

The role of physician assistants and their impact on cardiology specialty training in the United Kingdom

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Abstract

Background

The expansion of physician assistants (PAs) in the United Kingdom (UK) has raised concerns about patient safety and the impact on resident doctor training, with a lack of clarity about PA scope of practice and supervision. The role of PAs within cardiology remains poorly defined. We aimed to describe their scope of practice and assess their impact on resident doctor training in UK cardiology.

Methods

The 2024 British Junior Cardiologist's Association (BJCA) training and BJCA Starter surveys captured resident doctors' experience of PAs working within cardiology. Data were collected on three broad domains: scope of practice, impact on training and supervision. A combination of best match, checkboxes, Likert scale and free-text responses were used to gather responses. Analysis was performed using a mixed-methods approach.

Results

Responses were received from 553 resident doctors working in cardiology of whom 268 (46.8%) were currently or had previously worked with a PA. Of these, 255 (95.1%) reported PAs to be working in a ward-base setting and 70 (26.1%) in outpatients. Seventy-eight respondents (29.1%) reported witnessing PAs to be performing cardiology-based procedures, primarily echocardiography (n=55, 20.5%) and direct current cardioversion (n=32, 11.9%). Thirty-four respondents (12.6%) reported working with PAs who performed actions outside of their scope of practice including prescribing (n=7, 2.6%) or ordering ionising radiation (n=14, 5.2%). When stratified by training stage an inverse, graded relationship was observed: with those at earlier training stages reporting the most negative impact on their training, driven by increased workload and competition for training opportunities.

Conclusions

Evidence from this UK wide survey underlines the urgent need for PA national guidance within cardiology, a clear legal framework and a defined scope of practice to safeguard both patient safety and resident doctor training.

Keywords

Cardiology – Training – Resident doctor – Physician Assistant

Key messages

What is known on this topic?

Physician assistants (PAs) are an expanding workforce within the NHS, prompting concerns about patient safety, poorly defined role boundaries, and inadequate supervision. Within cardiology, the scope of PA practice and their impact on resident doctor training have not previously been described.

What this study adds

This study provides the first UK-wide evidence on PAs in cardiology. PAs were reported to perform a wide range of clinical activities, including some beyond their legal scope of practice. Early-stage resident doctors perceived the greatest negative impact on training opportunities, while more senior resident doctors reported neutral or mixed experiences.

How this study might affect research, practice, or policy

Our findings highlight the urgent need for cardiology-specific national guidance, clear legal frameworks, and consultant-led supervision of PAs. Policymakers and training bodies should prioritise protecting patient safety and resident doctor training when considering integrating PAs into specialty care.

Introduction

The National Health Service (NHS) in the United Kingdom (UK) is a varied and multidisciplinary working environment, working together to deliver high-quality patient care. Clinical roles within NHS hospitals include medical doctors, nursing staff, healthcare assistants, pharmacists and a wide range of allied health professionals (AHPs). Cardiology is a forward-thinking speciality in relation to expansion and use of AHPs, with a thriving multi-disciplinary team including specialist nurses, radiographers and cardiac physiologists.

Increasing demands within the NHS due to an ever ageing and increasingly multi-morbid population, staff shortages and issues with workforce recruitment, have led to the expansion of non-doctor clinical roles undertaking tasks which have historically only been performed by doctors. Physician assistants (PAs) were formally introduced into the UK healthcare system in 2003 with the intention of providing support to doctors with basic clinical and administrative tasks.[1] NHS England's 2023 workforce plan set a target of 10,000 PAs by 2036 and there has been a rapid expansion of PA courses in the UK over recent years. As of 2025, 34 universities offer programmes, with around 4,500 PAs in clinical practice [2].

In the UK, PAs are dependent practitioners who must work under the direct supervision of doctors, within a defined scope of practice and with limited autonomy. Despite NHS England policy stating, "PAs are not doctors, and cannot and must not replace doctors", there has been several reports of PAs substituting doctors on hospital medicine rotas and within General Practice.[3] In addition, multiple high-profile patient safety incidents and reports of PAs undertaking complex clinical activities with inadequate supervision have sparked significant concerns about the role of PAs amongst the medical community [4-6]. However, the distribution and scope of practice of PAs working within cardiology in the UK are unknown.

