Instructions for Use

EchoConfidence

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Preface

Intended Purpose

EchoConfidence is Software as a Medical Device (SaMD) that displays images from a Transthoracic Echocardiogram, and assists the user in reviewing the images, making measurements and writing a report.

Intended medical indication

The intended medical indication is for patients requiring review or analysis of their echocardiographic images acquired for their cardiac anatomy, structure and function. This includes automatic view classification; segmentation of cardiac structures including the left and right ventricle, chamber walls, left and right atria and great vessels; measures of cardiac function; and Doppler assessments.

Intended patient population

The intended patient population is both healthy individuals and patients in whom an underlying cardiac disease is known or suspected.

Intended Clinical Benefit

The intended clinical benefit of EchoConfidence is indirect rather than direct. Through demonstrating acceptable clinical performance, software validation, and summative usability, the indirect clinical benefit of EchoConfidence lies in the provision of accurate and precise medical information on patients, as assessed by being non-inferior to the generally accepted and established State of the Art of manual measurement of echocardiography by appropriately trained healthcare professionals. Providing such accurate and precise medical information (and allowing clinicians to manually adjust measurements) facilitates subsequent clinical assessment and management decisions for patients, made by the responsible clinician.

The AI is *augmentative* to the clinician, not *autonomous*.

The list of measurements that are integrated into the software that the user can make and be annotated are listed in Appendix A. The software also calculates derived measurements (such as ejection fraction) and provides indexing of measured parameters.

As this manual measurement process is often time-consuming, for many of the measurements, the validated AI incorporated into the software can automatically pre-position measurement points and provide the associated measurement.

Not all measurements have AI assistance available as either the image quality may be too poor for automated suggestions, or the current release of the software does not provide them. The availability of AI assistance for each measurement is detailed in Appendix A. The performance of the AI assistance for each measurement is detailed in the Clinical Investigation Report.

As a minimum, for an AI assistance measurement to be provided within EchoConfidence its average difference between it and a group of clinicians should be no more than 25% higher than the average difference between an individual clinician and the others taking part in the validation study.

Contraindications and Warnings

Contraindication - Limitation of use: The AI analysis components exclude patients with a known congenital cardiac abnormality and paediatric patients (age < 18). It has no special features to detect or make allowances for myocardial tumours.

Warning – Limitation of use: Poor images quality (including patient factors, acquisition factors and hardware factors, inappropriate gain, contrast or depth, or lack of ECG) may lead to poor AI annotations and reduced measurement performance. EchoConfidence includes systems to identify and exclude poor quality images, and methods for the user to edit or delete the AI measurements, however, the clinician should ensure adequate quality of images are acquired before ending the image acquisition.

Warning – EchoConfidence does not replace physician clinical judgement and is intended as an adjunct to good clinical care. Clinicians must interpret values within the patient's demographic and clinical context. EchoConfidence enables clinicians to review the AI-assistance provided for accuracy.

Warning – Age and biological sex are required for some normal range calculations.

Warning – AI assistance is not available for all measurements. This may occur if the image is of poor quality, or if no AI is available for that measurement. If AI assistance is not available for a measurement the associated image will have a line through it and faded on the measurement screen.

There are no other known contraindications to the use of EchoConfidence

Intended part(s) of the body or type of tissue applied to or interacted with

The AI software will not directly be applied or interact with any body part or tissue type. The AI software will only be applied to echocardiographic images.

Intended user profile

The intended user profile is a healthcare professional qualified and licenced to conduct and interpret echocardiographic images. This software can also be used by trainees with appropriate supervision.

The **EchoConfidence** software will aid these intended users in making decisions based on the output analytics. However, the responsibility of final reporting and adjudication of any clinically significant findings will remain with the clinician.

Use environment

Clinical environment

EchoConfidence is intended to be used in any environment in which an echocardiogram is performed or reported. Examples include, but are not limited to:

- In an echocardiography clinic, where patients come to undergo echocardiography.
- In a doctor's office where echocardiography is performed.
- On a ward in a hospital, when a healthcare practitioner travels to a patient's bedside to carry out an echocardiogram.
- In a research facility.

The EchoConfidence interface will show the images that it has received. If views have been omitted, the user may recognise this early, for example on a mobile tablet display, and acquire the additional views required.

If the user chooses to use EchoConfidence during the examination itself, they can review the Views Tab and the Measurements List to confirm that the necessary views and measurements have been obtained, before ending the examination.In research settings where thousands of echocardiographic images may need to be analysed as part of a study; a member of the research team will be able to feed large numbers of studies into EchoConfidence, which will then provide the output results in the form of tables of values.

Technical environment

The analysis runs on an institutional/customer managed server; the frontend software, i.e. user interface, runs on a desktop or laptop computer, or a tablet (mobile device), with specification for the desktop, laptop or tablet as given in these Instructions for Use.

Text style convention used in this manual

The following convention is used:

Style	Used for
Bold	Emphasis
Italic	Emphasis Publication titles
`Monospace`	Exact text as displayed on screen Exact input as intended to be typed into computer
Word in angle brackets <>, e.g. <age>	This does not mean the actual text "<age>", but rather the age of the patient, e.g. 58.

Safety warning convention used in this manual

The following convention is used:

Warning	Significance
WARNING!	Information that allows the user to be informed of any warnings, precautions, contra-indications, measures to be taken and limitations of use regarding the device

Read and accept the “End User Licence Agreement” before use of the software.

Read and understand at least the Instructions for Use section of this manual before using the product. Failure to do so can result in serious harm to your patients. Follow all the instructions. Keep all safety instructions for future reference and pass them on to other users of the software.

These Instructions for use are available in English. They may be accessed at https://www.demo2.ts.zomirion.com/manual.

Obtaining updated documentation and information

The latest version of the documentation is available at this web address:

www.mycardium.com

Feedback on documentation

If you have any feedback regarding this documentation, please let us know on info@mycardium.com. We appreciate your comments.

System lifetime

The system's lifecycle is divided into two phases. *Standard Support Phase* for 5 years from the date of first release, during which the system will receive regular updates, fixes, and technical support. *Extended Support Period* for an additional 2 years, designed to provide extended maintenance and security updates, but may not include new features or enhancements. Total System Lifecycle is therefore 7 years from the date of first release.

