



## **Standards of Radiographic Practice for Post-Mortem Cross- Sectional Imaging (PMC-SI)**

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### **Summary**

The standards in this document have been produced jointly by the Society and College of Radiographers (SCoR) and the International Association of Forensic Radiographers (IAFR) following a literature review and utilising the significant practical experience and knowledge of the expert group. It should be read in conjunction with the SCoR professional document: Guidance for Radiographers providing Forensic Radiography Services, 2014 for the overarching principles which apply to the provision of all forensic radiography services. For the purpose of this present document PMC-SI is used to indicate a service using either CT or MRI or both. Terms used by others to describe these examinations include virtual autopsy, and digital autopsy.

### **Foreword**

The standards in this document have been produced jointly by the Society and College of Radiographers (SCoR) and the International Association of Forensic Radiographers (IAFR) following a literature review and utilising the significant practical experience and knowledge of the expert group. It should be read in conjunction with the SCoR professional document: Guidance for Radiographers providing Forensic Radiography Services, 2014 for the overarching principles which apply to the provision of all forensic radiography services.

The Standard can be applied to any organisation performing post mortem Cross-Sectional Imaging regardless of the number of staff or the scope of imaging activities, from large NHS or private providers, to small private services.

The emphasis of this document is to:

- ensure that consistency of radiographic practice can be applied to all circumstances wherever PMC-SI is taking place;
- ensure that all PMC-SI examinations are provided at a high standard of imaging consistent with the purpose of the examination;
- recognise the resources and workforce required to provide a high quality and appropriate PMC-SI service;
- ensure the requirements for appropriate education and training are clearly emphasised;
- ensure that knowledge and understanding of United Kingdom (UK) and European legislation is current;
- recognise the unique challenges that successful PMC-SI provides;
- recognise that the appropriate care and respect for the deceased and their relatives

throughout the PMC-SI process is fundamental.

Cross-sectional imaging modalities, namely Multi Detector Computed Tomography (MDCT) and Magnetic Resonance Imaging (MRI) have been used in NHS premises and private mortuaries either as a major adjunct or alternative to invasive post-mortems. This follows on from the more traditional use of plain film radiographic imaging as a minor adjunct to invasive post-mortem investigations.

The term 'post-mortem cross-sectional imaging' (PMC-SI) refers to the ability to employ either or both CT and MRI as part of a post-mortem investigation which may also encompass angiographic examinations or other examinations using these modalities.

International experts in this field have proposed in the case of post-mortem computed tomography that the abbreviation PMCT be used and for post-mortem magnetic resonance imaging that PMMR be used. Additionally, for post-mortem computed tomography angiography (abbreviated to PMCTA) and for post-mortem magnetic resonance angiography (abbreviated to PMMRA) (Rutty et al 2012).

For the purpose of this present document PMC-SI is used to indicate a service using either CT or MRI or both. Terms used by others to describe these examinations include virtual autopsy, and digital autopsy.

The SCoR document 'Guidance for radiographers providing Forensic Radiography Services' (SCoR, 2014) provides invaluable advice in forensic imaging that forms the basis of good practice and which informs this present document.

## Introduction

Any request for PMC-SI will originate with the Coroner (or in Scotland: a Procurator Fiscal or Sheriff) and be made to a pathologist (under the Coroners and Justice Act, 2009). On the basis of the history and the circumstances of the death, the pathologist will be able to confirm whether PMC-SI is appropriate. Other investigations such as aspiration of fluids for toxicology, biopsy for histology and CT/MR angiography can be performed if and as required. These may be used to supplement the imaging in order to provide a precise cause of death without need for full invasive post mortem.

It is deemed axiomatic that the quality of outcome for any PMC-SI examination is dependent on the quality of the images produced in order for the pathologist or, in some facilities, the radiologist to provide a definitive cause of death. Hence it is imperative that the individual(s) providing the images is/are appropriately qualified to produce consistently high quality images and be able to voice opinions on the radiographic findings.

