GE Healthcare

Proven AI Tools from GE Healthcare Reshape Point of Care Ultrasound

Gain speed at the critical moment, with accuracy

Auto-VTI	Auto B-line	Auto-IVC
82% time savings with Auto-VTI[1] versus manual VTI calculations	**One step** calculation of overall lung score with Auto B-line	**90% equivalency** for minimal diameters and **97%** for maximum diameters with Auto- IVC[2] compared to expert user's ability.

The Basics of AI

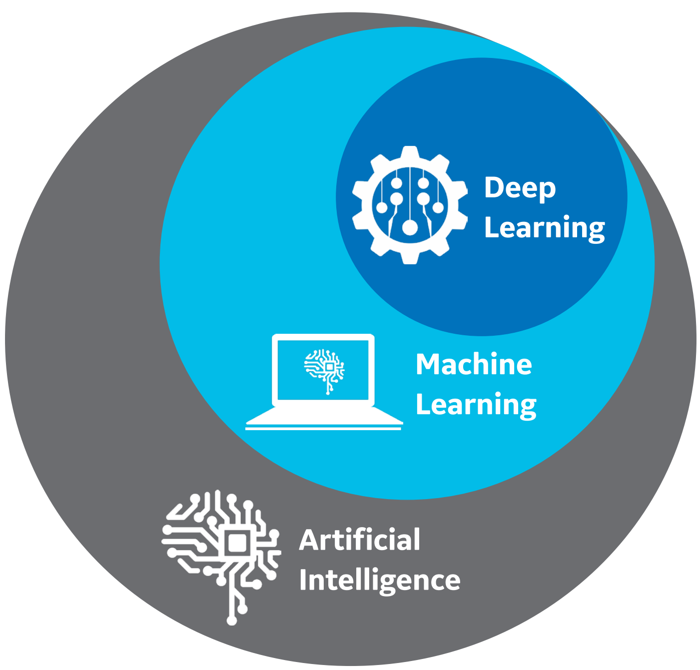
Artificial Intelligence (AI): Artificial Intelligence (AI) is a machine's ability to mimic human intelligence. In practice, it is a segment of computer science that involves designing computer applications to perform tasks that typically have required human intelligence such as visual perception, speech recognition, and decision making.

Machine learning (ML): The ability for a machine to "learn" with data, without being explicitly programmed. At its most basic is the practice of using algorithms to analyze data, learn from it, and then make a determination or prediction about something in the world.

Deep Learning (DL): A subset of machine learning that uses a network of algorithms (neural network) to mimic the way a human brain processes information as it learns.

Big Data: More data than you can simultaneously keep in the machine memory. (Think: Test the algorithm on 1 million images.)

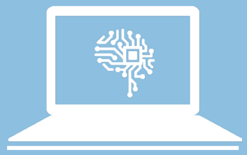
Convolutional Neural Network (CNN): A class of deep neural networks, most commonly applied to analyzing visual imagery.



GE Healthcare Goals for Using AI with Point of Care Ultrasound

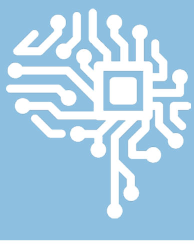
It is our mission to make point of care ultrasound accessible to all by developing tools that simplify complex patient assessments, enable faster clinical decision support and calculate precise results which ultimately result in better patient outcomes.

To do this, we use ML and AI to develop algorithms that enable the shift of cognitive burden from ultrasound acquisition to clinical reasoning at the point of care. The AI used with the Venue Family™ suggests a measurement for physicians to use when making the final decision. This measurement can also be edited as needed by the physician.



Examples of how we use ML and AI with the Venue Family of systems.

- **ML**: Auto VTI: Finding the right location and tracing the spectral doppler signal and calculate and display the VTI while you scan.
  - **Role of AI**: AI helps localize the acquisition
- **ML**: Auto B-Lines: Auto distinguishing between real B-lines and all other artifacts is hard to "program", but ML can enable it.
  - **Role of AI**: Classification between artifacts vs B-lines.
- **ML**: Auto IVC: One respiratory cycle Distensibility Index (DI) or Collapsibility Index (CI) can be displayed, and calculated
  - **Role of AI**: Identify the location and position IVC for measurements



To ensure GE Healthcare always leverages the latest innovations in this evolving space, we partner with leading companies such as Nvidia, Amazon and Intel.

