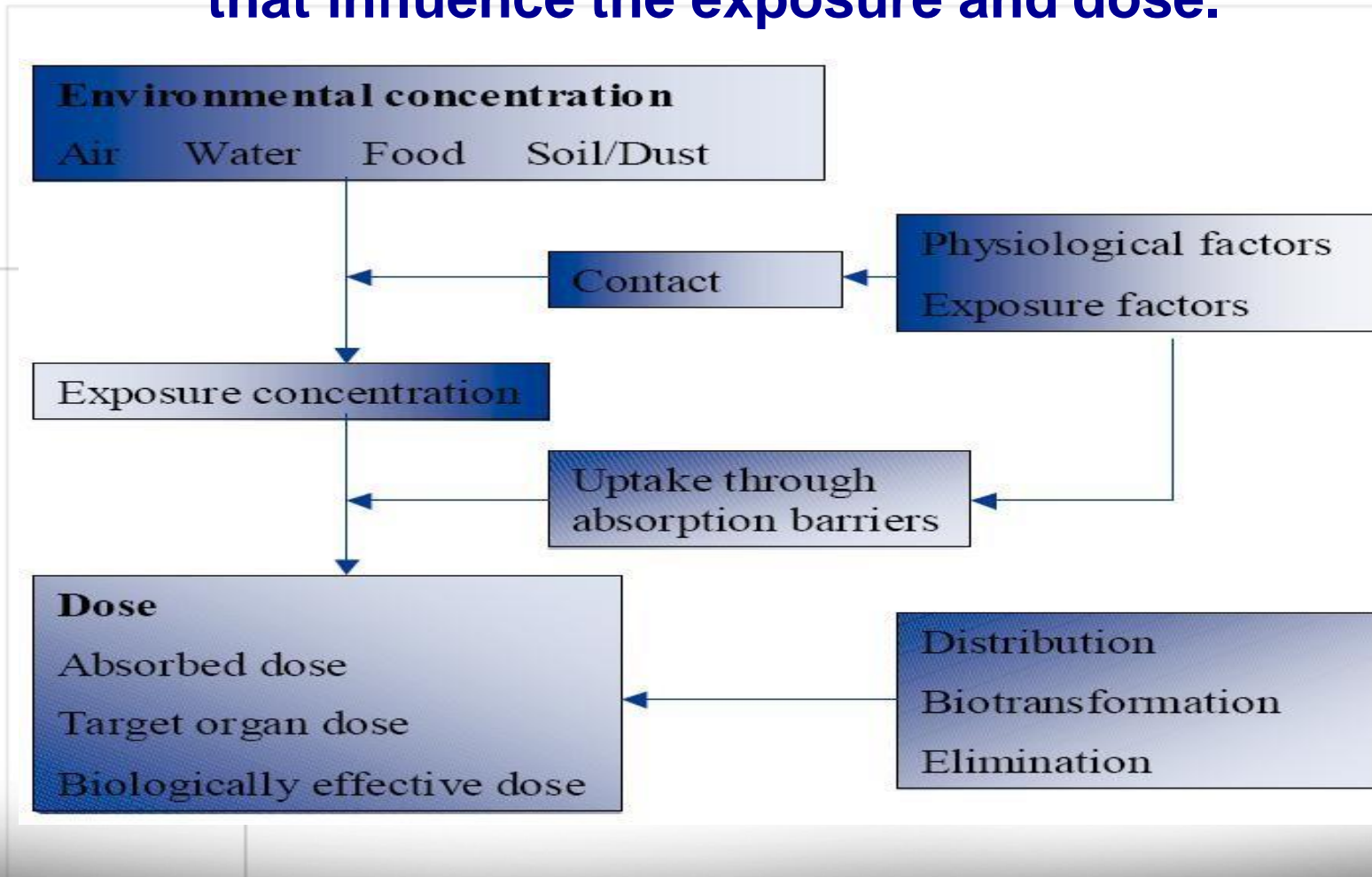
Various time frames of exposure

- Short-term exposure
 - Seconds, minutes, hours, days
- Long-term exposure
 - Weeks, months, years, lifetime
- Cumulative exposure
 - Total exposure over a given period of time

