# T-2 Mycotoxicosis
## Table of Contents

# T-2 Mycotoxicosis

## Overview[2,4,5]

T-2 mycotoxin is a potential bioterrorism weapon. If you suspect a bioterrorism situation, **immediately** contact local law enforcement, your District Communicable Disease Coordinator, or District Senior Epidemiology Specialist, or the Missouri Department of Health and Senior Service's (MDHSS) Emergency Response Center (ERC) at 800-392-0272 (24/7).

Mycotoxins are naturally occurring poisonous substances produced as by-products of certain fungal metabolism and have been the cause of adverse health effects in humans and animals that have had skin or eye contact with, or inhaled or ingested, these toxins. The toxic effect of mycotoxins on animal and human health is referred to as mycotoxicosis, the severity of which depends on the toxicity of the mycotoxin, the route of exposure, extent of exposure, age and nutritional status of the individual, and possible synergistic effects of other chemicals to which the individual is exposed. Various genera of toxigenic fungi are capable of producing mycotoxins. Several major mycotoxins are: aflatoxins, citreoviridin, citrinin, ergot alkaloids, fumonisins, ochratoxins, patulin, rubratoxins, satratoxins, trichothecenes, zearalenone, and 3-nitropropionic acid. Trichothecenes are a very large family of chemically related metabolites, of which T-2 is a member (i.e., T-2 is a trichothecene).

Although mycotoxins can occur naturally from moldy, improperly stored gains, they can also be produced commercially and used as a weapon of bioterrorism. Because of mass production capabilities, the chemical nature of the substances, and the serious health effects on humans and animals, it is thought that T-2 mycotoxins and aflatoxins have the greatest bio-threat potential. T-2 mycotoxins are unique among bio-agents in that systemic toxicity can result from any of the major routes of exposure – transdermal, gastrointestinal (GI), or inhalational. T-2 mycotoxins are resistant to heat and UV light, thus rendering them extremely stable in the environment.

T-2 mycotoxins are potent inhibitors of protein synthesis and have pronounced effects on actively proliferating cells, such as those found in skin, GI tract and bone marrow. T-2 mycotoxins alter cell membrane structure and function, inhibits mitochondrial respiration, and inactivates certain enzymes.

Symptoms of T-2 mycotoxicosis are usually observed within two to four hours, but significant exposure can cause onset of symptoms in minutes. T-2 mycotoxicosis symptoms will vary depending on the route of exposure; however systemic signs and symptoms via any route of exposure include weakness, prostration, dizziness, ataxia, and loss of coordination. With transdermal exposure the following symptoms are generally seen: burning pain, redness, tenderness, blistering, and progression to skin necrosis. Gastrointestinal exposure can cause anorexia, nausea, vomiting, and watery or bloody diarrhea with crampy abdominal pain. Inhalational exposure can cause nasal itching, pain, sneezing, epistaxis, and rhinorrhea. Pulmonary and tracheobronchial toxicity can produce dyspnea, wheezing, cough, and blood-tinged sputum. Mouth and throat exposure causes pain and blood-tinged saliva. Ocular exposure can cause eye pain, tearing, redness, foreign body sensation, and blurred vision. Tachycardia, hypothermia, and hypotension may follow in fatal cases.

Ingestion of the T-2 mycotoxin in the past has caused persons to develop the clinical syndrome alimentary toxic aleukia (ATA); characterized by nausea, vomiting, diarrhea, leukopenia, hemorrhaging, skin inflammation, and in severe cases, death. During one such incident in Russia after World War II, the mortality rate was 10 to 60%.

For additional information on T-2 mycotoxin, refer to the following reference:

- U.S. Army Medical Research Institute of Infectious Diseases (USAMRID). *T-2 Mycotoxins*. In: *Medical Management of Biologic Causalities Handbook*. 8th Edition. September 2014. Fort Detrick. Frederick, Maryland 21702-5001.

