Cardiology in focus

Simulation deficit in cardiology training: a missed opportunity for the modern trainee

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Introduction

Cardiology training today exists in a paradox. As the specialty becomes more complex, particularly in procedural domains, the time and resources available to train new cardiologists have dwindled. Simulation has become an increasingly important component of modern cardiology training, offering a safe, structured and reproducible environment in which clinical skills can be developed and refined.[1] The term simulation encompasses a broad spectrum of educational approaches, ranging from focused task training to high-fidelity scenario-based learning. Task training is used to develop specific technical skills by breaking down complex procedures into their component parts—for example, practising lead manipulation and placement in permanent pacing using a haptic simulator, or employing biological models such as porcine tissue to gain proficiency in venous isolation and generator implantation. At the other end of the spectrum, high-fidelity simulation recreates real-world clinical environments, enabling trainees to manage cardiac arrest scenarios, respond to complications in a mock catheterisation laboratory and address challenges in team-based practice. Importantly, such high-fidelity approaches extend beyond technical competence, emphasising human factors, patient safety and team dynamics. Together, these modalities highlight the evolving role of simulation as a complementary tool that enhances traditional cath lab-based education and prepares trainees for the increasing complexity of contemporary cardiology practice.

In this evolving landscape, simulation-based education should serve as a critical pillar. Yet, the 2022 UK Cardiology Curriculum[2] neither defines, embeds nor mandates simulation training in a meaningful way. This gap risks producing consultants who are underprepared to perform procedures safely and confidently in high-pressure clinical environments.

Recent evidence has also highlighted the shortfalls in cardiology training under the 2022 curriculum. The Joint British Societies' position statement on UK cardiology training emphasised concerns regarding training time, procedural exposure and the lack of structured simulation-based education, calling for a re-evaluation of training frameworks to ensure competency and patient safety.[3] Furthermore, the British Junior Cardiologists' Association surveys have consistently reported reductions in procedural opportunities, increased service pressures from dual accreditation and variability in access to supervised training, with potential implications for workforce readiness.[4]

Acknowledged, but not integrated

The term 'simulation' is mentioned in the 2022 curriculum, but only in passing. It is noted as one of several educational methods, yet no framework defines its role or links it to specific outcomes. Crucially, simulation is not tied to Capabilities in Practice (CiPs), the key domains that describe the essential skillset of a consultant cardiologist.

This omission is particularly concerning in areas where simulation is most beneficial: cardiac arrest management, procedural cardiology (eg, percutaneous coronary intervention) and care of the acutely unwell patient. These are high-stakes scenarios where clinical experience can be limited, but simulation can provide the critical rehearsal needed for confidence and competence.[5]

Internationally, the role of simulation in cardiovascular training is well established. Randomised and observational studies have demonstrated that high-fidelity simulation accelerates procedural competence, improves technical precision and enhances non-technical skills such as crisis management and team communication.[6 7] Simulation has also been shown to shorten the learning curve for invasive procedures, and in some cases, correlate with improved patient outcomes.[7]

Increased expectations, less time

Postgraduate cardiology training has fundamentally changed. With dual accreditation now mandatory, cardiology runs in parallel with General Internal Medicine training over 5 years. This dual path reflects the multi-

morbidity of cardiology patients, but it drastically reduces the time available for specialist procedural training.

Resident doctors are now expected to develop expertise across all major subspecialties, imaging, interventional cardiology, arrhythmia, heart failure and congenital disease, while simultaneously acquiring and maintaining general medicine competencies. This expansion in scope has not been matched by an increase in training time.

Beyond procedural training: the wider value of simulation

Although much discussion of simulation centres on procedural training, its true value extends well beyond technical skill acquisition.[8] Simulation provides structured opportunities to strengthen essential non-technical domains of cardiology education that are often difficult to teach in routine clinical practice.

