University of Nebraska Lincoln EXTENSION
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Managing the Risk of Pesticide Poisoning and Understanding the Signs and Symptoms

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Accidental exposure or overexposure to pesticides can have serious health implications. The potential for pesticide accidents is real. It has been estimated that more than 36 million pounds of pesticide active ingredients are used annually in Nebraska. While most of these pesticides can be used with relatively little risk (as long as label directions are followed), some are extremely toxic and require special precautions.

Agricultural pesticides are responsible for 4.6 percent of all accidental exposures reported to the Poison Center. A recent study surveyed callers to the Poison Center who were exposed to agricultural chemicals. Anhydrous ammonia caused 24 percent of the incidents. The remainder was caused by herbicides (22 percent), and insecticides (54 percent). Most of the herbicide exposures resulted in eye/skin irritations. The insecticide exposures tended to result in more evident symptoms of greater concern such as nausea/vomiting, headaches, dizziness and shortness of breath.

Routes of Exposure

Pesticides can enter the human body three ways: 1) by absorption through the skin or eyes (***dermally***), 2) through the mouth (***orally***), and 3) by breathing into the lungs (***inhalation***).

Dermal exposure results in absorption immediately after a pesticide contacts skin or eyes. Absorption will continue as long as the pesticide remains in contact with the skin or eyes. The *rate* at which dermal absorption occurs is different for each part of the body (*Figure 1*). The relative absorption rates are determined by comparing each respective absorption rate with the forearm absorption rate.

It is easy to transfer pesticide residues from one part of the body to another. When this occurs, the applicator increases the potential for pesticide poisoning. For example, residues can be inadvertently moved from a hand to a sweaty forehead (4.2) or to the genital area (11.8). After transfer and absorption of a pesticide, it is more dangerous than if it were swallowed!

Oral exposure may result in serious illness, severe injury or even death. Pesticides can be ingested by accident, through carelessness or intentionally.

The most common accidental oral exposures occur when pesticides have been removed from their original containers and placed into an unlabeled bottle, jar or food container. Children under 10 are victims of at least half of the accidental pesticide deaths in the United States. If pesticides were managed properly, children would never touch them.

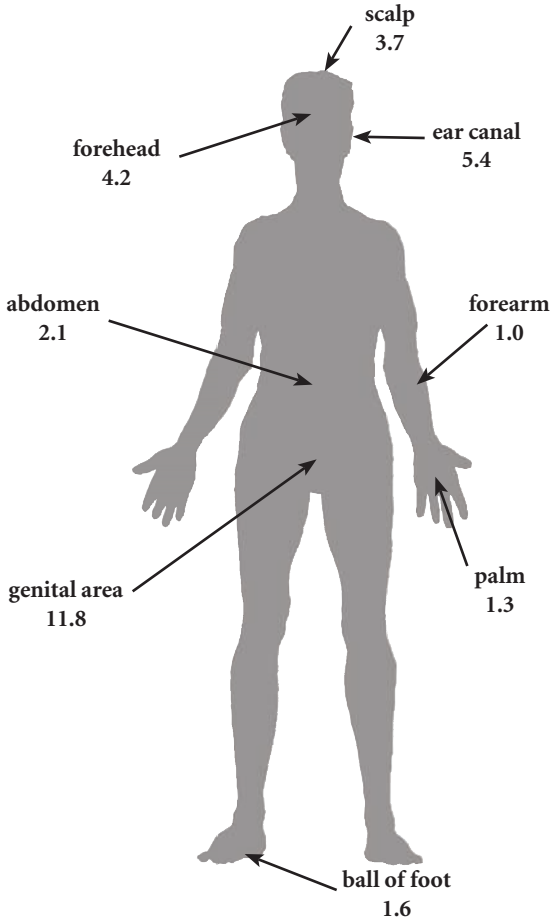

Figure 1. Absorption rates of the different parts of the body.

Follow these guidelines:

- Always store pesticides in their original labeled containers.
- Never use the mouth to clear a spray hose or nozzle, or to begin siphoning a pesticide.
- Never eat, drink or use tobacco until after leaving the work area and washing thoroughly.

Respiratory exposure is particularly hazardous because pesticide particles can be rapidly absorbed by the lungs into the bloodstream. Pesticides can cause serious damage to nose, throat and lung tissue if inhaled in sufficient amounts. Vapors and very small particles pose the most serious risks.

Lungs can be exposed to pesticides by inhalation of powders, airborne droplets or vapors. Handling concentrated wettable powders can pose a hazard if inhaled during

mixing. The hazard from inhaling pesticide spray droplets is fairly low when dilute sprays are applied with low pressure application equipment. This is because most droplets are too large to remain airborne long enough to be inhaled.

However, when high pressure, ultra low volume (ULV), or fogging equipment is used, the potential for respiratory exposure is increased. The droplets produced during these operations are in the mist- or fog-size range and can be carried on air currents for considerable distances.

