

How many cath labs do we need?

The population need for diagnostic cardiac catheterization & angiography, and pacemaker & defibrillator implantations, with the required laboratories.

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For the British Cardiac Society

Guidelines and Medical Practice Committee

1.1 The National Service Framework for Coronary Heart Disease¹ states that:

“By international standards, the UK has high rates of CHD but low rates of coronary artery revascularization. This does not appear to be because most other countries are over-using revascularization but rather there has been under-provision of revascularization in the UK. Another major difference between the UK and most other developed countries is that people in the UK wait considerably longer for investigation and treatment than people elsewhere.” (Chapter 5, paragraph 6, page 3.)

1.2 Under-provision of Percutaneous Coronary Intervention in Great Britain:² (1995 data)

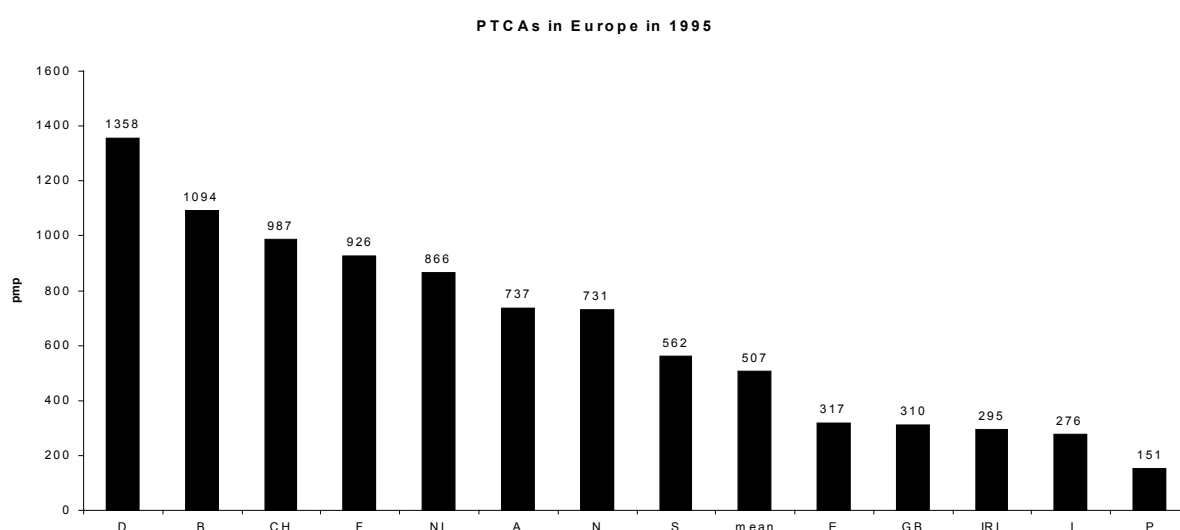


Figure 1: Numbers of Percutaneous Transluminal Coronary Angioplasties (PTCA) in Europe in 1995

1.3 Under-provision of Coronary Artery Bypass Graft (CABG) surgery in Great Britain:² (1995 data)

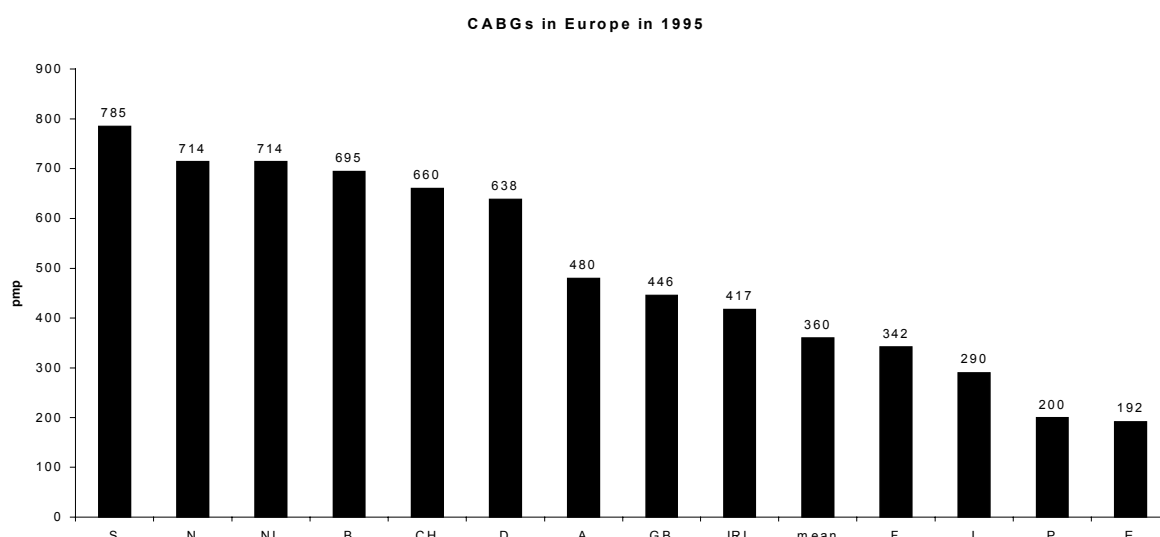


Figure 2: Numbers of Coronary Artery Bypass Graft (CABG) operations in Europe in 1995

1.4 The National Service Framework for Coronary Heart Disease¹ also states that:

“The average rates of revascularization in the 20 Health Authorities in 1996/7 with the highest rates of commissioning are equivalent to 500 Coronary Artery Bypass Graft (CABG) operations and 550 Percutaneous Transluminal Coronary Angioplasty (PTCA) procedures per million population (pmp), which is a total revascularization rate of 1100 pmp. This NSF aims to reduce inequalities and increase all HAs to an equivalent rate, relative to the local burden of disease. The NSF is expected to lead to an increase in the national rate beyond 750 CABGs and 750 PTCAs pmp.” (Chapter 5, paragraph 46, page 13.)