Product Description

Purpose

EchoConfidence is a software-only medical device manufactured by MyCardium AI Limited, which is designed to assist a healthcare professional who carries out transthoracic echocardiograms: sonographers and Cardiologists.

EchoConfidence takes as its input DICOM files of a transthoracic echocardiogram study. Each DICOM file stores a moving image of a few seconds, or a still image, showing the heart from a particular view. The **EchoConfidence** software processes images that it has received and presents them in a manner that assists the user in reviewing the images, making measurements, and writing the report.

First, the software classifies each image by the view of the heart that it represents, so that the user can quickly see if there is an image of any particular view of the heart, and view it in detail.

Second, the software pre-positions measurement callipers to measure many structures of the heart, ready for the user to fine-tune them, so that the user can more easily make multiple measurements of each structure, and cover all the structures in the report.

The user then uses the images and the measurements to write a report on the transthoracic echocardiogram, through the **EchoConfidence** reporting interface. This report is intended to be used by an interpreting clinician as an aid to diagnosis. The system is designed to reduce the time consumed by manual steps in the previous methods of manually analysing images and preparing a transthoracic echocardiogram report.

The ultimate interpretation of the transthoracic echocardiogram remains the responsibility of the reporting user, using all available information, which may include the results of the **EchoConfidence** software.

EchoConfidence is a prescription-only device and is intended to be used solely by highly trained clinicians who are qualified to perform and report transthoracic echocardiograms in the relevant territories (e.g. have formal accreditation with a recognised body in Adult Transthoracic Echocardiography). Trainees working towards these accreditations can use the software, under supervision. No further training in EchoConfidence is required.

Recommended minimum standards for your computer or tablet

To use the **EchoConfidence** system with adequate performance, we recommend your system have these minimum standards. The app contains links that will arrange internet speed and system performance tests, via the "Settings" > "System" panel.

Feature	Recommended minimum standard
Operating System	Windows XP, 10, 11 or later macOS X, 11, 12, 13, 14 or later iPadOS 14 or later Android 13 or later
Screen size	9.7 inches diagonal
Screen resolution	800 x 600 If a screen resolution lower than this recommended standard is detected, a warning message will be displayed.
Colour	24-bit RGB colour
Random access memory (RAM)	2 Gigabytes available before **EchoConfidence** software is started
System performance (single threaded)	At least 100 on the Browserbench JetStream 2.2 browser speed test
Internet speed	At least 30 Mbps on www.fast.com internet speed test

Compliance with harmonised (EU)/ consensus (USA) standards

Aspects	Standard complied with	US FDA Recognition Number
Risk Management	ISO 14971:2019 Medical Devices - Application of Risk Management to Medical Devices	5-125
Usability Engineering	IEC 62366-1:2020 Medical Devices – Application of	5-129

	Usability Engineering to Medical Devices	
Software Design	IEC 62304:2006+A1:2015 Medical Device Software - Software Life Cycle Processes	13-79
Images	NEMA DICOM PS3.1 2022d Digital Imaging and Communications in Medicine (DICOM) Set	12-349
Clinical Investigation	ISO 14155:2020 Clinical investigation of medical devices for human subjects - Good clinical practice	2-282

Product Elements

The **EchoConfidence** software is composed of two elements: the backend system and the frontend system.

The backend system operates on cloud computing infrastructure of MyCardium AI Limited. Your ultrasound scanner is programmed to send images securely to the backend system via an encrypted tunnel across the internet. The backend system assesses each image, and pre-positions measurement callipers.

The frontend system is the web app that you run on your computer, to view the transthoracic echocardiogram, make additional measurements, if required, and write the report. The frontend system communicates with the backend system, via an encrypted tunnel across the internet.

Precautions

Before using the **EchoConfidence** software for viewing, analysing, and reporting transthoracic echocardiograms, you should take a series of precautions.

Your computer

Check your computer or tablet meets the Recommended Minimum Standards described above. Do not attempt to use this software on a mobile phone or on a tablet with inadequate screen size or resolution.

Check that your operating system is up-to-date. How you do this depends on the operating system of your device.

- In Windows, select Start > Settings > Update & Security > Windows Update, and then select Check for updates
- In macOS, open Software Update, in System Settings or System Preferences, which you can open from the Apple menu in the corner of your screen: Choose Apple menu > System Settings. Click General on the left-hand side of the System Settings window, then click Software Update on the right.

Ensure that your system is free of malware.

Ensure that your web browser software is up to date. We recommend Google Chrome or Safari. If an incompatible browser is detected, a warning message will be displayed.

- If you are using Google Chrome on a Windows or Mac computer, open the browser and click the three-dot icon in the top-right corner of the window. Then hover over Help and click About Google Chrome. Wait for the update to finish and click Relaunch.
- If you are using Google Chrome on Android, open the Play Store app. At the top right, tap the profile icon. Tap ‘Manage apps and device’. Under 'Updates available', find Chrome. Next to Chrome, tap Update.
- If you are using Safari, simply carry out the process above for updating macOS or iPadOS. As long as you are using the up-to-date macOS or iPadOS, you will automatically have the up-to-date version of Safari.

Ensure that your system has enough memory available to perform adequately. Read your system's instruction manual to find how much memory is available for use before starting **EchoConfidence**, and check that the available amount meets the Recommended Minimum Standards described above.

Check whether your processor speed is sufficient to deliver acceptable performance of the software. A simple test of browser single-threaded

processing speed (not internet connection speed) is JetStream 2.2. You can run this by going to the following web address:

https://browserbench.org/JetStream/

A score of 100 or higher should be sufficient to deliver acceptable performance.

How to unlock rotation for tablet devices

For handheld devices that can be used in portrait or landscape orientation, it is better to use landscape. If your screen does not rotate when you rotate your device, try the steps below to unlock the orientation:

1. Swipe down from the top right-hand corner of your screen to open Control Centre.
2. Tap the Portrait Orientation Lock button to make sure that it's off.

You and other users of this software

The **EchoConfidence** software should only be used by trained clinicians familiar with transthoracic echocardiography. *Do not* rely solely on software-generated analyses and reports; always review the transthoracic echocardiogram images to ensure accurate clinical interpretation.

