

# Health effects of nitrogen oxides



# Occupational Exposure Standards

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# Occupational Exposure Standards

“Everything is poisonous – only the dose differentiates a poison from a remedy”

- Paracelsus (1493-1531)



# Occupational Exposure standards

Time weighted average = average level of exposure over a working day

For nitrogen dioxide = 3ppm



# Occupational Exposure standards

STEL = short term exposure limit

Safe exposure for up to 15 minutes not more than 4 times a day and with at least 1 hour between exposures

For nitrogen dioxide = 5 ppm



# Occupational Exposure standards

IDLH = immediately dangerous to life and health

For nitrogen dioxide = 20 ppm

# Nitrogen oxides

- **Nitric oxide** - NO (nitrogen monoxide)
- **Nitrous oxide** - N<sub>2</sub>O
- **Nitrogen dioxide** - NO<sub>2</sub>

# Asphyxiant gases

- Gases that cause injury and death by depriving the body of oxygen

(a = without + sphyxis (Gk) heartbeat)





# Asphyxiant gases

Three groups:

- Simple asphyxiants
- Chemical asphyxiants
- Irritant asphyxiants



# Simple asphyxiants

Gases that are not poisonous – but can't support life:

Air = 21% oxygen + 79% nitrogen

We breathe nitrogen, but on its own, nitrogen will not support life and is therefore a simple asphyxiant.



# Chemical asphyxiants

These are gases which chemically poison the body's oxygen transport systems, preventing oxygen from reaching the body tissues

The best example is carbon monoxide – it combines with haemoglobin, the red pigment in blood cells and blocks its ability to carry oxygen around the body.



## Irritant asphyxiant gases

These gases cause asphyxiation by producing severe irritation in the air passages and lungs.

Many of these dissolve in the moisture on any moist tissue surfaces, and form strong acids or alkalis which then burn the delicate tissues.

$\text{NO}_2$  is one of these

## Nitrogen dioxide – NO<sub>2</sub>

- One of the irritant asphyxiant gases
- Others include chlorine and sulphur dioxide (acidic)
- and anhydrous ammonia (alkaline)