1.5 The first and second stage waiting time aims for angiography in the National Service Framework¹ are:

- From decision to investigate to angiography:
 - first stage aim: 6 months maximum
 - second stage aim: 3 months maximum
- (Chapter 5, paragraph 43, page 12.)

1.6 The National Service Framework¹ goal:

“Everyone meeting the NSF criteria for angiography and revascularization is identified and treated within the agreed waiting times to the standards set out in this NSF. Current estimates are that this will equate to a national rate equivalent to at least 750 pmp for PTCA and at least 750 pmp for CABG.” (Original emphasis, Chapter 5, page 18)

1.7 Cardiac catheterization and angiography:

It is current worldwide cardiological practice in developed countries to undertake cardiac catheterization and angiography in appropriate patients for the diagnosis and assessment of suspected cardiac disease and abnormalities. It is unlikely that Magnetic Resonance Angiography (MRA) will be developed with a resolution and speed to provide general and adequate *coronary artery* imaging to routinely replace coronary angiography within the near future. Similarly, computed tomography or electron beam computed tomography is useful to diagnose coronary artery calcification, and the presence of coronary artery disease, but at present this technique cannot image or measure coronary morphology or severity of obstruction or guide the necessity for intervention and revascularization. It is not likely that electron beam computed tomography could routinely replace the need for coronary angiography within the near future.

Within a planning timescale, coronary angiography is expected to remain the standard method for investigation and assessment of appropriate patients with suspected coronary artery disease. Cardiac catheterization and angiography is also a necessary investigation in appropriate patients with various other suspected cardiac abnormalities or diseases.

2.1 Under-provision of coronary angiography in Great Britain:² (1995 data)

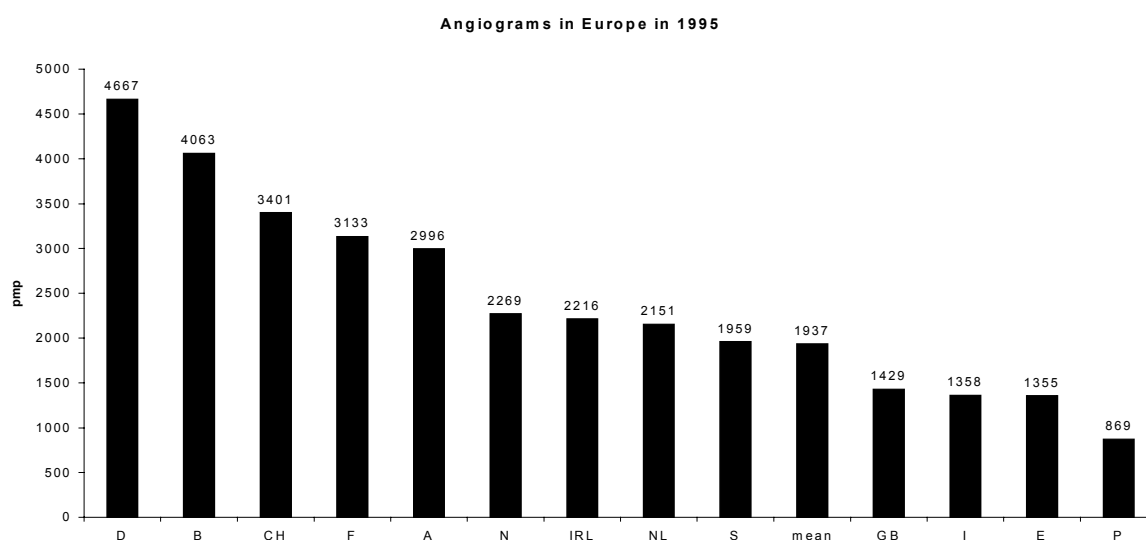


Figure 3: Numbers of angiograms in Europe in 1995

2.2 Coronary angiography in Great Britain:

In 1995 there were a reported 1429 coronary angiography procedures per million population in Great Britain, and 1621 in 1996.^{2,3} These rates compare with selected European means of 1937 in 1995, and 2672 in 1996, per million population.^{2,3} The British Cardiovascular Intervention Society (BCIS) has reported that there were 126 UK hospital centres (111 NHS and 15 independent) undertaking coronary angiography in 1998.⁴

2.3 European procedures per million population:^{2,3}

Table 1: Cardiac procedures in Europe

Country	ID	Angios 1995	PTCA 1995	PTCA/angio%	CABG 1995	angios/ revasc	Angios 1996	PTCA 1996	PTCA/angio%
Germany	D	4667	1358	29	638	2.3	5557	1548	28
Belgium	B	4063	1094	27	695	2.3	3094	1330	43
Switzerland	CH	3401	987	29	660	2.1	3508	1103	31
France	F	3133	926	30	342	2.5	3149	1090	35
Austria	A	2996	737	25	480	2.5	3296	838	25
Norway	N	2269	731	32	714	1.6	2535	824	33
Ireland	IRL	2216	295	13	417	3.1	NA	NA	NA
Netherlands	NL	2151	866	40	714	1.4	2941	927	31
Sweden	S	1959	562	29	785	1.5	2133	612	29

United Kingdom	GB	1429	310	22	446	1.9	1621	354	22
Italy	I	1358	276	20	290	2.4	1569	342	22
Spain	E	1355	317	23	192	2.7	1309	380	29
Portugal	P	869	151	17	200	2.5	1357	233	17
Mean		1937	507	26	360	2.2	2672	798	29

Rates are expressed per million population; Angios = coronary angiograms; PTCA = Percutaneous coronary Transluminal Angioplasty; CABG = Coronary Artery Bypass Surgery.

