Care CEUs

Continuing Education for Nursing Home Administrators

Thromboembolic Disease

Introduction

Thrombosis may dramatically impact a patient's health, overall well-being, and quality of life. Thrombosis may also lead to death. Therefore, health care professionals should work to identify patients potentially suffering from thrombosis, as well as work to effectively prevent and treat thrombosis. This course will provide insight into thrombosis, as well as highlight specific thrombosis prevention methods and treatment recommendations to provide health care professionals with the necessary skills to optimize patient care.

Section 1: Thromboembolic Events and Thrombosis

A 62-year-old female individual presents to a health care facility. The patient reports that she is experiencing a fever, body aches, fatigue, nasal congestion, a runny nose, and nausea. The patient also reports that she has "spent a lot of time in bed" in the past 48 hours. Upon questioning by a health care professional, the patient reports "some pain" in her left leg. Upon hearing the patient's reports, the health care professional considers the following: the patient may be suffering from coronavirus disease 2019 (COVID-19). The health care professional also poses the following question: is the patient suffering from a thromboembolic event? In the current climate of health care, the health care professional's question from the previous example is becoming more and more common place. Research presented by the Centers for Disease Control and Prevention (CDC) suggests that thromboembolic events are on the rise. Further research presented by the CDC suggests that the incidences of thromboembolic events may continue to rise due to a potential association with COVID-19. As a result, health care professionals should possess insight into thromboembolic events and thrombosis. With that in mind, this section of the course will provide insight into thromboembolic events and thrombosis to build awareness among health care professionals so they may work to effectively identify patients potentially suffering from a thromboembolic event. The information found within this section was derived from materials provided by the CDC (Centers for Disease Control and Prevention [CDC], 2021).

What is a thromboembolic event?

The term thromboembolic event may refer to a blood clot.

What is thrombosis?

Thrombosis may refer to the formation of a blood clot.

Health care professionals should note the following: the term venous thromboembolism (VTE) may refer to the presence of a blood clot in a vein; a blood clot in a vein.

What is the most common type of thrombosis?

The most common type of thrombosis is deep vein thrombosis (DVT) (note: the term DVT may refer to a condition characterized by the formation of a blood clot in a deep vein [e.g., a deep vein in the lower leg, thigh, or pelvis]).

What are the risk factors for thrombosis and DVT?

Anyone has the potential to develop thrombosis and DVT. Therefore, health care professionals should be aware of the risk factors for thrombosis and DVT. The risk factors for thrombosis and DVT may be found below.

- **Slow blood flow** - one of the first risk factors that may come to mind when considering thrombosis and DVT is slow blood flow. Slow blood flow may refer to inadequate or poor blood circulation through the body or to one specific area of the body (e.g., leg). Slow blood flow can be extremely dangerous and may lead to a life-threatening DVT. Health care professionals should note that slow blood flow may result from the following: bed confinement, limited movement (e.g., movement hampered by a broken bone), sitting for long periods of time, especially with crossed legs, and paralysis.

- **An injury to a vein** - another risk factor that may come to mind when considering thrombosis and DVT is an injury to a vein. Vein injuries caused by fractures, severe muscle injury, or major surgery (e.g., surgery involving the abdomen, pelvis, hip, or legs) may lead to a DVT. Health care professionals should note the following: health care professionals should observe and monitor patients suffering from vein injuries for DVT.

- **Age** - age may also come to mind when considering DVT. Health care professionals should note that individuals over the age of 60 are at increased risk for DVT.

- **Chronic medical illnesses** - chronic medical illnesses such as heart disease, lung disease, cancer, inflammatory bowel disease, Crohn's disease, and ulcerative colitis may lead to thrombosis/DVT. Health care professionals should note the following: patients suffering from the aforementioned conditions should be observed and monitored for DVT.

- **Increased estrogen levels** - research presented by the CDC indicates that increased estrogen levels can lead to DVT. Health care professionals should note that birth control pills and hormone replacement therapy may increase estrogen levels; patients receiving birth control pills/hormone replacement therapy should receive DVT education; health care professionals should observe and monitor patients receiving birth control pills/hormone replacement therapy.
- **Pregnancy** - pregnancy may lead to DVT. Health care professionals should note the following: women are at higher risk for DVT during pregnancy, childbirth, and up to 3-months after delivery; pregnant women are five times more likely to experience DVT compared with women who are not pregnant due to the natural changes that occur to a woman's body during pregnancy. Health care professionals should also note the following: pregnant women should receive DVT education; pregnant women should be observed and monitored for DVT.
- **Previous DVT; family history of DVT** - a previous DVT and a family history of DVT are risk factors for DVT. Health care professionals should note the following: patients with the aforementioned risk factors should be observed and monitored for DVT.
- **Inherited clotting disorders** - an inherited clotting disorder (e.g., Factor V Leiden thrombophilia) is a risk factor for DVT. Health care professionals should note the following: patients with inherited clotting disorders should be observed and monitored for DVT.
- **Obesity** - individuals who are obese are at risk for DVT. Specific information regarding obesity may be found below.
    - Obesity may refer to a condition characterized by abnormal or excessive fat accumulation, which may impair health.
    - The fundamental cause of obesity is an energy imbalance between the calories consumed and the calories expended.
    - An individual may be considered to be obese when his or her body mass index (BMI) is greater than or equal to 30 kg/m^2; body mass index (BMI) may refer to a value derived from an individual's height and weight.
    - Health care professionals may use the following formula to calculate an individual's BMI: BMI = weight (kg) / height $(m)^2$; health care professionals

may also use the following formula to calculate an individual's BMI: BMI = weight (lb) / [height (in)]^2 x 703.

- Health care professionals should note that BMI does not measure body fat directly.
- Health care professionals should note the following: BMI can be used to help determine if an individual is underweight, at a normal weight, overweight, and obese.
- Underweight - an individual may be considered to be underweight if his or her BMI is less than 18.5 kg/m^2.
- Normal weight - an individual may be considered to be at a normal weight if his or her BMI is between 18.5 - 24.9 kg/m^2.
- Overweight - an individual may be considered to be overweight if his or her BMI is between 25.0 - 29.9 kg/m^2.
- Obese - an individual may be considered to be obese if his or her BMI is greater than or equal to 30.0 kg/m^2.
- Obesity may be subdivided into the following categories: Class 1 (BMI of 30 kg/m^2 to < 35 kg/m^2); Class 2 (BMI of 35 kg/m^2 to < 40 kg/m^2); Class 3 (BMI of 40 kg/m^2 or higher) (note: Class 3 obesity may be categorized as extreme or severe obesity).

- **Coronavirus disease 2019 (COVID-19)** - research presented by the CDC suggests that individuals suffering from COVID-19 may be at risk for DVT. Specific information regarding COVID-19 and COVID-19 associated DVT may be found below.
    - Coronavirus disease 2019 (COVID-19) may refer to a respiratory illness caused by the novel coronavirus, SARS-CoV-2, that can spread from person to person.
    - It is currently believed that the virus that causes COVID-19 is transmitted or spread through person-to-person contact (note: the term person-to-person contact may refer to the transmission of a communicable disease/illness from a host to a healthy person by way of body fluids [e.g., respiratory droplets, blood]).

- COVID-19 may spread between people who are in close contact with one another (e.g., less than approximately 6 feet); COVID-19 may spread through respiratory droplets produced when an infected person coughs or sneezes.

- It may be possible for an individual to obtain COVID-19 by touching a surface or an object that has become contaminated with the virus; an individual may become infected with COVID-19 if he or she touches a surface contaminated with the virus and then touches his or her own mouth, nose, and/or eyes; the risk of obtaining COVID-19 by touching a surface or an object that has become contaminated with the virus is low (note: the COVID-19 virus may live on surfaces for up to 28 days).

- The incubation period for COVID-19 is 2 - 14 days (note: the term incubation period may refer to the time period between exposure to an infectious agent and the appearance of the first symptoms).

- The potential symptoms of COVID-19 include the following: fever, chills, cough, shortness of breath, aches and pain, fatigue, headaches, nasal congestion, runny nose, sore throat, nausea, vomiting, and diarrhea. Health care professionals should note the following emergency warning signs and symptoms of COVID-19: trouble breathing, chest pain, chest pressure, new confusion, inability to wake or stay awake, and pale, gray, or blue-colored skin, lips, or nail beds. Health care professionals should also note the following: individuals experiencing the aforementioned emergency warning signs/symptoms may require emergency health care; COVID-19 may lead to death.

- The diagnostic process for COVID-19 may include the use of the viral test. Health care professionals should note that the viral test checks specimens from the nose or mouth (saliva) to determine if an individual is infected with the COVID-19 virus.

- Research suggests that COVID-19 related DVT is associated with increased factor V levels (i.e., COVID-19 may impact factor V levels, which, subsequently, may lead to the potential for thrombosis/DVT). Health care professionals should note that factor V may refer to a protein, made in the liver, that is involved in the process that converts prothrombin into thrombin, which is an important step in the blood clotting process.

- **COVID-19 vaccination** - research presented by the CDC suggests that the Johnson & Johnson/Janssen COVID-19 Vaccine may by associated with thrombosis and, more specifically with, cerebral venous sinus thrombosis (CVST) (note: the term vaccination may refer to the act of introducing a vaccine into the body to produce immunity to a specific disease; CVST may refer to the formation of a blood clot in the brain's venous sinuses). Specific information regarding the Johnson & Johnson/ Janssen COVID-19 Vaccine may be found below.
    - The Johnson & Johnson/Janssen COVID-19 Vaccine is indicated for individuals 18 years of age and older.
    - The Johnson & Johnson/Janssen COVID-19 Vaccine is a suspension for intramuscular injection administered as a single dose (0.5mL). Each vial contains five doses.
    - The Johnson & Johnson/Janssen COVID-19 Vaccine is a colorless to slightly yellow, clear to very opalescent suspension. Health care professionals should visually inspect the Johnson & Johnson/Janssen COVID-19 Vaccine vials for particulate matter and discoloration prior to administration. If either of the aforementioned conditions exists, health care professionals should not administer the vaccine.
    - Before withdrawing each dose of the Johnson & Johnson/Janssen COVID-19 Vaccine, health care professionals should carefully mix the contents of the multi-dose vial by swirling gently in an upright position for 10 seconds (note: do not shake).
    - The Johnson & Johnson/Janssen COVID-19 Vaccine does not contain a preservative.
    - Health care professionals should store unpunctured multi-dose vials of the Johnson & Johnson/Janssen COVID-19 Vaccine at 2°C to 8°C (36°F to 46°F) (note: protect from light). Health care professionals should not store the Johnson & Johnson/Janssen COVID-19 Vaccine at frozen temperatures.
    - The most common adverse reactions associated with the Johnson & Johnson/Janssen COVID-19 Vaccine include: injection-site pain, injection-site erythema, injection-site swelling, headache, fatigue, myalgia, nausea, and fever.

- Health care professionals should note the following: vaccination providers enrolled in the federal COVID-19 Vaccination Program must report all vaccine administration errors, all serious adverse events, cases of Multisystem Inflammatory Syndrome (MIS) in adults, and cases of COVID-19 that result in hospitalization or death following administration of the Johnson & Johnson/Janssen COVID-19 Vaccine.

- Health care professionals should note the following Johnson & Johnson/ Janssen COVID-19 Vaccine contraindication: do not administer the Johnson & Johnson/Janssen COVID-19 Vaccine to individuals with a known history of a severe allergic reaction (e.g., anaphylaxis) to any component of the Johnson & Johnson/Janssen COVID-19 Vaccine.

