# European Association of Echocardiography recommendations for standardization of performance, digital storage and reporting of echocardiographic studies

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**Ultrasound machines should be equipped, as a minimum, with the following:**

- **broadband 2D imaging,**
- **M-mode imaging,**
- **spectral pulsed- and CW Doppler**
- **colour-flow imaging (or other forms of flow imaging)**

**as well as the capability of recording on CD, DVD or digital download via a network. Storage capability is mandatory for subsequent review and comparison of studies.**

**Table 1** Cardiac and vascular structures routinely evaluated as part of a complete adult echocardiographic report

| | |
|---|---|
| 1. | Left ventricle |
| 2. | Mitral valve |
| 3. | Left atrium |
| 4. | Aortic valve |
| 5. | Aorta |
| 6. | Right ventricle |
| 7. | Tricuspid valve |
| 8. | Right atrium |
| 9. | Pulmonary valve |
| 10. | Pulmonary artery |
| 11. | Pericardium |
| 12. | Inferior vena cava |
| 13. | Pulmonary veins |

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**Table 2** Minimal standard digital acquisition protocol for transthoracic echocardiography

| View | Data type |
|---|---|
| Parasternal long-axis view of the LV (2D + colour Doppler + M-mode)[a] | Loop |
| Parasternal short-axis view at aortic valve level (2D + colour Doppler + M-mode)[a] | Loop |
| Parasternal short-axis view at mitral valve level (2D)[a] | Loop |
| Parasternal short-axis view at mid-papillary level (2D) | Loop |
| Parasternal RV inflow-tract view (2D + colour Doppler)[a] | Loop |
| Parasternal RV outflow-tract view (2D + colour Doppler)[a] | Loop |
| Apical four-chamber view (2D + colour Doppler)[a] | Loop |
| Apical five-chamber view (2D + colour Doppler)[a] | Loop |
| Apical two-chamber view (2D + colour Doppler)[a] | Loop |
| Apical long-axis view (2D + colour Doppler)[a] | Loop |
| Subcostal four-chamber view (2D + colour Doppler)[a]-atrial septum | Loop |
| Subcostal-inferior vena cava collapse during inspiration or sniff (+M-mode) | Loop |
| Suprasternal long-axis view of the aortic arch (2D + colour Doppler)[a,b] | Loop |
| Transmitral velocities (PW Doppler) | Spectral Doppler (still frame) |
| LV outflow tract velocities (PW Doppler) | Spectral Doppler (still frame) |
| Transaortic/outflow tract velocities (CW Doppler) | Spectral Doppler (still frame) |
| Tricuspid regurgitant velocities (CW Doppler) | Spectral Doppler (still frame) |
| Transpulmonary velocities (PW Doppler) | Spectral Doppler (still frame) |
| Tissue Doppler on mitral annulus (septal, lateral velocities) | Spectral Doppler (still frame) |

[a]Doppler studies with colour-flow imaging may be performed at the end of the grey-scale (B-mode) imaging. M-mode optional in still frames and not necessary in both long- and short-axis views.

[b]In adults this projection may not always be required.

Abbreviations: LV, left ventricle; 2D, two-dimensional echocardiography; PW, pulsed-wave Doppler; CW, continuous-wave Doppler.

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**Table 3** Echocardiographic measurements at the echocardiographic report

| | Normal values by 2D or M-mode |
|---|---|
| LV dimensions: | |
| 2D or 3D volumes[a] | EDV: 35–75 mL/m$^2$ |
| | ESV: 12–30 mL/m$^2$ |
| M-mode diameters (end-diastolic–end-systolic) or 2D 'guided' | EDD: 22–32 mm/m$^2$ |
| | ESD: 14–21 mm/m$^2$ |
| Septum and posterior wall thickness | IVS: 6–10 mm |
| | PW: 6–10 mm |
| LV ejection fraction: volume-based quantitation advisable | >55% |
| LV regional wall motion abnormalities: from 1 (normal) to 4 (dyskinetic)[b] | |
| Left atrium: at least two orthogonal diameters, preferably volume[a] | 27–40 mm |
| | <29 mL/m$^2$ |
| Right ventricle: size (normal or dilated) | |
| Right ventricle systolic function: (normal, depressed: mild, moderate, severe) | |
| Right atrium: size (normal or dilated) | |
| Aortic root: maximum diameter at sinus level[c] | <39 mm |
| | <21 mm/m$^2$ |
| Inferior vena cava: diameters (inspiration–expiration) | <17 mm |
| Mitral valvular area planimetry[d] | |
| Comments: open-text field | |

[a]Preferably indexed.
[b]Using the 16 or 17 segment models.
[c]If abnormal or suspected pathology: sinotubular junction and ascending aorta.
[d]In mitral stenosis.
Normal values from ASE recommendations.[13]
Abbreviations as in *Table 2*.