Resident doctors encompass all grades of doctor from foundation training to the end of specialist registrar training, across all specialties. Postgraduate medical training progression is rigorous, closely regulated, and requires formal examinations alongside

annual completion of a satisfactory portfolio. Recent data from the Association of Surgeons in Training (ASiT) suggests PAs may have a harmful impact on surgical resident doctor training by increasing competition for key training opportunities. [7] However, the impact of PAs on resident doctors training within cardiology has not been evaluated.

We aimed to characterise the presence and scope of PA practice within UK cardiology departments that include resident doctors, and to assess their perceived impact on cardiology training.

Methods

The British Junior Cardiologists' Association (BJCA) is a professional body which represents approximately 1000 cardiologists in training across the UK. Any resident doctor working as a cardiology specialist registrar is eligible to join, including those with a National Training Number (NTN). It is an affiliated society of the British Cardiovascular Society. BJCA Starter is a designated committee within the BJCA, which represents pre-registrar resident doctors who are interested in pursuing a career in cardiology.

We conducted two surveys of current resident doctors with a cardiology NTN (the 2024 BJCA training survey) and the resident doctors interesting in pursuing a career within cardiology but had not entered cardiology specialty training (the 2024 BJCA Starter Survey). Both surveys aimed to assess the impact of PAs on training, in addition to exploring other training issues. A link to each online survey was disseminated via the BJCA electronic newsletters, post-graduate education deaneries, local trainee representatives and the BJCA website. The BJCA survey was distributed and accepted responses between March and May 2024, whilst the BJCA Starter survey was distributed and accepted responses between July and October 2024.

Survey responders were eligible for inclusion if they consented to take part in questions relating to PAs. Survey questions collected data in relation to whether the doctor had worked with PAs in a cardiology setting, the clinical environment, tasks and

procedures the PAs were reported to be undertaking, as well as the impact of PAs on resident doctors' clinical training opportunities, ward workload and procedural numbers. The survey also asked whether the respondent had seen examples of PAs working outside their clear current scope of practice (including but not limited to prescribing and the requesting or providing ionising radiation) and whether resident doctors had been asked to undertake a supervisory role. A combination of best match, checkboxes, Likert scale (from one to five) and free-text responses were used to gather responses. Both surveys can be found in supplementary material 1. The data from the BJCA and BJCA Starter surveys have been combined to provide insight into the impact of these roles on cardiology training in the UK across multiple grades. Whilst the term physician associate was used in both questionnaires, physician assistant (as denoted by PA) is used throughout this manuscript in line with the updated nomenclature recommended in the Leng Review.

Data analysis

Resident doctors were grouped according to self-reported training grade as either in foundation training (FY1-2), internal medical training (IMT1-3), core cardiology training (ST4-6), higher cardiology training (ST7-8), or other (including resident doctors working in a cardiology setting not formally in training). Training grade was self-declared. The BJCA Starter survey asked only whether the respondent had worked with a PA in a cardiology setting (yes/no), without specifying whether this was current or previous, unlike the main BJCA survey. Resident doctors who reported currently or previously working with PAs in a cardiology setting were therefore combined into a single group for analyses. Analyses relating to reported positive and/or negative impact of PAs on training are presented as the percentage of resident doctors who perceived a positive or negative impact in each domain, relative to the total number who had worked with a PA.

Statistical analysis

All analyses were performed using Stata software (Version 18, StataCorp LLC, Texas). Continuous data are presented as means and standard deviations (SD) and categorical data are presented as counts with percentages. Statistical significant

testing was done using Student's t-tests and χ^2 tests respectively for continuous or categorical data. Unadjusted and adjusted linear regression, adjusted for age, sex and year of training was performed for procedural training numbers and the number of outpatient clinics attended. Linear regression analyses are presented as the difference in reported procedural/clinic volume for those reporting to be working with a PA, relative to those who reported not working with a PA, alongside their 95% confidence intervals. All statistical tests were two sided with statistical significance defined as $p \leq 0.05$. Missing data was not imputed.

Qualitative analysis

Qualitative analysis was performed on white-space questions, provided to collect additional comments on the impact of PAs in cardiology training that were not covered in previous questions. Free text answers were imported into Looppanel (Obtan Technologies Inc., Wilmington, DE) for transcription, automated coding, and theme organisation. Looppanel is an AI-assisted qualitative analysis platform, to support transcription, initial coding, and theme generation for free-text survey responses. Looppanel's workflow generated initial thematic tags, which were subsequently reviewed and refined. Thematic analysis proceeded through familiarisation with the data, grouping into broader themes, and producing a narrative summary.. All outputs were reviewed, refined, and validated by AG, and the AI tool was not used for writing or editing the manuscript.

