Practice Skill IV:
Clinical Management of Pesticide Exposure

Presented here is basic information on recognition and management of exposures to different types of pesticides that health care providers should be knowledgeable about. The information is not intended as a handbook or practical guide. Providers are referred to EPA's *Recognition and Management of Pesticide Poisonings* (Reigart and Roberts, 1999) for detailed clinical information. Providers should be able to:

- Recognize the signs and symptoms of pesticide exposures (both acute and chronic).
- Diagnose pesticide-related illness using appropriate testing procedures and environmental history (see Practice Skill I).
- Treat and manage health conditions associated with pesticide exposure. Refer patients to appropriate specialists and resources. Follow up appropriately with preventive guidance and clinical evaluation.

The material in this section is organized around a series of tables and checklists, as follows:

IV-1. Basic Management Techniques

- Table 3: Basic Clinical Management Techniques

IV-2. Signs and Symptoms of Pesticide Exposure

- Table 4: Cross-Reference of Pesticides and Classifications
- Table 5: Symptoms, Effects, and Special Management Considerations, by Pesticide Classification

IV-3. Carcinogenic and Reproductive Effects

- Table 6: Evidence of Carcinogenicity of Pesticides
- Table 7: Adverse Reproductive Outcomes

IV-4. Rapid Reference Tables for Common Pesticides: Signs, Symptoms, Evaluation, and Key Points of Treatment

- Table 8: Insecticides
- Table 9: Herbicides
- Table 10: Fumigants
- Table 11: Rodenticides
- Table 12: Fungicides
- Table 13: Disinfectants
- Table 14: Miscellaneous

IV-1. Basic Management Techniques

Basic management of acute pesticide poisoning includes eye, skin, and gastrointestinal decontamination, airway protection, and control of seizures. These techniques apply to most pesticide poisonings although there are special concerns for specific pesticides. Basic techniques are outlined in Table 3 below.

Table 3. Basic Clinical Management Techniques

Skin and Eye Decontamination

- Shower patient, hair to toe with soap and water to remove chemical
- Rubber gloves should be worn during decontamination
- Remember to clean skin folds and under fingernails
- Flush eyes with lots of clean water for 10 to 15 minutes
- Contaminated clothing should be removed promptly and bagged
- Avoid contact with contaminated clothing and body fluids

Airway Protection

- Ensure clear airway
- Suction oral secretions
- Administer oxygen unless not recommended (i.e., in paraquat and diquat poisoning)

Gastrointestinal Decontamination

No technique should be considered as routine management in pesticide poisonings, but can be considered as an option.

- Gastric Lavage:
  - Use only with ingestion of potentially life-threatening amount of poison and if it can be done *within 60 minutes of ingestion*
  - Contraindicated in hydrocarbon ingestion
- Catharsis:
  - Should be used as a single dose to reduce harmful effects
  - Sorbitol – 1-2 g/kg one time dose or
    Adults: 70% sorbitol, 1-2 mL/kg
    Children: 35% sorbitol, 1.5-2.3 mL/kg
  - Contraindications include absent bowel sounds, abdominal trauma or surgery, and intestinal perforation or obstruction. Also contraindicated in volume depletion, hypotension, electrolyte imbalance, and ingestion of a corrosive substance
  - Sorbitol is not recommended for poisoning with organophosphate, carbamates, arsenical diquat, or paraquat
- Activated Charcoal:
  - Most effective if used within 60 minutes of ingestion
  - Dosage:
    Adults 12 years and older: 25-100 g in 300-800 mL of water
    Children under 12 years: 25-50 g
    Infants under 20 kg: 1g/kg
  - Contraindications include unprotected airway, non-intact gastrointestinal tract, if there is increased risk for aspiration of a hydrocarbon pesticide
- Syrup of Ipecac:
  - Check pesticide label to determine if induced vomiting is contraindicated
  - Dosage:
    Adolescents and adults: 15-30 mL followed immediately with 240 mL of water
    Children 1-12 years: 15 mL preceded or followed by 120-240 mL of water
    Infants 6 months to 12 months: 5-10 mL preceded or followed by 120 to 240 mL of water
  - Dose may be repeated if no emesis in 20 to 30 minutes
  - Contraindications include diminished airway protective reflexes, ingestion of a corrosive material, ingestion of a substance likely to lead to life support within the next hour

Control of Seizures

- Most patients respond to benzodiazepines
- Lorazepam for status epilepticus:
  Adults: 2-4 mg/dose given IV over 2-5 minutes. Repeat as necessary to 8 mg in 12 hours
  Adolescents: Same as adult with 4 mg maximum
  Children under 12 years: 0.05-0.10 mg/kg IV over 2-5 minutes. Repeat as necessary 0.05 mg/kg 10-15 minutes after first dose. Maximum of 4 mg
- Diazepam is often used for organochlorine poisonings
  Adults: 5-10 mg IV, repeat every 5-10 minutes to maximum of 30 mg
  Children: 0.2-0.5 mg/kg IV every 5 minutes to maximum of 10 mg in children over 5 years and 5 mg in children under 5 years
- Phenobarbital may also be used
  Adults, children and infants: 15-20 mg/kg IV loading. 5 mg/kg IV every 15-30 minutes for a maximum of 30 mg/kg. Do not push drug faster than 1 mg/kg per minute

IV-2. Signs and Symptoms of Pesticide Exposure

Symptoms of pesticide poisoning and acute and long-term effects of exposure are outlined in this section (Table 5). This type of information should be at the finger-tips of practitioners. The material is organized by pesticide classification (insecticides, herbicides, fungicides, rodenticides, disinfectants, and miscellaneous).

Trade Names:

Table 4 can be used as a cross reference to determine the classification of common pesticides. Health care providers need to be aware that it is difficult to be sure of the exact ingredients in a product without referring to the actual product label. Over the years, trade names may change. In many cases (and especially true of products marketed to general consumers rather than those used in agriculture), a trusted trade name remains the same but the identity and/or composition (percentage) of the specific active and inert ingredients may change. Another problem is that some trade names (and many common names) sound similar to many users, which may lead a patient to inadvertently misidentify the pesticide to which he/she was exposed.

