U.K. Radiopharmacy Group

Guidelines for the safe preparation of radiolabelled blood cells

UK Radiopharmacy Group

Abstract

This document is intended to reflect best practice for the radiolabelling of blood components in the UK, and is offered to the Nuclear Medicine community as a reference source based on opinions and experience from senior practitioners of radiopharmacy. Very little evidence-based information exists on the subject, and thus the guidance represents current agreed practice in the field.

Background

Following a report in the British Medical Journal [1] which made reference to a detailed paper in the Journal of the American Medical Association [2], the UK Radiopharmacy Group (UKRG) now proposes guidelines for suitable facilities for blood cell labelling with radionuclides in the UK.

The report referred to an investigation into the aetiology relating to sixteen patients who contracted Hepatitis C infection following the administration of contaminated radiopharmaceutical injections in the United States. The investigators of this incident were unable to ascertain the specific break in aseptic technique that led to transmission of the virus. However, they did propose that the most likely explanation was that a syringe or multi-dose vial of sodium chloride injection, used earlier during the radiolabelling of leucocytes from a patient infected with Hepatitis C, could have been used inadvertently in the preparation of ^{99m}Tc-sestamibi. The finding that the leucocyte labelling procedure was carried out approximately 15 hours earlier, in a different work station located in a separate room to that in which the ^{99m}Tc-sestamibi was prepared, is all the more puzzling. (In the UK, it is normal accepted practice that all materials used during radiolabelling of blood cells are discarded once the procedure has been completed).

UK hospital radiopharmacy practice adheres to current good manufacturing practice (cGMP) and to that aim, the Radiopharmacy Sub Committee of the Regional Pharmaceutical Officers (RPhO's) Committee (now known as the UK Radiopharmacy Group) first prepared a position statement on the conditions for the "radioisotopic labelling of blood components" in June 1980 and a document was submitted to the RPhOs. However, that group never published the document widely. More recently the UKRG, through the auspices of the British Nuclear Medicine Society developed an organisational audit document for radiopharmacy [3]. A current version is available through the BNMS website: http://www.bnms.org.uk/downloads/OARadiophAudit_Nov06.pdf. Part of this document covers radiolabelling of blood cells and has served as a good practice statement for the past 14 years. It should further be noted that the practice of radiolabelling of blood cells for autologous use is regarded as a clinical procedure by the Medicines and Healthcare Products Regulatory Agency (MHRA) and thus does not necessarily form part of the inspection process for maintenance of Manufacturer's "Specials" Licences unless it has been specifically included as part of the licensable activities of the licence holder [4].

The report from the USA and the recent publication by the National Patient Safety Agency of the Risk Alert 20 entitled "Promoting safer use of injectable medicines" [5] have highlighted the risks associated with the preparation of injections. In response to these alerts, the UKRG has compiled these guidelines for the conditions under which blood cell radiolabelling procedures should be performed. In the UK, these procedures are performed in diverse locations such as departments of haematology, medical physics, nuclear medicine and radiopharmacy. These guidelines are applicable to all.

1 Introduction

1.1 Blood has a composite structure and several of the individual components may be labelled with radionuclides in order to obtain information that will assist in the diagnosis and treatment of inflammation, infection and haematopoietic disease. The vast majority of blood for labelling is sourced autologously, and cells commonly radiolabelled include erythrocytes, platelets, leucocytes and lymphocytes. The radionuclides currently used are ^{99m}Tc, ^{111}In and ^{51}Cr.

1.2 "In vitro" labelling involves the handling of extra-corporeal whole blood in quantities not generally exceeding 120ml including anticoagulant. In some cases, 10ml is sufficient.

1.3 "In vivo" labelling is limited to the labelling of circulating erythrocytes with ^{99m}Tc. Since this does not involve handling of extra-corporeal blood, it is not discussed further in this document.

2 Identification of risks

Risks may be considered as "intrinsic" that is, arising from the biological nature of material being handled or "extrinsic", that is, arising from the introduction of

contaminants during the labelling process. These potential hazards can be related to:

2.1 The patient receiving the radiolabelled blood product

2.1.1 When handling multiple blood specimens, the potential exists for mis-identifying or transposing the contents of syringes and tubes if more than one specimen is handled at a time. For that reason, only one patient's blood should be handled at a time in a contained work station.