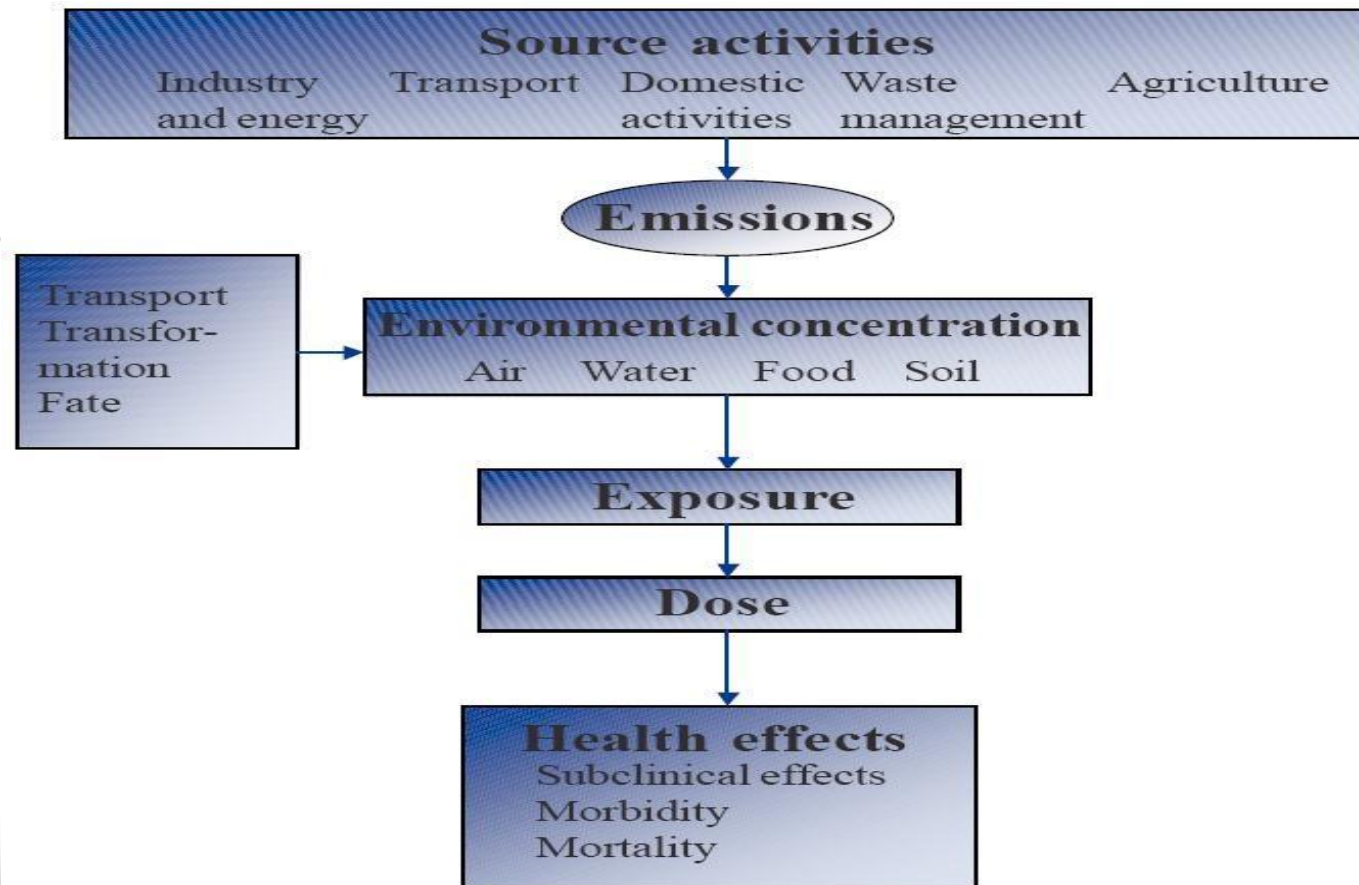
The scope of human exposure assessment

1. Identification and evaluation of sources of hazardous agents (type, amount released, geographic location)
2. Determination of concentrations of agents in environmental media such as air, water, food and soil
3. Identification of (major) pathways and routes of exposure
4. Determination of intensity, duration and frequency of exposure
5. Determination of dose resulting from exposure

The relationship of environmental concentration, exposure concentration, and dose, as well as factors that influence the exposure and dose.



