

ECMO Therapy

Life Support in the Intensive Care Unit



Allina Health

Your ECMO Health Care Team

Advanced heart failure doctors

Intensivists

Cardiothoracic surgeon

Interventional cardiologist

Perfusionists

Bedside nurses

Respiratory therapists

Physical therapists

Case manager and social workers

Chaplain

Others

ECMO Therapy

Life Support in the Intensive Care Unit

First edition

Developed by Allina Health.

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This publication is for general information only and is not intended to provide specific advice or recommendations for any individual. The information it contains cannot be used to diagnose medical conditions or prescribe treatment. The information provided is designed to support, not replace, the relationship that exists between a patient and his/her existing physician.

For specific information about your health condition, please contact your health care provider.





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ECMO (Life-support Machine)

Medical Term

ECMO is a life-support machine that supports your loved one's lungs and heart.

- **Extra** means something outside.
- **Corporeal** means the body.
- **Extracorporeal** means the machine sits outside of your loved one's body.
- **Membrane oxygenation** means that the machine helps to get oxygen inside the body.

What ECMO does

The life-support machine that takes over your loved one's heart and lungs is known as an ECMO. This stands for extra corporeal membrane oxygenation. (See the box at the left for more.)

ECMO is needed when a life-threatening illness (such as pneumonia or heart attack) prevents the heart and lungs from working properly. It helps your loved one's body work and helps it heal.

This machine helps your loved one by:

- pumping blood to their organs
- taking carbon dioxide out of the blood and putting oxygen into their blood.

ECMO does not cure your loved one. It is a short-term therapy to help just the lungs (VV ECMO) or both the heart and lungs (VA ECMO).



Different views of the equipment as part of the life-support treatment.

When ECMO is needed

ECMO is used for many different reasons such as:

- to treat seriously ill people who cannot get better with other types of treatment. Types of illness treated include:
 - severe lung injury or disease
 - acute respiratory distress syndrome (fluid leaks into the lungs)
 - pneumonia, asthma, influenza (flu)
 - heart muscle injury and disease
 - heart attack
 - heart failure
 - sepsis (a blood infection)
- a “bridge” to other medical options, such as a transplant
- to help during complex heart procedures.

The life-support machine is only used if your loved one’s health care team believes they will have a meaningful recovery.

Two Types of Life Support

There are two types of life support through ECMO:

- veno-arterial (VA): full support of the heart and lungs
- veno-venous (VV): support of the lungs.

Members of your loved one’s health care team will talk with you about the type of support your loved one has.

Medical Terms

Cannula is a special tube that connects your loved one to ECMO.

Cannulation sites are where the cannulas are connected to the ECMO. They are usually at the blood vessels in your love one's upper thigh or groin.

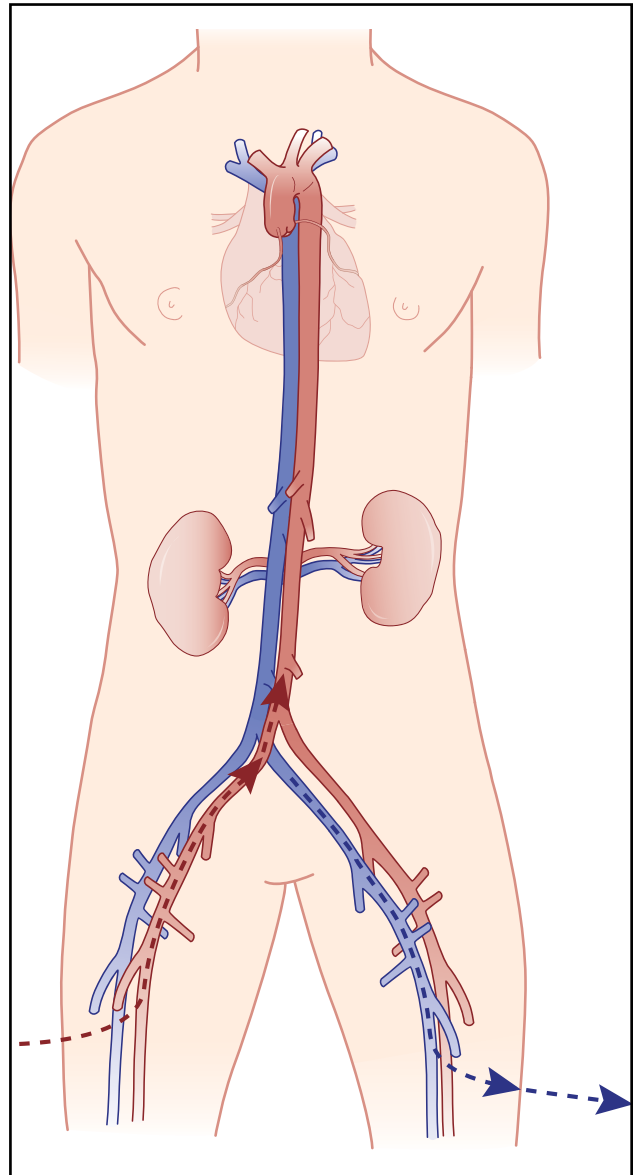
Oxygenator is the part of ECMO that takes out carbon dioxide and adds oxygen to your loved one's blood. It acts as an artificial lung.

