IPEM Institute of Physics and Engineering in Medicine

Ultrasound Workforce Calculator

UNIRSIG ultrasound workforce working party:
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Introduction

An ultrasound workforce survey conducted by IPEM's Workforce Intelligence Unit last year highlighted vacancy rates well beyond that of other MPCE specialisms. Despite over a million ultrasound scans being carried out every year across the UK and fast-moving technological and clinical developments including point-of-care ultrasound, artificial intelligence for image optimisation and to aid diagnosis, and new groups of staff performing ultrasound imaging, individual departments are struggling to build their workforce and many healthcare services are currently without specialist ultrasound physics services.

It is vital that ultrasound is used safely in healthcare, with suitable, quality assured equipment and up-to-date techniques to ensure that patients are protected from harm and get accurate diagnoses. This can only be achieved with a robust and well-trained ultrasound physics workforce. In March 2023, IPEM conducted a survey of the medical ultrasound physics workforce which identified an estimated 23% vacancy rate for Clinical Scientists and 14% for Clinical Technologists in ultrasound physics. This not only compromises clinical safety but limits the potential for development in the field that is a key role of healthcare scientists in the NHS and is essential to meet the growing demands of our healthcare system.

Leaders and managers of MPCE services need the full support of IPEM if they are to reverse the trend of dwindling ultrasound physics support. UNIRSIG have recognised this and are helping to lead us into a new era of ultrasound physics through:

1. Encouraging and developing regional consortia for the delivery and training of ultrasound physics services
2. Developing a new clinical technologist training curriculum and route to RCT registration
3. Delivering national workshops to help develop and support ultrasound physicists
4. Highlighting workforce shortages through an ultrasound workforce survey
5. Providing tools for leaders and managers to grow and develop ultrasound physics services, including an ultrasound physics workforce calculator

The workforce calculator is an essential part of this phase of ultrasound physics support from IPEM and is crucial for realising the necessary growth in our ultrasound physics workforce.

Background

The 2024 IPEM ultrasound workforce calculator has been built upon the success of recent diagnostic radiology and magnetic resonance physics workforce calculators developed by IPEM. Staffing requirements are based upon the quantity of equipment and the range of

clinical environments, along with research and training demands. To make best use of the medical physics workforce and ensure that roles are attractive, staffing allocation must exceed the minimum requirement for equipment quality assurance, with adequate resource available for both clinical/technical and personal development for every ultrasound physicist.

The role of physicists in medical ultrasound was informed by an expert panel supported by information gathered from the 2023 IPEM Ultrasound workforce survey[1] and a targeted discussion at the national IPEM Ultrasound Update in Leeds on 14th March 2023. Roles are further informed by the requirements of the three national ultrasound screening programmes (fetal anomaly, anterior aortic aneurism and breast cancer). Staffing requirements are divided into three levels, with roles separated into those that might typically be carried out by somebody working at the level of a medical physics technologist, a registered Clinical Scientist, or a lead scientist.

Whole Time Equivalent staffing calculations are primarily based upon the number of ultrasound probes overseen by the service. The overall clinical demand is expected to increase with both the number of ultrasound probes and the number of specialisms covered by the service. Some ultrasound systems require greater resources for medical physics support than others, so we have separated the input of probe numbers into complex and routine. Most probes will be included in the routine category, with probes requiring greater knowledge and more time to assess being classed as 'complex'. Examples of complex probes may include phased array probes, intracavity probes, and probes using advanced imaging techniques such as 4D imaging and elastography. For each probe, time is allocated for every step of the quality assurance cycle, including oversight on sonographer-led quality assurance programmes as recommended by BMUS and SoR[2]. A small amount of time proportional to the number of probes is put aside to allow for investigations into clinical incidents or findings.

We are aware that many healthcare providers are unable to obtain an accurate quantity of ultrasound equipment within their remit, in part due to the large numbers of devices and their relatively mobile nature. An approach for estimating probe numbers is therefore included for those services where only the number of ultrasound machines is known (or can be estimated). Further calculations take into account additional time requirements for services working across multiple sites.

