



PI Preclinical Imaging

# Preclinical Vevo 2100 Ultrasound Online Training

This online training is required for any researchers or staff who wish to use Comparative Medicine's ultrasound to image small animals for diagnostic or surgical purposes in the small animal vivarium. It is meant to be completed before in person training and also as a reference for future use of the equipment.

[Overview](#)

[Scientific Background](#)

[Imaging Procedure](#)

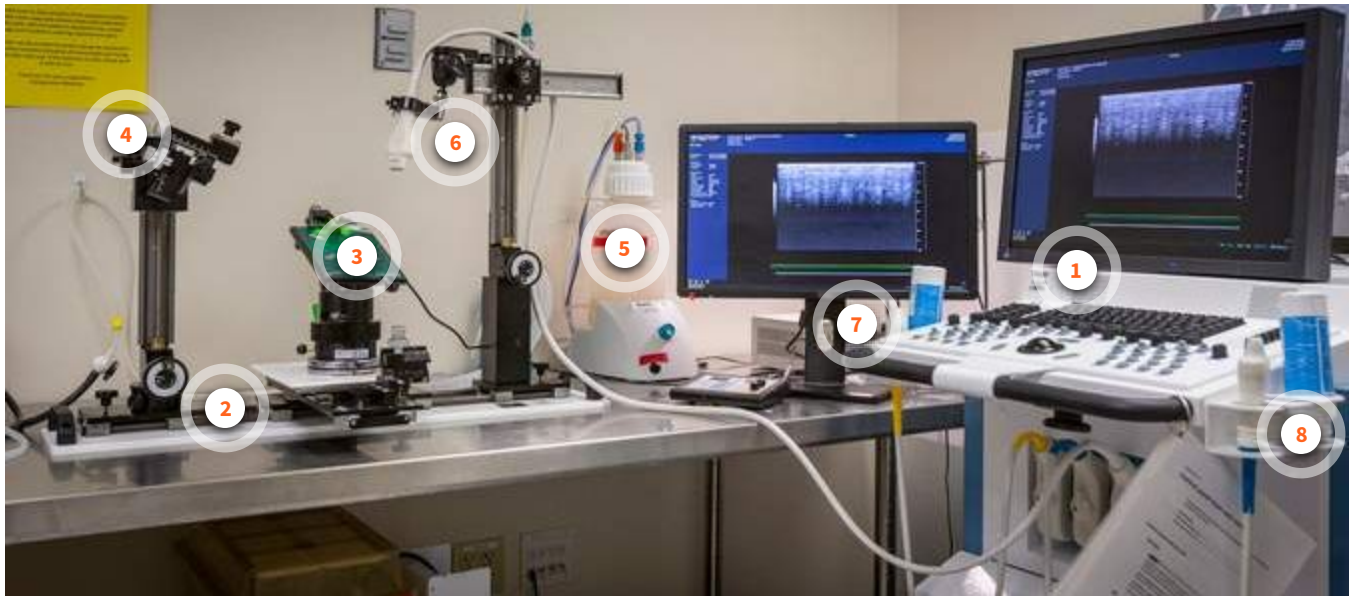
[Further Resources](#)

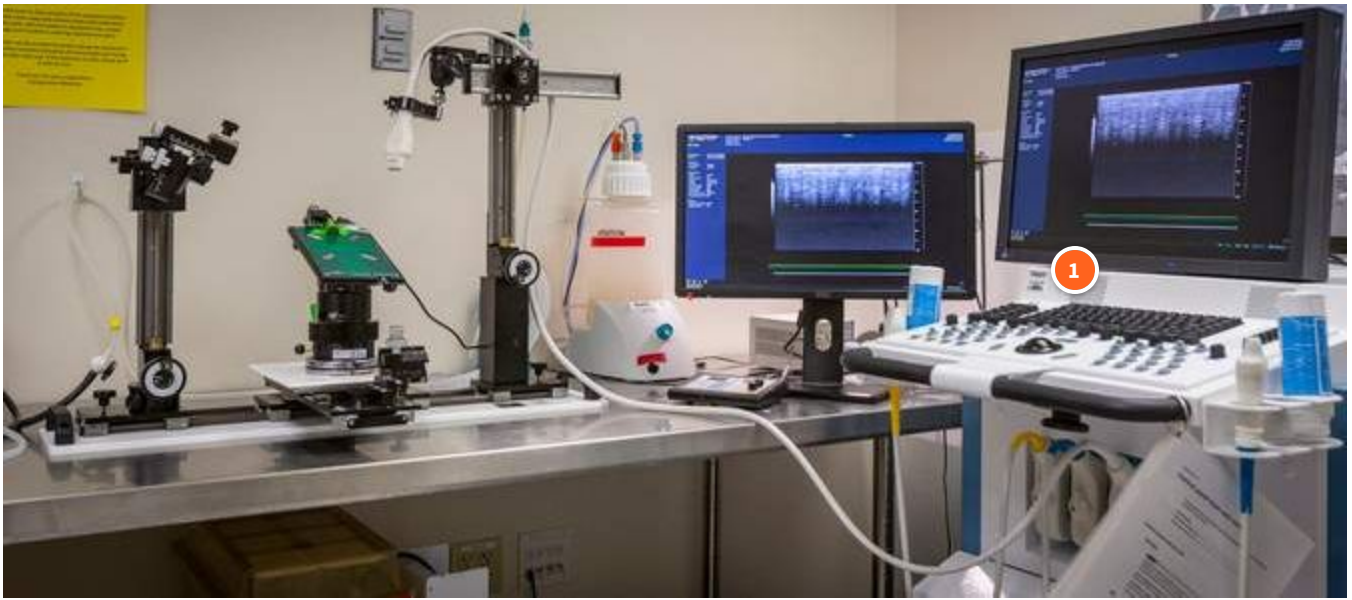
# Overview

PI Preclinical Imaging

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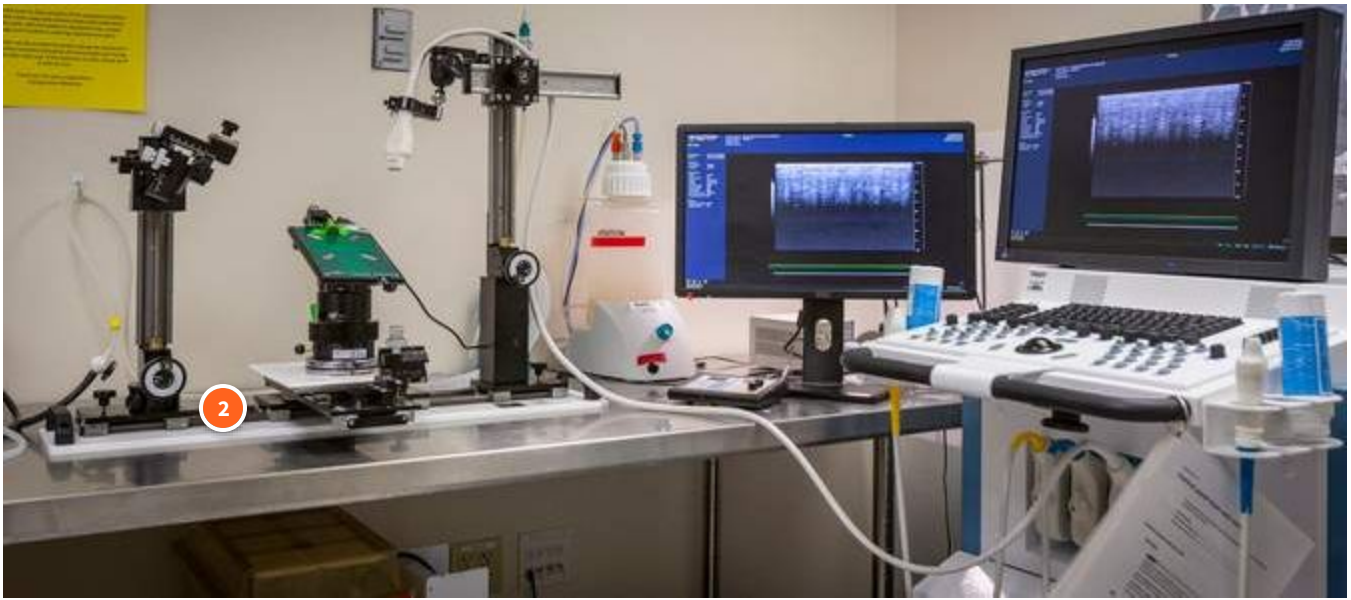
Reservations on the Vevo 2100 ultrasound can be made up to 30 days in advance in iLab. The machine can be reserved on weekends and holidays, with 24/7 access. Full access is granted after completing a Comparative Medicine facility tour, this online training, and a brief in-person ultrasound training.





