

**Benchmark statement:
Health care programmes**

Phase 2

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Clinical science

Subject benchmark statements: Health care programmes

Subject benchmark statements provide a means for the academic community to describe the nature and characteristics of programmes in a specific subject. They also represent general expectations about standards for the award of qualifications at a given level and articulate the attributes and capabilities that those possessing such qualifications should be able to demonstrate.

This subject benchmark statement refers to the degree of doctorate in clinical science.

Subject benchmark statements are used for a variety of purposes. Primarily, they are an important external source of reference for higher education institutions when new programmes are being designed and developed. They provide general guidance for articulating the learning outcomes associated with the programme but are not a specification of a detailed curriculum in the subject. Subject benchmark statements provide for variety and flexibility in the design of programmes and encourage innovation within an agreed overall conceptual framework.

Subject benchmark statements also provide support to institutions in the pursuit of internal quality assurance. They enable the learning outcomes specified for a particular programme to be reviewed and evaluated against agreed general expectations about standards.

Finally, subject benchmark statements may be one of a number of external reference points that are drawn upon for the purposes of external review. Reviewers do not use subject benchmark statements as a crude checklist for these purposes however. Rather, they are used in conjunction with the relevant programme specifications, the institution's own internal evaluation documentation, in order to enable reviewers to come to a rounded judgement based on a broad range of evidence.

The benchmarking of academic standards for this subject area has been undertaken by a group of subject specialists.

In due course, the statement will be revised to reflect developments in the subject and the experiences of institutions, and others who are working with them.

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Foreword

This benchmark statement describes the nature and standards of programmes of study and training in clinical science that lead to awards made by the Association of Clinical Scientists as well as higher education institutions (HEIs) in the United Kingdom (UK) in the subject.

The statement sets out a general framework for describing the nature and extent of these programmes under three main headings:

- A The clinical scientist as a registered healthcare practitioner: expectations held by the profession, employers and public.
- B The application of clinical science to securing, maintaining or improving health and well-being.
- C Knowledge, understanding and skills that underpin the education and training of clinical science.

Within the scope of this document it is not possible to provide benchmarking information for the many different areas in which clinical scientists work. Benchmarking has, therefore, been restricted to the generic areas of activity.

Consideration is being given currently to benchmark the modalities of clinical science as described below.

Benchmark statement for clinical science

Introduction

Clinical scientists are graduate scientists employed in healthcare and responsible for the application of science in the prevention, diagnosis and control of illness, disease and disability.

The primary job functions of clinical scientists are:

- maintaining the scientific basis of healthcare;
- practicing at the clinical interface;
- managing and auditing the application of scientific techniques and procedures;
- developing, evaluating and providing new scientific services;
- conducting and directing research and development;
- participating in clinical audit;
- teaching scientists, scientific support workers and other health professionals;
- developing and maintaining quality standards;
- advising and training clinical colleagues.

To perform these functions, clinical scientists require a complex set of interlocking skills - clinical, scientific, technical, research and development, problem-solving and managerial. The object of training programmes is to provide the knowledge and skill base to equip scientists with graduate qualifications in a basic science to make a safe and effective contribution to health care.

Clinical scientists have practised in health environments for many years, and have been subject to statutory regulation since October 2000, with the establishment of the Clinical Scientists Board of the Council for the Professions Supplementary to Medicine (CPSM). Statutory regulation is now the responsibility of the Health Professions Council (HPC), which was established in shadow form in April 2002 and became legally established on 9 July 2003. There are approximately 4,000 registered clinical scientists in the UK.

The HPC recognises 10 modalities of clinical science, each of which has various sub-specialties. The 10 modalities are divided into three major areas - life sciences, physical sciences and physiological sciences.

Life sciences

Clinical biochemists - who provide clinical interpretation of biochemical or toxicological data and advise on the diagnosis of disease and monitoring of treatments.

Clinical embryologists - who deal with fertility and carry out the collection of human ova. They also check fertilisation and embryo implants.

Clinical geneticists - who may specialise in cytogenetics or molecular genetics. Clinical cytogeneticists study chromosomes obtained from samples of patients' blood, tissue, bone marrow or other sources. Clinical molecular geneticists use chemical examination of nucleic acids to define genetic abnormalities.

Clinical immunologists - who develop and apply diagnostic tests and treatments involving the immune system.

