Working Group Report on
Simulation Based Learning
August 2011
Contents

Working Group ........................................................................................................................................5
Foreword..................................................................................................................................................6
Executive Summary .................................................................................................................................7
1. Introduction ........................................................................................................................................10
2. Basic concepts ...................................................................................................................................12
   2.1 Terminology ..................................................................................................................................12
   2.2 Why might Simulation Based Learning provide added benefit? ...............................................12
   2.3 What are the potential roles for Simulation Based Learning? ...................................................12
   2.4 What are the current drivers for Simulation Based Learning in the National Health Service? .................................................................................................................................13
3. Current status of Simulation Based Learning ..................................................................................14
   3.1 Current technology and capability ...............................................................................................14
      3.1.1 Medicine and surgery ...........................................................................................................14
      3.1.2 Cardiology ...........................................................................................................................14
   3.2 Current provision of Simulation Based Learning ..........................................................................16
      3.2.1. SBL in Europe and the USA ...............................................................................................17
   3.3 Current evidence base for Simulation Based Learning .................................................................18
4. Projected roles for Simulation Based Learning in Cardiology .........................................................20
   4.1 Basic skill training .........................................................................................................................20
   4.2 Complex skill training ...................................................................................................................21
   4.3 Team training ................................................................................................................................23
   4.4 Procedural planning and rehearsals, including the introduction of new techniques ...............21
   4.5 Trainee selection ............................................................................................................................22
   4.6 Trainee assessments .......................................................................................................................22
   4.7 Revalidation for consultants .........................................................................................................23
5. Delivery of Simulation Based Learning ...........................................................................................24
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Foreword

Simulator based learning has long been a feature of the airline industry, embedded in their training programmes and an established part of ensuring passenger safety. In medicine, the use of simulators as an educational tool for skills based training has gained popularity over the past few years and has already become an established part of the British Cardiovascular Society Annual Conference. Recognising the potential importance of simulator based learning, especially in procedural based specialities such as cardiology, the British Cardiovascular Society has commissioned this working group report to inform both the current and strategic positioning of simulator based learning and to assess potential roles and options for the BCS in its future development for training and revalidation.

In a specialty where innovation has always been at the heart of both diagnosis and treatment and, in a culture were patient safety is paramount, there is enormous potential for simulator based learning to fundamentally change the way we are trained as specialists, as well as maintain and develop our skills as cardiologists.

I believe this report provides valuable insight into the potential for simulator based learning for all those involved in cardiology training and education both nationally and internationally. The important recommendations it contains should form the basis for further develop of this exciting area for the benefit of our trainees, cardiology teams and ultimately for our patients.

Iain A Simpson

BCS President Elect
Executive Summary

Simulators have the potential to enhance learning.
The essential benefits of Simulation Based Learning (SBL) are:

- Learning can take place without exposing patients to risk
- Learning can take place at the speed of the learner
- Immediate feedback is available to the learner
- Learning can be adapted to the learner in a completely flexible way

Simulators have the potential to take the early and dangerous part of the learning curve away from patients and to accelerate learning.

There are currently several particular drivers for SBL:

- Opportunities for trainees are challenged by the European Working Time Directive which often leads to disruptive rotas
- Certain core procedures are being performed less frequently, particularly in the tertiary centres. This is happening at a time of increasing pressure to objectively validate and re-validate skills and competency
- Patient safety has always been a priority but increasing public availability of patient outcome metrics and National Health Service Litigation Authority grading of Trusts have established even greater scrutiny.

While the many qualities of SBL make a strong case for its value there is currently a lack of cardiac specific evidence for the added value of SBL. Observational data and limited trial data in other medical and surgical specialties do however provide evidence of benefit and there are no obvious reasons to doubt the transferability of these studies. It is a key recommendation of this Working Group (WG) that the BCS supports studies to improve the evidence base for SBL within Cardiology.

Within Cardiology a wide range of general simulation equipment can be used for generic skills and improving team working particularly in critical or crisis situations and at present there is underutilisation of simulators to improve team performance. In general effective team skills training can be achieved without using the most sophisticated simulators with attendant cost savings. In addition SBL can be applied for more specific areas of Cardiology practice such as coronary intervention, electrophysiology and echocardiography.

Within the UK SBL is undertaken during foundation years in most Deaneries but provision for higher training is patchy. The BCS have had Simulators available at their Annual Conference and these have proved very popular.
In the USA SBL has been embraced to a greater extent by regulatory and other authorities. The American Board of Internal Medicine, following a pilot study, includes Simulation training as an optional part of recertification for interventional cardiologists. The European Board for the Accreditation of Cardiology (EBAC) are aware of this WGs activity and it is hoped that, through subsequent discussions, a European integrated approach to SBL in Cardiology would be possible.

It is recommended that trainees undertake a course with a large SBL component early in their training to introduce them to basic cardiological skills and the principles of caring for critically ill patients as part of a team. However, isolated courses should not substitute but complement SBL that is integrated throughout generic and specialist Cardiology training. This practical training needs to be paralleled by acquisition of cognitive knowledge.

Trainees may gain from a focussed period of SBL at the start of subspecialist training in PCI or EP.

After initial training SBL will remain important to cardiologists learning new techniques and the use of new equipment.

While SBL may be used to assess trainees and the ongoing competence of trained cardiologists it is felt that the evidence base is insufficient currently to use SBL for high stakes or final summative assessment in isolation. SBL should be piloted as an optional, but encouraged, part of revalidation. SBL should not replace procedure numbers for training and revalidation.

The provision of SBL will require a network of trainers and equipment. Modelling the requirements suggests a figure around 4000 days of SBL and 500 days of trainer time may be needed with current trainee numbers. The current Deanery structure provides the most logical framework for the operational provision of SBL.

The WG recognises that the commitment of already over-burdened cardiologists and trainees and, the financial and human resource implications of this report represent barriers to implementing these recommendations that will need to be addressed and overcome.

The WG recommends the BCS focuses on setting objectives for SBL and for SBL courses, encourages studies into the added value of SBL, brings together stakeholder groups including the Deaneries, the affiliated groups (BJCA, BANCC, SCST) and potential funding sources for education and SBL related research. Through its recommendations and statements the BCS can influence Trusts and regulators. It is not recommended the BCS
takes over the role of providing SBL nor purchases equipment, but may wish to co-organise SBL courses.

In summary, evidence, if not yet sufficient evidence, exists that SBL offers a significant advance in the training of cardiologists and maintaining ongoing high quality practice with real benefits to patients. To achieve this will require human and financial investment and a well organised structure with clear objectives. The BCS has a significant role to play in promoting effective Simulation Based Learning.
1. Introduction

“Simulation is a technique—not a technology—to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.” Professor David Gaba (2004). Simulation Based Learning (SBL) can include the use of role play, simulated patients, part-task trainers, virtual reality devices (usually with haptic - or tactile - feedback) and electronic manikins. SBL already has a role in medical and Cardiology training and this role is only likely to expand in the next few years.

SBL has been used across a wide range of industries for many years. Perhaps best recognised in the airline industry where flight simulators have paralleled the development of aircraft, starting with mock ups in the early 20th century to modern digital cockpit simulators accurately reproducing flight that have been in use since the 1960s. Simulator based training is totally integrated into pilot training and ongoing maintenance of skills.

Simulation within medicine similarly has a long history. ‘Resus Annie’ was first introduced on the 1960s.¹

The Harvey Cardiology Mannequin was introduced in 1968 but the modern PC based simulation system probably first appeared in the late 1980s.