## Ultrasound machine

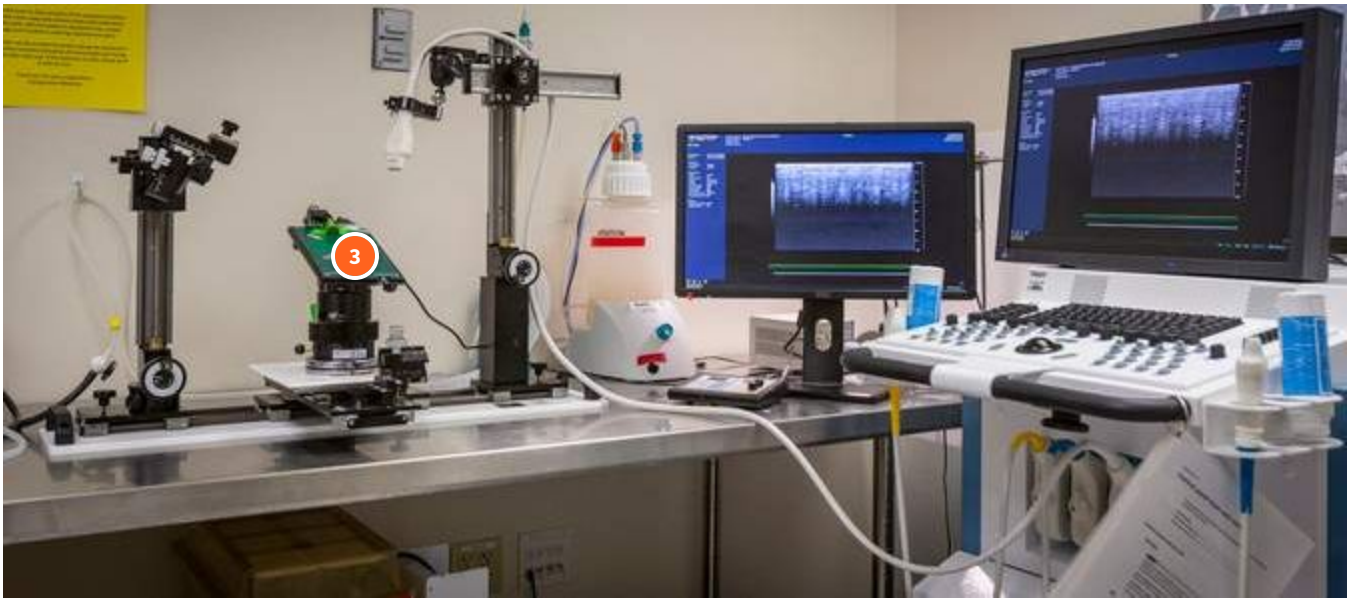
Vevo 2100 Ultrasound Machine from VisualSonics.



## Stereotaxic Frame

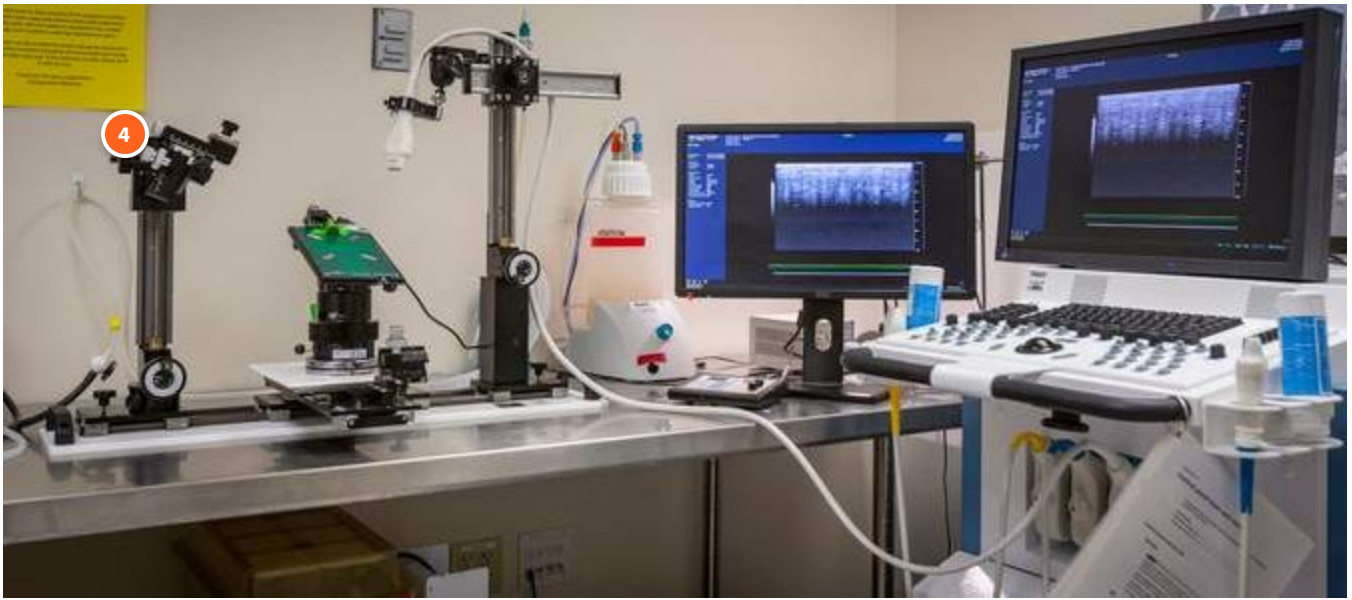
Allows for precise positioning of the animal on the heated platform, precise positioning of the ultrasound transducer, and excellent control of a syringe mount system for guided injections.