- Health care professionals should note the following Johnson & Johnson/ Janssen COVID-19 Vaccine associated warnings: appropriate medical treatment to manage immediate allergic reactions must be immediately available in the event an acute anaphylactic reaction occurs following administration of the Johnson & Johnson/Janssen COVID-19 Vaccine; individuals that receive the Johnson & Johnson/Janssen COVID-19 Vaccine should be monitored for the occurrence of immediate adverse reactions; individuals with a history of an immediate allergic reaction of any severity to another vaccine or injectable therapy should be monitored for 30 minutes; individuals with a contraindication to a different type of COVID-19 vaccine (e.g., individuals with a contraindication to mRNA COVID-19 vaccines) should be monitored for 30 minutes; individuals with a history of anaphylaxis due to any cause should be monitored for 30 minutes; all other individuals should be monitored for 15 minutes; thrombosis with thrombocytopenia syndrome (TTS) may occur.

- The use of the Johnson & Johnson/Janssen COVID-19 Vaccine was paused due to recommendations provided by the CDC and U.S. Food and Drug Administration (FDA).

- The pause was related to research that indicated a plausible causal relationship between the Johnson & Johnson/Janssen COVID-19 Vaccine and thrombosis with thrombocytopenia syndrome (TTS) (note: TTS may refer to a condition characterized by blood clots with low platelets).

- As of April 23, 2021, more than 8 million doses of the Johnson & Johnson/ Janssen COVID-19 Vaccine were administered in the U. S. As of April 23, 2021, experts reviewing safety reports for the Johnson & Johnson/Janssen COVID-19 Vaccine found 15 reports of women who received the Johnson & Johnson/Janssen COVID-19 Vaccine and later developed thrombosis with TTS.

- Safety reports for the Johnson & Johnson/Janssen COVID-19 Vaccine suggested an increased risk of TTS one to two weeks after vaccination. As of April 23, 2021, the reports reviewed all occurred in women between 18 and 59 years old, with a median of 37 years. The aforementioned reports represent a reporting rate of seven such events per 1 million vaccinations among women 18 through 49 years old and a rate of 0.9 per 1 million vaccinations among women 50 years and older (i.e., for all women, thrombosis with TTS is a rare adverse event; for women 50 years and older and men of all ages, thrombosis with TTS is even more rare). Health care professionals should note the following: Johnson & Johnson/Janssen COVID-19 Vaccine reports show that symptoms of thrombosis with TTS started between 6 and 15 days after vaccination.

- The CDC and FDA recommend that the use of the Johnson & Johnson/ Janssen COVID-19 Vaccine resume in the U. S., effective April 23, 2021.

- A review of all available data indicates that the Johnson & Johnson/Janssen COVID-19 Vaccine 's known and potential benefits outweigh its known and potential risks for those recommended to receive it.

- Women younger than 50 years old should be aware of the rare risk of blood clots with low platelets after vaccination, and that other COVID-19 vaccines are available where this risk has not been seen.

- Health care professionals should note the following: as of April 23, 2021, thrombosis with TTS has not been linked to the Pfizer-BioNTech or Moderna COVID-19 vaccines after more than 210 million doses administered.

- Health care professionals should note the following: pregnant or recently pregnant individuals can receive any FDA-authorized COVID-19 vaccine; research suggests that pregnancy does not increase the risk of developing thrombosis with TTS after receiving the Johnson & Johnson/Janssen COVID-19 Vaccine; TTS is a rare condition; all women younger than 50 years

old, regardless of whether they are pregnant or recently pregnant, should be aware of the rare but increased risk for TTS; other COVID-19 vaccines (Pfizer-BioNTech; Moderna) are available where this risk has not been seen.

What are the signs and symptoms of thrombosis/DVT?

The most common signs and symptoms of thrombosis/DVT include the following:

- Swelling
- Pain
- Tenderness
- Redness of the skin

Health care professionals should note that most individuals suffering from DVT are asymptomatic.

How may individuals potentially suffering from thrombosis/DVT present?

Individuals potentially suffering from thrombosis/DVT may present in a variety of different states including the ones found below.

- **Symptomatic state** - some individuals suffering from thrombosis/DVT may present with thrombosis/DVT signs and symptoms (e.g., swelling, pain, tenderness, and redness of the skin). Individuals in the symptomatic state may require immediate health care, and should be triaged accordingly. Health care professionals should note the following: in order to provide context for diagnosis/health care, health care professionals should attempt to ask patients in the symptomatic state the types of questions found below (note: much like with all presenting patients, patients presenting in the symptomatic state should be screened for COVID-19/ COVID-19 vaccination).
    - What are your current symptoms?
    - When did you start experiencing symptoms?
    - How long have you been experiencing symptoms?
    - When did your symptoms become severe?
    - Have you recently been confined to a bed?

- How long have you been confined to a bed?
- Is your mobility limited in any way?
- Have you recently been sitting for long periods of time?
- Did you recently experience a fracture or broken bone of any kind?
- Did you recently experience a muscle injury?
- Have you experienced any recent injuries?
- Have you experienced any recent vein injuries?
- Did you recently have surgery?
- Were you recently injured in any way?
- Have you had a blood clot before?
- When did you have a blood clot?
- How long ago was your last blood clot?
- Do you have a family history of blood clots?
- Do you have any blood clot disorders?

- **Asymptomatic state** - most individuals suffering from thrombosis/DVT will present in the asymptomatic state - meaning individuals will present to health care facilities for reasons other than thrombosis/DVT (e.g., COVID-19). Health care professionals can identify individuals in the asymptomatic state by observing patients for thrombosis/DVT risk factors such as: recent injuries, age, the presence of chronic medical illnesses, increased estrogen levels, pregnancy, previous DVT, family history of DVT, inherited clotting disorders, obesity, and COVID-19. Once asymptomatic state patients are identified health care professionals should work to determine the potential for DVT. Individuals in the asymptomatic state may require immediate health care, and should be triaged accordingly. Health care professionals should note the following: in order to provide context for diagnosis/ health care, health care professionals should attempt to ask patients in the asymptomatic state the types of questions found below (note: much like with all presenting patients, patients presenting in the asymptomatic state should be screened for COVID-19/COVID-19 vaccination).

- Have you recently experienced any of the following symptoms: swelling, pain, tenderness, and/or redness of the skin?
- Have you recently been confined to a bed?
- How long have you been confined to a bed?
- Is your mobility limited in any way?
- Have you recently been sitting for long periods of time?
- Have you had a blood clot before?
- When did you have a blood clot?
- How long ago was your last blood clot?
- Do you have a family history of blood clots?
- Do you have any blood clot disorders?

Health care professionals should note that patients may develop thrombosis/DVT while receiving health care (i.e., receiving treatment in a health care facility). For example, some patients may develop thrombosis/DVT due to immobility and/or the use of a central venous catheter (note: the term central venous catheter may refer to a tube inserted in a vein, which may be used to administer fluids, blood, and/or medications to a patient). Health care professionals should be aware of any patients that may be at risk for developing thrombosis/DVT while receiving health care. Health care professionals should note the following: health care professionals should follow their specific health care organizations' policies and procedures regarding thrombosis/DVT.

How is thrombosis/DVT diagnosed?

The diagnostic process for DVT typically involves DVT-related tests. Specific information regarding DVT-related tests may be found below.

- **Duplex ultrasonography** - duplex ultrasonography may refer to an imaging test that uses sound waves to look at the flow of blood in the veins. Health care professionals should note the following: duplex ultrasonography can be used to detect blockages or blood clots in the deep veins; duplex ultrasonography is the standard imaging test to diagnose DVT.

- **D-dimer blood test** - D-dimer blood test may refer to a blood test, which measures a substance in the blood that is released when a clot breaks up. Health care professionals should note the following: a positive D-dimer test may indicate the presence of a blood clot.
- **Contrast venography** - contrast venography may refer to a type of X-ray where contrast material (dye) is injected into a large vein in the foot or ankle to highlight the deep veins in the leg and hip. Health care professionals should note the following: contrast venography is the most accurate test for diagnosing blood clots.
- **Magnetic resonance imaging (MRI)** - MRI may refer to a test that uses radio waves and a magnetic field to provide images of the body. Health care professionals should note that MRI is used in conjunction with other DVT-related tests; MRI alone is not often used to diagnose DVT.
- **Computed tomography (CT) scan** - CT scan may refer to a medical imaging technique. Health care professionals should note that CT scans are used in conjunction with other DVT-related tests; CT scans alone are not often used to diagnose DVT.

What are the complications typically associated with thrombosis/DVT?

The complications typically associated with thrombosis/DVT include the following: pulmonary embolism (PE), post-thrombotic syndrome (PTS), DVT recurrence, and death. Specific information on the aforementioned complications may be found below.

- **Pulmonary embolism (PE)** may refer to a blockage in one or more of the pulmonary arteries in the lungs, which occurs when a part of a blood clot breaks off and travels through the bloodstream to the lungs. The signs and symptoms of a PE may include the following: difficulty breathing; faster than normal or irregular heart beat; chest pain or discomfort, which usually worsens with a deep breath or coughing; coughing up blood; low blood pressure; lightheadedness; or fainting (note: individuals suffering from the signs and symptoms of a PE may require emergency care). The diagnostic process for a PE typically involves PE-related tests. Specific information regarding PE-related tests may be found below.
    - **Computed tomographic pulmonary angiography (CTPA)** - CTPA may refer to a type of X-ray test that includes injection of contrast material (dye) into a vein. Health care professionals should note the following: CTPA can

provide images of the blood vessels in the lungs; it is the standard imaging test to diagnose PE.

- **Ventilation-perfusion (V/Q) scan** - a V/Q scan may refer to a specialized test that uses a radioactive substance to show the parts of the lungs that are getting oxygen (ventilation scan) and getting blood flow (perfusion scan) to see if there are portions of the lungs with differences between ventilation and perfusion (e.g., if there are clots in some of the blood vessels in the lungs; the V/Q scan might show normal amounts of oxygen, but low blood flow to the portions of the lungs served by the clotted blood vessels). Health care professionals should note the following: a V/Q scan is often used when CTPA is not available or when a CPTA test cannot be performed because it might be harmful to a specific patient.

- **Pulmonary angiography** - pulmonary angiography may refer to a type of X-ray test that requires insertion of a large catheter into a large vein (usually in the groin) and into the arteries within the lung, followed by injection of contrast material (dye) through the catheter. Health care professionals should note the following: pulmonary angiography can provide images of the blood vessels in the lung; it is, often, the most accurate test to diagnose PE; pulmonary angiography is an invasive test, thus, it is often reserved for specific patients.

- **Magnetic resonance imaging (MRI)** - MRI may refer to a test that uses radio waves and a magnetic field to provide images of the body. Health care professionals should note that MRI for a PE is often reserved for pregnant women or for patients who cannot be exposed to contrast material.

- **Post-thrombotic syndrome (PTS)** may refer to a chronic condition characterized by pain, swelling, and other symptoms related to DVT of the leg. The signs and symptoms of PTS may include the following: pain, swelling, edema, redness, thickening of the skin, and sensations of leg heaviness, pulling, or fatigue. PTS is primarily diagnosed based on the presence of typical signs and symptoms in a patient with previous DVT. Health care professionals should note the following: it may take a few months for the initial pain and swelling associated with acute DVT to resolve; the diagnosis of PTS should occur when the acute DVT resolves.

- DVT recurrence may occur after an acute DVT resolves (note: a previous DVT is a risk factor for DVT). Risk factors for DVT recurrence include the following:

hormone use, pregnancy, surgery, injury to the affected vein, cancer, and immobility. Health care professionals should note the following: DVT patients should receive DVT recurrence education.