The environment health chain: the relationship of source activities, environmental concentrations, exposure, dose, and health effects (adapted from Briggs et al, 1996).



The environment-health chain

• Sources and emissions

- The potentially harmful agents may be natural in origin, for example, emanating from volcanic outbreaks, but the **majority derive from human activities and interventions, such as industrial activities, transportation, or energy production.**
- There are different types of emission sources
 - point sources such as industries, releasing pollutants to air or water,
 - line-sources such as power-lines and roads, area sources such as run-off from agricultural lands and landfills.

The environment-health chain

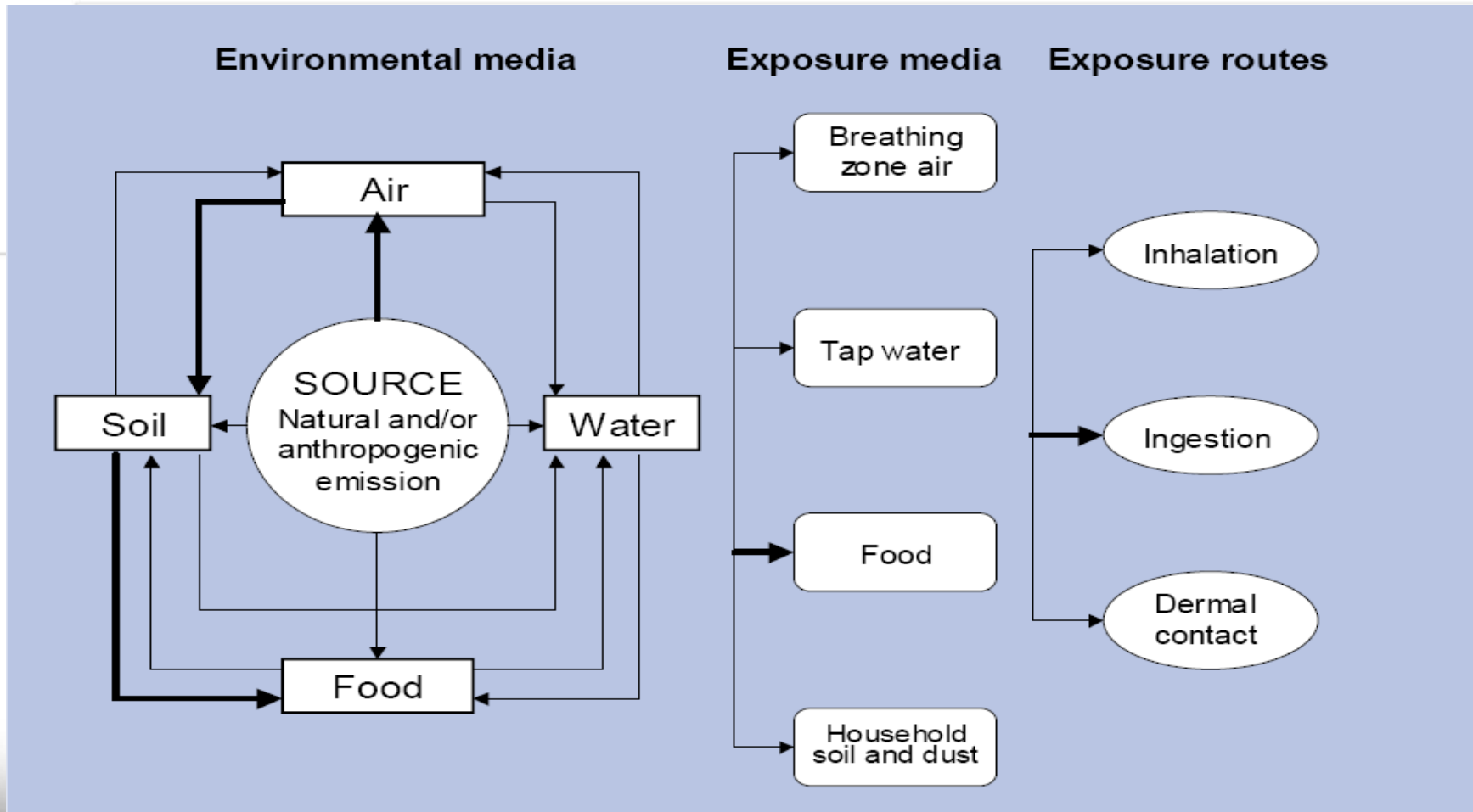
- **Transport, transformation and fate**
 - The dispersion and eventual fate of the pollutants depends on various factors including the pollutants' physical and chemical properties and on environmental factors such as water-flow and meteorological conditions.
 - The transport of a pollutant in the environment is influenced by a number of factors, including volatilization and sorption to soil.