Pesticide Toxicity

The toxicity of a pesticide can be measured several ways. Determining the toxicity of pesticides to humans is not easy, since humans can't be used as test animals. Other animals, usually rats, are used. However, if a pesticide is poisonous to rats, it is not necessarily poisonous to dogs, cows, wildlife or people. Toxicity studies are only guidelines. They are used to estimate how poisonous one pesticide is compared with another. Some pesticides are dangerous after one large dose (exposure). Others can be dangerous after small, repeated doses.

Measuring toxicity. The pesticide's toxicity is determined by laboratory testing on animals such as rats, mice and rabbits. The measuring method, LD_{50} (lethal dose, 50 percent), describes the dose of a pesticide that will kill half of a group of test animals from a single exposure (dose) by either the dermal, oral or inhalation routes. A pesticide with a lower LD_{50} is more toxic than a pesticide with a higher number because it takes less of the pesticide to kill half of the test animals.

The toxicity of fumigant pesticides is described in terms of the concentration of the pesticide in the air, LC_{50} (lethal concentration, 50 percent). A similar system is used to test the potential effects of pesticides against aquatic organisms in water.

Acute toxicity of a pesticide refers to the effects from a single exposure or repeated exposure over a short time, such as an accident during mixing or applying pesticides. Various signs and symptoms are associated with acute poisonings.

A pesticide with a high acute toxicity can be deadly even if a small amount is absorbed. It can be measured as acute oral toxicity, acute dermal toxicity or acute inhalation toxicity.

Chronic toxicity refers to the effects of long-term or repeated lower-level exposures to a toxic substance. The effects of chronic exposure do not appear immediately after first exposure and may take years to produce signs and symptoms. Examples of chronic poisoning effects may include:

- **Carcinogenicity —** ability to produce cancer or to assist carcinogenic chemicals.
- **Mutagenicity —** ability to cause genetic changes.
- **Teratogenicity —** ability to cause birth defects.
- **Oncogenicity —** ability to induce tumor growth (not necessarily cancers).
- **Liver damage —** death of liver cells, yellowing of the skin and tissue scarring.
- **Reproductive disorders —** such as reduced sperm count, sterility and miscarriage.
- **Nerve damage —** including accumulative effects associated with organophosphate insecticides.
- **Allergenic sensitization —** development of allergies to pesticides or chemicals used in formulation of pesticides.

The effects of chronic toxicity, as with acute toxicity, are dose-related. In other words, low-level exposure to chemicals that have potential to cause long-term effects may not cause immediate injury, but repeated exposures through careless handling or misuse can greatly increase the risk of chronic adverse effects.

Signal Words

Nearly all pesticides are toxic. They differ only in the *degree* of toxicity. Because of this, pesticides are potentially dangerous to people if exposure is excessive. A pesticide product label will normally have one of three signal words that clearly indicate the degree of toxicity associated with that product (*Table I*). The signal words indicate the degree of potential risk to a user, not the product's effectiveness.

Table I. Pesticide label signal words and relative acute toxicities.

Signal Word	*Toxicity*	*Oral Lethal Dose[a] (Human, 150 lbs.)*
Danger[b]	Highly toxic	Few drops to 1 teaspoon
Warning	Moderately toxic	1 teaspoon to 1 tablespoon
Caution	Low toxicity	1 ounce to more than a pint

[a]The lethal dose is less than those listed for a child or person under 150 lbs. and more for a person over 150 lbs.
[b]The skull and crossbones symbol and the word "Poison" are sometimes printed with the "Danger" signal word.

Read the Pesticide Label

Along with the signal words, pesticide labels also include statements about route of entry and specific actions that must be taken to avoid exposure. Route of entry statements indicate the outcome that can be expected from exposure. For example, a pesticide label might read: *"Poisonous if swallowed, inhaled or absorbed through the skin. Rapidly absorbed through the skin and eyes."* This indicates that the pesticide is a potential hazard through all three routes of entry, and that skin and eye contact are particularly hazardous. Specific action statements normally follow the route of entry statement and indicate what must be done to prevent poisoning accidents. In the case of the

pesticide discussed above, the statement might read: "*Do not get in eyes, on skin or on clothing. Do not breathe spray mist.*"

The route of entry and specific action statements are usually followed by first aid instructions (see *Table II*). If an accidental exposure occurs, pay attention to these instructions. By following the instructions carefully, you will help limit the amount of exposure you ultimately receive, even after the initial contact with the pesticide.

Table II. First aid section from a pesticide label.

FIRST AID:	Call a poison control center or doctor for treatment advice.
IF IN EYES	• Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
IF INHALED	• Remove individual to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.
IF SWALLOWED	• This product will cause gastrointestinal tract irritation. Immediately dilute by swallowing water or milk. Get medical attention. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

Another important section on a pesticide label is the personal protective equipment (PPE) section. This section provides instructions for pesticide applicators and other handlers to help them avoid pesticide exposure. It presents specific protective clothing and equipment requirements. For example, a moderately toxic pesticide label might read, "***Applicators and other handlers must wear:*** *long-sleeved shirt and long pants, shoes plus socks, and protective eyewear.*"

Manage Your Risk

Wear protective clothing and PPE when handling or applying pesticides to reduce the risk of pesticide poisoning. Risk of pesticide poisoning is reduced because the chance of exposure is reduced. This idea is expressed by the Risk Formula:

Risk = Toxicity *x* Exposure

Understanding a product's toxicity and the potential for personal exposure allows risk to be lowered. No matter how toxic a pesticide is, if the amount of exposure is kept low, risk can be held at an acceptably low level. The pesticide's toxicity can't be changed, but risk can be managed by the applicator by selecting less toxic pesticides and using the appropriate protective clothing and PPE.