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting, or dissemination of this study, which focused on resident doctors' perspectives on physician assistants in cardiology. As the aim was to capture trainee experiences via a national survey, direct patient or public input was not sought. Future work will incorporate these perspectives to inform recommendations and policy.

Results

Of the 539 responders to the 2024 BJCA survey (539 of 845 BJCA members, 64% response rate), 382 (69%) consented to answer questions relating to PAs, whilst all 171 (100%) responders to the 2024 BJCA Starter survey (171 of 307 BJCA Starter affiliated resident doctors, 56% response rate) answered questions relating to PAs. When combined, this resulted in 553 responders answering questions pertaining to PAs, of whom 268 (49%) reported having worked with a PA within cardiology: 90 (16%) resident doctors were currently working and 178 (32%) had previously worked with a PA within cardiology (**Figure 1A**).

There was variation across postgraduate training deaneries in the proportion of resident doctors who reported working with PAs (**Figure 1B**). The proportion of resident doctors working with PAs was highest within Peninsula deanery (92%) and least prevalent in West Yorkshire (23%). Resident doctors reporting to have worked with a PA were more likely to be older and at a more advanced stage of training (**Table 1**). There was no difference in the type of hospital (district general vs teaching hospital) where resident doctors who had worked with PAs were reported to be working.

Clinical settings and activities of physician assistants in cardiology

Most respondents reported PAs were encountered working in hospital ward settings (n=255, 95%), with one in four respondents reporting PAs also working in outpatient clinics (n=70, 26%), and a minority of respondents reporting PAs to be working in high-acuity clinical areas including the coronary care units (n=42, 16%) and in the cardiac catheterisation laboratory (n=9, 3%) (**Table 2**). In relation to clinical activities, most respondents reported PAs were witnessed performing administrative ward-based jobs (n=255, 95%). PAs were also reported to be performing cardiology procedures (n=78, 29%), seeing patients in clinic (n=70, 26%) and seeing cardiology referrals (n=40, 15%). The most common cardiology procedures PAs were reported to be undertaking were echocardiography (n=55, 21%), followed by direct current cardioversion (n=32, 12%) implanting loop recorders (n=6, 2%) and undertaking coronary angiography (n=6, 2%) (**Table 2**).

Physician assistants working outside their scope of practice.

Almost 1 in 8 resident doctors who had worked with a PA (n=34, 13%) reported PAs to be working outside their current legal scope of practice, including prescribing (n=7, 3%) and requesting or providing ionising radiation (n=14, 5%). Whilst eighteen (7%) resident doctors who had worked with a PA reported the PA to be reviewing patients independently in outpatient clinic settings or reviewing inpatient referrals without direct supervision (**Table 2**).

Impact of physician assistants on training

In relation to the impact of PAs on resident doctor training, the overall perceived impact of PAs reported by resident doctors who had worked with a PA on training was neutral (**Figure 2**). However, when stratified by training stage, an inverse graded relationship was observed (**Figure 2**, χ^2 test, $p = 0.02$). A negative impact was reported by 70% of foundation trainees, 48% of IMT trainees, 17% of core cardiology trainees, and 19% of higher cardiology trainees. Positive impact was reported by 0–19% across groups, with the highest in higher cardiology (19%). Neutral responses predominated among core (52%) and higher cardiology trainees (52%).

Amongst resident doctors working at a training stage prior to being awarded a cardiology NTN, PAs were perceived as having a negative impact on the volume of their ward work (33% of respondents), on-call work (26% of respondents) and continuity of patient care (13% of respondents) (**Figure 3**). Over two-thirds of FY and IMT doctors reported that working with PAs had a negative impact on their training opportunities, with none reporting a positive effect.

Resident doctors with a cardiology NTN were less likely to report any perceived impact, positive or negative, of PAs on training (**Figure 4**). However, PAs were seen as having an overall positive impact on continuity of patient care and the volume of ward work, whilst having an overall negative impact on on-call work burden and the

ability to attend clinic. The perceived effect on other domains was largely neutral. (Figure 4).

