



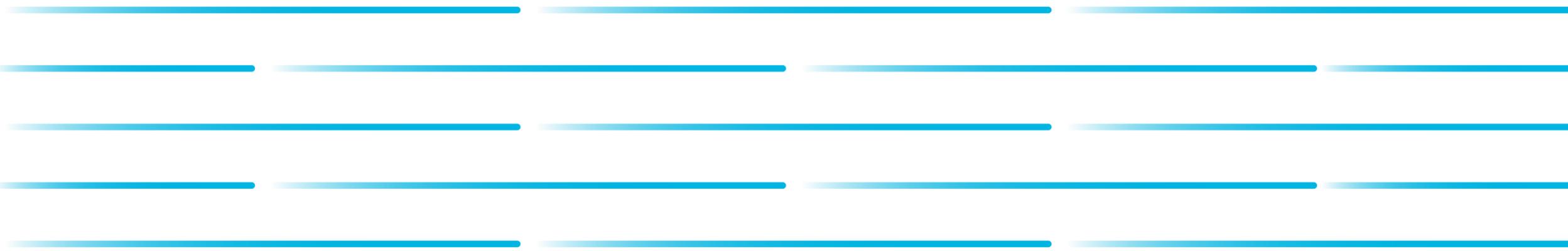
GE Healthcare

From HPC to AI with NVIDIA



GPU TECHNOLOGY
CONFERENCE

March 26-29, 2018 | Silicon Valley | #GTC18
www.gputechconf.com



This is GE Healthcare

Impact	Leader in Imaging & Mobile Diagnostics	Leader in China and Emerging Markets	Leader in Data and Analytics	Leader in Life Sciences
	1MM+ Installed Base 16+ Scans every minute	Portfolio breadth GE scale	230MM Exams 124K Assets under management	Biologics and Cell Therapies
At Scale	Revenue	Op Profit	OP%	FCF Conv.
'16A	\$18.3B	\$3.2B	17.3%	>100%
'17A	\$19.1B	\$3.4B	18%	>100%



A leading healthcare solutions provider



DIAGNOSTIC IMAGING & SERVICE

- Magnetic Resonance
- Computed Tomography
- Molecular Imaging
- Service & Solutions

\$8 Billion



MOBILE DIAGNOSTICS & MONITORING

- Ultrasound
- Clinical Solutions
- Monitoring
- Mobile Health

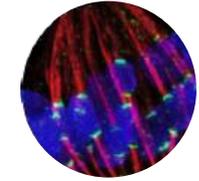
\$4 Billion



IT & DIGITAL SOLUTIONS

- Enterprise Imaging
- Financial Management
- Care Area Workflows
- GE Health Cloud™

\$2 Billion



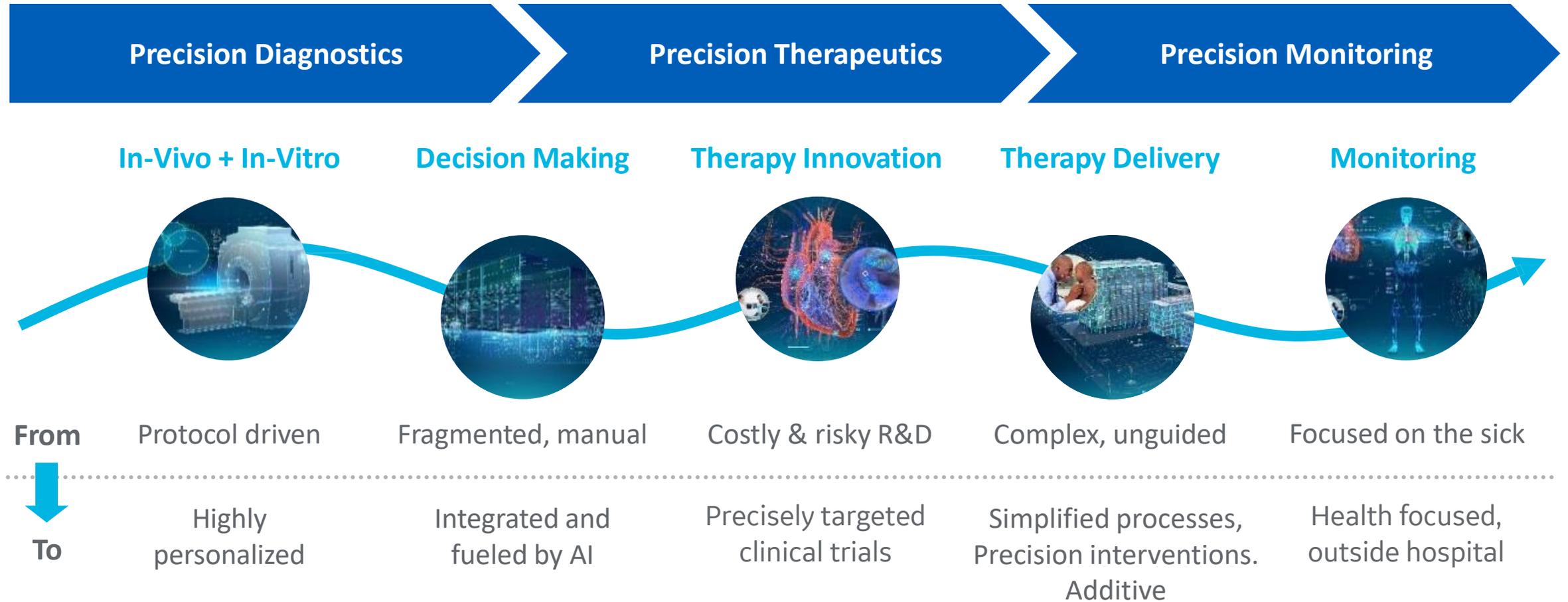
LIFE SCIENCES

- Bioprocess
- Protein and Cell Sciences
- Contrast Media and Nuclear Tracers
- Cell Therapy

\$5 Billion



What is Precision Health?