□ Veno-arterial (VA) ECMO

The machine does the work for the heart and lungs, which gives these organs times to rest and recover.

- The ECMO machine is connected to your loved one through special tubes (cannulas). The most common connection sites are the femoral vein and femoral artery, the blood vessels located in your loved one's upper thigh or groin area.

- The blood goes out of the femoral vein cannula and into the machine. ECMO supplies oxygen to the blood and takes out the carbon dioxide. This acts as a lung. The oxygen-rich blood goes back into your loved one's body through the femoral artery cannula. The blood travels to all of the organs to keep them working.



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The veno-arterial ECMO works like a lung. The machine removes your loved one's blood through the cannula in their thigh or groin. ECMO removes the carbon dioxide and adds oxygen to the blood, which is returned to your loved one through a different cannula in the thigh or groin.

- The cannulas may also be placed directly into the heart, especially if your loved one had heart surgery. Your loved one may return from surgery with their chest still open. This can be startling but it is part of the healing process and helps your loved one's heart rest.

Medical Terms

Venous means vein.

Cannula is a special tube that connects your loved one to ECMO.

Cannulation sites are where the cannulas are connected to the ECMO. They are usually at the veins in your loved one's neck and thigh or groin.

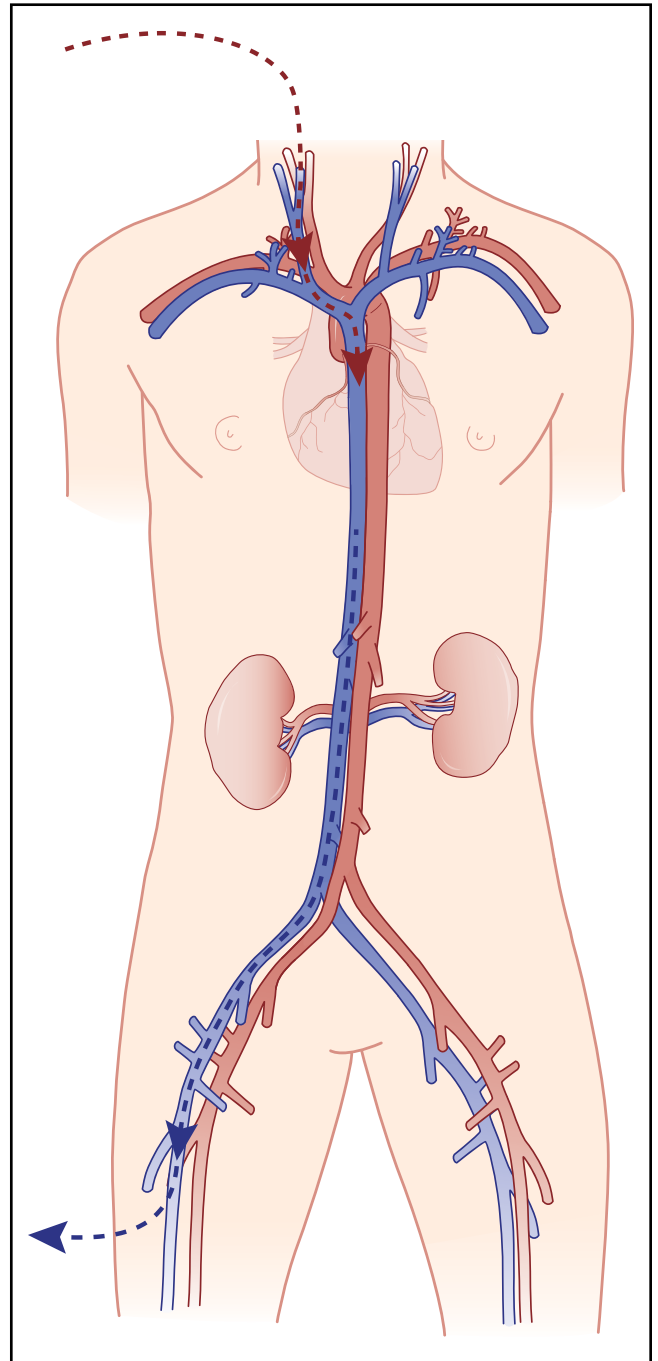
□ Veno-venous (VV) ECMO

The machine does the work only for the lungs. The heart will need to be able to work well on its own.

- The ECMO machine is connected to your loved one through special tubes (cannulas). The most common connection sites are the right internal jugular vein (the large vein in your neck), and the femoral vein (the large vein in your thigh or groin area).

- The blood goes out of the femoral vein cannula and into the machine. ECMO supplies oxygen to the blood and takes out the carbon dioxide. This acts as a lung. The oxygen-rich blood goes back into your loved one's heart through the jugular vein cannula right into the heart.

The blood travels to all of the organs to keep them working.



© Allina Health System

The veno-venous ECMO works like a lung. The machine removes your loved one's blood through the cannula in their thigh or groin. ECMO removes the carbon dioxide and adds oxygen to the blood, which is returned to your loved one's heart through a different cannula in the neck.

Length of Being on ECMO

Important

The machine helps save your loved one's life but it does not treat the disease or injury. ECMO provides support while members of the health care team provide treatment. This support helps your loved one's body heal.

