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# Chemical Emergency Medical Guideline

## Information and recommendations for healthcare professionals

# Formaldehyde

## CAS No.: 50-00-0

**GHS symbols:**

**GHS05**
Corrosive

**GHS06**
Acute toxicity

**GHS08**
Health hazard

**Signal word: Danger**

**Hazard statement:**

| | |
|---|---|
| H314 | Causes severe skin burns and serious eye damage. |
| H317 | May cause allergic skin reactions. |
| H330 | Fatal if inhaled. |
| H335 | May cause respiratory irritation. |
| H341 | May cause genetic defects. |
| H350 | May cause cancer. |
| H301+H311 | Toxic if swallowed or in contact with skin. |

**Brief information**

- Before paramedics/emergency doctors on site approach a patient, who has been or is exposed to formaldehyde, they must ensure that there is no danger to themselves from formaldehyde.
- There is no danger from contact with patients who have only been exposed to formaldehyde gas or vapors. A patient who is wet with liquid formaldehyde or formaldehyde solutions, or whose clothing is wet with them, may endanger other people through direct contact or through formaldehyde gas or vapor.
- Formaldehyde irritates the skin, eyes and upper respiratory tract, causing eye irritation, coughing, chest pain and breathing difficulties. Bronchospasm and signs of toxic pulmonary oedema (shortness of breath, cyanosis, sputum and coughing) may occur. Sensitisation through skin contact is possible.
- There is no known specific antidote. Treatment depends on the extent of exposure and the symptoms.

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## 1. Information about the substance

Formaldehyde (HCHO), CAS 50-00-0
Synonyms: formalin, formic aldehyde, methanal, methylene oxide
At room temperature, formaldehyde is an almost colorless gas with a sharp or pungent odor. The vapors are flammable and explosive. Since pure gas tends to polymerize, it is usually marketed as a 30-50% aqueous solution with up to 15% methanol as a stabilizer.
Formaldehyde is an important starting material in the manufacture of plastics, resins and urea-formaldehyde insulating foams. Resins containing formaldehyde are used in building materials (chipboard) and in the manufacture of paper, floor coverings, paints and furniture.

## 2. Exposition

### 2.1. Inhalation

Exposure to formaldehyde occurs mainly through inhalation and local exposure. The smell and irritant effect of formaldehyde have a clear warning effect. However, chronic exposure to low concentrations can lead to a dulling of the sense of smell and the irritant effects. As formaldehyde is heavier than air, there is a risk of suffocation in poorly ventilated, low-lying or enclosed spaces.

### 2.2. Skin/eye contact

Exposure to formaldehyde gas on wet or damp skin or eyes can cause irritation and chemical burns.

### 2.3. Ingestion

Ingestion of formaldehyde solutions can cause severe burns to the esophagus and stomach. Nausea, vomiting, diarrhoea and stomach pain may occur.

## 3. Acute health effects

### 3.1. Dose-response relationships

| **Formaldehyde concentration** | | **Effects** |
|---|---|---|
| 0.05 – 1.0 ppm | - | Odor perception (development of tolerance) |
| 0.5 – 3 ppm | - | Mild irritation of the eyes and upper respiratory tract |
| 3 – 10 ppm | - | Moderate irritation of the eyes and upper respiratory tract |
| 5–30 ppm | - | Chest pain, breathing difficulties, coughing, nausea and vomiting |
| 50–100 ppm | - | Toxic pneumonia and pulmonary oedema |
| > 100 ppm | - | Fatal |
| **Aqueous solutions** (amount ingested orally) | | |
| 20–200 mg | - | Mild stomach and throat discomfort |
| 600–2000 mg | - | Throat irritation, vomiting, cyanosis, cardiac arrhythmia |
| 5–10 g | - | Severe pain, ulceration, glottis oedema, asphyxia, death |

### 3.2. Respiratory tract

Formaldehyde causes irritation of the eyes and upper respiratory tract (throat irritation, coughing). At high concentrations, it can quickly lead to breathing difficulties with chest pain, shortness of breath, laryngospasm and toxic pulmonary oedema. The symptoms may increase over time. Massive exposure can lead to respiratory and cardiovascular arrest.

