
Information and recommendations for doctors at hospitals/emergency departments

- **Patients exposed only to formaldehyde gas or vapor do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with an aqueous solution of formaldehyde can secondarily contaminate rescue and medical personnel by direct contact or through evaporation of formaldehyde.**
 - **Formaldehyde vapor is irritating when it comes in contact with the eyes, skin, and upper respiratory tract causing eye irritation, coughing, chest pain and dyspnea. Laryngospasm and signs of pulmonary edema (shortness of breath, cyanosis, expectoration, cough) may occur.**
 - **There is no antidote to be administered to counteract the effects of formaldehyde. Treatment consists of supportive measures. Formaldehyde is a potent sensitizer.**
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1. Substance information

Formaldehyde (HCHO), CAS 50-00-0

Synonyms: formalin, formic aldehyde, methanal, methylene oxide. Formaldehyde is, at room temperature, a nearly colorless gas with a sharp or pungent odor. Its vapor is flammable and explosive. Because the pure gas trends to polymerize, it is usually used as an aqueous solution of 30–50 % formaldehyde, containing up to 15 % methanol as a stabilizer. Formaldehyde is widely used in the manufacture of plastics, resins, and urea-formaldehyde foam insulation. Formaldehyde containing resins are used in the processing of paper and the production of carpets, paints and furniture.

2. Routes of exposure

Inhalation

Most exposures occur by inhalation or skin/eye contact.

Formaldehyde's odor and irritant properties generally provide adequate warning of hazardous concentrations. Olfactory fatigue and tolerance may occur. However, persons who are sensitized to formaldehyde may react to concentrations below the odor threshold. Formaldehyde is heavier than air and may cause asphyxiation in poorly ventilated, low-lying, or enclosed spaces.

Skin/eye contact

Formaldehyde vapor or aqueous solutions can cause irritation and burns to the skin and the eyes.

Ingestion

Ingestion of aqueous solutions can result in severe corrosive injury to the esophagus and stomach. Nausea, vomiting, and abdominal pain may occur.

3. Acute health effects

Respiratory

Exposure to low concentrations of formaldehyde usually causes sore throat and coughing. Rapid development of respiratory distress with chest pain, dyspnea, laryngospasm and pulmonary edema may occur with inhalation of high concentrations of formaldehyde gas or vapor. Pulmonary injury may progress over several hours. After severe exposure, respiratory and cardiovascular failure may occur.

Dermal

Burning pain, redness, inflammation, blisters, and burns of the skin and mucous membranes may be caused by concentrated formaldehyde vapor or aqueous solutions.

Ocular

Low vapor concentrations cause burning discomfort, spasmodic blinking or involuntary closing of the eyelids, redness, and tearing. Corneal burns may occur at high concentrations or with exposure to aqueous solutions.

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Ingestion Ingestion of aqueous solutions may cause sore throat, nausea, vomiting, abdominal pain, and cyanosis. After severe exposure ulceration, edema of the glottis, asphyxia, and respiratory and cardiovascular failure may occur.

Dose-effect relationships Dose-effect relationships are as follows:

<u>Formaldehyde vapor concentration</u>	<u>Effect</u>
0.05-1.0 ppm	- Odor detection (some tolerance develops)
0.5-3 ppm	- Mild irritation of eyes and upper respiratory tract
3-10 ppm	- Moderate irritation of eyes and upper respiratory tract
5-30 ppm	- Chest pain, dyspnea, coughing, nausea and vomiting
50-100 ppm	- Toxic pneumonitis and pulmonary edema
>100 ppm	- Fatal
<u>Solution (amount ingested)</u>	
20-200 mg	- Mild gastric and pharyngeal discomfort
600-2000 mg	- Dry and sore throat, vomiting, cyanosis, rapid and irregular pulse
5000-10000 mg	- Severe pain, ulceration, edema of the glottis, asphyxia, death

Potential sequelae If the patient survives the initial 48 hours after exposure, recovery is likely. After acute exposure, pulmonary function usually returns to normal in 7 to 14 days. Complete recovery is usual; however, symptoms and pulmonary deficits may persist. Airways hyperreactivity to non-specific irritants may persist, resulting in bronchospasm and chronic inflammation of the bronchi; induced reactive airways dysfunction syndrome may persist for years. Sequelae of the pulmonary tissue destruction and scarring may lead to chronic dilation of the bronchi and increased susceptibility to infection. Skin sensitization may develop. After ingestion dysphagia and stenosis of the esophagus and stomach may occur.

4. Actions

Self-protection

Patients exposed only to formaldehyde gas or vapor do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with formaldehyde aqueous solutions can secondarily contaminate other people by direct contact or through evaporation of formaldehyde.

Decontamination

Patients exposed only to formaldehyde gas or vapor who have no evidence of skin or eye irritation do not need decontamination. All others require decontamination.

Patients who are able and cooperative may assist with their own decontamination. If the exposure involved liquid formaldehyde and if clothing is contaminated, remove and double-bag the clothing.

Assure that exposed skin and hair have been flushed with plain water for at least 15 minutes. If not, continue flushing during other basic care. Protect eyes during flushing of skin and hair.

Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 15 minutes. If not, continue eye irrigation during other basic care.

Remove contact lenses if present and easily removable without additional trauma to the eye.

Initial treatment

Therapy will be empiric; there is no antidote to be administered to counteract the effects of formaldehyde.