The amount of time your loved one is on the ECMO machine depends on their illness and how long recovery takes. The length of time ranges from days to weeks.

ECMO may be removed during a surgery. This may be done when:

- your loved one's heart, lungs or both have recovered and are working well
- a more appropriate treatment is identified
- your loved one:
 - develops uncontrolled bleeding or problems with clotting
 - is not being helped from ECMO support any longer.

Bridge to recovery

If your loved one's health improves, they may not need ECMO support. Members of the health care team will slowly reduce the amount of support ECMO is providing to see if your loved one can regain their own support. This process is called "weaning." It is also known as bridge to recovery.

This process can look different for each person. It depends on their recovery and future needs. Some people may need an implanted mechanical circulatory support device to help the heart pump. This is called a bridge-to-device. If this is an option for your loved one, members of the ECMO care team will talk with you in more detail.

Risks of ECMO

Medical Terms

Acute kidney failure means the kidney has stopped working.

Dialysis is a machine that does the work of the kidneys. It is also known as **hemodialysis**.

Complications (serious problems)

Members of the health care team will talk with you about the complications (serious problems) and risks with your loved one's health condition. The health care team's No. 1 goal is to avoid complications that may happen as a result of being on ECMO such as:

- **bleeding** can be caused to blood-thinning (anticoagulant) medicines that are needed while on ECMO (Bleeding can start from different areas of the body.)
- **blood clots** can cause a stroke, seizure or other injury
- **kidney failure** from not enough blood flow to the kidneys can cause the kidneys to stop working (If this happens, your loved one may need to be connected to a special machine that does the work of the kidneys.)
- **infection** can come from the tubes that are needed to provide support on ECMO go from outside directly to your loved one's bloodstream (This increases the risk for an infection.)
- **leg damage** can happen when tubes going in through veins and arteries in the thigh area to the ECMO machine do not get enough blood flow (In some situations, the tubes can reduce the blood flow into the leg, and the tissue in the leg may begin to die. If this occurs, the health care team will try to restore blood flow down the leg.)
- **stroke** can happen if certain areas of the brain does not always get as much blood flow as it needs, due to small blood clots
- **swelling** or problems with blood flow to different organs
- **death**.

