STRATEGIC REVIEW OF CARDIAC PHYSIOLOGY SERVICES IN ENGLAND: FINAL REPORT

CONTENTS

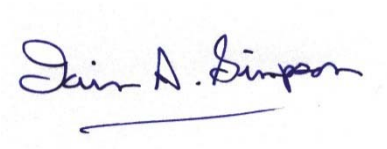
FOREWORD

In 2013, the Department of Health published the Cardiovascular Outcomes Strategy, a call to action to the health and care systems, which set out ten key actions to deliver for patients with cardiovascular disease improvements in their health outcomes.

Cardiac physiology services are key to delivering the improved treatment and care, which is the ambition of the Outcomes Strategy. This Strategic Review of Cardiac Physiology Services was set up to make recommendations to NHS England, Health Education England and across the health and care system about the innovations in service delivery, models of care and workforce configuration which are needed to transform patients' experience of cardiovascular disease care.

The Review has anticipated the vision for change outlined in NHS England's Five Year Forward View and presents recommendations which recognise the need to introduce new technologies, new systems for data management, to deliver services over seven days where there is a clinical imperative, and to pursue ongoing innovation.

We have been privileged to work with colleagues across the scientific and medical disciplines of cardiovascular care to develop these recommendations to transform the delivery of cardiac physiology services. We are grateful for their contribution to the Review, and the expertise they have brought to it.



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SUMMARY OF RECOMMENDATIONS

RECOMMENDATION 1

The Review recommends that to transform models of care the provision of cardiac physiology services is extended over 7 days. Trust Hospitals should implement this extension to service provision immediately to support emergency and urgent inpatient care and where the timeliness of care delivery is critical. These services will support:

- **interventions in patients with urgent acute coronary syndrome (ACS)**
- **the delivery of primary percutaneous coronary interventions (PCI)**
- **urgent permanent pacemaker implantation**
- **the interrogation of devices in patients requiring urgent care and deactivation where it is indicated, including for patients towards the end of life and after death**
- **urgent inpatient non-invasive diagnostic investigations including echocardiography investigations.**

In the longer term, consideration should be given to extending cardiac physiology services to support the delivery of elective care over 7 days to streamline services, shorten length of stay, support patient choice, and provide improved patient experience and outcomes.

RECOMMENDATION 2

The Review recommends that models of delivery for cardiac physiology services are redesigned to improve clinical quality, affordability, patient experience and sustainability. These new models recognise the need to give patients the best health outcomes by giving them the skills for appropriate self management of their cardiac conditions; providing services in the community closer to where patients live; and providing urgent and emergency treatment as soon as it is needed to return patients to health.

RECOMMENDATION 3

With the rapid development of information technology (IT) innovations, the Review recommends that NHS England strengthens the IT and telecommunications infrastructure available across healthcare providers to support web based, secure archiving which will allow for the transfer of electronic images and data with patients as they meet care providers along their clinical pathway. This will improve the quality of the information available to clinicians, reduce the duplication of investigations, and facilitate timely and accurate diagnosis and the provision of effective treatment and care.

RECOMMENDATION 4

Those technological innovations which are already available, and which have been shown to improve clinical outcomes and patients' experience of care, should be adopted at pace and scale. With the rapid development of technology and the need to promote adoption, the Review recommends that a 'horizon scanning' function is established for the rapid review of innovations, evaluation of their clinical benefit, and to make recommendations for their timely adoption across cardiac physiology services.

RECOMMENDATION 5

The Review recommends that all cardiac physiology investigations are delivered to defined and consistent quality standards (including the maintenance and calibration of equipment) and that these form a core component of the commissioning of services. These standards should be consistently and uniformly applied without variation by time, day or place of service provision. The Review recommends that NHS England establishes a partnership working group jointly chaired by the British Cardiovascular Society (BCS) and the Society for Cardiological Science and Technology (SCST) to agree a quality framework (including quality standards and key performance indicators) aligned to that of other medical disciplines.

RECOMMENDATION 6

The Review recommends that all cardiac physiology services should be accredited through the Improving Quality in Physiological Services programme (IQIPS) to demonstrate that the service they provide meets these defined quality standards. The Review recommends that all services are registered with IQIPS and are working towards accreditation by the end of 2015, and have achieved accreditation by 2017. The only exception will be services which only provide 12 lead ECG recording, which should be able to demonstrate appropriate quality standards for recording.

RECOMMENDATION 7

The Review recommends that urgent action is taken to address the considerable shortfall in the current cardiac physiology workforce at all levels across the career framework. The current workforce is inadequate to meet current demand, with marked variations in access to cardiac physiology investigations and significant waiting lists in some areas; and, in addition, it will be inadequate to meet future demands if the proposed service changes and resulting efficiency gains outlined above are not implemented alongside an expansion in the workforce.

RECOMMENDATION 8

To offset the strategic workforce risks, NHS England and Health Education England (HEE) will need to:

- **ensure the service can implement the full efficiency-gain service model, including the primary care strategy;**
- **recruit and retain its cardiac physiology trainees, including controlling the current 20% attrition rate;**
- **ensure the current level of post-graduate training places is maintained to maximise the benefits of the expanded graduate training programme;**
- **determine the future role of the lead cardiac physiologist with medical colleagues, in the light of the review of post-graduate medical education and training, and expand the current level of higher training in cardiac physiology accordingly;**
- **work with NHS Trusts and NHS Employers to develop local staffing strategies to address the projected assistants' shortfall and their training needs.**

RECOMMENDATION 9
Developing the workforce to meet current demand is not enough; the expansion of the workforce should be informed by a functional analysis of the role requirements of delivering emerging and innovative models of cardiac physiology service delivery. The Review recommends that NHS England and Health Education England both extend the current roles of consultant cardiac scientists into advanced practice and also promote the Modernising Scientific Careers (MSC) education and training models (Higher Specialist Scientist Training (HSST) and Accredited Specialist Scientific Expertise (ASSE) programme) as a standardised accredited training route to facilitate the development of this expertise in a planned way.

RECOMMENDATION 10
The Review recommends that Health Education England and Local Education and Training Boards (LETBs) understand the volume of uplift needed in the Scientist Training Programme (STP) and HSST programme to meet the demand for an increased highly skilled workforce. Both HEE and LETBs should make a case for additional funding for training places, and privilege the funding of both STP and HSST programmes for cardiac physiologists, to both fill current workforce gaps and meet workforce needs for the future.

RECOMMENDATION 11
IQIPS accreditation should form the basis of commissioning of cardiac physiology services. To further support commissioners, the Review recommends a re-evaluation of the current data sets for cardiac physiology investigations, and also of data collection mechanisms, to ensure commissioning processes are supported by accurate data on activity and demand, and also by robust coding.

RECOMMENDATION 12
To further support workforce investment planning, the Review recommends that the workforce model and modelling parameters, which have been developed to support this Review, are refined and updated in the next workforce planning round in the light of further evidence arising from the adoption of these recommendations and the workforce research that is in train under the aegis of Kings College, London.

BACKGROUND

1. Much progress has been made in the provision of good cardiac care in recent years. This has helped to reduce population morbidity and mortality rates. In particular, success in primary and secondary care prevention programmes have led to a slight fall in the future incidence of cardiac disease. The Review seeks to build on this success.

2. Cardiac physiology services are predominantly located in secondary care provider organisations as part of the clinical speciality of cardiology, and provide both invasive and non invasive diagnostic and therapeutic procedures (see Appendix 1). The provision of cardiac physiology services is a key factor in the delivery of care pathways across primary and secondary care sectors including critical care, transplantation and surgery. Great improvements have been made in reducing waiting times at the same time as delivering services to meet increased demand. However, against a backdrop of continual increasing demand, this is only sustainable for a relatively short time.

3. Currently, limited services are provided in primary care and more could be delivered locally to support earlier assessment and intervention. Secondary care services could be developed further to support, for example, a 7 day service. The commissioning of these cardiac physiology services is complex and includes both specialist commissioning elements as well as top slicing from block contracts and locally agreed arrangements. The introduction of service accreditation in the form of the Improving Quality in Physiological Services programme (IQIPS) has provided a greater focus on the critical aspects of quality in cardiac physiology services. However, ensuring the widespread adoption of IQIPS will be important in maintaining quality, and further consideration of the broader aspects of quality assurance still needs to be explored.

4. Healthcare scientists, and specifically cardiac physiologists, make up a large part of the workforce delivering these services, working in conjunction with medical and specialist nursing staff for certain procedures. Recently, through the UK Modernising Scientific Careers (MSC) programme, new education and training programmes in cardiac science have been introduced at both entry and postgraduate level. A higher specialist scientific training programme similar to Speciality Registrar Grade (StR) level training, has been developed. This programme will support the introduction of new workforce roles that are synergistic to, and compliment those of cardiologists. These need to be coupled with a visionary and aspirational service delivery model.