Recognizing Signs and Symptoms of Poisoning

Anyone who may become exposed to pesticides should be aware of the signs and symptoms of pesticide poisoning. Prompt action during pesticide overexposure can prevent serious consequences.

Poisoning signs can be seen by others; for example, vomiting, sweating or pinpoint pupils. Symptoms are any changes in normal condition that can be described by the victim of poisoning and may include nausea, headache, weakness, dizziness and others. Anyone who works with pesticides should learn these signs and symptoms to prevent serious injury and allow prompt treatment.

Persons who are frequently involved with pesticides should become familiar with these important steps:

1. Recognize the signs and symptoms of pesticide poisoning for pesticides you commonly use or to which you may be exposed.
2. If you suspect a pesticide poisoning, get immediate help from a local hospital, physician or the nearest poison control center.
3. In a pesticide emergency, identify the pesticide to which the victim was exposed. Provide this information to medical authorities.
4. Have a copy of the pesticide label present when medical attention begins. The label provides information that will be useful in assisting a pesticide poisoning victim.
5. Know emergency measures you can undertake until help arrives or the victim can be taken to the hospital. Both first aid and medical treatment procedures are listed on the product label.

Recognizing Common Pesticide Poisonings

All pesticides in a chemical group generally affect the human body in the same way; however, severity of the effects vary depending on the formulation, concentration, toxicity and route of exposure of the pesticide. It is important, therefore, to know both the type of pesticide you are using and the signs and symptoms associated with poisoning from it.

Pesticides that present the greatest potential health risks or those with better understood mode of actions are covered in the following sections. Some lower-risk pesticides that present little or no potential health risk are not mentioned at all. Large groups of pesticides that have similar signs and symptoms have been included together.

The listings of pesticides in *Tables II, III* and *IV* are not necessarily complete. They do, however, represent most of the products in common use for their respective chemical classifications.

Organophosphate and Carbamate Insecticides

Most pesticide poisoning cases involve either organophosphate or carbamate insecticides. Both chemical groups affect humans by inhibiting acetyl cholinesterase, an enzyme essential to proper functioning of the nervous system. Some organophosphate and carbamate insecticides commonly used in Nebraska are listed in *Table II*.

The effects of these materials, particularly organophosphate insecticides, are rapid. Symptoms begin shortly after exposure, and in acute poisonings, during the exposure. Exposure to either of these insecticide classes may pose special risks for persons with reduced lung function, seizure disorders, etc. In some cases, alcoholic beverage consumption may worsen the pesticide effects.

The onset of symptoms in milder exposures can occur anytime up to 12 hours later but usually within four hours. Consequently, diagnosis of a suspected poisoning must also be rapid. **It is imperative to be familiar with the signs and symptoms these types of pesticides cause.**

Signs and symptoms associated with ***mild*** exposures to organophosphate and carbamate insecticides include: headache, fatigue, dizziness, loss of appetite with nausea, stomach cramps and diarrhea; blurred vision associated with excessive tearing; contracted eye pupils; excessive sweating and salivation; slowed heartbeat, often fewer than 50 beats per minute; and rippling of surface muscles just under the skin.

These symptoms may be mistaken for those of flu, heat stroke or heat exhaustion, or upset stomach.

Moderately severe organophosphate and carbamate insecticide poisoning cases exhibit all the signs and symptoms found in mild poisonings, but in addition, the victim: is unable to walk; often complains of chest discomfort and tightness; exhibits marked pinpoint pupils; exhibits muscle twitching; and has involuntary urination and bowel movement.

Severe poisonings are indicated by loss of urinary control, unconsciousness and seizures.

The order in which these symptoms appear may vary, depending on how contact is made with the pesticide. If the product is swallowed, stomach and other abdominal manifestations commonly appear first; if it is absorbed through the skin, gastric and respiratory symptoms tend to appear at the same time.

Fortunately, good antidotes are available for victims of organophosphate or carbamate poisoning at emergency treatment centers, hospitals and many physicians' offices. **As with all pesticide poisonings, time is extremely critical**. If a pesticide is swallowed, obtain prompt medical treatment. If a dermal exposure has occurred, remove contaminated clothing, wash exposed skin and seek medical care.

Organochlorine Insecticides

The U.S. Environmental Protection Agency has sharply curtailed the availability of organochlorines because they persist in the environment. These materials affect the nervous system as stimulants or convulsants.