Projects are inherently variable in the commitments required, from externally funded multi-centre research projects to ongoing minor innovations. Projects at all scales require appropriate peer support and oversight, but this calculator assumes that the main work of many projects is undertaken by medical physicists working at the level of a registered clinical scientist. Also, the main burden of training is expected to fall on this staffing group, with a small but significant contribution from senior roles.

Finally, a proportion of the requirements for lead scientists is informed by the expected total practitioner and registered scientist staffing allocation.

The calculator has been peer reviewed by a select group of leaders in medical ultrasound physics in the UK and further reviewed by IPEM's Ultrasound and Non-Ionising Special Interest Group and IPEM's Professional & Standards Council. The results are a guideline for

minimum staffing levels and cannot account for variations in individual performance or unique service demands, for example. Regional or consortia models may require a different structure to small individual departments, although we find that the guideline staffing values provided by the proposed calculator provide a sensible estimate in both of these extreme cases, and a wide range of other examples.

Using the Calculator

Users of the calculator are asked to input the number of complex diagnostic probes, routine diagnostic probes and therapeutic ultrasound devices, along with the number of departments and sites across which their service works. Additional information is required for research, development and innovation projects, and training. The calculator automatically accounts for time required for work such as continuing professional development and supervision for each whole time equivalent member of staff and explicitly allows for travel time between sites.

We are aware that most medical physics services will not have an accurate count of probes within their remit, so guidance is provided for the typical number of probes per machine. Some example calculations are also included in the Appendix which provide typical numbers of ultrasound machines for medical physics services of varying remits.

The calculator produces a total WTE number of staff that is expected to support the workload. This is separated into three levels, described as lead, registered and practitioner physicists. These broad descriptors are indicative of an expected structure but are not intended to be prescriptive. For example, we are aware of the important contributions made at all levels by non-registered ultrasound physicists, in particular with the current lack of a suitable RCT pathway in this field.

An additional time requirement is included to account for medical physics services that work across multiple sites, taking into account the need for travel between sites as well as the additional requirements that come with working across a larger group of clinical and management colleagues, such as additional communications, and more MDT and RPC meetings. A simple input of the total number of sites is required.

The Spreadsheet:

The calculator has been published as a spreadsheet for IPEM Members to allow for simple user input and automated calculations for IPEM members. Users with access to the spreadsheet can easily adjust any aspect of the calculator, taking into account factors such as staff with additional needs or broader roles within ultrasound physics, varying distances between sites, or the complexity and commitment to research, development and innovation projects.

The spreadsheet contains three tabs. The first tab is the user interface and provides the necessary functions to input the required information and output an estimate of medical ultrasound physics staffing requirements.

The tab labelled ‘calculations’ includes detailed descriptions of the areas of ultrasound physics workload considered and how these are used to produce the staffing estimates.

These values have been informed by national data collection and input from an expert group of ultrasound physics leaders in the UK, before being peer reviewed. Users are free to download this spreadsheet and modify cells within this tab to reflect the requirements of their unique services but should ensure that this is justified explicitly when quoting any output from the spreadsheet.

An additional tab is included which provides some example calculations, using approximate figures from representative medical ultrasound physics services. This may be helpful for services who are unaware of the number of ultrasound machines within their remit or who may be looking to introduce a new or significantly changed ultrasound physics service.

Next steps

The IPEM ultrasound workforce calculator provides sensible guideline estimates of ultrasound physics staffing for a range of healthcare providers. We believe that it will serve as a useful tool to help leaders and managers ensure that physics departments of the future are adequately resourced to support the development and delivery of clinical ultrasound services.

The field of medical ultrasound is expanding rapidly, and the range of diagnostic ultrasound users is broadening. As such, the need for medical ultrasound physicists is also changing. It is important that the calculations used to model ultrasound physics services can adapt to this changing demand. This should be achieved through regular peer review at least every 5 years, supported by ongoing workforce surveys.