## The Domains

The Standard is divided into four domains:

- Clinical (C)
- Facilities and workforce (FW)
- Health and safety (HS)
- Privacy and dignity (PD)

## Clinical (C) standard

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## **Rationale**

The purpose of the clinical domain is to ensure that a PMC-SI service, wherever it is operated, provides a rapid, safe and accurate autopsy diagnosis while at the same time seeking to maintain and enhance the service. This is achieved through administrative and clinical practices appropriate to the client group; effective communication strategies; and the review of existing and new practice that develops and improves the service.

C1 The service implements and monitors systems for requests, referrals and other relevant information throughout the pathway.

C2 The service implements and monitors systems to ensure the acquisition of optimal diagnostic quality images.

C3 The service implements and monitors systems for appropriate communication of findings.

C4 The service implements and monitors systems to manage clinical records and confidentiality.

C5 The service implements and monitors systems for regular audit including current practice and the development of emerging practice.

## **C1 The service implements and monitors systems for requests, referrals and other relevant information throughout the pathway**

### **Rationale:**

Following a request for a PMC-SI, a Coroner (or, in Scotland, a Procurator Fiscal or Sheriff) must authorise the procedure before the Coroner's office contacts a pathologist. On the basis of a full history and circumstances of the death, the pathologist will be able to confirm whether PMC-SI is appropriate. The service should work collaboratively with colleagues to agree and deliver the appropriate imaging within required timescales.

### **Criteria:**

- a. Systems in place for appropriate referrals with sufficient relevant information for a scan to be carried out and any relevant post processing of the images undertaken.
- b. Systems in place to manage the administration of the client pathway from referral to return to the referral source.
- c. Systems in place to support collaboration between the image producers and other clinical staff (namely radiologists and pathologists).

### **Commentary:**

For any authorised PMC-SI examination, the pathologist must retain a central co-ordinating role (RCR 2012). Local systems for referral authorisation and record keeping will need to be developed and pass through the appropriate clinical governance procedures.

## **C2 The service implements and monitors systems to ensure the acquisition of optimal diagnostic quality images.**

### **Rationale:**

Good quality images are paramount. The workforce involved in acquiring the images must have the appropriate level of education and understanding of the modality and forensic imaging including the relevant anatomy. The scanning equipment being used should be considered when developing imaging protocols and due regard applied to the technical capabilities of each individual CT/MRI scanner. As technology evolves, protocols will need to be updated in line with equipment developments and care must be taken that protocols are not inappropriately 'shared' between different generations of scanners resulting in poor or inadequate images. The workforce should be able to demonstrate they have

sufficient knowledge to appropriately optimise the equipment. Post mortem results are predicated on reliable evidence for a diagnosis to be made.

### **Criteria:**

- a. Systems in place to ensure that persons undertaking the role of image producer have the understanding of, and ability to make the best use of, any imaging modality used to produce the images.
- b. Systems in place to ensure that consistently excellent quality images are produced to enable unequivocal findings.
- c. Systems in place to ensure that image acquisition protocols are developed and agreed through consultation between image producers, radiologist and pathologists.
- d. Systems in place to assure that protocols used for image acquisition are grounded in current best practice and reflect relevant professional guidance and statutory requirements (Imaging Services Accreditation Scheme - ISAS-, 2014).

### **Commentary:**

The appropriate level of education and understanding of the modality and the relevant anatomy demonstrated are required to ensure images are optimised for diagnosis. Images do not just 'appear' due to following a protocol, but require understanding of the nature of imaging. A

radiographer educated at Higher Education Level 6 (Bachelor) is able to undertake imaging at the appropriate level to ensure consistency in the production of suitable high quality images: this includes the basics of CT and MRI image production. Post registration training in complex Computed Tomography and Magnetic Resonance Imaging enables radiographers to understand and have the ability to modify scan parameters and sequences. In addition they have the fundamental education to be able to perform post processing in a wide range of image modalities. Postgraduate education in Forensic imaging is essential for radiographers to be able to fulfil the medico-legal requirements of these examinations (SCoR 2014). The highly trained CT radiographer in association with the Multi Disciplinary Team (MDT) is best placed to ensure that protocols are optimised for the equipment capability and image quality required.

