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*In this issue:* 

## "Safety Comes First"

# Case Western Reserve University Environmental Health and Safety

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# Cryogens and Dry Ice

Cryogens are substances used to produce very low temperatures [below - 153°C (-243°F)], such as liquid nitrogen (LN2) which has a boiling point of - 196°C (-321°F), that are commonly used in laboratories. Although not a cryogen, solid carbon dioxide or dry ice which converts directly to carbon dioxide gas at -78°C (-109°F) is also often used in laboratories. Cryogens, as well as dry ice, can be hazardous to workers if not handled properly. General Precautions When Working with Dry Ice or LN2

- Avoid eye or skin contact with these substances.
- Never handle dry ice or LN2 with bare hands.
- Use cryogenic gloves, which are designed specifically for working in freezers below -80°C and for handling containers or vials stored in these freezers.
- Cryogenic gloves need to be loose-fitting so that they can be readily removed if LN2 splashes into them or a piece of dry ice falls into them.
- Always use appropriate eye protection.
- Do not use or store dry ice or LN2 in confined areas, walk-in refrigerators, environmental chambers or rooms without ventilation. A leak in such an area could cause an oxygen-deficient atmosphere.
- Never place a cryogen on tile or laminated counters because the adhesive will be destroyed.
- Never store a cryogen in a sealed, airtight container at a temperature above the boiling point of the cryogen; the pressure resulting from the production of gaseous carbon dioxide or nitrogen may lead to an explosion.

For more information about specific cryogens, read the Material Safety Data Sheet for the substance in question.

# Cryogens and Dry 1 **Ice** Where Radiation Comes From Ebola Virus 5 Disease 10 Basic Steps for 10 Ladder Safety

2015-1



## RADUCATION-Where Radiation Comes From



that our focus is on "ionizing" radiation: 1. Radioactive decay and half-life Sources of radiation

This RADUCATION article will look at where radiation comes from, keeping in mind

- 3. Radiation in the environment
- 4. Radiation in the body

#### 1. Radioactive Decay and Half-life

Before we look at sources of ionizing radiation we need to touch on two concepts that are important to understanding how some radioactive materials are formed: radioactive decay and half-life. In the Sept./Oct. 2014 edition of "Safety Comes First," we briefly mentioned that an atom with too much energy in the nucleus is said to be unstable. All radioactive atoms - also known as radionuclides - are unstable and give up their extra energy through various methods, all of which we refer to as radioactive decay. How the energy is released and the amount of time it takes to reach a stable status depends on the radionuclide. Throughout the process a radionuclide may decay to a stable atom or to another radionuclide, which may itself decay to another different radionuclide, and so on. Only after all the extra energy has been released will the result be a stable atom, which may be a different element than the original. If you have a large number of atoms of a certain radionuclide it is impossible to be able to say exactly when any one of the atoms will decay. However, scientists have been able to calculate how long it will take for half of the atoms of the same radionuclide to decay, and this time period is called the half-life. The half-life may be as brief as a tiny fraction of a second, or as long as hundreds of thousands of years, and it is different for each radionuclide.

In the Sept./Oct. 2014 edition of "Safety Comes First," we used properties of the element Carbon to define the terms atomic number and isotope. Since we are already familiar with this element, we will use radioactive Carbon-14 to demonstrate radioactive decay and half-life. Let's imagine that we have gathered 100 atoms of the radioactive isotope Carbon-14 in a large bag. The half-life of Carbon-14 is 5730 years, which means that half of the 100 radioactive Carbon-14 atoms originally in our bag will have decayed after 5730 years, leaving us with 50 radioactive atoms remaining. Half of those 50 atoms will have decayed after the second 5730 years, leaving only 25 Carbon-14 atoms in the bag. This process will continue, leaving half of the previous number of atoms after each half-life has passed, until all the atoms of Carbon-14 have become stable.

"How the energy is released and the amount of time it takes to reach a stable status depends on the radionuclide."



