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Review article

IAFR Guidelines for best practice: Principles for radiographers and imaging practitioners providing forensic imaging services

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SUMMARY

Radiography for forensic purposes is a complex area of practice and the International Association of Forensic Radiographers (IAFR) is pleased to provide this guidance and advice document for Radiographers and Radiological Technologists involved in providing forensic imaging services. These guidelines were originally published as a collaboration between the IAFR and the College of Radiographers in the United Kingdom (UK), in 1998 [1]. As membership of the IAFR continues to grow internationally, these guidelines have now been updated to be more applicable outside the UK justice system [2]. The aim is that the principles outlined in these international 'best-practice' guidelines will be adapted by national professional bodies and relevant health and justice departments to suit local medico-legal systems within each country, and that departmental managers and employers should also find this document invaluable [3]. It is recognised that the level of best practice that can be achieved is dependent on local facilities and resources, as well as the expertise of the radiographer(s).

1. Introduction

1.1 This document is issued by the IAFR to provide guidance to radiographers working in the field of radiography and imaging for forensic purposes. It should be read in conjunction with the local/national Codes of Professional and Ethical Conduct or Scope of Practice and any other guidelines for radiographers relating to forensic issues or the law in that jurisdiction.

1.2 This document replaces all previous guidance documents for forensic radiography issued by the IAFR.

1.3 Local policies, protocols and procedures must be produced with which all members of staff should be familiar. These IAFR guidelines may be used as a basis for the production of such local protocols but do not constitute a protocol in their own right.

1.4 Radiographers undertaking radiography or imaging for forensic purposes must have appropriate training and education in the field of forensic practice, as recommended by the national professional body, and a good working knowledge of all applicable legislation and guidelines in that jurisdiction.

1.5 Radiographers undertaking radiography or imaging for forensic purposes must maintain clinical competence and currency of knowledge and skills as evidenced by their record of continuous professional development (CPD) or continuous education (CE). It is recommended that radiographers involved in forensic imaging maintain membership of appropriate professional bodies, including the IAFR.

1.6 Payment for undertaking forensic imaging is outside the scope of these guidelines and should be arranged at a local level with the referring service.

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2. Definitions

2.1. Forensic Medicine

The application of medical knowledge and technologies in the collection of evidence to be used in a court of law. Such evidence may be collected from either living or deceased subjects with the latter presented as either whole cadavers or as pathological specimens.

2.2. Forensic Imaging

The application of the science of diagnostic imaging to questions of law.

2.3. Diagnostic Imaging

For the purposes of this document, diagnostic imaging may include the following modalities:

- Radiography (digital and analogue)
- Intra-oral radiography
- Fluoroscopy
- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Ultrasound
- Nuclear Medicine

2.4. Post-Mortem Imaging

The application of diagnostic imaging techniques to assist in the death investigation process. Any cases which involve no likelihood of legal involvement (e.g. archeological imaging, research, audit), would not be considered forensic.

2.5. Minimally-Invasive Autopsy

The application of cross-sectional imaging to determine cause of death, gather evidence and, where possible, remove the need for invasive autopsy (post-mortem).

Contrast agents may be used to enhance the images, particularly to visualise the vascular system or for interventional guidance (e.g. biopsies or extraction of foreign bodies).

Pulmonary ventilation techniques may also be used to mimic deep inspiration and allow better assessment of lung pathology.

The use of cross-sectional imaging has been introduced in accordance with the public's general desire for less invasive autopsy techniques, particularly those related to children, neonates and foetuses. It is important to recognise that surgical or invasive autopsy may still be necessary following minimally-invasive autopsy. It is also important to understand that local, state and national standard operating procedures may supersede the results of forensic imaging, thus requiring full evisceration of the body regardless of imaging findings.

2.6. Forensic Radiographer/Radiologic Technologist

Any state registered radiographer/radiologic technologist who has undertaken a course of postgraduate education in forensics approved by the IAFR; or any state registered radiographer considered by their professional body/employer to have sufficient experience to carry out forensic examinations and with a good working knowledge of all applicable legislation and guidelines. The titles of radiographer and radiologic technologist are inter-changeable in these guidelines.

2.7. Appropriate Witness

A radiographer acting as a witness to the entire imaging process, with responsibility for ensuring that images are admissible in law as evidence and to reduce the risk that any challenge to the validity of that evidence will be successful. The IAFR recommends that this should be another radiographer who is experienced in this field of work. There is potential for the Appropriate Witness to appear in a court of law and it is unlikely that a non-radiographer, including students and assistant practitioners, would have the depth of knowledge and experience required for them to be regarded as a credible witness to the entire imaging examination.

2.8. Legally Designated Responsible Person

The local/regional person with legal responsibility for the forensic investigation (e.g. Coroner, Medical Examiner, Procurator Fiscal, Police Official, Forensic Physician).

2.9. Continuity Officer

A representative of the Legally Designated Responsible Person or a member of the police investigation team, responsible for the integrity and receipt of evidence as well as ensuring the continuity of evidence.

2.10. Continuity of Evidence

A documented audit trail to account for the possession and transfer of any evidence, from the time it is identified as evidence, until its presentation in court. The Continuity of Evidence must be ensured at all times. Radiographers undertaking forensic imaging should be aware of this as they may be required to leave primary evidence, in order to acquire or process images. The primary evidence must be secured, formally returned to custody/care of the mortuary or left in the presence of a Continuity Officer.

2.11. Integrity of Evidence

The protection of evidence from damage, alteration or unauthorised access. Integrity proves that the evidence has been dealt with in the appropriate manner and there has been no interference, either intentionally or accidentally. The Integrity of Evidence must be ensured at all times. The use of appropriate labelling, secure storage and tamper-evident packaging will help to maintain the integrity of evidence.

2.12. Master Copy

A copy of the original native imaging data, made immediately following the imaging examination. The Master Copy should be securely stored and only used when the integrity of the Working Copy images are brought into doubt.

2.13. Working Copy

A copy of all images (after post-processing or algorithm changes and manipulation were affected, as and when necessary) used to provide supportive evidence for the investigation. The final Working Copy should be used to support the radiological report.