Relying on any cross-reference of trade and common or chemical names is risky, as the actual active ingredient to which the patient was exposed may differ entirely from the one(s) listed in the reference. If the product label is not available, and the patient can accurately remember the trade name, one potential source of information is the most recent edition of the *Farm Chemicals Handbook*, published annually by Meister Publishing Co., Willoughby, OH. The local Cooperative Extension office (listed under County Government in the telephone book) is another reliable source. Pesticide products aimed at the consumer market are especially difficult to identify without a label, as their trade names are generally are not included in reference documents, partly due to the frequency with which these products change.

Table 4: Cross-Reference of Pesticides and Classifications

Pesticide	Classification	
Aldicarb	Insecticide	Carbamate
Aldrin	Insecticide	Organochlorine
Arsenic	Miscellaneous	
Arsine gas	Miscellaneous	
Bendiocarb	Insecticide	Carbamate
Boric acid	Insecticide	
Cadmium	Fungicide	
Calcium cyanimide	Miscellaneous	
Carbaryl	Insecticide	Carbamate
Carbofuran	Insecticide	Carbamate
Cationic detergents	Disinfectant	
Chlordane	Insecticide	Organochlorine
Chlordecone	Insecticide	Organochlorine
Chlorpyrifos	Insecticide	Organophosphate
Copper	Fungicide	
Creosote	Miscellaneous	
Cyanide	Fumigant	
DDT	Insecticide	Organochlorine
DEET	Insecticide	
Diazinon	Insecticide	Organophosphate
2, 4-D	Herbicide	Chlorophenoxy
Dichlorvos	Insecticide	Organophosphate
Dieldrin	Insecticide	Organochlorine
Dinitrocresol	Herbicide	
Diquat	Herbicide	
Endosulfan	Insecticide	Organochlorine
Endothall	Miscellaneous	
Endrin	Insecticide	Organochlorine
Ethion	Insecticide	Organophosphate
Ethyl parathion	Insecticide	Organophosphate
Ethylene oxide	Fumigant	
Fenvalerate	Insecticide	Pyrethroid
Fluoride	Insecticide	
Formaldehyde	Fumigant	
Glutaraldehyde	Disinfectant	
Heptachlor	Insecticide	Organochlorine
Lindane	Insecticide	Organochlorine
Malathion	Insecticide	Organophosphate
Metaldehyde	Miscellaneous	
Methamidophos	Insecticide	Organophosphate
Methomyl	Insecticide	Carbamate
Methyl mercury	Fungicide	
Methyl parathion	Insecticide	Organophosphate
Naphthalene	Fumigant	
Nicotine	Insecticide	
Nitrophenol	Herbicide	
Organotin	Fungicide	
Paraquat	Herbicide	
Pentachlorophenol	Herbicide	
Permethrin	Insecticide	Pyrethroid
Phenol	Disinfectant	
Phosphine gas	Fumigant	
Pine oil	Disinfectant	
Promecarb	Insecticide	Carbamate
Propetamphos	Insecticide	Organophosphate
Propoxur	Insecticide	Carbamate
Pyrethrin	Insecticide	
Sodium hypochlorite	Disinfectant	
Strychnine	Rodenticide	
Thallium	Rodenticide	
Toxaphene	Insecticide	Organochlorine
Trichlorfon	Insecticide	Organophosphate
Warfarin	Rodenticide	
Zinc phosphide	Rodenticide	

Inerts:

Headaches, irritation, and general malaise are the most likely symptoms of acute overexposure to inert ingredients, especially those derived from petroleum sources. Neurological damage is possible from extremely large exposure to some inerts. Treating physicians should contact the pesticide registrant (a contact number must be listed on the pesticide label) for information on the specific inert ingredients in a particular product.

Table 5: Symptoms, Effects, and Special Management Considerations, by Pesticide Classification

Organophosphates — INSECTICIDES

Acute symptoms
- Anorexia
- Nausea/vomiting
- Abdominal cramps
- Diarrhea
- Chest tightness
- Increased salivation and lacrimation
- Miosis/blurred vision
- Sweating
- Bradycardia
- Bowel/urinary incontinence
- Muscle twitching
- Hypertension
- Hyperglycemia
- Tachycardia

Possible long term chronic effects
- Weakness
- Malaise
- Headache
- Lightheadedness
- QT prolongation and torsade de pointes
- Delayed polyneuropathy (weakness, paralysis, paresthesias of extremities)- rare

Carcinogenicity
- Some epidemiologic studies have reported associations between some organophosphate pesticides and Non-Hodgkin's lymphoma, leukemia, and lung cancers

Potential reproductive adverse outcomes
- No human data
- Limited animal data

Evaluation
- Fasciculations with miosis
- Plasma pseudocholinesterase
- Red blood cell acetylcholinesterase

Special management considerations
- Tissue oxygenation is essential prior to administering atropine to minimize risk of ventricular fibrillation
- Be sure toxicity is not due to severe pyrethroid poisoning
- Atropine sulfate
- Pralidoxime
- Contraindications: morphine, succinylcholine, theophylline, phenothiazines, reserpine

Carbamates — INSECTICIDES

Acute symptoms
- Anorexia
- Nausea/vomiting
- Abdominal cramps
- Diarrhea
- Chest tightness
- Increased salivation and lacrimation
- Miosis/blurred vision
- Sweating
- Bradycardia
- Bowel/urinary incontinence
- Muscle twitching
- Hypertension
- Hyperglycemia
- Tachycardia

Possible long term chronic effects
- Weakness
- Malaise
- Headache
- Lightheadedness
- QT prolongation and torsade de pointes

Carcinogenicity
- Not considered carcinogenic

Potential reproductive adverse outcomes
- Carbaryl has been classified as a male reproductive hazard
- Carbaryl crosses the placenta
- High level exposure in pregnant women to Aldicarb resulted in premature stillborn infants

Evaluation
- Fasciculations with miosis
- Plasma pseudocholinesterase
- Red blood cell acetylcholinesterase

