Chemical Emergency Medical Guideline

Information and recommendations for healthcare professionals

Dimethylformamide

CAS No.: 68-12-2

GHS symbols:

GHS06
Acute toxicity

GHS08
Health hazard

Signal word: Danger

Hazard statements:

H319	Causes serious eye irritation.
H331	Toxic if inhaled.
H370	Causes damage to organs.
H302+H312	Harmful if swallowed or in contact with skin.
H360D	May damage the unborn child.

Overview

- There is no danger from contact with patients who have only been exposed to dimethylformamide vapors. A patient who is wet with liquid dimethylformamide (boiling point 153°C) or whose clothing is wet with it may endanger other people through direct contact or through dimethylformamide vapors.
- Dimethylformamide irritates the skin, eyes and respiratory tract and can cause headaches, nausea, dizziness, weakness, confusion and a drop in blood pressure. It can cause liver damage and alcohol intolerance reactions.
- There is no known specific antidote. Treatment depends on the extent of exposure and the symptoms.

Table of Contents

1. Information on the substance

Dimethylformamide $(CH_3)_2$ N-CHO), CAS 68-12-2
Synonyms: DMF, formic acid dimethylamide
At room temperature (boiling point 153°C), dimethylformamide is a clear to slightly yellowish liquid that is soluble in water and has a slight fishy odor. Dimethylformamide is stable under normal storage conditions, but reacts violently with halogens, alkyl halides, strong oxidizing agents and polyhalogenated compounds in the presence of iron. Toxic decomposition products include dimethylamine and carbon monoxide.
Dimethylformamide is an organic solvent with a low vapor pressure and is used in the manufacture of polar polymers and resins, adhesives and cleaners, in galvanizing and surface treatment, in paint and paint removers, films and in gas absorption. It is used in the manufacture of Orlon® and acrylic fibers, synthetic leather, polyurethanes, cable sheathing and in the production of chemicals and pharmaceuticals.

2. Expositon

2.1. Inhalation

Dimethylformamide can be inhaled and absorbed through the lungs.

2.2. Skin / eye contact

Exposure to dimethylformamide occurs mainly through contact with the skin. High concentrations or liquid dimethylformamide are readily absorbed through the skin and can lead to general symptoms of poisoning.

2.3. Ingestion

Dimethylformamide is readily absorbed through the gastrointestinal tract. However, ingestion is rare in the workplace.

3. Acute health effects

3.1. Dose-response relationships

Dimethylformamide concentration		Effect/effects
0.47 - 100 ppm	-	Odor threshold
10 ppm	-	Alcohol intolerance
25–60 ppm	-	Increase in liver enzyme levels
500–3000 ppm	-	Immediately life-threatening
10 g orally (p.o.)	-	Estimated lethal dose in humans

3.2. Respiratory tract

Dimethylformamide irritates the upper respiratory tract

3.3. Skin contact

Local exposure to liquid dimethylformamide may cause skin irritation with itching and flaking.

3.4. Eye contact

Local exposure to liquid dimethylformamide or high vapor concentrations may cause eye irritation with redness, burning, tearing or spasmodic eyelid closure.

3.5. Gastrointestinal disorders

Liver damage with jaundice, elevated liver enzyme levels and alcohol intolerance reactions may occur after inhalation or skin contact. Weight loss, taste disturbances, gastrointestinal complaints, nausea, vomiting, constipation, diarrhea and colic may also occur.

3.6. Systemic effects

Dimethylformamide can cause general symptoms of poisoning such as headache, nausea, dizziness, weakness, confusion and a drop in blood pressure. It can lead to loss of consciousness, respiratory arrest and cardiovascular failure.

3.7. Possible consequences

If the patient survives 48 hours after exposure, further improvement in symptoms can be expected. After acute exposure, organ functions usually normalize 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 infection. Ingestion or absorption through the skin can cause damage to the gastrointestinal tract, the cardiovascular and central nervous systems, and the liver.

3.8. Reproductive toxicity

According to Directive EC 1272/2008, dimethylformamide is classified as follows: Repr. 1B (substance presumed to be harmful to human reproduction; based largely on data from animal studies)

4. Measures

4.1. Self-protection of first aiders

If there is a suspicion that the area which the helper must enter contains dimethylformamide, 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 dimethylformamide vapors. A patient who is wet with liquid dimethylformamide or whose clothing is wet with liquid dimethylformamide may endanger other people through direct contact or through dimethylformamide vapors.

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 suitable 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 on any person who does not respond to verbal commands and is not breathing normally)

4.3. Cleaning

Patients who have only been exposed to dimethylformamide vapors 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 decontamination. If liquid dimethylformamide has been exposed and clothing is contaminated, it must be removed and securely wrapped.
In the event of exposure to dimethylformamide, rinse the 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 causing further injury to the eye. Continue other important first aid measures in the meantime.
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.