2.14. Disaster Victim Identification (DVI)

The process for the identification of a person as part of the investigation of a major incident/disaster or mass fatalities incident.

3. Applications of Imaging for Forensic Purposes

Examples of where imaging is of value in the forensic investigation include, but are not limited to [3]:

3.1 Investigation of non-fatal injuries: the production of evidence to support the investigation of injury to an individual or individuals. Examples can include:

- Suspected Physical Abuse (SPA) / Non-Accidental Injury (NAI) of vulnerable individuals (e.g. the young, elderly and those with disabilities, including reduced mental capacity)
- Assault
- Road traffic incidents
- Compensation claims
- Medical negligence
- Industrial injury or disease
- Custodial injury
- Torture or systematic abuses of human rights

3.2 Location of other forensic evidence: the provision of imaging evidence to demonstrate the presence of concealed foreign bodies. Examples include, but are not limited to:

- Human narcotic packing detection (e.g. drug smuggling)
- Detection of non-narcotics or other ingested material (e.g. diamond smuggling)
- Ballistic material (e.g. shotgun pellets, bullets, shrapnel, arrowheads)
- Non-ballistic material (e.g. knife blades, needles, spoons etc.)

3.3 Cause of death: the production of evidence to support the investigation of suspicious or unexplained death of an individual or individuals. Examples include, but are not limited to:

- Sudden unexpected adult death
- Sudden unexpected death in infants (SUDI) and sudden infant death syndrome (SIDS)
- Road traffic deaths
- Homicide
- Suicide
- Drug related death
- Death following medical intervention
- Custodial death
- Discovery of decomposed remains
- Mass fatality incidents, genocide or atrocity crime
- Sudden unexplained death in epilepsy (SUDEP)

3.4 Human Identification: the production of evidence to help confirm, determine or eliminate the identity of both living and deceased persons [4]. Techniques could include, but are not limited to:

- Demonstration of dental structures to facilitate identification of an individual through comparative techniques
- Demonstration of other anatomical structures, trauma and pathological conditions, to facilitate identification through comparative techniques (e.g. previous fractures, previous surgery, etc.)
- Determination of biological profile (e.g. age, stature, sex, socio-economic status, etc.) through evaluation of skeletal structures
- Three-dimensional (3D) reconstructions (e.g. facial reconstruction), demonstration of personal effects (e.g. jewellery to assist identification) or photo-superimposition.

4. Forensic Examinations of Living Individuals

4.1 Radiographers should be aware that any radiographic or imaging examination could potentially be forensic in nature and subject to scrutiny in a court of law. Therefore, the highest standards of imaging and care should prevail and all radiographers must recognise the need for accuracy and preserving the evidence/audit trail.

4.2 Radiographers undertaking forensic examination of living subjects should comply with the provisions as set out in the relevant codes of professional and ethical conduct and with all applicable regulations for diagnostic imaging and the safe and efficient use of both ionising and non-ionising radiation in the jurisdiction.

4.3 Radiographers undertaking forensic examinations must be familiar with, and comply with, the local protocol for forensic imaging which must address the following specific issues:

- Authorised referrers
- Justification and Optimisation
- Consent and confidentiality
- Continuity and integrity of evidence
- Clinical protocols for specific examinations such as SPA/NAI, demonstrating adherence to the As Low As Reasonably Achievable (ALARA) principle
- Requirements of particular care pathways, e.g. care of the elderly, child protection, age-estimation [5].

5. Forensic Examination of Deceased Individuals and/or Pathological Specimens

5.1 The Legally Designated Responsible Person (e.g. Coroner, Medical Examiner, Procurator Fiscal, Police Official) may request a forensic radiographer to undertake a post-mortem examination of a body in certain circumstances.

5.2 As suitably qualified persons in the field of diagnostic imaging, forensically-trained, specialist radiographers are the most appropriate professionals to undertake forensic radiography examinations of cadavers or pathological specimens.

5.3 Radiographers undertaking forensic examinations of cadavers and pathological specimens must comply with the provisions as set out in the relevant codes of professional conduct and with all relevant regulations for diagnostic imaging and the safe and efficient use of both ionising and non-ionising radiation.

5.4 Radiographers undertaking such forensic examinations must be aware of, and comply with, the local protocol for forensic imaging which needs to address the following specific issues [6]:

- Authorised referrers
- Optimisation
- Continuity and integrity of evidence
- Confidentiality
- Health and safety, including infection control, radiation protection and welfare of staff
- Cultural and religious sensitivities
- Privacy and dignity
- Out of hours service provision
- Transfer of cadavers and specimens

6. Departmental Forensic Protocol

6.1 Radiography for forensic purposes must be carried out in accordance with a written protocol [7]. The protocol should be specific to the local service and should adhere to the policies of the employer or appropriate professional bodies for the drafting of such documents. It is recommended that the protocol be developed in consultation with all key stakeholders who may include, but are not limited to:

6.1.1 Department:

- Lead Forensic Radiographer
- Clinical Lead (Radiologist)
- Departmental Manager/Hospital Governance

6.1.2 Hospital Clinical leads for:

- Pathology

- Paediatrics, including Child Protection
- Emergency Medicine
- Major Incident Planning
- Elderly Care
- Occupational Health/Welfare

6.1.3 External:

- Coroner, Medical Examiner or Procurator Fiscal
- Lead Forensic Pathologist
- Police Official
- Child Protection Authority
- International Association of Forensic Radiographers (IAFR)
- International Society of Forensic Radiology and Imaging (ISFRI)

6.2 Where a local template is not available, the generic structure of the protocol must address the following [6]:

- Introduction
- Statement of intent
- Implementation and review
- Scope of local service
- Referral pathways
- Roles, responsibilities and inter-professional relationships
- The list of trained radiographers providing the service
- Relevant contact details
- Education and training of staff
- Health and safety, including radiation protection
- Continuity of evidence
- Quality control and audit
- Welfare of staff

6.3 The subsequent paragraphs provide guidance on specific issues relating to the scope of the local service, referral pathways and roles and responsibilities. It is recommended that the local protocol include reference to all of these areas.