Special management considerations
- Tissue oxygenation is essential prior to administering atropine to minimize risk of ventricular fibrillation
- Atropine sulfate
- Pralidoxime not indicated
- Contraindications: morphine, succinylcholine, theophylline, phenothiazines, reserpine

Organochlorines — INSECTICIDES

Acute symptoms
- Headache
- Nausea
- Dizziness
- Incoordination
- Confusion
- Tremor
- Paresthesias

Possible long term chronic effects
- Anxiety
- Tremor
- Opsoclonus
- Personality change
- Oligospermia
- Pleuritic and joint pains
- Weight loss
- Liver disease

Evaluation
- Appropriate history of exposure

Special management considerations
- Contraindications: atropine, epinephrine, other adrenergic amines due to enhanced myocardial irritability, animal or vegetable oils or fats by mouth

Pyrethrum/Pyrethroids — INSECTICIDES

Acute symptoms
- Salivation
- Nausea and vomiting
- Diarrhea
- Irritability
- Tremor
- Incoordination
- Paresthesias
- Pulmonary edema
- Muscle fasciculation
- Seizures and death
- Asthma
- Contact dermatitis

Possible long term chronic effects
- Allergic rhinitis
- Asthma
- Contact dermatitis

Evaluation
- Appropriate history of exposure

Special management considerations
- Be sure toxicity is not due to organophosphates or carbamates

DEET — INSECTICIDES

Acute symptoms
- Headache
- Restlessness
- Irritability
- Ataxia
- Rapid loss of consciousness
- Hypotension
- Seizures

Possible long term chronic effects
- Flaccid paralysis and areflexia

Boric acid — INSECTICIDES

Acute symptoms
- Nasal irritation
- Mucous membrane dryness
- Cough
- Shortness of breath
- Chest tightness
- Beefy red skin rash on palms, soles, buttocks, scrotum
- Nausea
- Diarrhea
- Hypothermia

Possible long term chronic effects
- Persistent vomiting
- Abdominal pain
- Lethargy
- Headache

Evaluation
- Appropriate history of exposure
- Urine borate levels

Fluorides — INSECTICIDES

Acute symptoms
- Thirst
- Abdominal pain
- Vomiting
- Diarrhea
- Cardiac arrhythmia and shock

Possible long term chronic effects
- Gastric mucosal hemorrhage, ulceration, erosions
- Hypocalcemia

Evaluation
- Appropriate history of exposure

Special management considerations
- Milk, calcium gluconate, or magnesium citrate

Nicotine — INSECTICIDES

Acute symptoms
- Salivation
- Sweating
- Dizziness
- Nausea and vomiting
- Diarrhea

Possible long term chronic effects
- Burning in mouth, throat
- Agitation
- Confusion
- Headache
- Abdominal pain

Evaluation
- Urine cotinine levels

Special management considerations
- Atropine for severe salivation, diarrhea or bradycardia

Chlorophenoxy compounds — HERBICIDES

Acute symptoms
- Skin and mucosal membrane irritation
- Burning sensations of nasopharynx and chest
- Cough
- Dizziness
- Peculiar odor on breath
- Vomiting
- Headache
- Diarrhea
- Confusion
- Bizarre and aggressive behavior

Possible long term chronic effects
- Hyperventilation
- Muscle weakness
- Peripheral neuropathy

Evaluation
- Chlorophenoxy compound urine levels

Paraquat — HERBICIDES

Acute symptoms
- Burning pain in mouth, throat, chest, and upper abdomen
- Bloody diarrhea
- Giddiness
- Headache
- Fever
- Myalgia
- Lethargy
- Pulmonary edema and early lung damage

Possible long term chronic effects
- Abdominal pain due to pancreatitis
- Proteinuria
- Hematuria
- Pyuria
- Azotemia
- Pulmonary fibrosis

Evaluation
- Urine dithionite test – blue color

Special management considerations
- Gastrointestinal decontamination with Bentonite, Fuller's Earth, or activated charcoal
- No oxygen unless severely hypoxic

Diquat — HERBICIDES

Acute symptoms
- Nervousness
- Irritability
- Restlessness
- Combativeness
- Disorientation
- Nonsensical statements
- Inability to recognize family/friends
- Burning pain in mouth, throat, chest, and upper abdomen
- Bloody diarrhea
- Giddiness
- Headache
- Fever
- Myalgia
- Lethargy

Possible long term chronic effects
- Proteinuria
- Hematuria
- Pyuria
- Azotemia

Evaluation
- Urine dithionite test – green color

Special management considerations
- Gastrointestinal decontamination with Bentonite, Fuller's Earth, or activated charcoal
- No oxygen unless severely hypoxic

Pentachlorophenol — HERBICIDES

Acute symptoms
- Irritation of nose, throat and eyes
- Sweating
- Weakness
- Dizziness
- Anorexia
- Intense thirst
- Hyperthermia
- Tremor
- Shortness of breath
- Chest tightness

Possible long term chronic effects
- Contact dermatitis
- Diffuse urticaria or chloracne

Evaluation
- Blood and urine pentachlorophenol levels (ratio of blood to urine is 1:2.5)

Special management considerations
- Antipyretic therapy with salicylates is strongly contraindicated
- Reduce body temperature with sponge baths and fans

Nitrophenols/Dinitrocresols — HERBICIDES

Acute symptoms
- Profuse sweating
- Thirst
- Hyperthermia
- Headache
- Confusion
- Malaise
- Restlessness
- Tachycardia
- Tachypnea

Possible long term chronic effects
- Yellow staining of skin, sclera, and urine
- Renal failure
- Jaundice
- Weight loss

Evaluation
- Appropriate history of exposure
- Blood dinitro-ortho-cresol

Special management considerations
- Antipyretic therapy with salicylates is strongly contraindicated
- Reduce body temperature with sponge baths and fans
- Atropine is absolutely contraindicated
- While not contraindicated, NSAIDs and acetaminophen will not likely have much effect

Coumarins — RODENTICIDES

Acute symptoms
- Nosebleeds
- Bleeding gums
- Extensive ecchymosis
- Fatigue
- Dyspnea on exertion