A PMC-SI service needs to assure itself that the images are of an excellent quality. In CT, however, it is considered by some that no single protocol is the 'correct' protocol as acceptable image quality can be achieved using many different combinations of scan parameters (American Association of Physicists in Medicine). Local protocols should, however, reflect national guidance (RCR/RCPPath, 2012) and be based on best practice evidence. Radiographers have the depth of education to understand image quality issues and develop appropriate protocols for successful imaging outcomes.

### **C3 The service implements and monitors systems for appropriate communication of findings**

#### **Rationale:**

All radiographers are, by the very nature of their professional activities, film/image readers as well as image producers. Radiographers are educated to identify 'normal' appearances in the images they produce and thus as a corollary know when 'abnormal' appearances are present (Challen 2011). Further education will be necessary to identify relevant post mortem changes affecting image appearances and to differentiate between pathologies and post mortem artefacts.

#### **Criteria:**

##### **a.** Systems in place to ensure that the image producers (radiographers)

- understand the principles of image acquisition and are able to evaluate images,
- can distinguish between normal and abnormal findings/artefacts,
- are able to assess the quality of all images produced,
- understand and implement required actions where additional imaging may be required.

##### **b.** Systems in place to ensure that image producers are in a position to provide the relevant clinicians with information on pertinent findings.

#### **Commentary:**

The radiographers' role in reviewing and communicating information on acquired images should be agreed.

### **C4 Clinical records and confidentiality**

#### **Rational:**

Images, acquired data and other records generated in PM-CSI may be used as evidence in court. Ensuring the integrity of the data and the associated processes is essential for the images to be allowed as credible evidence.

#### **Criteria:**

**a.** Systems in place to ensure confidentiality is maintained in accordance with legislation and all relevant standards of professional conduct and ethics. All information relating to the case should be considered and is subjudice (SCoR Code of professional conduct 2013; HCPC Standards, SCoR Guidance for Radiographers providing forensic radiography services 2014).

**b.** Systems in place to ensure that all images produced include appropriate identifiers, ID markers, subject ID, radiographer ID, witness ID,

**c.** Systems in place to ensure that records are kept in line with SCoR Forensics guidelines 2012,

**d.** Systems in place that evidence the pathologists, lead radiographer and lead radiologist are satisfied that protocols and processes are in place that meet all the necessary medico-legal considerations for records and confidentiality ( SCoR, 2014),

**e.** Systems in place to ensure that images and raw data are handled in accordance with section 20 of the SCoR Guidance for radiographers providing forensic radiography services (2014), and systems exist for provision of the images and data to the referrer.

### **Commentary:**

HCPC registered radiographers' standards of practice require them to accurately annotate images, ensure subject identification occurs to rigorous standards and apply relevant professional or legal standards to their practice.

The issue of image storage or image access for the coroner or procurator fiscal will need to be considered in any agreed imaging protocols and service level agreements.

Postgraduate level education in forensic radiography is essential to provide the radiographer with the required knowledge and skills to image PMC-SI cases in accordance with all statutory and legislative requirements ensuring that, where required, images produced would meet all requirements for admission in court.

## **C5 Regular Audit including equipment quality assurance, current and emerging practices**

### **Rationale:**

All equipment used throughout the PMC-SI process must be fit for purpose, regularly quality assured and correctly maintained. As with any rapidly evolving technology providers of services will need to be aware of best practice in this field and have the ability to test their service provision against best practice parameters.

### **Criteria:**

- a.** Systems in place that demonstrate the PMC-SI service undertakes regular image quality control tests,
- b.** Systems in place that demonstrate the PMC-SI service undertakes regular audits,
- c.** Systems in place to ensure that radiographers and support staff have access to relevant CPD related to current and emerging practices in forensic imaging.