The following measures are recommended if the airborne exposure dose is 3-10 ppm or greater (depending on time exposed), if symptoms, e. g. eye irritation or pulmonary symptoms have developed, or if no exposure dose can be estimated but exposure has possibly occurred:

- Administration of oxygen

- **Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.**

Patients with severe clinical respiratory symptoms (e.g. bronchospasms, stridor) should be treated as follows:

a) Nebulization of adrenaline (epinephrine): 2 mg adrenaline (2 ml) with 3 ml NaCl 0.9% and inhale through a nebulizer mask.

b) Administration of a β 2-selective adrenoceptor agonist, e.g., four strokes of terbutaline or salbutamol or fenoterol (one stroke usually contains 0.25 mg of terbutaline sulfate; or 0.1 mg of salbutamol; or 0.2 mg of fenoterol); this may be repeated once after 10 minutes. Alternatively, 2.5 mg salbutamol and 0.5 mg atrovent may be administered by nebulizer mask.

If inhalation is not possible, administration of terbutaline sulfate (0.25 mg to 0.5 mg) subcutaneously or salbutamol (0.2 mg to 0.4 mg over 15 minutes) intravenously.

c) Intravenous administration of 250 mg methylprednisolone (or equivalent steroid dose).

Patients with clinical signs of a toxic lung edema (e.g. foamy sputum, wet crackles) should be treated as follows:

a) Start CPAP-therapy (Continuous Positive Airway Pressure Ventilation).

b) Intravenous administration of 1000 mg methylprednisolone (or an equivalent steroid dose) is recommended.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.

Note: Efficacy of corticosteroid administration has not yet been proven in controlled clinical studies.

If signs of hypoxemia or severe inhalation exposure are present, humidified supplemental oxygen should be administered.

Intubation of the trachea or an alternative airway management should be considered in cases of respiratory compromise. When the patient's condition precludes this, consider cricothyrotomy if equipped and trained to do so.

If formaldehyde vapor or formaldehyde generating solutions have been in contact with the skin, chemical burns may result; treat as thermal burns: adequate fluid resuscitation and administration of analgesics, maintenance of the body temperature, covering of the burn with a sterile pad or clean sheet.

After eye exposure chemical burns may result; treat as thermal burns. Immediately consult an ophthalmologist.

Note: Any facial exposure to formaldehyde aqueous solution should be considered as a serious exposure.

In case of ingestion of formaldehyde, **do not induce emesis. If signs or symptoms of esophageal irritation or burns are present, consider endoscopy to determine the extent of the injury; in severe cases surgical intervention should be considered if gastrointestinal necrosis or perforation is suspected.**

Only if a large dose has been ingested less than 30 minutes before evaluation of the patient's condition and if a perforation can be excluded, consider immediate gastric lavage with a small-bore tube.

To the standard intake history, physical examination, and vital signs add pulse oximetry monitoring and a PA chest X-ray.

Spirometry should be performed. Routine laboratory studies should include a complete blood count, blood glucose and electrolyte determinations. Arterial blood gases should be used to monitor for the presence of acidosis in symptomatic patients. If the formaldehyde is in aqueous solution with methanol, check a blood methanol level and treat accordingly.

Evidence of pulmonary edema - hilar enlargement and ill-defined, central-patch infiltrates on chest radiography - **is a late finding that may occur 6 to 8 hours or later after exposure. The chest X-ray is typically normal on first presentation to the emergency department even with severe exposures.**

Patients who have possible exposure or who develop serious signs or symptoms should be observed for a minimum of 24 hours and reexamined frequently before confirming the absence of toxic effects. Delayed effects are unlikely in patients who have minor upper respiratory symptoms (mild burning or a slight cough) that resolve quickly.

If oxygen saturation is less than 90 % or if it appears to drop, immediately check arterial blood gasses and repeat the chest X-ray.

If blood gasses begin to show deterioration and/or if the chest X-ray begins to show pulmonary edema start oxygen supplementation.

In case of worsening clinical signs (especially tachypnea >30/min with a simultaneous decrease of the partial pressure of carbon dioxide) CPAP-therapy (Continuous Positive Airway Pressure Ventilation) should be started within the first 24 hours after exposure.

In case of a pulmonary edema fluid intake/output and electrolytes should be monitored closely. Avoid net positive fluid balance. Central line or Swan-Ganz catheterization might be considered, to optimize fluid management.

As long as signs of pulmonary edema are present, intravenous administration of methylprednisolone (or an equivalent steroid) should be continued in intervals of 8-12 hours.

Prophylactic antibiotics are not routinely recommended but may be used based on the results of sputum cultures. Pneumonia can complicate severe pulmonary edema.

Clinically asymptomatic patients exposed to a concentration of **less than 3 ppm** (depending on the period of time exposed) **as well as patients who have a normal clinical examination and no signs or symptoms of toxicity may be discharged after an appropriate observation period in the following circumstances:**

- a) The evaluating physician is experienced in the evaluation of individuals with formaldehyde or irritant gas exposure.
- b) Information and recommendations for patients with follow-up instructions are provided verbally and in writing. Patients are advised to seek medical care promptly if symptoms develop or recur.
- c) The physician is comfortable that the patient understands the health effects of formaldehyde.
- d) Site medical is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release from the emergency department.
- e) Heavy physical work should be precluded for 24 hours.
- f) Exposure to cigarette smoke should be avoided for 72 hours; the smoke may worsen the condition of the lungs.

Patients who have serious skin or eye injuries should be reexamined in 24 hours.

Post discharge spirometry should be repeated until values return to the patient's baseline values.

In this document BASF has made a diligent effort to ensure the accuracy and currency of the information presented but makes no claim that the document comprehensively addresses all possible situations related to this topic. This document is intended as an additional resource for doctors at hospitals/emergency departments in assessing the condition and managing the treatment of patients exposed to formaldehyde. It is not, however, a substitute for the professional judgement of a doctor and must be interpreted in the light of specific information regarding the patient available to such a doctor and in conjunction with other sources of authority.

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