TO: ALL LUCAS COUNTY PARAMEDICS

FROM: Brent Parquette, NREMT-P
Lucas County EMS Continuing Education Program Administrator

DATE: October 15, 2012

SUBJECT: **Continuing Education – November 2012**

With the end of year in sight, and the approaching holiday season, the month of November will be the last training month for the year. Look for the 2013 CE schedule to be posted to the LCEMS website by the end of October.

In the month of November, Springfield firefighter/paramedic Aislinn Charlton-Dennis has graciously accepted an offer to present material on ***Infectious Diseases***. As a system we must continue, through education, increasing our knowledge of the infectious disease process and prevent and/or limit our exposure to potential harmful agents and organisms in the field.

Additionally, Jonathon Ziehr will cover ***Submersion Injury*** (as required by State guidelines), and new Scope of Practice material on ***Blood Product Administration/Maintenance*** will round out the CE session.

I have attached educational material related to blood product administration that I would like you to review before coming to class. A pre-test has been added for you to "test" your knowledge in the areas of infectious diseases and submersion injury.

I look forward to seeing all of you in the coming month. Please let me know if you have any questions or comments.

Brent
(419) 213-6508
bparquette@co.lucas.oh.us

November 2012 CE Schedule:

Date	Time	Shift
November 1, 2012 (Thurs)	0900 – 1300	B
November 6, 2012 (Tues)	1800 – 2200	A
November 7, 2012 (Wed)	1300 – 1700	B
November 8, 2012 (Thurs)	0900 - 1300	C
November 13, 2012 (Tues)	1800 – 2200	B
November 14, 2012 (Wed)	1300 – 1700	C
November 15, 2012 (Thurs)	0900 – 1300	A
November 20, 2012 (Tues)	1800 – 2200	C
November 21, 2012 (Wed)	1300 - 1700	A
November 27, 2012 (Tues)	0900 – 1300	A

Blood Products Module

Study Guide

Introduction

Blood is the only fluid connective tissue and possesses a number of important functions. It delivers oxygen and nutrients to the cells, carry away metabolic waste products for elimination, and facilitate the transport of hormones from endocrine organs to target sites. Blood plays a role in maintaining body temperature, acts as a buffer to combat excessive changes to pH, and sustains adequate fluid volume in the circulatory system by the means of oncotic forces. Finally, the blood also functions as a defense mechanism, possessing the ability to prevent infections, and halt the bleeding process with clotting factors.

The incidents of administering blood products in the field are very rare, except perhaps in the air ambulance setting. However, with the trend of increased patient transfers and specialized health care centers, the frequency Paramedics are required to initiate and monitor the transfusion of blood products is increasing. As a result, the practitioner must have a strong understanding of the different types of blood products; the importance of ensuring the blood product is administered to the intended recipient, the process of initiating and monitoring blood products and assessing the patient for adverse reactions.

Learning Objectives

1. Describe the various blood products and their indications.
2. Describe blood typing and crossmatching.
3. List possible complications during blood transfusions.
4. Demonstrate the correct procedure for the administration and documentation of blood products.
5. Describe issues specific to paramedics regarding emergency hospital transfusions and pre-hospital transfusions.

Objective 1

Describe Various Blood Products and Their Indications

The average male's circulatory system has 5-6 liters of blood traveling through it, while the average female has 4-5 liters. When blood is drawn and spun in a centrifuge, the different components separate. Plasma is a sticky straw-colored fluid consisting of approximately 90% water. Dissolved within the plasma are over 100 different solutes including proteins, nutrients, electrolytes and respiratory gases. Plasma makes up about 55% of the volume of blood. ***Erythrocytes*** (red blood cells) constitute approximately 45% of the blood's volume and have a dedicated role in the transportation of respiratory gases. ***Leukocytes*** (white blood cells) make up less than 1% of the entire blood volume and play a major role in defense against infection and disease. ***Platelets*** (also less than 1% of blood volume) are necessary for the clotting process and circulate in the vasculature, inactive until a blood vessel ruptures or is damaged. Red blood cells, plasma and other blood products collected from volunteer donors are available for transfusion.