Only GE can do this ... combining our expertise & leadership across Diagnostics, Providers, Pharma and Med-tech



Healthcare organizations face unprecedented challenges



Financial Pressure and Payment Reform

- Decreased reimbursement, and focus on outcomes and value
- Laser focus on treatment optimization and patient care gaps
- Competencies in patient throughput and care coordination are vital for success

Increased reliance on analytics to meet demands



Demand Outpacing Supply

- Chronic disease in U.S. expected to increase by 57% by 2020¹
- Current insatiable demand from global, aging population
- Shortage of ~4.3 million doctors and nurses worldwide¹

Seismic shift in efficiency needs analytic insight



Rising Cost and Waste

- Readmissions in the U.S. cost over \$41B² annually
- Cost variations, infections and readmissions cost £5B across U.K. hospitals³ annually
- Nearly \$12B of unnecessary medical imaging in U.S. annually⁴

Sustainability depends on financial analytic acumen



Digital Imaging & precision health demand analytics

Better patient outcomes delivered more efficiently

Software & Applications

Make better decisions, faster

Augmenting clinical and operational decision making across the Imaging Chain

Intelligent Devices

Reduce retakes, improve throughput

Integrated, aware, intuitive, and predictive

Services

Reduce downtime, maximize utilization

Connected, proactive and predictive services coupled with advisory services

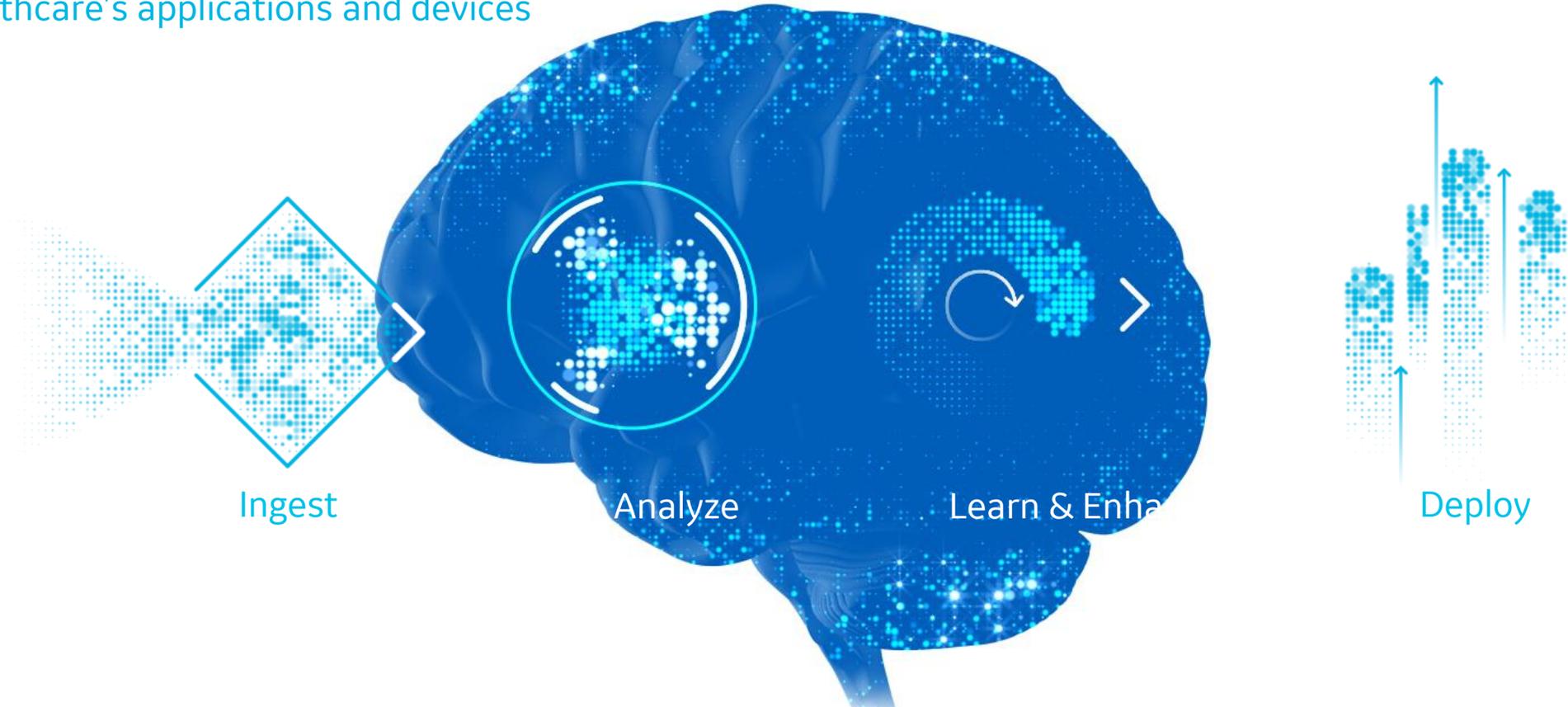


Applied Intelligence: Analytics & Artificial Intelligence



Applied Intelligence is our analytics platform

The analytics brain that powers
GE Healthcare's applications and devices



Actionable insights derived from data
using analytics and artificial intelligence