2.4 European rates of angiography:

It can be calculated from the European data from 1995 that the number of coronary angiography procedures was a ratio of 2.2 (mean; range 1.4 to 3.1) times the number of revascularization (PTCA + CABG) procedures. For most European countries, the ratio was within the range 2.0 times to 2.5 times, and in Great Britain was 1.9 times.

2.5 UK planning assumptions undertaken by The London Implementation Group⁵ and The British Cardiac Society^{6,7,8,9} in 1993 agreed that the number of diagnostic cardiac catheterization and angiography procedures needed would be twice the number of interventions performed; these include CABGs, and PTCAs, *as well as* valvular operations, electro-physiological and other cardiac surgical operations. Calculations then suggested 100 valve operations per million population and 30 miscellaneous operative procedures per million population, including electro-physiological procedures, would be required. This translated at the time into 260 diagnostic cardiac catheterization and angiography procedures needed per million population, in addition to all the coronary cases. The British Cardiac Society calculated in 1994 that there would be an annual need for 30-50 diagnostic electro-physiological cases per million population.⁹ In fact, the number of diagnostic and therapeutic procedures undertaken for cardiac electro-physiological indications has markedly increased since then.

2.6 Planning assumptions:

It would seem reasonable, for planning purposes, to assume that the number of diagnostic cardiac catheterization and angiography procedures required would be a ratio of 2.0 times the total number of cardiac surgical and interventional procedures performed or planned. Alternatively, for planning purposes, it could be assumed that the number of diagnostic cardiac catheterization and angiography procedures required would be a ratio of 2.2 times the number of cardiac revascularization procedures performed or planned. And, a ratio of 2.2 times the number of cardiac revascularization procedures is an easier surrogate to calculate and plan for, compared with twice the total number of cardiac surgical procedures planned. If an upper limit of possible numbers is required for planning assumptions, then a ratio of 2.5 times the number of cardiac revascularizations planned should be used.

2.7 Local planning:

The National Service Framework for Coronary Heart Disease states that provision of revascularization should be related to the local burden of disease (Chapter 5, paragraph 46, page 13). Planning assumptions, therefore, may need to be adjusted for the local burden of disease. This adjustment would usually be done by using the local Standardized Mortality Ratio (SMR) for Ischaemic Heart Disease.

Table 2: Population based procedures

Procedure	Per million population
CABGs	<i>At least 750</i>
PTCAs	<i>At least 750</i>
Total revascularizations	<i>At least 1500</i>
Diagnostic catheterizations = 2.2x	3300
Maximum diagnostic catheterizations = 2.5x	3750
(Local need = mean X local SMR of e.g. 1.10)	(e.g. 3630)
(Maximum local need for SMR of 1.10)	(e.g. 4125)

2.8 For medium-term planning assumptions, therefore, it should be the aim to provide approximately at least 3300 diagnostic cardiac catheterization and angiography procedures for each million population; and more where the local burden of coronary disease is high.

3.1 Cases per session:

The British Cardiac Society has stated that at least 4 cases should be performed in each diagnostic session in a cardiac catheterization laboratory.¹⁰ The Royal College of Physicians has stated that between 3-6 patients could be studied in each session in a cardiac catheterization laboratory.¹¹

3.2 Use of laboratory time

In order to allow for the case-mix of different types and complexity of investigation on patients in a cardiac catheterization laboratory, it is useful to quantify the level of workload that could be appropriately undertaken within a standard 3.5-hour session. The procedural times are defined from arrival of the patient in the laboratory to departure, but not pressure haemostasis, as this is usually secured by other clinical staff outside the laboratory; if pressure haemostasis is secured by the operating medical staff, then the time allowed for coronary cases should be increased accordingly. Efficient turn-around times will depend on well-organized portering arrangements, and good liaison between the cardiac catheterization laboratory and the day-ward and in-patient wards.

3.3 Units of laboratory time

Procedural times for straightforward cardiac catheterization and coronary angiography would be expected to be about 30 minutes. Procedural times for more complex cases of cardiac catheterization and coronary angiography, for example valve disease or studies of previous coronary artery bypass graft surgery, would be expected to be 45 minutes. It is expected that there will be an increasing proportion of complex cases which require diagnostic cardiac catheterization and angiography in the future, with more reinvestigations of patients who have had previous coronary interventions or surgery performed.

As coronary angiography is by far the most common diagnostic procedure performed in a cardiac catheterization laboratory, it is appropriate to designate the average 30-minute duration as one unit of laboratory time (ULT). And the average duration of complex cardiac catheterization and angiography at 45 minutes would be 1.5 units of laboratory time (ULTs).

3.4 Training and other factors

Training requirements, for example when a specialist registrar is being trained, would expect a longer duration of cases and thus fewer scheduled procedures to be appropriate. Thus fewer scheduled cases for each session would be appropriate. The duration of laboratory time required for cases when training other medical staff are involved might be 20% or 25% greater than that required when performed by an experienced skilled operator; for example 1.25 ULTs (37.5 mins) for a simple cardiac catheterization and coronary angiography case, and 1.75 ULTs (52.5 mins) for a complex cardiac catheterization and angiography case. And unexpected complications or difficulties, for example with vascular access, will prolong the duration of some cases.