Patient confidentiality

Ensure that patient data is treated with the utmost confidentiality, and follow all applicable data protection and privacy regulations.

Cybersecurity

EchoConfidence application uses industry-standard encryption protocols to secure all data in transfer and at rest. MyCardium AI uses industry best practices compliant with and certified to international information security standard ISO 27001.

For you as a **EchoConfidence** user, it is very important to keep in mind the following recommendations:

- Never share your **EchoConfidence** user credentials;
- Use a secured Internet connection;
- Only use compatible devices;

- In the event of any cybersecurity incidents or concerns involving **EchoConfidence** please contact support@mycardium.com, marking the email as ‘Urgent’
- In the event of any data breach resulting from the use of **EchoConfidence** contact support@mycardium.com, marking the email ‘Urgent FAO DPO’

If you encounter any software discrepancies, anomalies or uncertainties, contact your site's representative of MyCardium AI Limited, the manufacturer of this software.

Take any steps advised by MyCardium AI Limited to update the **EchoConfidence** software to keep it secure in the face of evolving security threats, and compliant in the evolving regulatory environment.

Safety instructions

WARNING! Only for use by clinicians

This software is designed solely for the use of highly trained clinicians who are qualified to perform and report transthoracic echocardiograms in the relevant territories (i.e. have formal accreditation with a recognised body in Adult Transthoracic Echocardiography). Use by persons without appropriate skills could lead to misinterpretation and misdiagnosis.

If you are in doubt regarding whether you are qualified to perform and interpret transthoracic echocardiograms, seek advice from an appropriate physician (e.g. a consultant cardiologist) or a healthcare professional holding an appropriate national qualification certificate for your country or territory.

Safety information for vulnerable people

This software is designed to be used by adults only. It will display images of transthoracic echocardiograms of patients.

Personal safety

When conducting or reporting transthoracic echocardiograms, personal safety remains paramount. All users must first be familiar with the facility's emergency procedures, wear appropriate protective equipment when necessary, and take care to reduce the risk of contamination or infection. Prolonged sessions of reporting transthoracic echocardiograms may require you to take regular breaks and ensure ergonomic practices to prevent physical strain. Always prioritise your well-being, and if you ever feel unwell or unsure about a situation, seek guidance or assistance.

Work area safety

The work area for reporting transthoracic echocardiograms should be organised, clutter-free, and designed with ergonomics in mind to ensure maximum efficiency and minimum risk. All equipment, including computers and peripherals, should be maintained in good working order. Ensure that walkways are clear of cords or other tripping hazards. Regularly sanitise surfaces to prevent the spread of pathogens, especially in areas where equipment comes into contact with patients. Familiarise yourself with the locations of fire extinguishers, emergency exits, and other safety equipment.

Electrical safety

Have regard to electrical safety when setting up your work area for transthoracic echocardiogram reporting. If you are using an additional computer for the **EchoConfidence** software, ensure its power cord is intact without any exposed wiring, and it does not overload outlets. Use surge protectors when necessary. Ensure that all electrical equipment is grounded and regularly inspected for potential faults. Keep liquids away from electrical devices to prevent accidental spills, which can cause electrical shorts or damage. Always unplug devices from the power source before cleaning or servicing them and consult the equipment's user manual or seek professional advice when in doubt about safe operation.

Operation of the Software

Accessing the User Interface

The user interface is how you interact with the frontend system, also called the “app”. You can reach this from any computer or tablet that has been set up by your site’s Information Technology team to access the secure tunnel to the **EchoConfidence** backend system.

Our software requires a modern, standards compliant web browser. In Windows or Linux, we recommend Google Chrome. In macOS, we recommend Google Chrome or Safari. In iPadOS, we recommend Google Chrome or Safari.

Your site (e.g. your hospital) will have a dedicated URL through which you access the user interface. For example, if your hospital is St Cuthberts, your site’s URL might be:

```
https://stcuthberts.ts.zomirion.com
```

Your site administrator will have given you the site URL and your personal username and password. In your browser, go to the site URL, and enter your username and password.

Status display

At the top of the screen you will see the name of the software (**EchoConfidence**).

At the top right you will see:

- Your name
- The **Settings** button
- The **Log out** button

“Settings” screen

Click on the Settings button to open the Control Panel. The Control Panel screen has multiple tabs.

Show team

You can use this setting to guide others in your team to the same case, same video and same frame.

Configure

This “Configure” tab allows you to choose your device preferences. You can configure settings for the “Whole app”, such as visual effects, hiding patient names and short or long explanatory text.

You can use the “Measurement list” and “Measurement review” options to select the type of measurements shown on the measurement panel, such as derived measurements and the layout of the videos on the screen.

The “Report” options let you select preferences for the reporting screen such as a light or dark background and between buttons or dropdown menus.

These configuration settings are also available in the relevant sections of the app, but have been consolidated within the main “Settings” for convenience.

System

The “System” box in this tab shows an ID for your site, called your “practice ID”. It also shows technical information about the frontend software that may be helpful if you need technical support.

The settings in the “Admin configuration” box may be used for troubleshooting by the technical support team.

The “System Test” can be used to test your internet speed and system performance, which may be required during troubleshooting.

Regulatory

The “Regulatory information” box presents required regulatory information for the territories in which the **EchoConfidence** software is on the market. The instructions for use can be accessed from this section.

The “Privacy” box gives you access to the privacy policies for you (the User) and the person whose transthoracic echocardiogram is being analysed (the Patient). Click the appropriate button to read the relevant privacy policy.

If a patient wants to read the privacy policy on their own device, they can enter the web address indicated. In most browsers, the address displayed, which is easy to transcribe and to speak, should successfully take them to the web page. If it does not, ask them to prefix it with “https://”.

The “Personal information” box shows you your user name and advises how you might delete your account from the **EchoConfidence** system.

Please read and accept the “End User Licence Agreement” before use of the software.

“List of studies” screen

The starting screen of the software is the list of transthoracic echocardiogram studies at your site.

Searching

To search for a study, enter part of a patient’s name or ID in the **Search** box. It does not have to be from the start of the name. The capitalisation (uppercase or lowercase) does not matter.