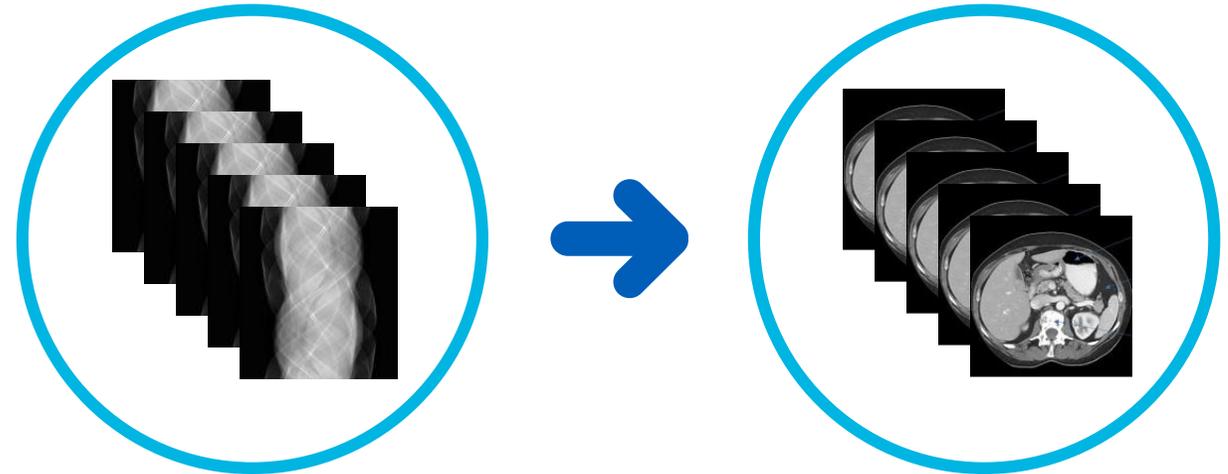
Augments clinical and operational decision making
for better patient outcomes with more efficiency



Analytics and algorithms demands HPC

(CT Example - CT image reconstruction algorithms complexity)

- Backprojection algorithm has a complexity of $O(N^3)$ for a single image, typical CT scan is 100-3000 images
- Other algorithms improve image quality
- 10s to 100s of different algorithms to produce a final image set
- A ten year journey from Tesla C870 to Tesla M2075 to the latest platform



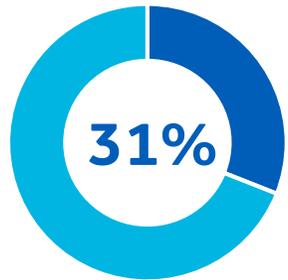


The Intelligent Cardiovascular Ultrasound Scanner

By Erik N. Steen, Chief Engineer GEHC Cardiovascular Ultrasound

This presentation partly describes ongoing research and development efforts. These efforts are not products and may never become products

Cardiovascular Disease (CVD): #1 cause of death globally



An estimated **17.7 million people** died from CVDs in 2015, representing **31% of all global deaths***

People with cardiovascular disease or who are at high cardiovascular risk (due to the presence of one or more risk factors) **need early detection** and management using counselling and medicines, as appropriate*)



* <http://www.who.int/mediacentre/factsheets/fs317/en/>

Echocardiography is the primary imaging modality for diagnosing cardiac disease

2016 Estimates:

Global **ultrasound** market: **> 6B \$**

Global **cardiovascular ultrasound** market: **> 1.1B \$**

Global **premium cardiovascular ultrasound** market: **> 0.6B \$**



Vivid™ E95

Cardiovascular Ultrasound
with

cSound™



Cardiologist

How can I be confident in my ability to manage my patient's heart health when 10-15% of the patients have suboptimal echoes?



Interventional Cardiologist

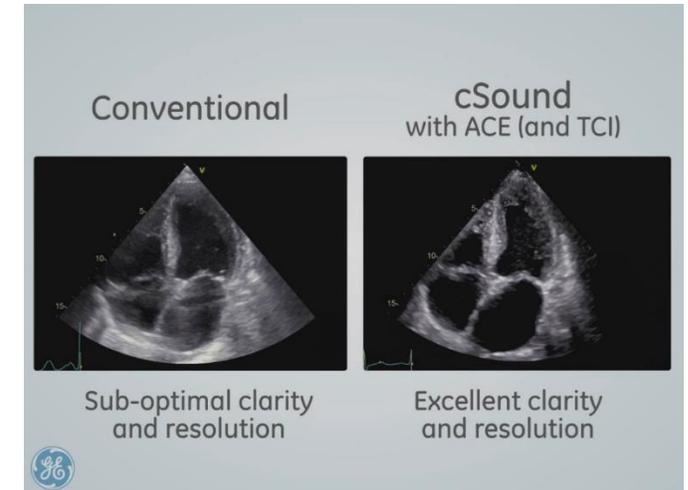
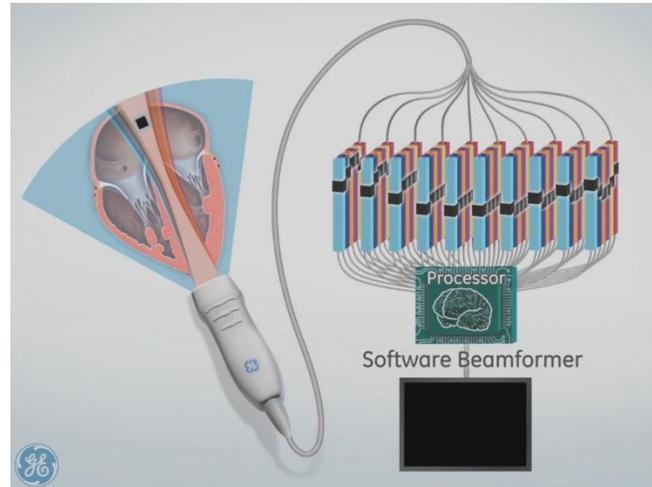
I need a better understanding of the anatomy and function during structural heart repairs