- Finally, DVT can lead to death. Health care professionals should note the following: up to 100,000 Americans die each year from DVT or DVT complications.

Section 1: Summary

Thrombosis may refer to the formation of a blood clot. The most common type of thrombosis is DVT. Anyone has the potential to develop thrombosis/DVT. The risk factors for thrombosis/DVT include the following: slow blood flow, an injury to a vein, age, chronic medical illnesses, increased estrogen levels, pregnancy, previous DVT, family history of DVT, inherited clotting disorders, obesity, COVID-19, and COVID-19 vaccination (e.g., Johnson & Johnson/Janssen COVID-19 Vaccine). The most common signs and symptoms of thrombosis/DVT include the following: swelling, pain, tenderness, and redness of the skin. Individuals potentially suffering from thrombosis/DVT may present in a variety of different states including the symptomatic state and the asymptomatic state. The diagnostic process for DVT typically involves DVT-related tests. The complications typically associated with thrombosis/DVT include the following: PE, PTS, DVT recurrence, and death. Finally, health care professionals should work to identify patients potentially suffering from thrombosis/DVT to optimize patient care.

Section 1: Key Concepts

- The most common type of thrombosis is DVT.
- Anyone has the potential to develop thrombosis/DVT.
- The risk factors for thrombosis/DVT include the following: slow blood flow, an injury to a vein, age, chronic medical illnesses, increased estrogen levels, pregnancy, previous DVT, family history of DVT, inherited clotting disorders, obesity, COVID-19, COVID-19 vaccination (e.g., Johnson & Johnson/Janssen COVID-19 Vaccine).
- The most common signs and symptoms of thrombosis/DVT include the following: swelling, pain, tenderness, and redness of the skin.
- Most individuals suffering from thrombosis/DVT are asymptomatic.

- Individuals potentially suffering from thrombosis/DVT may present in a variety of different states including the symptomatic state and the asymptomatic state.
- Patients may develop thrombosis/DVT while receiving health care (i.e., receiving treatment in a health care facility).
- The diagnostic process for DVT typically involves the following DVT-related tests: duplex ultrasonography, D-dimer blood test, contrast venography, MRI, and CT scan.
- The complications typically associated with thrombosis/DVT include the following: PE, PTS, DVT recurrence, and death.

Section 1: Key Terms

Tromboembolic event - a blood clot

Thrombosis - the formation of a blood clot

Venous thromboembolism (VTE) - the presences of a blood clot in a vein; a blood clot in a vein

Deep vein thrombosis (DVT) - a condition characterized by the formation of a blood clot in a deep vein

Slow blood flow - inadequate or poor blood circulation thought the body or to one specific area of the body

Obesity - a condition characterized by abnormal or excessive fat accumulation, which may impair health

Body mass index (BMI) - a value derived from an individual's height and weight.

Coronavirus disease 2019 (COVID-19) - a respiratory illness caused by the novel coronavirus, SARS-CoV-2, that can spread from person to person

Person-to-person contact - the transmission of a communicable disease/illness from a host to a healthy person by way of body fluids

Incubation period - the time period between exposure to an infectious agent and the appearance of the first symptoms

Factor V - a protein, made in the liver, that is involved in the process that converts prothrombin into thrombin, which is an important step in the blood clotting process

Vaccination - the act of introducing a vaccine into the body to produce immunity to a specific disease

Cerebral venous sinus thrombosis (CVST) - the formation of a blood clot in the brain's venous sinuses

Thrombocytopenia syndrome (TTS) - a condition characterized by blood clots with low platelets

Central venous catheter - a tube inserted in a vein, which may be used to administer fluids, blood, and/or medications to a patient

Duplex ultrasonography - an imaging test that uses sound waves to look at the flow of blood in the veins

D-dimer blood test - a blood test, which measures a substance in the blood that is released when a clot breaks up

Contrast venography - a type of X-ray where contrast material (dye) is injected into a large vein in the foot or ankle to highlight the deep veins in the leg and hip

Magnetic resonance imaging (MRI) - a test that uses radio waves and a magnetic field to provide images of the body

Computed tomography (CT) scan - a medical imaging technique

Pulmonary embolism (PE) - a blockage in one or more of the pulmonary arteries in the lungs, which occurs when a part of a blood clot breaks off and travels through the bloodstream to the lungs

Computed tomographic pulmonary angiography (CTPA) - a type of X-ray test that includes injection of contrast material (dye) into a vein

Ventilation-perfusion (V/Q) scan - a specialized test that uses a radioactive substance to show the parts of the lungs that are getting oxygen (ventilation scan) and getting blood flow (perfusion scan) to see if there are portions of the lungs with differences between ventilation and perfusion

Pulmonary angiography - a type of X-ray test that requires insertion of a large catheter into a large vein (usually in the groin) and into the arteries within the lung, followed by injection of contrast material (dye) through the catheter

Post-thrombotic syndrome (PTS) - a chronic condition characterized by pain, swelling, and other symptoms related to DVT of the leg

Section 1: Personal Reflection Question

How can health care professionals effectively identify patients potentially suffering from thrombosis/DVT?

Section 2: Thrombosis Prevention

Thrombosis can devastate an individual's health, overall well-being, and quality of life. Fortunately, thrombosis can be prevented. This section of the course will review methods to prevent thrombosis. The information found within this section was derived from materials provided by the CDC unless, otherwise, specified (CDC, 2020).

Physical Activity

One of the first methods that may come to mind when considering thrombosis prevention is physical activity. Physical activity can help patients prevent slow blood flow, improve circulation, and ultimately help prevent thrombosis. Therefore, health care professionals should provide patients with relevant physical activity recommendations to help prevent patient thrombosis. Specific age-related physical activity recommendations may be found below. The information found below was derived from materials provided by the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services, 2018).

- Physical activity may refer to any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level.
- Physical Activity Recommendations for Preschool-Aged Children
    - Preschool-aged children (note: the term preschool-aged children may refer to individuals ages 3 through 5 years) should be physically active throughout the day to enhance growth and development.
    - Adult caregivers of preschool-aged children should encourage active play that includes a variety of activity types.

- Physical Activity Recommendations for Children and Adolescents
    - It is important to provide young people opportunities and encouragement to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.
    - Children and adolescents ages 6 through 17 years should do 60 minutes (1 hour) or more of moderate-to-vigorous physical activity daily.
    - Most of the 60 minutes or more per day should be either moderate- or vigorous-intensity aerobic physical activity and should include vigorous-intensity physical activity on at least 3 days a week.
    - As part of their 60 minutes or more of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days a week.
    - As part of their 60 minutes or more of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days a week.
- Physical Activity Recommendations for Adults
    - Adults should move more and sit less throughout the day. Some physical activity is better than none. Adults who sit less and do any amount of moderate-to-vigorous physical activity gain some health benefits.
    - For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.
    - Additional health benefits are gained by engaging in physical activity beyond the equivalent of 300 minutes (5 hours) of moderate-intensity physical activity a week.
    - Adults should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

- Physical Activity Recommendations for Older Adults
    - As part of their weekly physical activity, older adults (note: the term older adult may refer to an individual 65 years or older) should do multicomponent physical activity that includes balance training, as well as aerobic and muscle-strengthening activities.
    - Older adults should determine their level of effort for physical activity relative to their level of fitness.
    - Older adults with chronic conditions should understand whether and how their conditions affect their ability to do regular physical activity safely.
    - When older adults cannot do 150 minutes of moderate-intensity aerobic activity a week because of chronic conditions, they should be as physically active as their abilities and conditions allow.
- Physical Activity Recommendations for Women During Pregnancy and the Postpartum Period
    - Women should do at least 150 minutes (2 hours and 30 minutes) of moderate-intensity aerobic activity a week during pregnancy and the postpartum period. Preferably, aerobic activity should be spread throughout the week.
    - Women who habitually engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy can continue these activities during pregnancy and the postpartum period.
    - Women who are pregnant should be under the care of a health care provider who can monitor the progress of the pregnancy. Women who are pregnant can consult their health care provider about whether or how to adjust their physical activity during pregnancy and after the baby is born.
- Physical Activity Recommendations for Adults With Chronic Health Conditions and Adults With Disabilities
    - Adults with chronic conditions or disabilities, who are able, should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic

physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.

- Adults with chronic conditions or disabilities, who are able, should also do muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.
- When adults with chronic conditions or disabilities are not able to meet the above key guidelines, they should engage in regular physical activity according to their abilities and should avoid inactivity.
- Adults with chronic conditions or symptoms should be under the care of a health care provider. Individuals with chronic conditions can consult a health care professional or physical activity specialist about the types and amounts of activity appropriate for their abilities and chronic conditions.

- Physical Activity Recommendations for Safe Physical Activity
  - Individuals should understand the risks, yet be confident that physical activity can be safe for almost everyone.
  - Individuals should choose types of physical activity that are appropriate for their current fitness level and health goals, because some activities are safer than others.
  - Individuals should increase physical activity gradually over time to meet key guidelines or health goals. Inactive people should “start low and go slow” by starting with lower intensity activities and gradually increasing how often and how long activities are done.
  - Individuals should protect themselves by using appropriate gear and sports equipment, choosing safe environments, following rules and policies, and making sensible choices about when, where, and how to be active.
  - Individuals should be under the care of a health care provider if they have chronic conditions or symptoms. Individuals with chronic conditions and symptoms can consult a health care professional or physical activity specialist about the types and amounts of activity appropriate for them.

Adequate Nutrition

Adequate nutrition can help individuals remain active, maintain a healthy weight, and, subsequently, help prevent thrombosis. Therefore, health care professionals should provide patients with relevant nutrition recommendations to help prevent patient thrombosis. Specific nutrition recommendations may be found below. The information found below was derived from materials provided by the U.S. Department of Health and Human Services (U.S. Department of Health and Human Services, 2020).

- Individuals should follow a healthy dietary pattern at every life stage
    - From 12 months through older adulthood, individuals should follow a healthy dietary pattern across their lifespan to meet nutrient needs, help achieve a healthy body weight, and reduce the risk of chronic disease (note: the term healthy dietary pattern may refer to the combination of foods and beverages that constitutes an individual's complete dietary intake over time; a description of a customary way of eating or a description of a combination of foods recommended for consumption).
- Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations - a healthy dietary pattern can benefit all individuals regardless of age, race, or ethnicity, or current health status.
- Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits - nutrient-dense foods provide vitamins, minerals, and other health-promoting components and have no or little added sugars, saturated fat, and sodium. A healthy dietary pattern consists of nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits (note: the term nutrient-dense foods may refer to the foods and beverages that provide vitamins, minerals, and other health-promoting components and have little added sugars, saturated fat, and sodium).
- Individuals should note that the core elements that make up a healthy dietary pattern include the following:
    - Vegetables of all types such as: dark green; red and orange; beans, peas, and lentils; starchy; and other vegetables
    - Fruits, especially whole fruit

    - Grains, at least half of which are whole grain
    - Dairy, including fat-free or low-fat milk, yogurt, and cheese, and/or lactose-free versions and fortified soy beverages and yogurt as alternatives
    - Protein foods, including lean meats, poultry, and eggs; seafood; beans, peas, and lentils; and nuts, seeds, and soy products
    - Oils, including vegetable oils and oils in food, such as seafood and nuts
- Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages - at every life stage, meeting food group recommendations, even with nutrient-dense choices, requires most of an individual's daily calorie needs and sodium limits. A healthy dietary pattern doesn't have much room for extra added sugars, saturated fat, sodium, or for alcoholic beverages. A small amount of added sugars, saturated fat, or sodium can be added to nutrient-dense foods and beverages to help meet food group recommendations, but foods and beverages high in these components should be limited. Limits for added sugars, saturated fat, sodium, and alcoholic beverages may be found below.
    - Added sugars - less than 10 percent of calories per day; avoid foods and beverages with added sugars for those younger than age 2.
    - Saturated fat - less than 10 percent of calories per day starting at age 2.
    - Sodium - less than 2,300 milligrams per day, and even less for children younger than age 14.
    - Alcoholic beverages - adults of legal drinking age can choose not to drink, or to drink in moderation by limiting intake to 2 drinks or less in a day for men and 1 drink or less in a day for women, when alcohol is consumed. Drinking less is better for health than drinking more. There are some adults who should not drink alcohol, such as women who are pregnant.
- Individuals ages 12 through 23 months should take in approximately 700 to 1,000 calories per day, depending on activity level.
- Individuals ages 2 through 8 years should take in approximately 1,000 to 2,000 calories per day, depending on activity level.