The display updates to show only studies containing what you entered.

Searching using multiple fragments

You can reduce search time by entering pieces of the patient's identification details.

Example: Andrew Jones

Enter in Search box: `an jo`

Sorting

To sort the studies into order, click the title of the column, such as, “Name”, “ID” or “Time” at the top of the table of studies.

For example, clicking Name will sort the studies into alphabetical order of the patient’s name. The small arrow at the right-hand end of the Name column will point upwards, indicating that the table is being sorted in alphabetical order.

To sort in reverse alphabetical order, click “Name” again. A small downward arrow indicates that the table is now sorted in reverse alphabetical order.

Selecting a study

To select a study, click on it. You will be transferred to the Study screen.

WARNING!

Check the patient's name, ID, date of birth, and other information displayed on the Study screen, to ensure that you are viewing the right data.

Hiding the patients' identities

Should you need to hide the patients' name, you can click the small "  " icon at the top of the screen.

Multiple studies

Should you wish to compare multiple studies, select the "Cadence" button. This allows you to select cases and select variables and then see a display of how those variables changed over time along with relevant images. You can change which images are shown at each timepoint by clicking on the 'delta' symbol or open that whole study by pressing the eyeball icon.

For research or audit purposes, you may wish to collate the numerical data or PDF summaries of multiple studies. To do this, click "Magiquant" or "Logbook", respectively.

Echo study home screen

This is the main home screen. It is the initial screen users will be shown after selecting a study.

Exit study button

This returns you to the “List Of Studies” screen.

Tour button

In each of the tabs there is a 'Tour’ button. Click this to be taken step by step through the key features of the tab.

Patient identity

This will show the patient’s name and ID. If you have entered the patient’s date of birth and sex when acquiring the transthoracic echocardiogram, the display will also show their age at the time of the scan, and sex. For example,

“67F” would indicate a 67-year-old female

“34M” would indicate a 34-year-old male

Hiding the patient’s identity

Should you need to hide the patient’s name, you can click the small “” icon at the top of the screen.

Date of study

This will show the date the study was performed.

Views, Measurements and Report tabs

These tabs allow you to toggle between the different screens to view measurements, make measurements and write the report. These are described in the sections below.

Settings

The “Settings” panel described earlier is also accessible from this screen.

“Views” panel

This panel consumes the majority of the screen and displays a compact summary of all the views of the heart taken in the study. It enables you to quickly determine which views have been acquired and which have not. This panel is described in more detail below.

“Measurement review” panel

This is a table of draft measurements that have been calculated based on the software pre-positioning of calliper points on the images of the study. This panel is described in more detail below.

Starting to review and report study

“Views” screen

Image display

This screen displays the Views panel or ‘Vizette’, which is an organised grid of all the images, automatically classified into standard views. The Vizette has a fixed square tile for each standard view of the heart, and each type of spectral Doppler image, making it easy to find any image in the study. (For simplicity, types of Doppler images are also referred to in this manual as “views”.)

If you adjust the size of the **EchoConfidence** window, this panel will resize and the images within it will be redistributed accordingly.

Level of detail

The Vizette can be adjusted to show different levels of detail. Some transthoracic echocardiogram studies deliberately acquire only a few views of the heart. Other studies acquire a larger number of views. The tabs at the top of the views panel allow you to change the level of detail in the Vizette, such as a focussed protocol, standard protocol, or advanced protocol. You can also turn off the Vizette, and instead see all the images in time order.

Selecting different tabs does not result in the loss of any images, i.e. selecting a different tab only reduces/increases the number of images seen on the screen and does not delete any data.

View squares

For each expected view of the heart, there is a square box in the Vizette. If an image of that view of the heart has been acquired, it is displayed in that box.

If no image of that view has been acquired, a cartoon is displayed instead.

For example, if the study did not include the PLAX or A4C view of the heart, you will see these two tiles as monochrome cartoons with a simple visual representation of these echo views. If a Doppler colour image is expected, you will also see a simplified colour bar on the tile.

Studies where more than one acquisition of the same view have been taken, one image will be displayed in that square with the addition of a small number to indicate the total number of images available of that view.

For example, a number "**5**" indicates that there are 5 images of this view in this study. To see each image, click that square.

This opens a display of all 5 images, together with the name of the view.

Reallocating images between views

If you are not satisfied with the classification of an image, you can change it. For example, if the system has classified an image as apical 3-chamber, but you consider it apical 2-chamber, you can reallocate it using the following steps.

1. Move the mouse cursor or your finger to the image that has been incorrectly classified.
2. Press the left mouse button or put your finger down on the image.
3. Drag the image to the correct view slot.
4. Release the left mouse button or lift your finger from the screen.

The image will now be moved to the view you have chosen. This information will be stored in the database that is shared across all users at your site. When you (or anyone else from your site) return to this study, that image will now be correctly categorized.

Selecting images to view in “Views” screen

You may wish to look closely at an image, or play a moving image frame-by-frame. To do this, click on the view in the “Views” screen.

Select the image of interest to you. It will be displayed full-screen. When you are finished, click the “X” icon to close it.

If it is a moving image, you have the option of flicking through it frame by frame. To pause the video, use the “||” button shown at the bottom left of the screen. You will now see a frozen frame.

To go to any point in the video, drag the circle along the line at the bottom of the freeze frame.

To step through the video frame-by-frame, click the “<” or “>” buttons or use the keyboard shortcuts shown.

To return to playing the video in the normal manner, click “▸”.

To download a frame or a video, click the “📷” icon. If a video is playing, the entire video is downloaded. If you are viewing a static frame, or have paused a video, that frame alone is downloaded.

To adjust the contrast, brightness or gamma settings of the image, click the “◐” icon. You can return these settings to default with the undo button.

If you want to skip ahead to the measurements made on this image, click the “📏” icon. However, it is recommended that you approach the measurement process from the measurement panel, which marshals for you all of the frames where this measurement can be made.

You can advance to the next video, or go back to the previous one, or change to the previous or next view, using the buttons on the bottom right.