3.5 Percutaneous Coronary Intervention (PCI)

This document has not estimated the population need for therapeutic or interventional coronary procedures and the cardiac catheterization laboratory time involved.

Pacemakers and cardiac electro-physiology:

4.1 Implant rate and Guidelines:

There were 17160 new pacemaker systems, and 4939 replacement pacemaker systems, implanted in The United Kingdom in 1999; these data indicate a new implant rate of 297 per million population, and a replacement generator rate of 86 per million population, a total of 383 new and replacement systems per million population.¹² Old guidelines from the British Cardiac Society, and the British Pacing and Electrophysiology Group, have recommended the annual need for 300 new pacemaker implants per million population in the UK.^{9,10,13} In addition, there is a need for replacement of

previously implanted systems when batteries run down, or in cases of device or lead malfunction or recall; currently about 20% of all implantations are generator changes or revisions, so any population target will need to incorporate this requirement. There may be greater numbers of new pacemaker systems required in the future with developments of pacing in patients with arrhythmias, heart failure, neuro-cardiogenic syncope, etc. The British Pacing and Electrophysiology Group have advised that it would be prudent to plan for a total of 450 new pacemaker systems and an additional 100 replacement pacemaker systems, a total of 550 pacemaker implants per million of the population.¹⁴

4.2 Comparison with Europe:

The new pacemaker implant rate in the European Community in 1997 varied from 247 to 585 per million population.¹⁵ A United Kingdom target of 450 new pacemaker systems implants per million of the population would seem very reasonable when compared with similar European Countries. In 1999, it can be seen that the implant rate in the United Kingdom was relatively low when compared with various other European Countries:¹⁴

Table 3: Pacemaker procedures in Europe 1999

Europe 1999		First PPM	AICD
Per million pop		implants	implants
Belgium	B	676	49
France	F	554	14
Austria	A	492	
Germany	D	482	67
Sweden	S	471	
Switzerland	CH	371	
United Kingdom	GB	297	18
Norway	N	292	33
Italy	I	287	29
Netherlands	NL	281	

PPM: Permanent pacemaker; AICD: Automatic implantable cardiac defibrillator

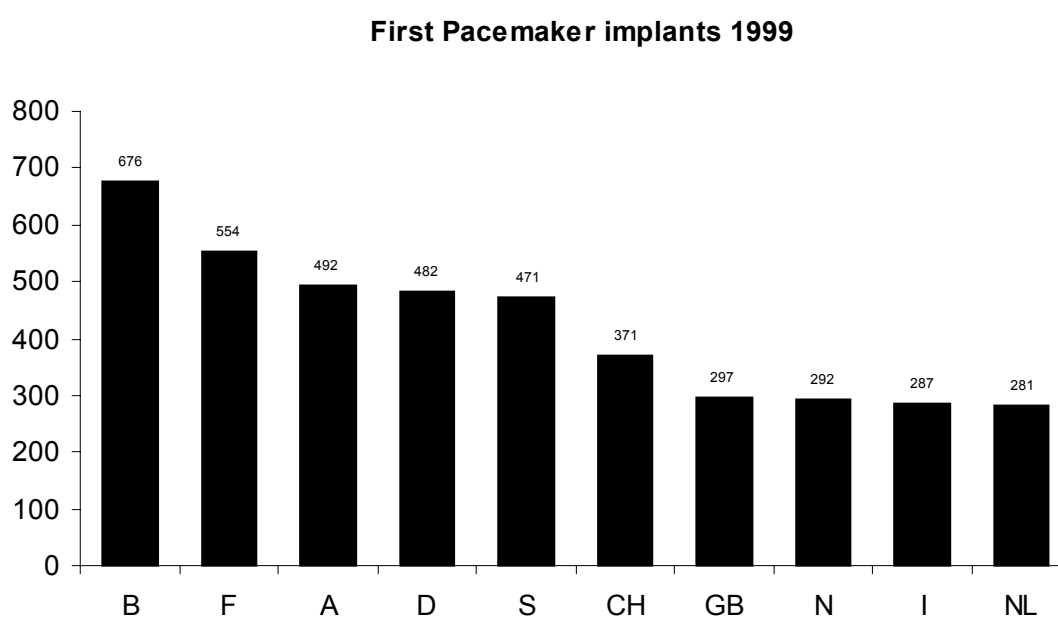


Figure 4: First pacemaker implants in Europe 1999

4.3 Therefore, it should be the aim to provide for the implantation of a total of 550 new and replacement permanent pacemaker systems annually per million population.

4.4 Facilities required for pacemaker implantation:

The British Pacing and Electrophysiology Group have published guidance on the facilities required for pacemaker implantation.¹³ The ideal facility for pacemaker implantation is an operating theatre or dedicated pacing laboratory in which the highest standards of sterility can be maintained. While it is both

feasible and commonplace to implant pacemakers in cardiac catheterisation laboratories or even in a general radiography department, it is unlikely that operating theatre standards can be maintained in such areas, which should be regarded as sub-optimal for pacing. Details of the relevant equipment requirements have also been provided.¹³ An institutional caseload of at least 60 implantations per year should be assured to maintain competence in the centre.¹³

4.5 Pacemaker implantation in a dedicated facility:

A dedicated operating theatre with adequate C-arm fluoroscopy may be preferable to a cardiac catheterization laboratory for pacemaker implants. Advantages of this facility include sterile air and environment quality, flexibility of access, and consultant availability. If general operating theatres are used, there may be lower standards of sterility, less flexibility of access, with restrictions to specified sessions; competition for theatre C-arm fluoroscopy from other specialties; possible competing demand on operating theatre time and sessions from all surgical specialties; possible competing demand from surgical waiting list initiatives; and possible restricted consultant availability for implants or replacements for specified alternative theatre sessions because of other commitments, e.g. out-patient clinics, etc.