Linear regression was performed to quantify the impact of working with a PA on procedural training volumes and clinic attendance (Table 3). After adjusting for age, training stage, and sex, no significant differences were observed between resident doctors who worked with a PA and those who did not in the number of coronary angiograms ($\beta = +35.2$ [95% CI: -39.3 to $+109.7$], $p = 0.35$), echocardiograms ($\beta = +8.5$ [95% CI: -33.6 to $+50.6$], $p = 0.69$), pacemaker implants ($\beta = -16.4$ [95% CI: -39.6 to $+6.7$], $p = 0.16$), or outpatients clinics attended ($\beta = +8.4$ [95% CI: -5.2 to $+22.0$], $p = 0.22$).

Finally, we asked resident doctors with a cardiology NTN if they had been asked to have a supervisory role in relation to PAs. Amongst those who had worked with a PA, 88 (46%) had been asked to have a supervisory role, of whom 66 (75%) had agreed to supervise.

Qualitative synthesis

Across both surveys, 51% (n=138 of 268) of resident doctors who had worked with a PA responded to the free text prompt. Many resident doctors raised concerns about the impact of PAs on training.

"I have worked with PAs in 5 different jobs across four hospitals in four different trusts and while I liked many of them as people, in every situation I was denied training opportunities as a result of them" – Male, IMT

Among more senior cardiology resident doctors, common themes included delays to career progression, displacement from clinics and procedural opportunities.

"The PA in our department is doing their BSE accreditation, they also write the rota for the department for all trainees and they write themselves into multiple training echo lists a week preventing me from also accessing these lists" – Female, Core cardiology trainee

More junior resident doctors (FY and IMT) particularly highlighted being burdened with administrative tasks, reduced access to key learning opportunities and having to informally supervise or prescribe for PAs, often without clear oversight structure, leading to stress and medico-legal concerns. While a minority noted positive or mixed experiences, such as support with ward cover or exposure to procedural training from experienced PAs, the overarching sentiment was one of frustration and concern about role clarity, patient safety, and training equity (**Appendix II**).

Discussion

In this large nationwide survey, we have identified considerable variation in the geographical distribution and scope of practice of PAs within UK cardiology. We observed several reports from resident doctors of PAs operating outside their defined legal framework in relation to prescribing and the use of ionising radiation, as well as reports of independent patient reviews and the undertaking of complex procedures such as coronary angiography. The perceived impact of PAs on cardiology training appears to vary by stage, with FY and IMT resident doctors reporting more negative effects, primarily due to competition for training opportunities, while more senior trainees report a more neutral experience.

The role of physician assistants within cardiology

Recent guidance from the Royal College of Physicians states that PAs must have a nationally defined scope of practice, with a clearly defined role in the multidisciplinary team and must never function as a senior decision maker. [8] However, there is currently no nationally defined, cardiology-specific scope of practice for PAs. When working to support doctors with basic clinical and administrative tasks, PAs may offer benefit to resident doctors. Indeed, we observed that resident doctors in cardiology reported a positive impact on the volume of ward work across all training stages as well as on patient continuity amongst those in higher training.

Previous evidence on the impact of PAs on medical training and clinical practice remains variable. In 2019, a small mixed-methods study of resident doctors across five hospitals in northern England found that the introduction of PAs had little overall impact on postgraduate training: around half reported no change, a third noted improved learning opportunities, and only a minority perceived any negative effect. [9] In 2023 the British Medical Association (BMA) surveyed nearly 19,000 doctors across all grades and specialties on their experiences and views on PAs. [10] They found that 82% of responders felt PAs were working beyond their scope of practice and 74% of responders believed PAs posed a risk to patient safety. [10] Amongst doctors working in medical specialities, this was significantly greater, with 86% of responders believing PAs posed a risk to patient safety. [10]

We observed several reports of PAs performing invasive procedures, such as coronary angiography, that require appropriate and comprehensive training to be performed at a high standard. Whilst we were unable to validate these claims, there have been previous reports of practitioners in non-doctor roles performing coronary angiography and more advanced cardiological procedures including trans-catheter aortic valve implantation. [11-13] Performing such procedures requires not only technical skill but also the integration of clinical judgment, risk assessment, ability to manage complications and an understanding of ethical and legal responsibilities – which is only developed through rigorous undergraduate and postgraduate medical education. This is undoubtedly beyond any reasonable scope of practice of a PA and raises concerns around consent and whether patients are aware that PAs are performing a procedure without formal medical training. Coronal concerns about PAs practising outside their remit have also been highlighted in several Section 28 reports as contributory factors in preventable deaths. [14,15]

Previous freedom of information disclosures have revealed that PAs in several UK hospitals have requested tests involving ionising radiation and prescribed medications including controlled drugs such as opiates. [16,17] These activities are illegal and must be met with appropriate disciplinary action. [18] Despite these breaches, it is notable that no individual PA or hospital trust has, to date, faced any legal action over such activity.