If your loved one's organs are not healing

Despite all of the efforts of the health care team and treatment options, your loved one may not get better. The health care team will always provide compassionate care and to limit your loved one's pain and suffering.

You have the option for palliative care. This can help increase your loved one's ability to cope during treatment while maintaining the best physical, emotional and spiritual health possible. It can also help manage symptoms. Talk with members of the health care team to learn more.

Medicines

- Your loved one will receive sedation and pain medicine through the IV in their hand or arm. These medicines will help your loved one feel more comfortable and remain calm.
 - Your loved one may sleep while under sedation. They may not be able to move much. Movement does not mean that they are in pain.
- Your loved one may also receive blood thinners (anticoagulants). These medicines help prevent blood clots.
 - Members on the health care team will watch your loved one's lab results closely. Medicine levels may be changed.

Blood Transfusion

Blood transfusions will help to make sure that your loved one has enough blood to:

- carry oxygen through the body for their organs (red blood cells)
- help the blood to clot or to stop or prevent bleeding (plasma and platelets).

Tests

While your loved one is on ECMO, tests will be done to watch and monitor their condition. These tests may include:

- **blood tests:** Blood tests let members of your health care team check your loved one's:
 - electrolytes (minerals such as sodium and potassium that help your loved one's body work well)
 - cells (the number and kinds)
 - oxygen and carbon dioxide levels.

Blood tests can also confirm if your loved one has an infection.

- **X-rays:** Images are used to check on the condition of the heart and lungs, and to make sure tubes and lines are inserted in the right places.

- **echocardiogram (echo):** An echocardiogram (echo) is an ultrasound of your loved one’s heart. The test uses sound waves to see how well your heart is working. A wand-like instrument makes the sound waves. As the wand is moved over your chest, pictures of the heart appear on a screen and are recorded digitally.

This allows the health care team to see the heart and how it is working at that time. This can help with measurements and treatments.

- **ultrasound:** An ultrasound uses sound waves to “see” the inside of your loved one’s body.

How Your Loved One May Look

Care Circle

Your care circle includes family members, friends and those close to you.

You can help prepare members of your care circle for what to expect.

- Your loved one may:
 - look swollen or puffy. This is normal. They are receiving a lot of fluids and blood products.
 - look pale
 - have skin that feels cool to the touch.
- Your loved one will have a breathing tube in their mouth. Also, they will have medicine (sedation) that makes them sleep. This means your loved one will not be able to talk with you.
- Your loved one will be connected to many machines. There are a lot of tubes coming from different areas of their body. It may seem like a lot of equipment, but each piece is important to watch and treat your loved one, and keep them comfortable.

Some of the tubes that are connected to your loved one are for the ECMO machine. Others include:

- **dialysis:** a machine that helps the kidneys remove waste
- **ventilator or respirator:** a machine that helps your loved one breathe
- **nasogastric tube (known as an NG):** a tube placed through the nose or mouth that goes into the stomach. The NG tube helps to drain the stomach, deliver nutrition or both. There may be 2 NG tubes.
- **drainage tubes:** tubes in the chest help to remove and drain fluid and waste

- **arterial line:** a small tube (catheter) that placed in the wrist or groin. It is used to draw blood samples for testing and to monitor pressures.
- **intravenous (IV) catheters:** a small tube inserted into veins. It is used to give fluids, blood products, pain medicines, antibiotics and sedation (medicine to make your loved one sleepy).
- **urinary catheter (Foley catheter):** a tube inserted into the bladder in order to drain urine
- **intra-aortic balloon pump:** a balloon is placed inside the aorta (main artery in the body) to help the heart pump blood.
- **LV (left ventricle) vent:** a tube placed in the left ventricle of the heart to help remove fluid so the heart does not over-stretch and become damaged.

How to Help Your Loved One

Protect them when visiting

- **Always** wash your hands before going into the room.
- If you have a cold or any other illness, try to wait to visit until your symptoms are gone.
- If you need to, wear a mask to prevent spreading germs. Ask a member of the health care team if you are not sure if you should visit.

Help with their care

You can help with your loved one's care.