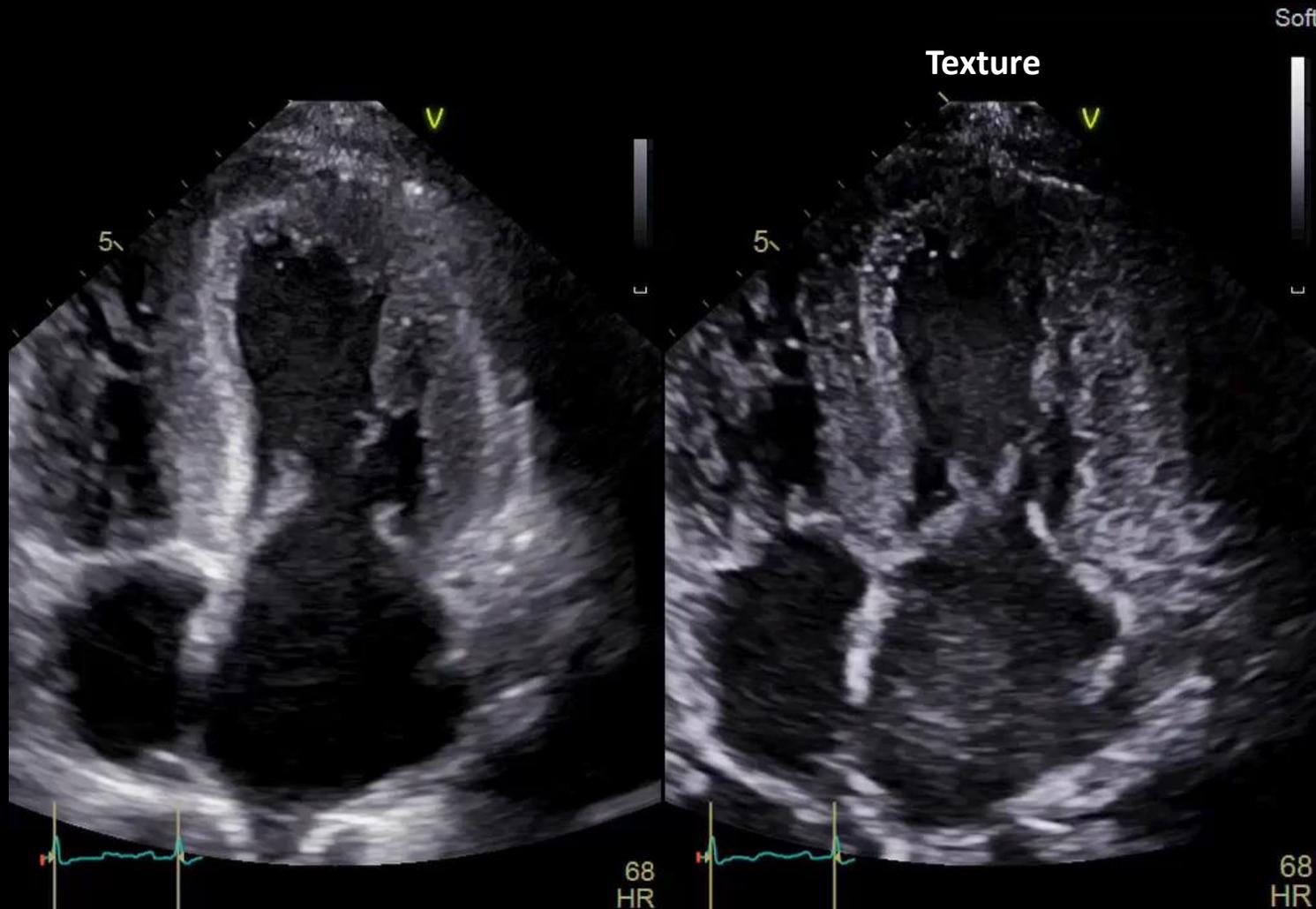
cSound Intelligent Processing

cSound™

- Channel data from many transmits collected into GPU memory in real time
- Image is computed in real time by software algorithms
- High performance
- Great flexibility to change algorithms



With cSound™, image reconstruction algorithms can be changed according to clinical needs