Communication skills are a prime example. High-fidelity simulation can replicate sensitive conversations such as breaking bad news after an unsuccessful resuscitation, discussing the risks and benefits of device implantation with a patient and their family or navigating complex issues around consent for high-risk procedures. These scenarios allow resident doctors to practise empathetic communication, receive immediate feedback and refine their approach without the pressure of a real patient interaction.[9]

Similarly, simulation fosters multidisciplinary team training. Cardiology care is increasingly delivered by coordinated teams, particularly in the cath lab or during acute cardiac emergencies. Simulation scenarios involving cath lab staff, anaesthetists, cardiac physiologists and nursing teams recreate the dynamics of real emergencies such as cardiac tamponade or major vascular complications. These exercises highlight the importance of clear communication, role allocation and situational awareness under time pressure, skills that cannot be acquired through individual technical training alone.[10]

Leadership and decision-making are also enhanced through simulation. Running a simulated cardiac arrest or leading the acute management of a patient with ST elevation myocardial infarction (STEMI) enables resident doctors to practise prioritising tasks, directing a team and making rapid clinical judgements with incomplete information. Studies have demonstrated that repeated exposure to such scenarios improves both confidence and performance during real emergencies, ultimately supporting patient safety.[11–13]

Finally, simulation strengthens broader non-technical skills such as resilience, adaptability and the ability to manage uncertainty. These attributes are vital for modern cardiologists who must work under constant pressure in environments where patient acuity is high and resources may be constrained.

By encompassing communication, teamwork, leadership and decision-making alongside procedural competence, simulation equips resident doctors not only to perform procedures but also to lead clinical teams effectively in complex, high-stakes situations. This holistic preparation is what makes simulation such a powerful adjunct to conventional clinical training.

The structural deficit in UK training

While simulation appears as a teaching method in the curriculum, it is never defined nor structurally integrated into CiPs. For high-risk areas such as ‘delivering effective resuscitation’ or ‘managing the acutely deteriorating patient,’ simulation is listed merely as optional evidence, not as a requirement.

By contrast, in some other specialties, simulation has a more clearly defined role in assessment progression. For example, anaesthesia curricula include structured workplace-based assessments and learning events in the Annual Review of Competency Progression (ARCP) process, and skills labs/simulation are frequently used as educational tools. Professional societies in the USA recognise simulation as an important adjunct in procedural training (eg, in interventional cardiology fellowships via Society for Cardiovascular Angiography and Interventions) and there is growing interest in Europe towards standardised exposure in simulation. However, formal mandates of simulation for credentialing remain variable and are an area for development.

In the UK, access to simulation depends on local resources and the enthusiasm of individual supervisors. There is no:

- Definition of what simulation-based education entails
- Mandated simulation exposure
- Requirement for simulation in high-risk procedural assessments
- National simulation curriculum or certification
- Integration of simulation into ARCP or Certificate of Completion of Training (CCT) decisions

This leads to geographic inequality, inconsistent skill acquisition and compromised patient safety standards.

Implementation of a national simulation strategy in cardiology will require significant infrastructure, coordination and investment. The establishment of regional or national centres of excellence, with standardised curricula and faculty training, would be essential to ensure consistency. Funding will need to cover not only equipment and facilities but also protected time for trainees and trainers, recognising that meaningful simulation requires structured debrief and feedback.

Barriers include variability in institutional support, potential regional inequities and the challenge of embedding simulation outcomes within national assessment frameworks. However, lessons can be drawn from other specialties, such as anaesthetics and surgery, where simulation has been successfully integrated into national curricula. A phased implementation strategy, beginning with high-stakes scenarios (eg, cardiac arrest, tamponade, pacing complications), may represent the most pragmatic way forward.

Risks of limited integration

- Patient safety concerns due to avoidable errors in high-stakes scenarios.
- Reduced confidence among resident doctors, potentially leading to hesitancy or over-reliance on senior colleagues.
- Burnout and stress from entering emergencies without prior rehearsal.
- Institutional risk in medico-legal contexts where competence cannot be assured.
- Erosion of CCT credibility, as variation in training undermines consistency across the workforce.