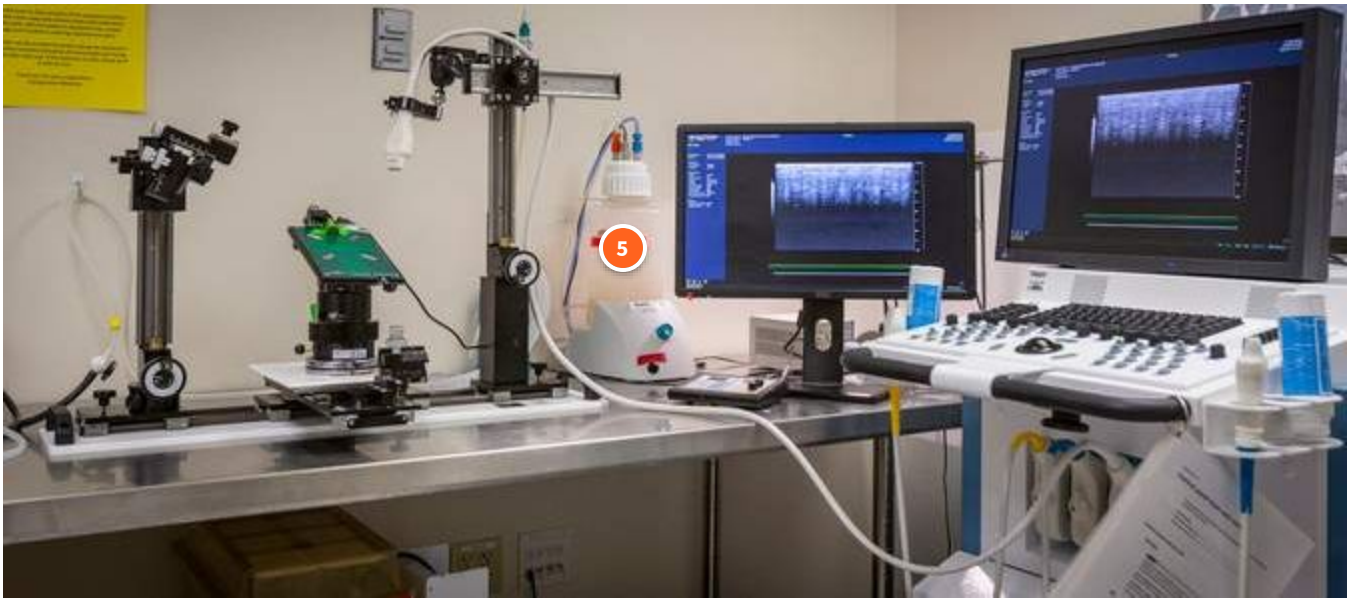
### Heated Animal Monitoring Stage

Keeps animals warm during imaging or surgery and prevents hypothermia



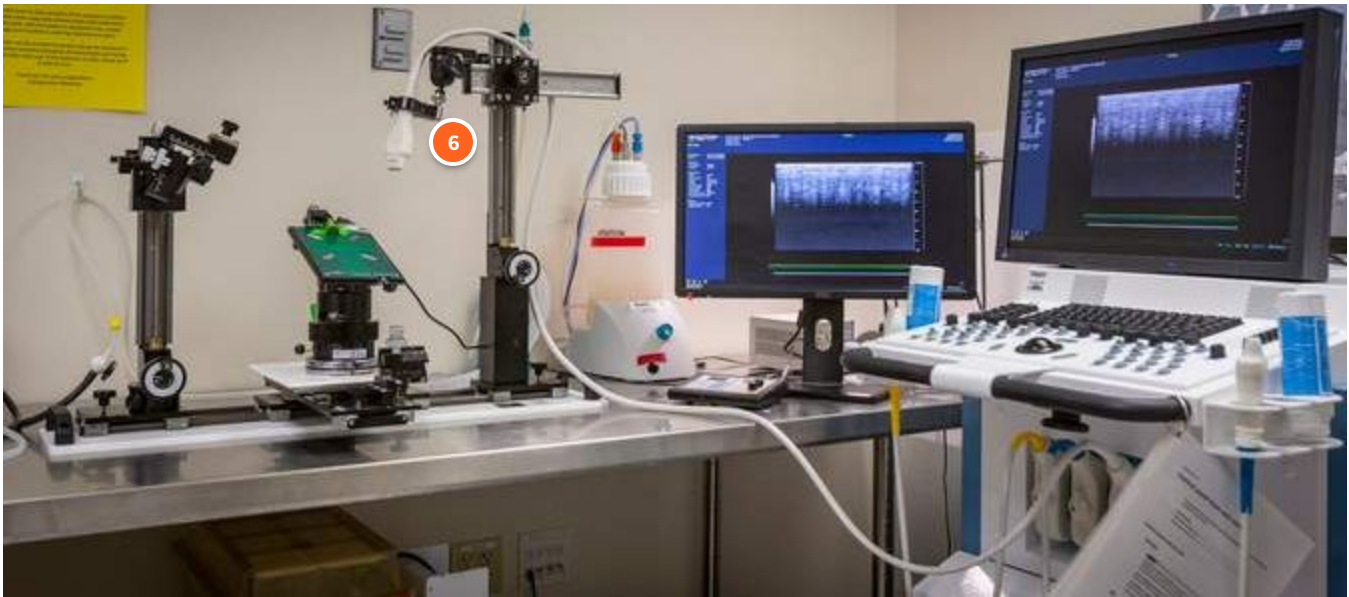
### Needle Injection Mount

Allows for precise positioning and delivery



### Vacuum pump

Can be used to suction ethanol and other fluids used for ultrasound-guided surgical procedures



## 55 MHz transducer

This is the most commonly used transducer in the vivarium. It is optimized for mouse/rat embryology, mouse abdominal, reproductive, epidermal imaging, tumor imaging (up to 13 mm in diameter), mouse vascular, small rat vascular, some abdominal (kidney), and ophthalmology.

Specifications:

- broadband frequency: 26 MHz - 52 MHz
- axial image resolution: 40 microns
- image size: 14.1 mm (w) x 15 mm (d)
- max frame rate: 557 fps



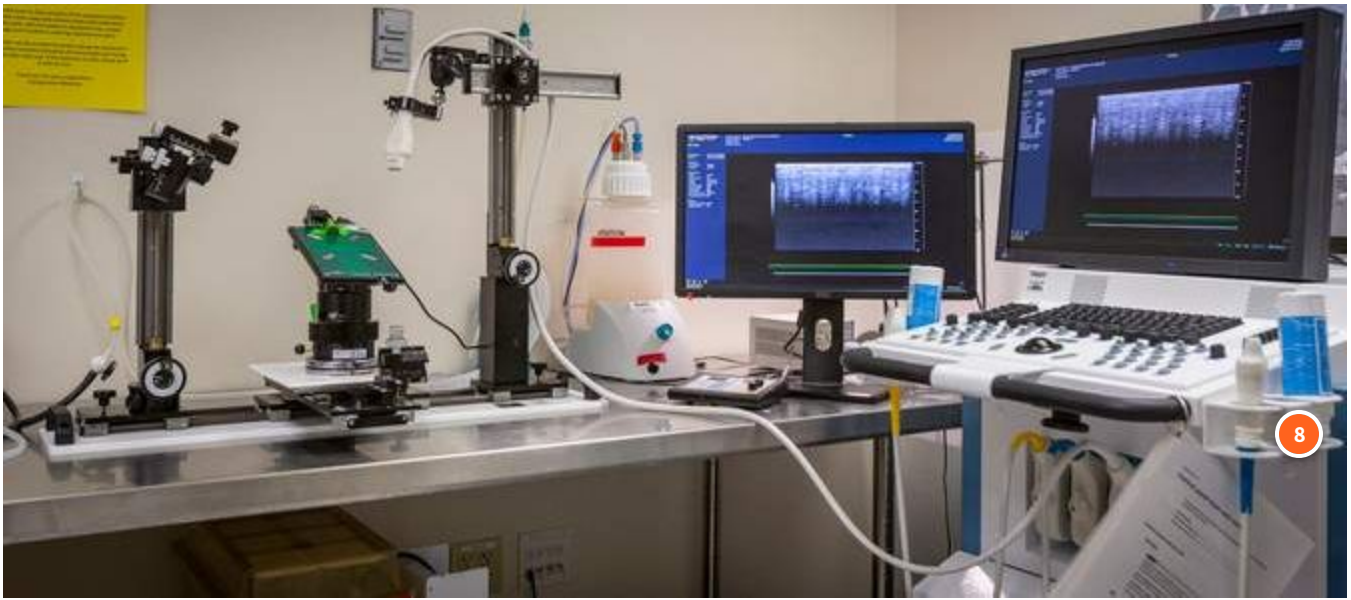
## 24 MHz Transducer

Alternative transducer less commonly used, but used for rat cardiology and abdominal imaging (less than 400 g), large tumor imaging (up to 23 mm in diameter), and all contrast applications.

Specifications:

- broadband frequency: 14 MHz - 28 MHz
- axial image resolution: 75 microns
- image size: 23 mm (w) x 30 mm (d)
- max frame rate: 367 fps



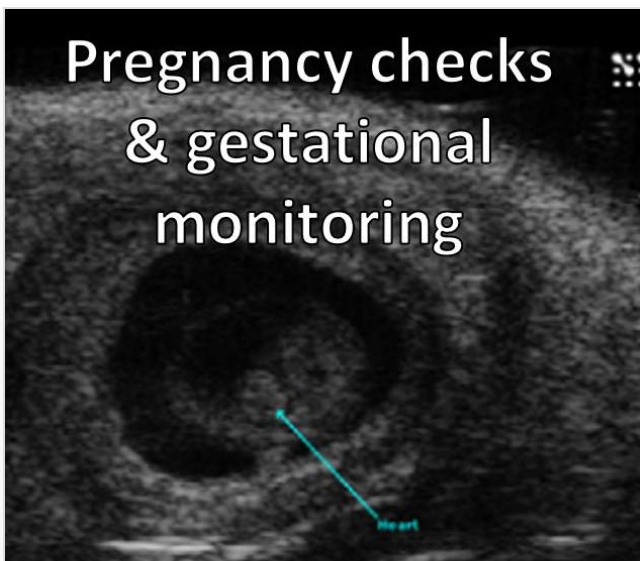


## Ultrasound Gel

Provided in the room and restocked daily

Click on the items in the image below to see more information about each of the ultrasound components.

Some ultrasound applications at Fred Hutch are...

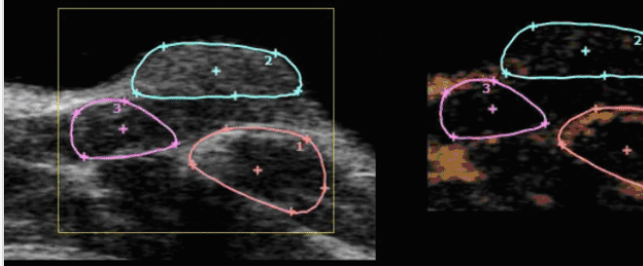


Verifying pregnancy and monitoring embryonic development.

*Image shows an embryonic mouse heart, non-invasively imaged through the mother's abdomen.*



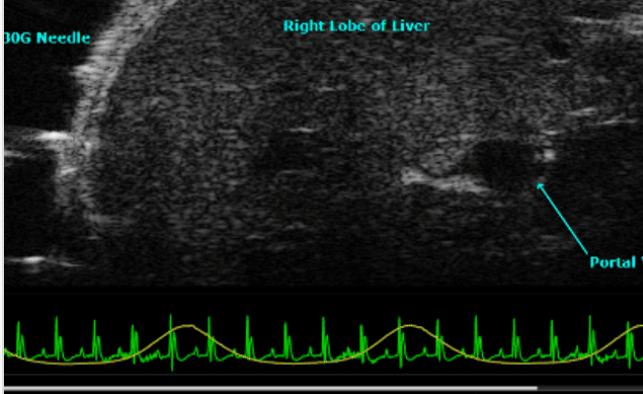
## Tumor monitoring and response to treatment



Monitoring the development and response of tumors to new forms of treatment.