7. Requests for Radiography for Forensic Purposes

7.1 Requests must be made by recognised, approved referral sources, which in addition to routine clinical referrers, may include but are not limited to:

- Forensic Pathologists
- Forensic Radiologists
- Forensic Odontologists
- Forensic Anthropologists
- Forensic Physicians
- Police and Security Services
- Border Control Officials

7.2 Requests for forensic post-mortem examinations may only be submitted when the investigation has been authorised by the Legally Designated Responsible Person. This should be clearly indicated on the request form, unless pre-authorised within a locally agreed policy or standard operating procedure (SOP).

7.3 Requests for forensic imaging examinations may also arise as a result of a major incident or mass disaster [8] (The employing authority's Major Incident Protocol should detail appropriate arrangements for the provision of radiography services on living individuals arising from such incidents).

7.4 The various referral pathways must be identified in advance and incorporated into the policy/SOP in order that appropriate management arrangements can be made and implemented.

7.5 It should be noted that all mass disasters are treated as crime scenes and therefore all referrals for imaging examinations of the living or the deceased arising from such incidents should be treated as forensic radiography referrals.

8. Consent

8.1 The departmental protocol must address the issues of consent [6, 9].

8.2 The employing authority, appropriate organisational policies or professional bodies' guidelines on consent, mental capacity and child protection should inform the production of the forensic imaging protocol.

8.3 It should be noted that all forensic requests on living subjects must be treated as non-medical referrals for the purposes of ionising radiation legislation and as such, fully informed, written consent is considered best practice. The referring clinician should explain the procedure, including radiation risks, and obtain consent. Although the law may not actually require consent to be written, diagnostic imaging for forensic purposes is an area of practice where validity of consent may be questioned, and therefore to obtain written consent would be considered best practice.

8.4 There are no circumstances when implied consent is acceptable.

8.5 The consent process will confirm that the consenting individual has been informed about, and understands, a range of issues that include, but are not limited to:

- Purposes of the examination
- Nature of the procedure
- Duration of the procedure
- Risks and benefits of the procedure (including clinical and radiation risk)
- Professionals involved
- Withdrawal of consent
- Dignity and privacy

8.6 For individuals unable to provide consent, appropriate arrangements should be made to obtain recognised third party authority. Examples include, but are not limited to:

- Parents
- Legal guardians
- Individuals appointed by the courts
- Proxy consent from a legally authorised person
- Default surrogates
- Advanced directives
- Designated person based on Living wills

8.7 It should be noted that for children and minors, such third-party consent may be in the domain of a suspected or alleged perpetrator of abuse. Appropriate sensitivity should be considered for obtaining such consent but the parent or guardian must be fully informed.

8.8 Third-party consent cannot be given by the referrer.

8.9 For individuals with language or communication issues, official translation services will be required.

8.10 When consent is withheld, the examination cannot be undertaken. It should be noted however, that this may lead to circumstances whereby:

- Children and other vulnerable individuals may be appointed wards of court and third-party consent obtained from the legal guardian.
- Psychiatric patients may be sectioned under the relevant mental health legislation, and limited powers given to the clinician.
- Narcotics traffickers may develop clinical symptoms of toxicity and become clinical emergencies. In the event of a clinical emergency, the informed consent process may not follow the routine consent protocols set forth in non-emergency situations, especially in instances where the doctor is taking action in the best interests of the

patient.

9. Confidentiality

9.1 Standard principles of client or relative confidentiality must be maintained in accordance with all relevant standards of professional conduct [7,9].

9.2 Forensic cases must never be discussed with any person not directly involved in the case (i.e. those outside the court or investigation) unless specific permission has been granted by the legally designated responsible person, until the investigation or inquest has been completed.

9.3 Furthermore, where a Coroner, Medical Examiner or Procurator Fiscal has referred a case for consideration by a court of law, the principles of client confidentiality will continue to apply throughout the proceedings.

10. Medico–Legal Aspects

An understanding of the medico-legal aspects of any forensic examination is critical if the evidence provided is to be of any value to the legal process. The following sections provide basic guidance and should inform both local protocols and procedures.

10.1. Evidence

10.1.1 Cadavers and/or body parts and associated artefacts in themselves constitute evidence.

10.1.2 Evidence from forensic imaging may include both images and imaging reports [6].

10.1.3 Before any images, statement or any other information can be accepted for use in a court of law, it must be judged to be admissible as evidence.

10.1.4 In order to be deemed admissible, the evidence must be properly authenticated and continuity of evidence must be demonstrated. The radiographer, supported by an appropriate witness should be able to attest in a court of law that any specific image was produced by them at the date and time indicated and that the image is of the identified evidence, individual or body part and has not been tampered with during, or as a result of, the image acquisition and production process.

10.1.5 In some jurisdictions the Daubert standard must be satisfied for evidence to be admissible in court and for this evidence to be discussed by expert witnesses [7,10].

10.1.6 To ensure authentication and continuity of evidence for forensic images, the following issues should be addressed.

10.2. Subject Identity

10.2.1 All subjects must have an authorised unique identification number prior to the examination and such identification must be used consistently throughout the process and on all documentation and images.

10.2.2 Where available, a name and subject identification number should be recorded but, where the identity of the individual is unknown at the time of the examination, a unique case identification must be used such as Police evidence numbers or hospital incident numbers.

10.2.3 Subject identifiers must be recorded on images using primary identification systems such as DICOM headers/examination data sets or light markers.

10.2.4 Anatomical side markers/indicators must be physically present within the primary radiation beam and should not be added during post-processing.

10.2.5 Locality identifier and date/time of examination must be recorded on images using primary identification systems such as DICOM headers/examination data sets or light markers.

10.2.6 Where a radiographer has followed the proper process and the image quality is satisfactory, except for the visibility of radiographic markers, repeat imaging may not be necessary or appropriate. The radiographer and radiologist should make a joint decision as to whether a repeat exposure is necessary. If the radiographer is unsure or there is anatomical incongruity, repeat imaging will be necessary [11]. Any decision to repeat should be justified and documented within any contemporaneous notes and the witness statement (Fig. 1).