### 3.3. Skin contact

High concentrations or aqueous solutions can cause burning pain, redness, inflammation, blistering and chemical burns to the skin and mucous membranes.

### 3.4. Eye contact

Low concentration can cause eye irritation with burning, redness, tearing and eyelid closure. Contact with liquid formaldehyde and high concentrations can cause chemical burns and corneal opacity.

### 3.5. Possible consequences

If the patient survives the first 48 hours after exposure, further improvement in symptoms can be expected. After acute exposure, lung function usually returns to normal within 7 to 14 days. Complete recovery is usually achieved. Increased sensitivity to irritants may persist and cause bronchospasm or chronic bronchitis. Such "reactive airways dysfunction syndrome" (RADS) may persist for several years. Destruction of lung tissue or scarring can lead to chronic dilation of the bronchi and increased susceptibility to infections. Sensitization through skin contact is possible. Ingestion may cause dysphagia and stenosis of the esophagus and stomach.

## 4. Measures

### 4.1. Self-protection of first responders

If there is a suspicion that the area the first responder must enter contains formaldehyde, a self-contained breathing apparatus and a chemical protection suit must be worn.
There is no danger from contact with patients who have only been exposed to formaldehyde gas or vapors. A patient who is wet with liquid formaldehyde or whose clothing is wet with liquid formaldehyde may endanger other people through direct contact or through formaldehyde gas or vapor.

### 4.2. Rescue

Patients should be removed from the danger zone immediately. If they are unable to walk unaided, they should be removed from the danger zone quickly using appropriate means, taking care to protect themselves. The "A, B, C procedure" has absolute priority.

**A) Clear the airways** (check for blockages caused by the tongue or foreign objects).
**B) Ventilation** (check the patient's breathing, if necessary, begin ventilation with adequate self-protection, e.g. breathing mask)
**C) Circulation** (begin resuscitation for any person who does not respond to verbal commands and is not breathing normally)

### 4.3. Cleaning

Patients who have only been exposed to formaldehyde gas or vapor and show no signs of skin or eye irritation do not require any special cleaning measures, unlike all others.
If possible, patients should assist in their own cleaning. If liquid formaldehyde or aqueous solutions have been exposed and clothing is contaminated, it must be removed and securely wrapped.
Rinse affected skin and hair with water for at least 15 minutes. Other important first aid measures must be continued during this time. Protect eyes while rinsing.
In case of formaldehyde exposure, rinse eyes with water or neutral saline solution for at least 15 minutes. If eye rinsing is impeded by spasmodic eyelid closure, the use of a local anesthetic solution (e.g. lidocaine, oxybuprocaine) may be considered. Remove any contact lenses, if possible, without additional risk to the eye.

### 4.4. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
The following measures are recommended if the formaldehyde concentration is 3 to 10ppm or more (depending on the duration of exposure), if symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is very likely:

- Oxygen administration
- Administration of 8 sprays of beclomethasone (800µg beclomethasone dipropionate) from a metered dose inhaler.

If there are signs of airway constriction (e.g. bronchospasm or stridor)
- Nebulization of adrenalin (epinephrine): mix 2mg adrenalin (2ml) with 3ml NaCl 0.9% and administer via a nebulizer mask
- Administration of a ß2-selective adrenoceptor agonist, e.g. four puffs of terbutaline or salbutamol or fenoterol (one puff usually contains 0.25mg terbutaline sulphate; or 0.1mg salbutamol; or 0.2mg fenoterol); this can be repeated once after 10 minutes.

Alternatively, 2.5mg of salbutamol and 0.5mg of ipratropium bromide can be administered via a nebulizer mask.
If inhalation is not possible, administer terbutaline sulphate (0.25mg to 0.5mg) subcutaneously or salbutamol (0.2mg to 0.4mg over 15 minutes) intravenously.
Intravenous administration of 250mg methylprednisolone (or an equivalent steroid dose)

If there are signs of toxic pulmonary oedema (e.g. frothy sputum, moist rales)
- CPAP therapy
- Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose)
- In case of (increasing) respiratory insufficiency, advanced airway management, e.g. endotracheal intubation or coniotomy if necessary.