A call to action: embedding simulation at the core of training

To strengthen UK cardiology training and ensure readiness for independent practice, the following reforms are proposed:

- Mandate Simulation Milestones: Incorporate simulation-based assessments for high-stakes capabilities such as procedural safety, cardiac arrest management, communication in emergencies and acute patient deterioration. These should complement, not replace, clinical logbook-based requirements.

- Develop a National Simulation Curriculum: Define a structured syllabus covering procedural, communication and non-technical skills, aligned with CiPs. Lessons can be drawn from anaesthesia and surgical specialties, where nationally mandated simulation benchmarks are already established.
- Assure Quality and Equity: Establish regional centres or networks with accredited faculty, supported by national quality assurance. Funding models should address existing variation across devolved nations, with ring-fenced budgets and protected trainer and resident doctor time.
- Phase Implementation Pragmatically: Begin with critical scenarios (eg, tamponade, pacing complications, cardiac arrest leadership), then expand to structural heart interventions, imaging and multidisciplinary team training. A phased approach will ensure feasibility while maximising early impact.

Implementation: challenges and opportunities

Developing a national simulation strategy in cardiology will require significant infrastructure, coordination and investment. Financial provision is one of the most pressing concerns. At present, study budgets vary widely across the UK. Such constraints restrict access to simulation training and exacerbate inequities between regions. A sustainable, ring-fenced budget is therefore essential if simulation is to be embedded fairly and consistently across the country.

Faculty development is equally critical. Simulation achieves its educational impact not through equipment alone but through the expertise of trained facilitators and the quality of structured debriefing. Meaningful simulation requires experienced educators who can guide reflection and integrate lessons into everyday practice, as well as protected time for trainers to deliver this teaching alongside clinical duties. Without this investment in faculty, simulation risks becoming a superficial exercise rather than a transformative learning tool.[7]

Equity of access must also be addressed through a coordinated national framework. Establishing regional simulation centres, connected through networks with national oversight, would help reduce geographic disparities and ensure consistent standards. Such centres could provide access to high-fidelity platforms for complex scenarios while supporting local programmes with standardised curricula, accreditation processes and quality assurance.

Implementation is likely to be most feasible if phased. Introducing simulation in high-stakes, high-impact areas, such as management of

cardiac tamponade, pacing complications or leadership during cardiac arrest, would deliver early benefits and establish proof of concept. Once embedded, simulation could then expand into advanced areas including structural heart interventions, imaging and multidisciplinary team training (figure 1).

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Figure 1

Central illustration representing the challenges to cardiology training and the added value of simulation. BJCA, British Junior Cardiologists' Association.

Potential risks and limitations

Although simulation offers considerable advantages, it should not be seen as a universal solution. An overemphasis on simulation risks displacing valuable time for real-world procedural experience, particularly in later

stages of training when clinical case volume and complexity are crucial. The fidelity of simulation platforms also varies: while high-fidelity environments can approximate the pressures of clinical practice, low-fidelity models may fall short in replicating the nuances of interventional cardiology, limiting their effectiveness for advanced learners.

Simulation is also resource-intensive. Establishing and maintaining high-quality facilities requires substantial financial investment, ongoing equipment renewal and significant faculty commitment. This resource demand can be difficult to meet within already constrained training budgets. Furthermore, the educational returns from simulation are greatest at earlier stages of training, when resident doctors are building confidence and competence. As clinical exposure accumulates, the incremental benefits of simulation diminish, underscoring the importance of careful integration into the curriculum.

For these reasons, simulation is best regarded as a complementary adjunct to clinical training rather than a substitute. Its role is to provide structured opportunities to gain baseline competence, practise non-technical skills and enhance confidence before exposure to real patients, while direct clinical experience remains the cornerstone of procedural mastery.

Conclusion

In a training environment characterised by compressed timelines, dual accreditation and increasing procedural complexity, simulation represents an essential adjunct to clinical experience. While real-world exposure remains the cornerstone of competency, simulation provides a reproducible, safe and high-feedback environment in which to acquire and refine both technical and non-technical skills.