## Case Definition: Trichothecene Mycotoxin[1] - (4/16)

### *Clinical description*

The trichothecene mycotoxins are a group of toxins produced by multiple genera of fungi. Some of these substances may be present as contaminants from mold or may occur naturally in foodstuffs or in livestock feeds. Symptoms may occur among exposed humans or animals. The likelihood of developing adverse effects following exposure depends on such variables as: toxin type and purity, dose, and duration of exposure. Dermal exposure in some situations could lead to burning pain, redness, and blisters, and oral exposure may lead to vomiting and diarrhea. Ocular exposure might result in blurred vision, and inhalational exposure might cause nasal irritation and cough. Systemic symptoms can develop with all routes of exposure (especially inhalation) and might include weakness, ataxia, hypotension, coagulopathy, and death.

### *Laboratory criteria for diagnosis*

- *Biologic*: Selected trichothecene mycotoxins can be detected in human urine to assess for exposure.
- *Environmental*: Detection of trichothecene mycotoxins (such as deoxynivalenol) in environmental samples; however there is no standard method of detection. FDA has established advisory levels of deoxynivalenol for safe foods and livestock feeds.

As a result of indoor air-quality investigations involving mold and potentially mold-related health effects, mycotoxin analyses of bulk environmental samples are now commercially available through environmental microbiology laboratories in the U.S. Studies measuring background levels of trichothecene mycotoxins in non-moldy homes and office buildings or nonagricultural outdoor environments are limited. Therefore, the simple detection of trichothecene mycotoxins in environmental samples does not necessarily indicate an intentional contamination or a health threat.

### *Case classification*

- *Suspected*: A case in which a potentially exposed person is being evaluated by health-care workers or public health officials for poisoning by a particular chemical agent, but no specific credible threat exists.
- *Probable*: A clinically compatible case in which a high index of suspicion (credible threat or patient history regarding location and time) exists for trichothecene mycotoxins exposure or an epidemiologic link exists between this case and a laboratory-confirmed case.

- *Confirmed*: A clinically compatible case in which laboratory tests of environmental samples have confirmed exposure.

The case can be confirmed if laboratory testing was not performed because either a predominant amount of clinical and nonspecific laboratory evidence of a particular chemical was present or the etiology of the agent is known with 100% certainty.

## Information Needed for Investigation

**Verify the diagnosis**. What was the clinical presentation? What laboratory tests were conducted and what were the results? Obtain demographic, clinical, laboratory, and other epidemiological information on the case from the attending physician, hospital, a knowledgeable family member, and/or laboratory to complete the Disease Case Report (CD-1). ***NOTE****: T-2 mycotoxicosis should be reported promptly to the District Communicable Disease Coordinator because of the potential public health impact and/or potential of T-2 mycotoxins being used as a bio-agent.* ***N.B.****: The possibility of mycotoxicosis should be considered when an acute disease response occurs in several persons where there is no evidence of infection with a known etiological agent, and no improvement in clinical presentation is observed after treatment.*[5]

**Establish the extent of illness**. Have there been other cases linked by time, place, person, or travel? Determine if household or other close contacts (e.g., child care contacts, associates / co-workers, travel companions) are, or have been, ill? Strongly urge exposed contacts to see their medical provider for evaluation. ***IMPORTANT*****:** *People who have been dermally exposed to T-2 mycotoxin should be decontaminated as soon as possible. Soap and water washing, even four to six hours after exposure, can significantly reduce dermal toxicity; washing within one hour may prevent toxicity entirely.*[2]

**Identifying the source of the toxin.** T-2 mycotoxin can be transmitted to humans via various mechanisms; transdermal contact with the mycotoxin, or ingestion of contaminated foods or beverages, or inhalation of the mycotoxin. Shared activities or exposures should be investigated among cases. ***NOTE****: Human-to-human transmission does not occur with T-2 mycotoxicosis, although direct contact with contaminated skin or clothing can produce secondary dermal exposures*.

- If the patient exhibits the inhalational or the dermal form of exposure, determine the recent locations the patient has visited.
- If ingestion of T-2 mycotoxin is indicated as the source of exposure, obtain a history of food and beverage consumption (including water), with emphasis on the last 2-4 hours. If available obtain samples of the suspected food or beverage source.
- Are there other cases linked by person, place, or time?