- Spend time with them. Talk about familiar, happy news and memories in a reassuring voice.
- Gently hold their hand.
- Touch them softly.
- Bring in soothing music to play.
- Bring in a special comfort item, such as photos, blankets or other familiar items.
- Keep a journal of progress.

Take care of yourself

Having a loved one on ECMO can be difficult. You need to be sure to take care of yourself.

- Get enough rest and sleep.
- Eat regular meals. Drink plenty of healthful liquids.
- Ask other friends or family to sit with your loved one so you can get out of the hospital for a while.
- Ask a member of the health care team to connect you with a chaplain or mental health specialist.
- Ask a member of the health care team about relaxation techniques and easy exercises to reduce your stress.

Glossary

Activated clotting time

This is a test that measures how many seconds it takes for the blood to clot. It is known as ACT.

Antibiotic

This is a medicine that kills bacteria or germs. It is used to prevent or cure an infection.

Aorta

This is the large artery that carries oxygen-rich blood from the heart to the body.

Artery

This is the type of blood vessel that pumps oxygen-rich blood to the organs.

Blood gas

This is a measure of the level of oxygen (good air), carbon dioxide (bad air), and pH (acid) in a blood sample. It helps tell how well your loved one's heart and lungs are working.

Bronchoscopy

This is an exam of your loved one's trachea and bronchial tubes in the lungs. A flexible lighted tube (a bronchoscope) will be passed through the mouth or nose into your lungs. The bronchoscope is about the size of a thin pencil and it has a bright light on the end.

Cannulas

Cannulas are plastic tubes placed into the veins and arteries leading to and from your loved one's heart. ECMO will be attached to the cannulas to provide support. The interventional cardiologist or cardiothoracic surgeons will insert the cannulas.

Cannulation

The process of placing the cannulas into the blood vessels. This process may be done in a surgery or through the skin like an IV (intravenous) line in a hand or arm.

Carbon dioxide (CO₂)

This gas carries waste products out of the body when your loved one exhales (breathes out.)

Cardiac

This is related to the heart.

Cardiac catheterization

This is a procedure where a small catheter is placed into a vein or artery that is threaded up to the heart. It lets the health care team use X-ray and contrast look to see how well your loved one's heart is working.

Carotid artery

This is the large artery in the neck that carries blood from the heart to the brain.

Centrifugal pump

This is the "artificial heart" in the ECMO machine. It pumps the blood through the ECMO circuit and then returns it back to your loved one.

Chest tube

A chest tube is a clear, flexible tube that is usually inserted into the lower side of the chest. It is used to drain fluids, to restore the normal air pressure inside the chest, or both.

Chest X-ray

This is an X-ray of your loved one's heart and lungs.

Clamped off

A trial period when your loved one is taken off ECMO before the cannulas are removed (de-cannulation).

Computerized tomography (CT)

A CT scan uses X-ray and a computer to create detailed images of your loved one's body.

Decannulation

Once your loved one is ready to be removed from ECMO, the cannulae will be removed during surgery.

Dobhoff tube

This tube is inserted through your loved one's nose to a part of the intestines to deliver nutrition and calories. It is also known as an NJ (nasojunal) tube.

Echocardiogram

An echocardiogram (echo) is an ultrasound study of your loved one's heart muscle, heart valves and pericardium (sac surrounding the heart). The test uses sound waves to see how well the heart is working.

ECMO

ECMO stands for extra corporeal membrane oxygenation. This machine takes over for your loved one's heart and lungs. It is known as a life-support machine.

ECMO flow

This is the amount of blood the pump moves through the machine. In general, a higher flow rate offers more support.

Electroencephalogram (EEG)

This test records the electrical activity from your brain (brain waves). Small metal discs (electrodes) attached to the scalp "pick up" the electrical activity from the brain. This activity goes through to the EEG machine, which records the activity.

Endotracheal tube

This is a tube that is placed in the mouth that goes into the lungs to help breathe and protect your loved one's airway.

HeartMate®

This device helps the left side of your loved one's heart while they wait for a heart transplant.

Heat exchanger

This is a machine that is connected to the membrane oxygenator that warms the blood before it is pumped back to your loved one.

Heparin

This is an anticoagulant (medicine). It helps reduce clots from forming in your loved one's blood.

