

# CMR at the Center of Cardiac Care: Case Example Service Delivery at Barts Heart Centre – Advanced Imaging Department

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## Introduction: The Barts Heart Centre

Cardiac services for a catchment area approaching 1/3 of greater London, specifically, North Central London, North East London and West Essex, are being reconfigured with a new state-of-the-art cardiovascular hospital – the Barts Heart Centre (BHC). Work will begin with the merger of cardiac services from St Bartholomew's Hospital, The London Chest Hospital and The Heart Hospital to be centralised at Barts site from Spring 2015, whilst construction work to complete BHC is carried out.

The Barts Heart Centre will be fully open from Autumn 2016 with a large scale operation – 232 cardiac inpatient beds, 10 catheter labs (incl. 1x hybrid), 8 cardiac theatres, 40 outpatient rooms with three additional hospitals within Barts Health NHS Trust and other secondary care hospitals outside the Trust all feeding into BHC, serving a catchment area of around 5 million. In addition the service will provide supraregional services including congenital heart disease and national services for cardiomyopathy.

We believe that imaging has an important role to play in the cardiac pathways putting imaging at the heart of this exciting initiative. Here we describe the UK position of CMR, the proposed structure and format of the new imaging department and the role of cardiovascular magnetic resonance (CMR) within it.

## CMR in the UK

CMR in the UK is growing fast. There are more than 60 centres performing CMR. Growth has over the last 5-10 years been consistent at 10-15% a year. Some of this has been new imaging, but much has been disinvestment in other modalities (e.g. nuclear imaging for ischemia). CMR is seen as essential for many well known areas – congenital heart disease, cardiomyopathies, many systemic rarer disease, and acute situations (e.g. troponin elevation with non-obstructive coronary arteries or post cardiac arrest); but it is also a preferred field for many practitioners. In the UK National Health Service CMR is not reimbursed according to a 'fee per procedure' structure, which enables national services to be managed and coordinated to maximize care quality. This means that the tra-

ditional 'turf war' between radiology and cardiology is generally more benign than in other environments. There are some training issues however – too many cardiology trainees want to learn CMR, whereas too few radiologists do.

## The imaging context at the Barts Heart Centre

The scale of the new unit is large. Anticipated activity per annum on site is 20,000 echocardiograms (plus 8,000 in satellite hospitals), 9,000 CMR scans, 3,500 cardiac CT scans and 500 nuclear scans (plus 500 in satellite hospitals). Advanced cardiac imaging will operate a network of 8 dedicated cardiac MRI scanners with 3 dedicated cardiac MRI scanners on site, and a further 5 operational in allied hospitals/services within a year (one additional research/private scanner planned, 2 dedicated cardiac scanners at Great Ormond Street, one new cardiac scanner at Royal Free Hospital and the existing scanner at The Heart Hospital continuing until 2018. Strategically the aim is that cardiac MRI functions within a multi-modality framework where the individual modalities work hand in hand – not just to share the clinical burden, but to ensure that patients are

investigated using the optimal technique to answer the clinical question cost-effectively, and to facilitate training and research opportunities. There will be a coherent operational model where the governance system is common across imaging, there will be common reporting rooms (echo, MRI and CT) – with distinctions being made between ‘quiet’ and ‘teaching’ reporting areas rather than modalities.

### CMR subspecialisation: New workflows

The main CMR department will have two 1.5T MAGNETOM Aera scanners and a 3T MAGNETOM Prisma. We chose Siemens because of the proven technical quality of their equipment, strong existing research relationships and their trajectory of investment and innovation in CMR. The first Aera and Prisma are currently operational. With 9,000 patients a year anticipated, we are aiming for CMR subspecialization: The 3T Prisma is anticipated to become almost exclusively a dedicated adenosine perfusion CMR platform, capitalizing on the high homogeneity and very high performance gradients. We aspire that perfusion scanning will be sufficiently robust on this magnet that the rest scan can be dropped, improving patient tolerability and workflow (we aim for two patients an hour instead of the standard 45 minute slots).

