Before approaching the patient the paramedics and doctors at the site must make sure that they do not risk exposing themselves to ammonia.

Patients exposed only to ammonia gas do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with ammonia-containing liquids can secondarily contaminate rescue and medical personnel by direct contact or through off-gassing ammonia.

Ammonia gas or solution is highly irritating and can cause serious corrosive burns to eyes or skin.

Irritation of the respiratory tract can result in rhinorrhea, coughing, 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 ammonia. Treatment consists of supportive measures.

1. Substance information
   Ammonia (NH₃), CAS 7664-41-7
   Synonyms include ammonia gas, anhydrous ammonia and liquid ammonia. Ammonia dissolves readily in water to form a caustic alkaline solution of ammonium hydroxide. Ammonia is at room temperature a colorless gas with a distinctive pungent odor. It is lighter than air but can behave paradoxically in an accidental release from storage in liquid form under pressure by undergoing rapid cooling to form a dense cloud that hugs the ground. Ammonia is widely used as a catalyst and reagent in the manufacture of fertilizers, plastics, explosives, pesticides, other chemicals, and as a refrigerant. It is found in many household and industrial-strength cleaning solutions.

2. Routes of exposure
   **Inhalation**
   Inhalation is a significant route of exposure. Ammonia’s odor and irritant properties may provide adequate warning of hazardous concentrations. However, olfactory fatigue may occur, making the presence of lower concentrations difficult to detect with prolonged exposure.

   **Skin/eye contact**
   Fairly low concentrations of ammonia produce rapid irritation of the eye and moist skin. Direct contact with liquid ammonia or concentrated gas on moist skin or eyes causes severe chemical burns.

   **Ingestion**
   Accidental ingestion of ammonia is unlikely. Ammonia solutions may cause corrosive injury to the mouth, throat, and stomach if ingested.

3. Acute health effects
   Ammonia exposure usually causes eye, nose, and throat irritation.
   Respiratory distress with coughing, dyspnea, upper airway obstruction, laryngeal edema, narrowing of bronchi and pulmonary edema may occur.
   If the skin is wet or moist, contact with ammonia can cause burning pain, inflammation, blisters, and ulceration. Contact with liquid ammonia under pressure can result in frostbite.
   Low gas concentrations cause burning discomfort, spasmotic blinking or involuntary closing of the eyelids, redness, and tearing. After exposure to higher concentrations or liquid ammonia, corneal burns occur and may lead to blindness.
Dose-effect relationships are as follows:

<table>
<thead>
<tr>
<th>Ammonia concentration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20 ppm</td>
<td>Odor detection (some tolerance develops)</td>
</tr>
<tr>
<td>50 ppm</td>
<td>Mild mucous membrane irritation</td>
</tr>
<tr>
<td>300-500 ppm</td>
<td>Marked irritation of skin, eyes, upper respiratory tract with conjunctivitis, sore throat, coughing Increases of blood pressure and pulse rate Maximal concentration tolerated for up to 1 hour</td>
</tr>
<tr>
<td>700 ppm</td>
<td>Immediate eye injury possible</td>
</tr>
<tr>
<td>&gt;1700 ppm</td>
<td>Chest pain, pulmonary edema, laryngospasm</td>
</tr>
<tr>
<td>2500-6500 ppm</td>
<td>Fatal within 30 minutes</td>
</tr>
<tr>
<td>10000 ppm</td>
<td>Fatal within a few minutes</td>
</tr>
</tbody>
</table>

4. Actions

Rescuer self-protection

In response situations that involve exposure to potentially unsafe levels of ammonia (> 500 ppm), pressure-demand, self-contained breathing apparatus and chemical-protective clothing shall be worn.

Rescuer exposure to a concentration lower than 500 ppm might be accepted without protective measures only for acute rescue operations. Patients exposed only to ammonia gas do not pose a significant risk of secondary contamination. Patients whose clothing or skin is contaminated with ammonia-containing liquids can secondarily contaminate other people by direct contact or through off-gassing ammonia.

Patient recovery

Patients should be removed from the contaminated zone immediately. If patients can walk, they should walk. Patients who are unable to walk may be removed on backboards or stretchers; if these are not available, carefully carry or drag patients to safety.

Immediate priorities must follow the "A, B, C’s" (Airway, Breathing, Circulation) of resuscitation.

Decontamination

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

Assure that exposed or irritated eyes have been irrigated with plain water or saline for at least 20 minutes, and that the pH of the conjunctival fluid has returned to normal (7.0). If not, continue eye irrigation during other basic care and transport. If eye irritation is impaired by blepharospasm, one to two drops of oxybuprocaine 0.4% may be instilled into affected eyes to allow adequate irrigation. Remove contact lenses if present and easily removable without additional trauma to the eye.

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.

Initial treatment

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

The following measures are recommended if the exposure concentration is 500 ppm or greater and if symptoms, e. g. eye irritation or pulmonary symptoms, have developed:

Administration of 8 puffs of beclomethasone (800 µg beclomethasone dipropionate) from a metered dose inhaler.
At exposure concentrations of 1500 ppm or greater establishment of intravenous access and intravenous administration of 1.0 g methylprednisolone (or an equivalent steroid dose).

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

If inhalation exposure has occurred, humidified air or oxygen should be provided. If signs of hypoxemia 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.

Patients with bronchospasms should be treated as follows:
   a) Aerolized $\beta_2$-selective adrenergic agonist, e.g. 4 puffs of terbutaline, or salbutamol, or fenoterol from a metered dose inhaler (1 puff usually contains 0.25 mg terbutaline sulfate, or 0.1 mg salbutamol, or 0.2 mg fenoterol, respectively); may be repeated once after 10 min. If inhalation is not possible, terbutaline sulfate (0.25-0.5 mg) subcutaneously or salbutamol (0.2-0.4 mg over 15 min) intravenously.
   b) If a) is not effective or insufficient: theophylline (5 mg/kg body weight intravenously over 20-30 min).
   c) If a) and b) are not effective or insufficient: 2 puffs of epinephrine (0.4 mg per puff) from a metered dose inhaler; may be repeated after 5 min. If ammonia has 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. If contact of the skin with liquid ammonia under pressure has occurred, evaluate for the presence of frostbite.

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

Note: Any facial exposure to liquid ammonia should be considered as a serious exposure.

Symptomatic patients exposed to a concentration of 500 ppm or greater should be transferred to a hospital/emergency department.

Asymptomatic patients and patients exposed to a concentration less than 500 ppm may be discharged in the following circumstances:
   a) The evaluating physician is experienced in the evaluation of individuals with ammonia 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 ammonia and the provided follow-up instructions.
   d) Site medical is notified, so that the patient may be contacted at regular intervals in the 24-hour period following release.
   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.
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 paramedics and doctors at the site in assessing the condition and managing the treatment of patients exposed to ammonia. It is not, however, a substitute for the professional judgement of a paramedic or a doctor and must be interpreted in the light of specific information regarding the patient available to such a paramedic or doctor and in conjunction with other sources of authority.