Whole Blood

Whole Blood contains all components of blood. However, the clotting factors and platelets quickly lose their function during storage. A unit contains approximately 450 ml of whole blood plus 63 ml of anticoagulant. This product is not commonly available from blood banks, and red blood cells are more commonly used for treatment of anemia and acute blood loss. Whole Blood must be ABO-identical to the recipient's blood group. (Group O is not universal donor for whole blood.) One unit of Whole Blood can increase the patient's hemoglobin by approximately 10g/L. The initial transfusion should be slow (5 ml/min for 15 minutes) while assessing the patient for adverse reactions. In the absence of any reactions, the product can be infused as quickly as the patient can tolerate it. The administration set must have a 170-260 micron blood filter. Whole Blood cannot be left at room temperature for longer than 4 hours. The transfusion should be completed within the 4-hour window. As soon as collection from the donor is complete, Whole Blood must be stored at 1-6 °C. At this temperature, depending on the anticoagulant used, the red blood cells will retain their function for up to 21-35 days.

Red Blood Cells along with normal saline are more commonly used than Whole Blood for acute blood loss. To process the product, donor blood is centrifuged separating the red blood cells from the plasma. A unit of Red Blood Cells is 240-340 ml and will be more viscous than Whole Blood. However, most Red Blood Cell components today have an additive solution mixed with the Red Blood Cells (eg. AS-3). With an additive solution, Red Blood Cells will have the same flow rate as Whole Blood. Red Blood Cells have minimal amounts of plasma (and ABO antibodies) so can give ABO-compatible blood rather than only ABO-identical. Group O is universal donor for Red Blood Cells. Red Blood Cell units are administered to patients requiring increased oxygen carrying capacity by increasing the circulating red blood cell mass. The initial infusion should be slow to assess for adverse reactions, then administered as quickly as the patient tolerates. A unit of Red Blood Cells must be administered within 4 hours and the administration set must have a 170-260 micron blood filter. Depending on the anticoagulant and additive solution used, Red Blood Cell units have a shelf life of 21-42 days. They must be stored at 1-6 °C.

Platelets

Platelets are produced from centrifuging Whole Blood. The platelets are then suspended in 40-70 ml of the original plasma constituting one unit. Platelets are indicated for patients with bleeding due to a decreased platelet production or abnormally functioning platelets. A standard 170-260 micron blood filter must be used when administering platelets and the infusion time must be less than 4 hours. For optimal survival of the platelets, they must be stored at 20-24 °C and gently agitated to prevent the formation of aggregates. The shelf life under these conditions is 5 days.

Fresh Frozen Plasma (FFP)

Fresh Frozen Plasma (FFP) is separated from Whole Blood by centrifugation or sedimentation and must be frozen within 8 hours of collection. A unit of fresh frozen plasma (FFP) contains approximately 250 mL (minimum 100 mL) of anticoagulated plasma. FFP is indicated for patients requiring plasma coagulation factors, patients on Coumadin requiring emergency invasive procedures before Vitamin K can reverse its effects, or patients with plasma protein deficiencies. FFP can be stored up to 12 months at temperatures –18 degrees C and for 24 hours at 1-6 °C once thawed. FFP should be thawed in a water bath at 30-37 °C (in a water tight protective plastic overwrap using gentle agitation); this may take 20-30 minutes. Once thawed, FFP must be used immediately and cannot be refrozen.

Objective 2

Describe Blood Typing and Crossmatching

Prior to a ***transfusion*** of blood products, it must be determined that the donor's blood will be compatible with the recipient's plasma or serum. Pre-transfusion testing includes the following:

- Blood Typing
- Antibody Detection (and antibody identification if antibody screen is positive)
- Crossmatch

A requisition for a crossmatch will be completed specifying the order for blood and a specimen will be drawn from the patient. Care must be taken to correctly identify the patient prior to collection of the specimen and the specimen must be correctly labeled immediately after collection. Pre-transfusion testing is done by a department in the laboratory called the ***blood bank lab***. Most hospitals have blood bank services; there may be 2 units or over 200 RBC units in stock depending on the needs of the hospital.

Blood Typing

Red blood cells have many different ***antigens***. During a transfusion if a red cell antigen is seen as foreign, antibodies that the patient has to that antigen will attach to the red cells. This may cause hemolysis of the red cells or a slower removal of the sensitized (coated with antibody) red blood cells from the system (***immune hemolytic transfusion reactions***).

