GE HealthCare

Leveraging artificial intelligence for greater ease and accuracy of bladder volume measurement

Accurate bladder volume measurement is crucial in the evaluation of bladder function, the assessment of urinary health and the effective monitoring of treatments. Too often, incorrect probe placement, tedious and difficult manual workflows, disparities in user proficiency and various other factors commonly delay or compromise the integrity and reliability of findings. This can lead to incorrect diagnoses and the need for repetitive diagnostic processes.

The solution

Auto Bladder Volume is an innovative AI-powered tool that automates bladder volume measurement using ultrasound images captured in orthogonal views (transverse and longitudinal). This tool leverages advanced deep-learning algorithms to provide accurate and reliable measurements, replicating the precision of manual caliper placement by clinical experts. Auto Bladder Volume combined with Vscan Air™ handheld ultrasound makes it an ideal and indispensable resource for a broad array of care environments. It supports timely assessments in both in-patient and outpatient settings.

Key benefits:

- AI-powered, automatic bladder volume measurements in seconds
- Real-time imaging for informed decision-making
- Non-invasive and patient-friendly — potential for fewer unnecessary catheterizations leading to reduced catheter-associated urinary tract infection (CAUTI) risk
- All-in-one dual-probe device for bladder, abdominal, lung, vascular, obstetrics, and MSK imaging
- Ultra-portable, robust, and cost-effective

Auto Bladder Volume in action

Auto Bladder Volume uses artificial intelligence to deliver automatic, non-invasive bladder size and volume measurements within seconds, following a simple two-step protocol.

The AI model training included:

- **Pre-processing:** Images were pre-processed to enhance quality, including scan conversion, cropping, resizing, and normalization.
- **Post-processing:** The model's output includes heatmaps from which landmark points are extracted. These points represent caliper placements that the user can edit.

The tool uses two U-net-based deep learning models trained for landmark detection in transverse and longitudinal views, providing robust and accurate measurements. The model learns the mapping from input ultrasound images to caliper placement points. It offers informed, precise and intuitive annotation capabilities using training from expert annotators. It directly estimates caliper positions, eliminating the need for manual segmentation and catering to various bladder sizes and shapes.

Design principle:
Auto Bladder Volume thrives at the intersection of speed and accuracy.

Real-life examples for real-time learning and reliability

Auto Bladder Volume's learning models were developed using thousands of images across multiple countries for maximum accuracy and diversity of case examples. To introduce variability, data augmentation techniques such as adding shapes ("blobs") and fog to the bladder images were used during training. This helps the model generalize better to different scenarios, like when pathology is present. Although this model didn't exclude pathology, it also wasn't validated to perform with specific pathology present. The model rather supports full visualization of anatomy for the user to make their own clinical assessment and maintain control of the AI measurements. This further supports the robustness and flexibility of our solution for a diverse set of cases that users will face in real-life clinical practice.

Designed for success

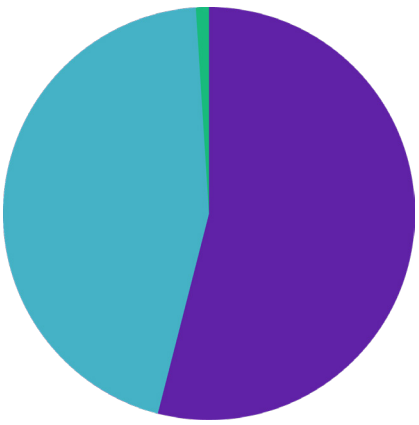
Use of Auto Bladder Volume in various clinical contexts have resulted in:

- A 92% acceptance rate of caliper placement accuracy in a reader study done with five experts
- A 90% success rate in automatic caliper placement when the bladder wall is fully visualized

View	Success rate	Total number of images
Transverse view	93.52%	972
Longitudinal view	90.77%	845
Total	**92.24%**	**1,817**

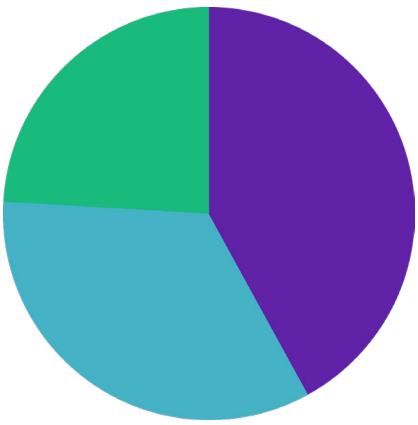
Test data demographics[1]:

Gender



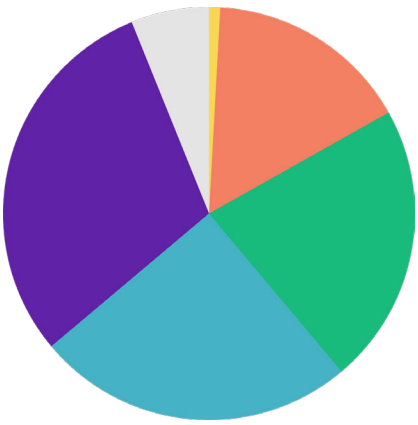
- **53%** Female
- **46%** Male
- **1%** Blank

Demography



- **42%** U.S.A.
- **34%** Europe
- **24%** Asia

Age



- **30%** 65+
- **25%** 50-64
- **22%** 30-49
- **16%** 19-29
- **1%** Under 18
- **6%** Blank

Enabling broader user and patient applicability

Bladder size, shape and volume during scanning are among the most common issues when it comes to accurate measurement and ultrasound. Auto Bladder Volume's functionality and benefits are suitable for adult patients with bladder volumes ranging from 30 to 700 mL, covering both full bladders and smaller post-void residuals. In addition to wireless accessibility to patients, the tool's interface allows easy editing and acceptance of AI-generated caliper placements, making it user-friendly for a variety of clinical settings and users.

Control the efficiency and effectiveness of your bladder volume measurement process

The Auto Bladder Volume algorithm has the potential to save time compared to manual measurements, enhancing workflow efficiency in clinical practice. Users have greater control over the AI measurements and process (compared to automatic 3D volume devices) with the ability to choose the images, manually check, and edit caliper placements, and see exactly how the volume is being calculated.

Our AI-powered bladder volume measurement tool offers a novel, accurate, and reliable solution for assessing bladder capacity and function. Automating the measurement process enhances efficiency and precision in clinical practice, ultimately improving patient care.

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1. DOC3045992 Assisted Bladder Volume Measurements using AI – Training and Validation Data.

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