

# Exposure to metalworking fluids and markers of early health effect among metal industry workers

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# Metalworking fluids

- Metalworking fluids (MWF) are used
    - to lubricate, cool tools and the work piece
    - during machining, cutting, grinding, drilling of metals
    - in many manufacturing processes
  - Two main families
    - Straight MWF that is mineral/synthetic oil containing no water
    - Aqueous MWF
      - > Soluble oils and semisynthetic fluids according to the amount of mineral oils emulsified in water
      - > Synthetic fluids that contain no mineral oil
- + performance additives



# Metalworking fluids and their aerosols

- Substances from the manufacturing process (e.g. hydraulic fluids)
- Substances potentially present in the aerosols from used MWF
  - Polycyclic aromatic hydrocarbons (PAHs)
  - Metals
  - Microorganisms ...
- The physical process of metalworking generates
  - a complex MWF aerosol: solid particles and droplets in suspension in a vapour phase
  - in the breathing zone of the worker for several hours

# Health issues due to MWF exposure<sup>1</sup>

- Cancer of the skin and the scrotum (IARC 1: 1984, 1987, 2012)
  - Mineral oils, poorly refined
- Non-malignant respiratory diseases
  - Hypersensitivity pneumonitis
  - Asthma
  - Respiratory symptoms: cough, expectoration, chronic bronchitis, rhinitis
- Non-malignant skin diseases

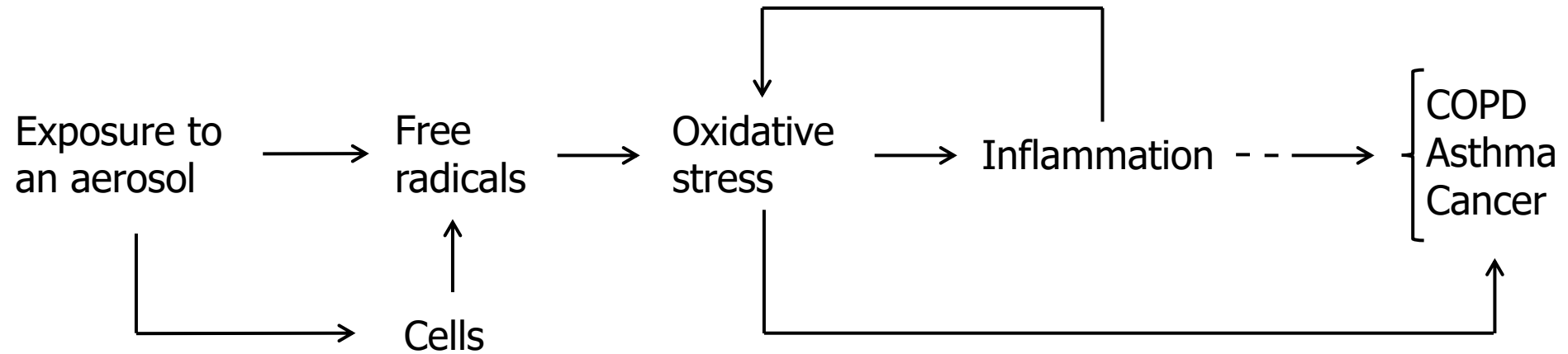
# What about current exposure to MWF?

- Composition of MWF is complex and constantly changing
- To set up an epidemiological study that could answer the question:  
Is there a relationship between current exposure and a health effect?  
→ Need to anticipate clinical effects by measuring biomarkers of early effects

## Early effect biomarker

- Biological indicator measurable in the body
- Allows the identification of biological alterations before the possible appearance of symptoms or diseases
- Most often reversible, can be taken over by the body's regulatory mechanisms and do not systematically lead to a disease