Hemofiltration

This machine removes extra fluid from your loved one's kidney. It is also known as "artificial kidney."

Intracranial or intraventricular hemorrhage

This is bleeding in or around your loved one's brain. This is a serious possible complication (side effect) of ECMO. It can be seen on ultrasound or on a CT scan.

Ligation of blood vessels

When the ECMO catheters are removed, the veins, artery or both they were in are often permanently closed off with a stitch (ligated).

Magnetic resonance imaging (MRI)

MRI uses a magnetic field to make three-dimensional (3-D) images of almost any part of your body.

Membrane oxygenator

This machine removes carbon dioxide from your loved one's blood and replaces it with oxygen. It is also known as an "artificial lung."

Nephrology

This is related to a kidney.

Neurology

This is related to the brain and spinal cord.

Oxygenator

This is the “artificial lung” of ECMO. It removes carbon dioxide and provides oxygen to your loved one’s blood.

Platelets

Platelets help prevent bleeding by causing the blood to clot.

Pneumothorax

This is a collapsed lung. Air from the lung escapes into the space between the lung and chest wall.

Pulmonary hypertension

This means your loved one has high blood pressure in their lungs. It is serious.

Pump

This is the “artificial heart” of ECMO. It moves the blood through the machine and back into your loved one’s body.

Respiratory distress

This means your loved one is having trouble breathing.

Sepsis

This is an infection in the blood.

Tracheostomy

This is a surgical opening in the windpipe (trachea) to create an airway for breathing. A tube is placed in the opening. A tracheostomy may be needed because of a blocked airway, facial injury and swelling, mouth or neck surgery or for long-term ventilator (respirator) use.

Trialing off

This is when the ECMO support is temporarily stopped or slowed down so the health care team can check how well the heart and lungs are working. If your loved one is getting better, the ECMO may be stopped.

Ultrasound

Ultrasound uses low-energy sound waves to create images on a monitor.

Veno-arterial (VA) ECMO

The veno-venous ECMO works like a lung. The machine removes your loved one's blood through the cannula in their thigh or groin. ECMO removes the carbon dioxide and adds oxygen to the blood, which is returned to your loved one's heart through a different cannula in the neck.

Veno-venous (VV) ECMO

The veno-venous ECMO works like a lung. The machine removes your loved one's blood through the cannula in their thigh or groin. ECMO removes the carbon dioxide and adds oxygen to the blood, which is returned to your loved one's heart through a different cannula in the neck.

Ventilator

The ventilator is a machine that helps your loved one breathe and supplies extra oxygen for the lungs. This oxygen goes into the lungs through a special breathing tube (an endotracheal tube). Also known as a respirator or vent.

Weaning

This is a process to slowly decrease the amount of support given to your loved one gets as they get better. The term can also be used to refer to the blood flow rate of the ECMO machine or the settings of the ventilator.

Getting to Abbott Northwestern Hospital

Parking

Ramp parking is available in the Main Parking Ramp off East 28th Street. Additional parking is available in the Blue/26th Street Ramp adjacent to The Mother Baby Center. Parking for the Piper Building specifically is available in a self-park surface lot on the corner of S 10th Avenue and E 26th Street.

Handicap parking is available on level E of the Main Parking Ramp and on the surface parking spaces outside Courage Kenny Rehabilitation Institute. State permits are required for designated handicapped-accessible parking places.

Valet parking **V** is available at the main hospital entrance Monday through Friday, from 7 a.m. to 7 p.m. Visitors to the Piper Building may use valet parking Monday through Friday, from 5 a.m. to 7 p.m. After 7 p.m., visitors may access valet-parked vehicles by calling Security at 612-863-5416.

Visitors to Abbott Northwestern's parking ramps use automated Parking Pay Stations to pay for their parking fees.

On-street parking around Abbott Northwestern is limited, and enforcement of parking meters and parking rules is strict. Vehicles parked in the Andersen Elementary parking lot off 10th Avenue S will be tagged and towed.

Parking rates range from \$0 for 1-15 minutes to a maximum of \$26. Discount ramp and valet exit tickets are available at the Valet Parking office in the main hospital entrance lobby, Monday-Friday, 7 a.m. to 7 p.m.