### **Commentary:**

Image audit and the contribution to definitive diagnosis should form part of the clinical governance procedures for the service.

In order to practice, radiographers must be registered with the Health and Care Professions Council (HCPC) which in turn requires demonstration of Continuous Professional Development (CPD) in the area(s) of each individual's professional activity. This implies keeping up to date with both current and emerging practices in Forensic Imaging.

## **Facilities and workforce (FW) standard**

### **Rationale**

Providing a PMC-SI service requires access to specific equipment and trained personnel. This domain describes the requirements for these facilities and the workforce required to deliver the standard.

- FW1 Facilities and environment
- FW2 Standard of education and competency of imaging staff

### **FW1 Facilities and environment**

## **Rationale:**

The service should be properly commissioned with clear identification of referral pathways, timescales and service availability plus other contractual requirements. This will be down to local agreement. Risk assessments for the whole work process should be included in any service specification.

## **Criteria:**

Systems in place for a service level agreement for provision of a PMC-SI whether undertaken in NHS or private sector Imaging Departments,

Systems in place to ensure that that the imaging equipment for any PMC-SI service is appropriate for the whole pathway from acquisition, reporting and review by the referrer,

Systems in place to ensure that required accessory equipment is available eg aids for lifting and handling of cadavers (see also HS 5).

## **Commentary:**

Consideration to age of equipment, specification and replacement plans may need to be considered within the service specification due to the fast developing nature of CT and MRI technology. It would be anticipated that PMC-SI would be performed using contemporary equipment.

## **FW 2 Standard of education and competency of imaging staff**

### **Rationale:**

Applying standards for education and training supports consistency in service provision between service providers.

Criteria:

- a. Systems in place that demonstrate those performing or assisting in post-mortem imaging studies are appropriately qualified and trained,
- b. Systems in place to ensure that HCPC registered radiographers performing PMC-SI have undertaken postgraduate level education and training in forensic radiography.

### **Commentary:**

All radiographers graduate with a standard competency in CT scanning. A workforce, therefore, currently exists that can be further developed to provide a minimally invasive autopsy service. The need for an experienced radiographer to adjust scan parameters to obtain optimal images cannot be underestimated, even with good protocols in place. By adjusting imaging parameters and by post acquisition processing and reconstruction of images, optimum images are available to aid the clinician interpreting and reporting the examination to provide an opinion on the underlying pathology and cause of death. Postgraduate radiographer experience in the field of MRI will provide them with similar skills.

Education and training to support post-mortem and forensic imaging are currently offered as postgraduate programmes by some universities approved for radiography education and the SCoR works with the IAFR to develop the skills and knowledge related to this area of radiographic practice. As part of the SCoR approval process, courses are reviewed against other appropriate standards such as the Skills for Justice Skillsmark (<http://www.sfjuk.com>)

The image recognition and reporting skills of radiographers means they are able to provide considered views/information on findings to assist the pathologist. Radiographers have skills in angiography that are transferrable to post-mortem imaging.

## **Health and safety (HS) standard**

### **Rationale**

A PMC-SI service requires the highest level of safety for staff and others. The risks associated with

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PMC-SI must be adequately managed to assure that staff and other personnel are protected from radiation, disease, physical injury and emotional distress.

HS1 Ionising radiation protection/occupational risk and hazard notices

HS2 Minimise exposure to EMF fields and hazard notices

HS3 Infection risk

HS4 Hazardous materials

HS5 Moving and handling

HS6 Psychological risks

## **HS1 Ionising radiation protection/occupational risk and hazard notices**

### **Rationale:**

Managing exposure to radiation provides a key element of safe working practices in PMC-SI.

### **Criteria:**

- a.** A PMC-SI service implements and monitors systems to manage risks associated with ionising radiation in accordance with all relevant legislation and local rules ,
- b.** Systems are in place to ensure that staff working with ionising radiation receive appropriate training in radiation safety and have access to any required protective equipment,
- c.** All areas where ionising radiation is used must be designated and monitored in accordance with regulations,
- d.** Hazard notices regarding the risks from ionising radiation must be clearly displayed within the service.