# Presumed physio-pathological mechanism



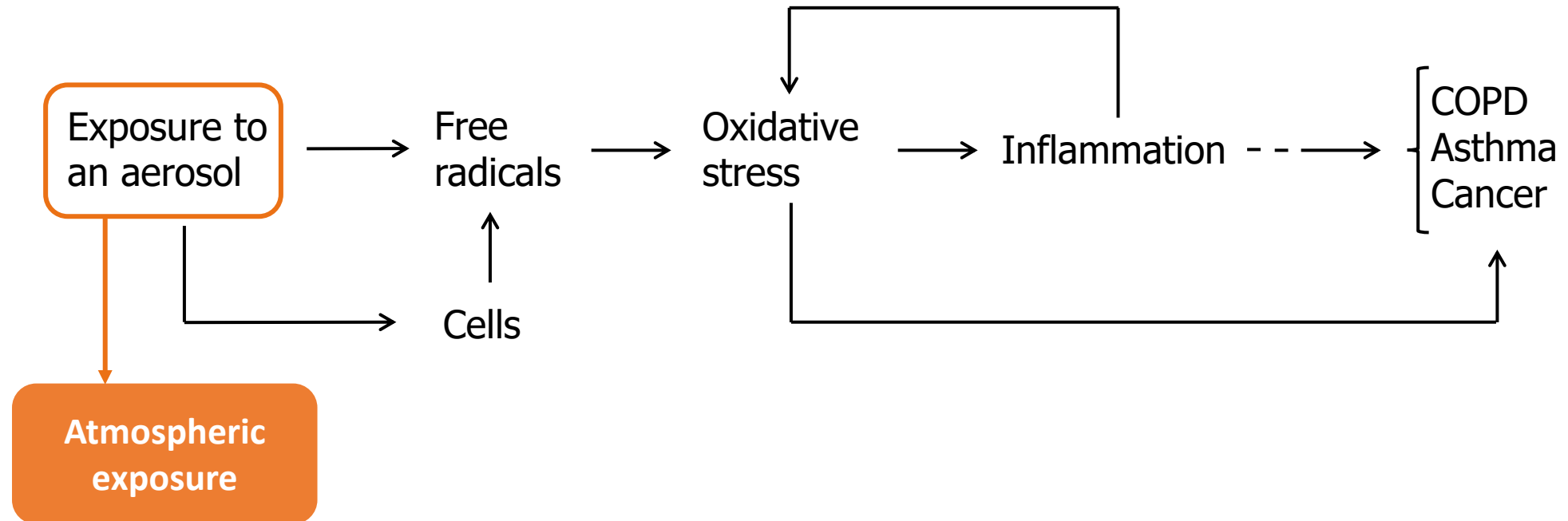
Adapted from Ayres *et al.*, 2008

## Objective

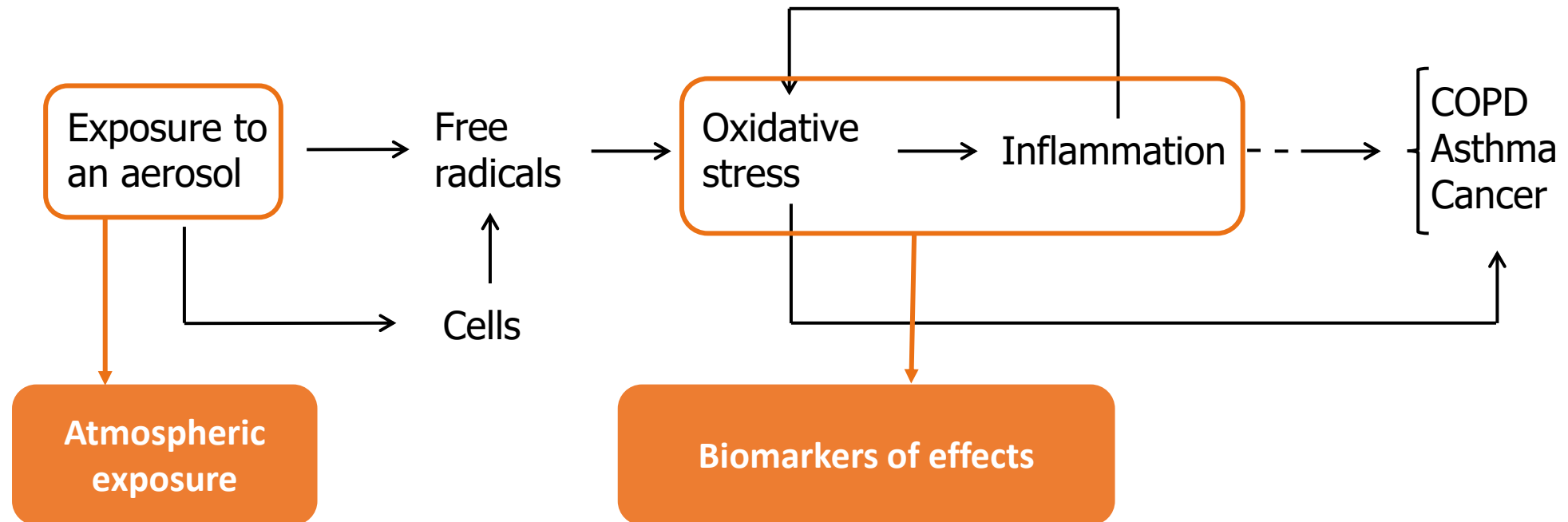
- To analyse the possible relationships between occupational exposure to MWF and early effects on health
- by measuring biomarkers of early non-specific effects
- at the respiratory level