Simulators for interventional Cardiology have been available since 2000.

The commitment to introducing Simulation Based Learning was enunciated by Lord Darzi (A High Quality Workforce: NHS Next Stage Review. London Department of Health, 2008): “We need to use modern education techniques if we are to fulfil our ambition to widen participation in learning and to enhance the learning environment for those both in training and those undertaking CPD. We will therefore review the appropriate use of e-learning and other modern education techniques, such as high-fidelity simulation suites, to develop a strategy for the appropriate use of elearning, simulation, clinical skills facilities and other innovative approaches to healthcare education”.

The British Cardiovascular Society (BCS) recognises the emerging and increasingly important role of SBL. The Council determined that a Working Group (WG) should be established to review the current status of Simulation use within Cardiology and make recommendations on the future use of Simulation and to what extent the BCS should promote, provide or support their use. A chair and a range of stakeholders representing those involved with training, the specialty groups and industry were invited to join the WG with access to additional expertise as needed. (See Appendix A for membership and conflict of interest statements).
The WG established a number of key questions central to the issues regarding SBL and the remit of the WG:

a) What is the current state of SBL in Cardiology and medicine?

b) What is the projected role of SBL in Cardiology?

c) How might Cardiology SBL be delivered in the UK?

d) What is the role of the BCS?

The WG then progressed through email, phone calls and meetings to work towards this report. In preparing recommendations the WG noted that the quality of evidence was variable. In particular, within Cardiology well controlled outcome studies of the added value of SBL were few. None the less it was felt important, and within the remit of the WG, to make recommendations combining the evidence where available and the consensus opinion of the WG and additional consulted experts.

*Figure 1 - A state of the art cockpit simulator*
2. Basic concepts

2.1 Terminology

The fidelity of a simulator is its sophistication and complexity in reproducing the simulated procedure e.g. a sheet placed over the operating theatre table versus a mannequin that talks and has breath sounds.

A haptic simulator is one that reproduces the feel and touch of a procedure e.g. manipulation of a laparoscope or endovascular catheter.

2.2 Why might Simulation Based Learning provide added benefit?

The essential benefits of simulation based education are:
- Learning can take place without exposing patients to risk
- Learning can take place at the speed of the learner and adapted to the performance of the learner
- Immediate physical, behavioural and professional feedback is available to the learner
- Learning can be adapted to the learner in a completely flexible way
- Simulators have the potential to move the steep and dangerous part of the learning curve away from patients and to accelerate learning

It is difficult to argue that these are not valuable attributes but it is important to recognise that adoption of Simulators will only occur if they provide added value to current learning methods.

2.3 What are the potential roles for Simulation Based Learning?

Simulators may add value at all stages of training as well as ongoing practice and these will subsequently be addressed in more detail.
- Trainee selection
- Basic technical skills training
- Training in complex (new) procedures
- Training teams to work effectively in complex and / or emergency (especially uncommon) situations
- Formative assessment
- Summative assessment
- Skill maintenance and revalidation
- Procedure or mission rehearsal (pre-procedural planning) for complex interventions
2.4 What are the current drivers for Simulation Based Learning in the National Health Service?

- Learning opportunities for trainees are compromised by the European Working Time Directive which often leads to disruptive rotas
- Certain core procedures are being performed less frequently, particularly in the tertiary centres where many of the trainees are based (e.g. coronary angiography)
- There is increasing pressure to objectively validate skills and competency and to re-validate skills and competency
- Patient safety has always been a priority but increasing public availability of patient outcome metrics and National Health Service Litigation Authority grading of Trusts have established even greater scrutiny. While enhancing individual skills is important, it is the potential to train teams particularly in critical situations that has the real opportunity to improve patient safety. By making Trusts aware of this role for SBL resources may be more easily attracted.

In summary, there is a wide potential role for simulators and both these drivers and current governmental policy supports its wide adoption.

*Figure 2 – A wide variety of simulation equipment is being marketed at meetings and conferences*
3. **Current status of Simulation Based Learning**

3.1 **Current technology and capability**

Any comment on the current state of simulation technology will be instantly out of date but a broad overview of current capability may be made.

3.1.1 **Medicine and surgery**

High fidelity systems are now available for training in acute and critical care medicine as they can reproduce acutely ill patients with abnormal and changing physiology including abnormal physical examination findings.

Vascular and laparoscopic surgical simulators are now sufficiently advanced to accurately reproduce surgical scenarios including complications. Carotid artery intervention simulators are particularly well developed including the uploading of CT angiograms to facilitate pre-procedural planning and practice.²

A number of companies are actively developing software and hardware for simulation. Device manufacturers maintain close links with these companies to provide product and generic simulation related to their device use.

See Appendix B for list of major manufacturers and their websites with product specific details.

3.1.2 **Cardiology**

For learning in Cardiology a wide range of general simulation equipment can be used as well as simulators for more specific areas of Cardiology practice.

SBL for the general skills of a cardiologist include training with ‘Resus Annie’ and the use of now well developed simulators for critically ill patients.

Current simulators for cardiac catheterisation vary from laptop based portable systems to equipment reproducing a full cardiac catheterisation laboratory. Basic stages of catheterisation procedures are reproduced in terms of equipment selection and catheter manipulation for diagnostic angiography. In some ways the haptic feedback from finer equipment (wires, and stents) is greater than for large bore catheters and therefore simulators for coronary intervention are more realistic.

Simulators can be programmed to only allow ‘successful’ completion of a procedure with certain equipment and a range of complications can be simulated.
For endovascular procedures e.g. carotid stenting the simulators can assess the suitability of equipment based on uploaded CT angiograms as part of procedure rehearsal. This is because of the 3D reconstruction facility of CT imaging. Current simulators are unable to automatically determine which equipment will fit or track around coronary arteries if imaged by standard 2D coronary angiography.

Simulation for right heart catheterisation is less well developed but simulators are now available for training in pericardiocentesis (http://www.meti.com/downloads/HPSCF.pdf)

While simulators can include physiological measurements from Intra Aortic Balloon Pumps (IABP) (http://www.ultramedic.com/products/PatientSimulators/MedSIM300B.htm) they are not yet specifically available for IABP insertion.

For electrophysiology including mapping and Atrial Fibrillation ablation, simulators have reached a high degree of sophistication and similarly simulators are available for temporary and permanent pacemaker lead insertion.

Echocardiography simulators are also available. Both transthoracic and transoesophageal echocardiography mannequins and systems are available demonstrating normal and abnormal cases, and allowing users to develop skills in obtaining appropriate views. These simulators include displays that allow 2D and 3D anatomical orientation of the images.

A further use is in training for percutaneous valve procedures (e.g. TAVI) where SBL is an essential component.

*Figure 3 - Training using a TOE Simulator at the British Cardiovascular Society Annual Meeting*
3.2 Current provision of Simulation Based Learning

General medical SBL is now available to some extent in most Deaneries and large teaching hospitals. However provision of SBL for Cardiology is much less prevalent. The WG determined the current provision of Simulation Based Learning through a survey of trainees, Deanery and other contacts. The trainee survey also sought other information and opinions (see Box)

**Trainee Survey**

Sample size = 30 trainees from 10 deaneries

1. Experience of simulators: 83%

2. Procedures for which used simulators: 62% PCI, 30% pacing, 25% TOE, 10% other (Total >100 as some trainees have used for more than one procedures at different places)

3. Where used simulators: 65% industry sponsored course, 50% BCS, 5% other

4. Found simulators useful: 90% users found it useful

5. Local availability of simulators: Generally not. Only 2 deaneries have limited/occasional availability for some procedures only

6. Who should provide simulator training: 50% Deanery or regional (group of deaneries), 47% BCS (-sponsored by industry), 3% no one

7. Should simulators be used as tool for assessment of competence: 14% yes, 21% not sure, 65% no

The current provision of Simulation Based Learning for specialist training in Cardiology is clearly patchy. While the London Deanery has adopted a systematic approach, this is not universal and elsewhere can rely on individual cardiologist enthusiasm rather than any systematic planning. Use tends to be on brief courses or industry led sessions rather than integrated with other learning methods which is likely to be more effective. The BCS has, since 2008, offered opportunities for sampling simulators at its Annual Conference through links with simulator manufacturers. These opportunities have proved very popular.