Clinical microbiologists - who act to prevent and control infections in the community and within hospitals, and may work as epidemiologists.

Clinical scientists in haematology - who analyse the cellular components of blood and blood-producing tissues such as the bone marrow. The results are used in the diagnosis and management of patients with anaemia, clotting disorders, haematological cancer and genetic disorders. Some scientists specialise in blood transfusion.

Clinical scientists in histocompatibility and immunology - who determine and match the immunogenetic characteristics of donor and recipient for organ transplantation, and assist in selecting bone marrow transplant donors.

Physical sciences

Medical physicists and clinical engineers - who apply the techniques of physics and the various branches of engineering to medical practice and are responsible for their safe and appropriate clinical application. The work they do covers many clinical areas. For example, a medical physicist may work in areas such as radiotherapy, radiation protection, nuclear medicine, diagnostic radiology, magnetic resonance imaging and non-ionising radiation techniques, while a clinical engineer may work in electronics, equipment management, rehabilitation engineering, computing and physiological measurement.

Physiological sciences

Audiological scientists - who carry out audiological testing and develop comprehensive diagnostic and rehabilitative corrective services for the hearing-impaired.

Clinical physiologists - who are involved in various specialist roles in investigating aspects of pathophysiology. Cardiology physiologists help in the diagnosis, treatment and management of heart disease; neurophysiologists are engaged in the application of electrodiagnostic procedures in neurology; and respiratory physiologists are concerned with diagnostic and therapeutic procedures in respiratory medicine.

All clinical scientists are involved in evaluation, research and development of investigative systems and set quality standards to meet current and new demands.

It is inherent to the nature of the subject that the medical applications of science grow and develop with time, and the above modalities therefore are not exclusive. Scientists in other areas may enter the profession with non-standard training in specific areas, and will need training packages tailored to their particular needs. Procedures for the assessment and eventual registration of such individuals are in active development.

Nature and extent of programmes in clinical science

Clinical science is a postgraduate discipline, and training programmes build on a first degree in a basic science. Entrants to training therefore must already have a comprehensive understanding of the philosophy, concepts, ideas and methods of science and mastery of the skills of experimentation, assessment and research. The specific knowledge base necessary to function as a clinical scientist is primarily delivered by postgraduate education, and a wide range of first degree science subjects may serve as foundations for training as a clinical scientist. Indeed, individual scientists with different training at first degree level make a unique and varied contribution to the service, and help to ensure that the profession can recognise and exploit opportunities for cross-discipline collaboration and development at the interface between discipline boundaries.

Entrants need a good honours degree in a science subject related to their chosen modality. The training programmes in all modalities are master's level programmes, aimed at developing first degree level scientists into clinical scientists with the skills and experience necessary for unsupervised, safe and effective practice in healthcare environments. Programmes combine a detailed theoretical training, relevant project work and supervised practical experience in the clinical setting, and frequently incorporate an MSc qualification awarded by an HEI working in cooperation with the relevant professional body. Experience while training must be obtained in a recognised and appropriate setting and supervised by an appropriately qualified individual. The overall supervisor of an individual's training must be registered with the HPC or the General Medical Council.

Programmes are usually of four years duration, leading to an assessment by the Association of Clinical Scientists (ACS), which acts as the qualifying body and awards a Certificate of Attainment to those who meet the requisite competences. The ACS Certificate of Attainment is a recognised qualification for registration as a clinical scientist with the HPC, and indicates compliance with the *Standards of proficiency - Clinical scientists* defined by the HPC.

A The clinical scientist as a registered healthcare practitioner: expectations held by the profession, employers and public

A1 Professional autonomy and accountability of the clinical scientist

The award holder should be able to:

- demonstrate understanding of the need for professional regulation;
- demonstrate understanding of, and ability to, practice within the legal and ethical boundaries of clinical practice;
- maintain the standards and requirements of professional and statutory regulatory bodies, including the HPC;
- adhere to relevant codes of conduct;
- show an understanding of the need to respect, and, so far as possible, uphold, the rights, dignity and autonomy of every patient, client and user, including their role in the diagnostic and therapeutic process;
- exercise a professional duty of care to patients/clients/carers;
- understand the obligation to maintain fitness for practice and the need for career-long self-directed learning;
- contribute to the development and dissemination of evidence-based practice within professional contexts;
- uphold the principles and practice of clinical governance.