# RADUCATION-Where Radiation Comes From , cont.

(Continued from page 2)

#### 2. Sources of Radiation

For purposes of this *RADUCATION* article, we will look at the production of ionizing radiation from two sources: through the use of radiation-generating equipment (i.e. X-ray machines) or emitted from radioactive material. With radiation-generating equipment, the radiation is produced as a result of the interaction of a focused beam of highly-energetic electrons with target typically made of copper or tungsten. The energy of the X-rays produced may be varied by changing the amount of energy applied to the electron stream. There is no decay associated with the ionizing radiation produced in this manner; once the source of power has been shut-off or disconnected the device will no longer generate X-rays. Radioactive materials may be present as a result of certain man-made activities. However, there is a very small quantity of radioactive material that is a natural part of our environment. These naturally-occurring radionuclides are present in the air and in the water, soil, and rocks throughout much of the earth. Whether the source is natural or man-made, radionuclides will continue to emit radiation until all the atoms have fully decayed away.

#### 3. Radiation in the Environment

Many people would probably be surprised to learn that there is radiation all around us and we are exposed to radiation from many different sources every day. Some radionuclides have been present in materials making up the earth's crust since our planet was created. Some of the most common of these naturally-occurring radioactive materials are isotopes of Potassium (K-40), Thorium (Th-232), Radium (Ra-226), and Radon (Rn-222). Many building products, like cement or bricks, may contain measurable quantities of these materials. Radionuclides can also be found in the air. Some, such as our previous example of Carbon-14, are a result of cosmic radiation from space interacting with Nitrogen and Oxygen atoms in the Earth's atmosphere. Other radionuclides, such as Hydrogen-3, Cesium-137 and Iodine-131, are present primarily as a result of nuclear weapons testing. These radioactive particles typically remain suspended by air currents, or may be "washed" from the atmosphere by rain or snow onto the earth's surface. Radioactive materials can also be detected in water. Some may be present as a result of being deposited from the atmosphere as described above. Other radionuclides may be collected as water moves on or through soil and rocks. Some naturally-occurring radioactive materials (i.e., Radium and Radon) may be released from the ground through erosion or seepage. How a radionuclide moves in water is dependent on several factors. If the radionuclide will dissolve easily in water it will likely stay in the water as it travels on or below the surface. Other radioactive materials may stick (adhere) to the surface of the materials they pass through, limiting the distance they will travel with the water.



"Radioactive
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Page 3



# RADUCATION-Where Radiation Comes From, cont.



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and beer."

(Continued from page 3)

#### 4. Radiation in the Body

Radiation is sometimes administered intentionally, usually for medical diagnosis or therapy. The method may be by injection, implants, or when taking X-rays. Outside of these medical uses there are three main pathways for radionuclides to enter the body:

- Absorption radioactive material is absorbed through the skin, or may enter through a wound or other break in the skin surface.
- Inhalation radioactive particles suspended in the air may enter the body through the normal breathing process.
- Ingestion radioactive materials may be present in water and many types of food and are taken in when an individual is eating or drinking.

Absorption and inhalation are generally thought of as occupational hazards, where radionuclides are used in the workplace in such areas as research, industry, or pharmacies. These materials may be accidentally spilled or become airborne during their use and then become absorption or inhalation hazards in that work area. However, there is one common example of inhalation – smoking – that contributes to much of the radiation received by some members of the public. As the tobacco plants grow, they absorb radioactive Lead and Polonium from the soil. These radionuclides remain in the leaves through the drying and curing processes and are still present when the tobacco is used to make cigars, cigarettes, and other products. Each time a smoker inhales, they are taking in small quantities of these radionuclides (in addition to tar, nicotine, and other chemicals) where they are then deposited directly in the lungs. Other than from medical procedures or occupational use, the primary method for radioactive materials to enter the body is ingestion through the food chain. As we described above, radionuclides may be present in many soils and minerals, and in the water. Plants growing in these areas may absorb radionuclides from the soil or water and these materials will remain in the plants. Animals eating these plants, or drinking the water, will also absorb some radioactive materials, and they will remain stored in their bodies. If people eat the plants or animals that have absorbed the radionuclides, they will in turn, absorb them into their own bodies. Where the plants or animals are grown will determine what radionuclides and how much is present. Some examples of "radioactive" foods are bananas, Brazil nuts, carrots, lima beans, and beer. While the radionuclides are present in these foods in very small quantities, they are measurable and are part of all the different types of radiation received by the public every day.