There is very little use of simulators to improve team performance within Cardiology despite widespread use in other specialties.
3.2.1. SBL in Europe and the USA

In the USA the use of SBL has been embraced to a much greater extent by regulatory and other authorities than in the UK. National standards are not yet available although collaboration on defining best practice is planned over the next couple of years. Simulation centres have been developed almost entirely co-located with large teaching and training institutions. The American Board of Internal Medicine, following a pilot study\(^3\), includes Simulation training as an optional part of recertification for interventional Cardiologists.\(^4\)

The American College of Cardiology has a Simulation Working Group. It is intended to develop the use of simulation to assessment of trainees but before progressing from formative to summative (and pass / fail) assessment it is felt that further studies of reliability and validity are needed (R Lipner personal communication). The USA perspective on the potential for Simulation in interventional Cardiology is summarised by Marco and Holmes on behalf of the ACC Scientific Council\(^\text{5}\) ‘Simulation for interventional cardiovascular applications is becoming an increasingly robust and important technology. It can play many roles—testing, teaching, training, credentialing, and practicing. Each of these areas has specific challenges, but as platform technology, simulation will improve the quality of our training and help to optimize patient outcome.’

Beyond Cardiology there are many examples of the development of SBL in the USA which include:

- Requirement by the American Board of Surgery for surgical trainees to pass an exam on Simulators for laparoscopic practice before Certification. The exam has been validated to reliably distinguish novice trainees, senior trainees and faculty

- Requirement for simulation training in all surgical residency programmes (although this is not further specified)

- Use of simulation exercises to identify institutional safety issues

- The inclusion of SBL to augment neuroradiology training
  (http://www.ajnr.org/cgi/content/full/25/10/1732)

- Reduction in insurance premiums for obstetricians who have participated in SBL

SBL in Europe is extremely patchy and particularly in Cardiology there are few examples of formal integration of SBL into training and practice. However simulation is listed as one of the learning methods (not mandatory) for coronary intervention in a document from the European
The European Board for the Accreditation of Cardiology (EBAC) are aware of this WGs activity and it is hoped that, through subsequent discussions, a European integrated approach to SBL in Cardiology would be possible.

3.3 Current evidence base for Simulation Based Learning

It is hard to argue that a training tool with all the qualities listed in section 2.2 does not have value. The widespread adoption by industries with a careful eye on their training budgets, and by armies where poor training has directly fatal consequences, are extremely persuasive arguments. Patients support and indeed assume there is widespread use of simulation in healthcare training. Further support for the widespread acceptance of the value of SBL, are the reduced insurance costs for American Obstetricians who have undergone simulation training. None the less it is equally reasonable to expect a body of evidence, both generally in health care and specifically in Cardiology, to be available. However currently searching PubMed for ‘simulators and cardiology and trials’ produces no articles.

An evidence base does exist for SBL but little of this relates to Cardiology a systematic review concluded ‘While research in this field needs improvement in terms of rigor and quality, high fidelity medical simulations are educationally effective and simulation based education compliments medical education in patient care settings’. From a scientific point of view it would be defensible to translate general evidence for the benefit of simulation in medical learning to Cardiology or evidence of benefit in carotid stenting to coronary stenting, but there is an additional factor in that Cardiology specific evidence would give ownership of SBL to cardiologists and accelerate the introduction of SBL.

The ABIM has studied Simulation to assess competence in interventional Cardiology. They found simulation was readily able to distinguish novices from trained interventional cardiologists. However experienced practitioners were not distinguished from newly trained operators. Those undertaking high procedure numbers fared better than equally experienced operators but undertaking lower volumes (which might represent trainers). Reliability was measured as acceptable but less than that seen in fully developed MCQ exams. However it is unlikely measures of reliability for simulation (rather like OSCEs) are likely to match those of MCQ exams but the many advantages, particularly increased validity, of practical assessment counter balance this.
There are examples of studies of simulators in interventional vascular procedures both in the UK and linked to Board Certification for Carotid Angioplasty in the USA.

Convincing evidence exists for improved and shortened training in laparoscopic procedures, colonoscopy and vascular surgery. In traditional classifications much of this evidence would be level B.

Prof Darzi’s group at Imperial College London have an extensive programme of research into SBL, particularly laparoscopic and endovascular surgery.

The WG is aware of studies currently being undertaken to investigate SBL for transoesophageal echocardiography 7 and planned for cardiac catheterisation (personal communication P. Kearney et al).

Within medicine examples of evidence for SBL include skills in:


These studies emphasised improved confidence of trainees with less evidence of superior training compared to control groups, although training was accelerated and there was evidence skills were better retained with SBL.

A clear benefit was demonstrated for SBL in laparoscopic surgery in a Danish randomised controlled trial involving 24 surgical trainees. The SBL group developed skills significantly faster than the control group. 8

Research into SBL is challenging. With increasing exposure of trainees to SBL, control groups may be hard to identify. Ensuring the study assesses the impact of SBL, not simply increased intensity of tuition is not straightforward. Relevant outcomes may be hard to identify and may be controversial (is screening time a suitable marker for skill in angiography?) As in any new field robust statistical analysis methods are developing. However not withstanding these challenges some excellent research into SBL has and is being undertaken, and should be encouraged.

**Key Recommendation: The British Cardiovascular Society should support studies developing Cardiology specific evidence for the added value of Simulation Based Learning**
4. **Projected roles for Simulation Based Learning in Cardiology**

4.1 **Basic skill training**

Trainees entering ST3 are increasingly likely to have been exposed to SBL in the foundation years and during core medical training. This is offered to all F1 / F2 doctors in London Deanery and is extending across the country. It is important that Cardiology SBL seamlessly builds upon and extends this training. Much of the previous exposure will have focused on the management of unwell patients, particularly as part of a team. Learning is a continuous process and SBL needs to be offered continuously through training. However there are some core skills that need to be acquired early in Cardiology training. Examples include basic echocardiography and cardiac catheterisation including arterial access. In addition, it is increasingly recognised that a broad range of surgical skills are valuable for Cardiology trainees including sterile technique and suturing.

These skills can be acquired with the help of SBL. It is nowadays unnecessary for trainees to undertake their learning curve entirely on patients. Sufficient evidence exists to suggest that simulation based training can accelerate the learning curve and move the steep and dangerous part of the learning curve away from patients. It is likely that many of these skills, once acquired, need little relearning (unless a break from clinical practice occurs) and so a short course, perhaps with limited ongoing training would be suitable to acquire these skills.