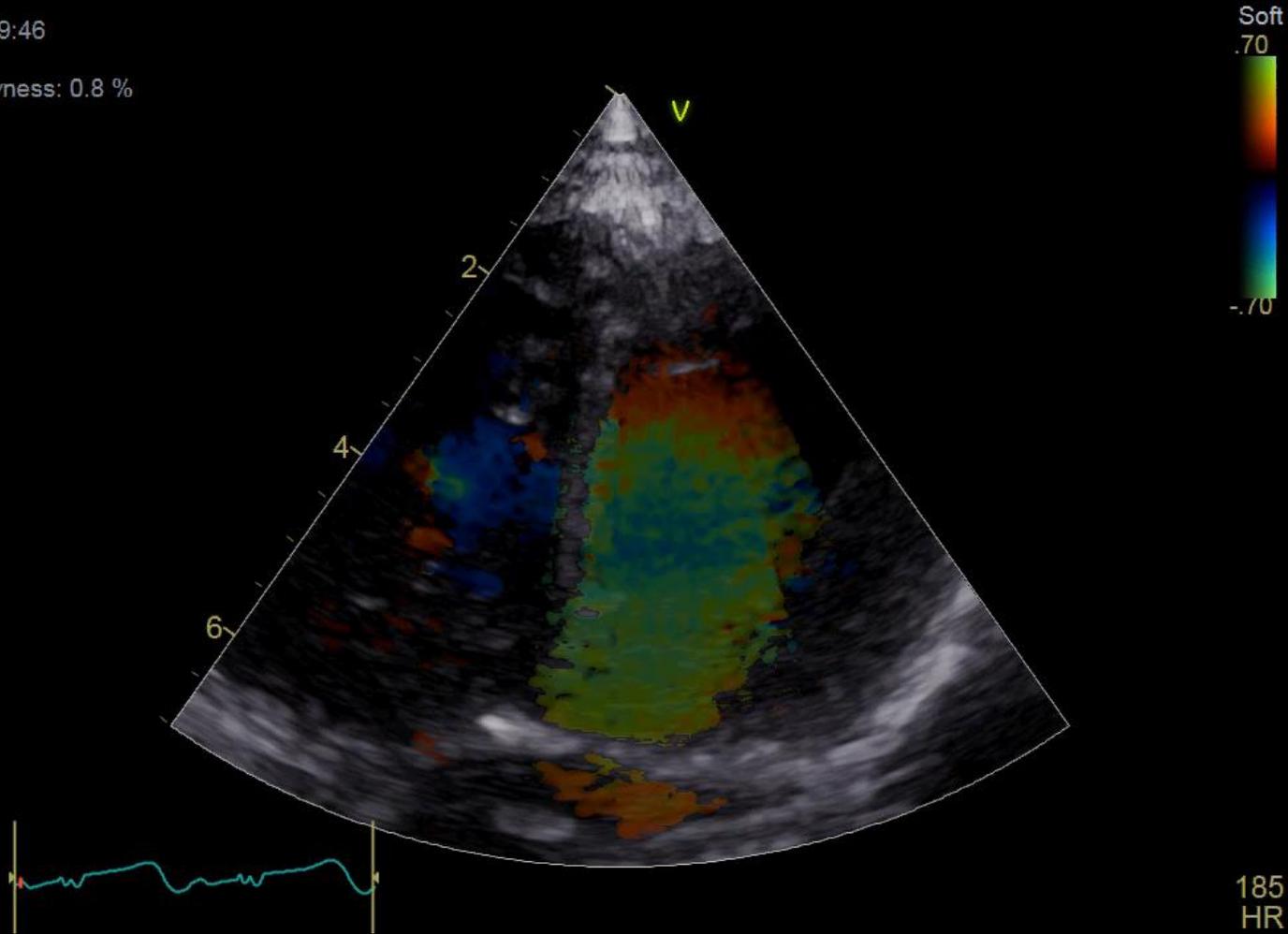


Amyloidosis example (ACE+TCI vs Texture)



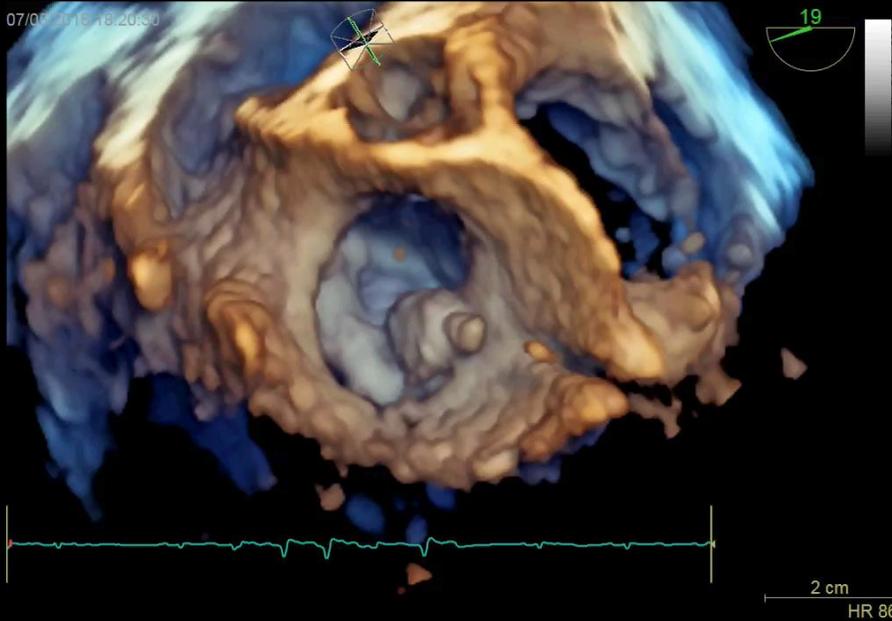
Blood flow can be visualized in completely new ways