The environment-health chain

- **Exposure pathways and routes**
 - Inhalation
 - Ingestion
 - Dermal contact (Absorption)
 - Injection

- Other important exposure routes are placental exposure of the fetus, exposure to noise via the ears, and exposure to UV-radiation via the eyes.

The relationships of environmental and exposure media, and exposure pathways and routes. **Bold arrows indicate one example of an exposure pathway (adapted from McKone and Daniels, 1991).**



Dose

- The amount of a pollutant that may enter the body is usually only part of the exposure, and is referred to as the dose
 - **Absorbed dose (internal dose)** → amount of an agent that passes into a tissue or organ over a time interval, example the concentration of a solvent in blood during, or shortly after, a work shift.

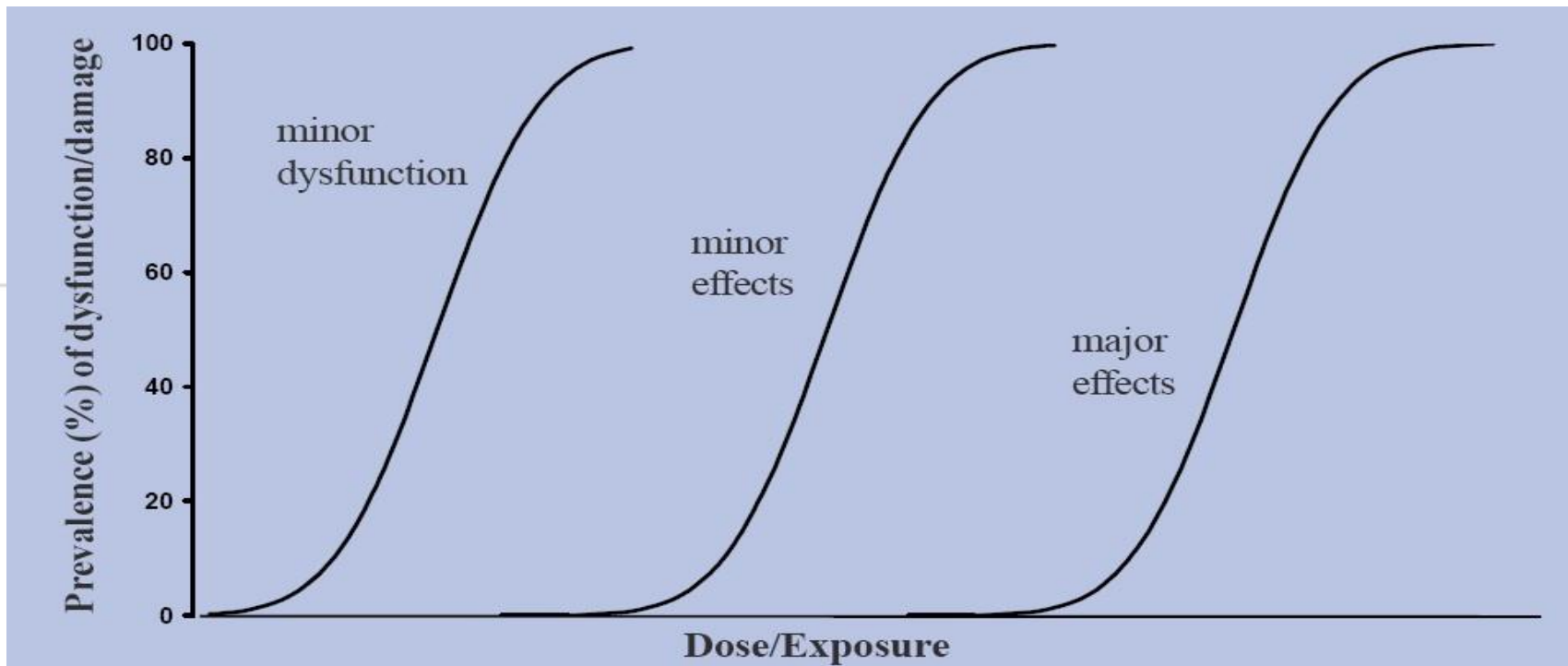
The absorbed dose can also be the amount of an agent accumulated in one or several body compartments

- **Target organ dose** → integrated concentration of the agent in the target organ, that is the organ where the particular agent may cause an adverse effect, over a time interval

Dose

- ***Biologically effective dose*** → the integrated quantity after subtraction of the non-contributing fraction of the dose, for example the bio transformed proportion of a substance that may cause an effect.