- Individuals ages 9 through 17 years should take in approximately 1,400 to 3,200 calories per day, depending on activity level.
- Male adults and male older adults should take in approximately 2,000 to 3,000 calories per day, depending on activity level.
- Female adults and female older adults should take in approximately 1,600 to 2,400 calories per day, depending on activity level.

Weight Loss

As previously mentioned, obesity is a risk factor for thrombosis. Thus, health care professionals should help overweight and obese patients lose weight when working to prevent thrombosis. Specific weight loss recommendations may be found below.

- Health care professionals should use BMI calculations to determine a healthy weight for a patient.
- As previously mentioned, health care professionals may use the following formula to calculate an individual's BMI: BMI = weight (kg) / height $(m)^2$; health care professionals may also use the following formula to calculate an individual's BMI: BMI = weight (lb) / $[height (in)]^2$ x 703; health care professionals should note that BMI does not measure body fat directly; health care professionals should also note that BMI can be used to help determine if an individual is underweight, at a normal weight, overweight, and obese.
- Waist circumference should be used to assess patients' abdominal fat content. Waist circumference may refer to a measurement taken around an individual's abdomen at the level of the umbilicus, otherwise referred to as the belly button. Health care professionals should note the following: measuring waist circumference can help screen patients for possible health risks that come with being overweight and obese; if most of a patient's fat is around the waist rather than at the hips, then he or she may be at a higher risk for heart disease and type 2 diabetes; the aforementioned risk goes up with a waist size that is greater than 35 inches for women/greater than 40 inches for men. Health care professionals should also note the following: to effectively measure a patient's waist circumference, health care professionals should follow the steps found below.

  <u>Steps for Measuring Waist Circumference</u>

1. Identify and procure necessary medical equipment (e.g., tape measure); identify and procure required personal protective equipment (PPE), when applicable (note: personal protective equipment (PPE) may refer to equipment designed to protect, shield, and minimize exposure to hazards that may cause serious injury, illness, and/or disease); done required PPE, when applicable, and follow relevant PPE protocols and measures; identify and engage in required hand hygiene practices (note: hand hygiene may refer to the process of cleaning hands in order to prevent contamination and/or infections).
2. Instruct the patient to stand up.
3. Place a tape measure around the patient's middle section, just above the hip bones.
4. Make sure the tape measure is horizontal around the patient's waist.
5. Ensure the tape measure is snug around the patient's waist, but is not compressing the patient's skin.
6. Instruct the patient to slowly breath in and out.
7. Measure the patient's waist just after the patient breathes out.
8. Record relevant information.

- Health care professionals should note the following: the initial goal of weight loss treatment should be to reduce the patient's body weight by about 10 percent from baseline.
- Patient weight loss should be about 1 to 2 pounds per week for a period of approximately 6 months.
- Reducing dietary fat alone without reducing calories is not sufficient for weight loss.
- A diet that is individually planned to help create a deficit of 500 - 1,000 kcal/day may be used to help patients achieve a weight loss of 1 to 2 pounds per week.
- Portion control may help patients lose weight. Portion control may refer to a method of moderating an individual's diet by determining the number of calories in each serving of food, and limiting consumption to fall below a predetermined number of calories to help individuals lose and maintain a healthy weight.

- Patients should be encouraged to self-monitor their weight in order to maintain a healthy weight. The term self-monitor, as it relates to weight loss and maintenance, may refer to the act of observing and recording aspects of behavior related to weight, weight loss, and weight maintenance (e.g., calorie intake per day).
- Health care professionals should encourage patients attempting to lose weight to seek support from family and friends - individuals who successfully lose weight and keep it off typically rely on support from others to help maintain motivation, a healthier lifestyle, and continued weight loss/healthy weight management.

Apply Graduated Compression Stockings

- Graduated compression stockings may be used to help prevent thrombosis. Graduated compression stockings may refer to health care-related stockings that may be used to put pressure on the legs in order to improve upon circulation, and, thus, reduce the chance of thrombosis.
- Health care professionals should note the following: graduated compression stockings, typically, fit tighter around a patient's ankle and may feel "looser" as they progress up the patient's leg; when assessing graduated compression stockings, health care professionals should ensure that they lie flat across a patient's leg, without any "bunching" or folds; health care professionals should ensure graduated compression stockings are not too long for a patient (e.g., come too far up a patient's leg, or hang off the tip of a patient's foot); health care professionals and/or patients should not fold or roll the tops of graduated compression stockings down the leg in any way; graduated compression stockings should be routinely changed.

Work to prevent health care-associated venous thromboembolism (HA-VTE)

A health care-associated venous thromboembolism (HA-VTE) may refer to a blood clot that occurs as a result of hospitalization, surgery, or other health care treatment or procedure. A HA-VTE can negatively impact a patient's care, and may lead to death. Therefore, health care professionals should work to prevent health care-associated venous thromboembolism. Specific HA-VTE prevention recommendations may be found below.

- Health care organizations should provide health care professionals with HA-VTE education. Health care professionals should note the following: health care information is always being updated; thus, health care professionals should pursue opportunities to further their education; remaining up to date on relevant health care topics can help health care professionals in their daily practice and can further their understanding of how to provide safe and effective health care to patients in need.
- Health care organizations/health care professionals should develop policies and procedures regarding HA-VTE.
- Health care organizations/health care professionals should consider developing HA-VTE prevention protocols. Health care professionals should note that an effective HA-VTE prevention protocol should include the points found below.
    - Accurately detect all patients at risk of developing a deep HA-VTE.
    - Reliably exclude patients who would be unlikely to develop a HA-VTE.
    - Provide actionable recommendations for permutations of VTE and bleeding risk.
    - HA-VTE prevention protocol should be simple to use in routine clinical practice, with minimal need for laboratory investigations or complex calculations.
    - Have predictors of VTE risk available to the ordering provider at the point of care.
    - Provide decision support regarding those who would benefit from combination mechanical and anticoagulant prophylaxis.
    - Integrate into clinical practice results in a way that decreases hospital-associated VTE without any increase in bleeding.
    - Lend itself to automation, and even to dynamic ongoing reevaluations
- Health care professionals should identify patients at risk for a HA-VTE (e.g., older adults; post surgery patients).

- Assess a patient's bleeding risk. Health care professionals should note that a patient's bleeding risk may be increased by surgery, medications, or other factors inherent to the patient.
- Health care professionals should observe/monitor patients at risk for a HA-VTE.
- Health care professionals should complete effective health care documentation when caring for patients at risk or suffering from a HA-VTE. Health care documentation may refer to a digital or an analog record detailing the administration of health care to patients. If completed effectively, health care documentation can be used, in daily practice, by health care professionals to communicate vital patient information to other health care professionals in order to facilitate positive health care outcomes and to decrease the potential for negative health care outcomes, such as adverse events and patient mortalities. Effective health care documentation may be used as a method to review patient cases and to ensure all aspects of an individual patient's health care are noted and evaluated to maximize therapeutic outcomes.

  In order for health care documentation to be considered effective, it must function as a viable form of communication, as well as a means to establish a detailed record of health care administration. There are many different forms of health care documentation - however, if health care professionals include specific characteristics in their documentation, they can ensure their documentation will be effective.

  The first characteristics of effective documentation are objectivity and accuracy. Health care documentation should include objective information free of subjective judgment, bias, or opinion. Health care documentation should also be accurate - meaning it should include information which can be measured or verified by another individual.

  Additional characteristics of effective health care documentation include clarity and completeness. Clarity, as it relates to health care documentation, may refer to a quality which enables multiple health care professionals to obtain meaning from recorded data and/or information relating to health care. Completeness, as it relates to health care documentation, may refer to a state where all of the necessary components and/or parts are present. Only when clarity and completeness are achieved can health care documentation be considered effective.

Finally, the information found within health care documentation should be readily accessible and available to all those who require it. Thus, health care professionals must include accurate times and dates of health care administration when completing their health care documentation to further its effectiveness. Health care professionals should note that completing effective health care documentation can help health care professionals foster effective communication and ensure patients receive the care they require.

Section 2: Summary

Thrombosis can devastate an individual's health, overall well-being, and quality of life. Fortunately, thrombosis can be prevented. Methods that may be used to prevent thrombosis include the following: physical activity; adequate nutrition; weight loss; apply graduated compression stockings; work to prevent HA-VTE.

Section 2: Key Concepts

- Thrombosis can be prevented.
- Methods that may be used to prevent thrombosis include the following: physical activity; adequate nutrition; weight loss; apply graduated compression stockings; work to prevent HA-VTE.

Section 2: Key Terms

Physical activity - any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level (U.S. Department of Health and Human Services, 2018)

Preschool-aged children - individuals ages 3 through 5 years (U.S. Department of Health and Human Services, 2018)

Older adult - an individual 65 years or older (U.S. Department of Health and Human Services, 2018)

Healthy dietary pattern - the combination of foods and beverages that constitutes an individual's complete dietary intake over time; a description of a customary way of eating or a description of a combination of foods recommended for consumption (U.S. Department of Health and Human Services, 2020)

Nutrient-dense foods - foods and beverages that provide vitamins, minerals, and other health-promoting components and have little added sugars, saturated fat, and sodium (U.S. Department of Health and Human Services, 2020)

Waist circumference - a measurement taken around an individual's abdomen at the level of the umbilicus, otherwise referred to as the belly button

Personal protective equipment (PPE) - equipment designed to protect, shield, and minimize exposure to hazards that may cause serious injury, illness, and/or disease

Hand hygiene - the process of cleaning hands in order to prevent contamination and/or infections

Portion control - a method of moderating an individual's diet by determining the number of calories in each serving of food, and limiting consumption to fall below a predetermined number of calories to help individuals lose and maintain a healthy weight

Self-monitor (as it relates to weight loss and maintenance) - the act of observing and recording aspects of behavior related to weight, weight loss, and weight maintenance

Graduated compression stockings - health care-related stockings that may be used to put pressure on the legs in order to improve upon circulation, and, thus, reduce the chance of thrombosis

Health care-associated venous thromboembolism (HA-VTE) - a blood clot that occurs as a result of hospitalization, surgery, or other health care treatment or procedure

Health care documentation - a digital or an analog record detailing the administration of health care to patients

Clarity (as it relates to health care documentation) - a quality which enables multiple health care professionals to obtain meaning from recorded data and/or information relating to health care

Completeness (as it relates to health care documentation) - a state where all of the necessary components and/or parts are present

Section 2: Personal Reflection Question

How can health care professionals use the above methods to prevent thrombosis while administering health care to patients in need?

Section 3: Thrombosis Treatment

Thrombosis can affect almost any patient at any time. Therefore, health care professionals should possess insight into thrombosis treatment recommendations to effectively care for any and all patients suffering from thrombosis. This section of the course will review thrombosis treatment recommendations, as well as recommendations to help health care professionals prevent thrombosis-related medical errors from occurring.