08:29:46
HD
Slowness: 0.8 %



HDlive™

Examples from interventions



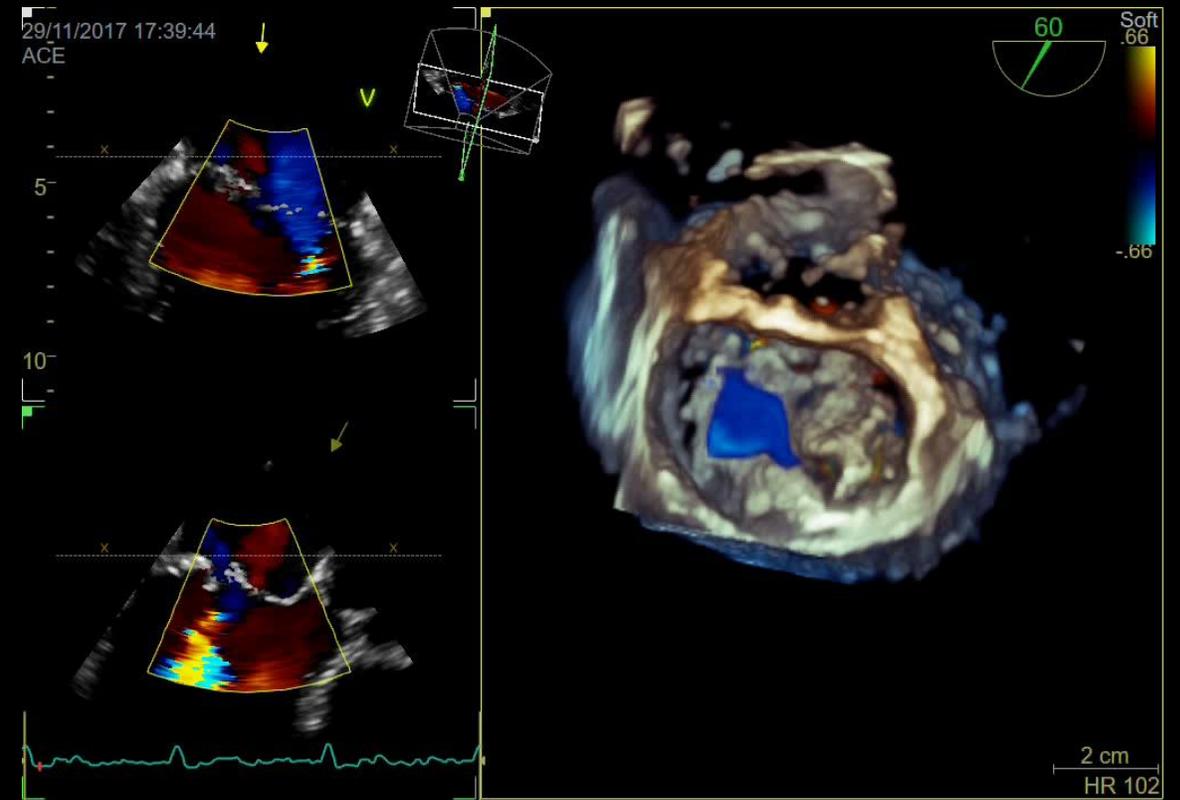
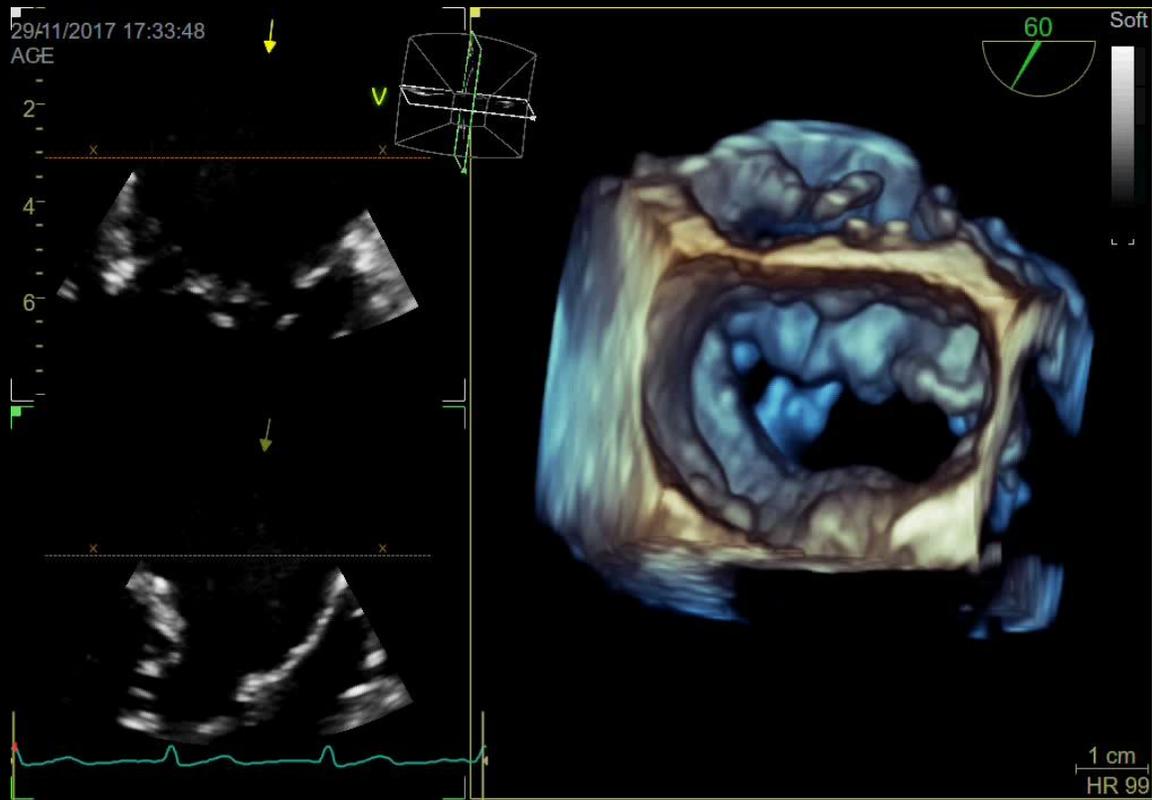
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Vmax: Anatomy and function in a single heart beat



Patient with Barlow's disease (thickened prolapsed valve)

Real time single beat capture of valve anatomy and movement - and flow leakage pattern around it