4.6 Pacemaker implantation in cardiac catheterization laboratory:

A dedicated pacemaker implantation laboratory is an alternative to the use of an operating theatre. An alternative, but probably less satisfactory for sterile quality, is a shared cardiac catheterization laboratory. An advantage of these facilities includes flexibility of access.

4.7 Efficiency:

Restricted access to shared theatres using one or two sessions per week results in patients waiting in beds ("bed-blockers") for urgent or emergency implantation of permanent pacemakers systems. Furthermore, the longer a patient has to wait for a permanent pacemaker implant the greater the clinical risks, which include infection, displacement, perforation and malfunction of temporary pacemaker leads. It is understood that the British Pacing and Electrophysiology Group are developing a guideline on the management of patients who require a temporary pacemaker, and which is likely to include the following recommendations:

- Temporary pacing, especially by the transvenous route, should be avoided if at all clinically possible; if it is necessary, it should be as short-lived as possible;
- The above may only be achieved by early referral of patients to pacing centers;
- Establish clear mechanisms for training appropriate junior medical staff;
- Development of clear guidelines regarding who does and (perhaps more importantly) who does not need temporary cardiac pacing. A

patient with syncopal bradycardia who requires emergency treatment should receive this as soon as possible, out of hours if necessary.

These recommendations will require easier access to permanent pacemaker implantation in many hospitals; and better co-ordination between those acute hospitals without permanent pacemaker implantation facilities and their local pacemaker implantation centre.

4.8 Pacemaker lead monitoring:

Rarely patients with pacemaker implants require regular radiographic surveillance of the pacemaker leads. This monitoring, screening, recording and archiving should probably be done in large centers. Large centres who have the required facilities and expertise can undertake lead extraction where this is appropriate, and which should only be undertaken in a few specialized centres.¹⁶

4.9 Units of laboratory time - pacemakers

A single chamber new pacemaker system implant would reasonably be expected to take 1 hour, or 2 units of cardiac catheterization laboratory time (ULTs). A dual chamber new pacemaker system implant would be expected to take 1.5 hours or 3 ULTs. In 1999, 47% of new implants were single chamber, and 53% were dual chamber pacemaker systems.¹² Current published guidance indicates that 80% of implants should be dual chamber systems. It would be expected that 20% of total cases would be replacement systems. These may be straightforward such as simple generator changes; or complex such as pacemaker dependent patients who would need temporary pacing electrodes, or needing lead revision, or replacement and extraction. The time required for these replacement cases is unpredictable, but on average might be expected to be 1.5 hours or 3 ULTs. Training requirements, for example in sessions in which a specialist registrar is being trained, would expect a longer duration of cases and thus fewer scheduled procedures to be appropriate. The duration of laboratory time for training purposes might be 2.5 ULTs (75 mins) for a simple new pacemaker implantation case, and 3.5 ULTs (105 mins) for a complex pacemaker implantation or renewal case. And unexpected complications or difficulties, for example with vascular access or lead placement, will prolong the duration of some cases.

4.10 Diagnostic cardiac electro-physiology:

The National Institute for Clinical Excellence has issued guidance on the indications and need for automatic implantable cardiac defibrillators (AICD).¹⁷ For this to be implemented, there will need to be an increase in the number of centres undertaking the implantation of cardiac defibrillators, and screening programs using invasive cardiac electrophysiological studies will be required to detect appropriate patients who are at high risk. It has been estimated that approximately 3% of new myocardial infarctions, about 66 patients per million population, should be screened with a limited invasive cardiac electro-physiological study using programmed ventricular stimulation to determine

whether ventricular tachycardia can be provoked.¹⁸ This procedure would be expected to take one hour or 2 units of laboratory time.