Possible long term chronic effects
- Fatigue
- Dyspnea on exertion

Evaluation
- Prothrombin time

Special management considerations
- Vitamin K1 (phytonadione)

Strychnine — RODENTICIDES

Acute symptoms
- Convulsions

Evaluation
- Appropriate history of exposure

Special management considerations
- Diazepam for seizure control

Thallium — RODENTICIDES

Acute symptoms
- Abdominal pain
- Nausea and vomiting
- Bloody diarrhea
- Stomatitis
- Salivation
- Headache
- Lethargy
- Muscle weakness
- Painful paresthesias
- Tremor
- Ptosis
- Ataxia

Possible long term chronic effects
- Alopecia
- Ileus
- Hypertension
- Ventricular arrythmias

Evaluation
- 24-hour urine excretion

Special management considerations
- Chelating agents are not recommended

Phosphides — RODENTICIDES

Acute symptoms
- Nausea and vomiting
- Excitement
- Chills
- Chest tightness
- Dyspnea
- Cough

Possible long term chronic effects
- Hepatic failure with jaundice and hemorrhage
- Delirium
- Convulsions
- Tetany due to hypocalcemia
- Anuria
- Ventricular arrythmias

Evaluation
- Appropriate history of exposure
- Foul rotten fish odor to vomitus, feces, and sometimes breath

Special management considerations
- Well-ventilated room in case phosphine gas evolves from emesis, lavage fluid, and feces

Organomercury compounds — FUNGICIDES

Acute symptoms
- Metallic taste in mouth
- Numbness and tingling of digits and face
- Tremor
- Headache
- Fatigue
- Emotional lability
- Difficulty thinking

Possible long term chronic effects
- Incoordination
- Slurred speech
- Loss of position sense
- Hearing loss
- Constriction of visual fields
- Spasticity/rigidity of muscle movements
- Deterioration of mental capacity

Evaluation
- Blood mercury level
- 24-hour urine mercury

Special management considerations
- Chelation with Succimer

Copper compounds — FUNGICIDES

Acute symptoms
- Metallic taste
- Nausea and vomiting
- Epigastric pain
- Jaundice
- Hepatomegaly

Possible long term chronic effects
- Hepatomegaly
- Hemolysis
- Methemoglobinemia
- Renal failure

Evaluation
- Appropriate history of exposure

Special management considerations
- Dilute with water or milk

Organotin compounds — FUNGICIDES

Acute symptoms
- Headache
- Nausea and vomiting
- Dizziness
- Photophobia
- Mental disturbances

Possible long term chronic effects
- Epigastric pain
- Hyperglycemia

Evaluation
- Appropriate history of exposure

Special management considerations
- Chelation not effective

Cadmium compounds — FUNGICIDES

Acute symptoms
- Eye, nose, throat irritation
- Fever
- Cough
- Malaise
- Headaches
- Abdominal pain
- Tenesmus

Possible long term chronic effects
- Chemical pneumonitis

Evaluation
- Blood and urine cadmium levels

Special management considerations
- Chelation with EDTA
- Dimercaprol (BAL) is not recommended

Cyanide — FUMIGANTS

Acute symptoms
- Pink/red skin color
- Bitter almond odor to breath
- Constriction and numbness of throat
- Jaw stiffness
- Salivation
- Nausea and vomiting
- Lightheadedness
- Apprehension

Possible long term chronic effects
- Violent convulsions

Evaluation
- Blood and urine thiocyanate

Special management considerations
- Continuous oxygen administration
- Cyanide antidotes: amyl nitrite, sodium nitrite, and sodium thiosulfate

Naphthalene — FUMIGANTS

Acute symptoms
- Eye, nose, and throat irritation
- Headache
- Dizziness
- Nausea and vomiting

Possible long term chronic effects
- Hemolysis

Evaluation
- Blood alpha naphthol level

Special management considerations
- Examine plasma for evidence of hemolysis

Phosphine gas — FUMIGANTS

Acute symptoms
- Fatigue
- Nausea
- Headache
- Dizziness
- Thirst
- Cough
- Shortness of breath
- Tachycardia
- Chest tightness
- Paresthesia
- Jaundice

Possible long term chronic effects
- Pulmonary edema
- Odor resembling decaying fish
- Ventricular arrythmias

Evaluation
- Appropriate history of exposure

Special management considerations
- Magnesium sulfate may decrease likelihood of fatality

Formaldehyde — FUMIGANTS

Acute symptoms
- Eye, nose, throat irritation
- Laryngeal edema
- Tracheobronchitis

Possible long term chronic effects
- Allergic dermatitis
- Asthma-like symptoms

Evaluation
- Appropriate history of exposure

Ethylene oxide — FUMIGANTS

Acute symptoms
- Headache
- Nausea
- Vomiting
- Weakness
- Persistent cough

Possible long term chronic effects
- Pulmonary edema
- Cardiac arrythmias

Evaluation
- Appropriate history of exposure

Glutaraldehyde — DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation
- Gastrointestinal irritation
- Diarrhea
- Rhinitis

Evaluation
- Appropriate history of exposure

Sodium hypochlorite — DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation

Evaluation
- Appropriate history of exposure

Special management considerations
- Dilution with water or milk
- Do not give acids due to risk of generating chlorine gas

Cationic detergents — DISINFECTANTS

Acute symptoms
- Eye irritation
- Skin rash and irritation
- Corneal and skin burns
- Burns to lips, oral mucosa, esophagus, and stomach
- Vomiting
- Diarrhea
- Abdominal pain

Evaluation
- Appropriate history of exposure

Special management considerations
- Gastrointestinal decontamination is contraindicated

Phenols — DISINFECTANTS

Acute symptoms
- Nausea
- Vomiting
- Diarrhea
- Eye and skin burns
- Corrosive injury to mouth and upper gastrointestinal tract

Possible long term chronic effects
- Hypotension
- Myocardial failure
- Pulmonary edema
- Liver and renal toxicity
- Methemoglobinemia
- Hemolysis
- Contact dermatitis