Nausea and vomiting commonly occur soon after ingesting organochlorines. Other early signs and symptoms include: apprehension, excitability, dizziness, headache, disorientation, weakness, a tingling or pricking sensation on the skin and muscle twitching. This is followed by loss of coordination, convulsions similar to epileptic seizures and unconsciousness. When chemicals are absorbed through the skin, apprehension, twitching, tremors, confusion and convulsions may be the first symptoms.

No specific antidotes are available for organochlorine poisoning. Remove contaminated clothing immediately, and then bathe and shampoo the person vigorously with soap and water to remove pesticide from the skin and hair. People assisting a victim should wear chemical resistant gloves and be careful to avoid becoming contaminated by the pesticide. If the pesticide has been swallowed, empty the stomach as soon as possible by giving the conscious patient syrup of ipecac and water or by inserting a finger into the throat.

Pyrethroid Insecticides

Pyrethroids are synthetically produced compounds that mimic the structure of naturally occurring pyrethrins. Some examples of pyrethroids are in *Table III*.

Whole body toxicity by inhalation and dermal absorption is low. There have been very few poisonings of humans by pyrethroids. Dermal contact may result in skin irritation such as stinging, burning, itching and tingling progressing to numbness.

Table II. Common organophosphate and carbamate insecticides.

Organophosphates			*Carbamates*	
Actellic	Dimethoate	Malathion	Baygon	Sevin, carbaryl
Co-Ral	Di-Syston	Mocap	Furadan	Temik
Counter	Dylox	Orthene	Lannate	
Cygon	Guthion	Penncap-M		
Diazinon	Imidan	Thimet		
Dibrom	Lorsban	Vapona, DDVP		

Table III. Common pyrethroid insecticides.

Allethrin	Fluvalinate
Cyfluthrin	Permethrin
Cypermethrin	Resmethrin
Esfenvalerate	Tetramethrin
Fenvalerate	Tralomethrin

Some may be toxic by the oral route, but usually ingestion of pyrethroid insecticide presents relatively little risk. Very large doses may rarely cause incoordination, tremors, salivation, vomiting, diarrhea and irritability to sound and touch. Most pyrethroids are promptly excreted by the kidney. Pyrethroids are not cholinesterase inhibitors.

Biological Insecticides

Azadirachtin. This insecticide, derived from the Neem tree, is an insect growth regulator that interferes with the insect molting process. Exposure to azadirachtin causes slight skin and gastrointestinal irritation. Stimulation and depression of the central nervous system have also been reported.

Eugenol. This compound is derived from clove oil and is used both as an insect attractant and an insecticide. Large doses can cause skin burns. Extremely large doses may result in coma and liver problems.

Pyrethrum and pyrethrins. Crude pyrethrum is a skin and lung allergen. Skin irritation and asthma have occurred following exposures. The refined pyrethrins are less allergenic but appear to retain some irritant and/or sensitizing properties.

In cases of human exposure to commercial products, the possible role of other toxicants in the products should be considered. The synergists, such as piperonyl butoxide (discussed later), have low toxic potential in humans, but organophosphates or carbamates included in the product may have significant toxicity. Pyrethrins themselves do not inhibit the cholinesterase enzyme.

Rotenone. This naturally occurring substance is present in many plants. It is formulated as dusts, powders and sprays for use in gardens and on food crops. Although rotenone is toxic to the nervous systems of insects, fish and birds, commercial rotenone products present little health hazard to humans.

Antibiotics. Examples of antibiotics include abamectin, ivermectin, *Bacillus thuringiensis* (*Bt*), and spinosad. Related is the antibiotic streptomycin that is used to control plant pathogens. These compounds are nearly nontoxic to humans. In studies involving deliberate ingestion by humans, slight inflammation of the gut occurred. Antibiotic insecticide emulsifiable concentrate formulations may cause slight to moderate eye irritation and mild skin irritation. NOTE: Antibiotic insecticides are completely different chemicals than the antibiotics taken by people to cure bacterial infections.

Inorganic Insecticides

Boric Acid and Borates. Boric acid is derived from borax and is usually combined with an anti-caking agent. Boric acid is commonly used to kill cockroaches. Although boric acid is relatively safe for humans and other mammals, it can be harmful if accidentally ingested. Care must be taken not to breathe in the dust when it is applied. Borax dust is moderately irritating to skin. Inhaled dust causes irritation of the respiratory tract and shortness of breath.

In severe poisonings of infants, a beefy red skin rash that most often affects palms, soles of the feet, buttocks and scrotum has been described. It has been called a "boiled lobster appearance." The intense redness of the skin is followed by extensive skin peeling.

Diatomaceous earth. Diatomaceous earth (DE) is mined from the fossilized silica shell remains of diatoms, microscopic sea animals. DE is used commercially to control crawling insects such as cockroaches, ants and grain-infesting insects. It is virtually nontoxic to humans. However, care should be taken to avoid inhaling diatomaceous earth as it can cause irritation to eyes and lungs.

Silica gel. Silica gel is a non-abrasive, chemically inert substance that is used as a dehydrating agent because the small particles absorb moisture and oils. Caution should be taken when handling silica gel to avoid inhaling the dust.