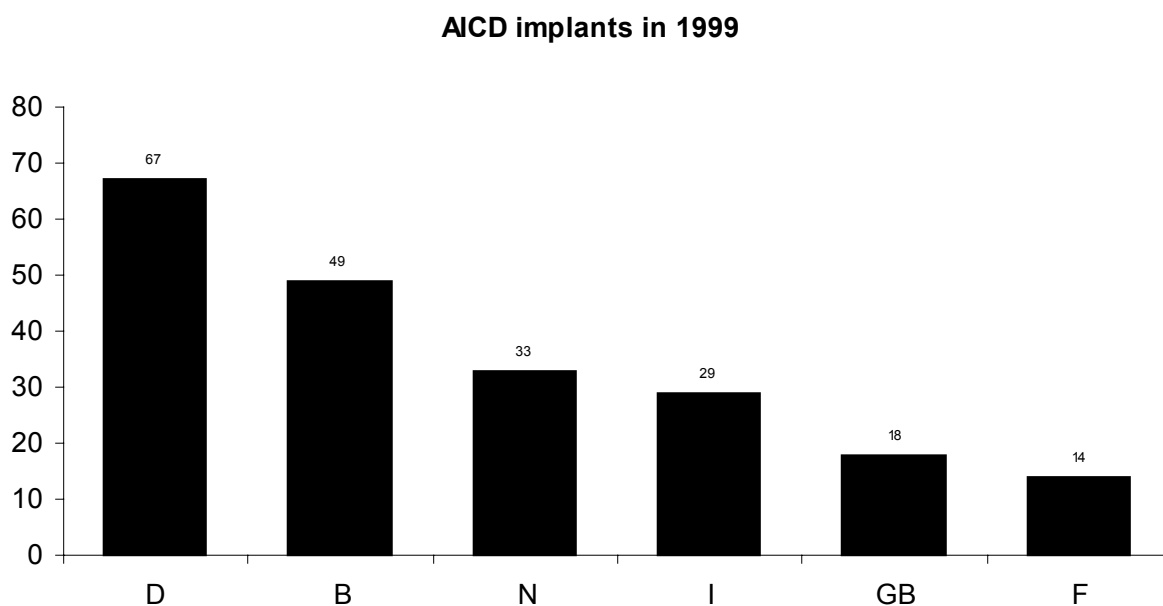


Figure 5: Automatic Implantable Cardiac Defibrillators (AICD) implants 1999

4.11 Units of laboratory time - implantable cardiac defibrillators

The National Institute for Clinical Excellence has estimated the total need for new and replacement implantable cardiac defibrillators at 50 per million population, with a new to replacement ratio of 2:1. This may be an underestimate if the criteria for patient selection listed by the National Institute for Clinical Excellence are widely applied. It is estimated that each cardiac defibrillator would take about 1.5 hours or 3 units of laboratory time to implant.

Cardiac defibrillators should be implanted in the same sterile conditions as pacemaker systems.

4.12 Cardiac electro-physiological ablations

There is probably no important role for other diagnostic invasive cardiac electrophysiological studies in a setting where cardiac ablation procedures are not available. This document has not estimated the population need for such therapeutic or interventional ablative cardiac electro-physiological procedures, and the cardiac catheterization laboratory time involved.

5.1 Laboratory times:

It can be calculated how many units of cardiac catheterization laboratory time (ULTs) in a diagnostic cardiac catheterization laboratory would be required to satisfy the predicted population need:

Table 4: Laboratory times for procedures

Procedure	Type	ULT*	Weighted ULT*
Cardiac catheterizn & angiography	Simple	1.0	1.25
	Complex	1.5	
Cardiac electro-physiological studies	VT stimulation post MI	2.0	2.0
Permanent pacemaker implants	New – single chamber	2.0	2.8
	New – dual chamber	3.0	
	Replacement	3.0	
Cardiac defibrillator implants	New	3.0	3.0
	Replacement	3.0	

*ULT = Units of Laboratory Time = 0.5h = 30mins

5.2 Laboratory requirements:

If it is assumed that 6 units of laboratory time can be utilized in a session of 3.5 hours, to realistically allow for slippage of time in the interchange between cases:

Table 5: laboratory requirements for procedures

Procedure	Cases per 10 ⁶ pop	Weighted ULT*	Total ULTs*	ULTs* per session	Total sessions per 10 ⁶ pop
Cardiac catheterizn & angiography	3300-3750	1.25	4125-4688	6	688-781
Cardiac electro-physiological studies	66	2.0	132	6	22

Subtotal: catheterization laboratory	3366-3816	1.26	4257-4820	6	710-803
Permanent pacemaker implants	550	2.8	1540	6	257
Cardiac defibrillator implants	50	3.0	150	6	25
Subtotal: pacing laboratory	600	2.64	1712	6	285
Total	3966 - 4416	1.5	5969 - 6532	6	995 - 1088

*ULT = Units of Laboratory Time = 0.5h = 30mins

5.3 Adjustments

These estimated catheterization requirements might need to be adjusted for several reasons and factors, which include the following:

- A. The estimated requirements assume complete efficiency. A stochastic model of bed occupancy concluded that spare capacity is essential for the effective management of emergency admissions, and these risks occurred when *average* bed occupancy exceeded about 85%.¹⁹ Similarly, it would be important to allow for the peaks of emergency work by planning too much rather than too little capacity in the cardiac catheterization and pacemaker laboratories. Non-clinical time is required for cleaning, maintenance and service of equipment, and additional clinical time to allow for the few more complex cases that take much longer than expected. (The times given for various procedures are estimated medians rather than means, and do not allow for the tail of the longer time required for the most difficult and complex procedures.) Thus, the estimated population needs for facilities for cardiac catheterization and angiography, as well as pacing and defibrillator implants, should be approximately 15% in excess of the actual capacity required.
- B. If permanent pacemaker and cardiac defibrillator implants are done in a cardiac catheterization laboratory, the total sessional requirements for these facilities will need to be increased by approximately 25-27% over those required for a cardiac catheterization and angiography laboratory alone.
- C. The need for coronary angiography could be adjusted for the local burden of coronary heart disease, usually done by using the local Standardized Mortality Ratio (SMR) for Ischaemic Heart Disease. Coronary mortality has declined disproportionately to its incidence in the United States, Canada, Australia and most Western European countries,^{20,21,22} but hospital admissions for coronary disease have increased.²³ Trends suggest that coronary disease is being delayed and presented in a less severe form, possibly because of modification of coronary risk factors and with modern innovations in treatment. The favourable national trends in risk factors and mortality in the United States and Europe since 1965 have

not resulted in much reduction of the national problem of cardiovascular disease. Morbidity, mortality and utilization of health care services remain high in the developed countries, and paradoxically the incidence appears not to have declined in many affluent parts of the world. Thus it should be questioned whether the use of a local SMR is an appropriate surrogate adjustment for the local incidence and clinical burden of coronary heart disease, at least when the mortality is falling.