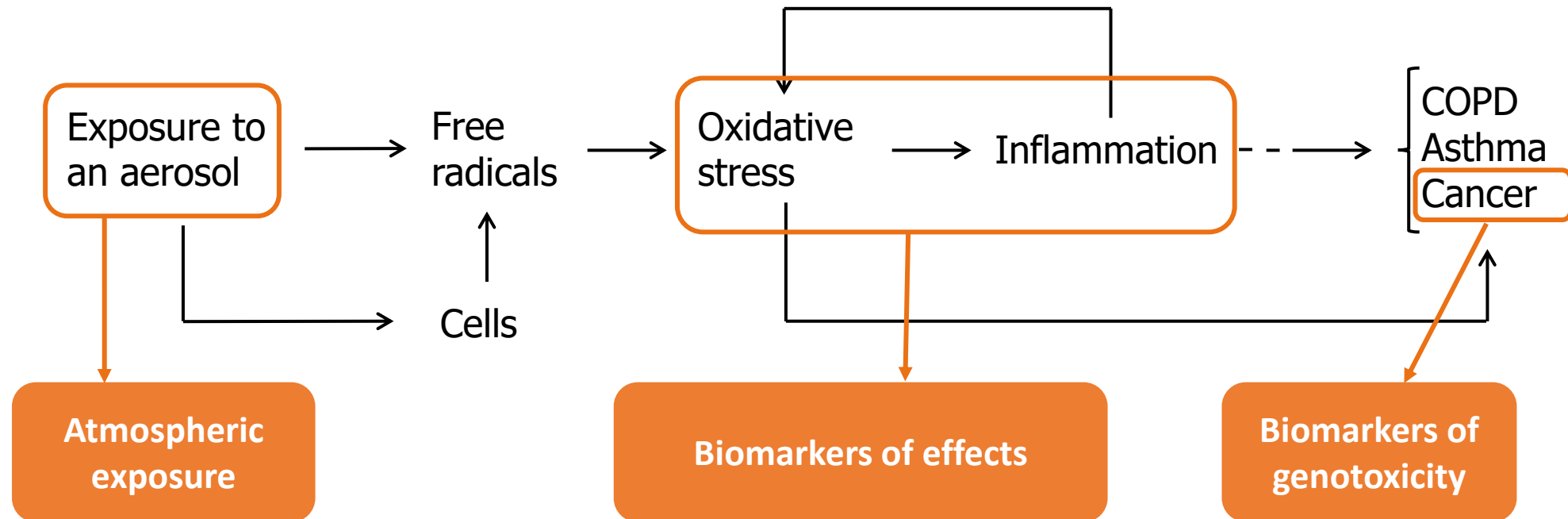
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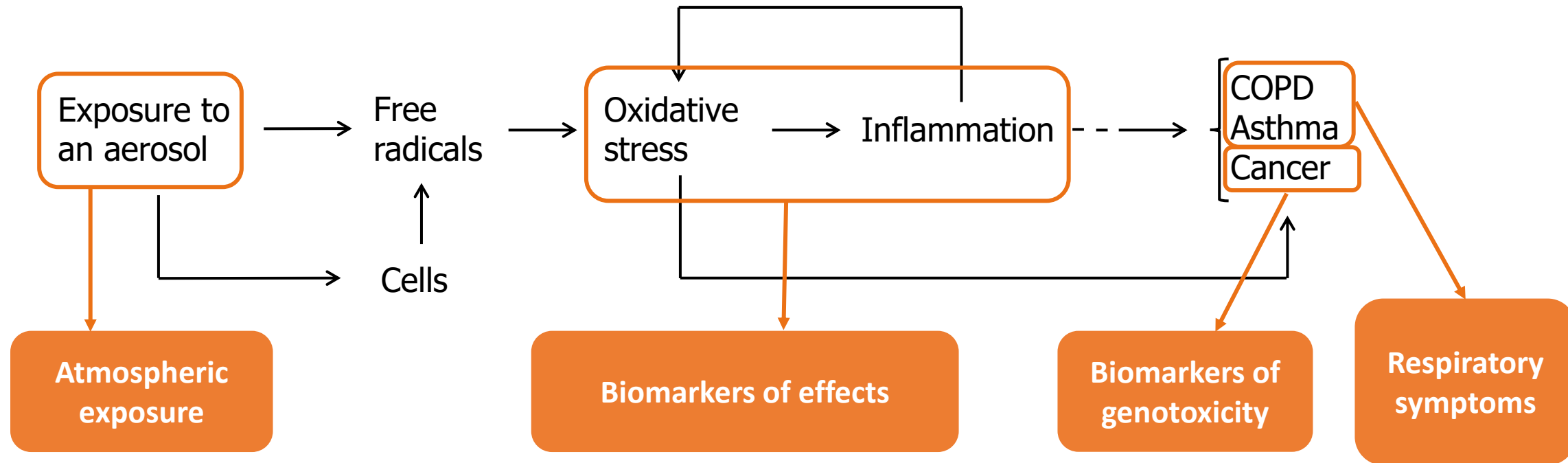
# Objective



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## Study - Population

- An epidemiological study among exposed / non exposed workers,
- males and females
- conducted in French and Swiss companies

# Data collection during 2 working days

- Occupational exposure
  - Atmospheric measurements
    - > Mass fraction of the respirable particulate MWF from personal and stationary sampling (INRS Metropol M-282)



# Data collection during 2 working days

- Occupational exposure
  - Atmospheric measurements
    - > Mass fraction of the respirable particulate MWF from personal and stationary sampling (INRS Metropol M-282)
    - > Overall airborne MWF : particulate fraction + volatile organic fraction (Khanh Huynh C. 2009)