In addition, there is a known shortage of medical ultrasound physicists, putting pressure on the current workforce to meet the existing workload and train more physicists. As such, work is required on a national level to support and develop the ultrasound physics workforce. For example, there is no direct pathway to become registered as a technologist in non-ionising radiations. Work is currently ongoing through IPEM to create such a pathway. This will also help to support the workforce and develop the roles of medical ultrasound physicists.

Parallel work is ongoing through IPEM to update Report 102 on quality assurance of ultrasound imaging systems. This is a substantial piece of work that includes national ultrasound quality assurance workshops for which an updated UK consensus set of quality assurance checks have been developed. This important national work shapes the role of quality assurance carried out and support by medical ultrasound physicists and supports the development of medical ultrasound physicists to help ensure that the staffing requirements laid out by this calculator can be met.

In addition to existing regular meetings and a small but active community of support for ultrasound physicists, more formal peer support systems and regular national and regional workshops are planned for the near future.

Tom Lister

Chair UNIRSIG and Ultrasound workforce task & finish group lead

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Ultrasound Physics Workforce Calculator

Organisation		WTE expected			
Number of:	**Value**	**Lead scientist**	**Registered scientist**	**HCS Practitioner**	**Total WTE**
# Complex probes e.g. phased, intracavity, 4D, elastography		0.000	0.000	0.000	0.000
# Routine probes e.g. linear, curvilinear, hockeystick		0.000	0.000	0.000	0.000
# Therapeutic ultrasound device e.g. physiotherapy, lithotripsy		0.000	0.000	0.000	0.000
# Departments covered Total departments support is provided for, across all sites		0.000	0.000	0.000	0.000
# Projects expected e.g., research projects		0.000	0.000	0.000	0.000
# Additional Sites Number of sites support is provided for, where travel exceeds 1 hour from primary site		0.000	0.000	0.000	0.000
# Trainees Number of STP/Route 2/other trainees		0.000	0.000	0.000	0.000
# Extra staffing requirements (e.g., management, CPD) Presented as initial WTE estimate in column B, plus extra WTE in columns C:F	0.0	0.000	0.000	0.000	0.000
	Total	**0.0**	**0.0**	**0.0**	**0.0**
Increase in workload due to multiple sites (travel, management, etc)	***site factor**	**0.0**	**0.0**	**0.0**	**0.0**

**typical mean number of probes per machine*

Specialty	Total	Complex	Routine
Point of care	*1.2*	*0*	*1.2*
Cardiology	*1.5*	*1*	*0.5*
Radiology	*3.5*	*0.5*	*3*
Obstetrics	*3*	*1.2*	*1.8*
General	*2*	*0.2*	*1.8*

Ultrasound Physics workload	Guidance notes	Unit	Annual time for different staffing groups			Annual WTE			Posts
Ultrasound safety		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Investigations following a clinical incident	e.g. Missed diagnosis which may be related to image quality, equipment suitability or staff training, harm to patient following a scan or deliver of therapeutic ultrasound	per incident (est 1 per 300 probes per year)	1 day	0	0	*0.0045*	*0.0000*	*0.0000*	0.0045
Equipment fault or image quality investigations	e.g. probe damage leading to reduced image quality, artifact investigation, inadequate preset designations, poor clinical outcomes	per incident (est 1 per 10 probes per year)		1 day	1 day		*0.0045*	*0.0045*	0.0091
QA and troubleshooting		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**

Ultrasound unit commissioning and basic optimisation	e.g. baseline image quality measurements, working with applications team to ensure adequate presets are present	Complex probe (e.g. 3D, endocavity)		30 mins			*0.0003*		0.0003
		Routine probe (e.g. linear, curvilinear)		20 mins			*0.0002*		0.0002
		Therapeutic ultrasound device		1 day			*0.0045*		0.0045
		Reporting of results		30 mins			*0.0003*		0.0003
Ultrasound routine QA only	Primarily annual equipment and image quality checks, production and management of QA reports, working with clinical team to determine necessary actions.	Complex probe (e.g. 3D, endocavity)		20 mins			*0.0002*		0.0002
		Routine probe (e.g. linear, curvilinear)			15 mins			*0.0002*	0.0002
		Therapeutic ultrasound device			1 day			*0.0045*	0.0045
		Reporting of results		20 mins			*0.0002*		0.0002
Oversight of sonographer QA	Includes management of a sonographer led QA programme, delivering of training to sonographers to perform quality assurance, responding to potential concerns.	Per department		1 days	1.5 days		*0.0045*	*0.0068*	0.0114