Basic Principles Followed

AI systems exist to compliment human intelligence and must:

1. Be designed for the benefit, safety and privacy of the patient
2. Be a trusted steward of the data and insights
3. Be transparent and produce explainable outputs
4. Guard against creating or reinforcing bias
5. Be designed for the benefit, safety and privacy of the patient

How does GE Healthcare Develop AI Enabled Tools for Point of Care Ultrasound?

AI tools available with the Venue family of systems do not just utilize a trained deep learning (DL) or convolutional neural networks algorithm. In fact, a team of data scientists alone could not have developed them. Rather, we use a combination of clinical workflow, unique acquisition methods, machine learning, deep learning, convoluted neural networks and a host of other imaging techniques. Our AI tools are then verified for accuracy by a large team of clinical thought leaders, educators, practicing physicians and AI experts.

What We Do

Gather data from multiple sources. GE Healthcare has more than **100,000** ultrasound machines installed with **80+ years** of ultrasound engineering behind it.

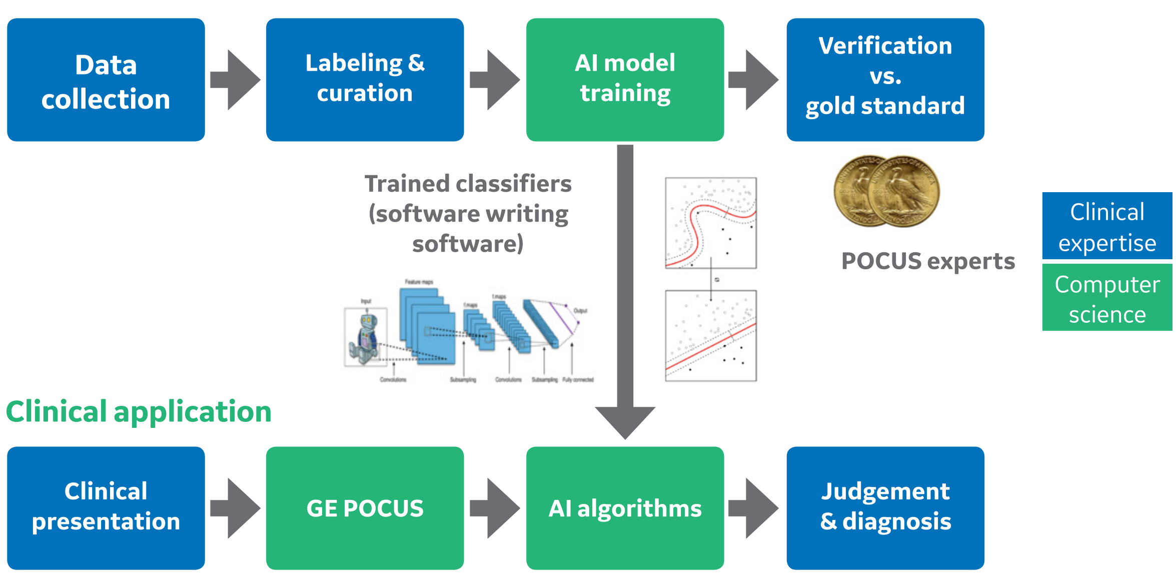
What We Do Not Do

GE Healthcare does **NOT** acquire **patient data** or modify our algorithms in **real time** from **customer sites**.

From Idea to product capability

Here is a visual representation of how the Venue Family AI model is trained

AI model creation



For example, for the Auto VTI tool we took the following steps:

Step 1 → **Step 2** → **Step 3**

We scanned thousands of patients with healthy and pathological hearts and then used expert inputs for placing PW gate and measuring LVOT VTI in them.

We then trained a deep learning (DL) algorithm based on these inputs to replicate an experts' decision on new patients.

Using deep learning (DL) and convolutional neural networks (CNN) we categorized the scanned images and identified key points within them.