The American Society of Hematology Treatment Recommendations

The American Society of Hematology provides recommendations that may be used by health care professionals to treat and manage thrombosis. Highlighted thrombosis treatment recommendations from the American Society of Hematology may be found below. The information found below was derived from materials provided by the American Society of Hematology (American Society of Hematology, 2020).

- For patients with uncomplicated DVT, health care professionals should consider offering home treatment over hospital treatment. Health care professionals should note the following: the aforementioned recommendation does not apply to patients who have other medical conditions that require hospitalization, have limited or no support at home, and cannot afford medications or have a history of poor compliance; patients with limb-threatening DVT or a high risk for bleeding and those requiring IV analgesics may benefit from initial treatment in the hospital.

- For patients with PE and a low risk for complications, health care professionals should consider offering home treatment over hospital treatment. Health care professionals should note the following: the aforementioned recommendation does not apply to patients who have other conditions that would require hospitalization, have limited or no support at home, and cannot afford medications or have a history of poor adherence; patients with submassive (i.e., intermediate-high risk) or massive PE or at high risk for bleeding and those requiring IV analgesics may benefit from initial treatment in the hospital.

- For patients with DVT and/or PE, health care professionals should consider using direct oral anticoagulants (DOACs) over vitamin K antagonists (VKAs). Health care professionals should note the following: the aforementioned recommendation may not apply to certain subgroups of patients, such as those with renal

insufficiency (i.e., creatinine clearance <30 mL/min), moderate to severe liver disease, or antiphospholipid syndrome.

- In most patients with proximal DVT, the American Society of Hematology suggests anticoagulation therapy alone over thrombolytic therapy in addition to anticoagulation. Health care professionals should note the following: thrombolysis is reasonable to consider for patients with limb-threatening DVT and for selected younger patients at low risk for bleeding with symptomatic DVT involving the iliac and common femoral veins; patients in these categories who value rapid resolution of symptoms, are averse to the possibility of PTS, and accept the added risk of major bleeding may prefer thrombolysis; the use of thrombolysis should be rare for patients with DVT limited to veins below the common femoral vein.
- For patients with PE and hemodynamic compromise, health care professionals should consider using thrombolytic therapy followed by anticoagulation over anticoagulation alone.
- For patients with PE with echocardiography and/or biomarkers compatible with right ventricular dysfunction but without hemodynamic compromise (submassive PE), health care professionals should consider anticoagulation alone over the routine use of thrombolysis in addition to anticoagulation. Health care professionals should note the following: patients with submassive PE should be monitored closely for the development of hemodynamic compromise.
- For patients with extensive DVT in whom thrombolysis is considered appropriate, health care professionals should consider using catheter-directed thrombolysis over systemic thrombolysis.
- For patients with PE in whom thrombolysis is considered appropriate, health care professionals should consider using systemic thrombolysis over catheter-directed thrombolysis.
- For patients with proximal DVT and significant preexisting cardiopulmonary disease, as well as for patients with PE and hemodynamic compromise, health care professionals should consider anticoagulation alone rather than anticoagulation plus insertion of an inferior vena cava (IVC) filter. Health care professionals should note the following: the aforementioned recommendation may apply to patients who are eligible to receive anticoagulation; for patients with a contraindication to anticoagulation, insertion of a retrievable IVC filter may be indicated with retrieval as soon as the patient is able to receive anticoagulation.

- For primary treatment of patients with DVT and/or PE, health care professionals should consider using a shorter course of anticoagulation for primary treatment (3 - 6 months) over a longer course of anticoagulation for primary treatment (6 - 12 months). Health care professionals should note the following: primary treatment, within the context of thrombosis, may refer to the minimal length of time a patient must be on therapeutic anticoagulation to treat the initial VTE before consideration is given to discontinuing anticoagulation or switching to a long-term anticoagulation regimen aimed at preventing VTE recurrence.
- Following completion of primary treatment for the initial VTE, health care professionals should consider whether to discontinue anticoagulant therapy or continue with long-term anticoagulation with the intent to prevent VTE recurrence, referred to as secondary prevention.
- For patients with unprovoked DVT and/or PE, the American Society of Hematology suggests against routine use of prognostic scores, D-dimer testing, or ultrasound to detect residual vein thrombosis to guide the duration of anticoagulation.
- After completion of primary treatment for patients with DVT and/or PE provoked by a chronic risk factor, health care professionals should consider indefinite antithrombotic therapy over stopping anticoagulation.
- For patients with DVT and/or PE who have completed primary treatment and will continue to receive secondary prevention, health care professionals should consider using anticoagulation over aspirin.
- For patients with DVT and/or PE who have completed primary treatment and will continue VKA therapy as secondary prevention, health care professionals should consider using an international normalized ratio (INR) range of 2.0 to 3.0 over a lower INR range (e.g., 1.5 to 1.9).
- For patients with DVT and/or PE who have completed primary treatment and will continue with a DOAC for secondary prevention, health care professionals should consider using a standard-dose DOAC or a lower-dose DOAC. Health care professionals should note the following: lower-dose DOAC regimens that may be considered for patients who have completed primary treatment and will continue with a DOAC include rivaroxaban, 10 mg daily, or apixaban, 2.5 mg twice daily.

- For patients with breakthrough DVT and/or PE during therapeutic VKA treatment, health care professionals should consider using low-molecular-weight heparin (LMWH) over DOAC therapy.
- For patients with DVT and/or PE with stable cardiovascular disease (CVD) who initiate anticoagulation and were previously taking aspirin for cardiovascular risk modification, health care professionals should consider suspending aspirin over continuing it for the duration of anticoagulation therapy.

National Institutes of Health Recommendations

The National Institutes of Health provides recommendations that may be used by health care professionals to treat and manage thrombosis in patients suffering from COVID-19. Highlighted recommendations from the National Institutes of Health may be found below. The information found below was derived from materials provided by the National Institutes of Health (National Institutes of Health, 2021).

- Patients who are receiving anticoagulant or antiplatelet therapies for underlying conditions should continue these medications if they receive a diagnosis of COVID-19.
- Patients with COVID-19 who are receiving concomitant medications (e.g., angiotensin-converting enzyme [ACE] inhibitors, angiotensin receptor blockers [ARBs], statins, systemic or inhaled corticosteroids, nonsteroidal anti-inflammatory drugs, acid-suppressive therapy) for underlying medical conditions should not discontinue the aforementioned medications during acute management of COVID-19 unless discontinuation is otherwise warranted by their clinical condition.
- For nonhospitalized patients with COVID-19, anticoagulants and antiplatelet therapy should not be initiated for the prevention of VTE or arterial thrombosis unless the patient has other indications for the therapy or is participating in a clinical trial.
- Hospitalized nonpregnant adults with COVID-19 should receive prophylactic dose anticoagulation; anticoagulant or antiplatelet therapy should not be used to prevent arterial thrombosis outside of the usual standard of care for patients without COVID-19.
- Hospitalized patients with COVID-19 should not routinely be discharged from the hospital while on VTE prophylaxis.

- For hospitalized COVID-19 patients who experience rapid deterioration of pulmonary, cardiac, or neurological function, or of sudden, localized loss of peripheral perfusion, the possibility of thromboembolic disease should be evaluated.
- When diagnostic imaging is not possible, patients with COVID-19 who experience an incident thromboembolic event or who are highly suspected to have thromboembolic disease should be managed with therapeutic doses of anticoagulant therapy.
- Patients with COVID-19 who require extracorporeal membrane oxygenation or continuous renal replacement therapy or who have thrombosis of catheters or extracorporeal filters should be treated with antithrombotic therapy as per the standard institutional protocols for those without COVID-19.
- If antithrombotic therapy is prescribed during pregnancy prior to a diagnosis of COVID-19, antithrombotic therapy should be continued.
- For pregnant patients hospitalized for severe COVID-19, prophylactic dose anticoagulation is recommended unless contraindicated.
- Like for nonpregnant patients, VTE prophylaxis after hospital discharge is not recommended for pregnant patients; decisions to continue VTE prophylaxis in pregnant or postpartum patients after discharge should be individualized, considering concomitant VTE risk factors.
- Anticoagulation therapy use during labor and delivery requires specialized care and planning; anticoagulation therapy should be managed in pregnant patients with COVID-19 in a similar way as in pregnant patients with other conditions that require anticoagulation in pregnancy.
- Unfractionated heparin, low molecular weight heparin, and warfarin do not accumulate in breast milk and do not induce an anticoagulant effect in the newborn; therefore, they can be used by breastfeeding individuals with or without COVID-19 who require VTE prophylaxis or treatment; the use of direct-acting oral anticoagulants during pregnancy is not routinely recommended due to lack of safety data.
- For hospitalized children with COVID-19, indications for VTE prophylaxis should be the same as those for children without COVID-19.

- In nonhospitalized patients with COVID-19, markers of coagulopathy, such as D-dimer level, prothrombin time, fibrinogen level, and platelet count, should not routinely be obtained; however, abnormalities in the aforementioned coagulation markers have been associated with worse outcomes, prospective data demonstrating that the markers can be used to predict the risk of VTE in those who are asymptomatic or who have mild COVID-19 virus infection is lacking.
- In hospitalized patients with COVID-19, hematologic and coagulation parameters are commonly measured; however, there are currently insufficient data to recommend either for or against using such data to guide management decisions.
- Whenever anticoagulant or antiplatelet therapy is used, potential drug-drug interactions with other concomitant drugs should be considered; in hospitalized, critically ill patients, low molecular weight heparin or unfractionated heparin is preferred over oral anticoagulants because the two types of heparin have shorter half-lives, can be administered intravenously or subcutaneously, and have fewer drug-drug interactions.
- COVID-19 outpatients receiving warfarin who are in isolation and thus unable to have international normalized ratio monitoring may be candidates for switching to direct oral anticoagulant therapy (e.g., apixaban).
- Patients receiving warfarin who have a mechanical heart valve, ventricular assist device, valvular atrial fibrillation, or antiphospholipid antibody syndrome or who are lactating should continue treatment with warfarin.
- For hospitalized patients with COVID-19, prophylactic dose anticoagulation should be prescribed unless contraindicated (e.g., a patient has active hemorrhage or severe thrombocytopenia). Health care professionals should note the following: data supporting the aforementioned recommendation is limited, a retrospective study showed reduced mortality in patients who received prophylactic anticoagulation, particularly if the patient had a sepsis-induced coagulopathy score ≥ 4.
- For those without COVID-19, anticoagulant or antiplatelet therapy should not be used to prevent arterial thrombosis outside of the standard of care; anticoagulation is routinely used to prevent arterial thromboembolism in patients with heart arrhythmias; there are reports of strokes and myocardial infarction in patients with COVID-19, the incidence of these events is unknown.

- When imaging is not possible, patients with COVID-19 who experience an incident thromboembolic event or who are highly suspected to have thromboembolic disease should be managed with therapeutic doses of anticoagulant therapy as per the standard of care for patients without COVID-19.
- Patients with COVID-19 who require continuous renal replacement therapy or who have thrombosis of catheters or extracorporeal filters should be treated as per the standard institutional protocols for those without COVID-19.

Medical Error Prevention Recommendations

The term medical error may refer to a preventable adverse effect of care that may or may not be evident or causes harm to a patient (Joint Commission, 2021). When treating patients suffering from thrombosis, health care professionals should work to prevent thrombosis-related medical errors from occurring. Recommendations that may be used by health care professionals to prevent and avoid thrombosis-related medical errors may be found below. The information found below was derived from materials provided by the Joint Commission unless, otherwise, specified (Joint Commission, 2021).

