AI-Guided Ultrasound Image Acquisition

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Ultrasound as a tool

Traditionally, ultrasound is a powerful tool that enables clinicians to make critical decisions intelligently assists
Surgical Assistant

By knowing what is going on at a similar level to the surgeon, the surgical assistant...

- Anticipates what is next
- Serves as another set of eyes

The surgeon gets...
- Efficiency
- Improved outcomes

Awareness ➔ Assistance
By knowing what is going on at a similar level to the clinician, the ultrasound assistant...

The clinician gets...

- Workflow enhancement... Efficiency
- Decision support... Improved outcomes

Awareness

Anticipates what is next

Serves as another set of eyes

Assistance
By knowing what is going on at a similar level to the clinician, the ultrasound assistant...

Anticipates what is next

Serves as another set of eyes

The clinician gets...

Workflow enhancement...
Efficiency

Decision support...
Improved outcomes

Goals of AI in medical imaging
Quadruple Aim

1. Improve outcomes (Effectiveness)
2. Efficiency
3. Patient experience
4. Clinician experience
Anatomy of an ultrasound exam
Anatomy of an ultrasound exam

Steps vary based on selected measurement

Multi Image Select → Freeze → Scroll

Enter Measure → Select Measurement → Place Caliper 1 → Place Caliper 2 → Complete Measurement

Patient Entry → Scan Setup → Scan Adjust → Identify View → Annotate → Measure → Capture & Restart → Review → End Exam

Mode Selection → Adjust Field of View → Optimize Image

Annotate → Measure → Capture & Restart

Enter Comment → Type or Select Text → Place Text → Complete Comment

Textual or Graphical

Store → Unfreeze
The guidance space
The guidance space

Scan Adjust → Identify View → Analysis

Effectiveness
Efficiency
Images have a purpose

Guide procedure

Support diagnosis

Enable measurement

Imaging Challenges...
- Getting the right views
- Getting good quality images
Broad spectrum of users

Variations across users both in terms of effectiveness and efficiency
Broad spectrum of users

Non user factors that impact effectiveness and efficiency

- Difficulty of the scan
Broad spectrum of users

Non user factors that impact effectiveness and efficiency

- Difficulty of the scan
- Capability of the equipment
Broad spectrum of users

What influences where an individual user falls on these curves?

- Training
- Experience
- AI-based assistance
Broad spectrum of users

Bringing a group of users to a higher and more similar level of effectiveness improves consistency & reproducibility
AI-assisted guidance

Getting the desired view

• Real-time CADe to highlight potential pathology while scanning
• Real-time anatomical identification and/or segmentation
• Guide probe movement by recognizing anatomy relative to the targeted view
• ...

Getting a good quality image of that view

• AI in the imaging chain to boost overall IQ
• Image recognition to drive better imaging settings
• Score the diagnostic or measurement quality of an image
• ...

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Volume acquisition supporting AI-based view selection

User performs a fetal head volume scan

Tool automatically
- Extracts 3 standard planes
- Performs 5 automatic measurements (BPD, HC, CM, CB, VP)
AI-based segmentation supporting view selection
AI-guided image acquisition
Combined with intra exam AI-assisted analysis

AI-based guidance and IQ → Current View

Guide procedure
Support diagnosis
Enable measurement

Intra exam AI-based analysis
AI-based measurements supporting view selection

AI-Assisted cardiac output measurement

AI-Assisted IVC collapsibility measurement
Well-designed AI

Ideally AI-assisted image guidance leads to a user being more effective even in the absence of AI.

AI-based assistance providing training & experience
Traditionally, ultrasound is a powerful tool that enables clinicians to make critical decisions intelligently assists.