**Key Recommendation:** Prior to, or very early on in their specialty training, Cardiology trainees should undertake a course which includes Simulation Based Learning to develop basic skills necessary for the practice of Cardiology

Such training should map to the competencies laid out in the Curriculum and focus on areas where SBL is an ideal learning method ([http://www.jrcptb.org.uk/specialties/ST3-SpR/Documents/2010%20Cardiology%20Curriculum.pdf](http://www.jrcptb.org.uk/specialties/ST3-SpR/Documents/2010%20Cardiology%20Curriculum.pdf))

Training in basic surgical skills, an introduction to echo and to invasive Cardiology would be of value. Trainees often find early experience of on-call Cardiology challenging and both the practical skills and team working skills when managing critically ill patients could be addressed. Simulation could be used to fundamentally improve early orientation to and provide patient safe induction into Cardiology. Developing a curriculum for a 3 – 5 day course may best be achieved by collaboration between the BCS and Affiliated Groups and representatives of the Specialist Advisory Committee (SAC) and Deaneries. Having established the objectives potential sponsors can be approached to design courses.
One established course for potential, or newly appointed Cardiology trainees has been running at the Queens University Hospital Simulation Centre (Appendix C). Much of the material is delivered through lectures but ‘hands on’ experience is included. Another 2 day course provides an introduction to invasive Cardiology and offers SBL. This has been advertised for those embarking on or planning Cardiology training (http://bmjcareers.mobi/careers/advice/view-article.html?id=20001649).

It is a concern that undertaking such a course would become an ‘entry criteria’ for Cardiology NTNs and if that was felt to be adverse, consideration on how to prevent such a development would be needed. Competitive pressures for entry to specialist training in Cardiology are however substantial.

*Figure 3 - A modern angiography / angioplasty training simulator*

Trainees in Cardiology need to acquire skills in undertaking complex procedures both in their general and subspecialty training. SBL is as yet unproven to add value to learning but sufficient evidence exists to strongly suggest it can safely accelerate skill acquisition. Training in complex procedures is a continuous process and so SBL needs to parallel and complement other learning methods. This means that trainees need access to SBL continuously during their training, rather than only through intermittent course attendance. Hence SBL must be provided or readily accessible at all centres offering and coordinating
training. It is important that general training is not manufacturer specific, although in training for the use of particular equipment this is appropriate.

There is evidence, from vascular surgical training to suggest that practical skill acquisition is accelerated by a strong knowledge or cognitive foundation (Rajesh Aggarwal personal communication). Hence for example, in providing SBL for PCI, courses and periods of simulation training need to be matched to knowledge through pre-course learning and assessments. In other words SBL must be synchronised to knowledge acquisition.

**Recommendation:** Trainees learning complex intervention skills (PCI, EP and Devices, TOE) should have SBL as one of their learning methods. This will require availability of SBL at centres offering complex procedure training including allocated time, equipment and availability of trainers. For maximum benefit SBL must be matched by knowledge acquisition.

Assessment should be learning outcome driven. Therefore it is extremely difficult to assess the time commitment required. By way of comparison, for endovascular or laparoscopic surgery a 1 – 2 week introductory course and 1- 2 sessions / week thereafter may be ideal. Similar times may be suitable for periods of training in the very practical elements of Cardiology.

*Figure 4 - Suggested intensity of SBL through a training programme*
4.3 Team training

The area of SBL with the widest (medical and non-medical) applicability is its use for training to enhance team based patient care. Yet this is not the first thoughts for the role of SBL amongst trainees and is generally underdeveloped, perhaps because industry support is less prevalent given that it is not equipment specific. Patients benefit considerably from training that supports the development of functional clinical teams.

Increasingly cardiologists work within large and dynamic multidisciplinary teams. For primary angioplasty an interventional cardiologist may work with > 5 different radiographers, nurses, physiologists and junior staff.

National Patient Safety Association (NPSA) data suggest that a substantial proportion of adverse events link to areas where more effective teamwork or patient journey management would have reduced the likelihood of error. This emphasises the potential value of SBL beyond initial training as part of ongoing service training and development and directly linking to enhancement of patient safety.

*Figure 5 - An F1 pit stop, an excellent example of team work*
<table>
<thead>
<tr>
<th>Incident category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slips, trips, falls</td>
<td>47</td>
<td>20.2%</td>
</tr>
<tr>
<td>Infection - cross / healthcare associated</td>
<td>17</td>
<td>7.3%</td>
</tr>
<tr>
<td>Delay or failure to monitor</td>
<td>11</td>
<td>4.7%</td>
</tr>
<tr>
<td>Treatment / procedure - delay / failure</td>
<td>10</td>
<td>4.3%</td>
</tr>
<tr>
<td>Treatment / procedure - inappropriate / wrong</td>
<td>10</td>
<td>4.3%</td>
</tr>
<tr>
<td>Diagnosis - delay / failure to</td>
<td>8</td>
<td>3.4%</td>
</tr>
<tr>
<td>Test results / reports - failure / delay to interpret or act on</td>
<td>7</td>
<td>3.0%</td>
</tr>
<tr>
<td>Delay / difficulty in obtaining clinical assistance</td>
<td>6</td>
<td>2.6%</td>
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<tr>
<td>Delay / failure in recognising complication of treatment</td>
<td>4</td>
<td>1.7%</td>
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<tr>
<td>Failure of device / equipment</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>Infection – wound</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>Lack / unavailability of device / equipment</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>Test results / reports - failure / delay to receive</td>
<td>3</td>
<td>1.3%</td>
</tr>
<tr>
<td>Transport - delay / failure</td>
<td>3</td>
<td>1.3%</td>
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<tr>
<td>Communication failure - outside of immediate team</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Communication failure - with patient / parent / carer</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Diagnosis – wrong</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Failure to follow up missed appointment</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Missing needle / swab / instrument</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Transfer delay / failure / inappropriate</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Absconder / missing patient</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Access / admission - unexpected readmission / reattendance</td>
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<td>0.4%</td>
</tr>
<tr>
<td>Access / admission - unplanned admission / transfer to specialist care unit</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Incident category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication failure - within team</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Failure in referral process</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Lack of suitably trained / skilled staff</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Sexual</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Tests - failure / delay to undertake</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Unplanned return to theatre</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Unsafe / inappropriate clinical environment (including clinical waste)</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Missing</td>
<td>14</td>
<td>6.0%</td>
</tr>
<tr>
<td>Other</td>
<td>62</td>
<td>26.6%</td>
</tr>
<tr>
<td>Total</td>
<td>233</td>
<td>100.0%</td>
</tr>
<tr>
<td>Themes from clinical review</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Fall (not collapse)</td>
<td>48</td>
<td>20.6%</td>
</tr>
<tr>
<td>Delay in treatment (excluding medication, diagnostic error, or deterioration)</td>
<td>35</td>
<td>15.0%</td>
</tr>
<tr>
<td>Severe pressure ulcer (grade 4 or above)</td>
<td>33</td>
<td>14.2%</td>
</tr>
<tr>
<td>Healthcare associated infection</td>
<td>23</td>
<td>9.9%</td>
</tr>
<tr>
<td>Peri/post operation or procedure (non-obstetric)</td>
<td>22</td>
<td>9.4%</td>
</tr>
<tr>
<td>Deterioration incident (excluding resuscitation)</td>
<td>21</td>
<td>9.0%</td>
</tr>
<tr>
<td>Medication incident (excluding resuscitation)</td>
<td>17</td>
<td>7.3%</td>
</tr>
<tr>
<td>Resuscitation incident</td>
<td>7</td>
<td>3.0%</td>
</tr>
<tr>
<td>Diagnostic error (cardiovascular)</td>
<td>5</td>
<td>2.1%</td>
</tr>
<tr>
<td>Diagnostic error (cancer)</td>
<td>4</td>
<td>1.7%</td>
</tr>
<tr>
<td>Equipment incident (excluding medication and resuscitation)</td>
<td>4</td>
<td>1.7%</td>
</tr>
<tr>
<td>Airway and feeding problems</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Peri/post procedure incident</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Thrombolytic event</td>
<td>1</td>
<td>0.4%</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>4.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>233</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Table 2 NPSA data on incidents where degree of harm = death linked to Cardiology. (01-Nov-2003 - present)