As a result, when a physician scans the heart, it only takes one click for our system to automatically place the LVOT gate in position and measure the VTI. The physician is able to clearly see both gate position and PW signal tracing so they can verify the measurement and the result.

Venue Family AI Tools | Benefits to the POCUS User

1 Gain speed at the critical moment

a. **80%** reduction in keystrokes for eFAST documentation[3].

b. **90%** reduction in keystrokes for VTI calculation[1].

2 Improve accuracy

a. AUTO VTI: A recent study determined, in an experimental model of Hemorrhagic Shock by Bobbia, et al., Venue Auto VTI tool was found to be better correlated with CO measurement by thermodilution than manual echocardiographic measurements[2].

b. Auto B-Line is comparable and highly reliable as compared to visual counting performed by experts[4].

3 Reduce user dependence

a. AI used with the Venue Family is designed to simplify the complexity of ultrasound acquisition.

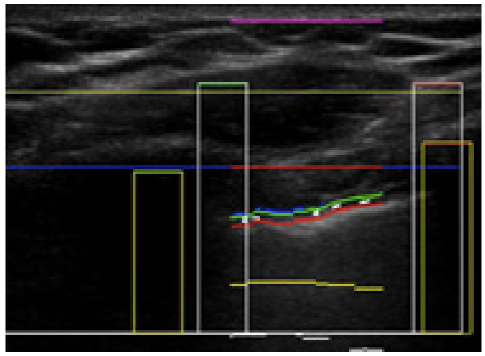
b. It may reduce inter-reader and inter-observer variability

c. The Quality Indicator may improve scanning skill with Red/Yellow/Green feedback.

4 Ge to the point of decision faster

a. Example: Auto VTI finds the LVOT, places the doppler gate and measures the VTI.

Supporting AI | Collaboration with the US Army



GE Healthcare collaborates with organizations like the **US Army** to further drive the development of **AI applications** in healthcare.

FAQs

Q **What field or discipline of AI are you using?**

A We are using both classical Computer Vision and Machine Learning methods as well as Deep Learning.

Q **Do you use CNN as your deep learning?**

A CNN is a very broad term. We use convolutional layers (The "C" in CNN) as well as other types of layers and proprietary network architectures tailored to each type of application. The deep learning we use requires a sustained engineering effort.

Q **How did you train your deep learning algorithms?**

A We use a variety of Data Science activity to train algorithms around the specific application accuracy demands. An example can be seen in the main text above.

Q **What kind of data did you use to train the deep learning algorithms? How did you get access to the data used for training?**

A We use data from our install base of ultrasound machines in addition to inputs from the many KOL physicians we partner with. This is a strong competitive advantage for GE Healthcare because very few companies have access to such a wide database of patient types and scanning techniques.

Q **How are you able to run deep learning on your hardware during cardiac exams? Do you have capable processors on your device (GPUs, CPUs, DSPs) to run deep learning quick enough to provide timely results for the users?**

A Our AI and DL solutions are tailored to the clinical problem we are solving for the customer. The cSound platform of the Venue family enables processing of Big-Data in real time in a manner that is unparalled to any other POC product,

Q **How many machine learning scientists do you have on staff and what experience do they have?**

A This is the true power of GE Healthcare's huge investment in AI and our continued believe and effort to improve patient outcomes (you may have heard of projects such as Health Cloud and Predix). Our Data Science force is working on applications from business intelligence and clinical workflows, to online diagnosis of health and fast reconstruction of CT and MRI volume imaging.

Imagination at work

1) Based on an GE internal study with Venue (DOC2222911)
2) Based on an GE internal study with Venue GO DOC ID
3) Xavier Bobbia; Laurent Muller, et al. A New Echocardiographic Tool for Cardiac Output Evaluation: An Experimental Study 2018 OI: 10.1097/SHK.0000000000001273 ,PMID: 30300317
4) Short J, Acebes C, Rodriguez-de-Lema G, et al. Visual versus automatic ultrasound scoring of lung B-Lines: reliability and consistency between systems. Med Ultrasonography 2019, Vol. 21 no. 1, 45-49 DOI: 10.11152/mu-1885

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