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## Information and recommendations for doctors at hospitals/emergency departments

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- Exposed or intoxicated patients do not pose a significant risk of secondary contamination.
- Ingestion of 30 ml ethylene glycol or more can cause severe systemic toxic effects, in particular central nervous system depression concomitant with metabolic acidosis. Dosage of approximately 100 ml ethylene glycol may result in death.
- Ethylene glycol is slightly irritating when it comes in contact with the eyes, skin, and upper respiratory tract causing redness and lacrimation of the eyes, coughing, defatting and inflammation of the skin.
- Inhalation of the aerosol or ingestion of the liquid may result in significant systemic toxicity. Skin absorption is poor, requiring large surface areas to reach toxic doses.
- Ethylene glycol intoxication can be treated by inhibiting the formation of toxic metabolites. This can be achieved by the administration of 4-methylpyrazole or ethanol. If conscious after ingestion of ethylene glycol and if not already done, the adult patient should immediately drink alcoholic beverages containing about 0.7 g ethanol/kg body weight, e.g. 150 ml of whiskey/brandy. Alternatively, or if the patient's consciousness is impaired, 4-methylpyrazole or ethanol should be administered intravenously.
- Correct metabolic acidosis and determine ethylene glycol blood concentrations, resp. glycolic acid. If the ethylene glycol concentration is greater than 500 mg/l, resp. glycolic acid greater than 8 mmol/l or if already signs or symptoms of metabolic acidosis are present (anion gap > 20 mmol/l, pH < 7.3), start hemodialysis. Adjust 4-methylpyrazole or ethanol doses.

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### 1. Substance information

Ethylene glycol (HOCH<sub>2</sub>CH<sub>2</sub>OH), CAS 107-21-1  
Synonyms: 1,2-dihydroxyethane, 1,2-ethane diol, 2-hydroxyethanol  
Ethylene glycol is, at room temperature, a colorless, odorless, viscous, hygroscopic liquid (boiling point 198°C, 387°F, respectively). Ethylene glycol is soluble in water, ethanol, and acetone, little soluble in ether, and insoluble in oil, fat, and hydrocarbon halogens.  
Ethylene glycol is widely used as a solvent, an antifreeze and hydraulic fluid, as a softener, dehydrating agent and as an intermediate in chemical production.

### 2. Routes of exposure

#### *Inhalation*

Ethylene glycol is well absorbed by the respiratory tract, but there is little risk due to its low volatility. Inhalation may occur as aerosol, when the liquid is heated, agitated, or sprayed.

#### *Skin/eye contact*

Ethylene glycol can cause slight irritation to the skin and the eyes. It is poorly absorbed through the intact skin.

#### *Ingestion*

**Ingestion of ethylene glycol results in severe systemic intoxication.** It is readily absorbed from the gut.

### 3. Acute health effects

**Ingestion of 30 ml ethylene glycol or more should be considered as severe, ingestion of more than 100 ml ethylene glycol as potentially lethal.** Severe inhalation of aerosol may also cause systemic toxicity. After a latent period of 1 to 4 hours clinical features develop. Three stages may be distinguished:

### 1. CNS effects

**The initial CNS depression is much like that of ethanol with dizziness, agitation, nystagmus, nausea, tachycardia, elevated blood pressure and vomiting.** In severe poisoning coma and convulsions occur. Hyperventilation increases as the metabolic acidosis becomes more and more pronounced. Depending upon the absorbed ethylene glycol dose, the individual's susceptibility, and the time at which treatment began, generalized convulsions and cerebral edema may occur.

### 2. Cardio-pulmonary effects

**About 8-24 hours after the ingestion dyspnea, hyperventilation, tachycardia, cyanosis, elevated blood pressure develop.** Pulmonary edema with massive bilateral infiltrations develops, especially in case of oliguria. Death may result in this stage.

### 3. Renal effects

**Oliguria gradually develops in severe cases not given correct treatment about 24 to 36 hours following ingestion.** The urine sediment contains various casts and, in most cases, calcium oxalate crystals. The acute oliguric renal failure may be reversed upon treatment.

### Local effects

Ethylene glycol is slightly irritating when it comes in contact with the eyes, skin, and upper respiratory tract causing redness and lacrimation of the eyes, coughing, and, defatting and inflammation of the skin.

### Potential sequelae

In rare cases cranial nerves (I-V-VII-XII) may be affected exhibiting sensory and motoric defects. Rhabdomyolysis may develop secondary to convulsions.