<table>
<thead>
<tr>
<th>Incident category</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slips, trips, falls</td>
<td>23</td>
<td>10.8%</td>
</tr>
<tr>
<td>Treatment / procedure - delay / failure</td>
<td>20</td>
<td>9.4%</td>
</tr>
<tr>
<td>Infection - cross / healthcare associated</td>
<td>14</td>
<td>6.6%</td>
</tr>
<tr>
<td>Delay / difficulty in obtaining clinical assistance</td>
<td>13</td>
<td>6.1%</td>
</tr>
<tr>
<td>Diagnosis - delay / failure to</td>
<td>10</td>
<td>4.7%</td>
</tr>
<tr>
<td>Delay or failure to monitor</td>
<td>9</td>
<td>4.2%</td>
</tr>
<tr>
<td>Delay / failure in recognising complication of treatment</td>
<td>6</td>
<td>2.8%</td>
</tr>
<tr>
<td>Treatment / procedure - inappropriate / wrong</td>
<td>6</td>
<td>2.8%</td>
</tr>
<tr>
<td>Failure of device / equipment</td>
<td>5</td>
<td>2.4%</td>
</tr>
<tr>
<td>Lack / unavailability of device / equipment</td>
<td>4</td>
<td>1.9%</td>
</tr>
<tr>
<td>Lack of suitably trained / skilled staff</td>
<td>4</td>
<td>1.9%</td>
</tr>
<tr>
<td>Access / admission - delay / failure in access to hospital / care</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>Test results / reports - failure / delay to interpret or act on</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>Absconder / missing patient</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Communication failure - outside of immediate team</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Communication failure - within team</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Extended stay / episode of care</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Inadequate check on equipment / supplies</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Transfer / delay / failure / inappropriate</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Documentation / missing / inadequate / wrong / illegible healthcare record / card</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Documentation - no access to</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Failure in referral process</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Infusion injury (extravasation)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Lack of / delayed availability of beds (general)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Incident category</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Lack of / delayed availability of beds (high dependency / intensive care)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Patient incorrectly identified</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Scans / X-rays / specimens - inadequate / incomplete</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Self-harm</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Unsafe / inappropriate clinical environment (including clinical waste)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Other</td>
<td>58</td>
<td>27.4%</td>
</tr>
<tr>
<td>Missing</td>
<td>12</td>
<td>5.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>212</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td>Themes from clinical review</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>-----------------------------------------------------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>Peri/post procedure incident</td>
<td>23</td>
<td>10.8%</td>
</tr>
<tr>
<td>Healthcare associated infection</td>
<td>20</td>
<td>9.4%</td>
</tr>
<tr>
<td>Delay in treatment (excluding medication, diagnostic error, or deterioration)</td>
<td>18</td>
<td>8.5%</td>
</tr>
<tr>
<td>Fall (not collapse)</td>
<td>16</td>
<td>7.5%</td>
</tr>
<tr>
<td>Deterioration incident (excluding resuscitation)</td>
<td>15</td>
<td>7.1%</td>
</tr>
<tr>
<td>Resuscitation incident</td>
<td>11</td>
<td>5.2%</td>
</tr>
<tr>
<td>Medication incident (excluding resuscitation)</td>
<td>8</td>
<td>3.8%</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>2.8%</td>
</tr>
<tr>
<td>Delayed or inappropriate treatment (excluding medication, diagnostic error, or deterioration)</td>
<td>3</td>
<td>1.4%</td>
</tr>
<tr>
<td>Airway and feeding problems</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Diagnostic error (cardiovascular)</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Equipment incident (excluding medication and resuscitation)</td>
<td>2</td>
<td>0.9%</td>
</tr>
<tr>
<td>Aspiration/choking</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Deterioration incident</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Diagnostic error</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Diagnostic error (cancer)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Inadequate discharge</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Suicide of patient associated with PSI (including inpatient missing without leave)</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Transfusion related</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>No theme given</td>
<td>79</td>
<td>37.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>212</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
High fidelity simulation is available but it is not necessarily the case that this improves the quality of the learning experience compared to simpler systems, particularly for non-haptic tasks like crisis management team working and dealing with emergencies.

SBL has been a part of ALS courses for many years and increasingly trainees will have been exposed to this learning method (http://www.onlinejets.org/text.asp?2010/3/4/378/70758). This general training should extend through their Cardiology programme. However there are Cardiology specific situations, e.g. out of hours’ interventions, adverse and emergency events in the catheter lab, where co-ordinated and effective team action saves lives. Widespread direct evidence from studies and indirect evidence, e.g. that US insurance companies reduce premiums for obstetricians who have undertaken SBL, suggest SBL enhances the quality of team based care (http://www.touchbriefings.com/pdf/3229/stepp.pdf). The observation that low fidelity simulation can be effective as a learning method means that cost of equipment is not a barrier to local delivery of SBL in this area of training. However space, trainer and trainee availability remain problematic.

It is likely that, even more so than individual training, skilled trainers or facilitators will be needed to maximise the value of SBL for team performance. Measuring the effectiveness of teams and therefore improvements following SBL represents a considerable challenge. The process of managing a scenario can be marked against a comprehensive score sheet much like Objective Structured Clinical Examinations (OSCEs), but ultimately it is improved outcomes that are the target for SBL. It is possible that door to balloon times or more broadly case duration, reflect team performance. Self reporting of team functioning can be assessed and may represent a suitable marker for SBL in this context.

**Recommendation:** Trainees should undergo SBL to improve team performance and patient safety. This should be appropriate to their level of training and practice but is likely to include some training with their local hospital teams as well as on designated training days.

**4.4 Procedural planning and rehearsals, including the introduction of new techniques**

New equipment for current procedures and the development of completely new procedures are a feature of Cardiology. Their introduction is often a partnership between industry and cardiologists. Training programmes for new techniques increasingly require the undertaking of SBL e.g. Transcutaneous aortic valve implantation (TAVI) training. This is a particularly valid approach because, almost by definition, there are not large numbers of trained practitioners available undertaking high procedure numbers. At present resourcing these
training courses is generally done by industry. It is in their interests that training is effective, so that outcomes from the use of their equipment are optimised.

Figure 6 - Using simulators for pre-procedural planning

Recommendation: SBL for new procedures is an important part of the learning curve. Current resource provision though industry is appropriate and should be continued

4.5 Trainee selection

Simulators can provide the opportunity to observe and record people undertaking procedures and measure movements and timings. It therefore has the potential to assess dexterity and procedural ‘adeptness’. Potential trainees may find it helpful to explore their own aptitudes, or lack of them, using simulators to aid career selection. It is also possible that analysis of such skills or aptitudes may reasonably be part of the assessment of potential Cardiology trainees. At present there are no data in this area so further research is needed. However the London Deanery are developing and using simulation stations as part of the assessment of potential Cardiothoracic Surgery trainees and in the selection of ophthalmology trainees. The outcomes of the simulation stations (knot tying, femoral dissection) have been found useful by selectors and acceptable to candidates.