10.2.7 If a repeat examination is not practicable, any patient or examination identification not included on an image should be added using post-processing facilities and reference made to this in the witness statement. It is acknowledged that this should only occur in exceptional circumstances.

The addition of patient or examination identification after the original exposure should be considered atypical since good practice requires inclusion within the primary field of radiation at the time of exposure during the original examination.

10.3. Continuity of Evidence

10.3.1 The entire imaging process must be properly witnessed by an Appropriate Witness who accompanies the radiographer when performing any tasks directly associated with the production of the radiographic images [6]. All actions and communications should be contemporaneously documented by the radiographer and the appropriate witness to be presented if, or when, necessary.

10.3.2 The witness to the imaging examination itself who remains with the subject/patient whilst the radiographer acquires the radiographic images, may be another radiographer, healthcare worker, healthcare professional, social worker or Continuity Officer. All actions should be guided by a locally agreed written protocol.

10.3.3 The identities of the radiographer, appropriate witness and any witnesses to the examination must be documented and securely recorded in the Radiology Information System (RIS) or paper-based equivalent. The radiographer and appropriate witness are required to initial any imaging evidence as proof of authenticity. The radiographer and appropriate witness will also be required to complete a witness statement to support their evidence.

10.3.4 The appropriate witness must be present throughout the examination and accompany the radiographer during the post-processing/development and recording of the images.

10.3.5 The radiographer and their appropriate witness must sign/appropriately authenticate all original analogue and digital hard copy images as being an accurate record of the examination.

10.3.6 Continuity of the primary evidence (i.e. the cadavers and/or pathological specimens) must be ensured at all times. Radiographers undertaking forensic imaging should be aware of this as they may be required to leave the primary evidence in order to process images. The primary evidence must be secured, formally returned to custody/care of the mortuary or left in the presence of a Continuity Officer.

10.3.7 There may be occasions when a Continuity Officer is required for living subjects undergoing forensic imaging, for example in the investigation of ingested narcotics.

10.3.8 The employing authority or appropriate organisation will be responsible for the security and continuity of all imaging evidence until formally handed over to a Continuity Officer who must sign to confirm that it has been received. In some situations, images are transferred to the responsibility of another investigating discipline. For example, dental radiographs that are produced in the investigation of post-mortem identity are handed over to an Odontologist who uses the images to develop a comparison report to present to the Identification Board. The rules of continuity of evidence still apply, and the Odontologist will sign for the images and the Continuity Officer will be aware at all times of their presence for retrieval at a later date.

10.3.9 A distinction should be made between imaging which commences as a health record and imaging which commences as forensic

evidence. In the case of the former, it may not be appropriate (in every case) for the employing authority or appropriate organisation to have security and continuity of the imaging until it is handed over to a Continuity Officer. In those cases, however, it is recommended that this guidance is discussed with the relevant employing authority or appropriate organisation so that suitable arrangements can be made for the security and continuity of the evidence in accordance with the applicable rules of evidence.

10.3.10 Arrangements should be made for the security of original analogue images and hard copy digital images. Such images constitute evidence and may require additional procedures to be put in place to ensure that the evidence is not misplaced or open to interference.

10.3.11 All relevant materials (e.g. images, discs, reports) should be retained in accordance with local/national data retention guidelines and legislation.

11. Digital Images

11.1 Digital imaging is an accepted practice in forensic science and the courts. Relevant, properly authenticated digital images that accurately portray an object are admissible in court. Digital images that have been enhanced are admissible when the enhancement can be explained by qualified personnel [12].

11.2 Only primary evidence is admissible in court. In the case of analogue radiographs, this will be the original hard copy image and report. In the case of digital images, the Working Copy, rather than the original data set will be produced to support the report. It is therefore essential that a Master Copy of the original native data must be made immediately, in order to demonstrate the integrity of the Working Copy images [6,13–15].

11.3 The IAFR recommends that the native data in the form of original images (prior to any post-processing) should be saved as the 'Master Copy'. This should be authenticated with the initials of the radiographer and appropriate witness at the time of production and stored in an appropriately secure environment, which prevents any unauthorised access and thus maintains the integrity of the evidence.

11.4 The digital image can be used as additional supportive evidence after algorithm changes and manipulation as necessary. These changes should be documented and the images should then be saved separately and referred to as the 'Working Copy'.

11.5 An additional (backup) Working Copy should be made in cases where image data is not automatically backed up (e.g. on a Picture Archiving and Communication System [PACS]).

11.6 Any subsequent algorithm changes and manipulation of images to Working Copy images (e.g. during reporting) should be documented and the images then saved as a new Working Copy. The final Working Copy should reflect the reported examination. All previous Working Copies will be evidence of image manipulation and documented in the witness documentation.

11.7 Any changes to an image made through image processing are acceptable in forensic applications providing that the Master Copy is preserved and that the Working Copy processing steps are documented in a manner sufficient to permit a comparably trained person to understand the steps taken, the techniques used and to extract comparable information from the image.

11.8 Opportunities exist for the later production of hard copy images from digital data and/or the copying of digital data sets. Legal advice should be sought for the production of any such copies. For forensic cases, specific permission from the Legally Responsible Designated Person is usually required. In all other cases permission from the appropriate legal representative should be sought.

11.9 All subsequent copies must be signed and witnessed by the radiographer who has produced the Working Copy and the appropriate witness, if possible; if not an appropriate alternative would be the PACS manager.

11.10 All image data on any media should be securely stored and all appropriate measures taken to prevent unauthorised access that may compromise the evidence in a court of law (i.e. maintaining the Integrity of Evidence).

11.11 All relevant materials (e.g. images, discs, reports) should be retained for the minimum period of time, according to local data protection legislation.

11.12 Images stored on PACS must be secure and only available to those involved in the investigation team. This is particularly important in a hospital setting.

12. Copy Analogue Images

NOTE: This section pertains only to situations where analogue imaging may be used.