Evaluation
- Appropriate history of exposure

Special management considerations
- Gastrointestinal decontamination is contraindicated

Pine oil — DISINFECTANTS

Acute symptoms
- Eye, nose, throat irritation
- Gastrointestinal irritation

Possible long term chronic effects
- Respiratory distress
- Renal failure
- Myoglobinuria

Evaluation
- Appropriate history of exposure

Special management considerations
- Induced emesis is contraindicated

IV-3. Carcinogenic and Reproductive Effects

The likelihood of pesticide exposure causing cancer is dependent on the frequency, duration, and magnitude or intensity of exposure as well as on latency (the length of time from exposure to onset of disease). The potential for carcinogenicity shown in Table 6 is based on EPA's classification system. The EPA classification system and its definitions are as follows:

- Group A - Carcinogenic to Humans. Pesticides in this group have sufficient evidence from epidemiologic studies to support a causal relationship between exposure to the agent and cancer. All uses of these pesticides have been cancelled except coal tar and chromium as a wood preservative and ethylene oxide as a fumigant.
- Group B – Probable human carcinogen. This group is divided into subgroups B1 and B2:
  - B1 – Pesticides in this subgroup have sufficient evidence for carcinogenicity from animal studies, but limited evidence from epidemiologic studies. All uses of these pesticides have been cancelled except creosote as a wood preservative and formaldehyde.
  - B2 – Pesticides in this subgroup have sufficient evidence from animal studies with inadequate or no evidence from epidemiologic studies. All or most of the uses from this class have been cancelled or were never approved; others have various food and other uses.
- C – Possible human carcinogen. Pesticides in this group have limited evidence of carcinogenicity in animals and no human data.
- D – Not classifiable as to human carcinogenicity. Pesticides in this group do not have adequate human and animal evidence for carcinogenicity or no data are available.
- E – Evidence on non-carcinogenicity for humans. Pesticides in this group show no evidence for carcinogenicity in at least 2 animal tests in different species or in adequate epidemiologic and animal studies.

This list of pesticides in Table 6 is not exhaustive and it changes as more data are acquired. Additional information on the EPA carcinogenicity classification of pesticides can be obtained from the EPA's Science Information Management Branch, Health Effects Division, Office of Pesticide Programs.

Table 6: Evidence of Carcinogenicity of Selected Pesticides

Pesticide	Carcinogenicity Classification
Insecticides	
Organophosphates	
Dichlorvos	C
Carbamates	
Aldicarb	E
Carbaryl	C
Organochlorines	
Aldrin	B2
Chlordane	B2
Chlordecone	B2
Dieldrin	B2
Heptachlor	B2
DDT	B2
Lindane	B2
Toxaphene	B2
Pyrethrins/pyrethroids	
Permethrin	C
Fenvalerate	E
Herbicides	
Pentachlorophenol	B2
Acetochlor	B2
Lactofen	B2
Fumigants	
Formaldehyde	B1
Ethylene Oxide	B1
Fungicides	
Captan	B2
Maneb	B2
Cadmium compounds	B1
Miscellaneous	
Arsenic	A
Creosote	B1

Source: U.S. Environmental Protection Agency. *Chemicals Evaluated for Carcinogenic Potential.* Science Information Management Branch, Health Effects Division, Office of Pesticide Program; U.S. EPA.

Table 7 outlines reproductive outcomes for certain pesticides for which there are either animal or human data. The information in this table is suggestive only and should not be considered conclusive.

Table 7: Adverse Reproductive Outcomes*

Pesticide	Sperm/testicular abnormalities	Infertility	Spontaneous abortion	Preterm delivery	Fetal death	Congenital abnormalities	Found in breast milk	Postnatal effects
Insecticides								
Organophosphates								
Chlorpyrifos	A		A				A	
Diazinon	A				A	A	A	
Malathion	A					A	A	
Carbamates								
Aldicarb					H			
Carbaryl	H, A					A	A	A
Organochlorines								
Chlordecone	H, A		A					A
DDT		H					H	A
Lindane	A		A				H	
Pyrethrins/pyrethroids								
Permethrin								A
Cypermetherin	A							A
Cyfluthrin								A
Herbicides								
Chlorophenoxy compounds								
Dichlorophenoxy acetic acid	H				A	A		A
Pentachlorophenol								
Fumigants								
Formaldehyde	A		H					H, A
Ethylene Oxide	A	A	H					
Fungicides								
Organomercury compounds								
Methyl mercury chloride	A					H	H	H
Cadmium compounds	A, H					A	H	
Miscellaneous								
Arsenic	A				H	A	H	

*A = animal data; H = at least some human data.

Source: Frazier LM and Hage ML. *The Reproductive Hazards of the Marketplace.* New York: Van Nostrand Reinhold, 1998.

IV-4. Rapid Reference Tables for Common Pesticides

Tables 8-14 can be used as rapid reference tables for signs and symptoms of common exposures, as well as evaluation tips and key points of treatment. Practitioners can identify common pesticides that may explain a patient's symptoms or physical findings and then identify basic evaluation and treatment recommendations. The following points should be kept in mind in using these tables:

- Included are those pesticides most often involved in symptomatic illness, based on 1996 data from the American Association of Poison Control Centers' Toxic Exposure Surveillance System.
- The symptoms and signs listed are not specific to pesticide poisoning, but can be manifestations of other illness or exposures.
- An individual exposed to a pesticide listed in the tables may present with signs and symptoms not listed in the tables.
- The main purpose of this reference is to provide the practitioner with hints that may indicate additional investigation or prompt referral for further evaluation and treatment.

For further information, refer to EPA's *Recognition and Management of Pesticide Poisonings* for more in-depth discussion of toxicology, poisoning confirmation, and treatment for these and other pesticides.