Recommendation: Simulators should not currently be used to determine selection of trainees into Cardiology but there may be a role in career guidance and as a part of trainee selection

4.6 Trainee assessments

An effective assessment method needs to demonstrate reliability, validity and utility. Reliability refers to the ability of a test to separate true differences from random variation,
validity refers to the ability of a test to measure what we want it to measure, and utility refers to the overall ability of a test to assess an important aspect of knowledge or skill or performance in an efficient way and with a positive educational impact. It is likely that simulation based assessments could be developed that provide sufficient reliability, validity and utility to become part of the assessment strategy for trainees in cardiovascular medicine. However it is important to note that multiple assessment methods will be needed in addition to simulation.

Hence, simulators could be used for formative or summative assessments and could be used to track, and provide feedback on, a trainee’s progress. Simulators could assess personal progress in terms of time to perform procedures, accuracy and efficiency of movements and outcome success.

For a ‘high-stakes’ or pass/fail summative assessment stringent criteria of reliability and validity are necessary and, based on the trainees survey, there is resistance to simulators being used for summative assessment at this stage. However, Objective Structured Clinical Examinations (OSCEs) are long established and use a variety of simulation based methods. These are widely accepted in undergraduate assessment in the UK. In the USA surgeons training in laparoscopic training have to pass a simulation based assessment to complete training.

The BCS has, in conjunction with the SAC, developed an MCQ style Knowledge Based Assessment (KBA) for Cardiology trainees. Having taken the step to test knowledge in this way it is reasonable to consider whether it is necessary to test practical skills in a similar fashion. Currently procedural competences are assessed using a workplace based assessment, directly observed procedural skills (DOPS). Whether these could be replaced by or augmented by an objective skills assessment using simulators should be considered. It will be necessary to determine whether this enhances the utility of the overall assessment strategy.

**Recommendation:** The BCS, SAC and Deaneries should work together to develop simulator based assessment of practical and professional skills for cardiology trainees. Initially this will probably be for formative assessment but could progress to summative assessment if robust data on reliability, validity and utility can be provided.

### 4.7 Revalidation for consultants

Although revalidation in the UK was originally designed to focus on individual performance, the realisation that team work and team performance are now so central to clinical care means that within Consultants CME and their revalidation submissions, team based training
and performance are highly relevant. Although SBL is an important part of enhancing team based performance, given current uncertainties about revalidation and uncertainties about resources it is not yet possible to mandate SBL for consultant CME.

While it is accepted that procedure numbers are an imperfect measure of skill acquisition and maintenance they are still used to measure clinical experience for the purposes of training and for revalidation. It is possible SBL may represent an alternative method of skill maintenance. However at present there are insufficient data to support this concept.

The BCS’s central role in establishing criteria for revalidation of cardiologists provides an opportunity. By piloting SBL as part of revalidation with monitoring and evaluation it would be possible to acquire data identifying the role and value of SBL in this context.

**Recommendation: SBL should be an accepted element of Consultant CME**

**Recommendation: Consultants should consider undertaking SBL particularly with members of their interdisciplinary hospital teams as part of CME / Revalidation**

**Recommendation: At present SBL should not substitute for procedure audit for revalidation purposes**

*Figure 7 - Possible intensity of use of simulation by consultants*
5. **Delivery of Simulation Based Learning**

5.1 Options for how and where Simulation Based Learning might be offered

Simulation centres including ones with ‘mock theatres’ are being established across the country albeit currently with patchy development. These current facilities are suitable for a broad range of SBL and are appropriate for the majority of the needs of Cardiology trainees. High fidelity simulators can be added to these centres by:

- purchasing hardware and software
- bringing portable high fidelity simulation equipment to these centres

Local SBL is particularly relevant to team based training. This may best be established by bringing simulation equipment to the team environment i.e. the local hospital. However much team based learning does not require high fidelity simulators and so it is relatively easy to use portable equipment for this purpose.

**Recommendation:** SBL for Cardiology trainees should largely be provided through established simulation centres

**Recommendation:** Portable SBL equipment should be available to use in local sites for aspects of SBL for trainees and trained staff

5.2 Resource implications

SBL requires an appropriate environment, up to date equipment and competent facilitators and trainers. General training of trainers is now offered through a wide range of courses for example those run by London Deanery (http://simulation.londondeanery.ac.uk/faculty-development). These faculty development courses typically last 2 days and focus upon developing insight into human factors, crisis management techniques and behavioural debriefing for teams and individuals. They also address specific technical aspects of running and designing simulation-based scenarios.

For basic cardiac skills, complex cardiac procedures, and improving team performance through simulation, the combination of a basic training in SBL combined with personal expertise in the particular skills will provide the mainstay of training.

Those running courses may benefit from having technician assistance when running SBL sessions on the more complex equipment.

Currently almost all NHS consultants include a commitment to teaching and training in their job plans. However facilitating SBL is likely to become a role for a sub-group of appropriately
enthusiastic consultants and it is important these roles are identified, appropriately distributed through teaching centres and recognised within job plans.

**Recommendation: A network of appropriately trained trainers should be developed**

**Recommendation: Training in SBL should be recognised within CME and facilitating SBL should be recognised within job plans**

It may be that facilitators / trainers other than cardiologists can be developed. For basic skills such as sterile technique, preparing and administering contrast safely, competent trainers could come from a multidisciplinary background relieving the pressure on cardiologists.

While very difficult to provide estimates of the human resource required some indicative numbers may be derived from the following analyses.

There are currently 22 Training programmes in the UK, 17 Deaneries in England, 1 each in N. Ireland and Wales and 3 programmes in Scotland. There are currently 586 NTNs in Cardiology registered with PTB and it is likely there will be around 100 new Trainees / year.

We have recommended an introductory basic skills course e.g. 3 days and ongoing exposure to Simulation Based Learning of perhaps 0.5 days / month averaged over training (there will also be local hospital specific SBL). This is a total of 3816 days of SBL.

It is very difficult to judge how much provision is needed in terms of trainers but most SBL is in small groups with of 2 – 4 learners (although days can be divided into sessions of larger group learning and smaller SBL practical work). Approximately 70% of the time can be spent on self-directed learning by the trainees.

The initial course are likely to be held 3 times a year in different locations, each one perhaps for 30 – 40 learners with perhaps 5 trainers = 45 days of trainer time. Overall a reasonable expectation is that 500 days of trainer time will be needed.

We would hope and expect some trainers to take a major interest in this work and offer to provide 10 – 12 days / year. It is likely each of the 22 programmes will need one such person and the approximately other 50% of training delivered by trainers perhaps offering 5-6 days per year = a further 40 – 50 trainers or 2 per programme.

For the trainers SBL provides an identifiable commitment to training which is often easier to demonstrate compared to specifying time integrated with service commitments e.g. explaining that fewer cases may be done on a list with a trainee.
For trained cardiologists there would be a mixture of local SBL to enhance team skills e.g. on Catheter laboratory service days, perhaps 1 – 2 days / year and SBL linked to gaining new skills.

Team development should be regarded as part of clinical governance, like audit and Mortality and Morbidity meetings, and therefore not part of a person’s study leave allowance.

**Recommendation:** Trained cardiologists improving team based performance through SBL should have this time integrated into their normal timetable and not taken from study leave allowances. This work should be seen as quality improvement work for the service.

Allied health care personnel are intimately involved with effective and safe Cardiology practice. A wider assessment of the human resource needs for SBL should include nurses and physiologists (approximately 2000 in the UK).
6. Role of the British Cardiovascular Society in the delivery of Simulation Based Learning for Cardiology in the UK

The BCS has a unique role in encouraging best clinical practice, representing cardiologists and advising, participating and delivering training. Relating this to the development and integration of SBL provides a number of roles for the BCS. It is equally important to consider the limits on BCS activity. In this area the WG recommends the BCS focuses on the following activities.