12.1 Copies are secondary evidence and are only admissible where originals can be proven to be lost or destroyed [6].

12.2 Recognising the risk from the loss of an original analogue image, the IAFR recommends that a duplicate hard copy image be made at the time of all forensic examinations.

12.3 For forensic cases, this arrangement should be made in advance and included in the locally agreed written protocol. The procedure for dealing with and storing such duplicate images while the case is under investigation should be detailed in the written protocol.

12.4 Any requests for additional copies must be referred to the legally designated responsible person or the appropriate legal representative with regard to other cases.

12.5 All copies must be signed and witnessed as copies of the originals by the radiographer who has produced the copies and an Appropriate Witness.

13. Records

13.1 All records must comply with all national and local guidelines with regard to maintenance and storage of confidential health records and Data Protection legislation.

13.2 Appropriate records, which must be defined in the written local protocol, must be kept of all forensic radiography examinations. Records that should be kept, include, but are not limited to, the following information [6]:

- identity of radiographer
- identity of witness(es)
- identity and role of any others present and/or formally involved
- date/time/location of examination(s)
- subject identifiers
- examination identifiers
- number and type of projections involved
- location of any evidence (e.g. pathology, retained materials)
- handover details for transfer of evidence (including name and signature of recipient) number and location of copies.

13.3 The IAFR recommends that formal documentation (i.e. an imaging proforma or witness document) be produced to incorporate the above details, support any image evidence that has been produced and facilitate any witness statement. Please see Fig. 1 for a working example of a witness document [16].

13.4 The IAFR recommends that all individuals involved in performing the imaging examination should complete their own written documentation in the event that they need to be referred to at a later date. Forensic radiographers should keep their own written documentation (i.e. contemporaneous notes) securely as this also forms a formal record of evidence.

13.5 To maintain continuity of evidence, the transfer of original (Working Copy) images for reporting must be logged and witnessed, the images must not be left unattended/unsecured at any time.

13.6 The reporting Radiologist/Radiographer/Pathologist should be

Template to be amended accordingly for documenting Radiographic/Fluoroscopic/PMCT Forensic Imaging examinations.

Forensic Imaging Examination

ID: *unique identifier*

Date of Examination:	*Time of Examination: Start and end time*
Name of Radiographer:	
Name of Appropriate Witness:	
Location of Examination:	*Specific location within hospital*
Modality used:	

Regions Examined: *such a diagram can be useful in identifying regions examined or pathology / evidence locations*

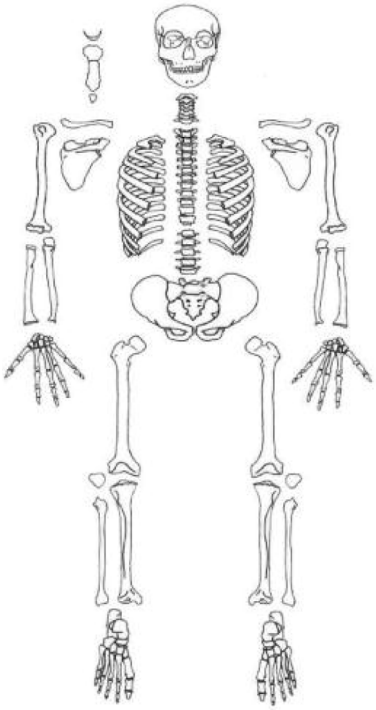

Fig. 1. Template for Witness Document / Contemporaneous Record of Examination (reproduced with permission from the Irish Institute Institute of Radiography and Radiation Therapy [16])

satisfied as to the continuity of evidence prior to reporting [17].

14. Education and Training

14.1 Radiographers who undertake radiography for forensic purposes should be educated and trained at postgraduate level in radiography for forensic practice and maintain competence through regular updates as part of their CPD or CE [6].

14.2 Such radiographers must have relevant and up-to-date knowledge and experience, which should be regularly documented as part of a CPD or CE portfolio. Information should include but not be limited to:

- Appropriate imaging techniques to meet the requirements of radiography for forensic purposes
- Specialist modality imaging such as paediatric SPA/NAI radiography
- Medico-legal issues relating to the admissibility of evidence
- National and local health and safety regulations, particularly with regard to the handling of deceased subjects

Examination Details:

Some sample information has been presented below:
All forensic radiographic/fluoroscopic/CT imaging was performed using the *xxxxxx* x-ray unit/fluoroscopy unit/CT scanner in room *xxx* in the presence of witness *xxx* between on *day/month/year*.
Others present and their role.

All exposures were made using a X-ray tube focus to detector distance of 100cm and exposure factors of *xxx* kVp and *xxx* mAs. Right and left sided anatomical markers were placed within the collimated field at time of exposure to allow sides to be identified for all exposures.
A total of x radiographic images were acquired:

All PMCT scans were acquired using *xxx* Protocol. Multi-planar and 3D Reconstructions were performed.

List, using correct terminology in order of actual acquisition

Preliminary Findings:
xxx

Name of Radiographer:	**Signed:**	**Date:**
Name of Appropriate Witness:	**Signed:**	**Date:**

xxx (number) of images/CDs printed/burnt. These were presented to *xxx* who signed to acknowledge receipt of them on day *date/month/year* at *time*.

Name of Representative of Radiology department:	**Signed:**	**Date:**
Name of Person who received images/CD:	**Signed:**	**Date:**

Fig. 1. (*continued*)

- Different cultural and religious ethics associated with the deceased and their relatives
- Appropriate communication skills for dealing with subjects who have undergone a traumatic experience (e.g. living victims, refugees, bereaved family members)
- Recognising signs and symptoms of post-traumatic stress disorder (PTSD) in yourself and others and identifying both positive and negative coping strategies
- Statutory legislation, government, professional and local guidelines related to radiography for forensic purposes.

14.3 The IAFR provides regular education events to keep forensic radiographers updated in various areas of practice.

14.4 Information on other postgraduate and training programmes is available from the IAFR website: www.iafr.org.uk

14.5 Some professional bodies (e.g. The Society and College of Radiographers [18]) have developed an education and career framework to guide education providers on the development of postgraduate programmes to support forensic imaging including minimally invasive autopsy.