Note: Some grades of diatomaceous earth contain small amounts of crystalline silica, which is known to cause silicosis (respiratory disease caused by breathing silica dust) and cancer. The risk of cancer depends upon duration and level of exposure. Pesticide-quality diatomaceous earth and silica gel are amorphous (non-crystalline) silica, which ***does not cause silicosis or cancer***.

Sulfur. Sulfur is moderately irritating to the skin and has been associated with occupational skin inflammation. If the dust becomes airborne, it is also irritating to the eyes and respiratory tract. If it is swallowed, it acts like a strong laxative.

Other Insecticides

Fluorines. One example of these insecticides is sulfluramid. It is formulated as an ant, roach or termite bait and is slightly irritating to the skin. Sulfluramid has low toxicity in lab tests; however, with repeated exposure, it has caused developmental toxicity and male reproductive system effects in lab animals.

Nicotinoids. Even though no cases of human poisoning are known to have occurred, signs and symptoms should be similar to nicotine insecticide signs and symptoms, such as fatigue, twitching, cramps and muscle weakness, including the muscles necessary for breathing. Imidacloprid and thiamethoxam are two common examples of a nicotinoid insecticide used to control termites, turf insects and some crop insects.

Pyrazoles. Fipronil, an example of this type of insecticide, is a moderately toxic product that may cause mild

irritation to the eyes and skin. It is used to control termites, cockroaches, certain corn insects, and fleas and ticks on cats and dogs. No human toxicity information is available, but lab animals exhibited reduced feeding, reduced urination, increased excitability and seizures following a toxic dose.

Pyrroles. Chlorfenapyr is the only product in this group. It is formulated to control ants, cockroaches, termites, and some insect and mite pests on fruits and vegetables. It is slightly toxic if swallowed or if it contacts the skin, and can be moderately irritating to eyes or skin.

Tetronic acids. Spiromesifen is the sole insecticide in this group. It is used to control mites and whiteflies on certain vegetable crops and ornamental trees. Spiromesifen is slightly toxic if swallowed or if it contacts the skin. No indication of eye irritation has been reported.

Insect Growth Regulators

Insect growth regulators (IGR) act on insects in different ways (i.e., juvenile hormone mimic and chitin synthesis inhibitor). Juvenile hormone mimics keep insects in the immature state and prevent insect reproduction. Chitin synthesis inhibitors prevent insects from molting and growing into adults. In general, IGR are very low in toxicity and show mild skin irritation with limited exposure. No human poisonings or adverse reactions in exposed workers have been reported. Some examples of insect growth regulators are in *Table IV*.

Table IV. Common insect growth regulators.

Diflubenzuron	Noviflumuron
Hexaflumuron	Pyriproxyfen
Hydroprene	Teflubenzuron
Methoprene	

DEET Repellent

DEET (Detamide, OFF). For many years, diethyltoluamide has been effective and generally well-tolerated when applied to human skin, although tingling and mild irritation have occurred followed repeated applications. In some cases, DEET has caused skin irritation and worsened pre-existing skin disease. It is very irritating to the eyes but not corrosive.

Serious adverse effects have occurred when the product has been used under hot, humid conditions and applied to skin areas that were in direct contact during sleep. Under these conditions, the skin became red and tender, and then blistered and eroded, leaving painful bare areas that were slow to heal. Permanent scarring resulted from most of these severe reactions.

Great caution should be exercised when using DEET on children. Only the products containing the lower concentrations should be used, and application should be limited to clothing, using as little repellent as possible. If headache or any kind of emotional or behavioral change occurs, DEET use should be discontinued immediately.

Fumigants

Various types of fumigants produce differing physiologic effects. Headache, dizziness, nausea and vomiting are common early signs and symptoms of excessive exposure.

Prompt medical treatment is critical with fumigant poisonings. Move victims of fumigant inhalation to fresh air immediately. Keep the individual quiet in a semi-reclining position even though initial signs and symptoms are mild. If breathing has stopped, give mouth-to-mouth or mouth-to-nose resuscitation. If there is no pulse, use cardiopulmonary resuscitation (CPR).

Sulfuryl fluoride (Vikane), phosphine (generated by aluminum or magnesium phosphide, e.g., Phostoxin, Fumitoxin and Fumi-Cel), chloropicrin, methyl bromide, acrolein (Magnacide H), and dazomet (Basamid) are commercial fumigant products.

Sulfuryl fluoride poisoning symptoms include depression, slowed walking pattern, slurred speech, nausea, vomiting, stomach pain, drunkenness, itching, numbness, twitching and seizures. Inhalation may be fatal due to respiratory failure. Inhalation of high concentrations may cause respiratory tract irritation. Skin contact with gaseous sulfuryl fluoride normally poses no hazard, but contact with liquid sulfuryl fluoride can cause pain and frostbite due to rapid evaporation.

Phosphine fumigants, such as aluminum and magnesium phosphide, affect cell function in the liver and lungs. ***Mild exposure*** is signaled by a sensation of cold, chest pains, diarrhea and vomiting. Somewhat more serious exposures will be evidenced by cough, chest tightness, difficult breathing, weakness, thirst and anxiety.