Annotate images

Normally, the only measurements you would be making is adjusting measurements that have been automatically prepared. However, if you want to make a measurement on an image in which the AI has not already prepared a measurement, use the Views tab and then the ‘ruler’ icon. First, you will have the opportunity of specifying which standard echo measurement you are making so that the value you have obtained can be added formally into the calculation and report. If, on the other hand, you are making a non-standard measurement (for example, measuring a vegetation) then click the ‘annotate image’ option, after which you will be asked which section of the report the measurement belongs to. You can then measure the structure as a linear

dimension or an area and make any other desired annotations. The image is automatically added to the report (you can delete it from the Report tab if required).

“Measurements” tab

Measurement display

This panel is a tall and narrow table. It will likely be taller than your screen: scroll to see the later entries.

Table of measurements

Each entry in the measurements table reports information about the measurement of one feature of the heart. These come in two types:

- *Direct* measurements, which are obtained from particular images. These are signified by a button-like shape, such as end diastolic dimension (LVIDd) and end-systolic dimension (LVIDs).
- *Derived* measurements, which are obtained from other measurements by arithmetical calculations. For example, the fractional shortening (FS) and cubic-formula ejection fraction are derived from LVIDd and LVIDs.

Listing options

Above the list of measurements, you will see the Listing options. This will allow you to select your preferences, such as filtering measurements by type and region.

Layout options

The Layout options at the top right of this panel, enables you to select your preferences such as the layout of the videos and explanatory text.

View measurement

You can click on a *direct* measurement to see the individual measured frames that contributed to that measurement. Ideally, there should be many measured frames contributing to each measurement, so that the uncertainty in the result is smaller.

Clicking on a *derived* measurement will display the list of measurements used to derive this measurement.

Some measurements have ranges for normal, mildly abnormal, moderately abnormal and severely abnormal. The normal range is shown as a green bar.

Where relevant, you will see red markers for the two boundaries between the three levels of abnormality. The mean value for the patient is shown as a vertical white line. Click on the measurement, to see an expanded, labelled version of this graphic. Where relevant, the cut-off values for the normal ranges and sources are also displayed.

Ignore measurements

If an image is not suitable for a particular measurement, you can choose to ignore the measurement by clicking the 'Ignore' button at the bottom right corner of the relevant image. Any ignored measurements will appear crossed-out at the bottom of this screen (you may need to scroll down to see them).

For some measurements and some beats automated assistance will not be provided. In these cases, the reporter can make manual measurements as is the current standard. Measurement assistance may not be available if either a) quality of the image and assistance is judged by the software to be poor, so assistance is not provided. b) no AI assistance for this measurement is available in the release of the software. Such images will be appear at the bottom of the screen and cross-out. The user can review these images, activate it, and make a manual measurement using the same interface.

Any beats in the 'ignore' section will be *omitted* from the measurement calculation. If you decide to undo ignoring this measurement, click on the "Use" button at the bottom right of the image. This will move the image back to the upper section of valid measurements to be used.

Edit a measurement

Click any frame where the measurement callipers may be imperfectly positioned. This opens the "Edit measurement" screen.

Refer to "Edit measurements" in the "Measurements" screen section below for details on how to edit a measurement.

“Measurements” screen

Reviewing AI measurements and derived values

When you click on the “Measurements” tab, you will access the main “Measurements” screen.

All *direct* and *derived* measurements are listed in the measurement panel. Users can manually descend and ascend through these parameters by either clicking on the measurement directly, or by using the scroll function. The selected parameters are visibly highlighted as you move through the list.

On selecting or scrolling through the measurements list, the corresponding images will also appear on the opposite side of the screen.

Editing measurements

To edit a measurement, click on the image you want to amend. This will take you to a full-screen view of the selected measurement. On this screen, you can edit the calliper positions by clicking and dragging them to the correct positions and clicking “Save” (or select ignore beat the measurement if the image is not suitable).

Adjusting label size in editing measurements view

You can adjust the size of the labels with the slider at the top right of the editing measurements view. There are three ways to make the labels disappear:

- Press the control key to hide the labels briefly
- Press the H key to hide the labels until you press the H key again
- Slide the label size slider to zero

Reviewing adjacent frames

You may wish to look at the frames before and after the suggested measurement frame, to confirm that the correct frame has been automatically selected. You can do this by dragging the scroll ball, or using the "<" and ">" frame-flicking buttons. Shortcut keys for these buttons are "," to flick one frame left and "." to flick one frame right.

If you decide that a different frame should be used, flick to that frame and click the button for "Measure on this frame", for which the shortcut key is "M".

If you decide that the originally selected frame was correct, and you want to return to it quickly, click "R".

Reviewing other replicates of the same measurement

From the editing measurements view, you can proceed to view and, if required, also edit the next replicate view. To move to the next replicate click the "Next beat" button or press the right arrow. This could be another beat in the same video or another video. You will see a stack of tiles that outline your progress through all the replicates available for this measurement. For example, if each video has two heartbeats, you will see a stack of pairs of tiles, where each pair is one video and each tile is one beat. You can click on these tiles to quickly jump to a particular replicate.

It is recommended that measurements are made from several different heartbeats for two reasons. First, the mean of many heartbeats shows less random variability between studies than the mean of a few heartbeats or just one. Second, the variation between the different replicates allows statistical processes to estimate for you the likely variability of the mean between one study and another. This is called the 95% confidence interval.

Moving to the next parameter in editing measurements view

To move to the next or previous parameter whilst in the editing measurements view, press either the up or down arrow on the bottom right of the screen. You will see the replicate tiles update to represent this new measurement. The name of the measurement in the top left, above the replicate tiles, will also update.

When you are finished, click the "Back to measurements" button to go back to the Measurement review screen.

“Report” screen

The “Report” screen contains a series of text boxes for the report.

Report options

The Report options button at the top of the screen, allows you to select your preferences for the Report screen, such as a light or dark background.

Editing patient information

Patient information is displayed along the top of the report screen. If any patient information is missing, or you would like to amend the existing information, click on the “” button.

Writing the report

On the Report tab, you will see a list of report sections displayed on the screen. Each box contains options for the observations and visual findings for that section. Clicking inside the box will display relevant images and measurements on the screen.

You can type your report for this section and then press tab to advance to the next section.

By default, there are shortcut buttons that you can click to enter standard text. Some of these have obvious hotkeys that you can press to enter the text from a keyboard without having to click a button with the mouse.