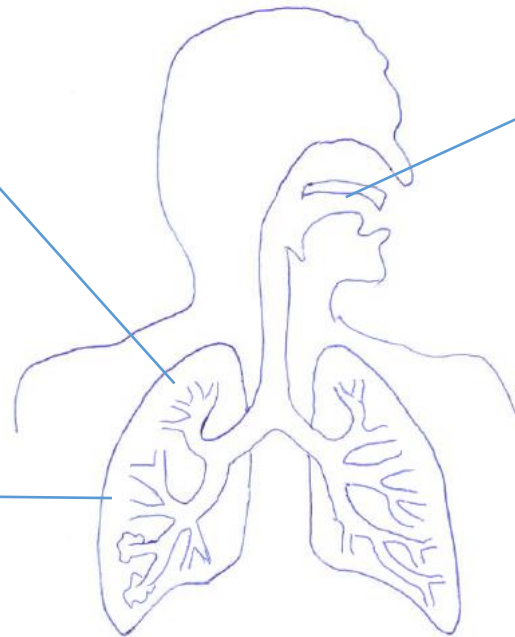
# Data collection during 2 working days

- Health effects at the respiratory level

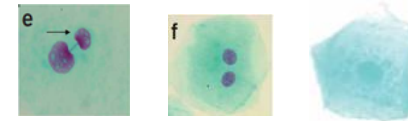
**Oxidative stress** in exhaled breath condensate



**Respiratory inflammation** in exhaled air



**Genotoxicity** in buccal cells



**Respiratory symptoms**

- Asthma-like
- Rhinitis
- Cough / Expectoration





# Results

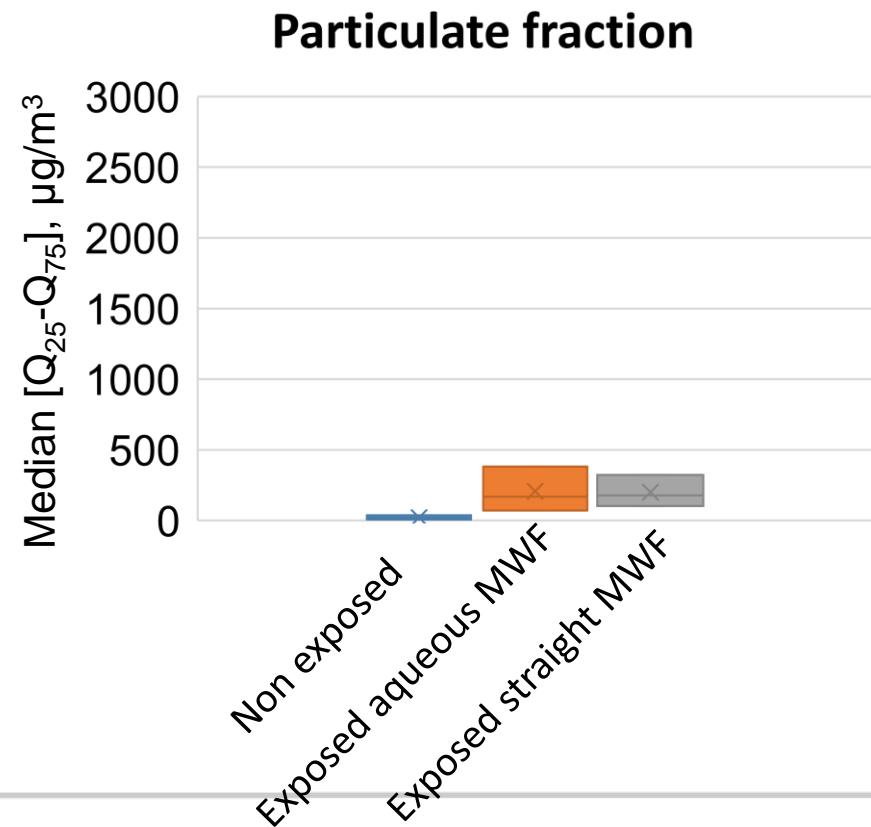
- Data collection from 02/2018 to 06/2019
- 120 workers
  - 86 exposed
  - 34 non-exposed
- 39 years old on average
- 27% females
- 32% smokers
- 15 companies
  - 9 in France
    - > automotive and aeronautical parts, cutting tools, sealing collars, and cylindrical bars and tubes
    - > using mainly aqueous MWFs
  - 6 in Switzerland
    - > watchmaking and medical parts, and electrical contactors
    - > using only straight MWFs

# Results: concentrations in the air

- Particulate fraction
  - 10% over the French recommended value ( $500 \mu\text{g}\cdot\text{m}^{-3}$ )