### Ebola Virus Disease

Ebola, previously known as Ebola hemorrhagic fever, is a rare and deadly disease caused by infection with one of the Ebola virus strains. Ebola can cause disease in humans and nonhuman primates (monkeys, gorillas, and chimpanzees). Ebola is caused by infection with a virus of the family <code>Filoviridae</code>, genus <code>Ebolavirus</code>. There are five identified Ebola virus species, four of which are known to cause disease in humans: Ebola virus (<code>Zaire ebolavirus</code>); Sudan virus (<code>Sudan ebolavirus</code>); Taï Forest virus (<code>Taï Forest ebolavirus</code>, formerly <code>Côte d'Ivoire ebolavirus</code>); and Bundibugyo virus (<code>Bundibugyo ebolavirus</code>). The fifth, Reston virus (<code>Reston ebolavirus</code>), has caused disease in nonhuman primates, but not in humans. Ebola viruses are found in several African countries. Ebola was first discovered in 1976 near the Ebola River in what is now the Democratic Republic of the Congo. Since then, outbreaks have appeared sporadically in Africa. The natural reservoir host of Ebola virus remains unknown. However, on the basis of evidence and the nature of similar viruses, researchers believe that the virus is animal-borne and that bats are the most likely reservoir. Four of the five virus strains occur in an animal host native to Africa.

#### Overview

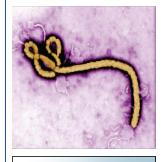
The 2014 Ebola epidemic is the largest in history, affecting multiple countries(http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/distribution-map.html#areas) in West Africa. There were a small number of cases reported in Nigeria and a single case reported in Senegal; however, these cases are considered to be contained, with no further spread in these countries. Two imported cases, including one death, and two locally acquired cases in healthcare workers have been reported in the United States (http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/united-states-imported-case.html). CDC and partners are taking precautions to prevent the further spread of Ebola within the United States. CDC is working with other U.S. government agencies, the World Health Organization (WHO), and other domestic and international partners and has activated its Emergency Operations Center to help coordinate technical assistance and control activities with partners. CDC has also deployed teams of public health experts to West Africa and will continue to send experts to the affected countries.

Symptoms of Ebola include:

- Fever
- Severe headache
- Muscle pain
- Weakness
- Fatigue
- Diarrhea
- Vomiting



"On
December 2,
WHO
officially
declared the
Ebola
outbreak
in Spain
over."



## Ebola Virus Disease, cont.



(Continued from page 5)

- Abdominal (stomach) pain
- Unexplained hemorrhage (bleeding or bruising)

Symptoms may appear anywhere from 2 to 21 days after exposure to Ebola, but the average is 8 to 10 days. Recovery from Ebola depends on good supportive clinical care and the patient's immune response. People who recover from Ebola infection develop antibodies that last for at least 10 years.

#### **Transmission**

Because the natural reservoir host of Ebola viruses has not yet been identified, the way in which the virus first appears in a human at the start of an outbreak is unknown. However, scientists believe that the first patient becomes infected through contact with an infected animal, such as a fruit bat or primate (apes and monkeys), which is called a spillover event. Person-to-person transmission follows and can lead to large numbers of affected people. In some past Ebola outbreaks, primates were also affected by Ebola and multiple spillover events occurred when people touched or ate infected primates. When an infection occurs in humans, the virus can be spread to others through direct contact (through broken skin or mucous membranes in, for example, the eyes, nose, or mouth) with:

- blood or body fluids (including but not limited to urine, saliva, sweat, feces, vomit, breast milk, and semen) of a person who is sick with Ebola
- objects (like needles and syringes) that have been contaminated with the virus
- infected fruit bats or primates (apes and monkeys)

Ebola is not spread through the air, by water, or in general, by food. However, in Africa, Ebola may be spread as a result of handling bushmeat (wild animals hunted for food) and contact with infected bats. There is no evidence that mosquitoes or other insects can transmit Ebola virus. Only a few species of mammals (e.g., humans, bats, monkeys, and apes) have shown the ability to become infected with and spread Ebola virus. Healthcare providers caring for Ebola patients and family and friends in close contact with Ebola patients are at the highest risk of getting sick because they may come in contact with infected blood or body fluids.