5. All of these different elements, together with a focus for the NHS on improving outcomes and implementing the Outcomes Strategy for Cardiovascular Disease[6], provide a platform for a strategic review of services to make recommendations to ensure that fit for purpose and sustainable services are commissioned for the future, and that all levers and opportunities for service improvement are fully exploited.

PURPOSE OF THE REVIEW

6. The overall purpose of the Review is to inform NHS England and other parts of the new health system architecture (for example Health Education England) of how cardiac physiology services and their associated scientific workforce need to respond to the challenges of:
   - increased demand and prevalence of some conditions coupled with an ageing population
   - increase in demand for long term follow up of patients with corrected congenital heart defects
   - scientific and technological advances (for example supporting early intervention, improved implantable devices and telemedicine and remote monitoring)
   - delivering services 7 days a week and supporting both emergency and elective care
   - reducing inequalities in provision and access through new models of care and new commissioning models informed by clinical standards and guidelines
   - defining, measuring and assuring quality
   - new training programmes, roles and training infrastructure
   - the NHS England Outcomes Framework and the delivery of the associated indicators[14]
   - delivering the Outcomes Strategy for Cardiovascular Disease[6].

7. The Review has considered a number of areas including:
   - identifying technological advances and their impact on future care
   - investigating innovative models of service delivery
   - reviewing the quality assurance and the assessment of quality in cardiac physiology services to identify a robust quality framework.
   - identifying what workforce, and education and training support is needed for cardiac physiology services to meet their potential

WORKING ARRANGEMENTS AND GOVERNANCE

8. The governance and working arrangements for the Review are outlined in Appendix 2.

DELIVERING A SERVICE MODEL FOR THE FUTURE

9. RECOMMENDATION 1

The Review recommends that to transform models of care the provision of cardiac physiology services is extended over 7 days. Trust Hospitals should implement this extension to service provision immediately to support emergency and urgent inpatient care and where the timeliness of care delivery is critical. These services will support:

- **interventions in patients with urgent acute coronary syndrome (ACS)**
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In the longer term, consideration should be given to extending cardiac physiology services to support the delivery of elective care over 7 days to streamline services, shorten length of stay, support patient choice, and provide improved patient experience and outcomes.

10. The Review fully supports the implementation of 7 day working to improve health outcomes for patients, but recognises that the cardiac physiology workforce will need support to make the transition to this different way of working. It recommends that delivery planning processes actively learn from nursing and medical specialities for the delivery of 24/7 care. Cross system agreements which underpin the implementation of a 7 day service will help to manage any employment disruption, and also facilitate cross site cover for the delivery of some services. Planning processes should give clear and evidence based justifications for introducing changes to models of service delivery, and these changes should be implemented within a timeframe which supports staff engagement, workforce recruitment and training and retention.

11. RECOMMENDATION 2

The Review recommends that models of delivery for cardiac physiology services are redesigned to improve clinical quality, affordability, patient experience and sustainability. These new models recognise the need to give patients the best health outcomes by giving them the skills for appropriate self management of their cardiac conditions; providing services in the community closer to where patients live; and providing urgent and emergency treatment as soon as it is needed to return patients to health.

12. Providing echocardiography services

The Review is aware that echocardiography services are currently provided outside traditional working hours but that this provision is often ad hoc and does not always meet an acceptable quality standard. For example, a number of Trusts provide weekend clinics for stress echo and transthoracic echocardiograms (TTE) with cardiac physiologists volunteering to deliver the service with enhanced pay arrangements, while others offer a routine inpatient service at the weekend through arrangements with bank staff.

13. The Review considers that echocardiography services should provide TTE over 7 days to defined quality standards. It recognises that this will involve changes in the working patterns of echocardiographers which might include the implementation of shift work. It will also require a review of the workforce requirements across the whole of the local cardiology team, including cardiologists to action and review investigation results; clinic nurses and receptionists to manage the inpatient and outpatient environment; and porters to transport patients.

14. The Review identified a variety of models for providing clinically urgent echocardiography investigations. It recommends that safe and effective systems for providing emergency echocardiography are implemented which meet local needs and reflect local service configurations. Echocardiography investigations can be performed by cardiac physiologists or doctors from cardiology, intensive care or emergency specialities who have received appropriate training and hold relevant accreditation, or can demonstrate equivalence. A specialist image review service will be needed to support this service and could be provided across a population defined system with an appropriate information technology and telecommunications infrastructure. Services must be provided to an assured quality standard (British Society of Echocardiography (BSE) accredited or equivalent), wherever they are delivered, and supported by formal quality assurance arrangements.

15. The Review considers there is little demand for emergency or urgent transoesophageal echocardiography (TOE) because this diagnostic information can be provided by imaging modalities such as cardiac computerised scanning (CT) for aortic dissection and through the increasing expertise of anaesthetists for perioperative studies. However, although they are required infrequently, services should have safe and effective local arrangements for providing emergency TOE.

16. Providing non-complex pacemaker implantation services

Where pacemaker implantation is only available during traditional working hours, the Review considers that this both gives both a poorer service to patients and also increases workload, where a patient presenting out of hours is fitted with a temporary pacemaker before permanent implantation.

17. The Review recommends that patients who need a pacemaker implantation procedure should have access to a permanent pacemaker implantation service 7 days a week. A population defined model of service delivery should be considered to ensure efficiency and cost effectiveness. The development of this provision will require support from a cardiac catheter laboratory.

18. The consensus view across the Review is that complex pacemaker and implantable cardioverter defibrillator (ICD) implantation procedures are rarely performed as emergency or urgent treatments – patients will need to engage with their multi-professional care team in considerable discussion before these treatments are considered. However, the Review does acknowledge that some centres may want to provide services at the weekend to manage local demand.

19. Follow up services for patients with implanted cardiac devices are generally undertaken by highly skilled cardiac physiologists who review complex arrhythmias and device technology issues; provide clinical advice on cardiac rhythm management (CRM) therapies; and review drug therapies using data from the implanted device. For the best patient outcomes, the delivery of emergency and urgent CRM follow up requires a CRM device specialist to be on call for device related emergencies, to analyse and re-programme devices, and to advise medical staff.

20. The Review recommends that follow up services for patients with pacemakers and ICDs are provided over 7 days. The effective and sustainable delivery of these services will need a population based solution where service delivery is actively managed over a networked system footprint.

21. Achieving the best health outcomes for patients with implanted cardiac devices requires the expertise of highly skilled cardiac physiologists. Currently, there is a small number of staff operating at an extremely high level in this field. Until the introduction of the MSC programme, there had been no standardised accredited training route for the development of this expertise. The MSC HSST programme and ASSE modules now provide a route for standardised and accredited professional skill and competence development.

22. The Review recommends that workforce planning processes across the whole system consider how these new training programmes can support innovative role development. Consultant cardiac scientists with highly specialist knowledge and skills in cardiac rhythm management techniques are key members of the CRM follow up team: they arrange appropriate diagnostic investigations; make onward referrals; and provide advice and guidance to both patients and clinical colleagues. These roles could be provided across a population defined system footprint to support the provision of safe and effective care, and to improve patient outcomes.

> ***Case study***
>
> *Helder Pereira, Principal Clinical Cardiac Physiologist at King's College Hospital London, leads a team of scientific and physiology staff providing specialist services to patients who are being treated with cardiac devices (pacemakers and implantable cardioverter defibrillators (ICDs) and Heart Failure Resynchronisation Devices (CRT). Patients attend clinics in Helder's department to have their device function and therapies optimised, abnormal rhythms assessed, and advice is also given to the Arrhythmia and Heart Failure Teams of any clinical or physiological changes. Helder's wealth of expertise in this niche specialism enables him to provide advice and guidance directly to the patient and, if necessary, to their consultant cardiologist. If further investigations are required, Helder has the authority to arrange these, providing a smooth journey for the patient and avoiding the need for onward referral to other specialists. Advances in technology mean that many patients no longer have to attend the hospital department for every visit as their devices are checked whilst they are at home using internet based technology. Helder's team can often identify potential issues long before they might affect a patient and Helder is able to take decisive action to minimise the chance of significant problems occurring. Whilst Helder's role is not unique, until recently there has been no clear route for scientific staff to follow to arrive at such a position of responsibility. The recent changes to the training of healthcare scientists provide the basis for developing staff to consultant scientist roles in a standardised and timely manner.*

23. Providing cardiac electrophysiology investigations and ablation treatments

Cardiac electrophysiology is a specialist area of cardiac physiology service provision and the service is traditionally provided in specialist centres, although some procedures are delivered in secondary care units. The need for emergency and urgent access to electrophysiology services is rare but requires a specialist scientific workforce to deliver it.