*Note: The efficacy of corticosteroid administration has not yet been proven in controlled clinical trials.*

Skin contact with formaldehyde can cause severe damage; this should be treated as burns: adequate fluid administration, analgesic therapy, maintenance of body temperature, covering the affected skin area with sterile dressing.
Exposure to the eyes can also cause serious damage; this should also be treated as a burn. Consult an ophthalmologist immediately.

*Note: Any exposure to liquid formaldehyde in the facial area can have serious consequences.*

Do not induce vomiting after swallowing formaldehyde solutions.
If there are signs or symptoms of esophageal irritation or burns, the patient should be taken to an endoscopy center as soon as possible. An endoscopy should be considered to determine the extent of the damage (suspected gastrointestinal necrosis or perforation?).
Only if a significant dose was swallowed less than 30 minutes before the patient's endoscopic examination and perforation can be ruled out should immediate gastric lavage be considered.

Patients with an exposure concentration of 3 to 10ppm or more (depending on the duration of exposure) and patients for whom no exposure dose can be estimated but who are very likely to have been exposed should be transported immediately to a hospital with intensive care facilities.

### 4.5. Further procedure and treatment

In addition to medical history, physical examination and vital signs, pulse oximetry, a p.a. chest X-ray and spirometry should be performed. Routine laboratory tests should include complete blood count, glucose and electrolytes.

Radiological signs of pulmonary oedema – enlargement of the hila, typical, centrally accentuated, patchy shadows on the chest X-ray – are late signs that often cannot be detected until 24 hours after exposure. The X-ray is typically normal on initial presentation at the hospital, even after inhalation of a relevant dose.

Patients with possible exposure or with significant complaints or symptoms should be monitored for an appropriate period and re-examined repeatedly before any consequential damage to health can be ruled out. Delayed effects in patients with only mild, rapidly subsiding upper respiratory tract symptoms (mild burning or coughing) are unlikely.
If oxygen saturation falls below 90%, arterial blood gas concentrations must be checked immediately and the chest X-ray repeated. If blood gas concentrations deteriorate and/or the chest X-ray shows signs of toxic pulmonary oedema, oxygen should be administered via a mask. If deterioration becomes apparent (especially in the case of tachypnoea (>30/min) and a simultaneous decrease in carbon dioxide partial pressure), CPAP therapy should be started within the first 24 hours after exposure.

In the event of pulmonary oedema developing, fluid intake and excretion as well as electrolytes should be closely monitored. A positive balance should be avoided. To optimize fluid management, the insertion of a central venous catheter should be considered.
If signs of pulmonary oedema persist, intravenous administration of methylprednisolone (or an equivalent steroid) should be continued at intervals of 8 to 12 hours.

Prophylactic antibiotic administration is not routinely recommended but may be considered based on the results of sputum cultures. Pneumonia may occur as a complication of severe pulmonary edema.

### 4.6. Discharge of the patient / instructions for further rules of conduct

Asymptomatic patients who have been exposed to a formaldehyde concentration of less than 3 ppm (depending on the duration of exposure) and who show no abnormal examination findings and no signs of toxic effects after an appropriate follow-up period may be discharged under the following circumstances:

- Information and recommendations for patients with instructions for further action were provided verbally and in writing. The patient was advised to seek immediate medical attention if any health problems arise.
- The patient is aware of and understands the toxic effects of formaldehyde.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Heavy physical work should be avoided for the next 24 hours.
- Do not smoke and avoid cigarette smoke for at least 72 hours; smoke can impair lung function.
- Patients with severe skin or eye damage should be examined again after 24 hours
- Spirometry should be repeated at regular intervals after discharge until the values have normalized to the patient's baseline values prior to exposure.

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**Administrative Information**

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