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**Table 4** Doppler measurements at the echocardiographic report

| |
|---|
| LV diastolic function |
| Normal or three degrees of dysfunction[a] |
| Velocity: *E*-wave, *A*-wave[b] |
| Deceleration time |
| Tissue Doppler PW Doppler at mitral annulus: *e′*-wave velocity[c] |
| Valvular heart disease: evaluation of corresponding affected valve |
| Mitral valve |
| Mean gradient[d] |
| PHT mitral valve area[d] |
| Regurgitation: none, mild, moderate, severe or 0–4 degrees[f] |
| Aortic valve |
| Maximum velocity |
| Mean gradient[d] |
| Area (continuity equation: VTI at LVOT)[e] |
| Regurgitation: none, mild, moderate, severe or 0–4 degrees[f] |
| Tricuspid valve |
| Mean diastolic gradient[d] |
| Regurgitation: none, mild, moderate, severe or 0–4 degrees[f] |
| Maximum RV–RA systolic gradient for PA systolic pressure estimation[g]. |
| Pulmonary valve |
| Maximum velocity |
| Mean gradient[d] |
| Regurgitation: none, mild, moderate, severe or 0–4 degrees[f] |
| Comments: open-text field |

[a]1 to 3: impaired relaxation, pseudonormal, and restrictive.
[b]Respiratory changes evaluated when necessary.
[c]For LV filling pressure estimation using E/e′ ratio. If E/e′ ratio consistent with elevation of LV filling pressure, PA systolic pressure estimation is recommended.
[d]If stenosis suspected.
[e]Particularly in cases of stenosis with LV systolic dysfunction or whenever stroke volume abnormalities are suspected.
[f]Is right to present quantitative data (ERO, regurgitant volume, vena contracta, colour surface area, etc.) but a defined degree of severity should also be reported.
[g]For PA systolic pressure calculation, estimated RA pressure is added.
Abbreviations: PHT, pressure half-time; LVOT, left ventricle outflow tract; RV, right ventricle; RA, right atrium; PA, pulmonary artery.

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**Table 5** Basic structure of a report in echocardiography

1. Heading: general data
2. Findings: core of the report, data that support conclusions
   Quantitative and qualitative evaluation of cardiovascular structures employing different technical modalities
      (a) Echocardiography: M-mode, bidimensional (and 3D)
      (b) Doppler: colour, pulsed-wave (PW), continuous-wave (CW) and tissue Doppler
   Additional modalities
      (c) Transoesophageal echocardiography.
      (d) Stress echo.
      (e) Other modalities (approaches): 3D, Intravascular, etc.
   For better comprehension, each section should end with some short comments
3. Summary
   'Essence' of the report, written to be understood by any physician
4. Signature and date
   Person responsible and date of reporting and the name of anyone senior who has reviewed the study

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**Table 6** Variables at the heading section of an echocardiographic report

| |
|---|
| Registration in the system[a]: Patient ID, location and demographics |
| Name, clinical history number or another single identifier[a] |
| Gender |
| Date of birth[b] |
| Study date[b] |
| Indication of the study: main reason for ordering the test[c] |
| Location of the patient (outpatient, inpatient, service, cardiology, CCU, etc.) |
| Name of responsible consultant or physician requesting echo |
| Image quality |

[a]Identifier should be the same used for imaging storage.
[b]Age automatically calculated for each study date.
[c]Desirably suitable for encoding: chest pain, mitral stenosis, LV systolic function, etc., and might allow combination of codes, i.e: aortic dissection and pericardial effusion.

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• **Routine digital storage of echo data is recommended and other analogue media, such as videotapes, should be replaced as soon as possible.**

• **To ensure a reliable digital database, the following requirements should be met:**

- **A standard protocol enumerating standard views and other echo data to be routinely acquired and stored digitally.**
- **Compatibility of different echo machines with the network and a data management and storage system must be ensured.**
- **Ideally, the data management of the laboratory should interface with other digital data management systems in the hospital (e.g. via a Health Level 7 interface) to ensure that patient identity and examination dates are uniformly registered.**
- **Provision of sufficient memory space, precautions against data loss (i.e. data backup), periodic software and hardware servicing and protection of medical data against unauthorized use must be ensured.**

• Accredited physicians, or sonographers in some countries, are ultimately responsible for the performance and quality of all echocardiographic studies conducted under their supervision.

• The time allocated for a standard transthoracic study should be at least 30 min. An average routine echocardiographic study, including acquisition, routine echocardiographic study, including acquisition, interpretation and report, takes between 30 and 40 min.

• Every echocardiographic laboratory should periodically review the quality of studies performed as a whole and by individual examiners.