Severe exposure is indicated by stomach pain, loss of coordination, blue skin color, limb pain, enlarged pupils, choking, fluid in the lungs and stupor. Severe poisonings lead to seizures, coma and death.

Chloropicrin and methyl bromide affect the central nervous system, lungs, heart and liver. People poisoned by this type of fumigant experience the common signs and symptoms of fumigant poisoning along with abdominal pain, weakness, slurred speech, mental confusion, muscle twitching and convulsions similar to epileptic seizures. Some liquid fumigants cause skin injuries indicated by areas of redness or blisters that burst, leaving raw skin or deep open sores.

Acrolein is an extremely irritating gas used as both a fumigant and an aquatic herbicide (Magnacide H). Inhalation of the vapor causes upper respiratory tract irritation, which may lead to a buildup of fluids in and narrowing of the air passages. If it is ingested, the stomach lining is attacked, resulting in open sores and cell death. Contact with skin may cause blistering.

Dazomet is a granular soil fumigant (Basamid G). It is used to sterilize the soil and eliminate weeds, nematodes and

soil diseases. It is highly toxic if swallowed and can be fatal. Frequent or prolonged skin exposure can result in irritation or more serious skin problems for some individuals. Inhalation can cause a variety of acute and chronic lung conditions, including local irritation, inflammation of the lungs, fluid buildup in the lungs and lung disease.

Rodenticides

Benzenamines. Bromethalin is the only chemical in this class of rodenticide and is *not* an anticoagulant (substance that slows blood clotting). Possible signs and symptoms of exposure to this compound include skin and eye irritation, headache, confusion, muscle twitching, convulsive seizures and breathing distress. Bromethalin poisoning in dogs usually results in paralysis or convulsions, and sometimes swelling or bloating of the abdomen.

Coumarins. Examples include brodifacoum (Jaguar, Talon, WeatherBlok), bromadiolone (Contrac, Maki), and warfarin (Kaput). The main signs and symptoms are nosebleed, bleeding gums, blood in the urine, tar feces and large, irregular blue-black to greenish-brown spots or patches on the skin.

Indandiones. Examples are chlorophacinone (Rozol) and diphacinone (Ditrac, Ramik). Unlike the coumarin compounds, some indandiones cause signs and symptoms of nerve, heart and blood system damage in laboratory rats, leading to death before hemorrhage occurs. None of these signs and symptoms has been reported in human poisonings.

Zinc phosphide. Zinc phosphide causes severe irritation if ingested. It reacts with water and stomach juices to release phosphine gas, which can enter the blood stream and affect the lungs, liver, kidneys, heart and central nervous system. Zinc phosphide is easily absorbed through the skin or inhaled from fumes. With repeated exposure, it accumulates in the body to dangerous levels.

Signs and symptoms of ***mild*** zinc phosphide poisoning include diarrhea and stomach pains. In more ***severe*** cases, nausea, vomiting, chest tightness, excitement, coldness, unconsciousness, coma and death can occur from fluid buildup in the lungs and liver damage. There is no antidote for zinc phosphide poisoning. It is a slow-acting material, which gives the victim time to get medical help.

Strychnine. Strychnine is not easily absorbed through the skin nor does it accumulate in the human body. When ingested, it acts on the central nervous system within 10 to 30 minutes. Violent seizures with involuntary jerking movements occur, causing breathing to stop.

Treatment of strychnine poisoning is geared toward eliminating outside stimuli. If strychnine poisoning occurs, it is important to place the victim in a warm, dark room, which reduces outside stimuli that trigger the violent seizures and involuntary jerking. Consequently, **in the case of strychnine poisoning, bring medical help to the victim** rather than transporting the victim to a medical center, because movement will trigger the seizures and jerking.

Wood Preservatives

Creosote (coal tar) exposure can cause skin irritation and prolonged exposure may lead to inflamed skin. Vapors and fumes of creosote are irritating to the eyes and respiratory tract. Ingested creosote may result in severe liver damage. Creosote is typically found on railroad ties that are sometimes used for landscaping.

Pentachlorophenol (PCP, Penchlorol, Penta), typically used on utility or fence posts, is irritating to the eyes, skin and respiratory tract, causing stuffy nose, scratchy throat and tearing. Prolonged skin exposure sometimes leads to an acne-like skin condition. Ingestion of PCP solutions, excessive skin contact or inhalation of concentrated vapors may cause fever, headache, weakness, dizziness, nausea and profuse sweating. Extreme cases can induce loss of coordination and seizures, high fever, muscle spasms and muscle twitching, difficult breathing, a sense of tightness in the chest, abdominal pain and vomiting, restlessness, excitement and mental confusion. Intense thirst is also characteristic. Pentachlorophenol poisoning can be fatal.

Arsenical wood preservatives such as chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA) were used extensively in the past to treat construction lumber for decks, play sets and fence posts. If swallowed, arsenicals can cause nausea, headache, diarrhea and abdominal pain. Extreme signs and symptoms can progress to dizziness, muscle spasms, violent mental agitation and seizures. Prolonged exposure to arsenical wood preservatives can result in persistent headache, abdominal distress, salivation, low grade fever and upper respiratory irritation.