2.1.2 Extrinsic contamination can be introduced during the labelling process. The potential sources of contamination are the environment and the operator and are the same as for other injectable radiopharmaceuticals.

2.2 Other radiopharmaceuticals prepared in the unit

2.2.1 Another product prepared subsequently in the same unit could conceivably be contaminated with blood as a result of aerosol formation, spillage or inadvertent transfer during the cleaning procedure.

Virally infected blood presents an insidious risk because of its incidence and the serious consequences of infection. The frequency of the hepatitis B carrier state varies from 1% in the United States and Western Europe to 35% in parts of Africa and Asia [6]. The rate of newly diagnosed HIV infection in the European Union (EU) has almost doubled since 1999, according to EuroHIV data from the European Centre for Disease Prevention and Control. In Western Europe, 25,241 new HIV diagnoses were reported in 2006 (82.5 per million inhabitants) of which 35% were female and 10% aged 15-24 years old [7]. According to figures from the Health Protection Agency it is estimated that between 200,000 and 500,000 people in England could be infected with Hepatitis C with the vast majority of these people unaware they carry the virus. In the UK the prevalence of hepatitis C is estimated to be 1.1 per cent of the population [8].

Other pathogenic micro-organisms and intrinsic pyrogenic materials are likely to be present because many of the Nuclear Medicine tests undertaken with radiolabelled blood cells are for detection of sites of infection.

2.3 The operator

The most serious risk to the operator is likely to arise from the manipulation of microbially infected blood samples. Skin puncture represents the most important potential route of transmission.

2.4 Handling radioactive materials

Since the labelling procedures involve handling and manipulating radioactive materials, they must be subject to the local rules for safe use of radioactive materials for which there is detailed guidance in the Medical and Dental Guidance Notes 2002 [9]. As "open" procedures are likely to be involved, the potential for gauntlet or glove contamination is considerably raised. However, both are effective in preventing the spread of radioactive contamination. It is also important that the procedures prevent any spread of radioactivity to surfaces of containers or other transportable equipment. Thus the need for routine radiation monitoring is paramount.

There will be exposure of the operator to gamma radiation from the radioactive materials handled. However, in contrast to radiopharmacy production work, the activity handled is much lower. It is typically only the activity required for a single patient investigation, plus an allowance to accommodate a labelling efficiency of less than 100%. Shielding provided by tungsten or lead containers should be used where practicable and these should be appropriate to the radionuclide and activity. Where manipulation requires good visibility of liquid contents, the relatively short duration of exposure to unshielded material should be at an acceptable level.

3 Assessment

3.1 Blood samples received for radiolabelling are unlikely to have been screened in advance for pathogenic organisms, thus it is prudent to treat all blood samples with equal respect irrespective of their final intended clinical use.

3.2 Whereas blood may be considered as a favourable growth medium, radiolabelled blood products are not stored prior to use apart from their time in transit back to the patient.

3.3 In view of the comparative complexity of manipulations during some blood cell labelling processes, especially where "open" procedures are used, the possibilities for the introduction of extrinsic contamination are greater than for other radiopharmaceuticals. Operator technique is therefore an important factor and personnel must receive additional training in aseptic manipulations.

3.4 Breakage of the vials or tubes during centrifugation may produce spillage of contents and possibly aerosol formation. The operation of the centrifuge must therefore be controlled and its construction must ensure that vial contents are contained if there is breakage – usually by putting the vial inside a robust sealed container [10].

3.5 Disinfection of materials and work surfaces prior to and following manipulations reduces the

chance of infecting blood from extrinsic sources. The use of an appropriate disinfectant in the event of a spillage provides suitable protection for the operator, and further disinfection at the end of the procedure reduces the risk to products prepared subsequently.

3.6 Should dedicated blood cell labelling facilities not be available, previous advice issued by the MHRA for occasional labelling (one labelling per week) in a separate suitable workstation sited in a room used for other radiopharmaceutical activities is no longer valid. Separation by time alone (campaign basis) is not sufficient to reduce the risk of cross contamination of other radiopharmaceuticals [4, 11].