Cardiologist

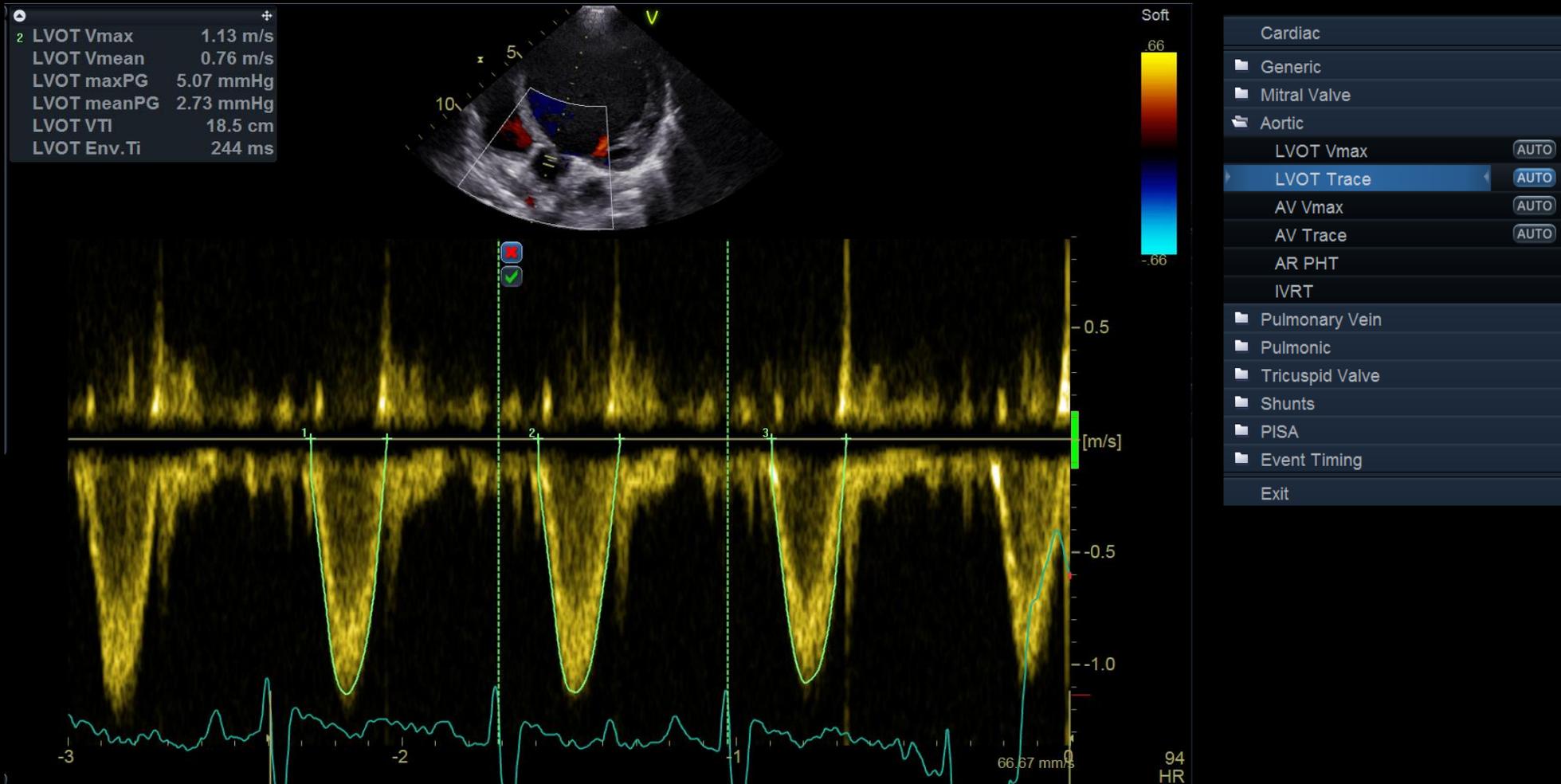


- How can I be confident in my ability to manage my patient's heart health when 10-15% of the patients have suboptimal echoes?
- I need a better understanding of the anatomy and function during structural heart repairs
- How can I become more efficient with the increased burden of cardiovascular disease and pressure on cost ?



Automatic Doppler Measurements

Performing manual Doppler measurements (tracings) is time consuming



Active for the most common measurements:

- LVOT Vmax
- LVOT Trace
- AV Vmax
- AV Trace
- TR Vmax
- MV E/A Velocity
- E'

Auto Doppler may **reduce scan time**, improve **consistency** (less user dependent) and eventually make the exam more **efficient**





Future development*

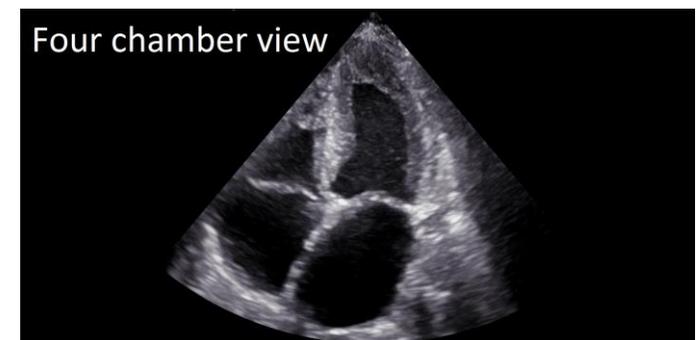
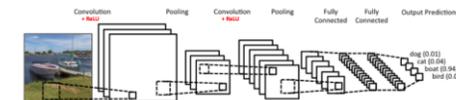
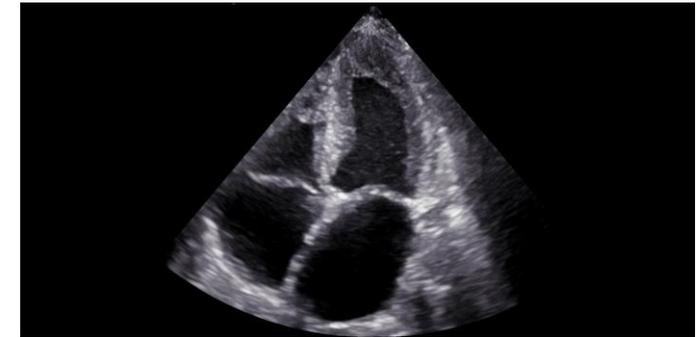
**Note: Technology in development that represents ongoing research and development efforts. These technologies are not products and may never become products. Not for sale. Not cleared or approved by the U.S. FDA or any other global regulator for commercial availability*

Deep learning in ultrasound

Deep Learning algorithms can potentially be used to guide inexperienced users and help experienced users to become more efficient