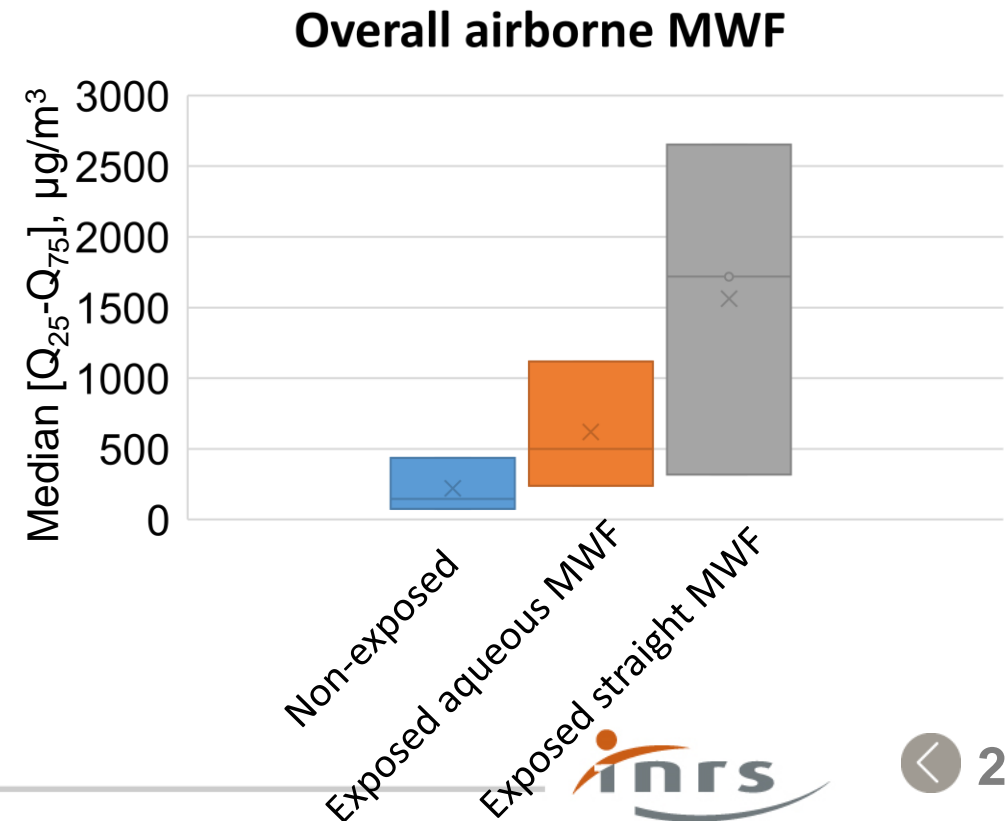
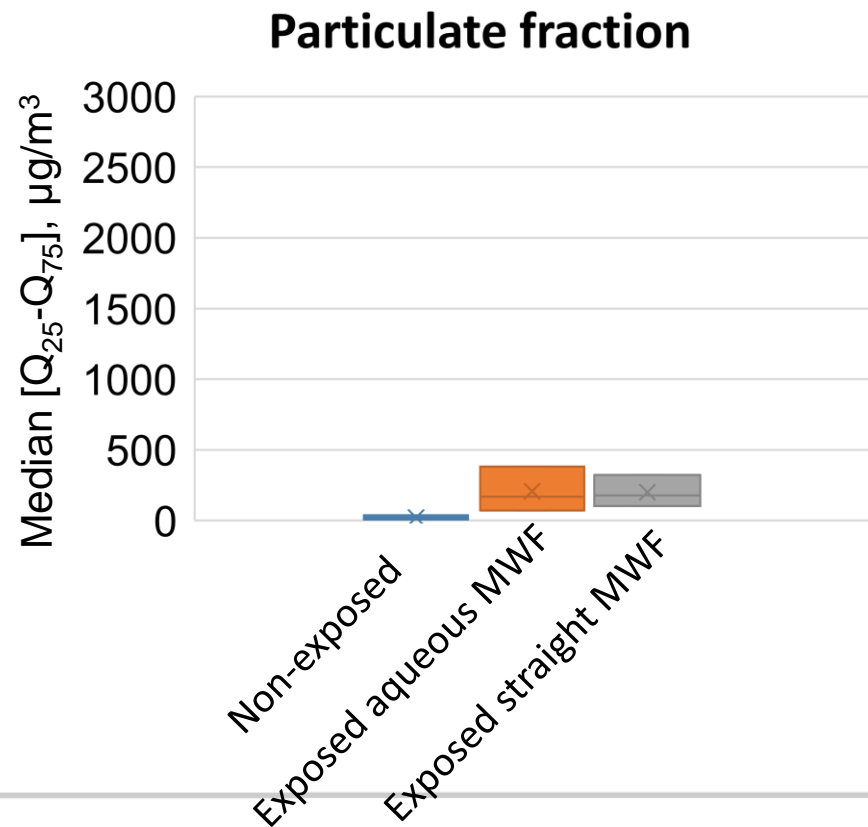