4 Decontamination technique for workstations contaminated with blood

4.1 Universal precautions apply, and no difference in procedure should be adopted when dealing with blood from a patient with a blood borne infection.

4.2 For clean-down between cell labelling sessions where no visible blood associated contamination can be seen, a proprietary chlorhexidine/cetrimide mixture has been proposed; which is a "soapy" disinfectant solution, to both wash and disinfect the main process area. This solution has cidal activity against bacteria, viruses and fungi, but not spores. In addition to clean downs between cell labelling, periodic fumigation with a viricidal agent such as formaldehyde may be considered.

4.3 In the event of a large blood spill, some centres use chlorine releasing agent in tablet form in the ratio of 4 tablets dissolved in 1 litre of sterile water (10,000ppm) to clean up the spill, after absorbing the liquid onto clean-room wipes. (N.B. Departments using this must have a COSHH assessment in place). Other centres use chlorine releasing granules designed for this purpose, and which absorb the liquid spill, so that this can then be removed as semi-solid waste. An alternative agent is Virkon, which is also an oxidizing agent.

As chlorine releasing tablets are not sterile, the initial clean-up should be followed by a sterile agent such as Klercide B which covers the whole spectrum of bacteria, viruses, fungi and spores. This should be allowed to dry, and then the residue removed using sterile 70% isopropyl alcohol (IPA) or denatured ethanol. The whole clean-up procedure takes approximately 20 minutes. In the event of only small spots of blood being spilled, it is acknowledged that Klercide B followed by sterile 70% IPA or denatured ethanol is sufficient. Spots of blood on gloves can be cleaned off using a dry wipe followed by a sporicidal Klercide B wipe.

It has been noted that during recent MHRA inspections, the procedure for cleaning up blood spills, and subsequent validation, has been specifically requested.

5 Advice on Hepatitis B vaccination and needle-stick injury

5.1 Hepatitis B: Guidance should be sought from the local Occupational Health Department as to whether operators who undertake blood labelling procedures should be vaccinated. If deemed necessary, vaccination can be difficult to arrange when rotational staff are involved. For new operators, the first dose of vaccine should be arranged during the induction week, and the second dose at 1-2 months. During the time between the first two doses, the new operator should observe the labelling process and then start labelling under supervision after the second dose, before the 3rd dose is given. A blood titre should be performed at 6 months after the 3rd dose. Different policies regarding booster doses appear to be in place. Some Occupation Health departments advocate a booster at 5 years in line with the current British National Formulary (BNF) and which may be sufficient for the lifetime of the individual.

5.2 Needle stick: Each Hospital should have a policy in place to deal with needle stick injury. The use of needles should be avoided in blood cell labelling procedures, though this may not always be possible. Sterile plastic mixing tubes should be used to transfer blood-associated fluids wherever feasible. However, if a butterfly needle is used to transfer blood or plasma from layers above sedimented red cells, then the plastic sheath should be left on. A venflon with the needle removed, a luer-luer straight connector or a 5 micron filter straw may be used to add a sedimenting agent to blood via the neck of the syringe.

6 Risk Assessment of process and facilities

The interaction between blood handling and traditional radiopharmacy activities should be looked at in each department, to ensure adequate separation.

The re-injection of radiolabelled cells into the correct patient is crucial. To ensure that this is achieved, samples should be identifiable at each stage of the process and the final label should contain two or more separate identifiers, for example the patient's name and hospital bar code or the patient's name and date of birth. In departments where more than one sample of blood is handled in a day, a secure system of labelling is essential as the risk of injection into the wrong patient is increased.

7 Shelf life of radiolabelled blood cells

7.1 Viability

The first step toward creating an environment that maintains cell viability is to use the correct anticoagulant when venesection takes place, and to ensure that a needle of no less than 21g is used unless

under special circumstances (e.g. neonate or paediatric use).

The recommended anticoagulant is Acid Citrate Dextrose NIH Solution A (ACD). As ACD in a suitable presentation is an unlicensed product, different approaches to its supply and use have been adopted. Some radiopharmacies require the person withdrawing the blood to obtain their own supply of ACD. Others supply the ACD in a pre-filled syringe labelled with the patient's name. In either case, blood specimens must be clearly labelled and tracked throughout the radiopharmacy and Nuclear Medicine department prior to its return to the patient.