During outbreaks of Ebola, the disease can spread quickly within healthcare settings (such as a clinic or hospital). Exposure to Ebola can occur in healthcare settings where hospital staff are not wearing appropriate personal protective equipment.

Dedicated medical equipment (preferably disposable, when possible) should be used by healthcare personnel providing patient care. Proper cleaning and disposal of instruments, such as needles and syringes, also are important. If instruments are not

"Ebola is not spread through the air, by water, or in general, by food."

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## Ebola Virus Disease, cont

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disposable, they must be sterilized before being used again. Without adequate sterilization of instruments, virus transmission can continue and amplify an outbreak. Once people recover from Ebola, they can no longer spread the virus to people in the community. Although Ebola virus has been detected in semen after patients have recovered, it is not known if the virus can be spread through sex (including oral sex). As a precaution, men who have recovered from Ebola are advised to abstain from sex (including oral sex) for three months. If abstinence is not possible, condoms may help prevent the spread of disease. Ebola viruses are found in several African countries. Ebola was first discovered in 1976 near the Ebola River in what is now the Democratic Republic of the Congo. Since then, outbreaks of Ebola among humans have appeared sporadically in Africa.

#### Risk

Healthcare providers caring for Ebola patients and family and friends in close contact with Ebola patients are at the highest risk of getting sick because they may come in contact with the blood or body fluids of sick patients. People also can become sick with Ebola after coming in contact with infected wildlife. For example, in Africa, Ebola may spread as a result of handling bushmeat (wild animals hunted for food) and contact with infected bats. The virus also can be spread through contact with objects (like clothes, bedding, needles, syringes/sharps or medical equipment) that have been contaminated with the virus.

#### Past Ebola Outbreaks

Past Ebola outbreaks have occurred in the following countries:

- •Democratic Republic of the Congo (DRC)
- •Gabon
- •South Sudan
- •Ivory Coast
- •Uganda
- •Republic of the Congo (ROC)

South Africa (imported)

#### Prevention

There is no FDA-approved vaccine available for Ebola. If you travel to or are in an area affected by an Ebola outbreak, make sure to do the following:

- Practice careful hygiene. For example, wash your hands with soap and water or an alcohol-based hand sanitizer and avoid contact with blood and body fluids.
- Do not handle items that may have come in contact with an infected person's blood or body fluids (such as clothes, bedding, needles, and medical equipment).

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## Ebola Virus Disease, cont



(Continued from page 7)

- Avoid funeral or burial rituals that require handling the body of someone who has died from Ebola.
- Avoid contact with bats and nonhuman primates or blood, fluids, and raw meat prepared from these animals.
- Avoid facilities in West Africa where Ebola patients are being treated. The U.S. embassy or consulate is often able to provide advice on facilities.

After you return, monitor your health for 21 days and seek medical care immediately if you develop symptoms of Ebola (http://www.cdc.gov/vhf/ebola/symptoms/index.html). Healthcare workers who may be exposed to people with Ebola should follow these steps:

- Wear appropriate personal protective equipment (PPE). Practice proper infection control and sterilization measures. For more information, see Information for Healthcare Workers and Settings (http://www.cdc.gov/vhf/ebola/hcp/index.html).
- Isolate patients with Ebola from other patients.
- Avoid direct, unprotected contact with the bodies of people who have died from Ebola.

Notify health officials if you have had direct contact with the blood or body fluids, such as but not limited to, feces, saliva, urine, vomit, and semen of a person who is sick with Ebola. The virus can enter the body through broken skin or unprotected mucous membranes in, for example, the eyes, nose, or mouth.

"Ebola virus is detected in blood only after onset toms..."

#### **Diagnosis**

Diagnosing Ebola in a person who has been infected for only a few days is difficult because the early symptoms, such as fever, are nonspecific to Ebola infection and often are seen in patients with more common diseases, such as malaria and typhoid fever. However, if a person has the early symptoms (http://www.cdc.gov/vhf/ebola/symptoms/index.html) of Ebola and has had contact with the blood or body fluids of a person sick with Ebola; contact with objects that have been contaminated with the blood or body fluids of a person sick with Ebola; or contact with infected animals, they should be isolated and public health professionals notified. Samples from the patient can then be collected and tested to confirm infection.

