1. Introduction

Health Informatics and Computing (HIC) incorporates the wide range of computing and information management activities that are important in the provision of healthcare. In Medical Physics and Clinical Engineering (MP&CE) HIC involvement can range from the control of relatively simple electronic devices to complex processes and systems used in areas such as radiotherapy planning and delivery, patient administration and national performance monitoring. Stringent legal restrictions, such as the Medical Devices Directive\(^1\), Data Protection Legislation\(^2,3,4\) and ISO standards\(^5\) apply. This document outlines how MP&CE staff may be used to best effect in developing and sustaining computing and information management strategies.

2. Staffing in HIC

Both Clinical Scientists and technologists are involved in HIC work. This can be as part of a dedicated HIC team who provide clinical and scientific computing services in large departments. In smaller departments, staff working on HIC tasks may be part of a defined service such as Radiotherapy Physics, Diagnostic Radiology or Clinical Measurement.

Traditionally, registered Clinical Scientists doing HIC clinical and scientific computing were trained through formal IPEM schemes; however some scientists enter with qualifications in computing and/or research and achieve registration by equivalence routes\(^6,7\). Currently entry to the register is possible through the STP Medical Physics, Clinical Engineering or Clinical Bioinformatics (Physical Scientist) Schemes\(^8\), as well as through equivalence routes. Arrangements differ slightly in the national devolved regions.

Technologists can enter MP&CE professions with suitable science or information technology qualifications or experience. The Practitioner Training Programme (PTP) provides a formal qualification route but is not essential for work as a technologist. Suitably experienced Practitioners can proceed to STP training.

Consultant level scientific staff often have managerial responsibility for the HIC work undertaken and are expected to have a considerable knowledge base covering all aspects
of HIC. Formal qualification to achieve recognised ‘consultant’ status is now promised through the Higher Specialist Scientist Training (HSST) Schemes, which follow on from the STP Schemes and includes undertaking a professional doctorate. With demonstrable equivalent skills at this level, applicants can make an ‘equivalence’ application.

HIC staff work alongside other MP&CE staff, clinicians, radiographers, nurses and many other healthcare specialists. In addition they interact with both Corporate IT staff and a wide range of equipment providers to ensure that safety, service availability and data security are maintained.

3 Scientific Services

3.1 Service Design and Development

Perhaps the best way to provide insight into the role of MP&CE staff in the design and development of a HIC service is to consider the lifecycle of a system. The essence of the role is Project Management. Procurement comes first and requires a business case that involves clinicians, potential users and the appropriate technical and scientific expertise. MP&CE staff can act as liaison between these disparate groups. As the case develops there will be need to approach potential equipment suppliers for potential solutions, and Corporate Clinical Governance and IT staff to consider Risk Management. After requirements and proposed solutions have been considered and funds have been approved, contracts will be agreed. Plans are needed for accommodation, delivery, installation and commissioning, with necessary checks at all stages, whether for new installations, upgrade, or replacement. Usually training will be required and this may cascade from the manufacturer to the end user via the HIC group. The compatibility with extant and legacy systems needs to be assessed, with problems being identified and solutions found. This may involve writing bespoke ‘middleware’ software to mediate between systems, or working with the vendor to achieve a solution. Finally, towards the end of the system’s life a decommissioning and replacement plan is required to ensure the continuity of the service.

3.2. Health Informatics

Health informatics involves the study of how health data is collected, stored, communicated and processed. It is the collective term for the interaction of the sciences of healthcare, information and computer technology. It can relate to an individual patient or it can involve groups of patients. The results can help clinicians determine appropriate treatments, the best use of resources, and allow epidemiological studies to investigate and even prevent disease.

The HIC role can involve creating, maintaining, using and analysing data in large-scale clinical databases. In-depth knowledge of the relevant healthcare processes and standards are essential for safe, effective and productive health informatics services. Governance and risk management form a significant part of the contribution, both in an advisory capacity and in ensuring compliance. Clinical data are frequently requested internally and externally for
individual patients, management decision-making and research. HIC staff help to respond to these requests through their ability to extract the required data. They must ensure accuracy, transfer data securely but only to approved recipients, and apply appropriate anonymisation. Advising on the scientific validity and potential pitfalls of techniques and systems is also part of the role.

3.3 Quality management
MP&CE HIC staff will usually be responsible for acceptance testing to ensure that equipment is properly configured and functioning. Appropriate end users may conduct final clinical tests, with liaison and record keeping paramount. In many cases, acceptance testing involves overseeing the commissioning tests of suppliers and establishing appropriate independent baseline measurements for future quality assurance (QA) testing.

With live systems HIC staff are involved in ensuring safe and effective system operation through the processes of QA. Monitoring of speed, data transfer, and available storage space are typical quality tests, which may form part of a larger hardware QA programme.

Finally, software quality management can include performing file integrity checks of programs and the use of standard datasets, at regular intervals, to ensure the systems provide standard outputs. It also involves checking that appropriate data backups and archives are being made and that contingency plans for failures are appropriate.

3.4 Safety
Computer systems and software involved in healthcare must be safe and reliable. This applies to both commercial systems and to systems developed in-house. For example, novel software to implement newly published clinical procedures may be required, or ‘middleware’ may be required to overcome shortfalls in commercial systems. These must be rigorously tested for safety, particularly as a system may constitute a Medical Device if it influences clinical diagnosis or treatment decisions. Analysing the problem, understanding the potential sources of risk, designing test procedures and documenting the results within a Quality Management System will all be undertaken by the MP&CE HIC staff, along with training and authorising users.

4. Research and Innovation
Examples of research and innovation that might involve HIC staff are data processing, improving digital image quality, compiling and data mining patient data (e.g. to look for trends which can lead to improved patient care), and creating and evaluating computationally intensive algorithms (such as Monte Carlo dose distributions). Activities may be in large-scale patient trials or small-scale innovative in-house projects. It may be necessary to design, conduct and analyse experimental work and compare results with empirical data. Such work may be written up for publication in peer-reviewed journals or presented at conferences, orally or as posters.

5. Education & Training
MP&CE HIC staff are required to keep up to date with scientific, technological and regulatory developments. Their knowledge is then disseminated to colleagues and other
relevant healthcare professionals. Opportunities exist for teaching students and trainees within the discipline, including both formal training (PTP, STP and HSST) and informally. Training and education is provided to other staff groups such as doctors, nurses and radiographers on relevant issues. This can be done as in-house training, conferences or in a post with university teaching obligations.

6. Scientific Leadership

As HIC staff progress in their careers management roles play an increasing part. Initial responsibility will be for small projects. As complexity develops more scientific leadership is required with greater technical challenges and the need for important leadership skills. Consultant clinical scientists will have the greatest overall responsibility for system specification, procurement, acceptance testing and commissioning. They will also take responsibility for the technical work of others. They are likely to stimulate system replacements, introduce innovations, and make policy and service design proposals. They should be able to act as the design authority for complex, institution-scale medical informatics systems and should lead on the design and implementation of a HIC group’s process management infrastructure.

7. Summary

MP&CE HIC staff directly impact on patient care and service provision. They provide a vital service in ensuring the safe specification, installation, quality assurance and management of scientific and clinical systems. They contribute much to healthcare research, to training professionals and to efficient departmental management.

References/bibliography

2 The Data Protection Act 1998
3 Information: To share or not to share? The Information Governance Review Caldicott NHS 2013
5 Some examples:
IEC 62304:2006 Medical device software -- Software life cycle processes
ISO 14971:2007 Medical devices -- Application of risk management to medical devices

6 The Association of Clinical Scientists
7 The Academy for Healthcare Science
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