15. Involvement of Students and Assistant Practitioners

15.1 Forensic imaging should be considered a specialist area of practice that requires additional postgraduate education and training. The involvement of any personnel in forensic imaging should comply

with forensic radiography and imaging guidelines. For these reasons, the IAFR recommends that accredited assistant practitioners and student radiographers should not participate in forensic radiography examinations.

15.2 Where students are permitted to observe specified forensic imaging examinations, this must be done under a local agreement between the employing authority or clinical department and the university. Where observation is permitted, there must be robust risk assessment and governance procedures to address the safety and welfare of the student and the robustness of the forensic evidence chain. Students who observe any forensic imaging examination must be aware that they may be called as a witness to any subsequent legal proceedings.

15.3 In order to limit the risk of potential contamination of evidence, the minimum number of personnel needed to carry out the examination should be present. For this reason, and the fact that student radiographers and assistant practitioners should not be considered an appropriate witness, it is not recommended that they be present.

15.4 Potentially, any diagnostic imaging examination could become forensic in nature and it would be unrealistic and undesirable to exclude accredited assistant practitioners and students from imaging investigations because they might possibly become part of a forensic examination. Where it is known and planned from the outset that the imaging examination is forensic in nature, students should not participate (unless under a local agreement as described above). It should be noted that all examinations for SPA/NAI are forensic examinations (see section 19.1).

15.5 For those imaging examinations which are known to be legal cases at the time of imaging (e.g. some assaults or road traffic accidents), the supervising radiographer will need to decide whether or not a student should observe or participate. In making this decision, the radiographer would need to consider the following rationale for excluding students:

- Forensic radiography is not a first-post competency.
- Forensic radiography or imaging should be considered a specialist area of practice that requires additional postgraduate education and training.
- Forensic radiography or imaging examinations are undertaken for medico-legal purposes and it is, therefore, essential to accurately document the examination, which would include a record of the student having been present. Therefore, the student may be asked by a Coroner/Medical Examiner or court to act as a witness to the examination itself. Student radiographers who find themselves in this position would be vulnerable due to their lack of practical and professional experience. The effects of being involved in such an incident may adversely affect their studies.
- The IAFR is not aware of any country that has a formal requirement for forensic radiography to be included within the curriculum for pre-registration education programs. Forensic radiography is therefore, not a requirement or competency within their clinical practice placements.
- In the event that a student chooses to observe a forensic imaging examination, appropriate support must always be available from the imaging department and the university must be notified that the student has observed a forensic radiography or imaging examination. Consequently, the university is in a position to offer appropriate counselling services to the student.

15.6 It is recommended that student radiographers are given the opportunity to develop a theoretical awareness of forensic radiography practice during their final year of study to enable them to make an informed decision about their involvement in forensic radiography when commencing their professional career.

15.7 Graduate radiographers should have the opportunity to be involved in forensic imaging practice upon qualifying. This should be undertaken following additional education and training, in accordance with these IAFR forensic imaging guidelines and staff should be appropriately mentored throughout the process.

16. Image Reporting

16.1 It is essential that any person carrying out any interpretation or reporting of forensic images must be trained, competent and authorised within the local medical guidelines and legal system [17,19].

16.2 Radiographers may be asked to provide a professional opinion on the images that they produce. It is imperative that the forensic radiographer practices within the scope of their competence when doing so.

17. Health and Safety

17.1 The employing authority or appropriate organisational policies on prevention and control of infection, care and handling of the deceased, control of hazardous substances and manual handling should inform the production of the forensic protocol.

17.2 Local mortuary and pathology occupational health and safety policies should inform the production of the forensic protocol.

17.3 All cadavers and human remains must be treated as potentially infected and a risk to the health of the staff. Appropriate personal protective equipment (PPE) should always be worn when dealing with human remains [20].

17.4 The protocol should address appropriate precautions to minimise any risks of cross-infection during radiography or imaging for forensic purposes.

17.5 It is recommended that forensic radiography or imaging examinations of cadavers and/or pathological specimens should be conducted in an x-ray room with appropriate shielding and dedicated imaging equipment. Where this is not available, the mortuary or a room specifically set up for that purpose may be an alternative option.

17.6 When performing the examination within the diagnostic imaging department, appropriate care should be taken to minimise the risk of cross-infection and to ensure that the conduct of the examination causes minimum distress to patients and staff (e.g. imaging performed outside routine working hours, arrival in the department via the most discrete entrance, etc.). Local diagnostic imaging department guidelines should be followed.

17.7 Examinations of this nature should be managed by prior agreement and a local referral pathway should be in place [9].

17.8. Radiation Protection

17.8.1 The forensic radiographer has a responsibility to ensure the radiation safety of all staff accompanying the patient/body, especially where imaging is performed outside the Radiology department [10]. The forensic radiographer along with the radiation protection officer is responsible for establishing and managing the “controlled area” of radiation.

17.8.2 Local Rules or Radiation Safety Procedures should be in place in all departments and should be written in consultation with, and under the guidance of a medical physicist.

17.8.3 Staff radiation dose should always be minimised. As such, staff should not be exposed to any unnecessary radiation in the performance of their duties. No member of staff should be required to hold equipment or stand within the recommended safe distance and all standard safety regulations must be observed consistent with routine diagnostic imaging procedures.

17.8.4 The minimum number of projections to obtain the required information should be requested and performed, particularly on living patients.

17.8.5 The exposure parameters and measurement of radiation dose should be documented for each examination.

17.8.6 Use of lead shielding should be in accordance with local departmental and imaging protocols.

17.8.7 Access to the imaging room should be limited to designated personnel and patients.

17.8.8 All forensic imaging of living individuals should be undertaken in accordance with departmental imaging protocols, best practice and the ALARA principle.