Viability studies are not required if radiolabelling is performed according to the protocol recommended by the manufacturer of the radiolabelling agent. However, individual variations in procedure should be validated locally, e.g. using alternative sedimenting agents or non-approved consumables such as Sterilin tubes which are for in-vitro use only.

If a new blood cell labelling service is being set up, appropriate validation must be undertaken.

Inappropriate centrifuge speeds dramatically affect the subsequent viability of radiolabelled blood cells. It should be noted that centrifuge speeds are no longer calibrated by service engineers at the time of servicing blood labelling isolators unless specifically requested. The Howie report [10] was only concerned with the closure of a centrifuge, and did not take other aspects into account. Advice needs to be established at local level regarding frequency of calibration for centrifuges situated within blood labelling isolators, as a full calibration may require removal of the front of the isolator.

7.2 Stability of radiolabelled cells

7.2.1 White blood cells

It has been reported that the rate of loss of label is 2% per hour for ^{111}In [12] and 9% per hour for ^{99m}Tc exametazime (HMPAO) [13]. Re-suspension of cells in cell free plasma optimises their viability. The consensus amongst the UKRG is that a maximum shelf life of 4 hours should be adopted where possible, although there is no scientific evidence to justify this figure. In practice, longer periods of time between blood being taken from a patient and the radiolabelled cells being re-injected have provided no evidence of problems, even when blood is transported long distances to the labelling facility. However the recommended advice is to re-inject radiolabelled cells as soon as possible.

Tests for cell activation are very time consuming and difficult techniques to set up. It is acknowledged that the patient study is the best monitor of the technique, as the best quality assurance is the fate of the cells in vivo. If imaging demonstrates that the cells have passed through the lungs within 40 minutes, then the cells have not been activated and are radiolabelled correctly. However this approach demands additional gamma camera time and may not be appropriate.

Trypan blue staining can be used to identify damaged or dead cells, but this technique is technically demanding, and the results may be misleading if taken in isolation.

7.2.2 Platelets

Labelling should only be undertaken by centres experienced in the technique and with a track record in, for example, platelet survival studies. Cell aggregation and activation can easily be induced during the procedure so it is imperative that tests designed to monitor these effects are carried out prior to setting up a routine service. Plasma adjusted to pH 6.5-6.6 with ACD should be the usual medium in which labelling is performed.

7.2.3 Red blood cells

Labelling with ^{51}Cr sodium chromate according to manufacturers instructions leads to a stable label with elution rate of less than 1% per day.

^{99m}Tc labelling by in vitro methods (e.g. Ultratag© kit) also provides a stable in vivo label with small losses by elution within 24 hours.

8 Training

Training and competency assessment must be designed for all operators who work in the radiopharmacy, and who are expected to perform these procedures. This includes Medical Physics Technologists and Physicists who work occasionally in the radiopharmacy and Authorised Persons, who sign off finished products. All require basic training in aseptic technique before starting this additional training.

8.1 Training guidelines

The training process consists of four stages:

i) Theoretical instruction and comprehension

ii) Observation by trainee

iii) Supervised practice

iv) Proficiency assessment

The assessment process therefore involves the trainee initially observing a correct procedure being undertaken by an experienced operator. This is followed by a period of working under close and observed supervision, whilst the trainee acquires competence in the particular skill. Prior to performing any of the skills unobserved, it is essential that the

trainee is assessed as competent by a suitable assessor, and feels him/herself to be confident to perform the procedure.

A specimen training and competency assessment proforma is included as Appendix I.

9 Facilities required for blood cell labelling

9.1 Facilities

Published guidance on the standards required for a blood cell labelling facility is scarce. Tissue products are outside the scope of the MHRA, and the inspection of such units has been handed over to another regulatory body. The Joint Accreditation Committee (JACIE) undertake accreditation inspections, and accreditation standards have been published on their website (www.JACIE.org), however they do not refer to any standards for facilities. The Pharmaceutical Inspection Co-operation Scheme (PIC/S) refers to blood products in the document PIC/S Guide to Good Practices for the Preparation of Medicinal Products in Healthcare Establishments [11], but does not specify radiolabelling facilities. However their advice is useful in this context.