Table 8: Rapid Reference Tables: Insecticides

Signs and Symptoms	Organophosphates	N-Methyl Carbamate	Solid Organochlorine	DEET	Boric Acid	Fluorides	Pyrethrins/pyrethroids	Nicotine
General								
Hyperthermia					X			
Thirst					X	X		
Anorexia	X	X						X
Salty, soapy taste in mouth						X		
Skin								
Contact dermatitis				X			X	
Beefy red palms, soles					X			
Urticaria				X		X		
Pallor			X			X		
Cyanosis								X
Sweating, diaphoresis	X	X						X
Eye								
Tearing	X	X					X	
Diplopia	X	X						X
Miosis	X	X						X
Dilated pupils						X		
Nervous system								
Paresthesias	X		X			X	X	X
Headache	X	X	X		X	X		X
Behavioral-mood disturbances	X	X	X			X		X
Depression, stupor, coma, respiratory failure	X	X			X	X		
Seizures/convulsions	X	X	X	X	X	X		X
Muscle twitching	X	X						X
Tetany, carpopedal spasms						X		
Tremor	X	X			X			X
Incoordination/ataxia	X	X	X					X
Paresis, muscle weakness	X	X						X
Hypotension, shock					X			X
Hypertension	X							X
Cardiovascular								
Cardiac arrythmias			X			X		X
Bradycardia	X	X						X
Tachycardia	X							
Respiratory								
Upper respiratory irritation					X			
Runny nose	X	X					X	
Pulmonary edema	X	X					X	
Dyspnea	X	X					X	X
Gastrointestinal								
Nausea/vomiting	X	X			X	X		X
Diarrhea	X	X			X	X	X	X
Abdominal pain	X	X			X	X		X
Salivation	X	X				X		X
Kidney								
Oliguria, polyuria						X		
Acute renal failure					X	X		
Ketonuria					X			
Blood								
Hypocalcemia						X		
Hyperkalemia						X		
Elevated LDH, GOT, GPT, ALT/AST, alkaline, phosphatase			X					
Depressed RBC, acetylcholinesterase and plasma pseudocholinesterase	X	X						

Table 8: Rapid Reference Tables: Insecticides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Organophosphate	■ Plasma pseudocholinesterase ■ RBC acetylcholinesterase	■ Adequate tissue oxygenation ■ Atropine ■ Pralidoxime ■ Skin and gastrointestinal decontamination
N-Methyl Carbamate	■ Plasma pseudocholinesterase ■ RBC acetylcholinesterase	■ Adequate tissue oxygenation ■ Atropine ■ Pralidoxime of little value ■ Skin and gastrointestinal decontamination
Solid Organochlorine	No routine test available	■ Supportive ■ Control seizures with Diazepam
DEET	No routine test available	■ Skin and gastrointestinal decontamination ■ Control seizures with Diazepam
Boric Acid	Urine borate	■ Skin and gastrointestinal decontamination
Fluorides	■ Blood fluoride ■ Serum electrolytes	■ Skin and gastrointestinal decontamination ■ Calcium and magnesium administration
Pyrethrins/pyrethroids	No routine test available	■ Antihistamines ■ Be sure that symptoms are not due to organophosphate or carbamate toxicity ■ Eye, skin and gastrointestinal decontamination ■ Control seizures with Diazepam
Nicotine	Urine cotinine	■ Skin and gastrointestinal decontamination

Table 9: Rapid Reference Tables: Herbicides

Signs and Symptoms	Chlorophenoxy compounds	Paraquat	Diquat	Pentachlorophenol	Nitrophenols/ dinitrocresols
General					
Hyperthermia (fever, pyrexia)	X			X	X
Hot sensations				X	X
Myalgias	X	X			
Thirst				X	X
Anorexia				X	X
Skin					
Irritation, rash, blistering, erosion	X	X	X	X	
Contact dermatitis		X			
Flushing					X
Urticaria					
Cyanosis		X			
Yellow stain					X
Jaundice		X	X		
Loss fingernails		X			
Sweating, diaphoresis				X	
Eye					
Conjunctivitis		X	X	X	X
Tearing				X	
Yellow sclera					X
Keratitis		X			
Nervous system					
Headache		X	X	X	X
Behavioral-mood disturbances			X	X	X
Depression, stupor, coma, respiratory failure	X	X	X		
Seizures/convulsions	X			X	X
Muscle twitching	X				
Myotonia	X				
Cardiovascular					
Tachycardia				X	X
Respiratory					
Upper respiratory irritation	X	X			
Runny nose	X				
Pulmonary edema		X			
Pulmonary consolidation		X	X		
Dyspnea		X		X	X
Gastrointestinal					
Nausea/vomiting	X		X	X	
Diarrhea	X	X	X		
Abdominal pain	X	X	X		
Somatitis		X	X		
Ileus			X		
Kidney					
Acute renal failure	X	X	X	X	X
Blood					
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase	X			X	X

Table 9: Rapid Reference Tables: Herbicides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Chlorophenoxy compounds	Blood and urine chlorophenoxy compound	■ Persons with chronic skin disease or known sensitivity to chlorophenoxy herbicides should avoid use ■ Skin and gastrointestinal decontamination ■ Use respiratory protection if symptoms develop after use
Paraquat	Urine Dithionite test for paraquat	■ Skin ,eye decontamination ■ GI decontamination with Bentonite, Fuller's Earth or activated charcoal ■ DO NOT administer oxygen unless severely hypoxic ■ Pain management
Diquat	Urine Dithionite test for diquat	■ Skin ,eye decontamination ■ GI decontamination with Bentonite, Fuller's Earth or activated charcoal ■ DO NOT administer oxygen unless severely hypoxic ■ Pain management
Pentachlorophenol	■ Total pentachlorophenol in urine ■ Free pentachlorophenol in plasma	■ No antidote, supportive treatment ■ Salicylates for fever control is strongly contraindicated ■ Control hyperthermia with sponge baths and fans ■ Decontaminate eyes, skin, hair , clothing ■ Consider GI decontamination after ingestion if within 1 hour of poisoning ■ High calorie, high vitamin diet to restore fat and carbohydrates during recovery
Nitrophenols/dinitrocresols	Blood nitrophenol and nitrocresol	■ No specific antidote ■ Hyperthermia control with sponge baths and fans ■ Salicylates for fever control is strongly contraindicated ■ Atropine absolutely contraindicated ■ Decontaminate skin, hair, clothing ■ High calorie, high vitamin diet to restore fat and carbohydrates during recovery