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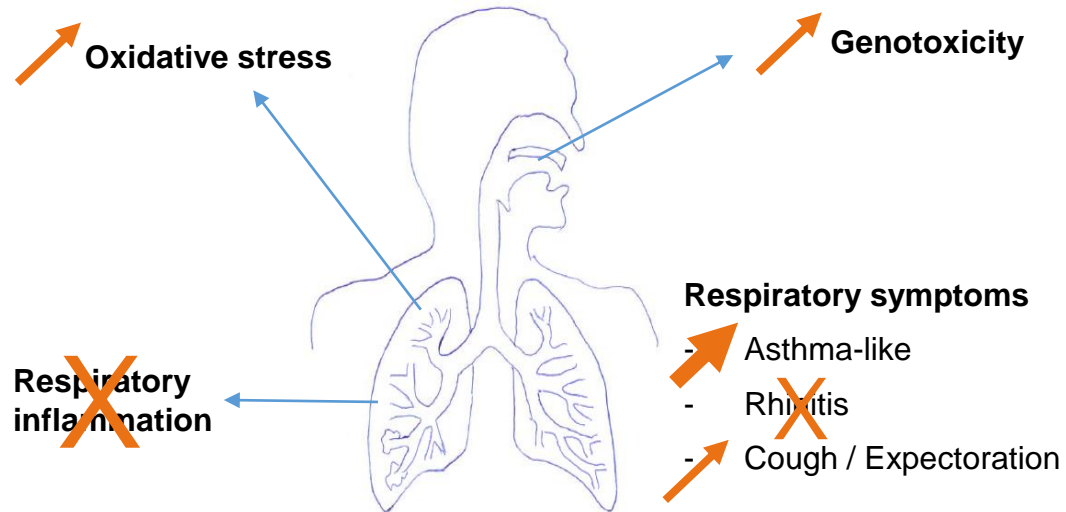
# Results: concentrations in the air