The relationship between exposure or dose and health effects



Relationships between dose or exposure and prevalence in percent (response) of individuals, as the dose or exposure increases, so too does the prevalence of individuals experiencing minor dysfunction, minor effects and major effects (response), from a few to almost 100 percent (Elinder et al, 1994).

The scope of human exposure assessment

- The aim of human exposure assessment is to identify and quantify past, present and future exposures to chemical, physical, and biological agents that may cause health effects.
- Exposure assessment includes:
 - *Identification and evaluation of sources of hazardous agents (type, amount released, geographic location)*
 - *Determination of concentrations of agents in environmental media such as air, water, food and soil*
 - *Identification of (major) pathways and routes of exposure*
 - *Determination of intensity, duration and frequency of exposure*
 - *Determination of dose resulting from exposure*
 - *Estimation of number of persons exposed*
 - *Identification of high-risk groups (highly exposed or more susceptible to effects)*

Key considerations of human exposure assessment

- Time and location

- **Exposure duration and frequency**

The duration and the frequency of exposure are both important determinants of total exposure. The minimum duration of exposure causing a disease is often not known.

- **Time between exposure and effects**

The time between initial exposure and the occurrence of a health effect can vary from instantly to decades depending on the agent and the type of effect.

This is important to know in order to assess exposure for a relevant period of time in relation to the expected effects.

Key considerations of human exposure assessment

- **Time-activity patterns and exposure settings**

Concentrations of potentially harmful agents differ in relation to time of the day, week, or season, etc., and between different settings.

Information on how people use their time, and where they spend it, may influence exposure considerably.

Human behaviour and use of time is referred to as the *time-activity pattern* of an individual or a population.

Key considerations of human exposure assessment

- **Time activity data**

Time-activity data in combination with micro-environmental concentration measurements or personal measurements can be used to identify sources of exposure and activities that contribute significantly to exposure.

Key considerations of human exposure assessment

- Additional factors modifying exposure and dose
 - **personal habits**
 - **life-style factors**