### **Commentary:**

Radiographers, as part of their education and training, are fully conversant with the requirements of legislation related to ionising radiation protection. Roles and responsibilities are mandated in legislation with regard to adequate expert physics support and monitoring of the environment and personnel.

## **HS2 Minimise exposure to EMF fields and hazard notices**

### **Rationale:**

There are significant risks associated with working in high strength magnetic fields. Safe working practices are essential for this technology to be used safely.

### **Criteria:**

- a.** A PMC-SI service implements and monitors systems to manage risks associated with magnetic resonance imaging,
- b.** Systems in place to ensure that appropriate procedures and checks are undertaken prior to the examination,
- c.** Systems in place to ensure safe exposure to the EMF field for accompanying personnel. Screening should be applied to all including the cadaver and staff involved in the examination.

### **Commentary:**

Post-mortem magnetic resonance imaging (PMMR) should be carried out only by specialist MR radiographers (Rutty et al 2012). MR Radiographers, as part of their education and training, are fully conversant with the requirements of all appropriate legislation related to MRI protection although may require further training related to the risks of MRI for post mortem examinations eg knowledge of implanted devices in the cadaver; systems to ensure no loose ferrous objects are within the body bag; body bags that are MRI safe.

The SCoR contends that HCPC registered radiographers have the most appropriate qualification to undertake CT as well as MR post-mortem imaging and that forensic imaging is within the scope of practice for radiographers who have completed the appropriate postgraduate level training in forensic procedures.

## HS3 Infection risk

### Rationale:

Risks associated with post-mortem imaging vary from the risks associated with imaging the living. Protection of personnel, visitors and other patients is essential.

### Criteria:

- a. A PMC-SI service implements and monitors systems to manage risks from infections,
- b. Systems in place to ensure that staff are trained in the processes required to protect themselves and other facility users from any infection risk posed by the deceased.

### Commentary:

A full risk assessment of likely contamination and control of the risks should be performed. Audit against the standards should take place to ensure effectiveness and compliance. Registered radiographers are trained in infection control and audit processes but will require up to date training and education with regard to procedures relating to the deceased. Access to expert infection control advice and training may need to be considered in the service specification. Access to occupational health expertise may also need to be considered should there be inadvertent exposure to an infection risk eg needlestick injury or skin abrasion.

## HS4 Hazardous materials

### Rationale:

Deceased bodies may have been exposed to harmful substances and contamination either pre or post-mortem. The normal channels of communication may not be available and therefore safe working practices must be developed.

### Criteria:

- a. A PMC-SI service implements and monitors systems to manage risks associated with hazardous substances and materials,
- b. Systems and processes in place to protect staff and other facility users from risk associated with hazardous substances and materials.

### Commentary:

A full risk assessment of likely hazardous substances and materials with control of the risks should be performed (Burnett 2004). Audit against the standards should take place to ensure effectiveness and compliance. Access to expert advice and training may need to be considered in the service specification. Access to occupational health expertise may also need to be considered should there be inadvertent exposure to a hazardous substance or material. Registered radiographers, as part of their undergraduate education, are conversant with the appropriate legislative requirements in the handling of a range of hazardous substances and materials, but will need extra training in those factors related to post-mortem practices.

## HS5 Moving and handling

### Rationale:

The movement of a deceased body carries significant risks for manual handling and attention must be paid to safe working practices for staff and accompanying personnel.

### Criteria:

- a. A PMC-SI service implements and monitors systems to manage safe moving and handling,
- b. Staff should be trained in systems, processes or equipment required for safe manual handling.

### Commentary:

A full risk assessment of likely manual handling associated with PMC-SI should be performed. Audit against the standards should take place to ensure effectiveness and compliance. Suitable equipment must be provided. Registered radiographers are trained in manual handling techniques. Access to expert advice and training may need to be considered in the service specification. Access to occupational health expertise may also need to be considered.