- **Use at least two patient identifiers when providing care, treatment, and service** - wrong-patient errors may occur in virtually all stages of patient diagnosis and treatment. Therefore, health care professionals should use at least two patient identifiers when providing care, treatment, and service to patients in order to reliably identify the patient as the individual for whom the service or treatment is intended, and to match the service or treatment to the specific patient. Health care professionals should note the following: health care professionals can work to effectively use at least two patient identifiers when providing care, treatment, and service by following the related elements of care found below.
    - Health care professionals should use at least two patient identifiers when administering medications, blood, or blood components (note: a patient's room number or physical location should not be used as an identifier).
    - When collecting blood samples and other specimens for clinical testing, health care professionals should use at least two patient identifiers when providing treatments or procedures.
    - Label containers used for blood and other specimens in the presence of the patient.

- **Report critical results of tests and diagnostic procedures on a timely basis** - the critical results of health care- related tests and diagnostic procedures may fall significantly outside the normal range, and may indicate a life-threatening situation. Therefore, health care professionals should report the critical results of tests and diagnostic procedures on a timely basis to optimize patient care. Health care professionals should note the following: health care professionals can work to effectively report the critical results of tests and diagnostic procedures on a timely basis by following the related elements of care found below.
    - Health care organizations/health care professionals should consider developing written procedures for managing the critical results of tests and diagnostic procedures.
    - Health care organizations/health care professionals should consider implementing procedures for managing the critical results of tests and diagnostic procedures.
    - Health care organizations/health care professionals should consider evaluating the timeliness of reporting the critical results of tests and diagnostic procedures.
- **Maintain and communicate accurate patient medication information** - there is evidence that medication discrepancies can affect patient outcomes, especially when related to thrombosis care. Therefore, health care professionals should work to maintain and communicate accurate patient medication information to prevent and avoid medication discrepancies. Health care professionals should note the following: medication reconciliation can be a method to effetely maintain and communicate accurate patient medication information; medication reconciliation is intended to identify and resolve discrepancies; medication reconciliation may refer to the process of comparing the medications a patient is taking (or should be taking) with newly ordered medications. Health care professionals should also note the following: health care professionals can work to effectively maintain and communicate accurate patient medication information by following the related elements of care found below.
    - Medication reconciliations should address medication duplications, omissions, and interactions, as well as the need to continue current medications.

- Health care professionals should use the following information to effectively reconcile medications: medication name, dose, frequency, route, and purpose.
- When reconciling medications, health care professionals should identify the information that needs to be collected in order to reconcile current and newly ordered medications and to safely prescribe medications in the future.
- When reconciling medications, health care professionals should obtain information on the medications the patient is currently taking when he or she is admitted to a health care facility or is treated in an outpatient setting.
- When reconciling medications, health care professionals should document relevant information in a list or other format that is useful to those who manage medications.
- When reconciling medications, health care professionals should compare the medication information the patient brought to the hospital with the medications ordered for the patient by the hospital in order to identify and resolve discrepancies.
- Health care organizations/health care professionals should provide patients (or patients' family members, caregiver, or support person as needed) with written information on the medications the patient should be taking when he or she is discharged from the health care facility or at the end of an outpatient encounter (e.g., name, dose, route, frequency, purpose).
- Health care organizations/health care professionals should explain the importance of managing medication information to the patient when he or she is discharged from a health care facility or at the end of an outpatient encounter (e.g., instruct patients to give a list of medications to their primary care physician; carry medication information at all times in the event of emergency situations).

- **Reduce the risk for patient suicide** - some patients receiving thrombosis care may be at risk for suicide. Therefore, health care professionals should work to reduce the risk for suicide. Health care professionals should note the following: the suicide of a patient while in a staffed, round-the-clock care setting is a frequently reported type of sentinel event; the term sentinel event may refer to an

unanticipated event in a health care setting that results in death or serious physical or psychological injury to a patient(s), not related to the natural course of the patient's illness; the identification of individuals at risk for suicide while under the care of or following discharge from a health care organization is an important step in protecting at-risk individuals. Health care professionals should also note the following: health care professionals can work to effectively reduce the risk for patient suicide by following the related elements of care found below.

- Health care organizations/health care professionals should consider conducting an environmental risk assessment that identifies features in the physical environment that could be used to attempt suicide; the hospital takes necessary action to minimize the risk(s) (e.g., removal of anchor points, door hinges, and hooks that can be used for hanging).
- Health care organizations/health care professionals should consider implementing procedures to mitigate the risk of suicide for patients at high risk for suicide such as: one-to-one monitoring, removing objects that pose a risk for self-harm if they can be removed without adversely affecting the patient's medical care, assessing objects brought into a room by visitors, and using safe transportation procedures when moving patients to various parts of a health care facility.
- Health care organizations/health care professionals should consider screening all patients for suicidal ideation who are being evaluated or treated for behavioral health conditions as their primary reason for care using a validated screening tool.
- Health care organizations/health care professionals should consider utilizing an evidence-based process to conduct a suicide assessment of patients who have screened positive for suicidal ideation.
- Health care organizations/health care professionals should consider documenting patients' overall level of risk for suicide and the plan to mitigate the risk for suicide.
- Health care organizations/health care professionals should consider developing and following policies and procedures addressing the care of patients identified as at risk for suicide.

- Health care organizations/health care professionals should consider developing and following policies and procedures for counseling and follow-up care at discharge for patients identified as at risk for suicide.

- Health care organizations/health care professionals should consider monitoring the implementation and effectiveness of policies and procedures for screening, assessment, and management of patients at risk for suicide and take action as needed to improve compliance.

- **Reduce the likelihood of patient harm associated with the use of anticoagulant therapy** - anticoagulant medications are more likely than others to cause harm due to complex dosing, insufficient monitoring, and inconsistent patient compliance. Therefore, health care professionals should work to reduce the likelihood of patient harm associated with the use of anticoagulant therapy. Health care professionals should note the following: health care professionals can work to effectively reduce the likelihood of patient harm associated with the use of anticoagulant therapy by following the related elements of care found below.

    - Health care organizations/health care professionals should consider utilizing approved protocols and evidence-based practice guidelines for the initiation and maintenance of anticoagulant therapy that address medication selection; dosing, including adjustments for age and renal or liver function; drug–drug and drug–food interactions; and other risk factors as applicable.

    - Health care organizations/health care professionals should consider utilizing approved protocols and evidence-based practice guidelines for reversal of anticoagulation and management of bleeding events related to each anticoagulant medication.

    - Health care organizations/health care professionals should consider utilizing approved protocols and evidence-based practice guidelines for perioperative management of all patients on oral anticoagulants (note: perioperative management may address the use of bridging medications, timing for stopping an anticoagulant, and timing and dosing for restarting an anticoagulant).

    - Health care organizations/health care professionals should consider developing and utilizing a written policy addressing the need for baseline and ongoing laboratory tests to monitor and adjust anticoagulant therapy.

- Health care organizations/health care professionals should consider developing and utilizing a process to identify, respond to, and report adverse drug events, including adverse drug event outcomes.
- Health care organizations/health care professionals should evaluate anticoagulation safety practices, actions taken to improve safety practices, and procedures for measuring the effectiveness of those actions in a specific time frame.
- Health care organizations/health care professionals should provide education to patients and families specific to the prescribed anticoagulant medication.
- Health care organizations/health care professionals should only use oral unit-dose products, prefilled syringes, or premixed infusion bags, when available.
- Health care organizations/health care professionals should utilize programmable pumps in order to provide consistent and accurate dosing when heparin is administered intravenously and continuously.

- **Reduce the likelihood of patient harm from high-alert medications** - when administering medications to patients, health care professionals should be aware of high-alert medications to reduce the likelihood of patient harm from high-alert medications (note: the term high-alert medication may refer to a heightened risk medication that may cause significant patient harm when used in error). Examples of high-alert medications that may be used in thrombosis treatment/prevention include heparin sodium, Lovenox, and warfarin. Specific information regarding heparin sodium, Lovenox, and warfarin may be found below. The information found below was derived from materials provided by the United States Food and Drug Administration (FDA) (United States Food and Drug Administration [FDA], 2021).

  Heparin sodium

  Medication notes - heparin is an anticoagulant indicated for: prophylaxis and treatment of venous thromboembolism and pulmonary embolism; atrial fibrillation with embolization; treatment of acute and chronic consumptive coagulopathies (disseminated intravascular coagulation); prevention of clotting in arterial and cardiac surgery; prophylaxis and treatment of peripheral arterial

embolism; anticoagulant use in blood transfusions, extracorporeal circulation, and dialysis procedures. The most common adverse effects associated with heparin include the following: hemorrhage, thrombocytopenia, Heparin-Induced Thrombocytopenia (HIT) and Heparin-Induced Thrombocytopenia and Thrombosis (HITT), hypersensitivity reactions, and elevations of aminotransferase levels.

Safety notes - contraindications associated with heparin include: history of HIT and HITT; known hypersensitivity to heparin or pork products; individuals whom suitable blood coagulation tests cannot be performed at appropriate intervals. Warnings and precautions associated with heparin include: fatal medication errors may occur; health care professionals should confirm choice of correct strength prior to administration; fatal hemorrhage may occur; use caution in conditions with increased risk of hemorrhage; HIT and HITT may occur; monitor for signs and symptoms and discontinue if indicative of HIT and HITT; monitor platelet count and hematocrit in all patients receiving heparin.

Considerations for special patient populations - a higher incidence of bleeding has been reported in patients over 60 years of age, especially women.

Enoxaparin sodium injection (Lovenox)

Medication notes - Lovenox is a low molecular weight heparin (LMWH) indicated for: prophylaxis of DVT in abdominal surgery, hip replacement surgery, knee replacement surgery, or medical patients with severely restricted mobility during acute illness, inpatient treatment of acute DVT with or without pulmonary embolism, outpatient treatment of acute DVT without pulmonary embolism, prophylaxis of ischemic complications of unstable angina and non-Q wave myocardial infarction (MI), and treatment of acute ST-segment elevation myocardial infarction (STEMI) managed medically or with subsequent percutaneous coronary intervention (PCI). The most common adverse effects associated with Lovenox include the following: bleeding, anemia, thrombocytopenia, elevation of serum aminotransferase, diarrhea, and nausea.

Safety notes - contraindications associated with Lovenox include: active major bleeding, thrombocytopenia with a positive in vitro test for anti-platelet antibody in the presence of enoxaparin sodium, hypersensitivity to enoxaparin sodium, hypersensitivity to heparin or pork products, hypersensitivity to benzyl alcohol (for multi-dose formulation only). Warnings associated with Lovenox include: epidural or spinal hematomas may occur in patients who are anticoagulated with LMWH or

heparinoids and are receiving neuraxial anesthesia or undergoing spinal puncture; these hematomas may result in long-term or permanent paralysis; consider these risks when scheduling patients for spinal procedures; factors that can increase the risk of developing epidural or spinal hematomas in these patients include: the use of indwelling epidural catheters, concomitant use of other drugs that affect hemostasis, such as non-steroidal anti-inflammatory drugs (NSAIDs), platelet inhibitors, other anticoagulants, a history of traumatic or repeated epidural or spinal punctures, a history of spinal deformity or spinal surgery; monitor patients frequently for signs and symptoms of neurological impairment; if neurological compromise is noted, urgent treatment is necessary; consider the benefits and risks before neuraxial intervention in patients anticoagulated or to be anticoagulated for thromboprophylaxis. Additional warnings and precautions associated with Lovenox include: use with caution in patients at risk for bleeding, obtain hemostasis at the puncture site before sheath removal, use with caution in patients with bleeding diathesis, uncontrolled arterial hypertension or history of recent gastrointestinal ulceration, diabetic retinopathy, renal dysfunction, or hemorrhage, use with caution in patients with a history of HIT, monitor thrombocytopenia closely, do not exchange with heparin or other LMWHs, and pregnant women with mechanical prosthetic heart valves and their fetuses, may be at increased risk and may need more frequent monitoring and dosage adjustment.