24. Cardiac electrophysiology investigations and ablation treatments are both diagnostic and therapeutic procedures. They are carried out by a consultant electrophysiologist in a cardiac catheter laboratory setting, supported by a specialist cardiac physiologist workforce with knowledge and skills in the theory and practice of electrophysiological techniques.

25. The Review recommends that safe and effective local arrangements are in place for the provision of an emergency and urgent cardiac electrophysiology service when it is required.

26. Catheter laboratory: diagnostic and percutaneous coronary intervention (PCI)
Primary PCI is already available 24/7 in designated 'heart attack centres' and graduate qualified cardiac physiologists are members of the team providing this service.

27. A 7 day catheter laboratory service requires a multi-professional team with full back up support which will include day case recovery areas and inpatient bed facilities.

28. The Review recommends that each locality reviews its need for a 7 day catheter laboratory service. This review should determine local requirements for elective, unstable and emergency treatments which will both inform local workload planning and also the design of weekend catheter laboratory schedules.

29. Delivering cardiac physiology services in community settings
The Review has particularly considered how services can be provided in community settings to increase accessibility for patients and improve health outcomes. As an example, echocardiography is often performed alongside other non-invasive diagnostic investigations such as electrocardiogram (ECG) or ambulatory monitoring. The Review recommends these tests are performed together where they are needed and at one community site where possible, to avoid multiple appointments and extra travelling for patients.

30. It considers that the development of any community based service providing cardiac physiology investigations should reflect local need and local service configuration, and demonstrate benefits for patients. The community based service should have readily available access to a support network providing clinical and technical expertise for test interpretation and review, and also to a web based image archiving service which allows images to be viewed with the patient – wherever they are.

31. The adoption of technological innovations, such as handheld echocardiography machines offers opportunities to introduce innovative community based models of service delivery, where echo investigations are carried out in patient's homes, or via mobile services which travel to where demand is greatest[18].

32. Maintaining quality is key: community based echocardiography studies should only be performed by accredited echocardiographers, working to established minimum standards, in an environment accredited to the BSE/IQIPS service standards.

33. Community settings offer an attractive environment for providing follow up services for patients who have been fitted with cardiac rhythm management devices. Evaluations of these services suggest they achieve high levels of patient satisfaction. The Review suggests that if recommended by evaluation studies, these services are rolled out at pace and scale, through population defined networked systems of provision.

34. The Review considers that it is neither safe nor effective to provide community based services for electrophysiology assessment and ablation treatments; or for pacemaker and ICD implantation services.

35. The Review supports emerging community models for the provision of clinics for syncope and arrhythmia assessments led by specialist cardiac physiologists. The MSC education and training pathways (ASSE and HSST) can support the development of these innovative roles for cardiac physiologists. The Review recommends that consultant cardiac physiologists lead specialist clinics in community settings assessing cardiac rhythm abnormality; undertaking or arranging for appropriate diagnostic investigations; managing triage and onward referral through the appropriate clinical/multidisciplinary pathway; and providing advice and guidance to both patients and the multi-professional care team.

36. Delivering 12 lead ECG and ambulatory monitoring investigations

The Review separately considered the provision of 12 lead ECG and ambulatory monitoring services.

37. 12 lead ECG recording

The Review recognises that 12 lead ECG recording is a key part of the assessment of a patient's cardiovascular status, and after physical examination, is the investigation most commonly performed. It is a vital component in the emergency assessment of many patients and performed 24/7 in emergency and acute care settings. Access to elective 12 lead ECG recording in all healthcare settings should be extended beyond traditional working hours.
The 12 lead ECG recording is discussed by the Review as two distinct elements: trace acquisition and trace interpretation.

38. 12 lead ECG recording: trace acquisition

The Review recognises that only a very small proportion of the 12 lead ECG recordings currently performed in hospital or community settings, are performed by cardiac physiologists. 12 lead ECG recordings are made by members of the healthcare team with variable levels of both training and ongoing assessment. The Review considers that many of the 12 lead ECGs recordings in both secondary care and community care settings are of poor quality.
The Review recommends that the Society for Cardiological Science and Technology (SCST) training towards the Award in Practical Electrocardiography should be made available to all members of the workforce who record 12 lead ECGs. More information about the SCST award is given in Appendix 3. The Review also recommends that the equipment used to record 12 lead ECGs should comply with standard NHS procurement policy and meet the SCST quality standards[19].

39. 12 lead ECG recording: trace interpretation

The Review recommends that 12 lead ECG recordings are only interpreted by members of the healthcare team who can demonstrate their skills and competence in interpretation.
The Review considers that the quality of acquisition and interpretation of the 12 lead ECG traces should not be affected by the time of day or the clinical setting where the trace is recorded.

40. The Review particularly considered 12 lead ECG interpretation in community healthcare settings. The Review recognises that 12 lead ECG recordings should be provided to patients as close to home as is possible, but is concerned to achieve a balance between ready access and quality of trace acquisition and interpretation. It understands that the provision of 12 lead ECG recording is not part of the core Contract of General Practice and is not referenced in GMS or PMS contracts. The Review recommends that 12 lead ECG recording should be

commissioned from providers in community healthcare settings to promote ready access for patients requiring the investigation.

41. Commissioning contracts should explicitly reference standards of recording quality, interpretation skills, and referral pathways for clinical management. There should be collaboration across healthcare providers through a shared electronic portal to provide seamless patient care. Any GP requesting an ECG should have ready access to clinical support for ECG interpretation and to flag the significance of observed abnormalities.

42. The Review recommends that action is taken to improve and maintain the quality of 12 lead ECG recordings by:
    - All providers of recordings – whatever their healthcare setting – supporting initial training and revalidation processes.
    - Commissioners applying quality and safety performance indicators. These should be applied universally, irrespective of where the investigation is performed.

43. Ambulatory ECG recording

The Review recognises that most 24 hour ambulatory ECG recordings are currently made in secondary and tertiary healthcare settings and analysed by a cardiac physiologist. It is important to maintain quality control of reporting and the Review recommends that systems are in place to manage the quality of 24 hour ECG reporting. The Review considers it good practice for a sample of ambulatory ECG recordings to be cross read for consistency by another cardiac physiologist.

The Review also recognises that 24 hour ambulatory ECGs are being recorded in primary care settings with reporting undertaken by a range of clinicians. It is important that commissioning specifications explicitly reference the quality standards for interpretation and reporting, and these standards should be common across all service providers including independent sector providers.

Where ambulatory ECGs are requested directly from a GP, the GP or GP colleague should have specialist skills in ECG interpretation and the significance of ECG abnormalities. IT systems should enable the electronic transfer of images with the patient and across the care pathway to support this service.

44. Ambulatory Blood Pressure (BP) recording

The Review recommends that all 24 hour ambulatory BP recording equipment is regularly maintained and calibrated to the international standards defined by the British Hypertension Society or the American Association for the Advancement of Medical Instrumentation. IT systems should be in place to allow the sharing of recordings across care providers.

45. Strengthening the information technology and telecommunications infrastructure

RECOMMENDATION 3

With the rapid development of information technology (IT) innovations, the Review recommends that NHS England strengthens the IT and telecommunications infrastructure available across healthcare providers to support web based, secure archiving which will allow for the transfer of electronic images and data with patients as they meet care providers along their clinical pathway. This will improve the quality of the information available to clinicians, reduce the duplication of investigations, and facilitate timely and accurate diagnosis and the provision of effective treatment and care.

46. Cost effective secure web based imaging archiving is already available – though not widely adopted – within echocardiography services, to allow remote review of studies for second opinion support, or review by a clinician in another healthcare provider as the patient moves through a pathway. Currently, many NHS providers are constrained by local archiving arrangements which are not web based and which lead to investigations being repeated. The introduction of web based archiving technologies would improve patient care by facilitating a seamless pathway for information exchange across community and secondary care based echocardiography services. The Review recommends that this web based archiving technology is adopted at pace and scale.

47. Remote real time review of images will be available shortly. The Review recommends investing in IT infrastructure to allow real time remote imaging reporting, with associated workforce development opportunities where clinical experts can provide a remote supervision function.

48. The Review also recommends the introduction of intelligent scanning, where a 3D data set collected by experienced echocardiographers can be retrospectively analysed using techniques such as deformation or speckle analysis without increasing the time taken for the scan.

49. Electronically driven appointment systems with real time updating should be routinely introduced across healthcare providers showing all the appointment slots available across a locality (including walk in clinic capacity). Patients and their GPs could agree on the best slot taking into account clinical urgency, transport needs and patient preference.

50. Driving technological innovations into care delivery systems

RECOMMENDATION 4

Those technological innovations which are already available, and which have been shown to improve clinical outcomes and patients' experience of care should be adopted at pace and scale. With the rapid development of technology and the need to promote adoption, the Review recommends that a 'horizon scanning' function is established for the rapid review of innovations, evaluation of their clinical benefit, and to make recommendations for their timely adoption across cardiac physiology services.

