

# UK Biobank

## Imaging modality: Carotid Ultrasound

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Version 1.0

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This document details the procedure for the carotid ultrasound performed at an Imaging assessment centre for UK Biobank.

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## 1. Introduction

**1.1:** This manual details the procedure for the carotid ultrasound performed at a UK Biobank Imaging Assessment Centre.

**Table 1:** Sequence of assessment visit

	Visit station	Assessments undertaken
1	Reception	<ul style="list-style-type: none"> <li>Welcome &amp; registration</li> <li>Generating a USB key for Participants</li> </ul>
2	Eligibility Section	<ul style="list-style-type: none"> <li>Eligibility questionnaire</li> <li>Consent</li> </ul>
3	Imaging scans	<ul style="list-style-type: none"> <li>Cardiac MRI scan</li> <li>Body MRI scan</li> <li>Brain MRI scan</li> <li>DXA scan of whole body, bone and joint</li> <li>12-lead ECG</li> <li>Carotid ultrasound</li> </ul>
4	Touchscreen	<ul style="list-style-type: none"> <li>Touchscreen questionnaire</li> <li>Hearing Test</li> <li>Cognitive function tests</li> </ul>
5	Interview & blood pressure	<ul style="list-style-type: none"> <li>Interviewer questionnaire</li> <li>Blood pressure measurement</li> <li>Measurement of arterial stiffness</li> </ul>
6	Physical measurements	<ul style="list-style-type: none"> <li>Height (Standing and Sitting)</li> <li>Hip &amp; Waist measurement</li> <li>Weight and Bio-impedance measurement</li> <li>Hand-grip strength</li> <li>Ultrasound Bone Densitometry</li> <li>Spirometry (Lung function test)</li> </ul>
7	Sample collection & exit	<ul style="list-style-type: none"> <li>Blood, urine and saliva sample collection</li> </ul>

**1.2:** At the start of their visit, each participant is issued with a USB key at the Reception station. This contains Participant ID, name, date of birth and gender. As the participant

progresses between stations the USB key acts as an identifying token. The USB key is encrypted so it can only be read by assessment centre computers. None of the participant's test data is transferred to the USB key. At the end of the assessment visit all identifying data on the USB key is removed.

**1.3:** This procedure is performed by a radiographer who has received suitable training and has been granted the relevant module permissions.

## **2. Equipment**

Images are acquired using a CardioHealth Station (Panasonic Biomedical Sales Europe BV, Leicestershire, UK), which has a linear array transducer and a frequency of 5-13MHz. Automatic region of interest detection and automatic image freeze are enabled.

## **3. Participant Preparation**

An explanation of the physical positioning for the scan is explained prior to image acquisition. The participant lies with his or her head rotated at 45° to the horizontal, supported by a triangular pillow. The right side is imaged first, followed by the left side.

## **4. Carotid scan**

Initially a 2D scan is performed along the short-axis (transverse plane) from below the carotid bifurcation to below the jaw. The scan is saved as a cine loop. This process is repeated in the long-axis (longitudinal plane).

## **5. Carotid intima-media thickness scanning**

After the 2D scan, the carotid intima-media thickness (CIMT) is measured at two pre-defined angles for each carotid, giving a total of four CIMT measurements: right 150°, right 120°, left 210°, and left 240°. Automated position location provides a real-time measurement of the angle of acquisition to the sonographer.

The distal common carotid is scanned in the long-axis, and the flow divider between the external and internal carotid arteries located. The image is optimised and the CardioHealth Station software positions a marker at the flow divider with a 10mm CIMT Measurement Box overlaid on the common carotid. The far-wall of the common carotid is automatically tracked within the box and after a number of cardiac cycles, the image auto-freezes in end-diastole. A mean, maximum and minimum of the CIMT tracking is recorded for each carotid for each angle of acquisition. Additional images for the same angle of acquisition are recorded if the initial image is not deemed satisfactory – the CIMT measurements are taken from the last recorded image.

## **6. Download/transfer of data**

Numerical measures of CIMT, .jpegs of acquired images and report as well as time (cine) scans are transferred from the CardioHealth Station to UK Biobank servers.

## 7. Quality control (QC) protocol

Scans are performed according to standard operating procedures. Every operator undergoes a training programme and is required to complete a logbook of scans deemed to be of sufficient quality by both the UK Biobank Senior Radiographer and by external validation at the Oxford Cardiovascular Clinical Research Facility. Quality of scans is assessed against predefined criteria based on expected key features of the carotid image and automated IMT measurement. During a study visit every scan acquisition is assessed in real time by the operator for quality based on these predefined quality criteria. In addition, every scan is over read, as a batch, at regular intervals, by the senior radiographer to assess quality of IMT measure. A random selection of 10% of these scans, and any identified as of borderline quality by the radiographer, are then double checked by external validation at the Oxford Cardiovascular Clinical Research Facility. The full QC protocol was developed as part of the pilot study programme and was fully implemented from November 2014. For each angle of acquisition, a QC flag is generated, where 1 indicates the image passed QC and 2 indicated the image failed QC.

## 8. Data collected

The following automated measure datasets and associated QC flags are currently available in Showcase. Only those studies with a QC flag are included in Showcase at the present time. A full dataset, including studies without a QC flag, will be available in late 2015/early 2016:

- Maximum CIMT – Right 120
- Mean CIMT – Right 120
- Minimum CIMT – Right 120
- Maximum CIMT – Right 150
- Mean CIMT – Right 150
- Minimum CIMT – Right 150
- Maximum CIMT – Left 210
- Mean CIMT – Left 210
- Minimum CIMT – Left 210
- Maximum CIMT – Left 240
- Mean CIMT – Left 240
- Minimum CIMT – Left 240
- QC flag – Right 120
- QC flag – Right 150
- QC flag – Left 210
- QC flag – Left 240