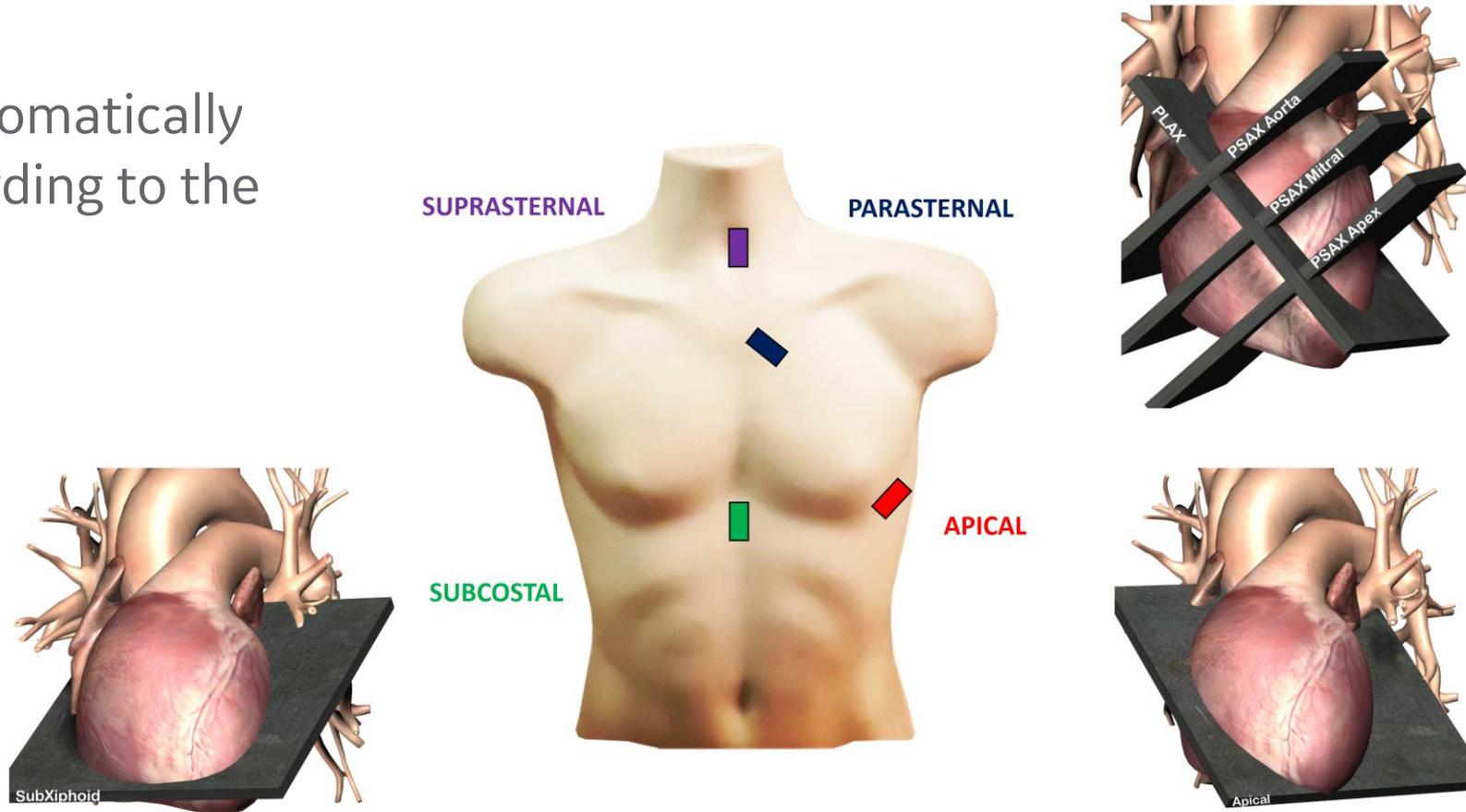
Examples

- Automatically identify and score views
- Automate measurements
- Automatically identify potential abnormalities

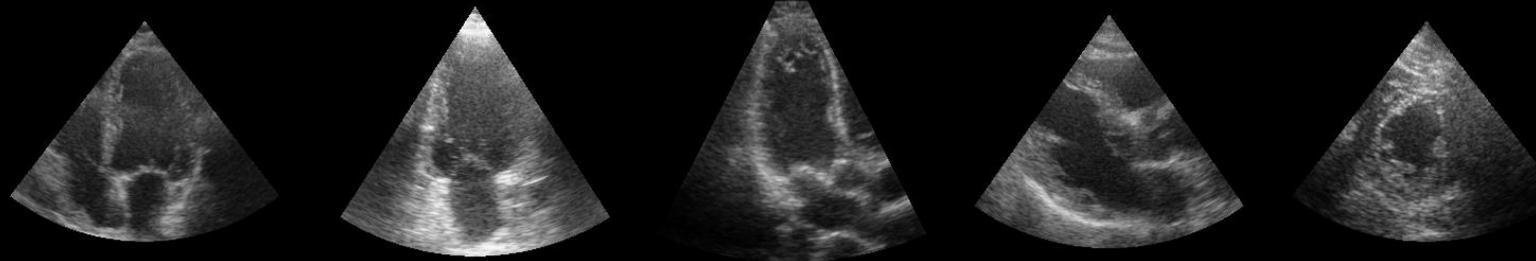


cSound Intelligent workflow

Workflow is automatically optimized according to the cardiac view.



Automatic Cardiac View Recognition (*)



Apical 4 chamber view

Apical 2 chamber view

Apical long axis view

Parasternal long axis view

Parasternal short axis view

Preliminary results (In cooperation with the Norwegian Computing Center & SINTEF Norway)

- **Data: >8000 loops with variable image quality & patient anatomy used for training**
- **~900 additional loops from a separate group of patients used for validation**
- **Various network architectures investigated**
- **Accuracy (ResNet-50): 98 % accuracy on frame level, 99 % accuracy on sequence level (using majority vote)**



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