Equipment management		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Equipment specification		Per procurement (est 1 procurement per 20 probes per year)	0.5 days			*0.0023*			0.0023
Equipment evaluation	e.g. objective comparison of multiple trial units	Per procurement (est 1 procurement per 20 probes per year)	0.5 days			*0.0023*			0.0023
Service delivery/development, protocol optimisation and sustainability (per department)		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Clinical service support eg MDT attendance	Other clinical service support, e.g. MDT attendance (per patient), discussion of results with clinicians/radiologists	Per department	0.5 days	0	0	*0.0023*	*0.0000*	*0.0000*	0.0023
Ongoing service development/delivery	Other aspects of ongoing service improvement, e.g. planning, business cases, software, analysis, development of clinical applications	Per department	0.5 days	0	0	*0.0023*	*0.0000*	*0.0000*	0.0023

Quality management and governance (per department)		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Clinical Governance including ongoing clinical audits/QI/clin effectiveness	Developing frameworks for this within Med Phys and/or Radiology, assisting with processes and evaluations, audit projects	Per department	1 day	0	0	*0.0045*	*0.0000*	*0.0000*	0.0045
R&D&I (per department active in research (assume 1 in 5 departments are active, factor of 0.2 applied in columns G-I)		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Research and Development including clinical research (clinical) - overarching strategic and operational support for clinical trials	Covering a wide range of ongoing work, including strategic, operational and academic involvement - planning, staffing, costings, grants, protocols etc, supporting either NHS or university work (count as separate depts)	Per project	5 days	5 days	0	*0.0045*	*0.0045*	*0.0000*	0.0091
Carrying out research led by your service (academic)	Own dept research	Per project	0	0.08	0	*0.0000*	*0.0160*	*0.0000*	0.0160
Ultrasound research leadership	Sitting on research management committees within Trust/University/region and providing ultrasound specific advice e.g. interdisciplinary groups, academic	Per project	10 days	0	0	*0.0091*	*0.0000*	*0.0000*	0.0091

	committees, NIHR groups. MSc/PhD supervision.								
Education and training (total)		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Delivering STP specialism training and Route 2 trainees		Per trainee	0.01	0.2	0	*0.0100*	*0.2000*	*0.0000*	0.2100
Delivering STP rotational training		Per trainee	0	0.05	0	*0.0000*	*0.0500*	*0.0000*	0.0500
Delivering academic teaching	e.g. FRCR, UG Physics med phys option, Biomed Eng MSc, sonographer training	Per commitment	0.02	0	0	*0.0200*	*0.0000*	*0.0000*	0.0200
Clinical scientific computing and informatics		***Item***	**Lead scientist**	**Registered Scientist**	**Healthcare Science Practitioner (Physics or Engineering)**	***Lead scientist***	***Registered Scientist***	***Healthcare Science Practitioner (Physics or Engineering)***	**Total WTE**
Computing network support and scientific computing input	e.g. DICOM connectivity, research networks (e.g. XNAT), PACS interactions, software development	Per site	0	0.01	0	*0.0000*	*0.0100*	*0.0000*	0.0100