Table 10: Rapid Reference Tables: Fumigants

Signs and Symptoms	Cyanide	Naphthalene	Phosphine gas	Formaldehyde	Methyl bromide	Ethylene oxide
General						
Hyperthermia		X				
Chills			X			
Skin						
Irritation, rash, blistering, or erosion				X		X
Dermal sensitization				X		X
Pallor	X	X	X	X		X
Jaundice			X			
Sweating, diaphoresis		X				
Eye						
Conjunctivitis		X		X		X
Yellow sclerae			X			
Miosis						
Dilated pupils	X					
Unreactive pupils	X					
Nervous system						
Headache		X	X			
Behavioral-mood disturbances	X					
Depression, stupor, coma, respiratory failure			X			
Seizures/convulsions	X		X			
Hypotension, shock			X	X		
Cardiovascular						
Cardiac arrythmias	X		X			X
Bradycardia	X					
Respiratory						
Upper respiratory irritation		X		X		
Pulmonary edema			X			X
Dyspnea	X					
Gastrointestinal						
Nausea/vomiting	X	X	X			X
Salivation	X					
Liver						
Enlargement			X			
Kidney						
Oliguria		X	X			
Acute renal failure						
Hemoglobinuria		X				
Blood						
Hemolysis		X				
Methemoglobinemia	X					
Hyperkalemia		X				
Anemia		X				
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase			X			

Table 10: Rapid Reference Tables: Fumigants *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Cyanide	Urine thiocyanate	■ Prompt administration of oxygen ■ Antidotes: amyl nitrite—sodium nitrite—sodium thiosulfate ■ GI decontamination if poisoning < 1 hour ■ Avoid Ipecac
Naphthalene	Urine alpha naphthol	■ Eye, skin decontamination ■ GI decontamination for ingestion if poisoning < 1 hour
Phospine gas	No test available	■ Fresh air ■ Skin decontamination
Formaldehyde	No test available	■ Fresh air ■ Eye, skin decontamination
Methyl bromide	Serum bromide ion	■ Fresh air ■ Eye, skin decontamination
Ethylene oxide	No test available	■ Fresh air ■ Eye, skin decontamination

Table 11: Rapid Reference Table: Rodenticides

Signs and Symptoms	Coumarins	Strychnine	Thallium	Zinc phosphide	
General					
Hyperthermia			X		
Thirst				X	
Skin					
Pallor	X				
Cyanosis		X			
Jaundice				X	
Eccymosis	X				
Loss of hair			X		
Brittle nails, white striations			X		
Eye					
Ptosis			X		
Optic atrophy			X		
Nervous system					
Paresthesias			X	X	
Headache			X		
Behavioral-mood disturbances			X		
Seizures/convulsions			X		
Tetany, carpopedal spasms				X	
Tremor					
Incoordination/ataxia			X		
Hypotension, shock			X	X	
Hypertension			X		
Cardiovascular					
Cardiac arrythmias			X	X	
Respiratory					
Pulmonary edema				X	
Gastrointestinal					
Nausea/vomiting			X	X	
Diarrhea	X			X	
Abdominal pain	X		X	X	
Ileus			X		
Kidney					
Oliguria				X	
Blood					
Hypoprothrombinemia	X			X	
Hypocalcemia			X	X	
Elevated LDH, GOT, GPT, ALT/AST, alkaline phosphatase				X	

Table 11: Rapid Reference Table: Rodenticides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Coumarins	Prothrombin time	■ Determine quantity ingested: if no more than a mouthful or two, treatment likely not necessary ■ Vitamin K for increased prothrombin time ■ GI decontamination if ingested within a few hours ■ Ferrous sulfate during recovery after more severe poisoning
Strychnine	No test available	■ Control seizures with Diazepam ■ GI decontamination if ingested < 1 hour ■ Avoid fluid overload ■ Monitor ECG ■ Calcium gluconate for hypocalcemia
Thallium	Serum and urine thallium	■ GI decontamination if ingestion < 1 hour ■ Seizure control ■ Chelating agents not recommended
Zinc phospide	■ Foul, rotten fish odor of vomitus, feces, breath ■ Serum phosphate and calcium	■ Skin decontamination. Make sure all particles of phosphorus have been removed ■ Phosphine gas may be formed from vomitus, lavage fluid and feces. Individual's room should be well-ventilated ■ Anyone attending patient should wear gloves

Table 12: Rapid Reference Tables: Fungicides

Signs and Symptoms	Organomercury Cmpds	Copper Cmpds	Organotin Cmpds	Cadmium Cmpds	
General					
Hyperthermia				X	
Metallic taste in mouth	X				
Skin					
Irritation, rash, blistering, erosion	X	X	X	X	
Cyanosis				X	
Jaundice				X	
Sweating, diaphoresis		X			
Eye					
Conjunctivitis		X	X		
Constricted visual fields	X				
Photophobia					
Nervous system					
Paresthesias	X				
Headache	X	X	X	X	
Behavioral-mood disturbances	X		X		
Seizures/convulsions			X		
Muscle twitching	X				
Tremor	X				
Incoordination/ataxia	X				
Paralysis, paresis, muscle weakness	X				
Hearing loss	X				
Hypotension, shock		X			
Cardiovascular					
Cardiac arrythmias					
Respiratory					
Upper respiratory irritation		X	X	X	
Runny nose		X	X		
Pulmonary edema				X	
Pulmonary consolidation				X	
Dyspnea				X	
Gastrointestinal					
Nausea/vomiting		X	X	X	
Diarrhea				X	
Abdominal pain		X	X	X	
Stomatitis		X			
Salivation				X	
Liver					
Enlargement		X			
Kidney					
Hematuria		X			
Proteinuria				X	
Acute renal failure			X		
Blood					
Hemolysis		X			
Methemoglobinemia		X			
Carboxyhemoglobinemia			X		