51. In the future, handheld echocardiography machines may function as an 'electronic stethoscope' to provide an extension of the clinical examination at the bedside for cardiologists and to inform triage to more detailed echocardiography investigations where needed.

52. Laptop sized **echocardiography** machines are generally compatible with conventional echo archives and have technical capabilities very similar to a full sized machine. They give images of sufficient quality to perform first line scans to exclude pathology and to triage patients for full studies. Currently, they are mostly used by cardiologists and cardiac physiologists in secondary care settings to a standardised protocol. There is potential to use these portable machines in community healthcare settings and in patients' homes to provide a safe and effective doorstep diagnostic service which reduces admissions to secondary care providers, either in outpatient or inpatient facilities[18]. Domiciliary echocardiography services could link with telehealth monitoring programmes, community heart failure services, hospital at home

and virtual ward programmes. Providing care closer to home will be facilitated by the introduction of developing technology which will mean that a patient's electrocardiogram and other physiological parameters can be measured through a tiny recording device injected subcutaneously.

53. There are rapid technological developments in **cardiac rhythm management** which have extended the lives of patients and also increased the referral base for CRM device implantation. The Review suggests that developments in pacemaker technology will drive a radical change in the follow up of pacemakers over the next decade. Remote analysis of information over wireless networks means that patients no longer have to attend for follow up in a clinic setting. In addition, these innovative devices are suitable for fitting in community settings.

54. Activity in **electrophysiology** has increased, driven by new technologies providing high quality imaging of cardiac structure and function, coupled with advanced analysis of complex arrhythmias, to treat a range of rhythm disturbances. This complex equipment is managed by staff with highly specialised knowledge and skills. The Review recommends that national workforce planning processes recognise the need to develop highly specialist healthcare scientists to deliver these services.

55. The Review recommends that studies evaluating the effectiveness of **remote device follow up** are critically reviewed on publication, to facilitate the adoption of those new technologies which are effective. It recognises that significant amounts of data are captured through the remote monitoring of devices, and recommends that evidence based protocols are developed and appraised to identify which data markers will trigger patient follow up. The roll out of remote monitoring will need support from a workforce competent to deliver these functions. The Review considers that healthcare scientists have a skill set which matches these role requirements and suggests that the National School of Healthcare Science (NSHCS) works with education and training providers to ensure that remote monitoring techniques and data analysis are covered in curricula.

DELIVERING A CARDIAC PHYSIOLOGY SERVICE TO QUALITY STANDARDS

56. The Review proposes a framework for delivering cardiac physiology services to a quality standard which ensures patient safety and good outcomes for patients. This framework integrates the concepts of:
    - quality assurance – a prospective process to ensure that any investigation or treatment will be performed within acceptable quality limits
    - quality assessment – an examination of evidence to ensure the service and its staff are appropriately configured to deliver a high quality service
    - quality management, including using commissioning processes as a primary lever to promote quality.

57. RECOMMENDATION 5

The Review recommends that all cardiac physiology investigations are delivered to defined and consistent quality standards (including the maintenance and calibration of equipment) and that these form a core component of the commissioning of services. These standards should be consistently and uniformly applied without variation by time, day or place of

service provision. The Review recommends that NHS England establishes a partnership working group jointly chaired by the British Cardiovascular Society (BCS) and the Society for Cardiological Science and Technology (SCST) to agree a quality framework (including quality standards and key performance indicators) aligned to that of other medical disciplines.

58. The Review recognises the need to introduce a standardised quality framework across cardiac physiology services to assure patients, the public, commissioners and other stakeholders that services are provided to a measurable quality standard. The Review has agreed a number of examples of key performance indicators for quality and these are presented in Appendix 4.

59. The Francis report[8] into the failures of performance at Mid Staffordshire NHS Trust and the responses to the report[5,11] point to the importance of introducing and maintaining independent systems of quality management to protect patients and support healthcare professionals to deliver safe and effective care.

60. The recommendation to introduce a robust quality framework across cardiac physiology services is supported by evidence from service improvement in other clinical areas where these frameworks have been introduced, such as the Clinical Pathology Accreditation (CPA)[1,17] in pathology, the Joint Advisory Group (JAG) programme for GI endoscopy[10], and the Imaging Services Accreditation Scheme (ISAS)[20] accreditation programme introduced across radiology services. There is considerable evidence that the introduction of quality measures both improves clinical outcomes and reduces costs. The introduction of the World Health Organisation's (WHO) surgical checklists has demonstrated significant reductions in clinical complications[2]. Currently, a range of quality standards cover aspects of cardiac physiology service delivery. For example, quality standards developed by professional bodies are available for electrophysiology and echocardiography services. Appendix 5 outlines the current status of standards development across a range of cardiac physiology investigations.

61. Accreditation training for cardiac physiologists is available through professional bodies and referenced in the clinical standards guidelines published by British Society of Echocardiography (BSE), Society for Cardiological Science and Technology (SCST), British Cardiovascular Society (BCS) and British Heart Rhythm Society (BHRS) and outlined in Appendix 6.

62. The MSC programme now provides a route to qualification through a nationally agreed educational and workplace based training framework. However, because of the historical variation in entry routes, the older cardiac physiology workforce has a diverse and fragmented training and development profile. The Review is concerned that this could adversely affect patient safety and the standards of clinical care delivery, and recommends that employers of cardiac physiologists providing NHS services support them to join as members of voluntary registers such as that held by the Academy for Healthcare Science (AHCS). Membership of a voluntary register demonstrates to patients and the public that the clinicians treating them are meeting professionally defined standards for practice; helps healthcare organisations demonstrate their commitment to delivering safe and quality care to patients; and promotes professional pride across the cardiac physiology workforce.

63. All healthcare professionals must be appropriately trained and competent to deliver cardiac physiology investigations. They should also be appropriately registered: on the General Medical Council (GMC) registers if they are a doctor; the Nursing and Midwifery Council (NMC)

register for nurses and for cardiac physiology clinical scientists, the Health and Care Professions Council (HCPC) register through AHCS or an appropriate voluntary register.

64. Improving Quality in Physiological Services (IQIPS)

The Chief Scientific Officer has brought together professional bodies from across the eight physiological sciences specialisms to develop a quality framework to improve services, care and safety for patients undergoing physiological tests, examinations and procedures. The IQIPS programme has identified standards across four domains (patient experience; facilities, resources and workforce; safety; and clinical domains). These standards describe a good cardiac physiology service provider with the capability to ensure that all patients consistently receive high quality diagnostic and treatment services, delivered by competent staff working in safe environments. IQIPS is hosted by the Royal College of Physicians which both develops and maintains the IQIPS standards, and provides a development and support system for services applying for accreditation. This is supported by an online self assessment and improvement tool (IQIPS SAIT) as services prepare for accreditation. The formal third party assessment and accreditation against the IQIPS standards for the IQIPS accreditation programme is provided by the United Kingdom Accreditation Service (UKAS).

65. RECOMMENDATION 6

The Review recommends that all cardiac physiology services should be accredited through the Improving Quality in Physiological Services programme (IQIPS) to demonstrate that the service they provide meets these defined quality standards. The Review recommends that all services are registered with IQIPS and are working towards accreditation by the end of 2015, and have achieved accreditation by 2017. The only exception will be services which only provide 12 lead ECG recording, which should be able to demonstrate appropriate quality standards for recording.

DEVELOPING A CARDIAC PHYSIOLOGY WORKFORCE FOR THE FUTURE

66. Meeting workforce challenges

RECOMMENDATION 7

The Review recommends that urgent action is taken to address the considerable shortfall in the current cardiac physiology workforce at all levels across the career framework. The current workforce is inadequate to meet current demand, with marked variations in access to cardiac physiology investigations and significant waiting lists in some areas[16]; and, in addition, it will be inadequate to meet future demands if the proposed service changes and resulting efficiency gains outlined above are not implemented alongside an expansion in the workforce.