A2 Professional relationships

The award holder should be able to:

- recognise the professional and personal scope of their practice and make referrals, where appropriate;
- be able to respond to enquiries regarding the service they provide when dealing with clinical colleagues;
- work, where appropriate, in partnership with other health and social care professionals and support staff and patients/users/clients/carers to maximise health outcomes and make an effective contribution to work undertaken as part of a multidisciplinary team;

- show an understanding of the need to build and sustain professional relationships both as an independent practitioner and as a member of a team;
- show an understanding of the need to engage patients, clients, users and carers in planning and evaluating care.

A3 Personal and professional skills

The award holder should be able to:

- deliver quality patient/client-centred care;
- practice in an anti-discriminatory, anti-oppressive manner;
- draw on appropriate knowledge and skills in order to make professional judgements, recognising the limits of their practice and knowing when to seek advice;
- assess a situation, determine the nature and severity of the problem and call upon the required knowledge and experience to deal with the problem;
- initiate resolution of problems and be able to exercise personal initiative;
- summarise and present complex scientific ideas in an appropriate form;
- communicate the outcome of problem-solving and research and development activities;
- communicate effectively with patients/clients/carers and other relevant parties when providing care, including communication in English to the standard equivalent to level 7 of the International English Language Testing System, with no element below 6.5;
- show an understanding of how communication skills affect the assessment of patients, clients and users, and how the means of communication should be modified to take account of factors such as age, physical and learning disability;
- be able to select, move between and use appropriate forms of verbal and non-verbal communication with patients, clients, users and others;
- be aware of the characteristics and consequences of non-verbal communication and how this can be affected by culture, age, ethnicity, gender, religious beliefs and socio-economic status;
- show an understanding of the need to provide patients, carers and users with the information necessary to make informed decisions;
- maintain the principles and practice of patient/client confidentiality and be able to obtain informed consent;
- recognise that relationships with patients, carers and users should be based on mutual respect and trust, and be able to maintain high standards of care even in situations of personal incompatibility;
- assist other health care professionals, support staff and patients/clients/carers in maximising health outcomes;
- recognise the need for effective self-management of workload and time, and be able to practise accordingly;
- engage in self-directed learning that promotes professional development;
- practise with an appropriate degree of self-protection;
- contribute to the well-being and safety of all people in the workplace.

A4 Profession and employer context

The award holder should be able to:

- demonstrate an understanding of their role within health and social care services;
- demonstrate an understanding of government policies for the provision of health and social care;
- take responsibility for their own professional development;
- recognise the value of research and other scholarly activity in relation to the development of the profession and patient/client care.

B The application of clinical science to securing, maintaining or improving health and well-being

B1 Identification and assessment of health and social care needs

The award holder should be able to:

- gather relevant information from a wide range of sources including electronic data;
- use appropriate assessment techniques;
- identify the clinical decision which the test or intervention will inform;
- undertake or arrange clinical investigations, as appropriate;
- undertake and record a thorough, systematic and detailed assessment using appropriate techniques and equipment;
- analyse and evaluate the information collected;
- recognise the place and contribution of their assessment within the overall health care profile/package, through effective communication with other members of the health and social care team.

B2 Formulation of plans and strategies for meeting health and social care needs

The award holder should be able to:

- use research, reasoning and problem-solving skills to make judgements/decisions in prioritising actions;
- describe methods commonly used in health and social care research;
- conduct fundamental or applied research;
- demonstrate a logical and systematic approach to problem-solving;
- formulate specific management plans for meeting needs/problems, setting these within a timescale and taking account of finite resources;
- record professional judgements and decisions taken;
- synthesise theory and practice.

B3 Practice

The award holder should be able to:

- search and critically appraise scientific literature and other sources of information;
- conduct evidence-based practice, evaluate practice systematically and participate in audit procedures;
- draw on appropriate knowledge and skills in order to make professional judgements;
- develop an investigation strategy which takes account of all the relevant clinical and other information available;
- demonstrate an ability to handle equipment appropriately, and conduct appropriate diagnostic or monitoring procedures, treatment, therapy or other actions safely and skilfully;
- perform a range of techniques employed in the modality;
- ensure patients clients and users are positioned (and if necessary immobilised) for safe and effective interventions;
- demonstrate understanding of the need to conform to standard operating procedures and conditions;
- demonstrate understanding of the need to work with accuracy and precision;
- solve problems that may arise during the routine application of techniques (troubleshooting);
- keep accurate and legible records and recognise the need to handle these records and all other clinical information in accordance with applicable legislation, protocols and guidelines;
- interpret data and provide diagnostic and therapeutic opinions, including any further action to be taken by the individual directly responsible for the care of the patient;