## 4. Actions

### Initial treatment

Patients exposed to ethylene glycol do not pose a significant risk of secondary contamination.

### After ingestion

**If conscious and if not already done, the adult patient should immediately drink alcoholic beverages containing about 0.7 g ethanol/kg body weight, e.g. 150 ml of whiskey/brandy.**

**Do not induce emesis. If the patient's consciousness is impaired or if a large dose has been ingested less than 30 minutes before evaluation of the patient's condition, consider immediate gastric lavage with a small-bore tube.**

**Rapid treatment is important – do not wait for symptoms to appear before treatment.**

**4-methylpyrazole, a synthetic alcohol dehydrogenase inhibitor, is often considered as first-line treatment:**

**If not already done, immediate intravenous infusion of the loading dose of 15 mg/kg body weight over 30 min.** Early administration of 4-methylpyrazole probably obviates the need for treatment by hemodialysis.

**If 4-methylpyrazole is not available, intravenous infusion of 0.7 g ethanol/kg body weight represents an alternative treatment option.**

If the patient has concurrently ingested ethanol, then the ethanol loading dose must be modified so that the blood ethanol level does not exceed 1 to 1.3 g/l (21.7 to 28.2 mmol/l).

If signs of hypoxemia are present, humidified supplemental oxygen should be administered. Intubation of the trachea in cases of respiratory compromise should be considered. When the patient's condition precludes endotracheal intubation, perform cricothyrotomy if equipped and trained to do so.

*After inhalation or skin/  
eye contact*

Patients exposed only to ethylene glycol 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 ethylene glycol and if clothing is contaminated, remove and double-bag the clothing.

**Treat patients exposed to high aerosol concentrations similarly to those having ingested ethylene glycol. 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 and transport. 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 20 minutes.** If not, continue eye irrigation during other basic care and transport.

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

*Further evaluation  
and treatment*

**Patients who have ingested ethylene glycol, or have been exposed to high aerosol concentrations of ethylene glycol:**

**To the standard intake history, physical examination, and vital signs add measurements of ethylene glycol blood concentrations - and if administered ethanol was administered ethanol blood concentrations.** Routine laboratory studies should include blood gas analysis, osmolality, a complete blood count, blood glucose, electrolyte determinations and renal function tests. These tests should be repeated as necessary to closely monitor the progression of toxic effects.

Consider ethylene glycol determination in blood and glycolate determination in urine. **Calculate the anion gap [sodium-(bicarbonate + chloride); normal  $12 \pm 2$  mmol/l], and the osmolal gap (normal range  $< 10$  mOsmol/kg). Administer sodium bicarbonate in case of metabolic acidosis. Continue treatment with either 4-methylpyrazole (10 mg/kg body weight every 12 hours for 3 doses, further doses dependent on ethylene glycol blood concentrations) or ethanol (0.1-0.2 g ethanol/kg body weight/hour, maintaining ethanol blood concentration between 1.0 and 1.5 g/l).**

*Hemodialysis*

**If the ethylene glycol blood concentration is greater than 500 mg/l, resp. glycolic acid greater than 8 mmol/l or if electrolyte imbalances and metabolic acidosis (anion gap  $> 20$  mmol/l,  $\text{pH} < 7.3$ ) are unresponsive to therapy or if deteriorating vital signs, renal failure, or visual disturbances are present, start hemodialysis. Adjust 4-methyl-pyrazole or ethanol doses, to account for removal by dialysis. Note: hemodialysis may not be needed with administration of fomepizole, for ethylene glycol concentrations greater than 500 mg/l, resp. glycolic acid 8 mmol/l, in the absence of both renal dysfunction and significant metabolic acidosis.**

**Patients who have possible systemic 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.**

**Treatment by hemodialysis and with 4-methylpyrazole or ethanol should be continued until blood ethylene glycol concentration is less than 200 mg/l, resp. glycolic acid less than 8 mmol/l and blood pH is normal.**

*Patient release/  
follow-up instructions*

**Asymptomatic patients, who have not ingested ethylene glycol or been have exposed to minor aerosol concentrations as well as patients with a blood ethylene glycol concentration of less than 200 mg/l, resp. glycolic acid less than 8 mmol/l and normal blood pH 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 ethylene glycol 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 ethylene glycol.
- 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.

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 ethylene glycol. 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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