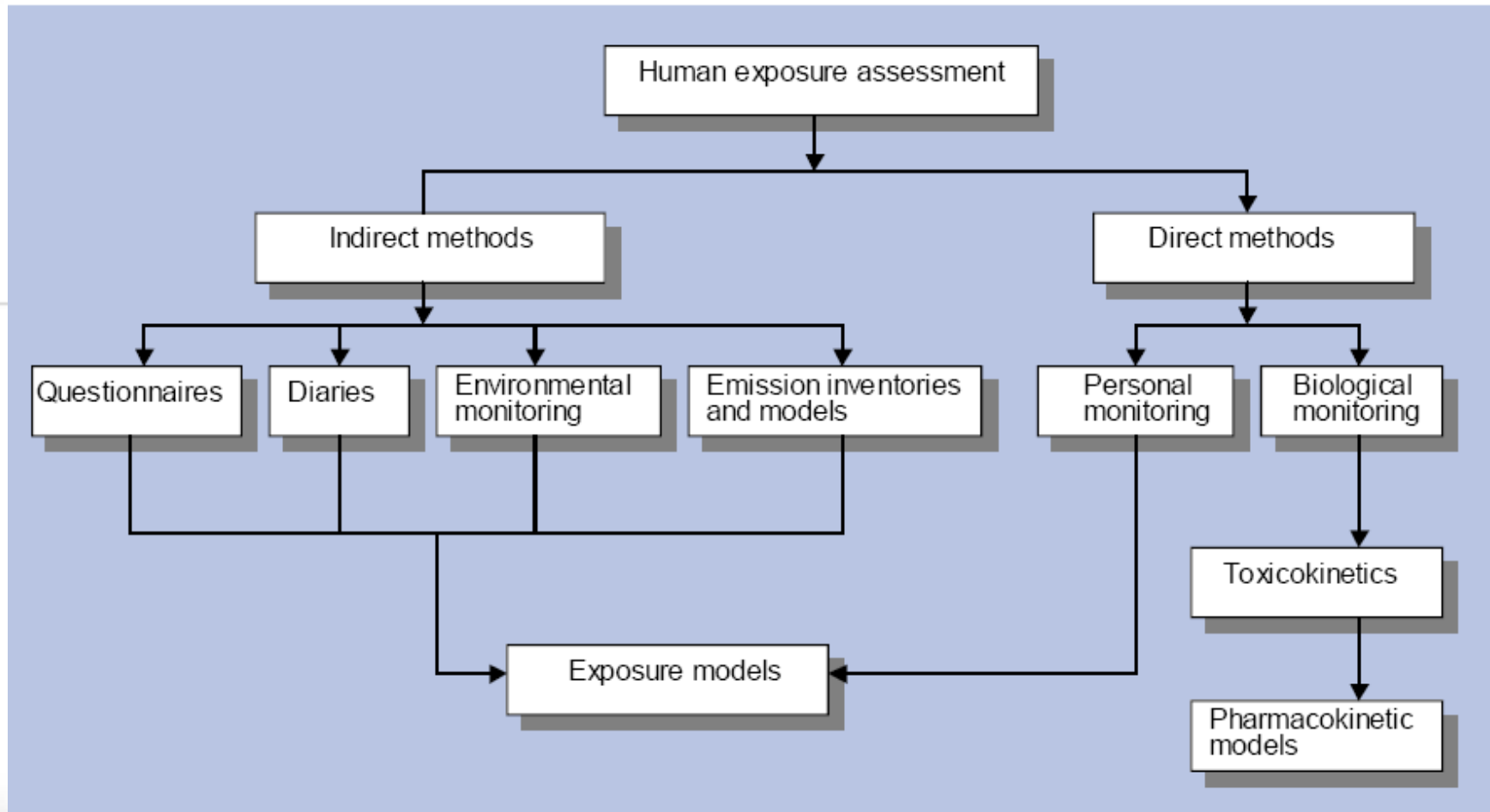
Life-style factors such as food choice and smoking habits will influence the exposure and dose.

- **socio-economic and cultural factors**

Key considerations of human exposure assessment

- **nutritional status**
- **Level of physical activity.**
- Physical activity has effects on uptake, metabolism and distribution of agents inhaled. For example, someone who is exercising heavily may inhale more than ten times as much air per minute as a person at rest.

Human exposure assessment approaches



Different aspects of the contact between people and pollution that are potentially important when planning a study and in the following exposure analysis (adapted from Sexton et al, 1995)

Agents		Sources
<ul style="list-style-type: none"> • Biological • Chemical • Physical 	<ul style="list-style-type: none"> • Single agent • Multiple agents • Mixtures 	<ul style="list-style-type: none"> • Anthropogenic/Nonanthropogenic • Area/Point • Stationary/Mobile • Indoor/Outdoor
Transport/Carrier media		Examples of exposure pathways
<ul style="list-style-type: none"> • Air • Water • Soil 	<ul style="list-style-type: none"> • Dust • Food • Product/Item 	<ul style="list-style-type: none"> • Eating contaminated food • Breathing contaminated air • Touching contaminated surfaces