The ***ABO blood typing*** is the most important test done prior to transfusion. This is because those people, whose red cells lack the A and/or B antigen, will naturally form an antibody to the antigen they lack. Anti-A and anti-B can cause immediate hemolysis of red cells. If the ABO blood group is done incorrectly or on an improperly identified specimen, the resulting transfusion could lead to patient fatality.

Blood Type	Antigen(s) on Red Cells	Antibody(ies) in Plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	Neither anti-A or anti-B
O	Neither A or B	Anti-A and anti-B

If unable to determine the patient's blood group prior to transfusion, only group O red blood cells and group AB plasma components should be transfused.

The ***Rh(D) type*** of the patient must also be determined. Approximately 80% of Rh(D) negative patients exposed to Rh(D) positive red blood cells through transfusion or pregnancy will develop anti-D. In emergency situations, Rh negative RBC should be given preferentially to children and women of childbearing age.

Antibody Detection

Because of previous transfusion or pregnancy, the patient may have been exposed to other foreign red cell antigens and formed antibodies. Antibody screening is done to detect unexpected clinically significant red cell antibodies. These are antibodies, which are known to cause hemolytic transfusion reaction, shortened survival of transfused red blood cells or Hemolytic Disease of the Newborn (HDN). If the antibody screen is positive, the antibody must be identified. RBC units that are negative for the antigen would be provided for transfusion.

Crossmatching

Crossmatching is the process of determining the compatibility of blood from a donor with that of the recipient before transfusion. RBC units are selected and compatibility with the patient is determined. A label or tag is applied to the unit identifying that unit for the intended recipient.

Objective 3

List Possible Complications During Blood Transfusions

Infectious Disease

Despite careful donor screening and blood testing, there is still a risk of transmitting an infectious disease. Blood donations are tested for diseases such as HIV, Hepatitis B and C, syphilis and West Nile Virus, among others. Even with negative results, there is a small risk of transmitting these diseases to the recipient.

Bacterial Contamination

Any patient experiencing chills, high fever or hypotension during or following a transfusion should give rise to the suspicion that the blood product may have been contaminated. This can be a life-threatening event and must be treated aggressively with fluids and vasopressors if necessary. The transfusion must be discontinued, and the remaining blood product and bag be returned to the blood center for investigation.

Febrile Reactions – Nonhemolytic

Febrile nonhemolytic reactions (FNHTR) occur in approximately 1% of all transfusions. It is believed that it is a result of ***cytokines*** being released by leukocytes.

Allergic Reactions

In approximately 1% of all transfusions, the recipient may present with an allergic reaction. Wheezing, ***urticaria***, ***angioedema*** may be present in these patients. Recipients presenting with an ***anaphylactoid reaction*** may present with severe bronchospasm and laryngeal edema. The transfusion must be stopped and the patient treated as per symptoms.

Transfusion Related Acute Lung Injury (TRALI)

Transfusion Related Acute Lung Injury (TRALI) is condition where the patient develops non-cardiogenic pulmonary edema. The cause for this condition is believed to be the presence of antibodies in the donor's blood to the recipient's leukocytes. The patient's leukocytes aggregate in the pulmonary vasculature causing a release of mediators, which increase capillary permeability leading to pulmonary edema. If detected in patients receiving blood products, stop the transfusion and treat the patient accordingly.

Circulatory Overload

As with any fluid administration, excessive volumes or excessively rapid administration can lead to pulmonary edema. Administration of blood products should generally be no faster than 2-4 ml/kg/hr unless indicated for significant blood loss.

Immune Hemolytic Reactions

Unfortunately there are times when recipients are given blood products that react with their circulating antibodies. The consequences can be devastating resulting in intravascular ***hemolysis***. Signs and symptoms that may be present are lumbar pain, fever, hypotension and ***hemoglobinuria***. ***Disseminated intravascular coagulation (DIC)*** and renal failure are later complications of acute hemolytic reaction. Delayed hemolytic reaction is also immune-mediated but by non-ABO antibodies. The reaction can take days to occur and results in the extravascular sequestration and early destruction of the donor red cells. As with all transfusion reactions, the blood product administration must be stopped, the bag and tubing kept for the blood bank lab, and a normal saline line must be attached to the intravenous site. Aggressive IV therapy and diuresis is indicated with the goal of maintaining urine output at 100mL/hr.