Campus Services

Service	Building	Level
Admitting	E	1
Emergency Department	H	1
Main Radiology	E	1
Minneapolis Heart Institute® Clinic	H	2
Outpatient Imaging Center	CK	1
Patient Pick-Up	CK	1
Valet, Main Entrance	E	1
Valet, Piper Building	PB	1
Virginia Piper Cancer Institute®	PB	1, 3, 4 & 6

Address

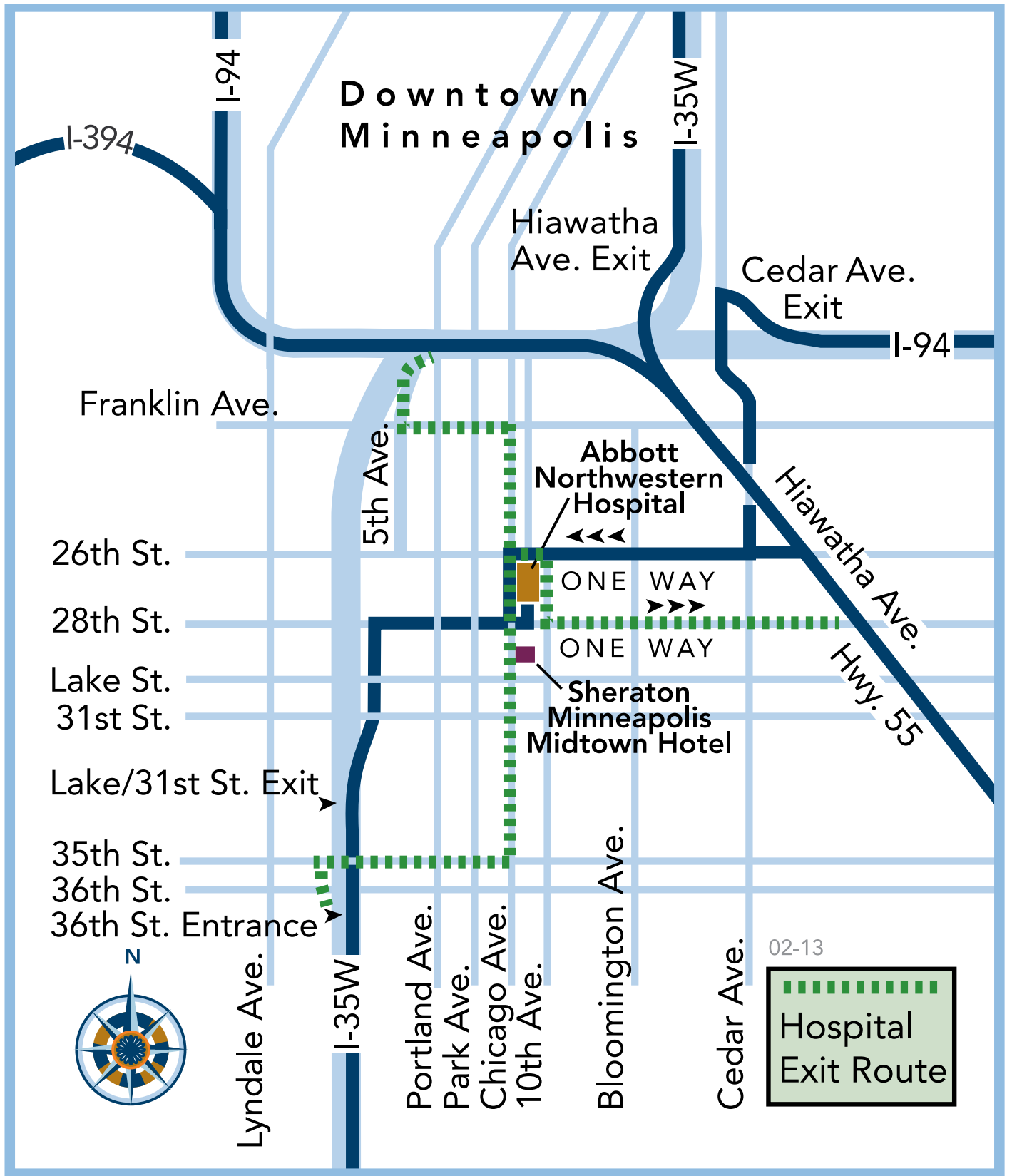
The mailing and delivery address for Abbott Northwestern Hospital is:
800 East 28th Street
Minneapolis, MN 55407
Main number: 612-863-4000

When making your appointment, please ask the staff to confirm the name of the building to which you should go.

allinahealth.org/abbottnorthwestern

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If you need further directions when you reach this campus,
do not hesitate to ask an employee or volunteer.