However, the narrow bore is not for all – the two MAGNETOM Aera scanners with 70 cm bores will take the larger or claustrophobic patients. Here there will also be further specialization – one of these magnets is going to be technician led as is standard, but the other will be mainly doctor run – our research fellows (currently >10) are all trained to run the CMR scanners and, at the Heart Hospital pass through 4 grades (observer, junior fellow, senior fellow, and level 3 supervisor – who are capable of running clinical lists at weekends without on-site consultant cover). This training is invaluable and generates a cohort of medics with PhDs capable of really leading and innovating in CMR – even if they never press the buttons themselves again. For reporting we have switched to a 3<sup>rd</sup> party server based viewing and reporting solution with



1 The new hospital sits behind the existing façade of the Barts square top (this is computer generated imagery from the architects) – a blend of the old and new.



2 The first 2 magnets – a Siemens 1.5T MAGNETOM Aera (2A – after a hard days work) and 3T MAGNETOM Prisma (2B) are up and running with the third arriving in around 6 months.



3 The atrium – which is hard to capture on just one view – serves as a focal point for the hospital.

25 floating licences. We will also be increasing the number of patients with implantable cardiac devices *in situ* that we scan – many local hospitals are unwilling to scan patients with even MR conditional devices and we have therefore found ourselves providing a regional service for this area.

### CMR research

Although there is a major service provision aspect, the BHC will have CMR clinical and research activity integrated. To this end, the Barts Cardiovascular Registry was set up to approach all our patients to consent

for clinical and image data use and sharing for research, audit and service improvement purposes with consent for the acquisition of additional sequences that may not yet be part of clinical service provision. Major research interests span the entire translational pathway: From rapid imaging and new sequence design to establish new imaging biomarkers to using imaging surrogate endpoints in clinical trials to better diagnosing, prognosticating and monitoring treatment in cardiomyopathy, heart failure and coronary artery disease to cost-effectiveness analyses of imaging strategies.

One particular focus is in the use of T1 mapping to identify abnormal myocardium. Major new insights have been gained in rare diseases – amyloid, Fabrys and myocardial iron overload, and rapid progress is being made in diffuse fibrosis in the more common diseases such as aortic stenosis and hypertrophic cardiomyopathy. These developments and a community approach (in part coordinated by the 'T1 mapping development group' led to an international consensus statement on T1 mapping and very rapid technical improvements leading to a commercial sequence 'MyoMaps' containing a suite of mapping sequences.

The magnets are available for use for researchers out of hours at cost – to maximize flexibility and value-for-money from precious research funds. We also work closely with academic physics and engineering groups to maximize the potential of the scanners, and are acting as a Corelab facility for multicenter trials. Our research has been successful over the last few years – more than 15 young investigator awards or shortlists at international meetings have been achieved by the fellows over the last five years in the now merging units. The 2015 SCMR meeting in Nice emphasises this synergy – three fellows are shortlisted for investigator awards, each with a different supervisor, all now coming together under one roof in one institution – a great platform to grow from.

### CMR teaching

Course fellows are an integral part of the unit. We limit the numbers to ~two per MR scanner and typically for three months so there is involvement – helping with 'first reads' and providing a fresh perspective. Any fees paid are cycled into the research program – particularly for funding fellow travel, education, small equipment items and bridging costs. Several more didactic courses exist e.g. a biannual stress perfusion course, and the course portfolio is expected to expand to multimodality. We also host the London CMR meeting, a quarterly meeting of approximately 80 CMR specialists who meet to share clinical and research ideas and information. We have been