4.4. Estimation of inhaled dose

Patients with an exposure concentration of 100ppm or more (depending on the duration of exposure) and patients for whom no exposure dose can be estimated but exposure is very likely should be transported immediately to a hospital with intensive care facilities.

4.5. Initial treatment (preclinical or clinical)

Empirical therapy; no specific antidote available.
The following measures are recommended if the dimethylformamide concentration is 100 ppm or more (depending on the duration of exposure), symptoms are present (e.g. irritation of the eyes or upper respiratory tract) or if no concentration can be estimated but exposure is likely to have occurred:

- 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 salbutamol and 0.5mg 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 1000mg 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 liquid dimethylformamide can cause skin irritation; this should be treated as a burn.
Exposure to the eyes may also cause irritation; this should also be treated as a burn. Consult an ophthalmologist.

Note: Any contact with liquid dimethylformamide in the facial area can have serious consequences.

4.6. Further action and treatment

The diagnosis of dimethylformamide poisoning is based primarily on the clinical signs of irritation, central nervous system disorders and liver damage, together with confirmed or probable exposure to dimethylformamide. In addition to taking medical history, performing a physical examination and checking vital signs, spirometry should be carried out.

However, various laboratory tests can be performed to monitor and assess complications. Blood count, liver enzymes, kidney function values, glucose and electrolytes should be determined routinely. Furthermore, the thromboplastin time (Quick value) should be determined. There may also be an increase in creatine kinase and hypercholesterolemia.

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 administration of antibiotics is not recommended but may be considered based on the results of sputum cultures.

As with other liver toxins, the administration of N-acetylcysteine (NAC) at a dose like that used to treat paracetamol poisoning may be indicated. If jaundice, elevated liver enzymes or coagulation disorders occur, transfer to a department specializing in liver disease should be considered.

4.7. Biomonitoring

To estimate the systemic dose absorbed after exposure, biomonitoring can be performed by determining the concentration of N-acetyl-S-(N-methylcarbamoyl)cysteine (AMCC) in the urine.

4.8. Discharge of the patient / instructions for further rules of conduct

Clinically asymptomatic patients who have been exposed to a concentration of less than 10ppm (depending on the duration of exposure) and who show normal clinical 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 dimethylformamide.
- The attending physician has been informed that regular contact between the patient and the physician is possible in the following 24 hours.
- Strict prohibition of alcohol for at least 72 hours. Alcohol intolerance may occur.
- Heavy physical work should not be done in the following 24 hours.
- Do not smoke for at least 72 hours and avoid cigarette smoke; smoke can impair lung function.
- Patients with serious skin or eye injuries should be re-examined after 24 hours.
- Spirometry should be repeated at regular intervals after discharge until the values have returned to the patient's baseline values prior to exposure.

5. References

Buttgereit F, Dimmeler S, Neugebauer E, Burmester GR. Wirkungsmechanismen der hochdosierten Glucocorticoidtherapie. Dtsch Med Wschr 1996; 121: 248-252.

Diller WF. Anmerkungen zum Unglück in Bhopal. Dtsch Med Wschr 1985; 110: 1749-1751.

Ellenhorn MJ, Schonwald S, Ordog G, Wasserberger J. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore: Williams & Wilkins, 1997: 1674-1677.

Goldfrank LR, Flomenbaum NE, Lewin NA, Weisman RS, Howland MA, Hoffman RS. Toxicologic Emergencies. 6th ed. Norwalk: Appleton & Lange, 1998: 216-222.

Foncerrada G et al, Safety of Nebulized Epinephrine in Smoke Inhalation Injury, J Burn Care Res 2017;38:396–402

Walker PGF et al, Diagnosis and management of inhalation injury: an updated review, Critical Care (2015) 19:351

Foncerrada G et al, Safety of Nebulized Epinephrine in Smoke Inhalation Injury, J Burn Care Res 2017;38:396–402

Walker PGF et al, Diagnosis and management of inhalation injury: an updated review, Critical Care (2015) 19:351

Olasveengen TM, Semeraro F, et. Al: European Resuscitation Council Guidelines 2021: Basic Life Support. Resuscitation 2021, 161: 98-114

Administrative Information

Document Type	Chemical Emergency Medical Guideline
Version number	EN.1.0.0
Initial Publication	01.01.2026
Next Revision	2029
Responsible Unit (Author)	ESG/CH ESG/AS
Contact	ESG/CH: Dr. M. Conzelmann, T. Schröck ESG/AS: Dr. D. Frambach

BASF SE
Corporate Health Management
Carl-Bosch-Straße 38
67056 Ludwigshafen
Germany