- Particulate fraction
  - 10% over the French recommended value ( $500 \mu\text{g}\cdot\text{m}^{-3}$ )
- Overall airborne MWF (particulate + volatile fractions)
  - [Airborne] for straight MWF > [Airborne] for aqueous MWF




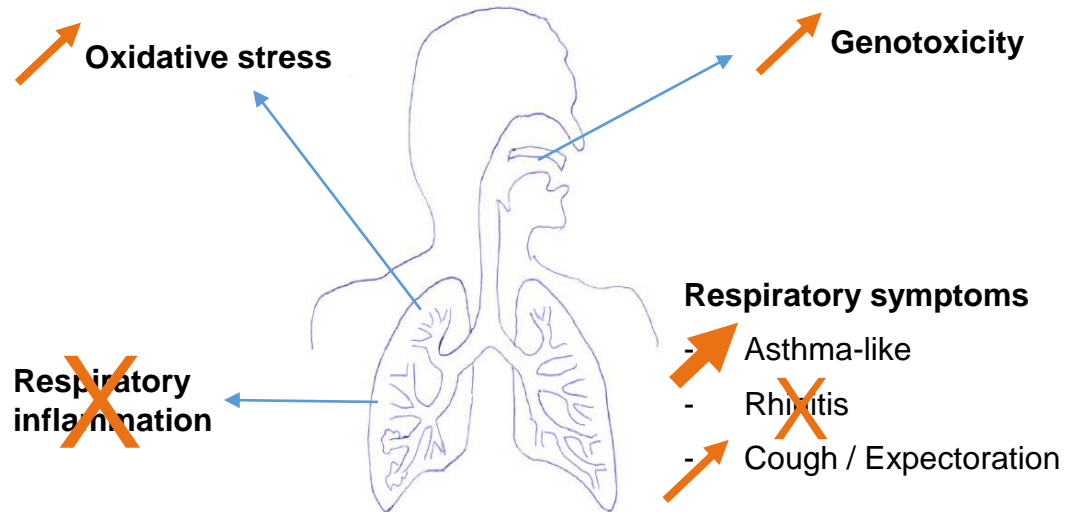
# Results: exposure and health effects

Relationships between  concentration of **particulate fraction** and:

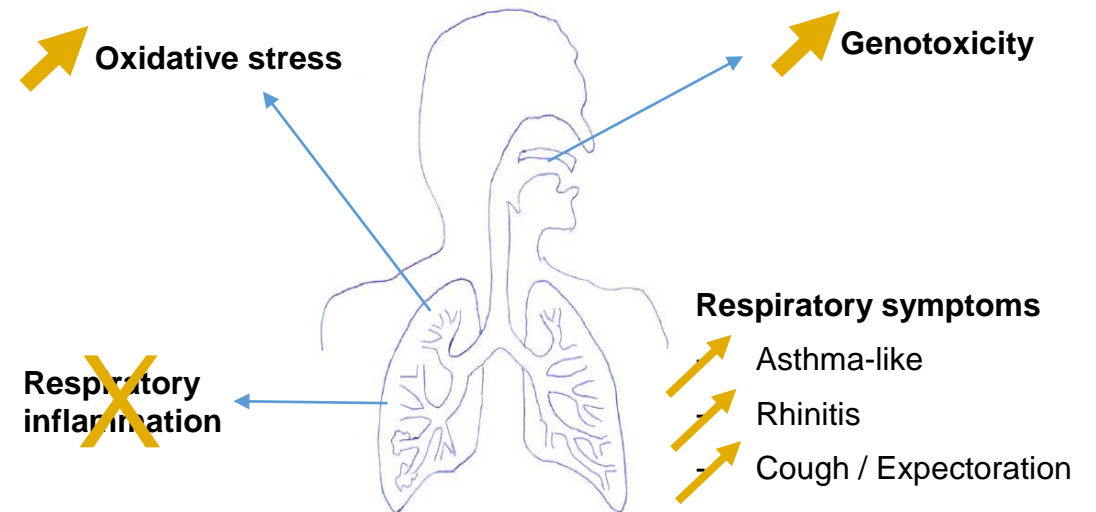


# Results: exposure and health effects

Relationships between  concentration of **particulate fraction** and:



Relationships between  concentration of **overall airborne MWF** and:



# Conclusion

- These results are
  - in favour of an association between exposure to MWF at the current job and
    - > early effects at the respiratory level, such as oxidative stress and genotoxicity
    - > prevalence of respiratory symptoms
  - Association often more marked when considering the overall airborne MWF
  - The gas fraction an important element to control?
- Issue
  - Until now, the preventive measures applied in French companies have only considered the oil mist problem from the particulate aspect
  - Need to measure the gas fraction in a reliable way to confirm the results of the study
  - To propose adequate preventive actions if confirmed



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