Ebola virus is detected in blood only after onset of symptoms, most notably fever, which accompany the rise in circulating virus within the patient's body. It may take up to three days after symptoms start for the virus to reach detectable levels. Laboratory tests used in diagnosis include:

#### **Treatment**

No FDA-approved vaccine or medicine (e.g., antiviral drug) is available for Ebola.

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## Ebola Virus Disease, cont

Symptoms of Ebola and complications are treated as they appear. The following basic interventions, when used early, can significantly improve the chances of survival:

Timeline of Infection	Diagnostic tests available
Within a few days after symptoms begin	Antigen-capture enzyme-linked
	immunosorbent assay (ELISA) testing
	● IgM ELISA
	Polymerase chain reaction (PCR)
	Virus isolation
Later in disease course or after recovery	IgM and IgG antibodies
Retrospectively in deceased patients	Immunohistochemistry testing
	• PCR
	Virus isolation

- Providing intravenous fluids (IV) and balancing electrolytes (body salts).
- Maintaining oxygen status and blood pressure.
- Treating other infections if they occur.

Experimental vaccines and treatments for Ebola are under development, but they have not yet been fully tested for safety or effectiveness. Recovery from Ebola depends on good supportive care and the patient's immune response. People who recover from Ebola infection develop antibodies that last for at least 10 years, possibly longer. It is not known if people who recover are immune for life or if they can become infected with a different species of Ebola. Some people who have recovered from Ebola have developed long-term complications, such as joint and vision problems.

For further and up-to-date information on Ebola, visit the CDC at:

http://www.cdc.gov/vhf/ebola/index.html

Power Point Presentation for healthcare workers:

**Ebola Virus Disease** CDC Slides for U.S. Healthcare Workers

"Experimental vaccines and treatments for Ebola are under development..."



# 10 Basic Steps for Ladder Safety



With fall and winter holidays among us, many may find ourselves on a ladder at some point. Whether it is an everyday job function, or cleaning utters and hanging decorations, or the casual chore from a "honey-do" list, we may use some type of ladder in the coming months. The Consumer Product Safety Commission reports an estimated 90,000 annual ER visits are caused by ladder falls, and the Bureau of Labor statistics claims that 50% of all work related ladder falls, are caused by workers holding materials while climbing. A ladder, like any other tool, requires safe, prudent use. Here are some simple safety steps that will keep you from becoming one of these statistics.

- 1. If you feel tired or dizzy, or are on medications that can cause these symptoms, stay off the ladder.
- 2. Do not use ladders in high winds or storms. Multiple accidents were the result of working on ladders in inclement weather.
- 3. Wear clean slip-resistant shoes. Shoes with mud or grease on the bottoms are not ideal for climbing a ladder with. Leather soles are not appropriate for ladder use since they are not considered sufficiently slip-resistant.
- 4. Before using a ladder, inspect it to confirm it is in good working condition. Do not use a ladder if it is visibly damaged or have visible defects.
- 5. When the ladder is set-up for use, it must be placed on firm level ground, without any type of slippery condition present at either the base or top support points.
- 6. Only one person at a time is permitted on a ladder unless the ladder is specifically designed for more than one climber (such as a Trestle Ladder).
- 7. Ladders must not be placed in front of closed doors that can open toward the ladder. The door must be blocked open, locked, or guarded.
- 8. Never jump or slide down from a ladder or climb more than one rung/step at a time.
- 9. Select the right ladder for the job.
- 10. AND MOST IMPORTANTLY, always maintain 3 points of contact when using a ladder. This is both feet and one hand, or both hands and one foot. A ladder is a vital tool for completing jobs at heights. Please remember to follow these safety tips, as well as the user guide provided with the ladder to ensure a safe and productive summer and autumn!

"...always
maintain 3
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contact
when using
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https://lifenetems.org/EMSNews/preview.aspx?id=66

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