17.8.9 Where applicable, pregnancy status must be documented for all radiographic examinations.

18. Welfare of Radiographers

18.1 Employers should pay particular regard to the potentially distressing nature of some aspects of forensic practice, which could lead to PTSD in the individual forensic radiographer undertaking the examination [6]. Forensic and post-mortem imaging should only be performed on a voluntary basis. Radiographers should never be coerced into undertaking forensic or post-mortem imaging examinations if it is not specifically included within their scope of employment (e.g. dedicated post-mortem/forensic radiographers). Any concerns should be discussed on an individual basis with the departmental manager.

18.2 Employers have a responsibility to protect the psychological and physical well-being of their employees under health and safety requirements, and must undertake a robust risk assessment for all forensic imaging examinations.

18.3 The forensic protocol must include matters pertaining to the welfare of staff undertaking forensic examinations and this should include, but is not limited to, the following:

- Information regarding the symptoms and common feelings experienced with PTSD
- Basic advice on coping strategies
- Aetiology of PTSD
- Types of treatment available and information relating to the availability of support mechanisms (e.g. contact details for support)
- Debriefing led by an appropriately trained facilitator

18.4 The emphasis should be on primary prevention and it is recognised that training and education is an integral aspect in minimising PTSD [21]. Such training should be specific to radiography or imaging for forensic purposes (see section 14) and raise the awareness of the effects of PTSD.

18.5 It is recommended that operational debriefs that cover all aspects of any significant incident are undertaken. These should be facilitated by qualified personnel. Such debriefs should not focus on the traumatic incident alone and should adhere to relevant guidelines, such as the National Institute of Health and Care Excellence (UK)[22], Phoenix (Australia) [23], the Health and Human Services Disaster Behavioural Health Concept of Operations (CONOPS) [24] and the American Psychiatric Association (USA) [25].

18.6 Radiographers involved in DVI following a mass disaster should be offered sessions of appropriate debriefing (e.g. Trauma Risk Management (TRiM)), in order to undertake a risk assessment and monitor those individuals who are deemed at risk of developing PTSD [26]. These sessions should be conducted by an appropriately trained practitioner or mental health professional.

18.7 The IAFR is available for further advice on welfare issues for forensic radiographers and can be contacted via the website: www.iafr.org.uk or email: welfare@iafr.org.uk

19. Suspected Physical Abuse (SPA)/Non-Accidental Injury (NAI)

19.1 All examinations for SPA/NAI are forensic examinations and may be requested in relation to any vulnerable person [27,28].

19.2 Separate protocols specific to suspected SPA/NAI are required to cover clinical aspects. It is recommended that any such protocol should both recognise the forensic nature of SPA/NAI and cross-refer to the forensic protocol.

19.3 Requests for skeletal survey examinations (SPA/NAI), secondary to the initial clinically justified radiographic examination(s), must be regarded as purely forensic in nature and are not clinically justified (i.e. are not anticipated to affect the clinical management of the patient).

19.4 The issues of consent should be agreed with the paediatricians in advance and addressed in any separate SPA/NAI protocol. The implications of sections 8.6 and 8.10 should be noted.

19.5 There are multiple guidance documents published internationally on SPA/NAI, SUDI and SIDS [29–31].

20. Mass Disasters

20.1 A mass disaster is defined as an unexpected event of calamitous proportions that causes widespread injury or death [8]. Any plan for dealing with fatalities needs to be integrated with all aspects of the response to, and recovery from, such situations and incidents. Organisations need to work in collaboration with others (e.g. INTERPOL) on key activities and ensure that their own plans are robust [4].

20.2 The IAFR has considerable experience in planning for and responding to mass disaster incidents throughout the world and is able to offer planning assistance to relevant authorities. Contact details for Emergency Planners are available on the IAFR website: www.iafr.org.uk

20.3 The IAFR recognises that mass fatality incidents/mass disasters are likely to be dealt with by regional or national DVI teams who are encouraged to work with the IAFR Forensic Radiography Response Team (IAFR FRRT).

20.4 IAFR FRRT is an international team of radiographers who are members of the IAFR and have successfully completed IAFR accredited training, ideally with experience in imaging for forensic purposes, including mass disasters. This team has the capacity to provide a coordinated response to mass disasters and advise national, regional and local authorities on radiography issues when planning for such incidents.

20.5 The IAFR endorses the international call-out response of IAFR FRRT and recommends that the IAFR DVI Coordinator is contacted in the event of a mass disaster. Responsibility for emergency planning lies with the legally designated responsible person and local authority and their plans should include the provision of forensic imaging. It is recommended that service managers ascertain that this has taken place. Further information may be obtained from the IAFR website: www.iafr.org.uk

20.6 The IAFR recognises that some response systems do not currently have dedicated radiography teams, with radiographers being deployed as specialists within a larger team. The IAFR recommends that radiographers should lead the management and organisation of their specialist functional areas within these teams which will be contingent on the type of incident and by the decision of leadership.

21. Out-of-Hours Services

21.1 It should be recognised that in certain circumstances such as homicide, SUDI, SIDS and for religious and legal reasons, there may be persuasive reasons for acquiring forensic imaging as soon as possible.

21.2 Capacity, confidentiality, respect and dignity issues may result in a requirement for forensic imaging to be undertaken out-of-hours.

21.3 In extreme cases, deterioration and decomposition of body parts may affect the quality of forensic imaging and its interpretation - again, there may be persuasive reasons for obtaining forensic imaging as soon as possible.

21.4 Local written protocols should address the provision of an out-of-hours service. Further guidance on the provision of an out-of-hours imaging service for forensic purposes can be obtained from the IAFR

website: www.iafr.org.uk

22. Advice to Employers

22.1 Employers are advised to ensure that any forensic imaging is undertaken using the guidance of a formal local protocol [6].

22.2 Due to the potentially distressing nature of the work, the IAFR recommends that every department providing a forensic imaging service should have appropriate support services in place for staff members. The department should identify sufficient radiographers who are willing to undertake forensic imaging examinations and ensure that they are appropriately educated and trained for that purpose.

22.3 Individual radiographers should never be coerced into participating in the provision of the forensic radiography service.