6.1 Setting objectives

The possibilities for SBL are endless, so ensuring that teaching courses and ongoing learning episodes have a clear objective is essential to maximise added value for SBL. In addition, by establishing objectives for SBL this will ensure consistency across the different Deaneries.

6.2 Liaising with Deaneries

Through its representation on the SAC the BCS can inform and influence the curriculum for Cardiology trainees. Specifying the importance and relevance of SBL as a learning method is important. It should be an agenda item whenever education is discussed or educational programmes are designed and perhaps a standing item for relevant committees. Further, the concepts of a basic skills course and subsequent continuous engagement with SBL can be recommended. Particular elements of the curriculum can be identified as being most suitable for the use of SBL as a learning resource.

The BCS should work closely with Deaneries to ensure

i) facilities are available and appropriately distributed across the UK

ii) adequate trainers are identified, trained and refreshed

6.3 Communicating with trainees

The BCS and through the BJCA, one of the Affiliated Groups, has a unique role in communicating with trainees. The BCS should promote SBL and also listen and forward feedback on the implementation of SBL.

6.4 Communicating with trained cardiologists

As the representative body for cardiologists the BCS has direct and regular opportunities to communicate with practicing trained cardiologists. Through this report, if endorsed by BCS
Council, and through a comprehensive communications strategy the benefits of SBL should be promoted.

6.5 Communicating with Allied Health Care Professionals

Directly and via Affiliated Groups including the British Association for Nursing in Cardiac Care (BANCC) and the Society for Cardiological Science and Technology (SCST), the BCS needs to ensure not just adequate communication of SBL in training but also engage all health care professionals in the benefits and practice of SBL for team performance. Perhaps the most important aspects of SBL to improve patient safety are predicated on involvement of a diversity of health care professionals.

6.6 Communicating with employers and health service leaders

If cardiologists are to be allowed time and resource for SBL, service and educational commissioners, their employers and political masters need to be persuaded of the benefits.

6.7 Sponsoring and supporting evaluation and research into SBL

While the Deaneries establish quality assurance for training and will need to integrate evaluation of SBL, there is also a role for the BCS in developing an evidence base within Cardiology for SBL. The BCS may not wish to devote financial resource to promoting research into SBL, but it can assist developing an evidence base by:

i) publicising ongoing work and increasing awareness of potential sources of funding that already exist for SBL

ii) facilitating communication between researchers (e.g. at the BCS Annual Conference through abstracts and plenary sessions)

iii) engaging with large funding organisations e.g. the British Heart Foundation (BHF) to emphasise the importance of SBL and therefore expand their funding for associated research

iv) discuss sponsorship of SBL by the pharmaceutical and device industry. In particular the BCS can recommend that industry sponsored SBL is generic unless it is very specifically training with a particular piece of ‘kit’ that is being offered

As a general principle the introduction of SBL should be accompanied by evaluation. This role should be the responsibility of Deaneries and the training programme directors. At a
basic level it is necessary to ensure SBL is delivered and at an acceptable standard across all sites. Like any other form of training SBL should be Quality Assured.

The BCS Endorsement and Approval processes (http://www.bcs.com/pages/page_box_contents.asp?PageID=743) provide an existing framework to 'kite mark' quality education upon which standards for SBL could be built. Standards and programmes for QA visits will need to be set and an independent review process established. However, wherever possible evaluation should go beyond this and aim to assimilate evidence of the (added) value of SBL.

6.8 Liaising with Industry

The BCS has excellent links with industry. These can be utilised to present unified requirements to manufacturers and to include SBL in the BCS Annual Conference. For several years now there have already been successful and popular demonstrations of SBL at the Annual Conference. These demonstrations inevitably focus on the rather narrow area of ‘one off’ personal skills training but hopefully in addition, raise awareness of the role of SBL as a continuous aid to individual and team learning.

Figure 8 - SBL at the British Cardiovascular Society Annual Meeting

Once objectives are set the BCS may pursue, perhaps as a joint venture with the BJCA, to liaise with industry in organising or co-organising some basic courses that include SBL e.g. the introductory course for new Cardiology trainees.

6.9 What may not be the role of the BCS?

The BCS is not the sole provider of education and training. By recommending that the Deanery structure is the optimal setting for SBL this implies that Deaneries may choose how to integrate SBL. A hub and spoke model of simulation centres, portable simulators brought on a rotational basis to training environments, large multi-trainee courses or continuous small
group learning are all reasonable models of provision. Advocating a single or specific delivery model would be undesirable and overstepping the limits of BCS involvement.

It is not recommended that the BCS purchase or lease simulation equipment. Furthermore, for all providers the rapidly advancing hardware and software means that leasing arrangements or purchases with inbuilt service contracts that include upgrades are the recommended models for procuring equipment.
7. Implementation of the recommendations and Summary

7.1 Barriers to implementation

There are several barriers to the implementation of the recommendations in this report:

- Commitment of trained cardiologists and trainees

These are challenging times for all doctors and engaging them in any innovations or changes difficult. To overcome this, an effective communication programme and Cardiology specific evidence of added value to encourage ownership will be required.

- Financial resources

SBL requires a financial investment. However in these financially difficult times training imposes a strain on health care providers. By reducing the amount of the learning curve trainees undertake on live patients and in the midst of service work, there is a demonstrable financial drive to introduce SBL. Health care providers are increasingly aware that improving patient safety is both clinically and cost effective. Throughout this report the link between SBL and patient safety has been emphasised.

Clear recommendations from the BCS, which must therefore be proportionate, are also a powerful stimulus to resource allocation.

The cost of Simulators are a potential brake on their introduction. It should therefore be reinforced that effective SBL can often be delivered with moderate fidelity and therefore moderate cost equipment.

- Human resources

Financial pressures are matched by human resource pressures at present. SBL requires competent trainers and facilitators. For trainers the very clear allocation of time to SBL may actually present a more overt contribution to training than the less encapsulated work of being supported or working with trainees in general daily activity.

For trainees there are very real pressures at present. Certain procedures may be less commonly performed and there is a trend to consultant delivered care. Transferring part of the learning curve away from patients and service work is a necessary response to these trends.
7.2 Next Steps

The recommendations in this report require a broad range of actions over a prolonged period of time. However there are some actions which are a priority if the recommendations are to be fulfilled:

- communicate the recommendations in this report to the Deaneries

- convene stakeholders (Deaneries, SAC, trainees) to establish objectives and an outline for an SBL course for new trainees with the aim of providing courses for the October 2011 cohort

- undertake discussions with potential funding organisations (industry and charities) who might sponsor research as well as education using SBL

- encourage and promote current and planned studies into SBL to enhance the evidence base