*Image shows quantification of tumor size using non-linear contrast agents.*

## Ultrasound-guided surgical techniques



Ultrasound-guided surgical techniques to improve animal health outcomes.

*Image shows an image-guided injection into the portal vein of an adult mouse.*

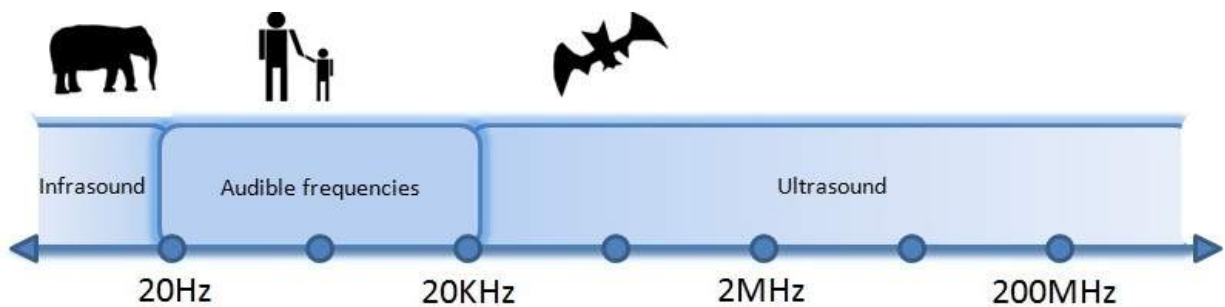
CONTINUE

# Scientific Background

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## Ultrasonic Waves & Transducers

The ultrasound transducer sends out very high frequency soundwaves above 20 kilohertz, these soundwaves cannot be heard by the human ear.

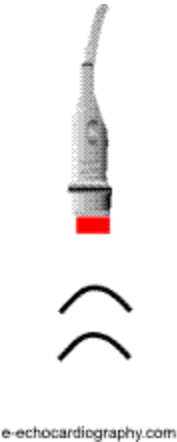


Sound frequency range. Image courtesy of teachengineering.org


As these ultrasonic waves travel through a medium, they reflect off the different membranes and edges that they encounter. Some of these reflected soundwaves are re-detected by the transducer and are compiled together to form an image.




The more material the ultrasound waves encounter in a medium, the more those waves will be attenuated. Thus, the intensity of the images farther into a sample are going to be lower than they are at the top of the image. The imaging depth limit of our ultrasound machine is around 10 mm, but this number can vary with tissue type, the transducer used, and the application.



Further detail on how ultrasound imaging works:

 **YOUTUBE**



## Ultrasound medical imaging | Mechanical waves and sound | Physics | Khan Academy

You can actually use sound to create images of the inside of the body. Wild!

Created by David SantoPietro. Watch the next lesson:

<https://www.khanacademy.org/...>

**VIEW ON YOUTUBE >**

What is the source of image formation in ultrasound imaging?

- Sound waves with frequencies above 20,000 Hz are sent out from a transducer. These ultrasonic waves are reflected off tissues as they are encountered. Some of these reflections are detected by the transducer and reconstituted to form an image.
- Modulated electromagnetic pulses from the transducer sense tissue boundaries and report linear array positions to the computer program
- Light waves reflected off asymmetric tissue interfaces are backscattered through the objective which are raster-scanned to make an image

SUBMIT





Complete the content above before moving on.

Lesson 3 of 4

# Imaging Procedure

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## Getting Started with the Ultrasound



## Step 1

### iLab Reservation and log-in



iLab

Reserve time on iLab and log in at the start of your session to turn the monitor on.

For instructions on how to register for iLab if you have not yet done so, [click here](#).

## Step 2

### Anesthesia System Set-Up

- Check isoflurane level, ensure you have brought your own isoflurane to refill at the end of your session
- Open oxygen tank and check oxygen tank level
- Turn on heat monitoring stage (35 - 40 celsius)
- Place mouse in induction box and turn isoflurane vaporizer level between 1.5-2.5% to put the mouse to sleep. Make sure air flow to box is open.



### Step 3

## Mouse positioning for imaging

- Once mouse is anesthetized, transfer to heated platform in a supine configuration. Make sure air flow to nose cone is open.
- Use tape to hold arms and legs securely so the mouse does not shift while imaging, being careful not to over-extend limbs.
- If necessary, shave mouse in area where imaging will occur, or use Nair to remove hair to improve image quality.
- Place a generous amount of ultrasound gel over the region of interest for scanning.

**You are ready to begin imaging!**

See the next section on how to operate the ultrasound machine

## **Keyboard layout and Control Panel**

The seven most commonly used features of the control panel are labeled in the below image.





Mouse/Scroll bar

Moves the cursor around on the screen



Prefs, also known as "User Preferences"

Go here to add a new user, or Map to Network Drive to save and transfer your data





## Select/Click

Select button effectively 'clicks' on whatever the cursor is hovering over



## Study Management

Takes the user to the data overview page, where they can begin a new study or add a series to their existing studies. Here users can see images that they have just acquired and review their data.



## B-Mode

This is the main method for imaging. Shows the 2-D image acquired live from the transducer in use.





## Cine Store

Saves a video of the previous 100 frames (NOT the following 100 frames) after it is pressed.

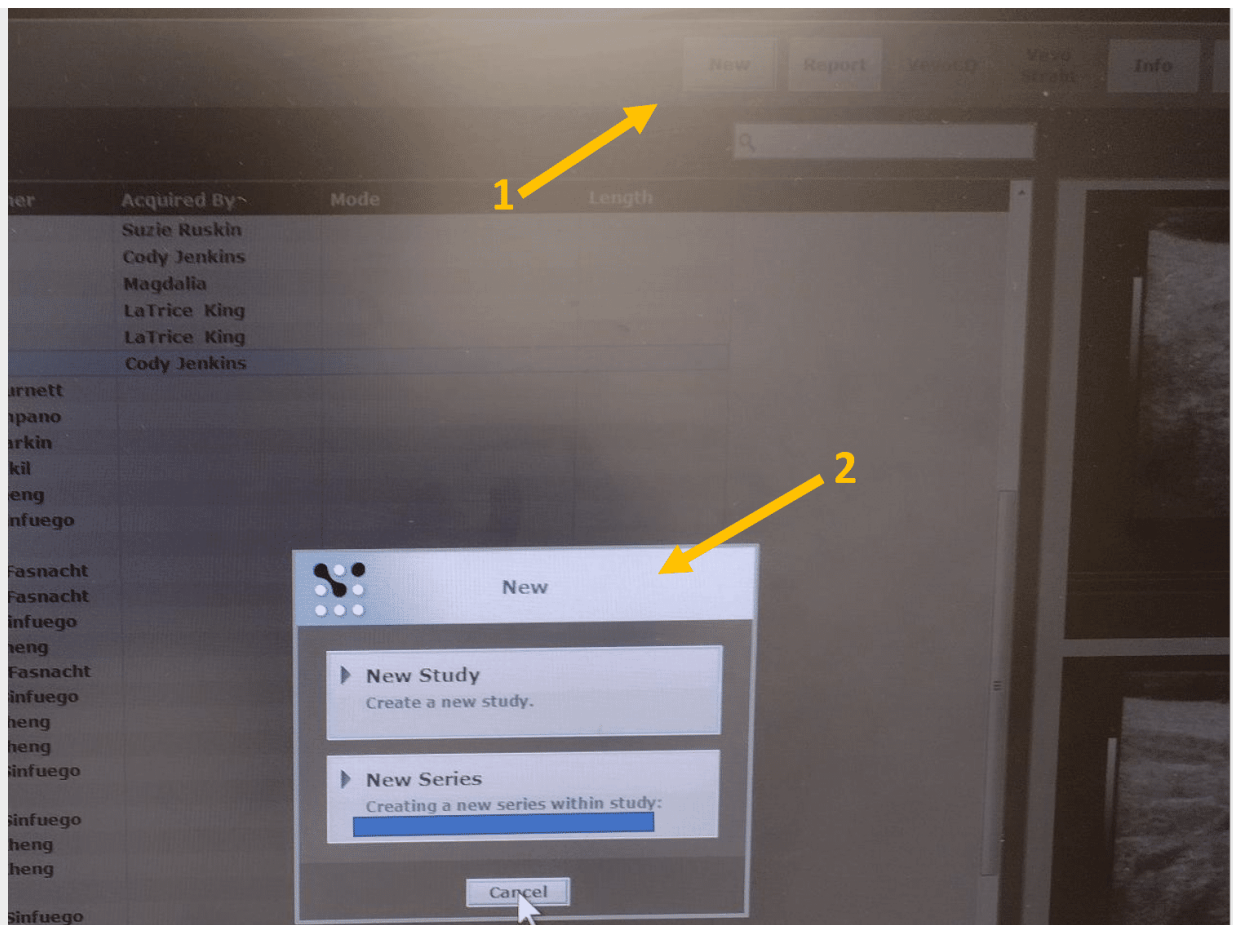


## Frame Store

Saves a single image (1 frame) while in B-mode.