- D.** The requirement for coronary angiography could be adjusted for possible expected future reductions in local coronary heart disease morbidity. Factors leading to expected future reductions in coronary heart disease incidence, with fewer expected coronary events, might include secondary and primary prevention measures with statins, prevention associated with Our Healthier Nation initiatives, and an increase in the proportion of people receiving optimal medical treatments. Adjustments might also be appropriate for a configuration of the local population which differs from the national structure, such as relatively more older people, or for local ethnic groups with a high incidence or prevalence of coronary morbidity.
- E.** Training requirements, for example in sessions in which a specialist registrar is being trained, would expect a longer duration of cases and thus fewer scheduled patients would be appropriate. The duration of laboratory time required for cases when training other medical staff might be 20% or 25% greater than that for cases performed by an experienced skilled operator. Thus the ULTs, and the sessional requirements, might need to be increased (or the caseload reduced) by perhaps 20%-25% for those training sessions.
- F.** The requirements for the National Health Service provision of cardiac facilities should be adjusted for the expected local demand for independent cardiac services, and for the provision to the local health care system of independent cardiology facilities and services.

5.4 Cardiac catheterization laboratory requirements

Table 6: Cardiac laboratory requirements

Procedure	Cases per 10 ⁶ pop	Total sessions per year	Sessions per week @49wks/yr*	Sessions per week @44wks/yr**
Cardiac catheterizn and angiography	3300 - 3750	688 - 781	14.0 - 15.9	15.6 - 17.8
Cardiac electro-physiological studies	66	22	0.5	0.5
Subtotal: catheterization laboratory	3366-3816	710-803	14.5-16.4	16.1-18.3

15% excess capacity (Sect 5.3A)	3366-3816	835-944	17.0-19.3	19.0-21.5
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Permanent pacemaker implants	550	257	5.2	5.8
Cardiac defibrillator implants	50	25	0.5	0.6
Subtotal: pacing laboratory	600	282	5.7	6.4
15% excess capacity (Sect 5.3A)	600	330	6.7	7.5

Combined total	3966 - 4416	992 - 1085	20.2 - 22.1	22.5 - 24.7
15% excess capacity (Sect 5.3A)	3966 - 4416	1165 - 1274	23.7 - 26.0	26.5 - 29.0

*= Assumes that cases are performed during 49 weeks each year (i.e. no planned cases over two weeks at christmas & new year periods, and on five other days of public & bank holidays), and are performed by an alternative specialist when consultant is away on leave; **= assumes that cases are performed during 44 weeks each year, and are not done when consultant is away on leave.

5.5 Day-ward:

In planning for the expected number of patients having invasive cardiac procedures, it would be essential to calculate the appropriate number of beds required in a day-ward. It could be calculated that perhaps 75%-80% of cases could be done electively as day-cases, and 20%-25% as in-patients; and in-patients would still need some recovery time in a cardiology day-ward. These proportions might need to be adjusted in future if more patients with acute coronary syndromes have urgent in-patient investigations. It is an essential requirement for optimal efficiency that a day-ward is located adjacent or convenient to the cardiac catheterization laboratory. Furthermore, patients having elective permanent pacemaker systems implanted or renewed would require a bed in a day-ward; and there will be a need for day-case beds from patients having cardioversions, initiation of various drugs such as beta-blockers in advanced heart failure, etc. The planning of a cardiology day-ward for a cardiac catheterization laboratory should include all the cardiology departmental needs for these beds.

A cardiology day-ward would also require a reception area for patients to attend and wait; a suitable area for a receptionist/secretary to perform administration/ clerical/ IT/ database tasks; enough space for patients to sit out between their time after using a day-ward bed and before full mobilization; and suitable areas for medical staff to confidentially discuss results and plan treatment with patients.

5.6 Diagnostic cardiac catheterization laboratories: Therefore, there should be the provision of:

- one diagnostic cardiac catheterization and angiography laboratory per 450,000 to 600,000 population; and
- one pacemaker and defibrillator implantation laboratory per 1.3 to 1.5 million population; or
- one combined laboratory per 350,000 to 400,000 population if pacing and cardiac defibrillators are implanted in the same facility.

This provision should be adjusted:

- Relative to the local burden of disease; and
- For the possible reduction in local incidence of coronary *morbidity* in the future; and
- For training requirements; and
- For the independent provision and use of local cardiology services.

6.1 Consultant staffing required:

The Royal College of Physicians and British Cardiac Society advise that consultant job plans should include a specific number of fixed sessions; and that there should not be more than one session devoted to procedures in a cardiac catheterization and angiography laboratory for consultants working in a secondary centre; or 2-3 sessions for a consultant working in a tertiary centre.¹¹ This is because there will be other demands from fixed sessions of outpatient clinics, non-invasive laboratory outpatient clinics, and ward rounds, etc. Therefore, the number of consultant cardiologists required to plan consultant staffing should be on the basis of one fixed session for each consultant in a cardiac catheterization laboratory in secondary care. This would require 24-29 whole time equivalent (WTE) consultant cardiologists per million population to perform cardiac catheterisation and angiography procedures, and pacing and defibrillator implantations, with the range depending on whether cover for leave is provided or not. Not all consultant cardiologists will perform these procedures, and not all will be full-time; on the other hand, it is expected that some consultants will spend two fixed sessions in a local cardiac catheterization laboratory. If it is assumed that each consultant cardiologist spends an average of 1.5 sessions each week devoted to these laboratory activities, the required numbers to perform these procedures would be 16-19 whole time equivalent (WTE) consultants per million population.

Table 7: Number of consultant cardiologists required for invasive procedures per million population

Per million population	Cardiac catheterization and angiography	Pacing and defibrillator implants	Combined procedures
Total sessions required	17-21.5	6.7-7.5	23.7-29.0
1 session/week per consultant	17-22	7-8	24-29

1.5 sessions/week per consultant	11-14	5-5	16-19
2 sessions/week per consultant	9-11	3-4	12-15

The ranges provided are dependent on whether there is another specialist able to perform these procedures when consultants are away on leave.