Objective 4

Demonstrate the Correct Procedure for the Administration and Documentation of Blood Products

The most serious adverse transfusion reactions can be due to the administration of a blood product to an unintended recipient. ***Transfusion record tags*** are used to minimize the potential of this error occurring. The tag should include the following information:

- Patient's last name, first name
- Patient's PHN and hospital record number
- Product type
- Product unique unit number, pooled unit number or lot number
- ABO and Rh of the patient for blood components
- ABO and Rh of the blood product

In order to transfuse blood products at an adequate rate, a minimum of an 18-gauge IV catheter should be used for the adult patient. For pediatric patients, a 23 gauge catheter or larger should be used. Once the blood product is matched with the intended recipient, the contents should be visualized for any abnormalities including, but not limited to clumps and clots, cloudiness and leaks. Follow the blood administration set manufacturer's instructions for attaching and charging the line. The blood product administrations set must incorporate a 170-260 micron filter and be free of any defects. Using aseptic

technique, the administration set must be attached to the blood product bag and a previously inspected bag of normal saline. Use the normal saline to charge the blood administration line and attach it to the IV. For RBC units, mix the blood product by turning it over end-to-end in your hands to re-suspend the cells. Initiate the transfusion of the blood product at a rate of no faster than 5 ml/min for the first 15 minutes while assessing the patient for any adverse reactions. In the absence of any reactions, adjust the flow to the desired rate; usually 2-4 ml/kg/hr. Continually reassess the patient. If any adverse reaction is observed, stop the blood product transfusion immediately and attach an IV line of normal saline to the site. Save the blood product and administration set so it can be returned to a blood bank lab for investigation, and carefully document the reaction witnessed. Treat the patient accordingly following local protocol.

Blood product administration requires careful documentation on the Patient Care Report. Be sure that the blood bank lab **that issued the blood product** is informed of the final status of each unit ASAP (i.e. whether you transfused the unit or gave it to the receiving hospital, if you are on a transfer.) The following information should be included:

- Type of blood product
- Unit number
- Volume administered
- Date and time of initiation
- Date and time of completion
- Amount of Normal Saline administered
- Vital signs
- Treatment evaluation
- Description of adverse reactions
- Name and position (Paramedic, Physician, RN) initiating transfusion
- Name and position (Paramedic, Physician, RN) completing transfusion

Objective 5

Describe Issues Specific to Paramedics Regarding Emergency Hospital Transfusions and Pre-Hospital Transfusions

Emergency Transfusion

The safest transfusion is transfusion of group-specific blood that has been found to be compatible by crossmatch. For stable patients with ***anemia*** resistant to pharmacological treatment, this is the normal situation. However, for some patients, blood may be needed quickly, as in a case of trauma or gastrointestinal bleed. If there is not time for a crossmatch prior to transfusion, the next best alternative is for the lab to determine the patient's blood type and release group-specific blood. The lab would continue with the compatibility testing while the transfusion is started. If there is no time to start testing,

group O Red Blood Cells can be released. Preferably the red cells would be Rh negative especially if the patient is a child or woman of childbearing age. If plasma components are to be given, only group AB plasma can be released.

Whenever an emergency transfusion of ***uncrossmatched blood*** is required due to life-threatening situations, a properly labeled specimen for crossmatch purposes must be drawn prior to starting the transfusion. If the person's identity is unknown, a special identification system should be used. This usually consists of a fictitious name (eg John Doe) and unique identification number used on the patient's armband.

Prior to giving unmatched blood, a signed statement from the requesting physician must be obtained which indicates that the clinical situation was sufficiently urgent to require release of the blood components prior to completion of compatibility testing. If possible, consent from the patient should also be obtained.

Which Patients Require a Transfusion?

It is a decision that should made on a case-by-case basis with consideration of established protocols. The risks versus benefits must be weighed for each patient, as with other medical treatments. In pre-hospital care, we usually do not have our patient's hemoglobin level. That is just as well, as the hemoglobin level does not reflect the amount of blood loss until we replace the fluid volume with crystalloids anyway. Often it is too difficult to accurately estimate blood loss. Our patient who benefits from an RBC transfusion will likely have a mechanism of illness or injury consistent with a serious hemorrhage. Most patients will compensate well for a small to moderate amount of blood loss. The RBC transfusion is an attempt to prevent or treat ***hemorrhagic shock*** only when the situation warrants it.