## HS6 Psychological risks

### Rationale:

Employers should pay particular regard to the potentially distressing nature of some aspects of forensic practice which could lead to post traumatic stress disorder (PTSD) in the individual undertaking the examination.

<https://www.sor.org/learning/document-library/guidance-radiographers-pro...>

### Criteria:

A PMC-SI service implements and monitors systems to address any psychological or emotional factors which may affect staff,

Systems are in place that ensure staff have access to appropriate support.

### Commentary:

There is a potential risk associated with the sensitive nature of post-mortem examinations that may result in radiographers suffering from emotional or psychological problems. Radiographers and associated staff should have access to emotional and psychological support. This should be reflected in appropriate risk assessments and governance processes. Support may be through in-house processes such as occupational health services or via an external Health and Wellbeing service. Radiographers should be able to access immediate and ongoing support as required without need for formal referral through a managerial system. The guidance provided in the overarching forensic document should be followed.

## Privacy and dignity (PD) standard

### Rationale

A PMC-SI service is by its very nature a sensitive service. Relatives, carers and friends of the deceased will seek assurance that the service is delivered and carried out with respect; preserving the dignity and privacy of the deceased. Facilities should be designed and staff should be trained appropriately for this key part of service delivery. Where facilities are shared or not dedicated to post-mortem imaging, particular attention should be paid to managing the flow of the work through the facility to ensure that other users and PMC-SI users are adequately and respectfully separated. Details about the service should support equality of access to both information and the service.

PD1 Privacy and dignity of the deceased is maintained

PD2 Provision of information

PD3 Equalities legislation and respect for personal characteristics and traits

### PD1 Privacy and dignity of the deceased is maintained

#### Rationale:

Facilities for PMC-SI may be dedicated to post-mortem use or form part of a larger diagnostic imaging service. Wherever the service is delivered there should be evidence to support a sensitive approach to service delivery from arrival of the deceased through to their return back to the referral service.

#### Criteria:

**a.** Systems in place to evidence that respect for the deceased while in transit, waiting areas or undergoing a scan is considered eg documented systems of work, appropriate communication channels, sensitive signage,

**b.** Systems in place to demonstrate that all relevant staff are aware of, and trained to, demonstrate appropriate respect for the deceased.

## **Commentary:**

No discrimination should be made on any grounds and culturally sensitive needs should be considered. eg timeliness of examinations, religious artefacts remaining with the deceased etc. Documentation around processes and systems of work is required. A protocol should exist and staff should be trained in the protocol for managing the deceased's examination pathway.

## **PD2 Provision of information**

### **Rationale:**

A PMC-SI service should implement and monitor systems to provide sensitive and useful information to relatives and significant others of the deceased about PMC-SI. Wherever and however the service is delivered, due regard to providing suitable information to relatives, carers or friends should be made.

### **Criteria:**

- a. Systems in place to ensure that information is provided in a format that is accessible to the client and presented in such a way as to support understanding,
- b. Systems in place to audit information provided.

### **Commentary:**

Information provided must be appropriate and take account of local circumstances. Where possible user feedback should support the development of appropriate information.

## **PD3 Equalities legislation and respect for personal characteristics and traits**

### **Rationale:**

Clients from all walks of life may require access to the service. Clients should be treated as individuals with respect for their own particular unique characteristics. Issues around access and referral to the service should be considered including uptake. Staff will require the appropriate training and information to ensure compliance with the Equalities Act, 2010 and ensure that any individual accessing the service has their personal characteristics and traits respected.

### **Criteria:**

- a. Systems in place that demonstrate staff have the required knowledge and training to deliver the service in line with legislation and with regard to cultural mores.

### **Commentary:**

Relatives or people associated with the deceased may be in an emotional state at the time of the examination and particularly sensitive. They may have a raised awareness of protecting the cultural, religious or personal preferences of the deceased. Staff should be confident and competent to address concerns or requests made to the service and respond appropriately.

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