If you prefer to have dropdowns for your shortcut entry of standard text, go to Report options and switch off the buttons and switch on the dropdowns.

Saving and exporting a PDF of the report

Once completed, you can either download a PDF of the report, by clicking “PDF” on the top right hand corner of the Report screen or click on “Close report” to go back to the “Views” screen.

The report will automatically be saved on exiting the “Report” screen, and can be returned to by clicking the “Report” tab. Updates, amendments and redactions can be made at any stage.

Autotext

For some measurements, there are explicit standard definitions of a normal range, sometimes with subdivisions of abnormality into mild, moderate and severe. For these, echoconfidence can insert standardized text with the associated numerical and graphical data including the confidence interval where available and normal range. You can activate this option by clicking “enable autotext” and then individually remove any of the suggestions you disagree with using the ‘checkboxes’ at the left of the comments.

Instructions For Use

This section describes the specific steps involved in achieving common tasks.

In advance of the following instructions, your institution (or "site") will need to be set up with a URL specific to your site and also issue your username and password. Contact your site administrator for these details.

Use Google Chrome or another modern browser to visit the URL, and log in.

How to choose a study

1. After opening the **EchoConfidence** app, you will see a list of studies. Within this list you can:
    - Filter the studies, by typing a part of a patient's name or ID
    - Sort the studies, by clicking on a heading (click again to sort in the other direction)
2. Click on a study to open it.

How to see which views have been taken

1. Once you have opened a study from the "List of Studies" screen, you can see how well the images of the study cover the transthoracic echocardiogram protocol. You will also see a list of draft measurements, initially based only on the automatically pre-positioned callipers. Each view that has one or more images will have one of its images displayed in its tile. Views without an image will show a cartoon icon indicating the missing view.
2. Click on any tile to see the full name of the view and all its replicates.

How to review images of a particular view

1. Click on the tile of the image you want to review. This will open the image or video in the full-screen view.
2. If it is a moving image, use the "<" or ">" buttons to navigate frame-by-frame.
3. Adjust contrast, brightness, and gamma and save a freeze frame or video loop.
4. Click on the "  " icon to view all the measurements made on this video.

How to make a measurement

1. Click the “Measurements” tab. A list of measurements will appear on the screen.
2. Some measurements have ranges for normal, mildly abnormal, moderately abnormal and severely abnormal. The normal range is shown as a green bar. Where relevant, you will see red markers for the two boundaries between the three levels of abnormality. The mean value for the patient is shown as a vertical white line. Click on the measurement, to see an expanded, labelled version of this graphic and the normal range for this measurement, where relevant.
3. Scroll down to the measurement of interest and click its name. You will see where this measurement comes from, which will be from callipers on one or more mini image frames.
4. If you are not sure that the callipers are correctly placed, click on the mini image frame. You will see it in full-screen view where you can decide to measure a slightly different frame, or edit the calliper positions.
5. You can look at neighbouring frames to confirm that the frame automatically selected for measurement is indeed the correct end-systolic or end-diastolic frame. Once you have flicked to these adjacent frames, you can quickly return to the automatically chosen frame with the “R” key, or decide to measure on a different frame with the “M” key.
6. Click “Save” (or delete the measurement if the image is not suitable). The overall measurement will be updated on the Measurement screen.

How to clear edits

You can clear all the edits done by all users by clicking the dustbin icon at the top of the list of measurements. This allows you to clear it back to any previous authorised state, or even back to no edits at all.

You can also clear the edits to each variable independently by clicking the dustbin icon inside its measurement panel.

How to write your report

1. Click the “Report” tab.
2. Patient information such as age, gender, etc., will be displayed along the top of the report. If you want to amend any of these for the report, click the “✎” icon. This modifies these values for the calculation of reference ranges and for the report, but does not edit the original DICOM data saved by the scanner, nor the patient list in the “Choose Study” screen.
3. You will see a box for each section of the report. Clicking inside the box will display relevant images and measurements on the screen.
4. Use the buttons within each box to describe the visual findings for that section. Clicking the buttons will automatically populate the text boxes with standard text. Some buttons have shortcut keys which are shown at the bottom right of the button.
5. Add further details or findings by typing directly into the text box.
6. Once all sections are completed, click the “PDF” button to save the PDF report.

Versions

At your site, all users will be using the same version of the software, because this is controlled at the site level. To find which version you are running, click the Cogwheel button and then the 'Regulatory' tab. The version number is shown in the format "v01.02.03".

Updates to the software

Mycardium Limited provides updates to the software, as appropriate. This software is updated on the server. When you start the app, you will automatically receive the latest version. If a version updated becomes available, while you are using the app, you will see a notification of this if you are in the middle of making an edit to the study. If you are not making an edit to the study, the app will update itself automatically.

Rollbacks to the software

Rarely, an update to the software may cause a problem. If this happens, Mycardium will roll your site back to a previous version, by changing the version on the server. This will not automatically rollback the app if you are currently using it. However, when you close the app and re-open it, you will receive the intended, rolled-back version.

Uninstalling the software

The backend software exists only on the cloud servers of MyCardium AI Limited, and does not become installed on your computer.

The frontend software is only present on your computer while you have your browser open at the **EchoConfidence** URL. To remove it, close that browser page.

Troubleshooting

Please contact your site's company representative if you experience issues with operating the **EchoConfidence** software. This section contains some hints that may allow you to resolve your issue immediately.

"I cannot reach the site URL from my computer"

Try these troubleshooting steps.

1. Does your computer's web browser reach other websites?

Try a current news website, such as:

https://www.bbc.co.uk

If that does not work, your computer may be disconnected from the internet. Resolve this and do not continue down to the steps below.

2. Does the site URL work on any other computer belonging to your site?

If not, then the cloud servers of MyCardium AI Limited may be out of service, or not reachable by your site due to network disruption between them. Contact your representative from MyCardium AI Limited for advice. Do not continue down to the steps below.

3. Is your computer connected to the secure VPN Tunnel?

All communication between you and the cloud servers of MyCardium AI Limited must pass through a "Tailscale" secure VPN Tunnel which will have been set up by your site's Information Technology department.