Pre-Hospital Transfusions

In pre-hospital care, we must carry only Group O Red Blood Cells. They should be Rh Negative. As explained above, never transfuse a female of childbearing age or younger with Rh Positive blood. The risks of transfusing uncrossmatched blood include the risk of an immune hemolytic transfusion reaction. It would be prudent to be sure the reasons for the transfusion are clear from the patient care report.

Tracking Blood Products

It is very important to have the final disposition of all blood products recorded by the blood bank lab that issued the blood. For example, let's say a patient is to be transfused during transfer. The EMS crew might take 4 units of blood along, transfuse 3 and give the other 1 to the receiving facility. This needs to be communicated back to the original blood bank, along with each unit identification number ASAP. (The receiving facility may or may not accept the unit into their stock; it may end up being discarded.)

Summary

Paramedics will encounter transfusions in a variety of situations. One is the transfusion of uncrossmatched O Rh Negative Red Blood Cells in a pre-hospital care setting. Another setting is the interfacility transfer with an ongoing transfusion of blood that has probably been crossmatched. Whatever the circumstances, unexpected events may arise and there are always several risks involved. The paramedic who encounters blood products must be familiar with the process of initiating, monitoring and documenting blood product administration. This module is designed to give the Paramedic an overview of the challenging subject of blood product transfusions.

Review Questions
Infectious Diseases / Submersion Injury

1. Which of the following is a government agency that monitors for infectious diseases?
    a. CDC
    b. NIOSH
    c. NFPA
    d. OSHA

2. A small, unicellular organism that causes an infection that is treatable by antibiotics is a:
    a. Bacterium
    b. Virus
    c. Fungus
    d. Parasite

3. Which of the following statements is true regarding infectious agents?
    a. Some bacteria have developed resistance to antibiotics
    b. Secondary infections following antibiotic therapy may be more serious than the original infection
    c. Exotoxins may become deactivated in the presence of heat or light
    d. All of the above

4. A microscopic agent of infection that invades cells and is not treatable by antibiotics is a:
    a. Bacterium
    b. Virus
    c. Fungus
    d. Parasite

5. Examples of blood-borne diseases include all of the following ***EXCEPT***:
    a. Hepatitis A
    b. Hepatitis B
    c. AIDS
    d. Syphilis

6. Examples of airborne diseases include all of the following ***EXCEPT***:
    a. Meningitis
    b. Tuberculosis
    c. Measles
    d. Hepatitis A

7. Which of the following microorganisms is considered virulent?
    a. HBV
    b. HIV
    c. Syphilis
    d. All of the above

8. In order to test a paramedic for immunity to hepatitis B, it is necessary to:
    a. Test for the presence of antigens
    b. Wait for symptoms to occur
    c. Test for the presence of antibodies
    d. None of the above

9. The paramedic should be concerned about infection control procedures:
    a. Before the incident
    b. During the incident
    c. After the incident
    d. All of the above

10. Appropriate universal precautions include:
    a. Never recapping needles
    b. Wearing gloves during all patient contact
    c. Isolating all body fluids
    d. All of the above

11. Which of the following statements is true regarding AIDS?
    a. It is transmitted via most body fluids
    b. Paramedics are included in the high-risk group for contracting this disease
    c. The disease weakens the body's immune system by affecting T lymphocytes
    d. All of the above

12. The most frequent source of AIDS infection in health care workers is:
    a. Airborne droplets
    b. Accidental needle stick
    c. Endotracheal intubation
    d. Mouth-to-mask ventilation

13. The type of hepatitis transmitted from restaurant workers who fail to wash their hands before handling food is:
    a. A
    b. B
    c. C
    d. D

14. A yearly PPD test is necessary to monitor for the presence of which disease?
    a. Hepatitis B
    b. Meningitis
    c. Tuberculosis
    d. AIDS

15. Chicken pox, a childhood disease, may manifest itself later in life in a disease called:
    a. Varicella
    b. Shingles
    c. Rubeola
    d. Rubella

16. Your patient who presents with general malaise, low-grade fever, headache, and a stiff or sore neck may be suffering from:
    a. Hepatitis A
    b. Meningitis
    c. Tuberculosis
    d. AIDS