- change practice as needed to take account of new developments;
- demonstrate understanding of the requirement to adapt practice to meet the needs of different client groups distinguished by, for example, physical, psychological, environmental, cultural or socio-economic factors;
- demonstrate understanding of the need to maintain the safety of patients, clients and users and those involved in their care;
- conduct fundamental research;
- develop the aims and objectives associated with a project;
- develop an experimental protocol to meet the aims and objectives in a way that provides objective and reliable data (free from bias);
- perform the required experimental work and produce and present the results (including statistical analysis);
- interpret the results in the light of existing knowledge and the hypothesis developed, and formulate further research questions;
- present data and a critical appraisal of it to peers in an appropriate form;
- use appropriate and accepted terminology in making clinical records;
- recognise opportunities to influence health and social policy and practices.

B4 Evaluation

The award holder should be able to:

- recognise the value of research to the systematic evaluation of practice;
- recognise the need to monitor and evaluate the quality of practice and the importance of participation in quality assurance and improvement programmes;
- use quality control and quality assurance procedures, including restorative action when performance deteriorates;
- monitor and review the ongoing effectiveness of planned activity and modify it accordingly;
- gather information (both qualitative and quantitative) that helps to evaluate the responses of patients, clients and users to their care;
- make judgements on the effectiveness of procedures;
- make reasoned decisions to initiate, continue, modify or cease treatment, or the use of techniques or procedures, and record the decision and reasoning appropriately;
- maintain an effective audit trail and work towards continual improvement;
- demonstrate understanding of the role of audit and review in quality management, including the use of appropriate outcome measures;
- demonstrate understanding of the importance of participation in accreditation systems related to the modality;
- evaluate management plans against treatment milestones using recognised health outcome measures and revise the plans as necessary in conjunction with the patient, client or user;
- demonstrate understanding that outcomes may not always conform to expectations but may still meet the needs of patients, clients or users;
- state the value of reflection on clinical practice and the need to record the outcome of such reflection;
- recognise the value of case conferences and other methods of review;
- appreciate the importance of awareness of emerging technologies and new developments.

C Knowledge, understanding and skills that underpin the education and training of clinical scientists

C1 Knowledge and understanding

The award holder should be able to demonstrate:

- understanding of the key concepts of the disciplines that underpin the education and training of all health care professionals, and detailed knowledge of some of these. This includes a broad understanding of:
 - a the structure and function of the human body, as relevant to practice, together with a knowledge of health, disease, disorder and dysfunction, and pathology;
 - b the role of other professions in health and social care;
 - c the theoretical basis, and the variety of approaches to, assessment and intervention;
 - d the legislation and professional and statutory codes of conduct that affect health and social care practice;
 - e philosophy and policy of health and social care and its translation into ethical and evidence-based practice;and detailed knowledge of:
 - a the principles and applications of scientific enquiry, including the evaluation of treatment efficacy and the research process;
 - b the basic science underpinning the modality in which the registrant practices, relevant basic clinical medicine and the fundamental principles of clinical practice;
 - c the wider clinical situation relevant to the patients presenting to the speciality;
 - d the ways in which professional principles are translated into action through a number of different diagnostic, monitoring, treatment and management approaches, and how to select approaches to meet the needs of an individual;
 - e the clinical applications of the specialty and the consequences of decisions made upon actions and advice;
 - f the evidence base that underpins the use of the procedures employed by the service;
 - g the principles associated with a range of techniques employed in the modality;
 - h the standards of practice expected from techniques;
- understanding of the need to establish and maintain a safe practice environment, including:
 - a awareness of applicable health and safety legislation, and any relevant safety policies and procedures in force at the workplace, such as incident reporting, and the ability to act in accordance with these;
 - b understanding of sources of hazard in the workplace, including specimens, raw materials, clinical waste and equipment;
 - c awareness of immunization requirements and the role of occupational health;
 - d knowledge of the principles and proper applications of disinfectants, methods for sterilisation and decontamination, and procedures for dealing with waste and spillages.