To check whether it is working, first find the "Tailscale" icon on your computer. The icon looks like this:

Windows

Look in the icon tray at the bottom right of the screen. You may have to press the "^" icon to reveal it, if you have many icons. Right click on the "Tailscale" icon to reveal the context menu.

macOS

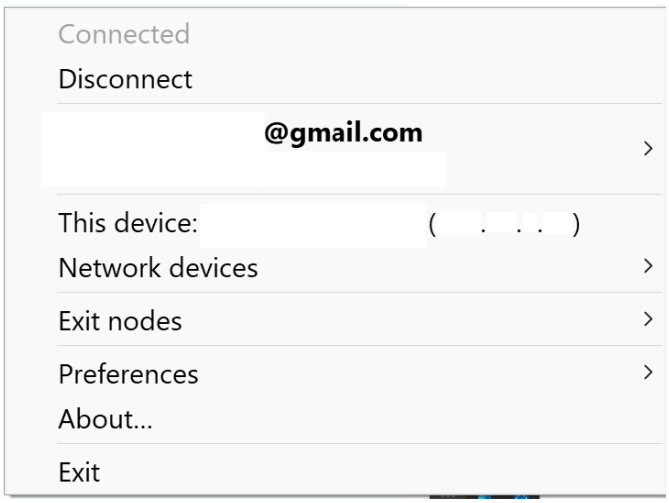
Look in the Menu Bar at the top right of your screen. Control-click the "Tailscale" icon to reveal the context menu.

iPad

Look in the Menu Bar at the top right of your screen. Click the "Tailscale"cale icon to reveal the context menu.

All systems

The context menu should appear like this. Importantly, it should display the word "Connected", and show your "Tailscale" identity, for example a gmail address.



If you do not have a "Tailscale" icon, or the context menu does not show the word "Connected", then:

- Your computer has become disconnected from the secure VPN Tunnel.
- You may need to contact your Information Technology department for help.
- If there is no "Tailscale" icon, you or they will need to install Tailscale from https://tailscale.com/download
- You will then need to log in to Tailscale, typically through a Google login
- This should resolve the problem. If it does not, contact your MyCardium AI Limited representative.

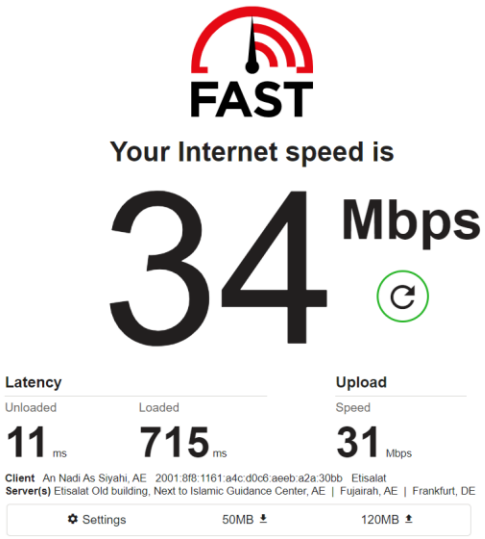
“The system is running very slow”

Try these troubleshooting steps.

1. Is your internet connection too slow?

Try an internet speed checker such as https://www.fast.com

This will test and report the speed of download and upload of data at your computer. For example, the report may be as follows:



Check the download and upload speed against the recommendations in the “Recommended Minimum Standards” section of this manual.

2. Does your system have sufficient memory?

Close the **EchoConfidence** software. Check your Operating System’s manual to find how to determine the amount of free memory remaining in your computer before **EchoConfidence** is started.

Compare this with the recommendations in the “Recommended Minimum Standards” section of this manual.

3. Are there too many other programs or browser tabs open?

Modern computers offer multi-tasking, which means they can run several programs at the same time, and display several browser tabs at the same time. While this can offer great convenience, it has the disadvantage that the other programs (or browser tabs) may be occupying memory and placing work demands on your computer processor.

Shutting down the other browser tabs and other programs where possible, can help minimise this impact. Sometimes, even when those programs appear to have been closed, they continue to consume memory or processor resources. To resolve this, restart the computer.

Performance

EchoConfidence uses AI developed by MyCardium AI Limited. The underlying methods and measurement science are published, with these 2 principal publications:

- Howard, JP et al. "Improving ultrasound video classification: an evaluation of novel deep learning methods in echocardiography." Journal of medical artificial intelligence vol. 3 (2020): 4. doi:10.21037/jmai.2019.10.03
- Howard, JP et al. "Automated Left Ventricular Dimension Assessment Using Artificial Intelligence Developed and Validated by a UK-Wide Collaborative." Circulation. Cardiovascular imaging vol. 14,5 (2021): e011951. doi:10.1161/CIRCIMAGING.120.011951

The AI has been designed to be generalizable - any scanner, any disease, anywhere. It is also explainable – that is, it displays fiducial points and curves to the user. These can be edited. The AI uses computer vision and specifically CNNs (convolutional neural networks).

The AI in **EchoConfidence** is fixed and does not "learn" from presented data during use. However, all edits you make are stored in your institution's database so that if you wish, you can provide them and the associated anonymised images for use in future improvements of the AI.

The processing pathways always have a "human in the loop": all view classifications, fiducial points and curves are visible and editable.

The user is assisted by EchoConfidence to make measurements of the structure and function of the heart, valves, major vessels, and pericardium and pleura. The annotations provided by EchoConfidence have been validated against six experts in the field.

The primary endpoint and validation criterion used to validate the measurement parameters provided within EchoConfidence is the difference between:

- The mean of absolute differences between the EchoConfidence algorithm against each of the 6 expert readers, termed the EchoConfidence Mean Absolute Error (EchoConfidence MAE),
- The mean of absolute differences (Expert mean absolute error - MAE) between each of each possible paring of the 6 expert readers (i.e. 15 pairs), termed the Expert Mean Absolute Error (Expert MAE).

For each of the measurement parameters, this was calculated for every case. The criterion standard was that the upper limit 95% limit on this difference is ≤ 25%, i.e. the upper 95% CI on the average difference between the EchoConfidence algorithm and an expert reader is no greater than 25% larger

than the average difference between two expert readers. This estimate was calculated for every variable under test.