***WARNING*****:** T-2 mycotoxin is easily absorbed through the skin as well as through the respiratory tract. Do **not** come in contact with contaminated patients, or their clothing. Do **not** enter a suspect area or conduct environmental sampling unless you are trained and equipped to do so safely. ***N.B.****: If dermal transmission is suspected, contaminated clothing may serve as a reservoir for further toxin exposure.*

**Provide T-2 mycotoxin information to persons at risk for exposure and the general public as needed.** Efforts should be made to promote T-2 mycotoxicosis awareness. A "T-2 Mycotoxicosis Fact Sheet" is provided at the end of this section.

**T-2 Mycotoxin Surveillance.** An epidemiological questionnaire will be developed to capture information from select groups to assess exposure, risk factors, occurrence of disease, and assist with identifying other contacts that may have had exposure.

## Notification

- Contact the District Communicable Disease Coordinator, the Senior Epidemiology Specialist for the District, or the Missouri Department of Health and Senior Services (MDHSS) - BCDCP, phone (573) 751-6113, Fax (573) 526-0235, or for afterhours notification contact the MDHSS/ERC at (800) 392-0272 (24/7) immediately if T-2 mycotoxicosis is suspected.
- If a case(s) is associated with a childcare center, BCDCP or the LPHA will contact the BEHS, phone (573) 751-6095, Fax (573) 526-7377 and the Section for Child Care Regulation, phone (573) 751-2450, Fax (573) 526-5345.
- If a case(s) is associated with a food handler, BCDCP or the LPHA will contact BEHS, phone (573) 751-6095, Fax (573) 526-7377.
- If a case(s) is associated with a long-term care facility, BCDCP or the LPHA will contact the Section for Long Term Care Regulation, phone (573) 526-8524, Fax (573) 751-8493.
- If a case is associated with a hospital, hospital-based long-term care facility, or ambulatory surgical center BCDCP or the LPHA will contact the Bureau of Health Services Regulation phone (573) 751-6303, Fax (573) 526-3621.

## Control Measures

***T-2 mycotoxicosis presenting as a non-intentional exposure*.** Potentially hazardous concentrations of T-2 mycotoxins can occur naturally in moldy grains, cereals, and agricultural products. The control of T-2 mycotoxicosis relies on strict controls on food quality, the proper storage of grains (to include the proper storage of livestock feeds). No specific antidote is available; treatment is supportive. Superactivated charcoal may be given orally if the toxin is swallowed.[2]

For information on the management of T-2 mycotoxicosis, see:

- U.S. Army Medical Research Institute of Infectious Diseases (USAMRID). *T-2 Mycotoxins*. In: *Medical Management of Biologic Causalities Handbook*. 8th Edition. September 2014.
- The Poison Control Center can be contacted at (800) 222-1222.

***T-2 mycotoxicosis suspected to be the result of a terrorist act or intentional / deliberate release.***[2] If T-2 mycotoxicosis is the result of a terrorist act or an intentional or deliberate release, T-2 mycotoxin would most likely have been disseminated via an aerosol. In such a release, the T-2 mycotoxin could adhere to and penetrate the skin, be inhaled, or be ingested; thus exposure from all three routes can occur. High attack rates, dead animals of multiple species (both domestic and non-domestic), along with physical evidence such as yellow, red, green, or other pigmented oily liquids, may suggest mycotoxin exposure. Rapid onset of

symptoms within minutes to hours supports a diagnosis of a chemical or toxin attack. In addition, the following clues may also be used to determine if an intentional or deliberate release occurred.[6]

1. The presence of a large epidemic, with greater caseloads than expected, especially in a discrete population.
2. More severe disease than expected for a given pathogen, as well as unusual routes of exposure.
3. A disease that is unusual for a given geographic area, is found outside the normal transmission season, or is impossible to transmit naturally in the absence of the normal vector for transmission.
4. Multiple simultaneous epidemics of different diseases.
5. A disease outbreak with zoonotic as well as human consequences, as many of the potential threat agents are pathogenic to animals (death or illness among animals that precedes or accompanies illness or death in humans).
6. Unusual strains or variants of organisms or antimicrobial resistance patterns disparate from those circulating.
7. Higher attack rates in those exposed in certain areas, such as inside a building if the agent was released indoors, or lower rates in those inside a sealed building if an aerosol was released outdoors.
8. Intelligence that an adversary has access to a particular agent or agents.
9. Claims by a terrorist of the release of a biologic agent.
10. Direct evidence of the release of an agent, with findings of equipment, munitions, or tampering.