The requirement of PAs to formally register with the General Medical Council (GMC), which will be mandatory by November 2026, provides the legal framework to ensure patients are safeguarded from this. [19] However, all doctors are legally and morally responsible in ensuring any such behaviour is highlighted and patient safety maintained.

The impact of physician assistants on training

Expansion of PAs coincides with an era of significant increased pressure on resident doctors, with rising competition ratios for higher speciality training applications and challenges in accessing protected training time due to a high burden of service provision. [20-22] Moreover, excess service provision is the primary factor cited as negatively affecting trainee wellbeing. [23] While we did not find a significant impact of PAs on higher training opportunities, their contribution to service provision (e.g. ward work) may help alleviate these pressures.

We observed an inverse relationship between training stage and the reported impact of working with a PA. This likely reflects the predominantly ward-based deployment of most current cardiology PAs, which places them in more direct competition with pre-NTN resident doctors for clinical exposure and learning opportunities. This not only diminishes training opportunities but may also deter some resident doctors from applying for a cardiology NTN. [20] While supervision of resident doctors is a structured and time-limited process central to the professional development of doctors, PAs are not expected to progress toward autonomy. Their clinical role depends on sustained, hands-on direction from supervising doctors. As such, the relationship is more accurately described as ongoing direct instruction in that PAs will never achieve independent autonomous practice. This distinction is often overlooked, yet critical to understanding their impact on medical training. The continuous instruction PAs require can divert senior clinicians' time from supervising resident doctors, reducing both the quantity and quality of training. [24]

The 2024 ASiT survey gathered responses from 1,978 resident doctors in surgical specialties, exploring the impact of PAs on training, workload, patient safety and supervision. [7] Approximately 80% of respondents reported that PAs reduced

training opportunities in theatre, and 71% perceived a decline in logbook numbers. Heterogeneity was seen across training grade with resident surgical doctors towards the end of training reporting a less negative impact on training opportunities—consistent with our findings. [7] The BMA survey reported a more consistent harmful impact of PAs on medical training, with over 65% of respondents indicating a negative effect on the training, including medical students and doctors across both medical and non-medical specialties. [10]

In contrast to resident doctors who have not entered specialty training, cardiology registrars may be better protected in terms of defined job roles and procedures – supported by our observation of no objective impact on procedural volumes or clinic attendance. Nonetheless, concerns were raised about PAs undertaking procedures generally reserved for cardiologists or appropriately trained AHPs - most notably, echocardiography. Echocardiography training is frequently cited as a difficult area for cardiology resident doctors to access. [25,26] It is difficult to justify allocating echocardiography training to PAs when resident doctors are frequently unable to meet their training requirements. Moreover, this practice introduces further competition with trainee cardiac physiologists - who, once qualified, play a key role in delivering echocardiography training for cardiology trainees.

Given the growing number of resident doctors without training posts, public funding currently used to employ PAs may be better directed toward employing doctors and expanding the number of speciality training posts. [27] This policy decision would expand the resident doctor workforce, improving capacity to meet patient care demands and allow for more protected training time away from service provision. In the longer term, it would offer a more sustainable investment in the future of the NHS, by strengthening the medical workforce with more experienced clinicians capable of independent decision-making and practice, unlike PAs who remain dependent practitioners.

The supervision of physician assistants

Recent GMC guidance states that PAs must have a named supervisor who should be a consultant, GP or autonomously practising Specialty, Associate Specialist or

Specialist doctor. [28] The BMA published national guidance for the supervision of medical associate professions in May 2024, which clearly states that resident doctors are not, and must not be expected or asked to be, responsible for the clinical supervision of PAs. [29]

In our survey, almost half of respondents had been asked to assume a supervisory role for PA, suggesting that cardiology trainees are frequently involved in direct oversight of PAs. These findings align with the ASiT survey, where 66% of surgical trainees reported supervising PAs and alarmingly 16% of respondents reported that PAs were supervising doctors. [7] This raises concerns regarding both adequate training for a supervisory role and legal indemnity for resident doctors who supervise PAs. These findings reinforce the broader issue and need for consultant-led supervision and clarifying the legal position with whom the responsibility lies with should a PA make a medical error.