Scientific leadership and management (including own)		*Item*	Lead scientist	Registered Scientist	Healthcare Science Practitioner (Physics or Engineering)	*Lead scientist*	*Registered Scientist*	*Healthcare Science Practitioner (Physics or Engineering)*	Total WTE
Management of scientific service (eg direct management of scientific support for clin service developments) - including other meetings/responsibilities	Management and supervision of Ultrsasound/non-ionsing Physics team and related responsibilities	Per person	0.01	0	0	*0.0100*	*0.0000*	*0.0000*	0.0100
Maintain knowledge - reading, courses, conferences, lectures, peer reviews	Gathering of new information and learning	Per person	0.05	0.05	0.1	*0.0500*	*0.0500*	*0.1000*	0.2000
Attend section meetings, supervisor meetings and maintain CPD (IPEM work)	Own supervision and development	Per person	0.05	0.025	0.1	*0.0500*	*0.0250*	*0.1000*	0.1750
Involvement in wider NHS activities and professional bodies	Wider professional activities e.g. IPEM, NIHR, BIR commitees	Per commitment	0.05	0	0	*0.0500*	*0.0000*	*0.0000*	0.0500
General admin	Invoicing, contracts, arranging travel, annual leave, stat and mand training, meeting organising etc	Per person	0.01	0	0	*0.0100*	*0.0000*	*0.0000*	0.0100

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Examples

Organisation		WTE expected			
Number of:	**Value**	**Lead scientist**	**Registered scientist**	**HCS Practitioner**	**Total WTE**
# Complex probes e.g. phased, intracavity, 4D, elastography	150	0.036	0.902	0.068	1.006
# Routine probes e.g. linear, curvilinear, hockeystick	100	0.024	0.136	0.061	0.221
# Therapeutic ultrasound device e.g. physiotherapy, lithotripsy	0	0.000	0.000	0.000	0.000
# Departments covered Total departments support is provided for, across all sites	8	0.153	0.036	0.055	0.244
# Projects expected e.g., research projects	0	0.000	0.000	0.000	0.000
# Additional Sites Number of sites support is provided for, where travel exceeds 1 hour from primary site	1	0.020	0.010	0.000	0.030
# Trainees Number of STP/Route 2/other trainees	3	0.030	0.750	0.000	0.780
# Extra staffing requirements (e.g., management, CPD) Presented as initial WTE estimate in column B, plus extra WTE in columns C:F	2.3	0.052	0.138	0.037	0.226
	Total	**0.3**	**2.0**	**0.2**	**2.5**
Increase in workload due to multiple sites (travel, management, etc)	***site factor**	**0.3**	**2.1**	**0.2**	**2.8**

Organisation		WTE expected			
Number of:	**Value**	**Lead scientist**	**Registered scientist**	**HCS Practitioner**	**Total WTE**
# Complex probes e.g. phased, intracavity, 4D, elastography	150	0.036	0.902	0.068	1.006
# Routine probes e.g. linear, curvilinear, hockeystick	400	0.097	0.545	0.242	0.885
# Therapeutic ultrasound device e.g. physiotherapy, lithotripsy	4	0.001	0.023	0.020	0.044
# Departments covered Total departments support is provided for, across all sites	40	0.764	0.182	0.273	1.218
# Projects expected e.g., research projects	2	0.027	0.041	0.000	0.068
# Additional Sites Number of sites support is provided for, where travel exceeds 1 hour from primary site	10	0.200	0.100	0.000	0.300
# Trainees Number of STP/Route 2/other trainees	1	0.010	0.250	0.000	0.260
# Extra staffing requirements (e.g., management, CPD) Presented as initial WTE estimate in column B, plus extra WTE in columns C:F	3.8	0.189	0.153	0.121	0.463
		1.3	**2.2**	**0.7**	**4.2**
Increase in workload due to multiple sites (travel, management, etc)	*site factor	**1.6**	**3.8**	**1.3**	**6.4**

References

[1] IPEM (2023) "2023 Ultrasound Workforce Survey – Summary Report". Available at: https://www.ipem.ac.uk/resources/workforce-intelligence/ultrasound-non-ionising-radiation-resources/2023-ultrasound-workforce-survey-summary-report/ (Accessed: 2 Aug 2024).
[2] SoR and BMUS (2023) "Guidelines for Professional Ultrasound Practice" 8th ed., *Society of Radiographers and British Medical Ultrasound Society*. ISBN: 978-1-909802-89-6