C2 Skills

Information gathering

The award holder should be able to demonstrate:

- an ability to gather and evaluate evidence and information from a wide range of sources;
- an ability to use methods of enquiry to collect and interpret data in order to provide information that would inform or benefit practice.

Problem solving

The award holder should be able to demonstrate:

- logical and systematic thinking;
- an ability to draw reasoned conclusions and sustainable judgements.

Communication

The award holder should be able to demonstrate effective skills in communicating information, advice, instruction and professional opinion to colleagues, patients, clients, their relatives and carers, and, when necessary, to groups of colleagues or clients.

Numeracy

The award holder should be able to demonstrate a high level of ability in understanding, manipulating, interpreting and presenting numerical data.

Information technology

The award holder should be able to demonstrate an ability to engage with technology, particularly the effective and efficient use of information and communication technology.

Safe practice environment

The award holder should be able to demonstrate:

- an ability to work safely, including the ability to select appropriate hazard control and risk management, reduction or elimination techniques in a safe manner in accordance with health and safety legislation;
- an ability to select appropriate personal protective equipment and to use it correctly;
- an ability to establish safe environments for clinical practice, which minimise risk to patients, clients and users, those treating them, and others, including safe equipment operation, the use of hazard control and infection control procedures.

Teaching, learning and assessment

Clinical science is a rapidly evolving and broadly based subject, ranging from clinical biochemistry to medical physics, from genetics to bioengineering. Teaching, learning and assessment must also evolve in parallel with the subjects, and, to some extent, be tailored to the specific area of clinical science.

The primary thrust of teaching, learning and assessment methods is to encourage students to develop as independent scientists, actively engaged in the process of seeking to understand, thus preparing them for a career of continuing professional development.

In addition to obtaining the knowledge and skills outlined in the subject framework, programmes foster the development of key scientific skills such as problem solving, team working and communication.

Clinical science requires all practitioners to achieve an honours degree in a basic science, followed by a masters level programme, approved by the Department of Health, that will give the knowledge, skills and competences needed for a practitioner in a specific branch of clinical science. The programme usually includes an MSc degree accredited by the relevant professional body.

Assessments take place throughout the training period. These may take the form of examinations, both written and oral, continuous assessments, project reports and clinical assessments. The assessment of competence to practice is determined by an oral assessment based around a portfolio of evidence demonstrating achievement of standards of proficiency. Professional registration is dependent upon meeting both statutory body and HEI requirements.

Appendix 1

Clinical science benchmark group membership

Dr Ian Barnes

Association of Clinical Scientists

Mr Mike Hallworth

Royal Shrewsbury Hospital

Professor Peter Sharp

University of Aberdeen

Appendix 2

Benchmark steering group membership

Professor Michael Aulton	Royal Pharmaceutical Society
Dr Elizabeth Campbell	The British Psychological Society
Mrs Margaret Coats	General Chiropractic Council
Mr Vince Cullen	General Osteopathic Council
Ms Jill Galvani	The Royal Liverpool University Hospital
Ms Rosemary Grant	Avon, Gloucestershire and Wiltshire Strategic Health Authority
Dr Mike Hewins	Norfolk, Suffolk and Cambridgeshire Strategic Health Authority
Ms Ruth Howkins succeeded by Ms Meriel Hutton	Quality Assurance Team, Department of Health (England)
Ms Prue Kiddie	Department of Health
Professor Jeff Lucas	University of Bradford
Mrs Helen Marshall	Standing Conference of Principals
Mrs Susan Montague	University of Hertfordshire
Professor Audrey Paterson	The Society of Radiographers (representing Allied Health Professions)
Professor Mike Pittilo (Chair)	University of Hertfordshire
Ms Jenny Routledge	University of East Anglia
Mr Alvan Seth-Smith	General Dental Council
Mr David Skinner	General Medical Council
Mr Roger Thompson	Nursing and Midwifery Council
Professor Steve Trevillion	General Social Care Council
Professor Diane Waller	Health Professions Council
Professor Barry Winn	University of Hull
Mr David Young	Universities UK

Quality Assurance Agency for Higher Education

Southgate House
Southgate Street
Gloucester
GL1 1UB

Tel 01452 557000
Fax 01452 557070
Email comms@qaa.ac.uk
www.qaa.ac.uk

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