Future implications

The recently published independent *Leng Review* highlights widespread concerns around patient safety, regulation, and role clarity for PAs. [30] This comprehensive review advises returning to the original role title of physician assistants and establishing professional standards to guide scope of practice amongst other recommendations. [30] These changes aim to clearly delineate the roles of PAs and doctors, remove ambiguity in terminology and provide clarity for patients. In addition, it recommends strengthening governance, defining clear scopes of practice, and ensuring appropriate medical supervision. These findings reinforce the need for specialty-specific guidance to protect training and patient care standards within the NHS. [30]

Our findings align with these conclusions, indicating that clearer delineation of responsibilities between PAs and doctors within cardiology may help ensure both safe practice and effective team functioning. Departments should remain attentive to the potential impact of PA deployment on resident doctor training, ensuring that clinical exposure and learning opportunities are maintained. Providing protected

training time for pre-registrar doctors could help preserve core cardiology experience, while supervision of PAs should be strictly undertaken by consultants to uphold high standards of patient care and medical education. Collectively, such measures may contribute to a more balanced and sustainable workforce that benefits patients, trainees, and the wider cardiology service.

Limitations

Although our data provides a comprehensive insight into the perceived roles and impact of PAs in cardiology, we acknowledge there are limitations. First, we cannot exclude response bias; although question phrasing was neutral and non-judgmental, resident doctors may have been more likely to respond to the survey if they had more polarised views. In addition, missing data was present for several questions which may be non-random. Our survey is of resident doctors' perceptions of PAs, and as it was anonymous and confidential, reports on the scope of PA practice could not be validated.

Conclusion

The impact of PAs on cardiology training varies by stage, with early-stage trainees reporting reduced access to training opportunities and greater service burden. While PAs may support continuity of care and ward workload, concerns remain around informal supervision and role clarity. Training bodies should urgently define a specialty-specific scope of practice to preserve training quality and protect patient safety.

Other Information

Contributor statement: OIB planned the survey, collected and analysed the results, and wrote the manuscript. GF analysed the results and wrote the manuscript. AG analysed the results. MD, LL, JJHB and SS planned the survey, collected the results and contributed to the manuscript. CFC planned the survey, collected the results, contributed to the manuscript, and advised on recommendations for trainees. AQ, GAN, JP and JN contributed to the manuscript and advised on recommendations for trainees. HM planned the survey, collected the results, reviewed the manuscript and is the guarantor. All authors reviewed the final manuscript.

Ethics approval: This was a national survey of all UK Cardiology trainees. This survey has been running annually for decades and as such was entered willingly without the need for ethical committee approval. Participants gave informed consent to participate in the study before taking part

Transparency statement: OIB affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; there are no discrepancies from the study as originally planned.

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Conflicts of interest: The authors have no conflicts of interest to declare.

Data sharing statement: To protect the anonymity of participating resident doctors, the data generated during this study are not publicly available; however, they may be obtained from the corresponding author on reasonable request.

Dissemination to participants: The study results will be disseminated to participants via the British Junior Cardiologists' Association weekly news bulletin and website.

Tables and Figures

Table 1 – Baseline demographics of survey responders

		Worked with PA			Total (n=553)
		Missing	No	Yes	
Sex		6			
	Male		170 (59.7%)	183 (51.8%)	p=0.08 353 (64.0)
	Female		112 (39.4%)	82 (30.6%)	p=0.08 194 (35.1)
Age		10			
	20-24		12 (66.7%)	6 (33.3%)	p<0.01 18 (3.3%)
	25-29		75 (74.3%)	26 (25.8%)	p<0.01 101 (18.6%)
	30-34		118 (49.6%)	120 (50.4%)	p<0.01 238 (43.8%)
	35-39		66 (42.6%)	89 (57.4%)	p<0.01 155 (28.6%)
	40+		10 (32.3%)	21 (67.8%)	p<0.01 31 (5.7%)
Ethnicity		6			
	White		114 (51.6)	107 (48.4)	p=0.74 221 (40.0%)
	Asian		135 (49.3)	139 (50.7)	p=0.74 274 (49.5%)
	Black		17 (60.7)	11 (39.3)	p=0.74 28 (5.1%)
	Mixed		9 (60.0)	6 (40.0)	p=0.74 15 (2.7%)
	Other		5 (55.6)	4 (44.4)	p=0.74 9 (1.6%)
Training stage		2			
	Foundation		30 (75.0)	10 (25.0)	p<0.01 40 (7.2%)
	IMT		57 (61.2)	36 (38.7)	p<0.01 93 (16.8%)
	Core cardiology trainee		92 (46.0)	108 (54.0)	p<0.01 200 (36.3%)
	Higher cardiology trainee		66 (43.7)	85 (56.3)	p<0.01 151 (27.4%)
	Other*		40 (59.7)	27 (40.3)	p<0.01 67 (12.1%)
Hospital type		3			
	DGH		135 (55.3)	109 (44.7)	p=0.13 244 (44.4%)
	Tertiary		141 (49.3)	145 (50.7)	p=0.13 286 (52.0%)
	Other		7 (35.0)	13 (65.0)	p=0.13 20 (3.6%)