Considerations for special patient populations - doses of Lovenox should be adjusted for patients with creatinine clearance <30mL/min. Health care professionals should monitor older adult patients for increased risk of bleeding.

Warfarin

Medication notes - warfarin is a vitamin K antagonist indicated for the following: prophylaxis and treatment of venous thrombosis and its extension, pulmonary embolism; prophylaxis and treatment of thromboembolic complications associated with atrial fibrillation and/or cardiac valve replacement; reduction in the risk of death, recurrent myocardial infarction, and thromboembolic events such as stroke or systemic embolization after myocardial infarction. The dose of warfarin may be based on patient INR. Adverse effects associated with warfarin include fatal and nonfatal hemorrhage from any tissue or organ.

Safety notes - contraindications associated with warfarin include pregnancy, except in women with mechanical heart valves and hemorrhagic tendencies or

blood dyscrasias. Warnings associated with warfarin include the following: warfarin can cause major or fatal bleeding; perform regular monitoring of INR in all treated patients; drugs, dietary changes, and other factors affect INR levels achieved with warfarin therapy; instruct patients about prevention measures to minimize risk of bleeding and to report signs and symptoms of bleeding. Additional warnings and precautions associated with warfarin include the following: necrosis or gangrene of skin or other tissues can occur; initial therapy with warfarin in heparin-induced thrombocytopenia has resulted in cases of amputation and death; discontinue warfarin if emboli occur. Health care professionals should note the following related monitoring recommendations: obtain daily INR determinations upon initiation until stable in the therapeutic range; obtain subsequent INR determinations every 1 to 4 weeks.

Considerations for special patient populations - use with caution in a nursing woman.

- **Reduce the risk of health care-associated infections** - a health care-associated infection may refer to an infection acquired while receiving care, treatment, and services in a health care organization. Research presented by the CDC indicates that millions of patients acquire, potentially, life-threatening health care-associated infections each year. Therefore, health care professionals should work to reduce the risk of health care-associated infections. Health care professionals can reduce the risk of health care-associated infections by engaging in effective hand hygiene and by using personal protective equipment (PPE) (note: hand hygiene may refer to the process of cleaning hands in order to prevent contamination and/or infections; PPE may refer to equipment designed to protect, shield, and minimize exposure to hazards that may cause serious injury, illness, and/or disease). Specific information regarding effective hand hygiene and PPE may be found below. The information found below was derived from materials provided by the CDC (CDC, 2021).

  Hand Hygiene

  - Hand hygiene is most effective when dirt, soil, microorganisms, and other contaminants are removed from the hands.
  - Health care professionals should complete effective hand hygiene when evaluating, assessing, and administering health care to all patients.

- Health care professionals may use a variety of different products to carry out effective hand hygiene including the following: detergents, plain soap, antimicrobial (medicated) soap, antiseptic agents, and alcohol-based handrubs.
- Health care professionals should select efficacious hand hygiene products that have low irritancy potential.
- Health care professionals should determine any known interaction between products used to clean hands and skin care products.
- Health care professionals should obtain information from manufacturers about the risk of product contamination, when applicable.
- Health care professionals should ensure that hand hygiene product related dispensers function adequately and reliably, as well as deliver an appropriate volume of the product.
- Health care professionals should ensure that the dispenser system for alcohol-based handrubs is approved for flammable materials.
- Health care professionals should not add soap or alcohol-based formulations to a partially empty soap dispenser.
- Effective hand hygiene may include handwashing. Handwashing may refer to the process of washing one's hands with plain or antimicrobial soap and water.
- Effective hand hygiene may include alcohol-based handrubbing. Alcohol-based handrubbing may refer to the application of an alcohol-containing preparation to the hands in order to reduce the number of viable microorganisms.
- The major indications for hand hygiene can be broken down into the following five key moments:

    1. Before patient contact
    2. Before an aseptic procedure or task
    3. After a body fluid exposure risk occurs
    4. After touching a patient
    5. After contact with a patient's surroundings

- Health care professionals should wash their hands with soap and water when they are visibly dirty or visibly soiled with blood or other body fluids or after using the toilet.
- Health care professionals should use an alcohol-based handrub when their hands are not visibly soiled to reduce bacterial counts.
- Health care professionals should engage in hand hygiene if exposure to potential spore-forming pathogens is strongly suspected or proved (note: handwashing with soap and water is the preferred means).
- Health care professionals should engage in hand hygiene before handling a device for patient care.
- Health care professionals should engage in hand hygiene after contact with body fluids or excretions, mucous membranes, non-intact skin, or wound dressings.
- Health care professionals should engage in hand hygiene if moving from a contaminated body site to another body site during the care of the same patient.
- Health care professionals should engage in hand hygiene after contact with inanimate surfaces and objects (including medical equipment) in the immediate vicinity of a patient.
- Health care professionals should follow the steps in the following procedure when washing their hands with soap and water to optimize hand hygiene results. The duration of the entire handwashing procedure should last between 40 - 60 seconds.

<u>Hand Hygiene Procedure with Soap and Water</u>

1. Health care professionals should wet their hands with water.
2. Health care professionals should apply enough soap to cover all hand surfaces.
3. Health care professionals should rub their hands palm to palm.
4. Health care professionals should rub the right palm over the back of the left hand with interlaced fingers and vice versa.

5. Health care professionals should rub their hands palm to palm with fingers interlaced.
6. Health care professionals should rub the backs of fingers to opposing palms with fingers interlocked.
7. Health care professionals should engage in rotational rubbing of the left thumb clasped in the right palm and vice versa.
8. Health care professionals should engage in rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa.
9. Health care professionals should then rinse their hands with water.
10. Health care professionals should then dry their hands thoroughly with a single use towel.
11. Finally, health care professionals should use a towel to turn off the faucet.

- Health care professionals should follow the steps in the following procedure when using an alcohol-based formulation to optimize hand hygiene results. The duration of the entire alcohol-based procedure should last between 20 - 30 seconds. When using an alcohol-based formulation, health care professionals should note the following: alcohol-based handrubs with optimal antimicrobial efficacy usually contain 75% to 85% ethanol, isopropanol, or n-propanol, or a combination of the aforementioned products.

Hand Hygiene Procedure with an Alcohol-Based Formulation

1. Health care professionals should first apply a palmful of alcohol-based product in a cupped hand, making sure to cover all surfaces.
2. Health care professionals should then rub their hands palm to palm.
3. Health care professionals should rub the right palm over the back of the left hand with interlaced fingers and vice versa.
4. Health care professionals should rub their hands palm to palm with fingers interlaced.
5. Health care professionals should rub the backs of their fingers to opposing palms with fingers interlocked.

6. Health care professionals should engage in the rotational rubbing of the left thumb clasped in the right palm and vice versa.

7. Health care professionals should engage in rotational rubbing, backwards and forwards with clasped fingers of the right hand in the left palm and vice versa.

8. Finally, health care professionals should note that their hands are "safe" once they are dry.

- Health care professionals should note that alcohol-based hand sanitizers do not contribute to antibiotic resistance; alcohol-based hand sanitizers kill germs, including antibiotic-resistant germs, by destroying the proteins and breaking down the protective outer membrane that germs need to survive.

- Health care professionals should note the following: the CDC recommends the use of alcohol-based hand sanitizers as the primary method for hand hygiene in most health care situations; alcohol-based hand sanitizers effectively reduce the number of germs that may be on the hands of health care professionals after interacting with patients; using hand sanitizers is an effective and efficient way for health care professionals to clean their hands; the use of an alcohol-based hand sanitizer can improve hand hygiene compliance in health care facilities.

PPE: Masks

- Health care professionals should wear medical procedure masks, otherwise referred to as surgical masks or disposable face masks, when treating of caring for patients (note: a medical procedure mask may refer to a single-use mask that is not made of cloth and is not designed to be washed or laundered).

- To effectively don a medical procedure mask, health care professionals should engage in hand hygiene before touching a mask; a health care professional should ensure the mask completely covers his or her mouth and nose. A health care professional should also ensure a mask fits snugly to the face and below the chin. Health care professionals should note that, often, masks can be secured to the head and neck via separate ties.

- To effectively remove a medical procedure mask, health care professionals should untie the bottom ties, if applicable, followed by the upper ties. The

mask should then be pulled off and discarded in the appropriate waste container. Health care professionals should not touch a contaminated mask. Health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing a masks; health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing all PPE.

- Health care professionals should note that a mask is not, necessarily, a substitute for social distancing; masks should still be worn in addition to staying at least six feet apart from other individuals, especially when indoors (note: the term social distancing, otherwise referred to as physical distancing, may refer to the act of keeping at least six feet apart from an individual when interacting or engaging with an individual).
- The CDC does not recommend using masks with exhalation valves or vents. The hole in the material may allow respiratory droplets to escape and reach others.
- The CDC does not recommend using face shields or goggles as a substitute for masks.
- Health care professionals should note the following: face shields and goggles are primarily used to protect the eyes of the person wearing the face shield or goggles; goggles do not cover the nose and mouth; typically, face shields have large gaps below and alongside the face, where respiratory droplets may escape or enter; face shields may not be as effective as masks.
- Health care professionals should avoid placing a mask around the neck or up on the forehead.
- When working to prevent the transmission of COVID-19, health care professionals should note the following: some children over the age of two and some individuals with disabilities may not be able to wear a mask (note: children under two years of age should not wear a mask).
- Health care professionals should note that some individuals with underlying medical conditions (e.g., asthma) may not be able to wear a mask.
- Health care professionals should note that wearing a mask does not raise the carbon dioxide (CO_2) level in the air that is inhaled and exhaled.

PPE: Respirators

- A respirator may refer to a personal protective device that is worn on the face or head and covers at least the nose and mouth.
- A respirator is used to reduce the wearer's risk of inhaling hazardous airborne particles (including infectious agents), gases, or vapors.
- A N95 respirator may refer to a particulate-filtering, face piece respirator that filters at least 95% of airborne particles.
- Health care professionals should note that N95 respirators reduce the wearer's exposure to airborne particles.
- Health care professionals should note that N95 respirators are capable of filtering out all types of particles, including bacteria and viruses.
- A "fit test" may be required to determine the appropriate size respirator needed for each individual health care professional; health care professionals may also require training regarding how and when to use a respirator.
- Hand hygiene should be performed before donning a respirator.
- When donning a respirator, a health care professional should make sure the respirator completely covers his or her mouth and nose; health care professionals should also ensure the respirator fits snug to the face and below the chin; additionally, a health care professional should be sure the respirator is properly sealed.
- Health care professionals should note that achieving an adequate seal to the face is essential when wearing a N95 respirator.
- Health care professionals should note that when properly fitted and worn, minimal leakage should occur around the edges of the respirator when the user inhales.
- To effectively remove a respirator, a health care professional should untie the bottom ties, if applicable, followed by the upper ties; the respirator should then be pulled off and discarded in the appropriate waste container; a health care professional should not touch a contaminated respirator. Health care professionals should engage in hand hygiene after removing

respirators; health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing all PPE.

- Health care professionals should note the following: a surgical N95 respirator (also referred as a medical respirator) is recommended only for use by health care professionals who need protection from both airborne and fluid hazards (e.g., splashes, sprays).