Further information on additional keys are on laminated sheets in the room and can be discussed at the in-person component of the ultrasound training.

## Setting up the computer for an experiment



Choose new study or new series

- Select study management
- Click "New " in top banner
- A Study is a group of Series
- You can later add more images or videos from a series to a study
- Once a series is closed, you cannot add more to the series



vevo 2100

New Series

**Study Information**

Study Name  Study Notes

Owner

Granting Institution

**Series Information**

Series Name  Series Notes

Acquired By

Application

Measurement Package

Animal ID

Type

Color  Strain

Source  Weight

Heart Rate  BPM Temperature

Date of Birth

Sex  Male  Female

Anesthetic Type

Anesthetic On

Anesthetic Off

Protocol ID

Protocol Name

Injectable

Injection Site

Injection Amount

Input Study or Series info

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- Input your Study and/or Series name
- "Owner" and "Acquired by" can be different users (e.g. the PI name and then technician name)
- Most of the time "General Imaging" and "Abdominal Package" should be used. When ready to begin, hit "OK"
- Press B-mode to start scanning

How could you record a 100-frame video of an ultrasound-guided injection?

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- Appropriately position transducer, perform injection, then quickly press 'Cine store'
- Appropriately position transducer, press 'Cine Store', then perform injection
- Appropriately position transducer, perform injection, then quickly press 'Frame store'

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## Wrapping Up



## Step 1

### Recover animals



If applicable, let each mouse wake up in a warm cage. Once awake, return it to its home cage.

## Step 2

### Save data to network drive

1. Click "Prefs"
2. Select the "Network" tab.
3. Click on "Map Network Drive".
4. Fill in "network location" with: \\file.fhcrc.org\home "Z:" drive should be selected. Box labeled "log on with different credentials" should be checked.
5. Log on with your hutch user ID (followed by @fhcrc.org) (your ID should look like username@fhcrc.org.) and password
6. Once connected to the network, exit out of window by clicking "ok" in the top right corner of the screen.
7. In the study browser, select datasets by holding [Ctrl] and clicking the desired studies.
8. To save, click "copy to." Select your mapped network and desired folder then click "ok".
9. Once finished, go back to "Prefs" key, Network tab, select your network drive and click "delete network drive" to disconnect.

These instructions are also printed out in the room.

*Please note that Comparative Medicine is not responsible for saved data. It is the responsibility of the user to copy and store their data in a different location.*

### Step 3

## Clean up!



1. Clean gel off transducer with T-spray and kim wipes (do *not* use C-Dox on the ultrasound as it can rust or damage the materials)
2. Remove magnetic mount and clean anything that may have accumulated under it! (see photo above)
3. Wipe up water and ethanol mess that may have accumulated under stage (NOT doing this results in the equipment rusting)
4. Turn off oxygen tank
5. Turn off vaporizer and refill with isoflurane
6. Turn off heat stage and heated platform
7. Clean stage and any tape residue
8. If you used the vacuum pump bottle, empty it in sink (nearby sinks are in necropsy, BE-351, or BE-157)



Step 4

## iLab log-off



iLab

Log out of iLab to avoid being charged for further time.

## Summary

Wrap up complete!

See the next section for further organ-specific imaging guides and information on how to view the images that you have just acquired!

Which of the following should you *always* do when finished imaging with the ultrasound?

*Select all that apply:*

---

Turn off heat stage

Top off isoflurane in the vaporizer

Turn off oxygen tank



- Clean ultrasound gel off transducer with T-spray and Kim Wipe
- Clean induction box
- Clean heated bed
- Wipe up any water or ethanol that has accumulated on the platform, under the magnetic mount, or under the rails
- spray everything with C-DOX
- tell someone from Preclinical Imaging that you are done using the machine
- tell CM staff that you are done in the room
- Log out of iLab
- Report any issues , including low isoflurane or that the previous user did not clean up after themselves

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Complete the content above before moving on.

# Further Resources



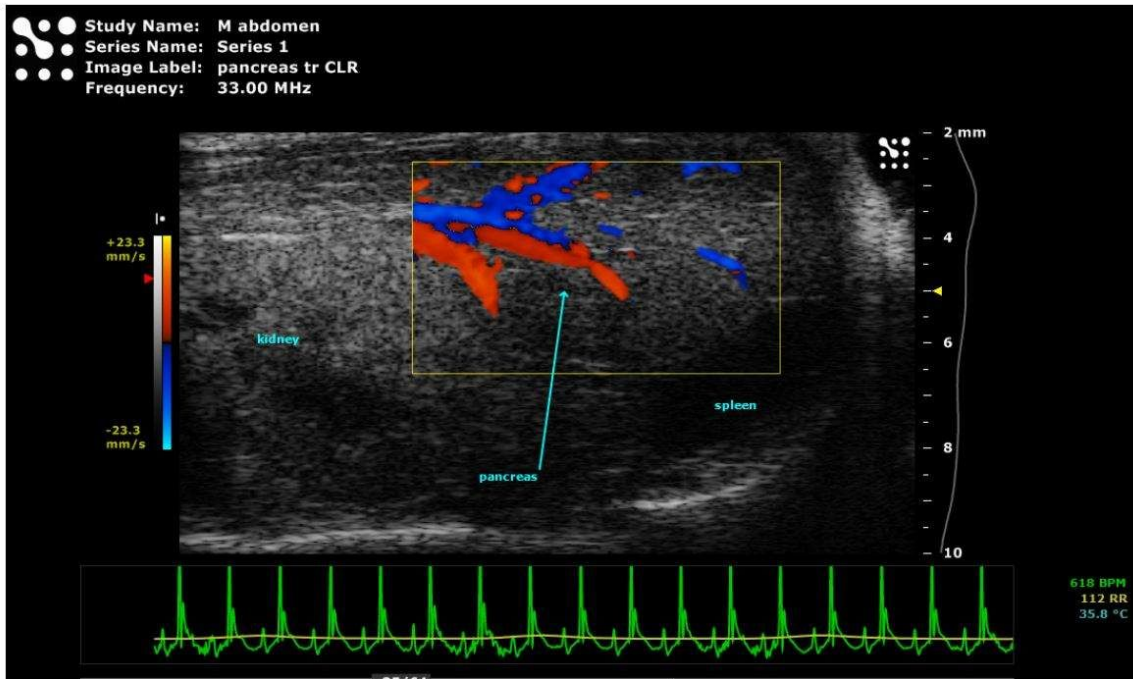
## Organ-Specific Imaging Guides and examples

Select from below the organ(s), areas, and applications for your own research to explore the further guides available and see example images, all courtesy of VisualSonics.

### Pancreas —

Pancreatic Imaging guide:

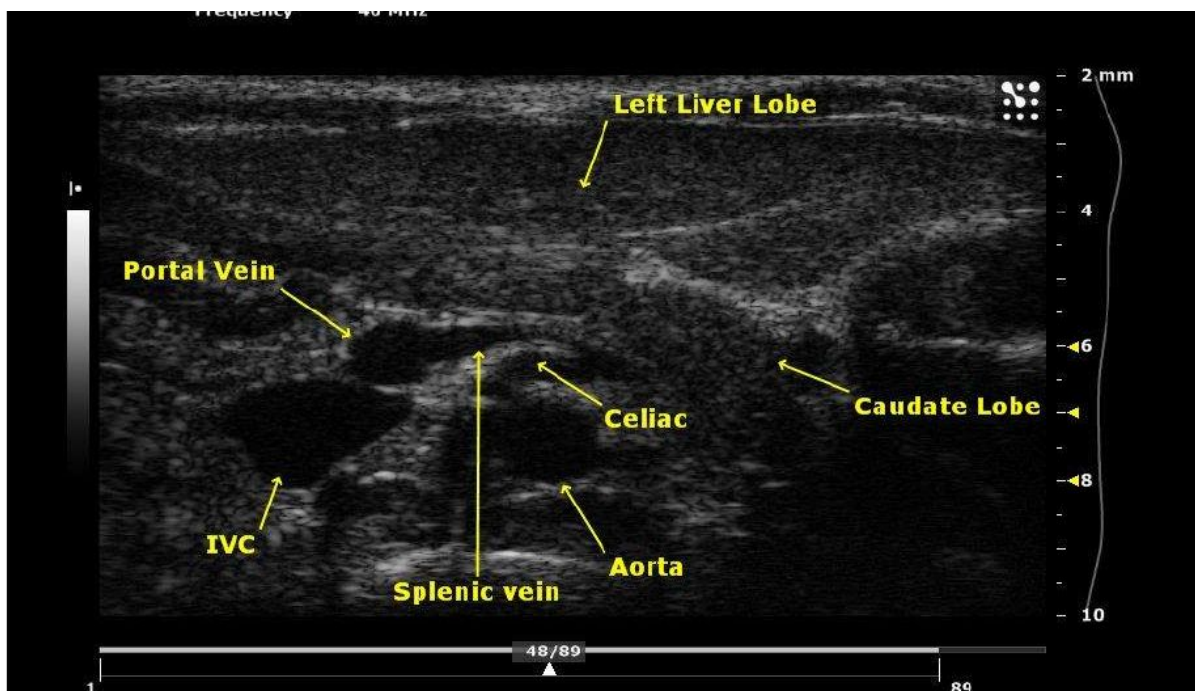
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/949f3932-72e9-493b-be3f-17f480ed018f\\_IG\\_2100\\_Ab\\_Pancreatic\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/949f3932-72e9-493b-be3f-17f480ed018f_IG_2100_Ab_Pancreatic_v1.0.pdf)



## Liver —

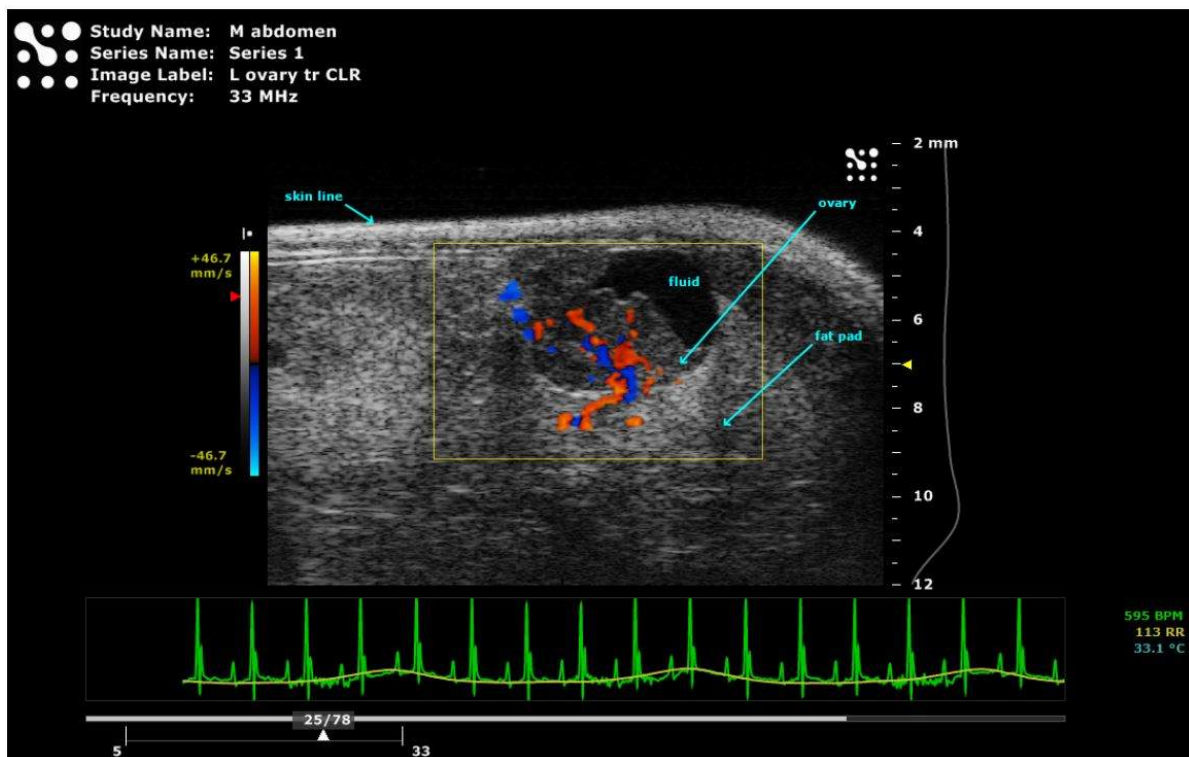
Liver imaging guide:

[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/0a5c0d6f-8536-471c-85bf-ba3df93f6a58\\_IG\\_2100\\_Ab\\_Liver\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/0a5c0d6f-8536-471c-85bf-ba3df93f6a58_IG_2100_Ab_Liver_v1.0.pdf)



## Reproductive Organs & Embryonic Development Monitoring

- Embryonic Mouse Imaging  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/5356ede8-45fd-40e8-ac37-fa1a6cdece66\\_IG\\_2100\\_Db\\_Embryonic\\_Mouse\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/5356ede8-45fd-40e8-ac37-fa1a6cdece66_IG_2100_Db_Embryonic_Mouse_v1.0.pdf)
- Ovarian Imaging guide:  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/f392466f-27d9-4f41-8601-93a10496e1ad\\_IG\\_2100\\_Re\\_Ovarian\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/f392466f-27d9-4f41-8601-93a10496e1ad_IG_2100_Re_Ovarian_v1.0.pdf)
- Testicle and epididymus guide:  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/8befbe57-f100-4a52-90a4-b666e896b986\\_IG\\_2100\\_Re\\_Testicle\\_and\\_Epididymus\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/8befbe57-f100-4a52-90a4-b666e896b986_IG_2100_Re_Testicle_and_Epididymus_v1.0.pdf)
- Prostate Gland and Surrounding Structures  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/179cfc76-9273-4c36-aa35-545e87961fd6\\_IG\\_2100\\_Re\\_Prostate\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/179cfc76-9273-4c36-aa35-545e87961fd6_IG_2100_Re_Prostate_v1.0.pdf)



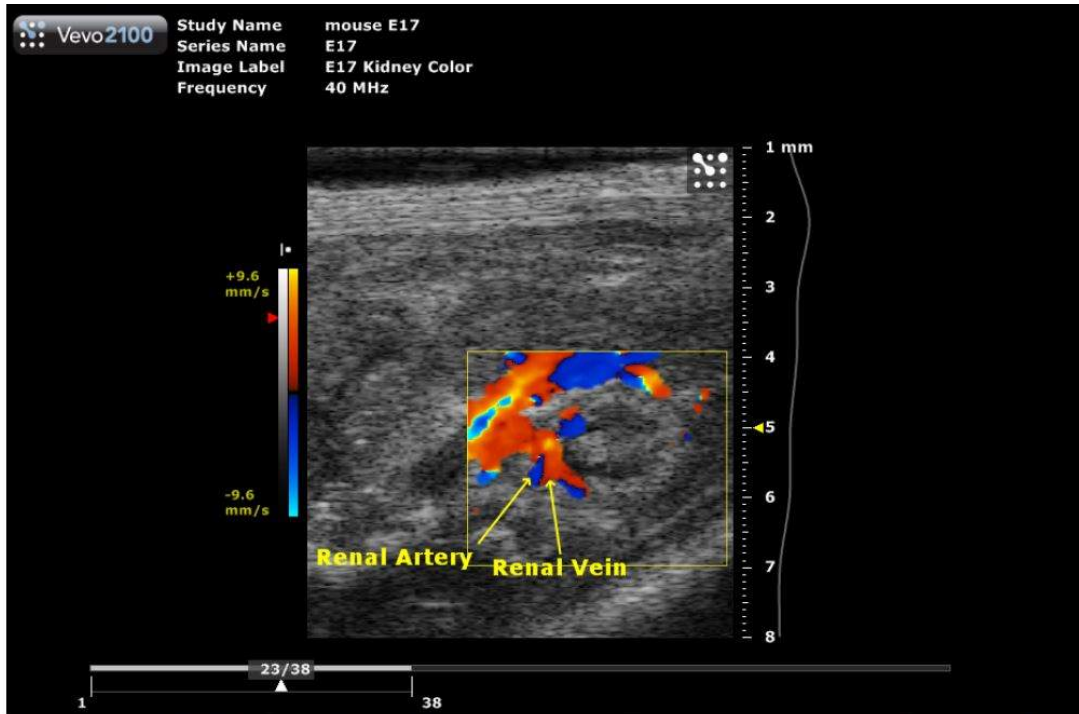
## Adrenal and Renal Glands

- Adrenal gland imaging guide:

[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/83048a32-0b48-4c71-abee-a1ea80601087\\_IG\\_2100\\_Ab\\_Adrenal\\_Gland\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/83048a32-0b48-4c71-abee-a1ea80601087_IG_2100_Ab_Adrenal_Gland_v1.0.pdf)

- Renal System Imaging

[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/6bde8c6f-2176-4e21-8294-e79ddc332113\\_IG\\_2100\\_Ab\\_Renal\\_System\\_v1.1.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/6bde8c6f-2176-4e21-8294-e79ddc332113_IG_2100_Ab_Renal_System_v1.1.pdf)

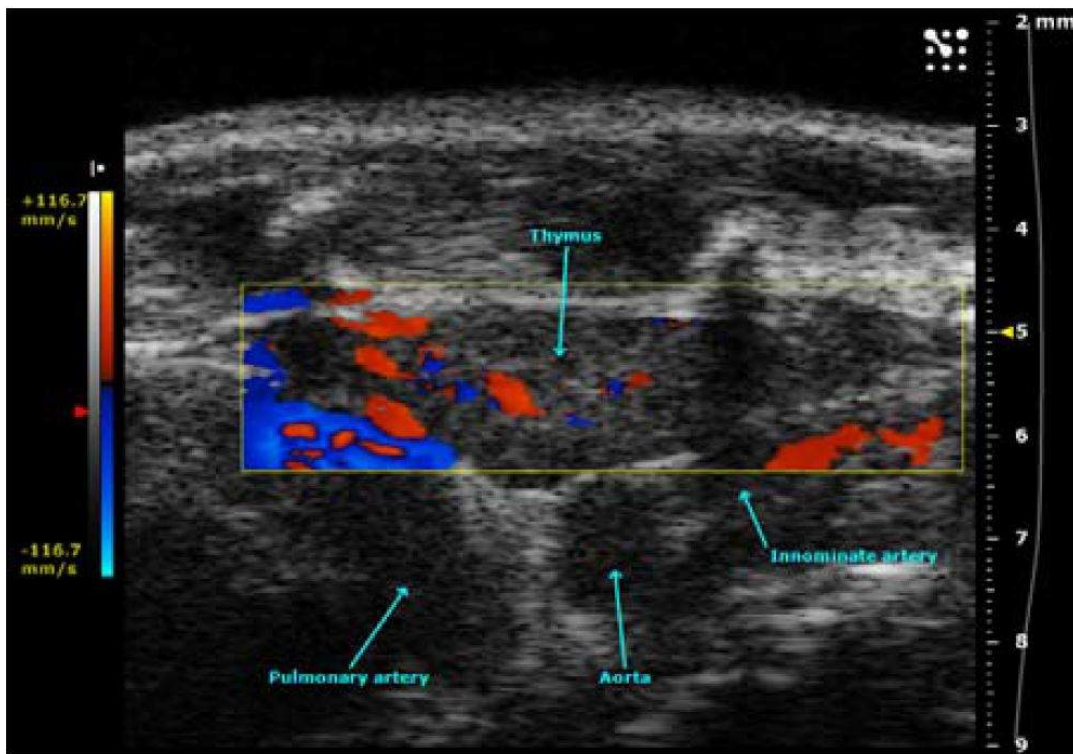


**Images 6 & 7:** E17 Renal Artery from the Aorta above and E16 below

## Thymus —

Thymus imaging guide:

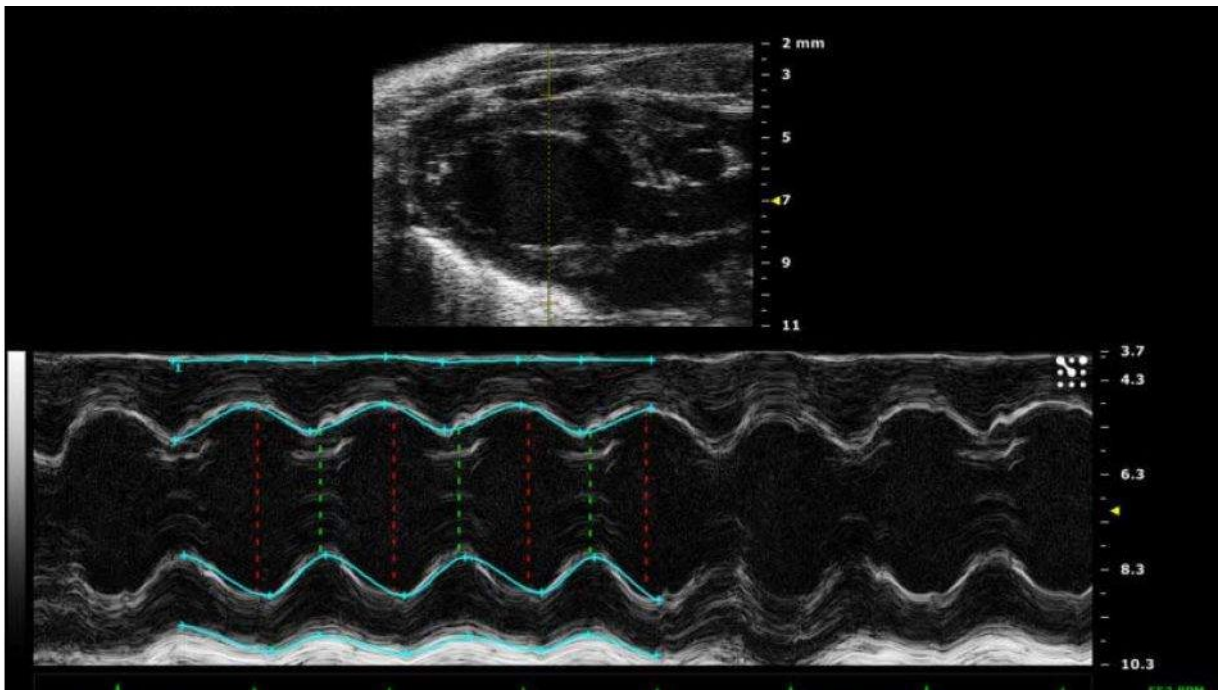
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/62d4a79e-4e15-4a4f-a666-ac85d6a2bc66\\_IG\\_2100\\_Cv\\_Thymus\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/62d4a79e-4e15-4a4f-a666-ac85d6a2bc66_IG_2100_Cv_Thymus_v1.0.pdf)



## Heart & Vasculature

- Carotid Imaging  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/a5eab1c2-5478-4210-9352-16d85a379fb1\\_IG\\_2100\\_Cv\\_Carotid\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/a5eab1c2-5478-4210-9352-16d85a379fb1_IG_2100_Cv_Carotid_v1.0.pdf)
- Powerpoint on How to do Mouse EchoCardiography  
<https://fredhutch.csod.com/ui/lms-learning-details/app/material/3dc236ee-e2d5-4808-b6da-f0ab20d53757>
- Vascular Imaging  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/820e4002-8903-42fb-a75e-5da0a114c0f9\\_IG\\_2100\\_Cv\\_Vascular\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/820e4002-8903-42fb-a75e-5da0a114c0f9_IG_2100_Cv_Vascular_v1.0.pdf)
- Echocardiography Imaging (PDF)  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/45a486ca-5599-4d10-ae53-d0f5f77f1ac7\\_IG\\_2100\\_Cv\\_Echocardiography\\_v1.1.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/45a486ca-5599-4d10-ae53-d0f5f77f1ac7_IG_2100_Cv_Echocardiography_v1.1.pdf)