6.2 Recommended consultant cardiologist numbers in the United Kingdom:

The Royal College of Physicians and British Cardiac Society have previously recommended a staffing level for cardiologists of 1.0 WTE consultant per 80,000 population (= 12.5 WTE consultants per million population).¹¹ The fifth report on the provision of services for patients with heart disease recommends an immediate increase in cardiologist staffing to one WTE consultant per 50,000 population (from the present 630 to 1194 cardiologists); and a further increase to one WTE per 40,000 population (1500 consultant cardiologists, equating to 25 per million population) by 2010 to deliver modern cardiac services.²⁴

6.3 European comparisons:

Manpower data from 1997-98 demonstrate the under-provision of cardiologists in the UK compared with Europe (although it is accepted that there may be different definitions of what a cardiologist is, and what they do, in different European countries).²⁵

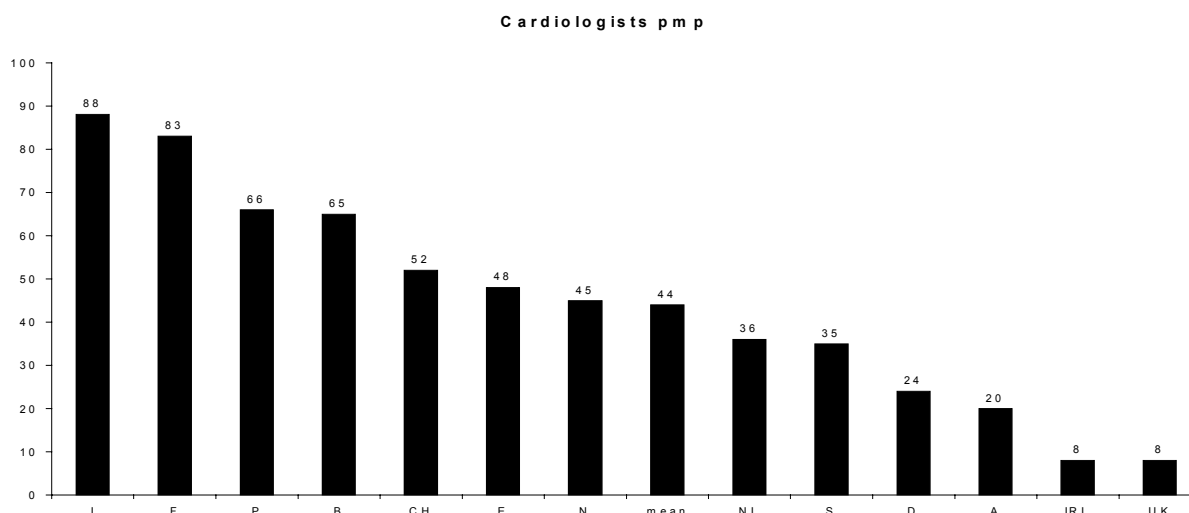


Figure 6: Numbers of cardiologists in Europe

6.4 UK staffing:

It can be seen that for the European countries indicated, the average number (arithmetic mean) of cardiologists was 44 per million population (= 1:23,000) in 1997-98.²⁵ In comparison from the same data source, the UK had 8 per million population (= 1:125,000). The Royal College of Physicians has estimated that the average number of cardiologists in 1997 was 10 per million

population (= 1:102,299) in England, Wales and Northern Ireland.¹¹ Even if the recommended increase to 25 cardiologists per million (= 1:40,000) population is achieved by 2010, the numbers will remain small in comparison to current cardiology staffing in European countries.

7.1 Requirements for diagnostic cardiac catheterization and angiography laboratories:

The British Cardiac Society published a statement in 1994 on the "Strategic planning for cardiac services and the internal market: the role of cardiac catheterization laboratories in district general hospitals".²⁶

Options considered by the British Cardiac Society included:

1. All invasive cardiac work done in specialist centres by own staff.
2. All invasive cardiac work done in specialist centres; elective cases done by DGH cardiologists.
3. Some DGHs develop cardiac catheterization facilities.
4. Elective invasive work in DGHs becomes the norm.

The Council of the British Cardiac Society recognized that option 1 was not appropriate. Options 2 and 3 were considered appropriate strategies, and that such developments would in effect move closer to Option 4 in time.

7.2 Place of invasive diagnostic procedures:

In the case of diagnostic cardiac catheterization and angiography, it is clear that such procedures can and should be provided in specialized departments within local acute general hospitals serving an appropriate population size. The risks of elective diagnostic cardiac catheterization and angiography are relatively small, and it can be considered a relatively low risk intervention.²⁷ Permanent pacemaker implantation and renewal is a low risk intervention and appropriate to be performed in acute general hospitals.¹³

7.3 Requirements for a cardiac catheterization laboratory:

The British Cardiac Society has published criteria for the provision and use of a cardiac catheterization laboratory in district general hospitals.²⁶ The British Cardiac Society has also published guidelines for the use of mobile cardiac catheterization laboratories.²⁸

7.4 The National Service Framework for Coronary Heart Disease¹ states:

Facility and operator standards for angiography, (PTCA and CABG):
(Chapter 5, paragraph 34, page 9)

Angiography:

- In any single institution undertaking coronary angiography, a minimum of 500 cardiac catheterization procedures per year should be carried out by a minimum of two operators;

- Each individual operator (consultant level) should perform a minimum of 100 cardiac catheterizations per year.

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