Each variable for which AI-assistance is provided within EchoConfidence is considered to have passed.

Training data

The training dataset was composed of over 100,000 labelled images from over 20,000 patients, from populations with a wide age spectrum and high rate of comorbidity, such as hypertension and diabetes.

Validation

We apply strict quality control standards for our AI. A validation set of images never seen by the AI during training is independently labelled by between 8 and 15 qualified experts (consultant cardiologists and nationally certified sonographers). Their mean is used as the reference standard.

Their individual variation from that reference standard is used as an indicator of acceptable variation from the reference standard. The AI is required to have a performance within the range of the experts. Early studies with the open source model have been published (Howard et al. Automated Left Ventricular Dimension Assessment Using Artificial Intelligence Developed and Validated by a UK-Wide Collaborative [Circ Cardiovasc Imaging. 2021 May;14(5)], Stowell et al. JACC Imaging in press 2024).

The **EchoConfidence** AI has been extensively trained on expert data provided by MyCardium AI Limited, and then platformed within the **EchoConfidence** system. Formal testing in this platform has been undertaken. Full results have been reviewed and lodged with the relevant international bodies as part of regulatory approval.

Performance

The performance of the AI-assistance of EchoConfidence is detailed in Appendix A.

Applicable symbols found on software label

MD	This software is a medical device
REF	V01.00.00 *(example version number - the version is shown on the label)*
UDI	Unique Device Identifier (UDI) - Quote the UDI seen in the software user interface when submitting feedback or complaints
	Release date: 2024-05-22 *(example date - the actual date is shown on the label)*
	MYCARDIUM AI Limited The Spine, 2 Paddington Village, Liverpool, L7 3FA, United Kingdom
EC REP	Name, address and contact email for EU Authorised Representative - *this symbol is shown in the software only when it is released for use in the EU.*
	Consult instructions for Use in the app. Users have access to IFU, accessible on our webpage: www.mycardium.com
Rx only	Prescription-only – *this symbol is shown in the software only when it is released for use in the USA.*

CE 2797	CE-marked medical device – *this symbol is shown in the software when it is released for use in the EU (and in the UK under the* UK Medical Device Regulation 2002*'s recognition of certificates issued by EU Notified Bodies).*
	Importer - Indicates the entity importing the medical device into the locale. This symbol shall be accompanied by the name and address of the importing entity, adjacent to the symbol

Contact details

For more information or questions, please contact us at support@mycardium.com

Serious incidents that have occurred in relation to the device shall be reported to:

(1) the legal manufacturer via support@mycardium.com

(2) the local competent authority (the Food and Drug Administration in the USA)

Manufacturer

MyCardium AI Limited

The Spine, 2 Paddington Village, L7 3FA, United Kingdom

Appendix A

List of all pre-specified measurements and presence of AI assistance in making the measurement

Notes on the performance of the AI-assistance

The user is assisted by the AI within EchoConfidence to make measurements of the structure and function of the heart, valves, major vessels, and pericardium and pleura.

The parameters for which AI-assisted annotations are provided in EchoConfidence have been validated against six experts in the field.

For some measurements, no AI-assistance is provided as validated AI is not currently available within EchoConfidence.

The criterion standard for validated measurements is that EchoConfidence provides values where the upper 95% confidence limits on the median difference in error is no greater than 25% of the experts' mean absolute error. This endpoint encapsulates both precision and accuracy in comparison to the experts. I.e. consistent bias, increased noise, or both will lead to poor performance on this endpoint. The bias and the 95% Bland-Altman Limits of Agreement (LoA) between the AI and the consensus of experts is also provided for reference.

The primary endpoint and validation criterion is the difference between:

1) The mean of absolute differences between the EchoConfidence algorithm against each of the 6 expert readers, termed the EchoConfidence Mean Absolute Error (EchoConfidence MAE)
2) The mean of absolute differences (Expert mean absolute error - MAE) between each of each possible paring of the 6 expert readers (i.e. 15 pairs), termed the Expert Mean Absolute Error (Expert MAE).

For each of the measurement parameters this was be calculated for every case. The median and bootstrapped 95% confidence interval was calculated across all cases a measurement parameter. This median and its associated confidence interval will then be expressed as a percentage of the Expert MAE.

The criterion standard will be that the upper limit 95% limit on this difference is ≤ 25%, i.e. the upper 95% CI on the average difference between

the EchoConfidence algorithm and an expert reader is no greater than 25% larger than the average difference between two expert readers.

This estimand was calculated for every parameter under test. Each parameter will individually fail or pass.

Descriptive statistics of the distribution of values obtained by the EchoConfidence algorithm and expert readers will also be provided.

Measurement / parameter types

The following "types" of measurements are performed within EchoConfidence. Parameters that are directly measured (Direct Measurements), or are derived from multiple direct measurements (Derived Measurements) are validated individually against experts. Parameters that are calculated from a single direct or derived measurement and a non-echo measurement are calculated (Calculated Measurement) and pass validation if the underlying echocardiographic measurement passes validation. Similarly, indexed values pass validation if their underlying measurement passes validation.

Measurement/ parameter type	Comments	Validation method
Direct	Based on the annotations provided by an expert or AI. E.g. Length, area, volume	Validated by direct clinical evaluation and statistical assessment
Derived	Obtained by combining multiple direct measurements, or a non-linear transform (e.g. from peak velocity to pressure)	Validated by direct clinical evaluation and statistical assessment
Calculated	Obtained by a linear transform of a direct or indirect measurement by a constant for the patient. (e.g Cardiac output = Stroke volume x Heart rate)	Passes if the underlying direct or derived measurement passes
Indexed	Obtained by a linear transform of a direct or indirect measurement by a constant for the patient	Passes if the underlying direct or

	relating to their height, weight, or body surface area.	derived measurement passes

Abbreviations

CE: CE Validation dataset

BA: Bland-Altman

MAD: Mean absolute difference

SDD: Standard deviation of the difference.

LoA: 95% Limits of Agreement.

cm: centimetres

s: seconds.

ml: millilitre, equivalent to cm^3

mmHg: pressure, millimetres of mercury

WHEN SENDING - DELETE THIS PAGE AND SUBSTITUTE IN THE CONTENTS OF REPORT_A PDF