Your loved one will be transferred to Abbott Northwestern- Heart Hospital and will likely be on H4200 which is the Cardiovascular ICU

Please check in at the desk when you arrive

From the East on I-94

Exit I-94 at Cedar Avenue (Exit 234C), turn left. Follow Cedar Avenue (Cedar veers to the right at the traffic lights) to E 26th Street and turn right.

■ **If visiting the Heart Hospital or main hospital,** take E 26th Street to Chicago Avenue and turn left. Proceed to E 28th Street and turn left. Turn left again onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning left onto 10th Avenue S and proceed to E 26th Street. Turn left onto E 26th Street and proceed to Chicago Avenue. Turn right on Chicago Avenue. Proceed to Franklin Avenue, turn left. Turn right on 5th Avenue. Proceed north on 5th Avenue to I-94 East entrance ramp.

From the north on I-35W

Exit I-35W at the Hiawatha/Highway 55 Exit (Exit 17A). Follow Hiawatha/Highway 55 to E 26th Street. Turn right onto E 26th Street.

■ **If visiting the Heart Hospital or main hospital,** take E 26th Street to Chicago Avenue and turn left. Proceed to E 28th Street and turn left. Turn left again onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning right onto 10th Avenue S and proceed to E 28th Street. Turn left onto E 28th Street and follow to Hiawatha/Highway 55. Turn left and proceed to 35W North.

From the northwest on I-94:

Exit I-94 at the Hiawatha/Highway 55 Exit (Exit 234A). Follow Hiawatha/Highway 55 to E 26th Street. Turn right onto E 26th Street.

■ **If visiting the Heart Hospital or main hospital,** take E 26th Street to Chicago Avenue and turn left. Proceed to E 28th Street and turn left. Turn left again onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning right onto 10th Avenue S and proceed to E 28th Street. Turn left onto E 28th Street and proceed to Hiawatha/Highway 55, turn left and follow to I-94 West entrance ramp.

From the west on I-394:

Follow I-394 to I-94 East (Exit 8B). Exit I-94 at the Hiawatha/Highway 55 Exit (Exit 234A). Follow Hiawatha/Highway 55 to E 26th Street. Turn right onto E 26th Street.

■ **If visiting the Heart Hospital or main hospital,** take E 26th Street to Chicago Avenue and turn left. Proceed to E 28th Street and turn left. Turn left again onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning right onto 10th Avenue S and proceed to E 28th Street. Turn left onto E 28th Street and proceed to Hiawatha/Highway 55, turn left and follow to I-94 West entrance ramp. Follow I-94 West to I-394 West.

From the south on I-35W

Exit I-35W at the 31st Street/Lake Street Exit (Exit 15). Proceed north on the frontage road (which is S 2nd Avenue). Turn right onto E 28th Street and proceed to Chicago Avenue.

■ **If visiting the Heart Hospital or main hospital,** cross Chicago Avenue and immediately turn left onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning left onto 10th Avenue S and proceed to E 26th Street. Turn left onto E 26th Street and proceed to Chicago Avenue. Turn left onto Chicago Avenue, proceed to E 35th Street, turn right. Proceed over the interstate and turn left immediately to enter the I-35W South entrance ramp.

From the southeast on Hiawatha/Highway 55

Turn left off Hiawatha/Highway 55 onto E 26th Street.

■ **If visiting the Heart Hospital or main hospital,** take E 26th Street to Chicago Avenue and turn left. Proceed to E 28th Street and turn left. Turn left again onto the hospital campus.

■ **Leaving the Heart Hospital, main hospital or Piper Building:** Exit the parking ramp or lot, turning right onto 10th Avenue S. At E 28th Street, turn left. Follow E 28th Street to Hiawatha, turn right.





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