RECOMMENDATION 8

To offset the strategic workforce risks, NHS England and Health Education England will need to:

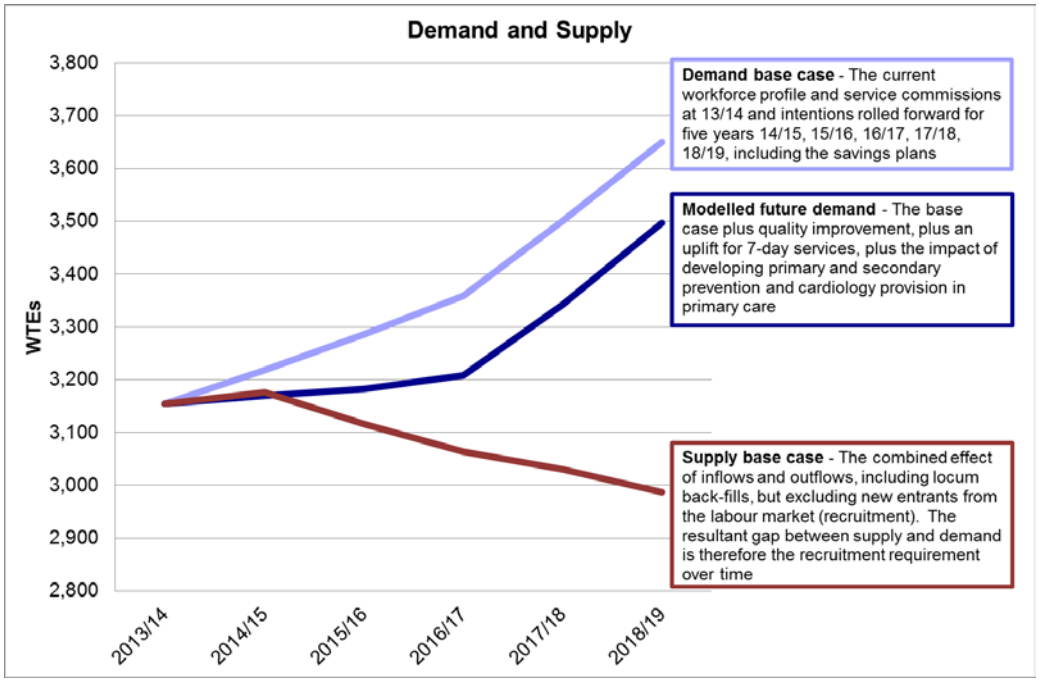
- **ensure the service can implement the full efficiency-gain service model, including the primary care strategy;**
- **recruit and retain its cardiac physiology trainees, including controlling the current 20% attrition rate;**
- **ensure the current level of post-graduate training places is maintained to maximise the benefits of the expanded graduate training programme;**

- **determine the future role of the lead cardiac physiologist with medical colleagues, in the light of the review of post-graduate medical education and training, and expand the current level of higher training in cardiac physiology accordingly;**
- **work with NHS Trusts and NHS Employers to develop local staffing strategies to address the projected assistants' shortfall and their training needs.**

67. The workforce model is set-out in the Technical Report in Appendix 7.

68. Data from the modelling summarised in Figure 1 below shows the workforce demand growing from 3,155 WTE to 3,650 WTE by 2018/19 (Demand base case in Figure 1). Workforce supply (without additional recruitment) will fall to 2,987 WTE, a projected gap of 663 WTE (Supply base case in Figure 1).

Figure 1: Summary workforce modelling



69. After implementing the 7-day services policy recommended by the Review, and after applying the quality improvement programme and assumed efficiency gains associated with the proposed transfer of much of the routine ECG work to primary care, the demand-side projection changes to 3,497 WTE by 2018/19 (Modelled future demand in Figure 1).

70. Workforce supply (without additional recruitment) is projected to fall to 2,987 WTE, giving, in this full efficiency-gain service model, a projected gap of 509 WTE. It is important to note that the current workforce includes locums, bank and agency staff. If there is action to reduce these staffing groups, then the projected workforce gap will expand. Please see the Technical Report at Appendix 7 for more details.

71. Sensitivity analysis shows that by expanding both the recruitment of cardiac physiology graduates and the post-graduate training scheme, and increasing the number of assistants, assistant practitioners and associates supporting these professional staff, and by implementing

the full efficiency-gain service model, we can achieve a workforce demand and supply-side balance within 5 years.

72. Growing and extending the cardiac physiology workforce

RECOMMENDATION 9

Developing the workforce to meet current demand is not enough; the expansion of the workforce should be informed by a functional analysis of the role requirements of delivering emerging and innovative models of cardiac physiology service delivery. The Review recommends that NHS England and Health Education England both extend the current roles of consultant cardiac scientists into advanced practice and also promote the Modernising Scientific Careers (MSC) education and training models (Higher Specialist Scientist Training (HSST) and Accredited Specialist Scientific Expertise (ASSE) programme) as a standardised accredited training route to facilitate the development of this expertise in a planned way.

73. In the absence of data concerning the future roles of the various medical grades in cardiology, cardiac physiology workforce modelling has assumed the current role definitions will not change over the next 5 years. Given the medical workforce reviews under the ægis of 'The Shape of Training' Report, this assumption may not hold. Therefore, as the medical workforce reviews progress in cardiology, there needs to be an impact assessment of any potential changes to medical staff's deployment on the cardiac physiology workforce, including the future roles of the support staff – assistants, assistant practitioners and associates.

74. Similarly, the full impact of technological developments on the above has not been assessed so this will need to be included in a functional analysis.

75. Cardiac physiologists deliver much of the basic training in diagnostic techniques for medical and nursing staff in training. There is evidence that this commitment has expanded in recent years but it has not been sized. This work will need to be recognised and expanded in the post-Francis future as medical and nursing staff will need to be accredited in this clinical domain.

76. Building a strong education and training infrastructure

RECOMMENDATION 10

The Review recommends that Health Education England and Local Education and Training Boards (LETBs) understand the volume of uplift needed in the Scientist Training Programme (STP) and HSST programme to meet the demand for an increased highly skilled workforce. Both HEE and LETBs should make a case for additional funding for training places, and privilege the funding of both STP and HSST programmes for cardiac physiologists, to both fill current workforce gaps and meet workforce needs for the future.

COMMISSIONING FOR QUALITY

77. All commissioning of services, at both a national and local level, should ensure that cardiac physiology investigations are delivered to a standard which supports high quality patient care, ensures value for money for the NHS, and reduces health inequalities. Commissioners should explore all levers to change clinical behaviour including financial levers[7].

78. Commissioning will reflect best practice outlined in the Outcomes Strategy for Cardiovascular Disease[6] and in the relevant National Institute for Health and Care Excellence (NICE) guidelines[12], and be a process for system improvement and not simply procurement. The Review recognises that because of the complexity of the clinical activity they commission, commissioners need simple guidelines for rapid service appraisal and to establish service quality. The Review suggests the adoption of the commissioning checklist given in Table 1.

Table 1 **Checklist: Commissioning for quality. A cardiac physiology service should:**
1. be accredited with IQIPS or working towards accreditation 2. provide a quality report to commissioners at least quarterly 3. support research and development as well as training 4. provide a service integrated across the care pathway with an underpinning IT infrastructure which allows information to flow freely around the care pathway 5. provide a 24/7 emergency and urgent services, and an extended hours service where this has been agreed.

79. RECOMMENDATION 11

IQIPS accreditation should form the basis of commissioning of cardiac physiology services. To further support commissioners, the Review recommends a re-evaluation of the current data sets for cardiac physiology investigations, and also of data collection mechanisms, to ensure commissioning processes are supported by accurate data on activity and demand, and also by robust coding.

80. The Review considers that the IQIPS accreditation framework provides a helpful tool for measuring and demonstrating that a cardiac physiology service is meeting quality standards of service delivery, and recommends that commissioners only commission services from providers who have achieved service accreditation through IQIPS[9]. IQIPS will be the quality measure for services at any point along a care pathway, and will be required for services commissioned locally or through specialist commissioning mechanisms. The only exception will be for services only providing 12 lead ECG recording – these services should be able to demonstrate appropriate quality standards for recording.

81. Commissioning services in primary and community care settings

Many cardiac physiology investigations are conducted in primary and community care settings. Some – such as 24 hour blood pressure monitoring – are part of existing care pathways and attract an enhanced service payment. Others – such as 12 lead ECG investigations – do not receive any specific reimbursement. The Review considers that the volume of cardiac physiology investigations performed in primary and community care settings will increase and new technologies such as the ultrasonic stethoscope will drive diagnostics investigations closer to patients. To assure the quality of these services and to reduce variation in their delivery, the Review recommends that a Primary and Community Care Commissioning framework is developed which uses IQIPS accreditation as its quality management tool.

82. RECOMMENDATION 12

To further support workforce investment planning, the Review recommends that NHS England utilises the workforce model and modelling parameters, which have been developed to support this Review. These should be refined and updated in the next workforce planning round in the light of further evidence arising from the adoption of these recommendations and the workforce research that is in train under the aegis of King's College, London.

83. The report of the workforce model's design and modelling parameters, and the data collection and research, to support the Review, are shown in Appendix 7. The workforce model has been built to reflect the recommendations above but as some data were not available, a number of service factors have been established based on the views of Review experts. While an Interim Workforce Risk Assessment Statement has been submitted to HEE's Investment Planning Process to flag early the concerns about this workforce, it will have to be buttressed with a more substantiated submission in 2015 when more data are available and when more is known about NHS England's intentions regarding the adoption of these recommendations.