Gloves

- Nonsterile disposable patient examination gloves, which are used for routine patient care in health care settings, are appropriate for patient care.
- The use of gloves does not replace the need for hand hygiene by either handrubbing or handwashing.
- Gloves do not provide complete protection against hand contamination.
- Health care professionals should be sure to wear gloves when it can be reasonably anticipated that contact with blood or other potentially infectious materials, mucous membranes, or non-intact skin, will occur.
- Health care professionals should note that the prolonged use of gloves for contact precautions in the absence of considering the need to perform hand hygiene can result in the transmission of germs.
- Health care professionals should note that the use of contaminated gloves caused by inappropriate storage, inappropriate patient care moments, and techniques for donning and removing gloves, may also result in germ transmission.
- Typically, gloves are single-use items, glove decontamination and reprocessing are not recommended and should be avoided.
- The CDC does not recommend wearing double gloves when providing care to patients.
- Hand hygiene should be performed before donning gloves.
- When donning gloves, health care professionals should be sure to touch only a restricted surface of a glove corresponding to the wrist (e.g., at the top edge of the cuff).

- When wearing gloves, health care professionals should avoid touch contamination; touch contamination may refer to touching one's self and/or other surfaces such as tables, light switches, and doors while wearing gloves; touch contamination may lead to contamination and/or the passing of potentially infectious materials.
- Health care professionals should change their gloves as they administer care to different patients (i.e., a new patient means a new pair of gloves).
- Health care professionals should remove gloves after caring for a patient.
- To effectively remove a pair of gloves, a health care professional should use one gloved hand to grasp the palm area of the other gloved hand; once the health care professional has a firm grip on the palm of one gloved hand, the health care professional should then peel off the first glove; after removing the first glove, the health care professional should then hold that glove in one hand; using his or her fingers, the health care professional should slide the fingers off his or her ungloved hand under the remaining glove at the wrist and peel off the second glove right over the first glove; both gloves should then be placed in the appropriate waste container.
- Health care professionals should engage hand hygiene after removing gloves; health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing all PPE.

PEE: Gowns

- As with any type of PPE, the key to proper selection and use of gowns is to understand the hazards and the risk of exposure; some of the factors important to assessing the risk of exposure in health care facilities include: sources, modes of transmission, types of contact, and duration and type of tasks to be performed by the user of the PPE.
- Gowns that protect against microorganisms are available to health care professionals; for health care activities with low, medium, or high risk of contamination, surgical gowns may be used (note: the term surgical gown may refer to a type of gown intended to be worn by various health care professionals during surgical procedures).

- For a medium to high risk of contamination and need for a large critical zone, health care professionals should use isolation gowns that claim moderate to high barrier protection.
- Health care professionals should engage in effective hand hygiene before donning a gown.
- When putting on a gown, a health care professional should make sure the gown completely covers his or her torso from the neck to the knees; a gown should also completely cover a health care professional's arms and wrist; a gown should be wrapped around the back and fastened at the back of the neck and waist.
- To effectively remove a gown, a health care professional should unfasten the gown's ties and pull the gown away from the neck and shoulders; when the gown is removed from the body, it should be rolled or folded and placed in the appropriate waste container.
- Health care professionals should engage in hand hygiene after removing a gown; health care professionals should wash their hands or use an alcohol-based hand sanitizer after removing all PPE.

Section 3: Summary

Health care professionals should possess insight into thrombosis treatment recommendations to effectively care for patients suffering from thrombosis. When administering care to patients suffering from thrombosis, health care professionals should consider relevant thrombosis treatment recommendations, as well as work to prevent thrombosis-related medical errors from occurring.

Section 3: Key Concepts

- When administering care to patients suffering from thrombosis, health care professionals should consider relevant thrombosis treatment recommendations, as well as work to prevent thrombosis-related medical errors from occurring.

Section 3: Key Terms

Primary treatment (within the context of thrombosis) - the minimal length of time a patient must be on therapeutic anticoagulation to treat the initial VTE before consideration is given to discontinuing anticoagulation or switching to a long-term

anticoagulation regimen aimed at preventing VTE recurrence (American Society of Hematology, 2020)

Medical error - a preventable adverse effect of care that may or may not be evident or causes harm to a patient (Joint Commission, 2021)

Medication reconciliation - the process of comparing the medications a patient is taking (or should be taking) with newly ordered medications (Joint Commission, 2021)

Sentinel event - an unanticipated event in a health care setting that results in death or serious physical or psychological injury to a patient(s), not related to the natural course of the patient's illness (Joint Commission, 2021)

High-alert medication - a heightened risk medication that may cause significant patient harm when used in error (Joint Commission, 2021)

Health care-associated infection - an infection acquired while receiving care, treatment, and services in a health care organization (Joint Commission, 2021)

Handwashing - the process of washing one's hands with plain or antimicrobial soap and water

Alcohol-based handrubbing - the application of an alcohol-containing preparation to the hands in order to reduce the number of viable microorganisms

Medical procedure mask (otherwise referred to as a surgical mask or a disposable face mask) - a single-use mask that is not made of cloth and is not designed to be washed or laundered

Social distancing (otherwise referred to as physical distancing) - the act of keeping at least six feet apart from an individual when interacting or engaging with an individual

Respirator - a personal protective device that is worn on the face or head and covers at least the nose and mouth

N95 respirator - a particulate-filtering, face piece respirator that filters at least 95% of airborne particles

Touch contamination - touching one's self and/or other surfaces such as tables, light switches, and doors while wearing gloves

Surgical gown - a type of gown intended to be worn by various health care professionals during surgical procedures

Section 3: Personal Reflection Question

How can health care professionals use the above recommendations to effectively treat patients suffering from thrombosis?

Case Study: Thromboembolic Event/Thrombosis

A thrombosis-related case study is presented below to review the concepts found in this course. A case study review will follow the case study. The case study review includes the types of questions health care professionals should ask themselves when considering thrombosis and how thromboembolic events relate to the administration of health care. Additionally, reflection questions will be posed, within the case study review, to encourage further internal debate and consideration regarding the presented case study and thrombosis. The information found within the case study review was derived from materials provided by the CDC (CDC 2021).

Case Study

A 64-year-old male patient presents to a health care facility. Upon initial screening, the patient reports that he is not experiencing COVID-19 symptoms. The initial screening process also reveals that the patient does not have a fever. Upon examination, the patient reports that he is currently working from home due to the COVID-19 pandemic. The patient also reports that he has been "inactive" recently due to the COVID-19 pandemic, and is not currently "exercising regularly." Further examination reveals that the patient's BMI is 30.0 kg/m^2. Additionally, the health care professional conducting the patient exam observes redness on the skin of the patient's left leg. The patient reports that the "red area" observed by the health care professional is "slightly tender." As the patient's exam continues the health care professional begins to consider the possibility of a thromboembolic event.

Case Study Review

What patient details may be relevant to the possible presence of a thromboembolic event?

The following patient details may be relevant to the possible presence of a thromboembolic event: the patient is 64 years old; the patient reports that he is not experiencing COVID-19 symptoms; the initial screening process reveals that the patient does not have a fever; the patient reports that he is currently working from home due to

the COVID-19 pandemic; the patient reports that he has been "inactive" recently due to the COVID-19 pandemic, and is not currently "exercising regularly;" patient examination reveals that the patient's BMI is 30.0 kg/m^2; the health care professional conducting the patient exam observes redness on the skin of the patient's left leg; the patient reports that the "red area" observed by the health care professional is "slightly tender."

Are there any other patient details that may be relevant to the possible presence of a thromboembolic event; if so, what are they?

How are each of the aforementioned patient details relevant to the possible presence of a thromboembolic event?

Each of the previously highlighted patient details may be potentially relevant to the possible presence of a thromboembolic event. The potential relevance of each patient detail may be found below.

The patient is 64 years old - the previous patient detail is relevant because the patient's age is a risk factor for thrombosis. Health care professionals should note the following: individuals over the age of 60 are at increased risk for thrombosis/DVT.

The patient reports that he is not experiencing COVID-19 symptoms - the previous patient detail is relevant because COVID-19 is a risk factor for thrombosis. The previous patient detail is also relevant because the CDC recommends that all patients should be screened for COVID-19 signs and symptoms when entering a health care facility. Health care professionals should note the following related CDC recommendation: screen and triage everyone entering a health care facility for signs and symptoms of COVID-19 (note: the signs/symptoms of COVID-19 may include: fever, chills, cough, shortness of breath, aches and pain, fatigue, headaches, nasal congestion, runny nose, sore throat, nausea, vomiting, and diarrhea).

The initial screening process reveals that the patient does not have a fever - the previous patient detail is relevant because fever is a symptom of COVID-19. The previous patient detail is also relevant because the CDC recommends that all patients should be screened for COVID-19 signs and symptoms when entering a health care facility. Health care professionals should note the following related CDC recommendation: establish a process to ensure that everyone (e.g., patients, health care professionals, and visitors) entering a health care facility is assessed for COVID-19 signs/symptoms (note: fever can be either a measured temperature ≥ 100.0°F or a subjective fever [e.g., patient reported fever]; individuals might not notice symptoms of a fever at the lower temperature threshold that is used for those entering a health care facility; individuals should be

encouraged to actively take their temperature at home or have their temperature taken upon arrival at a health care facility).

The patient reports that he is currently working from home due to the COVID-19 pandemic - the previous patient detail is relevant because it may indicate a reduction in patient mobility/activity, as well as the possibility that the patient often sits for long periods of time. Health care professionals should note the following: slow blood flow is a risk factor for thrombosis and DVT; slow blood flow may refer to inadequate or poor blood circulation throughout the body or to one specific area of the body (e.g., leg); slow blood flow can be extremely dangerous and may lead to a life-threatening DVT: slow blood flow may result from the following: bed confinement, limited movement (e.g., movement hampered by a broken bone), sitting for long periods of time, especially with crossed legs, and paralysis.

The patient reports that he has been "inactive" recently due to the COVID-19 pandemic, and is not currently "exercising regularly" - the previous patient detail is relevant because it may further indicate a potential reduction in patient mobility/activity, and the possibility that the patient often sits for long periods of time. Health care professionals should note the following: exercise/physical activity can help prevent thrombosis.

Patient examination reveals that the patient's BMI is 30.0 kg/m^2 - the previous patient detail is relevant because the patient's BMI indicates that the patient is obese. Health care professionals should note the following: an individual may be considered to be obese if his or her BMI is greater than or equal to 30.0 kg/m^2; individuals who are obese are at risk for thrombosis/DVT.

The health care professional conducting the patient exam observes redness on the skin of the patient's left leg - the previous patient detail is relevant because it may indicate a sign/symptom of thrombosis/DVT. Health care professionals should note the following potential signs/symptoms of thrombosis/DVT: swelling, pain, tenderness, and redness of the skin.

The patient reports that the "red area" observed by the health care professional is "slightly tender" - the previous patient detail is relevant because it may indicate an additional sign/symptom of thrombosis/DVT. Health care professionals should note the following: individuals potentially suffering from DVT may present in a variety of different states including the symptomatic state and the asymptomatic state.

What other ways, if any, are the patient details relevant to the possible presence of a thromboembolic event?

Is it possible that the patient may be suffering from a thromboembolic event?

Based on the information found in the case study, it does appear possible that the patient may be suffering from a thromboembolic event.

How can a health care professional potentially gather additional patient information to help confirm the possible presence of a thromboembolic event?

Conclusion

Thrombosis may dramatically impact a patient's health, overall well-being, and quality of life. Thrombosis may also lead to death. Therefore, health care professional should possess insight into thrombosis, as well as work to effectively prevent and treat thrombosis.

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