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References

[1] The College of Radiographers, Guidance for the provision of forensic radiography services, COR, London, 1999.
[2] The Society and College of Radiographers, International Association of Forensic Radiographers, Guidance for Radiographers providing Forensic Radiography services, SOR, London, 2014.
[3] M Thali, MD Viner, BG Brogdon, Brogdon's Forensic Radiology, CRC Press, Florida, 2011.
[4] International Society of Forensic Radiology and Imaging. Sub-committees - disaster victim identification - publications: ISFRI; 2020 [Available from:http://www.isfri.org/sub-committees/disaster-victim-indentification/publications/.
[5] E Doyle, N Márquez-Grant, L Field, T Holmes, OJ Arthurs, RR van Rijn, et al., Guidelines for best practice: Imaging for age estimation in the living, J. Forensic Radiol. Imaging 16 (2019) 38–49.
[6] MD Viner, PF. Laudicina, Organisation and management of forensic radiology, in: M Thali, MD Viner, BG Brogdon (Eds.), Brogdon's Forensic Radiology, 2nd ed., CRC Press, Florida, 2011, pp. 493–504.
[7] Eisenberg RL.Radiology and the law: malpractice and other issues:Springer-Verlag; 2004.
[8] MD Viner, JE. Lichtenstein, Radiology in mass casualty situations, in: M Thali, MD Viner, BG Brogdon (Eds.), Brogdon's Forensic Radiology, 2nd., CRC Press, Florida, 2011, p. 177.
[9] Dimond B.Legal Aspects of Radiography and Radiology. Oxford: Blackwell Science; 2002.
[10] BG. Brogdon, M Thali, MD Viner, BG Brogdon (Eds.), 2nd ed., CRC Press, Florida, 2011, pp. 43–53.
[11] Royal College of Radiologists, The Society and College of Radiographers, Imaging for non-accidental injury (NAI): use of anatomical markers, RCR, London, 2011.
[12] Scientific Working Group Imaging Technology. SWGIT; 2010-12 [Available from:https://www.swgit.org/documents/.
[13] Association of Chief Police Officers, ACPO Good Practice Guide for Digital Evidence, ACPO, London, 2012 [v5:[Available from: https://www.digital-detective.net/digital-forensics-documents/ACPO_Good_Practice_Guide_for_Digital_Evidence_v5.pdf.
[14] Australia New Zealand Policing Advisory Agency. Australia and New Zealand guidelines for digital imaging processes Docklands, VIC: ANSPAA; 2013 [Available from:https://nla.gov.au/nla.obj-275320904/view.
[15] H Blitzer, K Stein-Ferguson, J Huang, Understanding Forensic Digital Imaging, Academic Press, 2008.
[16] Irish Institute of Radiography and Radiation Therapy, Forensic Imaging. Guidelines on best practice, IIRRT, Dublin, 2016.
[17] International Society of Forensic Radiology and Imaging, Sub-committees - Guidelines, ISFRI, 2020 Available from: http://www.isfri.org/sub-committees/guidelines/.
[18] The Society and College of Radiographers. Education and career framework for the radiography workforce London: SCoR; 2013 [Available from:https://www.sor.org/learning/document-library/education-and-career-framework-radiography-workforce.
[19] The Society and College of Radiographers. Preliminary clinical evaluation and clinical reporting by radiographers: policy and practice guidance2013. Available from:https://www.sor.org/learning/document-library/preliminary-clinical-evaluation-and-clinical-reporting-radiographers-policy-and-practice-guidance.
[20] The Royal Institute of Public Health and Hygiene, A Handbook of Mortuary Practice & Safety, The Royal Institute of Public Health and Hygiene, London, 1994.
[21] Parkinson F. Post-trauma stress: a personal guide to reduce the long-term effects and hidden emotional damage caused by violence and disaster, Revised ed., Fisher Books, Tucson, Ariz., 2000.
[22] National Institute for Health & Care Excellence, Post-traumatic stress disorder, (2018) NICE guideline [NG116]Available from: https://www.nice.org.uk/guidance/ng116.
[23] Phoenix Australia -Centre for Posttraumatic Mental Health, Australian Guidelines for the Treatment of Acute Stress Disorder and Posttraumatic Stress Disorder, Phoenix Australia,, Melbourne, 2013 Available from: https://www.phoenixaustralia.org/resources/ptsd-guidelines/.
[24] US Department of Health & Human Services. HHS disaster behavioral health concept of operations: US DHH; 2011 [Available from:https://www.hsdl.org/?view&did=697340.
[25] American Psychiatric Association. What is posttraumatic stress disorder?2020 [Available from:https://www.psychiatry.org/patients-families/ptsd/what-is-ptsd.
[26] N Jones, H Burdett, K Green, N Greenberg, Trauma Risk Management (TRiM): Promoting help seeking for mental health problems among combat-exposed U.K, Mil. Pers. Psychiatry [Internet]. 80 (3) (2017) 236–251.
[27] BG Brogdon, Child Abuse, in: M Thali, MD Viner, BG Brogdon (Eds.), Brogdon's Forensic Radiology, 2nd ed., CRC Press, Florida, 2011, pp. 255–278.
[28] BG Brogdon, JD. McDowell, Abuse of intimate partners and of the elderly. an overview, in: M Thali, MD Viner, BG Brogdon (Eds.), Brogdon's Forensic Radiology, 2nd ed., CRC Press, Florida, 2011, pp. 279–293.
[29] American College of Radiology, ACR Appropriateness Criteria: Suspected Physical Abuse–Child ACR, (2016) Available from: https://acsearch.acr.org/docs/69443/Narrative/.
[30] The Society and College of Radiographers, The Royal College of Radiologists, The radiological investigation of suspected physical abuse in children, 1st ed., RCR, London, 2018 Revised.
[31] KL Phillips, ST Bastin, D Davies-Payne, D Browne, HL Bird, S Craw, et al., Radiographic skeletal survey for non-accidental injury: Systematic review and development of a national New Zealand protocol, J. Med. Imaging Radiat. Oncol. 59 (1) (2015) 54.