Even with the presence of more than one of the above indicators, it may not be easy to determine that an attack occurred through nefarious means.

***NOTE**: If T-2 mycotoxicosis is suspected to be the result of an intentional or deliberate release – **law enforcement must** be involved in the investigation. Therefore; the LPHA should:*

1. **Notify local law enforcement** and the Senior Epidemiology Specialist for the District or the MDHSS (ERC) at (800) 392-0272 (24/7), immediately.
2. Work with law enforcement and implement "Chain of Custody" procedures for all laboratory samples, as they will be considered evidence in a criminal investigation.
3. Work to define the population at risk, which is essential to guide response activities. Public health authorities will play the lead role in this effort, but must consult with law enforcement, emergency response, and other professionals in the process.
4. Once the mechanism and scope of delivery has been defined, identify symptomatic and asymptomatic individuals among the exposed and recommend medical evaluation as appropriate.
5. Establish and maintain a detailed line listing of all cases and contacts with accurate identifying and locating information.

***N.B.**: The only defense to prevent exposure from an intentional or deliberate release is by physical barrier protection of the skin, mucous membranes, and airway (use of HAZMAT suits or chemical protective mask and clothing.* Because the laboratory confirmation of a T-2 mycotoxin

could be delayed; specific epidemiological and clinical findings that suggest an intentional release of a T-2 mycotoxin should result in the release of a Health Alert.

**WARNING:** T-2 mycotoxin is a dermally-active toxin. Although secondary aerosols are not a hazard, direct contact with contaminated skin or clothing can produce secondary dermal exposures. First responders and health care personnel should not have direct contact with the patient without adequate personal protective equipment (PPE). Clinicians must use contact precautions when seeing a patient suspected of being exposed to T-2 mycotoxin until decontamination is completed. After decon, standard precautions should be used.[2]

- Clothing of persons exposed to a T-2 mycotoxin should be removed and destroyed or properly decontaminated. Contaminated clothing as well as wash waste from the decon process should be exposed to bleach (5% sodium hypochlorite) for 6 hours or more to neutralize any residual mycotoxin.[2]
- No specific antidote is available for T-2 mycotoxicosis.
  - Provide supportive measures addressing respiratory and cardiovascular status as necessary.
  - Administer superactivated charcoal if toxin ingestion is a possibility.
  - If the patient complains of eye pain or tearing, irrigate the eyes with copious amounts of normal saline solution or water.
  - You can contact the Poison Control Center for additional clinical guidance at (800)-222-1222.
- A 3-5% solution of sodium hypochlorite should be used for environmental decontamination.

***NOTE**: Decontamination is extremely important in order to avoid cross-contamination. Never assume that a patient has been decontaminated. Contact precautions are warranted until decontamination is assured; then standard precautions should continue to be followed. Reassess the patient's decontamination status. If the degree of prehospital decontamination is uncertain, rewash the patient to ensure the safety of staff and the facility.*

***Decontamination is as follows:***

- Remove all of the patient's clothing and clean the entire skin surface with soap and water. Washing the contaminated area(s) of the skin within 6 hours post-exposure can remove 80-98% of the toxin.
- Contain clothing to avoid contamination of the environment.[2]

For additional information on T-2 mycotoxicosis see:
U.S. Army Medical Research Institute of Infectious Diseases (USAMRID). *T-2 Mycotoxins*. In: *Medical Management of Biologic Causalities Handbook*. 8th Edition. September 2014.