Radiolabelled cells are administered by intravenous injection. The environmental standards under which sterile radiopharmaceuticals are prepared therefore apply equally to the preparation of radiolabelled blood cells. Some extra requirements are applicable due to the additional risks associated with the handling of blood. The principal requirements for a blood cell radiolabelling facility are summarised below.

- Preparation should be undertaken in a Grade A environment that is under negative pressure to protect the operator.
- An isolator with integral centrifuge and radionuclide calibrator is the ideal means of providing a Grade A environment that protects both operator and product.
- A laminar flow cabinet (LFC) is not suitable but a biological hazard safety cabinet (Class II) (BSC) with a vertical downward airflow is an alternative means of achieving Grade A.
- The isolator or BSC should be sited in a dedicated room. When an isolator is used, the room should provide a Grade D environment. When a BSC is used, the room should provide a Grade B environment.
- The room should be entered via a changing room in which the operator changes into a protective garment that is worn only for cell radiolabelling. This is particularly important when a BSC is used due to the increased potential for contamination of garment with blood.
- A sterilised protective garment should be worn when a BSC is used. A non-sterilised clean garment can be worn when an isolator is used.
- The operator should not be able to move from the room in which blood is handled to a room in which other radiopharmaceuticals are prepared without a change of garment.
- Sinks should be sited outside the preparation / changing room facility.

9.2 Environmental monitoring for cell labelling operations

Despite the fact that blood cell labelling is a clinical activity, most departments use the same processes for monitoring during blood cell labelling as they do when preparing other radiopharmaceuticals. Typically they will undertake settle plates and finger dabs although there is uncertainty as to the usefulness of results, as growth on plates is more likely to be due to inadvertent plate contamination due to aerosols of blood than to poor aseptic technique of the operator. An alternative method, where available, is to take in-process samples for pre and post labelling blood cultures which are then sent for sterility testing.

Further and more detailed information relating to the standards for facilities undertaking aseptic preparation are given in the current edition of the QA of Aseptic Preparation Services [14].

10 References

1. Outbreak of hepatitis C traced to contaminated vial of radionuclide. British Medical Journal; 2006, **333,** 963

2. Patel PR, Larson AK, Castel AD et al. Hepatitis C virus infections from a contaminated radiopharmaceutical used in myocardial perfusion studies. JAMA; 2006, **296**, 2005-2011

3. Cox JA, Hesslewood SR and Palmer AM. A mechanism for professional and organizational audit of radiopharmacy departments. Nucl. Med. Commun 1994; **15**: 890-898

4. Monger P. Recent changes in UK legislation and the licensing of radiopharmacies. Nucl Med Commun. 1992; 13, 411-415

5. Safety in Doses: Improving the use of medicines in the UK (National Patient Safety Agency). NPSA March 2007.

6. Crombleholme William R, "Chapter 19. Obstetrics & Obstetric Disorders" (Chapter). McPhee SJ, Papadakis MA, Tierney LM, Jr.: CURRENT Medical Diagnosis & Treatment 2009: http://www.accessmedicine.com/content.aspx?aID=9353.

7. Herida M et al. *HIV/AIDS in Europe: epidemiological situation in 2007 and a new framework for surveillance*. Eurosurveillance Weekly Release: 12, 11, November 22nd 2007

8. Bialek SR, Terrault NA. The changing epidemiology and natural history of hepatitis C virus infection. Clinics in Liver Disease. 2006; 10:697-715

9. Institute of Physics and Engineering in Medicine. Medical and Dental Guidance Notes. A good practice guide on all aspects of ionising radiation protection in the clinical environment. York IPEM 2002.