The absence of structured, nationally mandated simulation in UK cardiology training risks perpetuating inequities and missed opportunities for competence assurance. At the same time, we acknowledge that simulation is not without limitations; it requires substantial investment, dedicated faculty time and careful integration to avoid displacing clinical experience. Its value is greatest at earlier stages of training, and it must be deployed in a way that complements, rather than substitutes for, patient-based learning.

By embedding a national framework for simulation, UK cardiology training can be strengthened to produce confident, competent and resilient resident doctors. The aim is not to accelerate the CCT, but to ensure that the time to CCT produces doctors who are safer, better prepared and more consistent in their skills across the country.

Ethics statements

Patient consent for publication
Not applicable.

Ethics approval
Not applicable.

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References

1. ↲
    1.
    2. Kweki AG ,
    3. Sarwar Khan Tharin M ,
    4. Baptista V , *et al*

    . The Impact of Simulation-Based Training in Cardiovascular Medicine: A Systematic
    Review. Cureus 2023;**15**:e50414. doi:10.7759/cureus.50414

    Google Scholar

2. ↲
    1. Joint Royal Colleges of Physicians Training Board (JRCPTB)

    . *Cardiology 2022 curriculum*. London: General Medical Council, 2022.

    Google Scholar

3. ↲
    1. Joint British Societies

    . Position statement on cardiology training in the
    UK. Heart 2024;**110**:325037.

    Google Scholar

4. ↲

BJCA survey. 2023 Available: https://bjca.tv

Google Scholar

5. ↲

1.
2. Weile J ,
3. Nebsbjerg MA ,
4. Ovesen SH , *et al*

. Simulation-based team training in time-critical clinical presentations in emergency medicine and critical care: a review of the literature. Adv Simul (Lond) 2021;**6**:3. doi:10.1186/s41077-021-00154-4

Google Scholar

6. ↲

1.
2. Nayahangan LJ ,
3. Stefanidis D ,
4. Konge L

. Simulation-based training in cardiology: current perspectives and future directions. Arch Cardiovasc Dis 2021;**114**:44–54.

Google Scholar

7. ↲

1.
2. Barsness GW , *et al*

. Simulation training for structural heart procedures: a systematic review. Catheter Cardiovasc Interv 2021;**97**:1049–58.

Google Scholar

8. ↲

1.
2. Lynch A

. Simulation-based acquisition of non-technical skills to improve patient safety. Semin Pediatr Surg 2020;**29**:150906. doi:10.1016/j.sempedsurg.2020.150906

PubMedGoogle Scholar

9. ↵
    1.
    2. De Ponti R , *et al*

. The role of simulation in electrophysiology and interventional cardiology training. Europace 2019;**21**:665–74.

Google Scholar

10. ↵
    1.
    2. Rosen MA ,
    3. Salas E ,
    4. Wu TS , *et al*

. Promoting teamwork: an event-based approach to simulation-based team training. Simul Healthc 2008;**3**:33–41.

PubMedWeb of ScienceGoogle Scholar

11. ↵
    1.
    2. Weinstock P ,
    3. Halamek LP

. Simulation for healthcare: where do we come from? where are we now? where are we going? Simul Healthc 2008;**3**:207–13.

Google Scholar

12. ↵
    1.
    2. Wayne DB ,
    3. Didwania A ,
    4. Feinglass J , *et al*

. Simulation-based education improves quality of care during cardiac arrest team responses at an academic teaching

hospital: a case-control study. Chest 2008;**133**:56–61. doi:10.1378/chest.07-0131

CrossRefPubMedWeb of ScienceGoogle Scholar

13. ↵
    1.
    2. Hunziker S ,
    3. Johansson AC ,
    4. Tschan F , *et al*

. Teamwork and leadership in cardiopulmonary resuscitation. J Am Coll Cardiol 2011;**57**:2381–8. doi:10.1016/j.jacc.2011.03.017

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