Table 12: Rapid Reference Tables: Fungicides *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Organomercury compounds	Blood mercury	■ Skin decontamination ■ Chelation with Succimer most effective
Copper compounds	No test available	■ Skin decontamination ■ Water or milk as soon as possible ■ Do not induce emesis
Organotin compounds	No test available	■ Skin decontamination ■ GI decontamination if ingestion < 1 hour ■ Chelating agents not effective
Cadmium compounds	Blood and urine cadmium	■ Skin decontamination ■ GI decontamination may be considered ■ Chelation with EDTA may be considered ■ Dimercaprol (BAL) is contraindicated

Table 13: Rapid Reference Tables: Disinfectants

Signs and Symptoms	Glutaraldehyde	Sodium hypochlorite	Cationic detergents	Phenols	Pine Oil
Skin					
Irritation, rash, blistering, erosion		X	X	X	
Nervous system				X	
Respiratory					
Upper respiratory irritation	X				X
Runny nose	X				
Aspiration pneumonia					X
Asthma	X				
Pulmonary edema			X		
Gastrointestinal					
Nausea/vomiting				X	
Diarrhea	X			X	X
Abdominal pain	X				
Blood					
Methemoglobinemia				X	

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Glutaraldehyde	No test available	■ GI decontamination if ingested < 1 hour
Sodium hypochlorite	No test available	■ GI decontamination is contraindicated ■ Dilution with water or milk ■ Do not administer acids due to risk of formation of chlorine gas ■ Eye, skin decontamination
Cationic detergents	No test available	■ Eye, skin decontamination ■ GI decontamination is contraindicated ■ Endoscopy for ingestion of highly concentrated solution or oral burns ■ Use of corticosteroids is controversial
Phenols	No test available	■ GI decontamination is contraindicated ■ Dilution with water or milk
Pine oil	No test available	■ GI decontamination is contraindicated ■ Skin, eye decontamination ■ Observation for at least 6 hours for pulmonary symptoms

Table 14: Rapid Reference Tables: Miscellaneous

Signs and Symptoms	Inorganic arsenicals	Arsine gas	Calcium cyanimide	Creosote	Endothall	Metaldehyde
General						
Hypothermia				X		
Hyperthermia	X					X
Chills		X				
Thirst	X					
Anorexia	X					
Alcohol intolerance			X			
Metallic taste in mouth	X					
Skin						
Irritation, rash, blistering, erosion				X	X	
Contact dermatitis				X		
Pallor				X		
Cyanosis						
Keratoses, brown discoloration	X					
Jaundice	X					
Loss of hair	X					
Brittle nails, white striations	X					
Eye						
Conjunctivitis				X	X	
Nervous system						
Paresthesias	X					
Headache	X			X		
Behavioral-mood disturbances	X					
Depression, stupor, coma, respiratory failure	X					X
Seizures/convulsions	X			X	X	X
Tremor						X
Paralysis	X					
Hypotension, shock	X		X		X	
Cardiovascular						
Cardiac arrythmias	X					
Tachycardia			X			X
Respiratory						
Runny nose	X					
Pulmonary edema				X		
Dyspnea			X	X		
Gastrointestinal						
Nausea/vomiting	X				X	X
Diarrhea	X				X	
Abdominal pain	X					X
Stomatitis	X					
Liver						
Enlargement	X					
Kidney						
Proteinuria	X	X				
Hemoglobinuria		X				
Smoky urine				X		
Blood						
Hemolysis		X				
Methemoglobinemia				X		
Hyperkalemia		X				
Anemia	X	X				
Leukopenia, thrombocytopenia	X					

Table 14: Rapid Reference Tables: Miscellaneous *(continued)*

Evaluation and Key Points of Treatment

	Evaluation	Key Points of Treatment
Inorganic arsenicals	24-hour urinary arsenic	■ Skin decontamination ■ GI decontamination if ingested < 1 hour ■ Chelation with Dimercaprol (BAL)
Arsine gas	24-hour urinary arsenic	■ Fresh air ■ Intravenous fluids
Calcium cyanimide	No test available	■ Skin decontamination ■ GI decontamination if ingested < 1 hour ■ Hypotension: Trendelenburg, IV fluids ■ Atropine not indicated
Creosote	Dark, smoky urine turns violet/blue with ferric chloride solution	■ Skin, eye decontamination ■ GI decontamination with activated charcoal if patient alert. Should not induce emesis or lavage with pharyngeal redness or swelling ■ Check for methemoglobinemia, BUN, liver function tests, urine for protein, cells and "smoky" phenolic excretion products
Endothall	No test available	■ Skin decontamination ■ GI decontamination if ingested < 1 hour and patient is alert ■ Lavage is contraindicated ■ Administer oxygen by mask ■ Monitor blood pressure closely
Metaldehyde	Blood and urine metaldehyde	■ No specific antidote ■ GI decontamination if ingested < 1 hour ■ Seizure control with Diazepam ■ Liver function tests

References

Brown AE, Miller M, Kiefer M. *Cholinesterase Monitoring -- A Guide for the Health Professional*. Pesticide Information Leaflet No. 30. Pesticide Education and Assessment Program, Univ. of Maryland. http://pest.umd.edu/spatc/Leaflets/LeafletList.html

Frazier LM, Hage ML. *Reproductive Hazards of the Workplace*. New York: Van Nostrand Reinhold, 1998.

Kiefer, MC. *Human Health Effects of Pesticides*. Philadelphia, PA: Hanley and Belfus, 1997.

Reigart JR, Roberts JR. *Recognition and Management of Pesticide Poisonings*. 5th ed. Washington, DC: U.S. Environmental Protection Agency, 1999. Online at http://npic.orst.edu/rmpp.htm.

Rosenstock L, Cullen MR. *Textbook of Clinical and Occupational and Environmental Medicine*. Philadelphia: W.B. Saunders Company, 1994.

National Pesticide Information Center,Technical Pesticide Information, http://npic.orst.edu/tech.htm. Includes links to factsheets on toxicology and active ingredients, health information databases, environmental and chemical properties databases; and product, label, and MSDS databases.