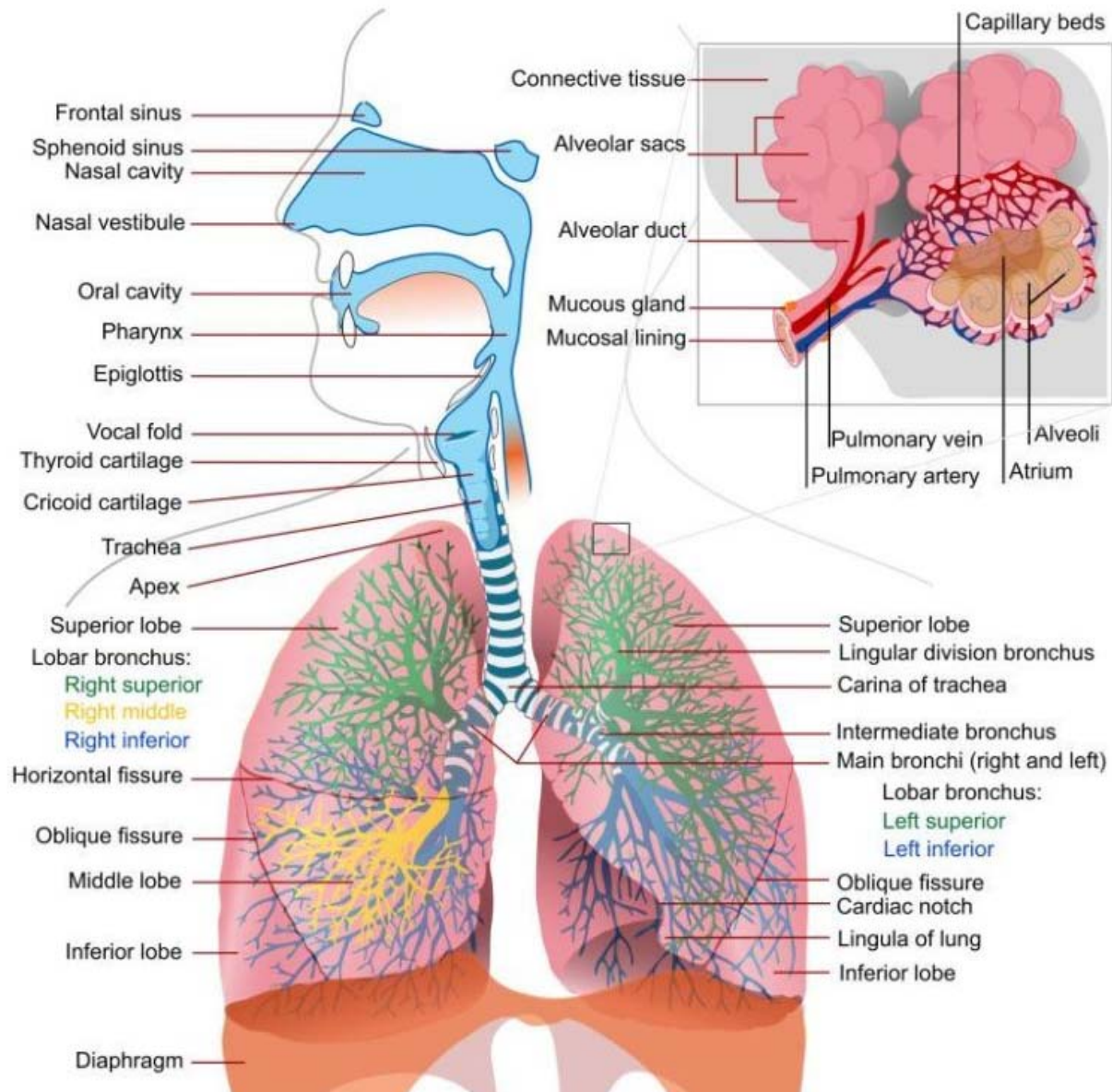
## Nitrogen dioxide – NO<sub>2</sub>

Health effects are related to its ability to dissolve in moisture to produce nitric acid – a strong mineral acid

# Nitrogen dioxide – NO<sub>2</sub>

## Acute health effects:

- Eye irritation –stinging and watering
- Throat irritation – pungent smell, stinging nose & coughing
- Lung irritation – coughing, wheezing and tight chest – difficulty breathing
- Triggers asthma in asthmatics





# Nitrogen dioxide – NO<sub>2</sub>

The most serious **acute** effects occur after significant exposure

Acute pulmonary oedema (edema – U.S)

Fluid from damaged lung tissue pours out into air spaces preventing air from getting to deeper lung – causes choking (asphyxia)

# Nitrogen dioxide – NO<sub>2</sub>

Pulmonary oedema - may occur :

- immediately – with heavy exposure, but is more likely to be -
- **delayed – usually for several - 24 hours after exposure.**
- \*

# Nitrogen dioxide – NO<sub>2</sub>

## Pulmonary oedema:

- Increasing chest tightness and difficulty breathing
- May cough frothy, whitish “phlegm”
- Lips may appear blue

**Pulmonary oedema is a medical emergency**

# Nitrogen dioxide – NO<sub>2</sub>

**Chronic** (long term) health effects:

Asthma – like condition called RADS

Small air passages **react** (constrict and narrow) to any irritant.  
(chemicals, cigarette smoke, even cold air) may cause an asthma attack

Obliterative bronchiolitis – the smallest air passages (bronchioles) are seriously scarred and become distorted & blocked.

The person becomes short of breath which can worsen over time.

(E.g. - condition suffered by WW1 soldiers who survived being gassed [chlorine] - damaged lungs, poor health and often early death).

# Nitrogen dioxide – NO<sub>2</sub>

## Testing for exposure:

- NO<sub>2</sub> reacts mainly in the lung and blood tests are not very useful in determining exposure
- (Higher exposures may alter haemoglobin to methaemoglobin which can be measured)

# Nitrogen dioxide – NO<sub>2</sub>

Treatment of exposure:

- Treatment = treating the symptoms (e.g. - eye irritation – flush with water and use soothing drops)

**Warning:** If you are seen by a doctor and released – be aware of the possibility of delayed **pulmonary oedema**

**Seek URGENT attention if breathing becomes difficult**