84. To this end, the model has policy placeholders awaiting more data and the results of further research into the cardiac physiology workforce, which is in train under the aegis of King's College, London. The key modelling parameters to improve the Workforce Risk Assessment are given below.

    Revised estimates for Health Education England's 2015/16 planning round will need to take account of:

    i) the medical workforce review

    ii) the latest post-graduate training commissions, attrition and conversion rates

    iii) the service's progress in implementing the full efficiency gain service model

    iv) the settled view of experts concerning how NHS England's Emergency and Urgent Care Review and the priorities set out in the 5-Year Plan will affect the organisation and provision of cardiac care services

    v) the workforce research that is being conducted by King's College, London, concerning the workforce's views about their careers; students' career choices and influencing factors to stay in the profession; and service managers' views about the impact of developing specialist centres, and staff career development needs

    vi) Health Education England's review of the service's clinical placement capacity and the factors that might limit its expansion in this clinical domain

    vii) the new government's priorities for developing cardiology services in primary care, 7-day services provision, and quality improvements.

Appendix 1

Cardiac Physiology Service Summary (indicative not exhaustive)

ECHOCARDIOGRAPHY

Standards: Guidance as set out by the British Society of Echocardiography Education Committee "Minimum dataset for adult Transthoracic echocardiography"
Recommended views for a standard adult Transthoracic echocardiography (www.bsecho.org)
Note: test times include reporting.

Test	Test Time				Function	Indication
	Procedure					
Echocardiograms TTE.	NI	D	OP/IP	D/E	To assess structure and function of the heart.	Heart failure, valve disease, congenital heart disease, cardiomyopathy, pericardial effusion, to detect the presence of thrombus, infective vegetations, tumours.
Echocardiograms Bubble Contrast.	I	D	OP/IP	D/E	As above, but an injection of microbubble contrast is given intravenously.	ASD (atrial septal defect) or VSD (ventricular septal defect).
Echocardiograms Dobutamine Stress Echo.	I	D	OP/IP	F	Assessment after the heart has been put under stress (using an infusion of dobutamine).	To assess LV function, allows detailed studies of regional wall movement - coronary heart disease, myocardial viability.
Echocardiograms GUCH.	NI	D	OP/IP	D/E	Complex, specialist knowledge of the congenital cardiac conditions is needed.	
Echocardiograms TOE.	I	D	DC/IP	D/E	To assess the structure and function of the heart but where more detailed pictures are required or where images from TTE were not adequate.	Valve replacements, suspected blood clot or infection in the heart or where inadequate images have been obtained using the transthoracic approach.
Intraoperative TOE.	I	D	DC/IP	D/E	As above, but in theatre for monitoring during a surgical procedure.	Intraoperative monitoring e.g. to assess valvular incompetence following repair.

ELECTROPHYSIOLOGY

Test	Test Time				Function	Indication
	Procedure					
Electrophysiological Study (EPS).	I	D	DC/IP	G/I	To assess the electrical conduction system within the heart.	Abnormal heart rhythm or arrhythmia. Diagnosing Wolff Parkinson White Syndrome.
EPS + Ablation.	I	T	DC/IP	G/I	To destroy (ablate) abnormal electrical circuits / foci for the treatment of arrhythmias.	To treat the above.
EPS + Mapping +/- Ablation.	I	D/T	DC/IP	G/I	As above – but instead of using X-rays for positioning, electromagnetic mapping systems are used.	As above - normally used for AF ablation.
VT Stim.	I	T	DC/IP	G/I	To induce and attempt to terminate Ventricular Tachycardia.	Life threatening arrhythmias (VT). As a guide to treatment with an AICD.

Key:

Procedure - NI: Non-invasive; I: Invasive; D: Diagnostic; T: Therapeutic; OP: Outpatient, DV: Domiciliary Visit; IP: Inpatient
Test Time - A: 10 mins; B: 15-30 mins; D: 30-45 mins; E: 45-60 mins; F: 1-1.5 hrs; G: 1.5-3 hrs; H: 3-4 hrs; I: >4 hrs (Average times only. Complex cases may take longer)

ECG & BLOOD PRESSURE RECORDING AND MONITORING

Standards:

[1]The Society for Cardiological Science and Technology; Clinical Guidelines by Consensus, Number 1 Recording A Standard 12-Lead Electrocardiogram, July 2010.
[2] Guidelines for Ambulatory Electrocardiography (Circulation 1999: 100: 886-893).
[3]The Use and Interpretation of Ambulatory Blood Pressure Monitoring: Recommendations of the British Hypertension Society BMJ 2000;320;1128-1134.
[4]Practice Guidelines of the European Society of Hypertension for Clinic Ambulatory and Self Blood Pressure Measurement. Journal of Hypertension 2005, 23:697–701.
[5] Hypertension: clinical management of primary hypertension in adults. NICE Clinical Guidelines 127. August 2011
[6] The Society for Cardiological Science and Technology; Clinical Guidelines by Consensus: Recommendations for Clinical Exercise Tolerance Testing, March 2008

Test	Procedure			Test Time	Function	Indication
Electrocardiograms: Standard and 12 lead ECGs[1].	NI	D	OP/IP	B	To record the rhythm and electrical activity of the heart.	Suspected heart disease/heart condition. Widespread screening investigation. Pre operative assessment.
Ambulatory ECG monitoring: Application (Holter monitoring)[2].	NI	D	OP/IP	B	To monitor the ECG over an extended period, normally 24 hours.	When an ECG does not show the arrhythmia and it is still suspected to be the cause of symptoms.
Ambulatory ECG Monitoring: Analysis.	NI	D	OP/IP	D/E	To analyse and report the 24 hour recording.	
Patient activated ECG monitoring/event recorder: Application.	NI	D	OP/IP	B	To monitor over a longer period to try and detect infrequent rhythm events.	When symptoms are infrequent and have not been detected by ambulatory ECG monitoring.
Patient activated ECG monitoring: Analysis.	NI	D	OP/IP	C/D	To analyse and report the 24 hour recording.	
Ambulatory BP. Monitoring: Application[3,4.]	NI	D	OP/IP	C	To monitor the BP over an extended period, normally 24 hours.	To assess if the patient has true hypertension/monitor of treatment.
Ambulatory BP. Monitoring: Analysis[3,4,5.]	NI	D	OP/IP	B	As Ambulatory ECG monitoring analysis.	
Exercise tolerance testing[6.]	NI	D	OP/IP	D/E	To make a graphical recording of the heart's rhythm and electrical activity during exertion.	Assessment of chest pain during exercise. Measure outcome of treatment. Arrhythmias/cardiomyopathy.
Metabolic exercise testing (or Cardio-respiratory Exercise Testing).	NI	D	OP/IP	D/E	To measure maximum O2 uptake whilst monitoring ECG, blood pressure and respiratory gases.	Assessment of heart failure for cardiac transplantation.
Tilt testing and Autonomic Function.	NI	D	OP/IP	D/E	To induce the symptoms of syncope while ECG, heart rate and BP are monitored.	Syncope/falls.
Stress thallium/radionucleide scans. (Also relevant under Catheter Lab/ Other Imaging Procedures)	I	D	OP/IP	D/E	To assess heart function and myocardial perfusion during exertion, but where more detailed information is required.	Assessment of ischaemic heart disease.
Pharmacological challenge.	I	D	OP	D/E	To record ECG changes with drug challenge.	To assess arrhythmias/conduction pathways.

Key:

Procedure - NI: Non-invasive; I: Invasive; D: Diagnostic; T: Therapeutic; OP: Outpatient, DV: Domiciliary Visit; IP: Inpatient
Test Time - A: 10 mins; B: 15-30 mins; D: 30-45 mins; E: 45-60 mins; F: 1-1.5 hrs; G: 1.5-3 hrs; H: 3-4 hrs; I: >4 hrs (Average times only. Complex cases may take longer)

CATHETER LABORATORY/OTHER IMAGING PRODEDURES

Standards

[1.] Guidelines produced by the British Cardiovascular Intervention society and the British Cardiac Society Percutaneous coronary intervention: recommendations for good practice and training) *Heart* 2005 (www.bcis.org.uk).

