### Blood Agents and their Countermeasures

**N≡C−H**
- **Hydrogen Cyanide**
  - **LD₅₀**:
    - Inhalation: 300 mg/kg
    - Ingestion: 50 – 200 mg/kg
    - Skin: 100 mg/kg

**N≡C−C≡N**
- **Cyanogen**
  - **LD₅₀**:
    - Inhalation: 350 mg/kg
    - Ingestion: 64 mg/kg
    - Skin: 10 - 15 mg/kg

**N≡C−Na**
- **Sodium Cyanide**
  - **LD₅₀**:
    - Inhalation: 39 – 52 mg/kg
    - Ingestion: 25-50 mg/kg
    - Skin: 250-1000 mg/kg

**N≡C−Br**
- **Cyanogen Bromide**
  - **LD₅₀**:
    - Inhalation: 350 mg/kg
    - Skin: 10 – 15 mg/kg

### Effect

- Cyanide ion (CN⁻) binds to hemoglobin, the oxygen-carrying molecule in red blood cells.
- It distributes throughout the body via the bloodstream where it binds to the metabolic enzyme cytochrome c oxidase. This prevents cells from using oxygen and producing energy.
- Symptoms of hydrogen cyanide poisoning:
  - Headache, nausea, dizziness (mild doses)
  - Convulsions and coma (high doses)
  - Respiratory and cardiac arrest (very high doses)

### Countermeasures including supportive measures

**Sodium nitrite / Sodium Thiosulfate**
- **Structure**: NaNO₂ / Na₂S₂O₃
- **Effect**: Nitrite oxidizes iron from the ferrous (+2) state to the ferric (+3) state, increasing the concentration of circulating ferric ion which competes for cyanide binding to the ferric ion of cytochrome c oxidase. Sodium thiosulfate binds to cyanide to produce thiocyanate, which is less toxic and eliminated via the kidneys.

**4-Dimethylaminophenol (4-DMAP)**
- **Structure**: 4-Hydroxybenzylamine
- **Effect**: Oxidizes iron from ferrous (+2) to ferric (+3) state at a faster rate than sodium nitrite.

**Hydroxocobalamin**
- **Structure**: A form of Vitamin B₁₂
- **Effect**: Binds to cyanide to form a complex that can be cleared from the body via the kidneys.

**Dicobalt EDTA**
- **Caution**: High incidents of side effects have been observed in patients receiving this treatment.

**Nitrocobinamide**
- **Structure**: NO₂-vitamin B₁₂
- **Effect**: Reverses cyanide inhibition of the enzyme cytochrome c oxidase.

**Hyperbaric Oxygen Therapy**
- **Effect**: Potentiates activity of other counter-measures by displacing CN⁻ from heme.