10. Howie J. Code of Practice for the prevention of infection in clinical laboratories and post mortem rooms. HMSO London 1978

11. PIC/S Guide to Good Practices for the Preparation of Medicinal Products in Healthcare Establishments. Pharmaceutical Inspection Co-operation Scheme (PIC/S) April 2008

12. Becker W, Schomann E, Fischbach W, Borner W, Gruner KR.Comparison of $^{99}Tc^{m}$-HMPAO and ^{111}In-oxine labelled granulocytes in man: first clinical results. Nucl Med Commun 1988;9:435

13. Danpure HJ, Osman S, Carroll MJ. The development of a clinical protocol for the radiolabelling of mixed leucocytes with $^{99}Tc^{m}$hexamethylpropyleneamine oxime. Nucl Med Commun 1988;9:465

14. Beaney A.(ed) The Quality Assurance of Aseptic Preparative Services. 4th edition. Pharmaceutical Press London. 2006

Appendix I - Cell labelling training and competency assessment form

Subject and competency	SOP to be read	Date	Level required	Date achieved	Signed by Supervisor with comments	Signed by trainee
Blood labelling isolator Be able to prepare the isolator including flow checks and glove manometry (SOP) Know which monitoring plates are required and set them out correctly	**Y**					
Preparation of items for cell labelling Be able to identify the correct worksheet and procedure for the label required Prepare the worksheet correctly to include all patient details and any required calculations Be able to calculate doses for paediatric white cell labelling Be able to collect all items required for the label and spray items into the isolator	**Y**					
Technetium-99m White Cells Understand how the procedure works (read relevant radiopharmacy textbook) Make notes to indicate understanding of the process Read procedure (SOP) Observe procedure and show evidence of understanding of the procedure Perform the procedure under supervision Show competence to perform the procedure unsupervised	**Y**					

Appendix I - Cell labelling training and competency assessment form (continued)

Subject and competency	SOP to be read	Date	Level required	Date achieved	Signed by Supervisor with comments	Signed by trainee
Technetium-99m Red Cells Understand how the procedure works (read relevant radiopharmacy textbook) Make notes to indicate understanding of the process Read procedure (SOP) Observe procedure and show evidence of understanding Perform the procedure under supervision Show competence to perform the procedure unsupervised	**Y**					
Indium-111 White Cells Understand how the procedure works (read relevant radiopharmacy textbook) Make notes to indicate understanding of the process Read procedure (SOP) Observe procedure and show evidence of understanding Perform the procedure under supervision Show competence to perform the procedure unsupervised	**Y**					
Other labelling procedures Read relevant radiopharmacy textbook Read procedures for other labelling procedures Indium-111 Platelet labelling Technetium-99m Denatured Red Cell labelling Indium-111 transferrin labelling Chromium-51 Red Cell labelling	 **Y** **Y** **Y** **Y**					

Appendix I - Cell labelling training and competency assessment form (continued)

Subject and competency	SOP to be read	Date	Level required	Date achieved	Signed by Supervisor with comments	Signed by trainee
Identification of problems						
Know when blood cells are not settling as expected						
Be able to follow the centrifugation procedure if settling does not occur adequately (SOP)	**Y**					
Be able to identify a clotted sample of whole blood or poor white cell pellet which would indicate the potential for poor labelling						
Labelling efficiency						
Be able to calculate labelling efficiency						
Be able to identify poor labelling efficiency and report to appropriate member of staff						
Understand when a label is not suitable for reinjection						
Cleaning procedures						
Know how to dispose of blood products correctly (SOP)	**Y**					
Know the procedure to follow in case of a blood spill	**Y**					
Be able to clean the isolator at the end of the labelling procedure (SOP)	**Y**					
Be able to perform finger dabs (if undertaken) and change the isolator gloves after the procedure	**Y**					
Be able to replenish the isolator in readiness for the next procedure	**Y**					

APPENDIX II - Risk Assessment for radiolabelling of blood

Processes to be assessed:

1. Transfer of blood through a general support area into the radiopharmacy blood labelling support area/clean room where blood labelling is undertaken in a dedicated blood labelling cabinet or isolator.
2. Packaging and release from the radiopharmacy of radiolabelled blood for injection into the patient.
3. Emptying and cleaning of the blood labelling cabinet or isolator at the end of the procedure. The materials removed in this process may also be contaminated with blood.