Herbicides

Herbicides that present the greatest potential health risks are covered in the next four sections. The vast majority of the remaining herbicides, regardless of their chemical structure, generally affect the human body in a similar way. In general, they can irritate the skin, eyes and respiratory tract. And they exhibit a low systemic toxicity potential. Always read and follow label recommendations carefully to avoid any of these potential health risks.

Bipyridyl Herbicides

Diquat and paraquat are the most common bipyridyl herbicides. Paraquat is more toxic than diquat and produces chronic abnormal cell growth in the lungs, cornea and lens of the eye, nasal mucus, skin and fingernails. Diquat affects the eye lens and intestinal tract lining but does not usually produce the frequently fatal lung changes characteristic of paraquat.

Ingesting diquat or paraquat causes severe irritation to the mucous membranes of the mouth, esophagus and stomach. Repeated vomiting generally follows. Large doses of diquat also produce restlessness and reduced sensitivity to stimulation.

Large doses of paraquat initially can affect the lungs, kidneys, liver and adrenal glands; potentially fatal fluid accumulation in the lungs can occur in 24 to 72 hours.

Lesser amounts of paraquat will cause decreased urine output because of kidney failure. Yellowing of the skin due to liver damage is sometimes observed. The initial phase is followed by an inactive period lasting up to two weeks, during which the victim appears to improve. However, permanent and gradually advancing lung damage caused by rapid growth of connective tissue cells that prevent proper lung function eventually leads to death through respiratory failure. Paraquat selectively concentrates in lung cells.

Skin exposure to paraquat and diquat concentrates may cause severe skin irritation and burning. Contact with dilute liquids and diquat dusts may cause slight to moderate irritation. Skin absorption of paraquat apparently is slight, but diquat is absorbed and after repeated contact will produce symptoms similar to those following ingestion.

Exposure to paraquat and diquat spray mist may produce skin irritations, nasal bleeding, irritation and inflammation of the mouth and upper respiratory tract, coughing and chest pain. Exposure to paraquat concentrates may cause blackening of the nails and abnormal nail growth.

There are no specific antidotes to counteract effects of paraquat, diquat and other bipyridyl herbicides once significant exposure and absorption has occurred. If ingested, induce vomiting immediately unless a physician advises not to. Flush affected eyes with water or wash skin with soap and water. Seek medical attention promptly.

Chlorophenoxy Herbicides

2,4-D and MCPA are examples of chlorophenoxy herbicides. These compounds are moderately irritating to skin and mucous membranes. Inhalations may cause burning sensations in the nose, sinuses and chest, and coughing may result. Prolonged inhalation sometimes causes dizziness.

Stomach irritation usually leads to vomiting soon after ingestion. Chest and abdominal pain and diarrhea may happen. Headache, mental confusion and bizarre behavior are early signs and symptoms of severe poisoning, which may progress to unconsciousness.

Arsenical Herbicides

Ansar, Montar, MSMA and cacodylic acid are some examples of arsenical herbicides. Acute arsenic poisoning usually appears within one hour of ingestion. Garlic odor of the breath and feces may help to identify the responsible toxicant in severe cases. Digestive tract effects include inflammation of the mouth and esophagus, burning abdominal pain, thirst, vomiting and bloody diarrhea.

Central nervous system effects include headache, dizziness, muscle weakness and spasms, low body temperature, sluggishness, violent mental agitation, coma and seizures. Liver damage may lead to yellowness of the skin. Injury to blood-forming tissues may cause a reduction in red and white blood cells and blood platelets. Death usually occurs one to three days after symptoms began and is usually the result of heart failure.

Chronic arsenic poisoning through skin exposures is usually more important than the intestinal tract effects that characterize acute poisoning. Chronic arsenic poisoning symptoms include overgrowth of the eye's cornea; scaling off of dead skin; excessive fluids under the skin of the face, eyelids and ankles; white streaks across the nails; loss of nails or hair; and brick red coloration of visible mucus membranes.

Other Herbicides

Endothall. Endothall is most commonly used as an aquatic herbicide or algaecide. It is irritating to skin, eyes and mucous membranes. In one lethal case, a man died after eating endothall. In this case, bleeding and swelling were noted in the gut and the lungs.

Sodium Chlorate. Sodium chlorate is used as a defoliant, nonselective herbicide and soil sterilant. It is irritating to skin, eyes and stomach. Even though sodium chlorate is poorly absorbed in the digestive tract, severe poisoning follows ingestion of a toxic dose. The irritant action on the gut causes nausea, vomiting and abdominal pain. Bluish skin is sometimes the only visible sign of poisoning. Dark brown staining of the blood and urine is an indicator of sodium chlorate poisoning.

Fungicides

Fungicides are extensively used in industry, agriculture and the home and garden. Fungicides vary in their potential for causing adverse effects in humans. Most fungicides currently used are unlikely to cause frequent or severe poisonings. However, fungicides have probably caused a large number of irritant injuries to skin and mucous membranes, as well as some skin sensitization. Always read and follow label recommendations carefully to avoid any potential health risks and to become aware of other possible risks that a specific fungicide may pose.