## Laboratory Procedures[2]

Testing for T-2 mycotoxin is available through commercial clinical laboratories. The isolation and identification of T-2 mycotoxin can confirm a diagnosis. Serum and urine should be collected and set to a reference lab for antigen detection. Pathologic specimens include blood, urine, lung, liver, and stomach contents. The mycotoxin and metabolites are eliminated in

the urine and feces; 50-75% are eliminated within 24 hours, however, metabolites can be detected as late as 28 days after exposure.

***NOTE:*** *The Missouri State Public Health Laboratory (MSPHL) does not conduct testing for T-2 mycotoxin. However, you can contact the MSPHL at (573) 751-3334 for instructions on how and where to request testing for T-2 mycotoxin. The MSPHL may be contacted afterhours through the MDHSS/ERC by calling (800) 392-0272 (24/7).*

## Reporting Requirements

Instances, clusters, or outbreaks of unusual, novel, and/or emerging diseases appearing to be naturally occurring, but posing a substantial risk to public health **or** instances, clusters, or outbreaks of unusual diseases or manifestations of illness and clusters or instances of unexplained deaths which appear to be a result of a terrorist act or the intentional or deliberate release of biological, chemical, radiological, or physical agents, including exposures through food, water, or air are **immediately** reportable upon knowledge or suspicion by telephone, facsimile or other rapid communication to the local health authority or to the MDHSS. The MDHSS may be contacted 24/7 through the MDHSS/ERC by calling (800) 392-0272 (24/7).

Other instances of T-2 mycotoxicosis are a Category 2(A) disease and shall be reported to the local health authority or to the MDHSS **within one (1) calendar day of first knowledge or suspicion** by telephone, facsimile or other rapid communication. The MDHSS may be contacted 24/7 through the MDHSS/ERC by calling (800) 392-0272.

Multiple cases of T-2 mycotoxicosis, temporally / spatially clustered would be categorized as **IMMEDIATE, URGENT REPORT to the CDC.** MDHSS will report these conditions to the CDC EOC at (770) 488-7100 within 24 hours of becoming aware of cases meeting the notification criteria, followed by submission of an electronic case notification (WebSurv) in the next regularly scheduled electronic transmission.

1. For confirmed, probable, suspect cases, complete a "Disease Case Report" (CD-1) and send the completed form to the DHSS District Health Office.
2. Entry of the completed CD-1 into the MOHSIS database negates the need for the paper CD-1 to be forwarded to the District Health Office.
3. MDHSS will report to CDC following the above reporting criteria (see box).
4. All outbreaks or "suspected" outbreaks must be reported as soon as possible (by phone, fax or e-mail) to the District Communicable Disease Coordinator. This can be accomplished by completing the Missouri Outbreak Surveillance Report (CD-51).
5. If an outbreak is associated with food, a CDC 52.13 form (National Outbreak Reporting System – Foodborne Disease Transmission) is to be completed and submitted to the District Communicable Disease Coordinator at the conclusion of the outbreak.
6. Within 90 days from the conclusion of an outbreak, submit the final outbreak report to the District Communicable Disease Coordinator.

## References

1. CDC's Emergency Preparedness & Response Web Site, Specific Hazards Case Definitions. http://emergency.cdc.gov/agent/trichothecene/casedef.asp (5/16).
2. U.S. Army Medical Research Institute of Infectious Diseases (USAMRID). *T-2 Mycotoxins*. In: *Medical Management of Biologic Causalities Handbook*. 8th Edition. September 2014. Fort Detrick. Frederick, Maryland 21702-5001. http://www.usamriid.army.mil/education/bluebookpdf/USAMRIID%20BlueBook%208th%20Edition%20-%20Sep%202014.pdf (5/16).
3. US Army Medical Research Institute of Infectious Diseases, Division of Medicine, Fort Detrick. In: *Quick Bio-Agents: USAMRIID's Pocket Reference Guide to Biological Select Agents & Toxin.2012*. http://www.usamriid.army.mil/education/docs/Quick_Bio-Agents_Giude.pdf (5/16).
4. U.S. National Library of Medicine. National Institutes of Health & Human Services. *Mycotoxins*. Bennett JW, Klich, M. In: *Clinical Microbiology Reviews, 2003 Jul; 16(3): 497-516*. National Center for Biotechnology Information. PubMed Central. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC164220/ (5/16).
5. *Toxic effects of mycotoxins in humans* M. Peraica,1 B. RadicÂ ,2 A. LucicÂ ,3 & M. PavlovicÂ Bulletin of the World Health Organization, 1999, 77 (9) 765 http://www.who.int/bulletin/archives/77(9)754.pdf (5/16).
6. Pavlin JA. Epidemiology of Bioterrorism. Emerging Infectious Diseases, Volume 5, Number 4-August 1999. Available from: http://wwwnc.cdc.gov/eid/article/5/4/99-0412.htm. (5/16).