A number of potential hazards can be identified:

- Hazard of the blood to the operator. – *This risk may addressed in the Trusts policies about handling blood*
- Hazard in administering blood products. - *This risk may be addressed in the Trusts policies about handling blood*
- Contamination of clean facilities/items through the handling of blood.
- Spillage of blood in the arrival and general support area
- Spillage in the blood labelling support area/clean room.
- Spillage in the cabinet/isolator.
- Contamination through reuse of stock items.
- Contamination through equipment used.
- Contamination through waste disposal.
- Spread of contamination via the operator.

Procedures that can be used to reduce these hazards or minimise the risk

Blood spillages in the general support area/clean room

- On arrival the blood sample should be bagged to ensure it is contained within a secondary clean container.
- Should blood be dropped and spilt from the secondary container in a support area or transfer hatch, it should be cleaned up as per the hospital infection control policy or relevant departmental SOP. This should ensure that the area is thoroughly cleaned.
- Until such a spill is cleaned the general support area, clean room or hatch should be considered compromised and no other work should be started.

Blood spillage in the cabinet/isolator

- To assist in containing spills, all work should be performed in a tray or over a chemo protect mat. During the work, bubbles may burst or filling tubes may flick creating spots of contamination. These should be removed entirely with a sterile 70% alcohol impregnated wipe before they have chance to dry. A larger spill of blood should be dealt with as detailed below:
- During labelling, spills should be mopped up immediately with a sterile 70% alcohol impregnated wipe to limit the spread of contamination. If practical, work may then proceed.
- After labelling – Metal Isolators/Cabinets: If a surface is contaminated, the area should be treated with sodium hypochlorite 10,000ppm. A small quantity should be applied then washed/sprayed off with excess sterile 70% alcohol and sterile wipes. [NOTE: Hypochlorite will seriously affect the metal so it is essential that it is thoroughly removed].
- After Labelling – Centrifuge, Tube Holders, Lead Shielding: If blood has contaminated a removable item, including the centrifuge bucket, then the item should be removed from the radiopharmacy, sanitised with sodium hypochlorite 10,000ppm and then washed out thoroughly as per the cabinet surfaces.
- After Labelling - Gloves: If blood is found on the gloves, this should be removed using sterile wipes and sterile 70% alcohol. If the gloves can be decontaminated in this way then they can be changed at the end of the cleaning in the normal manner. If all the blood cannot be removed from the gloves then they should be changed before cleaning can be completed, then changed again when cleaning is complete (in this instance it is acceptable to spray the inside of the contaminated gloves with sterile 70% alcohol and then change them by inserting the new pair from the outside of the cabinet, so that the blood stained gloves fall inside the cabinet on removal. In this way it should be possible to prevent the spread of blood onto the easy change cuffs).
- After labelling - Gauntlets: If blood is found on the gauntlets, this should be removed with sterile wipes and sterile 70% alcohol. If the blood cannot be completely removed, the gauntlet should be changed.

Potential for contamination through reuse of stock items

- All stock present during a blood labelling procedure should be disposed of in a bag or sharps bin which is then removed from the radiopharmacy.

Potential for contamination through equipment used

- All equipment used in the blood labelling support area and cabinets/isolators should be dedicated to that process. This may include:
    - Water baths used for denaturing red cells. The bath should be filled with sterile water. At the end of the procedure the bath should be emptied and dried.
    - Cuff rings and other isolator sundries
    - Syringe shields: these should be treated as any other removable equipment with regard to cleaning.
    - Dose calibrator

Potential for contamination through waste disposal

- At the end of cleaning the cabinet/isolator, all the rubbish should be removed from the support area/clean room. In particular the sharps bin within the cabinet/isolator should not be used for items from a subsequent blood labelling procedure.

Potential for spread of contamination via the operator

- The blood labelling support room should only be accessed through a dedicated change area where general support area garments are removed and dedicated blood room garments are donned. The reverse disrobing should take place on exit from the blood support area.
- The operator should only be in contact with a blood container when transferring it into or out of the cabinet/isolator. The operator should dispose of their outer gloves immediately after this procedure to prevent the spread of any potential contamination.
- Departments not possessing such facilities should ensure that plans for a new build should incorporate separate clean rooms and changing facilities for blood labelling and aseptic production.