17. Meningitis is spread primarily by which of the following methods?
    a. A needle stick
    b. Consumption of contaminated food
    c. Blood transfusion
    d. A sneeze or cough

18. The childhood disease characterized by fever and salivary gland swelling is:
    a. Mumps
    b. Rubeola
    c. Varicella
    d. Chicken pox

Match the following airborne diseases with their respective characteristics:

19. _____Influenza
20. _____Rhinovirus
21. _____Rubella
22. _____RSV
23. _____Pertusis

    a. Whooping cough
    b. Childhood respiratory infection
    c. German measles
    d. Common cold
    e. Types A, B, and C

24. To minimize your personal risk when caring for a patient with a suspected infectious disease, you should consider:
    a. The infectious agent
    b. The host
    c. The environment
    d. All of the above

25. The primary cause of death from drowning is:
    a. Acid-base abnormality
    b. Asphyxia
    c. Pulmonary edema
    d. Hemodilution

26. Which of the following factors has an impact on drowning survival?
    a. Cleanliness of water
    b. Length of submersion
    c. Age and health of victim
    d. All of the above

27. Which of the following is a result of the mammalian diving reflex?
    a. Tachypnea
    b. Bradycardia
    c. Vasodilation
    d. All of the above

28. Prehospital management of the drowning victim includes all of the following ***EXCEPT***:
    a. C-spine management and oxygenation
    b. The Heimlich maneuver
    c. Defibrillation as indicated
    d. CPR as indicated

29. A diver who holds his breath during ascent may experience:
    a. Air embolism
    b. Pneumothorax
    c. Alveoli rupture
    d. All of the above

30. A diver who ascends without allowing time for gradual recompression may experience:
    a. Air embolism
    b. Pneumomediastinum
    c. Eustachian tube rupture
    d. The bends

31. Drowning is the 10th leading cause of unintentional injury death for people of all ages in the US:
    a. True
    b. False

32. Your patient is a 13-year-old male who suffered an immersion injury. He presents awake, responsive with a complaint of respiratory difficulty. Lung assessment reveals bilateral course crackles in the lower lung lobes. RR-28; HR-115; BP 110/70; SpO2-91%. You would consider all of the following treatments ***EXCEPT***:
    a. 100% Oxygen
    b. Heimlich maneuver to expel water from lungs
    c. CPAP (5.0cm pressure valve setting)
    d. Spinal immobilization

Review Questions
Answers / Rationale

1. **A.** The U.S. Department of Health and Human Services (DHHS) Centers for Disease Control (CDC) in Atlanta, Georgia, monitors for and tracks the morbidity and mortality rates of infectious diseases.

2. **A.** Bacteria are small, unicellular organisms that live throughout the environment and frequently cause infection. Most bacterial infections respond to treatment with drugs called antibiotics.

3. **D.** In recent years, some bacterial strains have developed resistance to antibiotics. Secondary infections following antibiotic therapy may be more serious than the original infection because the protective flora has been eliminated. Exotoxins may become deactivated in the presence of heat or light. This is why the body's normal response to a bacterial infection is fever.

4. **B.** Most infections are caused by biological agents called viruses. Viruses are referred to as intracellular parasites, since they must invade the cells of the organism they infect. Once inside the cell, they use the various cellular enzymes to replicate and produce more viruses. They cannot produce outside the host cell, and unlike bacteria, they are very difficult to treat. Once a virus infects a cell, it can be killed only by destroying the infected cell. Drugs have not yet been developed that can selectively destroy cells infected by viruses, while simultaneously leaving uninfected cells unharmed.

5. **A.** Blood-borne diseases are those transmitted by contact with the blood or body fluids of an infected person. Blood-borne diseases include AIDS, hepatitis B, hepatitis C, hepatitis D, and syphilis.

6. **D.** Airborne diseases are those transmitted through the air on droplets expelled during a productive cough or sneeze. Examples of airborne diseases include tuberculosis, meningitis, mumps, measles, rubella, and chicken pox.

7. **A.** Virulence is the microorganism's strength or ability to infect or overcome the body's defenses. Some organisms, such as hepatitis B virus (HBV), are very virulent and can remain infectious on a surface for weeks. Some, such as HIV and syphilis, die when exposed to air.