Other Pesticides

The three pesticides listed here are among the many pesticides that have not previously been mentioned. These are listed because of the relatively high potential for risk that they present.

4-aminopyridine. This compound is a highly toxic powder used as a bird repellent (Avitrol). It is often mixed with whole or cracked corn. It is toxic to all vertebrates. No human poisonings have occurred through normal use. However, when intentional ingestion occurred, the result was immediate abdominal discomfort, nausea and vomiting, weakness, dizziness, profuse sweating and sometimes death.

Metaldehyde. This substance has been used to control slugs and snails for many years. Poisoning of animals (particularly dogs) and children occurs occasionally when metaldehyde is swallowed. Ingestion of a toxic dose is often followed by nausea and vomiting, then fever, seizures and mental status changes, sometimes leading to coma. Other signs and symptoms that can occur are excessive salivation, facial flushing, dizziness, rapid breathing and excessively acidic blood. While most poisonings are dramatic, fatal events are rare.

Piperonyl butoxide. Piperonyl butoxide is not a pesticide but one of the most common synergists in use. Synergists are typically added to insecticide products to enhance the killing power of the active ingredient. Toxicity in mammals is low. The presence of synergists may enhance the toxic hazard of an insecticide; however, this has not been shown.

What if a Pesticide Poisoning Occurs?

The key to surviving and recovering from pesticide poisoning is ***rapid*** treatment. **Take emergency action immediately when you suspect a pesticide poisoning.** As time continues to elapse after exposure, recovery is hindered and the toxic effects are heightened.

If the common emergency telephone number is available in your area, immediately dial **911** whenever a pesticide poisoning is suspected. An advanced life support team will be dispatched to provide assistance.

If the common emergency telephone number is ***not*** available in your community, contact:

1. **Poison Center, 1-800-222-1222.** The Poison Center will be able to provide specific directions on procedures to follow until a life support team arrives
2. the nearest hospital
3. a physician.

Another source of medical information related to pesticides during nonemergencies is the National Pesticide Information Center, **1-800-858-7378.** Medical and consumer information on pesticides is available through this hotline and on the Web site *(npic.orst.edu*).

What a victim might think is a cold or the flu could be a fatal pesticide poisoning. Whenever possible, find out the following critical information:

1. Has the victim been exposed to a pesticide?
2. If so, which one and how did the exposure occur?
3. What emergency actions are on the pesticide label?

Many pesticide labels direct that vomiting be induced. Vomiting can be induced by giving the patient syrup of ipecac and water or by inserting the finger into the throat of the victim. **Do not induce vomiting when**:

1. the label says not to
2. seizures accompanied by involuntary jerking movements have occurred
3. the victim is unconscious or
4. the pesticide contains petroleum products such as xylene.

Caution: Inhaling vomitus can be life-threatening. Timely emergency treatment is vital to survival.

Always wash the victim's exposed skin with a detergent and plenty of water. Skin irritation can result from continuous exposure if not treated. If skin exposure occurs, obtain medical treatment. If the victim's clothing has been contaminated by a pesticide that is readily absorbed dermally, remove the clothing and decontaminate the victim's skin.

Remember to protect yourself as you help the victim. Wear chemically resistant gloves. If a pesticide spill is involved, move the victim away from the spill. Assist the victim first, take action to clean up the spill after all first aid has been completed.

Even though careful pesticide application is the norm, accidents can happen. Be prepared. Keep the number for the Poison Center readily available either in your telephone directory or near your telephone. Do not hesitate to contact medical authorities if any symptoms of pesticide poisoning occur. It is better to be safe than sorry.

Most pesticides used by Nebraska farmers, ranchers, lawn owners and gardeners exhibit lower toxicity than many of the pesticides discussed in this publication. When applied properly, with the required protective clothing and equipment, they are unlikely to cause problems for the user.

However, ***any*** pesticide ***can*** cause exposure problems. **Use all pesticides safely. Read the pesticide label completely and comply with all directions. Failure to do so may subject you to sanctions or penalties provided by federal and/or state laws.**

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The Pesticide Book. 2004. George W. Ware and David M. Whitacre. Sixth Edition. MeisterPro Information Resources. Willoughby, Ohio.

Pesticide Safety Telephone Numbers

Nonemergency Telephone Numbers

National Pesticide Information Center — **(800) 858-7378**
6:30 a.m. to 4:30 p.m. PT, 7 days a week

Chemical Referral Center (weekdays only) — **(800) 262-8200**
Referrals to manufacturers on health and safety related to chemicals

Emergency Telephone Numbers

Poison Center — **(800) 222-1222**
For aid in human poisoning cases

Pesticide Accident Hotline (CHEMTREC) — **(800) 424-9300**
For help involving spills, leaks, fires

Nebraska State Patrol — **(800) 525-5555**
To report chemical spills or releases
To report motor vehicle accidents

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