[2.] Guidelines for follow up of implantable cardiac devices for cardiac rhythm management. Heart Rhythm UK and The Society for Cardiological Science and Technology, October 2008

Test	Procedure			Test Time	Function	Indication
Implantable Devices:						
Implantable devices: Pacemaker, Bi-ventricular pacemaker.	I	T	IP/DC	F/G	To restore electrical activity and hence improve pumping action of heart.	Syncope. Bradycardias and complete heart block etc.
Implantable devices: Defibrillator.	I	T	IP/DC	F/G	To terminate life threatening arrhythmias.	Dangerous arrhythmias.
Implantable ECG recorder.	I	D	IP/DC	D/E	To record ECG over extended time period (>1 week).	To detect arrhythmia when symptoms occur very infrequently.
Pacemaker, Bi ventricular pacemaker: Follow-up.	NI	D/T	OP	D/E	To monitor pacemaker's function.	
Implantable Defibrillator: Follow-up.	NI	D	OP	D/E	To monitor defibrillator function.	
Implantable ECG recorder: Follow-up.	NI	D	OP	D/E	As above.	
Diagnostic Catheters:						
Cardiac Biopsy +/- Right Heart Catheters.	I	D	IP/DC	*	To obtain detailed information about the functioning of the heart and condition of the coronary arteries. Right heart catheter - to measure right heart / pulmonary pressures and the oxygen saturations of the blood.	Diagnosis of cardiomyopathies/monitoring for rejection post cardiac transplantation etc. Right heart catheter- Severity of congenital heart disease (e.g. Atrial septal defect ASD, ventricular septal defect VSD, and valvular heart disease, etc.).
Cardiac Catheterisation: Diagnostic.	I	D	IP/DC	D/E	To obtain detailed information about the functioning of the heart and condition of the coronary arteries.	Diagnosis and stratification of treatment for coronary artery disease. Diagnosis of structural heart disease.
Cardiac Catheterisation: GUCH/neonatal/paediatric/congenital	I	D	IP/DC	D/E	As above, but more complexity involved.	As above, but congenital heart disease.
Invasive Cardiac Output Measurement.	I	D	IP/DC	D/E	To measure the cardiac output - invasive method.	
Other Coronary Interventions:						
Coronary Angioplasty / Other Coronary Interventions - includes: - Balloon/Stent. - Atherectomy. - Flow wire. - Pressure wire. - Distal protection device. - IVUS. - Laser. - Alcohol mediated septal ablation^. - Thombectomy. - Brachytherapy.	I	 T T D D T D T T T T	IP/DC	D/E (F/G)	To widen / stent areas of coronary artery narrowing. (^ To reduce obstruction to left ventricular outflow.)	Treatment of coronary artery disease. (^ Treatment of hypertrophic obstructive cardiomyopathy.)

(cont.) CATHETER LAB/OTHER IMAGING PRODEDURES

Test	Procedure			Test Time	Function	Indication
Valvuloplasty - includes: - Mitral Balloon. - Tricuspid Balloon. - Pulmonary Balloon. - Aortic Balloon.	I	T	DC/IP	E/F/G	To widen valve using balloon valvuloplasty.	Treatment of valvular heart disease.
Great Vessel Intervention (Coarc/Recoarc Aortic Valve). Aortic Dilatation other than Coarc. Pulmonary Artery Dilatation. SVC / other large vein intervention. Carotid Intervention/Scanning. Balloon pericardiotomy.	I	T	DC/IP	E/F/G	To dilate areas of vascular narrowing.	Percutaneous treatment of cardiovascular (non valvular) lesions.
Closures: (ASD, VSD, PFO, PDA).	I	T	DC/IP	E/F/G	To close cardiovascular defects.	Treatment of cardiovascular defects.
Other Imaging:						
Cardiac Magnetic Resonance Imaging (MRI).	O	D	OP	D/E	To obtain additional information regarding anatomical/structural cardiac function.	

*Usually carried out during another diagnostic procedure.
Stress thallium/radionucleide scans (see ECG and Blood Pressure Recording and Monitoring, above) also relevant in this section.

Key:

Procedure - NI: Non-invasive; I: Invasive; D: Diagnostic; T: Therapeutic; OP: Outpatient, DV: Domiciliary Visit; IP: Inpatient
Test Time - A: 10 mins; B: 15-30 mins; D: 30-45 mins; E: 45-60 mins; F: 1-1.5 hrs; G: 1.5-3 hrs; H: 3-4 hrs; I: >4 hrs (Average times only. Complex cases may take longer)

Appendix 2

STRATEGIC REVIEW OF CARDIAC PHYSIOLOGY SERVICE IN ENGLAND: WORKING ARRANGEMENTS AND GOVERNANCE

An overarching Strategic Review Steering Group was established with the President of the British Cardiovascular Society in the Chair, supported by the Chair of the Society for Cardiological Science and Technology. The Strategic Review Steering Group met at least four times over the lifespan of the review to discuss and challenge the outputs from the three Review working groups detailed below and to ensure alignment with NHS England plans and priorities to improve outcomes.

Members of the Review were appointed to support its strategic focus with appropriate clinical and scientific expertise, with additional representation from provider and commissioning organisations and from lay and patient bodies.

The Review is accountable to the Chief Scientific Officer and the National Clinical Director for Cardiac Care for NHS England.

The Review was driven through three working groups which reported to the Strategic Review Steering Group. Each working group was co-chaired by a cardiac scientist and a cardiologist covering:

1. **Workforce**
   The working group established a roadmap of the current workforce and related issues. Through analytical modelling, it assessed the different types and number of workforce roles required to deliver service models, and the most appropriate training models to deliver this workforce.
2. **Service models**
   The working group explored the options for delivery based on projected demand and changes in prevalence of cardiac conditions, the drive for enhanced service delivery over 7 days and improved access in primary care and the impact of scientific and technological advances.
3. **Quality and commissioning**
   The working group systematically reviewed all aspects of quality including defining, measuring and assuring quality and identifying all the levers and opportunities within the current commissioning system and new service models to drive change.

The working groups met face to face three and four times, with electronic work conducted between these meetings. Membership of the working groups reflected the skills and expertise required for the work programme.

Appendix 3

SOCIETY FOR CARDIOLOGICAL SCIENCE AND TECHNOLOGY: AWARD IN PRACTICAL ELECTROCARDIOGRAPHY (APECG)

SCST has developed the Award in Practical Electrocardiography (APECG) to recognise competence in recording a 12 lead ECG. Achievement of the award rests on the successful completion of both a knowledge and a skill component; skills are assessed through observation of ECG recording technique. It is recommended that competence re-assessment is conducted every three years.

A package of training which support APECG was developed by the North of England Cardiovascular network, and has been delivered by cardiac physiologists in Durham, Newcastle and Leeds to 80 staff in primary care.

Training in 12 lead ECG recording should be delivered by suitably qualified staff holding for example, BSc Clinical Physiology (Cardiology) or SCST Diploma in Electrocardiography. Organisations providing training can include secondary care cardiac physiology services, charitable organisations or independent education providers.

To support the roll out of APECG, SCST holds a register of approved APECG assessors and can offer training to those wishing to join the register.

Appendix 4

PROPOSED KEY PERFORMANCE INDICATORS

1. All individuals or departments should be appropriately accredited and registered across the range of services they provide.
2. All departments undertaking cardiac physiology investigations or treatments for which a recognised national database is available, should ensure accurate data is available to allow timely submission.
3. Each provider should have designated member of staff responsible for ensuring adherence to quality standards
4. All health care professionals undertaking cardiac physiology investigations or treatments should be registered on the appropriate statutory or voluntary register.
5. Those healthcare professionals undertaking cardiac physiology investigations should be suitably accredited (where available) for the activities they undertake.
6. Those conducting and interpreting ECGs only should have undertaken training to the SCST curriculum level and be SCST certified for recording and interpretation, or equivalent. This should be current and subject to periodic recertification.
7. Each provider should have a process in place to ensure staff providing cardiac physiology investigations and treatments are suitably accredited and registered, and this should form part of the annual appraisal.
8. Locum agencies should be required to verify the accreditation and registration of staff they offer for temporary positions.
9. No member of staff should undertake out of hours investigations for which they have not been accredited, or deemed fully competent by the provider.
10. All providers undertaking cardiac physiology investigations or treatments should aim to become accredited by IQIPS by 2017.
11. Single specialist accreditation (such as BSE accreditation) may be appropriate alternatives.
12. ECG only services should ensure all healthcare professionals hold current certification in the recording of the resting 12 lead ECG if they perform this investigation, and there must be access to medical professionals with certified ECG interpretation accreditation to support interpretation. All equipment should be in good working order with a regular service contract. Appropriate policies for patient experience dignity and safety should be in place.
13. All health care providers should accept responsibility for the quality and safety of the services they provide and this should be supported by well-developed clinical governance processes.
14. All providers undertaking cardiac physiology investigations or treatments should be able to transfer data in the form of a report, a PDF image or for imaging files an AVI quality access to images.
15. Providers should be aiming within 3 years to develop systems to allow the transfer of primary data (such as imaging DICOM files) to support the patient pathway.
16. The data protection act should be adhered to in all cases.
17. All providers should demonstrate compliance with the Data Protection Act.