Continuous data presented as mean (standard deviation), categorical data presented n (%). P value generated from Chi² test or t-test respectively for categorical or continuous data. *Includes resident doctors working on a cardiology ward not formally in training.

Table 2 – Clinical settings, activities and scope of practice of physician assistants within cardiology.

	Total (n=268)
<i>Place of work</i>	
Ward	255 (95.1%)
Cath lab	9 (3.3%)
CCU	42 (15.7%)
Outpatients	70 (26.1%)
<i>Work based activity</i>	
Ward jobs	255 (95.1%)
Cardiology referrals	40 (14.9%)
Clinics	70 (26.1%)
<i>Cardiology procedures</i>	78 (29.1%)
Coronary angiography	6 (2.2%)
Transthoracic echocardiography	55 (20.5%)
DCCV	32 (11.9%)
Loop recorders	6 (2.2%)
<i>Outside legal scope of practice</i>	34 (12.6%)
Prescribing	7 (2.6%)
Ionising Radiation	14 (5.2%)
Reviewing patients without supervision	18 (6.7%)

Data presented as n (%). Abbreviation: coronary care unit (CCU), direct current cardioversion (DCCV).

Table 3 - Impact of physician assistants on cardiology resident doctor procedural and clinic volume

	Number of procedures/clinics		Unadjusted model	Adjusted model*
	Worked with PA	Not worked with PA		
Coronary angiograms	145 (53-353)	102 (30-265)	49.9 (95% CI: -34.2 to 134.0, p=0.24)	35.2 (95% CI: -39.3 to 109.7, p=0.35)
Transthoracic echocardiograms	205 (65-300)	200 (50-337)	13.4 (95% CI: -36.8 to 63.6, p=0.60)	8.5 (95% CI: -33.6 to 50.6, p=0.69)
Pacemaker implants	26 (5-60)	24 (2-53)	-12.1 (95% CI: -36.8 to 12.6, p=0.34)	-16.4 (95% CI: -39.6 to 6.7, p=0.16)
No. of clinics attended	60 (30-150)	60 (20-120)	9.7 (95% CI: -7.8 to 27.2, p=0.28)	8.4 (95% CI: -5.2 to 22.0, p=0.22)

Linear regression estimates show the effect of working with a physician assistant on the number of procedures performed or clinics attended. Only resident doctors with a cardiology national training number included. Number of procedures/clinics is presented as median with 25th and 75th centile. *Model adjusted for cardiology trainee age, sex and training year.

Figure Legends

Figure 1 – Prevalence and geographical distribution of resident doctors in cardiology working with physician assistants

Panel A – Flow chart showing the number of survey responders who report working with a physician assistant (PA). Panel B – Percentage of survey responders within each cardiology training deanery who report having worked with a PA.

Figure 2 - Perceptions of physician assistants among resident doctors in cardiology, stratified by stage of training

Numbers within each bar represent the percentage of resident doctors within each training stage who selected that response.

Figure 3 – Reported positive and negative impacts of working with physician assistants among doctors in foundation and internal medical training working in cardiology

Percentages reflect the proportion of resident doctors who perceived a positive or negative impact in each domain, relative to the total number who had worked with a physician assistant .

Figure 4 – Reported positive and negative impacts of working with physician assistants among doctors in cardiology specialty training

Percentages reflect the proportion of resident doctors who perceived a positive or negative impact in each domain, relative to the total number who had worked with a physician assistants.

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