- encourage and promote training in facilitating SBL

7.3 Conclusion

Simulators have great potential to enhance learning. An expanding body of evidence, though mostly outside Cardiology, suggests this potential can be fulfilled. With current patterns of training and a focus on patient safety this is particularly relevant. SBL has the ability to take the early part of the learning curve away from patients and accelerate training. SBL can support trainees from career selection to basic skill acquisition and subspecialty training, both as part of learning and as part of assessment. Individual skills and team work can be addressed. For trained cardiologists there is a role in revalidation and the acquisition of new skills in a rapidly changing specialty. The evidence base needs to be expanded and the introduction of SBL monitored and its added value documented. The BCS has a unique role to help set objectives and standards for SBL, and to bring together all the stakeholders needed to introduce and develop SBL as a key driver of improved patient care.
8. **Summary of recommendations**

i) The British Cardiovascular Society should support studies developing Cardiology specific evidence for the added value of Simulation Based Learning

ii) Prior to, or very early on in their specialty training, Cardiology trainees should undertake a course which includes Simulation Based Learning to develop basic skills necessary for the practice of Cardiology

iii) Trainees learning complex intervention skills (PCI, EP and Devices, TOE) should have SBL as one of their learning methods. This will require availability of SBL at centres offering complex procedure training including allocated time, equipment and availability of trainers. For maximum benefit SBL must be matched by knowledge acquisition

iv) Trainees should undergo SBL to improve team performance and patient safety. This should be appropriate to their level of training and practice but is likely to include some training with their local hospital teams as well as on designated training days

v) SBL for new procedures is an important part of the learning curve. Current resource provision though industry is appropriate and should be continued

vi) Simulators should not currently be used to determine selection of trainees into Cardiology but there may be a role in career guidance and as a part of trainee selection

vii) The BCS, SAC and Deaneries should work together to develop simulator based assessment of practical and professional skills for Cardiology trainees. Initially this will probably be for formative assessment but could progress to summative assessment if robust data on reliability, validity and utility can be provided

viii) SBL should be an accepted element of Consultant CME

ix) Consultants should consider undertaking SBL particularly with members of their hospital interdisciplinary teams as part of CME / Revalidation
x) At present SBL should not substitute for procedure audit for revalidation purposes

xi) SBL for Cardiology trainees should largely be provided through established simulation centres

xii) Portable SBL equipment should be available to use in local sites for aspects of SBL for trainees and trained staff

xiii) A network of appropriately trained trainers should be developed

xiv) Training in SBL should be recognised within CME and facilitating SBL should be recognised within job plans

xv) Trained cardiologists improving team based performance through SBL should have this time integrated into their normal timetable and not taken from study leave allowances. This work should be seen as quality improvement work for the service
References

(Additional references are given as web addresses in the text)


Appendices

Appendix A: Working Group members and additional contributors including reviewers of draft versions of the report

Dr Kevin Fox (chairman)  Conflicts of Interest: None declared
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Prof Mike Gammage  Conflicts of Interest: None declared
Prof Huon Gray  Conflicts of Interest: None declared
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Dr Javaid Iqbal  Conflicts of Interest: None declared
Dr Duncan McNab  Conflicts of Interest: None declared
Dr Peter Mills  Conflicts of Interest: None declared

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Dr Iqbal Malik, Imperial College London
Dr Craig Reickert, The Henry Ford Hospital, Detroit
Mr Ken Timmis, Heart Care Partnership UK
Dr Roland Valori, Gloucester Hospitals NHS Trust
## Appendix B: List of selected manufacturers of Simulator hardware and software

<table>
<thead>
<tr>
<th>Company</th>
<th>Website</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentice</td>
<td><a href="http://www.mentice.com">www.mentice.com</a></td>
<td>A wide variety of simulators including those used at the BCS Annual Meeting</td>
</tr>
<tr>
<td>Medical Simulation</td>
<td><a href="http://www.medsimulation.com">www.medsimulation.com</a></td>
<td>A wide variety of simulators and courses</td>
</tr>
<tr>
<td>Corporation</td>
<td></td>
<td>A wide variety of simulators and educational material</td>
</tr>
<tr>
<td>Symbionix</td>
<td><a href="http://www.simbionix.com">www.simbionix.com</a></td>
<td>A wide variety of simulators and educational material</td>
</tr>
<tr>
<td>CATHI</td>
<td><a href="http://www.cathi-online.com">www.cathi-online.com</a></td>
<td>Medical simulators including for Cardiology</td>
</tr>
<tr>
<td>Heartworks</td>
<td><a href="http://www.heartworks.me.uk/">http://www.heartworks.me.uk/</a></td>
<td>Echo simulation</td>
</tr>
<tr>
<td>Vimedix</td>
<td><a href="http://www.vimedix.com">http://www.vimedix.com</a></td>
<td>Echo simulation</td>
</tr>
</tbody>
</table>
Appendix C: Foundation Course in Cardiology

Learning Outcomes: On completion of the course students will:

1. Be familiar with the principles of transthoracic and transoesophageal echocardiography.

2. Have understood and experienced the technology and procedures involved in cardiac catheterisation, right heart studies, temporary transvenous and permanent pacemakers, ICDs and Biventricular devices, and intra-aortic balloon pumps.

3. Have explored the principles and technology involved in electrophysiology studies and radiofrequency ablation.

4. Have gained experience in the fundamentals of cardiac surgery along with cardiovascular physiology in the perioperative cardiac surgical patient.

5. Be able to understand the process of decision making in Cardiology.
## Draft Course Outline

### Day 1:

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity / Tutor</th>
</tr>
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</table>
| 09:00 | **Introduction.**  
Objective setting. Group allocations. |
| 09:15 | **Echocardiography**  
Principles and Practice. |
| 10:15 |  |
| 10:30 | **Workshop I:** Transthoracic, Transoesophageal and Advanced Echocardiography |
| 13:00 |  |
| 14:00 | **Introduction to the cardiac catheterisation laboratory** |
| 14:30 | **How to do it I:** Moderator -  
Cardiac Catheterisation live cases: |
| 15:00 | **Haemodynamics/Right Heart Studies** |
| 15:30 | **How to do it II:**  
Cardiac Catheterisation live cases:  
- Left and Right Heart Catheterisation |
| 16:00 |  |
| 16:30 | **Workshop II:**  
Interpreting coronary angiograms  
- Groups |
| 17:30 | Review of outcomes and reflection |
## Day Two:

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>09:00</td>
<td>Cardiac Surgery for Cardiology</td>
</tr>
<tr>
<td>10:00</td>
<td>Implanting Permanent Pacemaker, ICD and CRT Devices</td>
</tr>
<tr>
<td>11:00</td>
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</tr>
<tr>
<td>11:15</td>
<td><strong>How to do it III:</strong></td>
</tr>
<tr>
<td></td>
<td>Live case: Permanent Pacemaker</td>
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<td>12:45</td>
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<tr>
<td>13:30</td>
<td><strong>Workshop II:</strong></td>
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<tr>
<td></td>
<td>Pacemaker programming and trouble shooting. Groups</td>
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<tr>
<td>15:30</td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td><strong>Academic Cardiology/Research</strong></td>
</tr>
<tr>
<td>16:30</td>
<td><strong>Electrophysiology Studies &amp; Ablation</strong></td>
</tr>
<tr>
<td>17:15</td>
<td>Review and Reflection</td>
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## Day Three:

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>09:00</td>
<td>“How to interact with Industry Representatives – and How Not To”</td>
</tr>
<tr>
<td>09:30</td>
<td>Intra-aortic Balloon Pump Principles and Practice</td>
</tr>
<tr>
<td>10:30</td>
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</tr>
<tr>
<td>11:00</td>
<td>Workshop III:</td>
</tr>
<tr>
<td></td>
<td>IABP Insertion and Trouble Shooting</td>
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<tr>
<td></td>
<td>Datascope</td>
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<tr>
<td>13:00</td>
<td>Problem based learning</td>
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<td></td>
<td>I: Managing arrhythmias</td>
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<td>Clinical Skills Area 1</td>
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<tr>
<td>16:00 –</td>
<td>Group B</td>
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