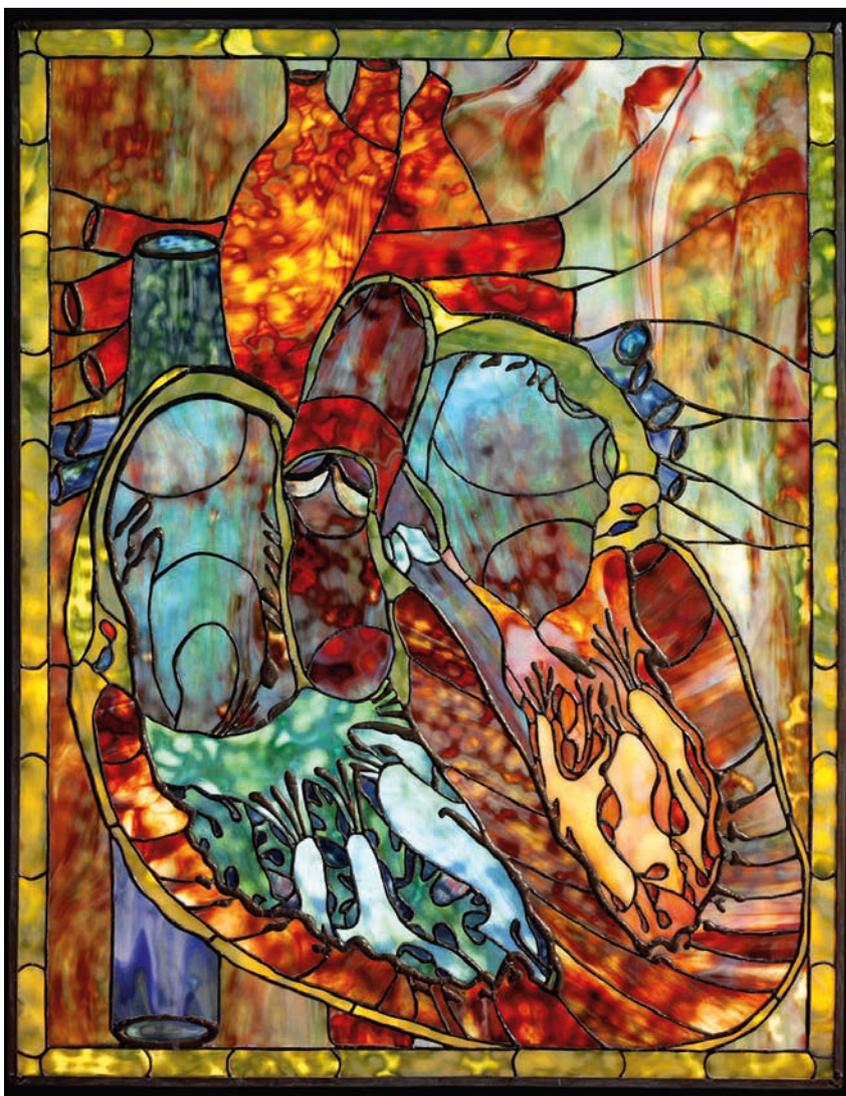
leading the European CMR certification and exam boards for the last few years.

### First impressions

The Cardiac Imaging unit has been open since 15 September 2014 with the other units due to decrease activity in Spring 2015, which means the service is currently working across multiple sites, increasing the capacity to remove waiting lists. Weekly staffing meetings are helping to define the culture and operating procedures, a process approached with the good will that is needed when the methods and cultures of three sites have to merge. We have not even started to touch the potential of the scanners – certainly much of our basics are being rewritten with new standards e.g. two cine slices per breath-hold typical, motion correction (MOCO) for perfusion always, PSIR for LGE always with T1 mapping on the majority and a future of new approaches such as potentially ceasing to breath-hold for the majority, dropping rest perfusion.

A visitor to the unit, Peter Kellman, MR physicist from NIH sums it up: “To see a new facility, a brand new hospital with CMR at the centre of cardiac care is very exciting. There is nothing niche about this high throughput environment. As a researcher in CMR, I feel proud of the efforts of the CMR community – their commitment, talent and resources is putting CMR to the forefront for decision making.”

We endorse Peter’s views. The future potential of the unit is hard to scope in detail – we look forward to delivering excellent care and the research aspects that go hand-in-hand – exploiting the gradient performance of the Prisma, a closer relationship with Industry to transition academic ideas and innovations into clinical practice and commercial products; and the use of new CMR endpoints for drug development and the at-scale use of CMR in bio-banking studies, such as UK Biobank. Certainly, the future potential of the unit as a trail-blazing unit is massive.



- 4 The reception of the unit will benefit from a new stained glass window being created and gifted by the artist Erica Rollings and her husband Robert Rollings, a CMR practitioner from Savannah, GA, USA. This is a coronal view example of her work.



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