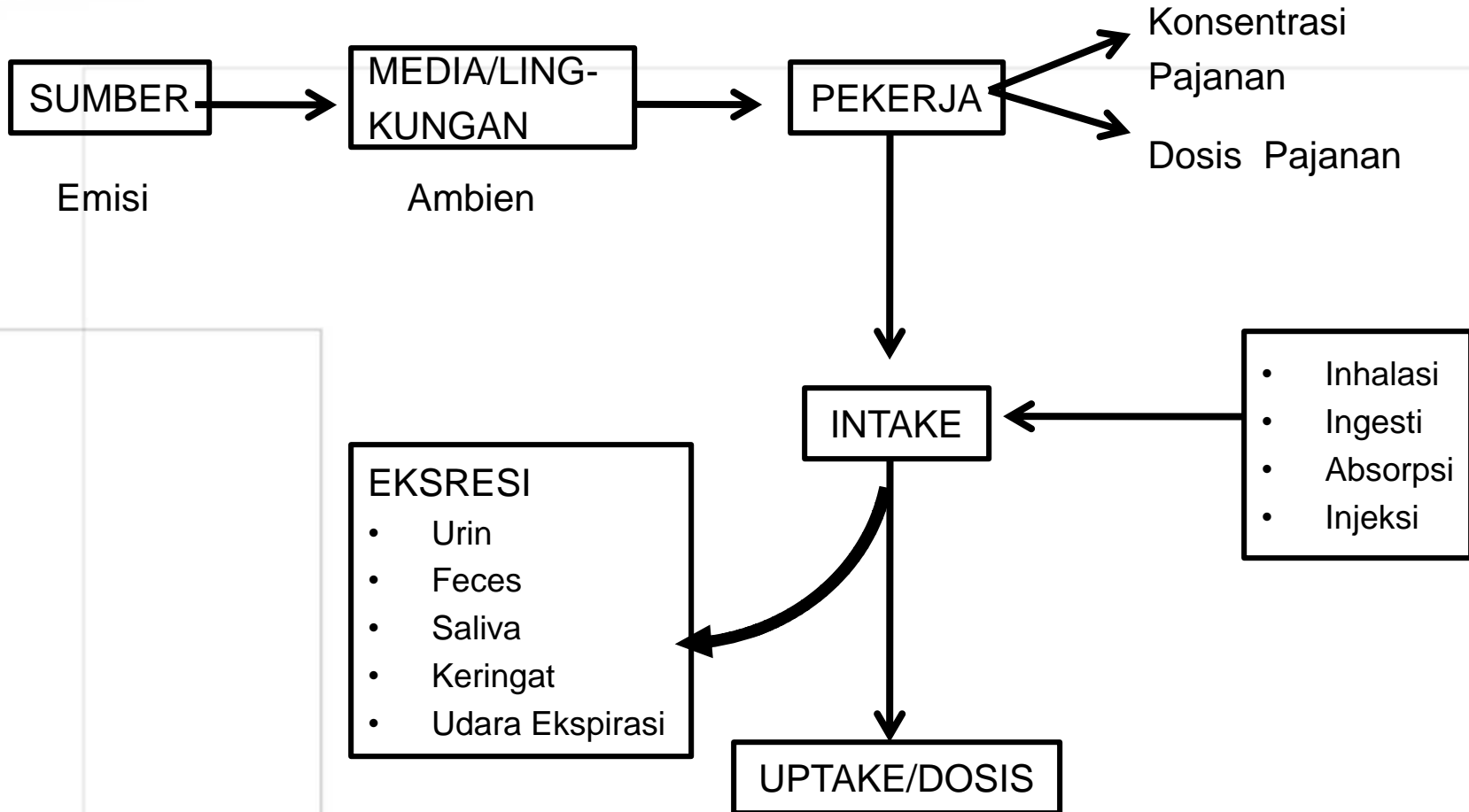
Different aspects of the contact between people and pollution that are potentially important when planning a study and in the following exposure analysis (adapted from Sexton et al, 1995)

Exposure concentration		Exposure routes	
• mg/kg (food)	• $\mu\text{g}/\text{cm}^2$	• Inhalation	• Dermal contact
• mg/L (water)	• % by weight	• Ingestion	• Multiple routes
• $\mu\text{g}/\text{m}^3$ (air)	• Fibers/ m^3 (air)		
Exposure duration		Exposure frequency	
• Seconds	• Weeks	• Continuous	• Random
• Minutes	• Months	• Intermittent	• Rare
• Hours	• Years	• Cyclic	
• Days	• Lifetime		

Different aspects of the contact between people and pollution that are potentially important when planning a study and in the following exposure analysis (adapted from Sexton et al, 1995)

Exposure settings	Exposed population
<ul style="list-style-type: none"> • Occupational/Nonoccupational • Residential/Nonresidential • Indoors/Outdoors 	<ul style="list-style-type: none"> • General population • Population subgroups • Individuals
Geographic scope	Time frame
<ul style="list-style-type: none"> • Site/Source specific • Local • Regional • Days 	<ul style="list-style-type: none"> • National • International • Global • Past • Present • Future • Trends • Lifetime

Simple Flow of Exposure Assessment



Thank You