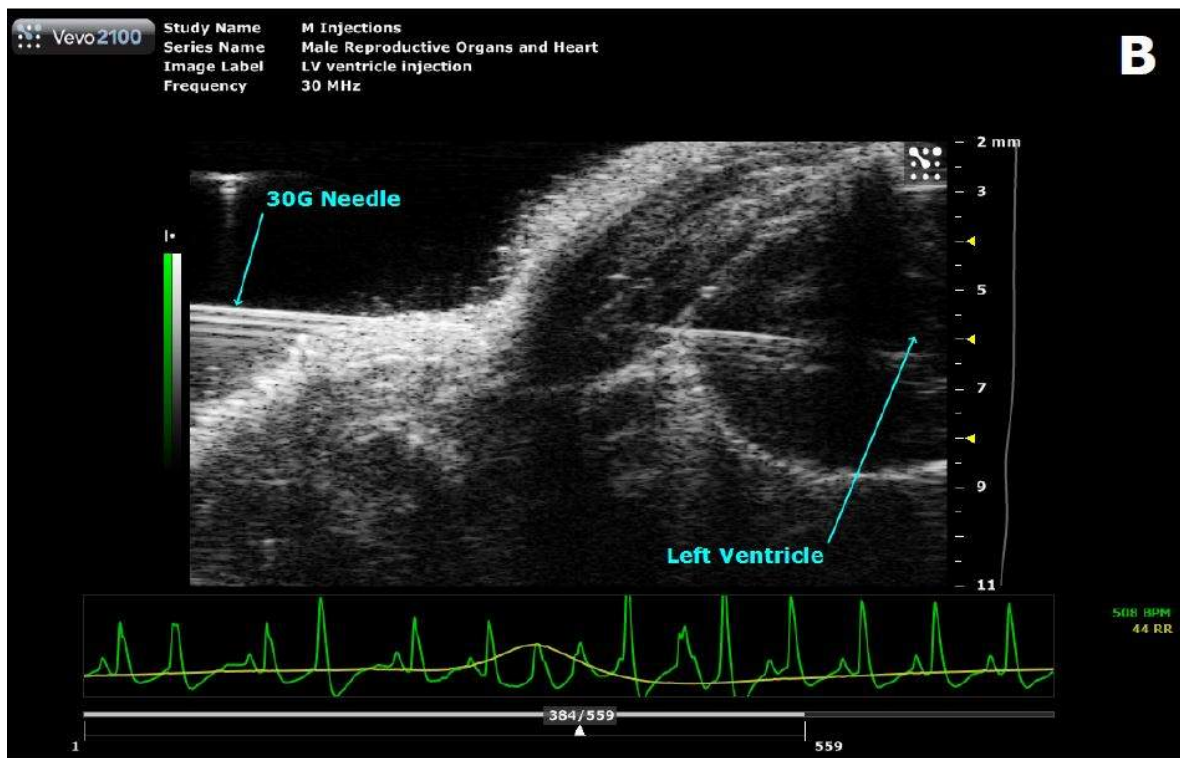




## Image-guided needle injections —

- Embryo image-guided needle injections  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/06af9b1b-b63c-4424-9cb0-7585a1dcf65e\\_IG\\_2100\\_Ot\\_IGNI\\_Embryo\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/06af9b1b-b63c-4424-9cb0-7585a1dcf65e_IG_2100_Ot_IGNI_Embryo_v1.0.pdf)
- Adult small animal image-guided needle injections  
[https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/8bda3eaa-fabd-48b8-b1ef-8dfb952be962\\_IG\\_2100\\_Ot\\_IGNI\\_Adult\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/8bda3eaa-fabd-48b8-b1ef-8dfb952be962_IG_2100_Ot_IGNI_Adult_v1.0.pdf)

Preclinical Imaging offers in-person trainings on performing image-guided needle injections. Contact us if you'd like to schedule a training!



#### Other organs and applications —

- Bladder [https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/5949bb74-30c0-40c1-9a08-162c8cfc90e6\\_IG\\_2100\\_Ab\\_Bladder\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/5949bb74-30c0-40c1-9a08-162c8cfc90e6_IG_2100_Ab_Bladder_v1.0.pdf)
- Spleen [https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/be98129b-987f-46fc-b081-12bb1172c393\\_IG\\_2100\\_Ab\\_Spleen\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/be98129b-987f-46fc-b081-12bb1172c393_IG_2100_Ab_Spleen_v1.0.pdf)
- Thyroid [https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/f91ddd40-05fd-4791-a79c-c10d11dd6bf8\\_IG\\_2100\\_St\\_Thyroid\\_Gland\\_v1.0.pdf](https://fredhutch.csod.com/clientimg/fredhutch/MaterialSource/f91ddd40-05fd-4791-a79c-c10d11dd6bf8_IG_2100_St_Thyroid_Gland_v1.0.pdf)

Click below if you would like to save a PDF of this training for future reference or to print out for your records



**preclinical-vevo-2100-ultrasound-online-training-nWahS3Fx.pdf**  
10.8 MB



## How do I view my ultrasound images after I have taken them?

After you transfer your data to your personal network drive, the images can be viewed in several different types of software. See below for possible options:

### Some ultrasound image analysis software options:

#### FIJI / Image J

FIJI (also known as ImageJ) is a free and open source software developed by the NIH. FIJI is the recommended analysis method for viewing basic ultrasound images, as it can be downloaded to any computer without a license. However, you will need to export your ultrasound images to a different file format (.tiff is preferable) before transferring them off of the ultrasound computer. Some more advanced ultrasound imaging applications should be viewed with VevoLab.

All Arnold Library windows computers have ImageJ installed for use as well.

[FIJI INFO](#)

#### VevoLab

Vevo Lab is the image analysis software from VisualSonics, who is the manufacturer of the Comparative Medicine Vevo 2100 ultrasound.

This software is available for use on Arnold Library Computer #5 and on the Arnold Fellows Office Computer.

[VEVOLAB INFO](#)


## Analyze 14

Analyze 14 is an advanced data viewing software. If users already are familiar with it, it can be a powerful tool for more complex image analysis. However, if you are not already familiar with Analyze 14 or do not need very advanced analysis, we do not recommend using this modality for viewing ultrasound images. We rather refer users to ImageJ or VevoLab.

Analyze 14 is available on Arnold Library Computer #5 or on the Steam Plant PC.

[ANALYZE 14 INFO](#)

## Thank you for completing this part of the ultrasound training!

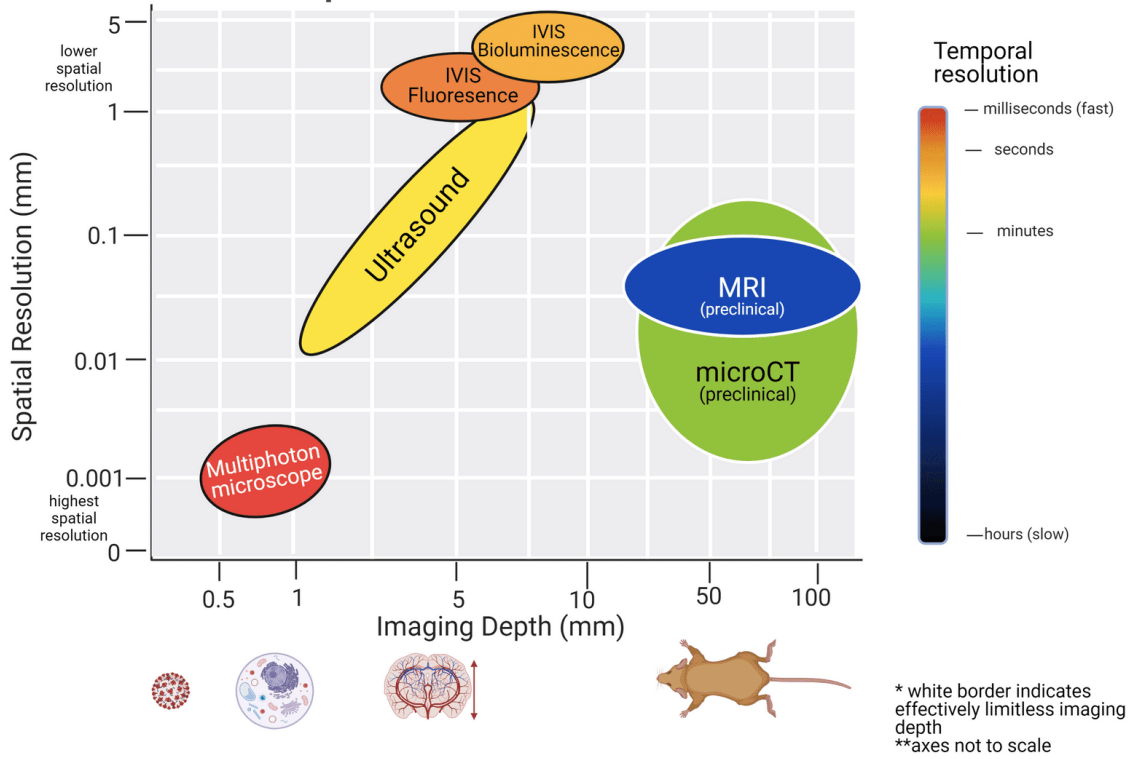
 You will need to complete a brief in-person component of this training before being able to access the ultrasound. Please contact [preclinicalimaging@fredhutch.org](mailto:preclinicalimaging@fredhutch.org) with any questions or feedback regarding this training.

## Have questions or want further information?

Preclinical Imaging offers an array of imaging services, including one-on-one consultations and analysis advice!

See below charts for further information regarding the services provided by Preclinical Imaging and feel free to send an inquiry to us at [preclinicalimaging@fredhutch.org](mailto:preclinicalimaging@fredhutch.org).

## Preclinical Imaging Modalities Available in Comparative Medicine at Fred Hutch



Spatial, temporal, and depth imaging capabilities of the Modalities available in Preclinical Imaging