Appendix 5

CURRENT STATUS OF STANDARD DEVELOPMENT ACROSS A RANGE OF CARDIAC PHYSIOLOGY INVESTIGATIONS

Resting 12 lead electrocardiography

1. Resting 12 lead Electrocardiography is the most frequently performed cardiac physiological investigation and one which is commonly provided in both primary and secondary care settings. The variation in accuracy of both recording and interpretation are marked[15].
2. All staff undertaking ECG examinations should be able to demonstrate current competence. As the recording and interpretation of the resting ECG crosses many professional boundaries, and the opportunities for systematic quality assurance are limited, a more universal approach is warranted. It is therefore proposed that the national standards for certification for the conduct and interpretation ECG examination should be developed around the existing SCST courses and examinations. Criteria for approval and quality assurance of training schemes need to be developed.
3. It is recognised that this represents a major departure from current practice and will require the appropriate infrastructure to deliver. It is therefore recommended that NHS England and SCST convene a working party of broad ranging relevant stakeholders to define the structure, assessment, delivery and quality assurance of the certification.

General cardiology investigations

1. While resting 12 lead ECG is a clear example of an investigation where standards and competence vary significantly because of the range of professionals undertaking it, (cardiac physiologists, cardiographers, doctors, nurses, health care assistants, etc.), other areas of cardiac physiology suffer from similar issues. This section covers the areas of general cardiac physiology, including exercise ECG and ambulatory ECG and BP analysis. These are most frequently performed in the traditional hospital setting, but increasingly in alternative settings such as primary care.
2. Mechanisms to assess competence are part of the traditional training for cardiac physiologists (SCST part II) and form part of the assessed exit competences from the MSC programme for healthcare practitioners. There is no specific measure of continuing competence.
3. At present, no formal training or assessment programme for other health care professionals (such as nurses or doctors) exists. It is therefore recommended that a process to ensure the competence and continuing competence of all staff undertaking these investigations is developed in collaboration with SCST.
4. The departmental standards for undertaking these investigations are covered by the IQIPS programme.
5. There are no formal standards for quality assurance in these investigations and these should be generated locally and contribute to the departmental quality assurance programme.

Echocardiography

1. Accreditation for individuals, including reaccreditation which demonstrates an ongoing commitment to scanning and the attendance at an agreed level of education, is well established in echocardiography. Both the British Society of Echocardiography and the European Association of Echocardiography offer accreditation processes, and these are the best ways in which staff can demonstrate appropriate training and continuing education.

2. At a departmental level, both the British Society of Echocardiography and IQIPS share a common set of standards against which departments can be accredited. Over time the IQIPS programme should remove the need for single subspecialty accreditation in echocardiography.
3. There is a general understanding of the required processes for quality assurance in echocardiography. These include departmental meetings, where cases can be discussed, systematic second reporting of a proportion of the departmental output, benchmarking exercises around agreed standards, internal and external auditing of results and quality specific leadership[13].
4. The BSE has developed an external quality assurance model at the level of the independent sonographer. This benchmarking exercise involves each sonographer in an accredited department being asked standard questions based on a typical video clip, twice per year. The results are scored on a RAG scale and are fed back to the local quality assurance lead. This system is nationally scalable[3].
5. The recent availability small handheld ultrasonic devices, able to image the heart, provide a powerful tool to aid clinical diagnosis. The role of these devices in clinical practice is yet to be fully identified. Clear guidelines for the safe use of this technology and appropriate credentials should be established with the British Society of Echocardiography.

Cardiac rhythm management and cardiac electrophysiology

1. Accreditation for individuals, including reaccreditation is well established by the British Heart Rhythm Society (BHRS), the European Heart Rhythm Association (EHRA) and the International Board of Heart Rhythm Examiners (IBHRE). There is variation in the means of accreditation. BHRS and EHRA combine an examination with a logbook that demonstrates application of knowledge to clinical application whereas IBHRE is a standalone examination.
   These accreditation processes are available to all staff involved in CRM and EP including doctors, nurses, cardiac physiologists and staff working in the CRM and EP industry and are encouraged to promote quality.
2. At a departmental level, both the British Heart Rhythm Society and IQIPS share a common set of standards against which departments can be accredited.
3. Submission of device implant, device follow-up and EP procedure data into the NICOR national database is a vital component of all CRM and EP services.

Invasive cardiology

1. Academic and theoretical training in haemodynamics, as well as a suitable level of clinical experience in the field with clinical assessment has formed part of the previous cardiac physiology degrees and is contained within the MSC Practitioner Training Programme (PTP).
2. Cardiac Physiologists working within the CCL environment should be trained to this level and undergo regular CPD. The same standards of education and experience should apply in cardiac catheterisation labs where cardiac physiologists are not used.
3. At a departmental level, both the British Cardiovascular Intervention Society (BCIS) and IQIPS share a common set of standards against which departments can be accredited.
4. Submission of procedure and complication data into the BCIS national database is a vital component of all cardiac catheterisation services.

Appendix 6

Cardiac Physiology Services: current training, accreditation and standards

Physiological investigation	Individual accreditation available	Standards published by	Accreditation provided through
Resting 12 lead ECG recording	Award in Practical Electrocardiography Certificate of Electrocardiography SCST Part 1	SCST	SCST IQIPS Internal validation
Resting 12 lead ECG interpretation	Diploma in Electrocardiography SCST Part 1	SCST	SCST IQIPS Internal validation
Ambulatory BP	SCST Part 1 (post 2009) SCST Part 2 (pre 2009)	SCST	SCST IQIPS Internal validation
Ambulatory ECG application	SCST Part 1 (post 2009) SCST Part 2 (pre 2009)	SCST	SCST IQIPS Internal validation
Ambulatory ECG analysis	SCST Part 2	SCST	SCST IQIPS Internal validation
Tilt table testing	None presently	None presently	IQIPS Internal validation
Exercise ECG	SCST Part 2	SCST	SCST IQIPS Internal validation
Echocardiography	BSE EACVI	BSE EACVI	BSE IQIPS BSE Dept. accreditation EACVI Lab accreditation Internal validation
Cardiac rhythm management	BHRS IBHRE	British Heart Rhythm Society Heart Rhythm Society	BHRS IBHRE IQIPS NICOR Internal validation
Invasive and interventional cardiology	SCST Part 2	BCS BCIS	IQIPS BCIS peer review Internal validation
Cardiac electrophysiology	BHRS IBHRE	British Heart Rhythm Society Heart Rhythm Society	BHRS IBHRE IQIPS NICOR Internal validation

Appendix 7

To open the Workforce Model Technical Report, please click the file under attachments which should appear on either the left hand side or bottom of the screen. If you have any difficulty opening and accessing the technical report please contact Lynn Webb at lynn.webb@lesleyburnconsultancy.co.uk for a copy.

NATIONAL REVIEW OF
CARDIAC PHYSIOLOGY SERVICES

Modelling the Future Workforce

Outputs from the Workforce Model

Technical Report*

* Prepared by Stephen Voysey and Patricia Oakley @ 17.12.2014
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GLOSSARY

ACS	Acute Coronary Syndrome
AHCS	Academy for Healthcare Science
APECG	Award in Practical Electrocardiography
ASSE	Accredited Specialist Scientific Expertise
AVI	Audio/Video Interleave
BCIS	British Cardiovascular Intervention Society
BCS	British Cardiovascular Society
BHRS	British Heart Rhythm Society
BP	Blood Pressure
BSE	British Society of Echocardiography
CCL	Cardiac Catheterisation Laboratory
CPA	Clinical Pathology Accreditation
CPD	Continuing Professional Development
CRM	Cardiac Rhythm Management
CRT	Cardiac Resynchronisation Therapy
CT	Computerised Tomography
DICOM	Digital Imaging and Communications in Medicine
EACVI	European Association of Cardiovascular Imaging
ECG	Electrocardiogram
EHRA	European Heart Rhythm Association
EP	Electrophysiology
GI	Gastrointestinal
GMC	General Medical Council
GMS	General Medical Services
GP	General Practitioner
HCPC	Health and Care Professions Council
HEE	Health Education England
HSST	Higher Specialist Scientific Training
IBHRE	International Board of Heart Rhythm Examiners
ICD	Implantable Cardioverter Defibrillator
IQIPS	Improving Quality in Physiological Services programme
ISAS	Imaging Services Accreditation Scheme
IT	Information Technology
JAG	Joint Advisory Group
LETBs	Local Education and Training Boards
MSC	Modernising Scientific Careers programme
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NICOR	National Institute for Cardiovascular Outcomes Research
NMC	Nursing and Midwifery Council
NSHCS	National School of Healthcare Science
PCI	Percutaneous Coronary Interventions
PMS	Personal Medical Services
PTP	Practitioner Training Programme
SAIT	Self Assessment and Improvement Tool
SCST	Society for Cardiological Science and Technology

SRSPS	Strategic Review of Cardiac Physiology Services
STP	Scientist Training Programme
StR	Speciality Registrar Grade
TOE	Transoesophageal Echocardiography
TTE	Transthoracic Echocardiograms
UKAS	United Kingdom Accreditation Service
WHO	World Health Organisation

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