8. **C.** In order to test a paramedic for immunity to hepatitis B, it is necessary to test for the presence of antibodies. This is known as a titer.

9. **D.** There are four phases of infection control in prehospital care. These include preparations before, response to, patient contact during, and recovery from emergency incidents.

10. **D.** Appropriate universal precautions include never recapping needles, wearing gloves during all patient contact, and isolating all body fluids.

11. **D.** AIDS, a worldwide problem and virtual threat to every individual on this planet, is caused by the human immunodeficiency virus (HIV). It is transmitted through most body secretions and by most body fluids. It weakens the body's immune system by affecting the T lymphocytes. Paramedics are included in the high-risk group for contacting this disease.

12. **B.** The most frequent source of AIDS infection of health care workers is the accidental needle stick.

13. **A.** Hepatitis A is the most common form of hepatitis. The route of transmission is usually fecal-oral. Patients usually become infected by eating food contaminated with stool from another person infected with the disease.

14. **C.** A purified protein derivative (PPD) test is necessary to monitor for tuberculosis. It consists of placing a small amount of protein from tuberculosis bacteria into the skin. After 48 hours, the site is examined. If there is a firm, raised area greater than 10 millimeters in diameter, the patient is said to have converted, indicating prior exposure to tuberculosis.

15. **B.** Chicken pox, a childhood disease, may manifest itself later in life in a disease call shingles. Once a person has been infected, his is usually immune for life, but the virus may remain dormant in the body for many years, generally living in nerves along the back. In later life, the virus may become active, causing shingles.

16. **B.** Meningitis is the most common central nervous system infection encountered in prehospital care. The disease infects the lining of the brain and spinal cord. It occurs more frequently in children, but adults can also be victims. It is caused by bacteria, viruses, and occasionally fungi.

17. **D.** Meningitis is primarily transmitted through airborne droplets expelled by a productive cough or sneeze.

18. **A.** The childhood disease characterized by fever and salivary gland swelling is called mumps. The infection results from the mumps virus, which is transmitted usually through the saliva of an infected person.

19. **E.** Influenza
20. **D.** Rhinovirus
21. **C.** Rubella
22. **B.** RSV
23. **A.** Pertusis
    a. **Whooping cough**
    b. **Childhood respiratory infection**
    c. **German measles**
    d. **Common cold**
    e. **Types A, B, and C**

24. **D.** To minimize your personal risk when caring for a patient with a suspected infectious disease, you should consider the infectious agent, the host, and the environment.

25. **B.** Deaths due to drowning are primarily caused by asphyxia from airway obstruction in the lungs secondary to the aspirated water or laryngospasm.

26. **D.** Factors that have an impact on drowning and near-drowning survival rates include the cleanliness of the water, the length of time the victim is submerged, and the age and general health of the victim.

27. **B.** When a person dives into cold water, he or she reacts to the submersion of the face. This is known as the mammalian diving reflex. As a result of this reflex, breathing is inhibited, the heart rate becomes slower, and vasoconstriction develops in the tissues.

28. **B.** Prehospital management of the drowning victim includes C-spine management, oxygenation, defibrillation, and CPR as indicated.

29. **D.** The most serious barotrauma can occur if a diver holds his breath during ascent. As a diver ascends, the air in the lungs, which has been compressed, expands. If it is not exhaled, the alveoli may rupture. If this occurs, the result may be structural damage to the lung and air embolism. This may also produce mediastinal and subcutaneous emphysema or pneumothorax.

30. **D.** A diver who ascends without allowing time for gradual recompression may experience "the bends." This is a condition that develops in divers subjected to a rapid reduction of air pressure after ascending to the surface following exposure to compressed air. Nitrogen bubbles enter the tissue spaces in small blood vessels. Bubbles produced by rapid decompression are thought to obstruct blood flow and lead to local ischemia, subjecting tissues to anoxia stress.

31. **A.** Drowning is the 10th leading cause of unintentional injury death for people of all ages in the U.S., but it disproportionally affects children. It's the most common cause of deaths by unintentional injury for 1-4 year olds and the 2nd most common cause of unintentional injury deaths for 5-9 year olds.

32. **B.** The Heimlich maneuver is not routinely used to expel water from the lungs. Reference for treatments**: LCEMS Protocols – Tab 900: Section L (Drowning / Near Drowning).**