# T-2 Mycotoxicosis
## Fact Sheet

**What are T-2 Mycotoxins?**
T-2 mycotoxins are poisonous substances produced by a number of species of filamentous fungi (molds). They can cause adverse health effects in humans and animals who have gotten the toxin on their skin or eyes, or who have inhaled or ingested the toxin.

Exposure to T-2 mycotoxins can occur naturally in certain situations (for example, through accidental ingestion of contaminated foodstuffs). T-2 mycotoxins have also, because of their environmental stability and dissemination potential, been identified as potential agents of bioterrorism. If T-2 mycotoxins were used in a bioterrorism attack, they would most likely be disseminated in the air (i.e., as an aerosol).

**How would I get exposed to T-2 Mycotoxin?**
T-2 mycotoxins can be absorbed through the skin, or they can be inhaled or ingested.

**How long after exposure before I become ill?**
Symptoms can begin within minutes to a few hours (2 to 4 hours), depending on the dose and route of exposure.

**What are the symptoms?**
Symptoms – which vary by the route and duration of exposure, and toxin concentration – may include any of the following:

- ***Skin contact***: Burning skin pain, redness and blistering, progressing to patches of skin tissue death and sloughing off of the skin.
- ***Eye contact***: Pain, tearing, redness, foreign body sensation, blurred vision.
- ***Inhaled***: Nasal pain, itching and bleeding, sneezing, runny nose, mouth and throat pain with blood-tinged saliva, coughing, shortness of breath, wheezing, and blood-tinged sputum.
- ***Ingested***: Loss of appetite, nausea, and vomiting, abdominal pain, watery or bloody diarrhea.

Severe poisoning from any route may result in serious systemic symptoms that can include weakness, prostration, dizziness, and loss of coordination. Rapid heart rate, low body temperature, low blood pressure, reduced cardiac (heart) output, and shock can follow in severe or fatal cases. A late effect of systemic absorption of the toxin is a decrease in the numbers of red and white blood cells as well as platelets, potentially leading to bleeding and sepsis.

**What should I do if I think I have been exposed?**

- Leave the area where exposure is believed to be occurring immediately.
- Do not touch people who have been in an attack.
- Do not touch your eyes, nose, or mouth.
- Rapid decontamination is extremely important to reduce the amount of exposure to the toxin, and to avoid possible contamination of other persons.
    - Remove your outer clothing as soon as possible. (**Note** that contaminated clothing may serve as a reservoir for further toxin exposure. Avoid direct contact with all potentially contaminated clothing once it is removed until it can be properly decontaminated.)
    - Shower with plenty of soap and water.
    - Flush your eyes with copious amounts of water.
- Notify your health care provider immediately, and follow his/her directions.
- Contact the Missouri Department of Health and Senior Services immediately (24/7) at **(800) 392-0272**.
- The Poison Control Center may be contacted at: (800) 222-1222.

**Is there any treatment?**

There is no specific antidote or vaccine available for T-2 mycotoxicosis at this time. Treatment is supportive (for example, your health care provider will provide supportive measures addressing respiratory and cardiovascular status as necessary). Washing the skin with soap and water, even four to six hours after exposure, can significantly reduce toxicity associated with skin contact. Your health care provider may administer superactivated charcoal if T-2 mycotoxin is swallowed. Eye exposure should be treated with copious normal saline irrigation.

**Can T-2 mycotoxicosis** be **life-threatening?**

Exposure to T-2 mycotoxins can be life-threatening in instances of severe intoxication.