

**POLICY AND PROCEDURE MANUAL**  
**PETER S. ALLEN MRI RESEARCH CENTRE**  
**(FORMERLY CALLED THE IN-VIVO NMR CENTRE)**  
**THE UNIVERSITY OF ALBERTA**

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## 1. INTRODUCTION

The Peter S. Allen MRI Research Centre is located on the lower level of the Emergency wing of the University of Alberta Hospital. This is a facility totally devoted to research. There are three MRI machines located within the Centre. These include a 3.0 Tesla Siemens Prisma, a 3.0 Tesla Magnex/SMIS system and a 4.7 Tesla Varian system. Medical accreditation was approved for a 1.5 Tesla Siemens Sonata magnet that was replaced by the 3.0 Tesla Siemens Prisma in 2015. The 3.0 Tesla Magnex/SMIS and the 4.7 Tesla Varian systems are for investigational use only.

This is a research Centre. Both basic science and clinical research are undertaken in this Centre. Many of the clinical research studies will involve the scanning of patients from the University of Alberta Hospital or patients who are seen in outpatient clinics associated with the University of Alberta Hospital. For this reason it is necessary for us to maintain accreditation with the College of Physicians and Surgeons of Alberta. The Centre itself is a University of Alberta facility located within the University of Alberta Hospital, which, in turn is administered by Alberta Health Services. Because this is a University of Alberta facility rather than an Alberta Health Services facility, separate accreditation is required from that of the clinical MRI systems within the hospital itself. The scanning and safety standards utilized in the –Peter S. Allen MRI Research Centre will be modeled after those of Alberta Health Services. It is essential that all clinical research patients and their images are treated with the same care and attention as non-research clinical patients and images. In many cases it is important that the images obtained during research studies are interpreted by a qualified radiologist and the information obtained in these studies is communicated to the clinicians caring for the patients, in order that this information can be used to enhance the medical care of the given patient. Thus, the quality of the images and the interpretation of the images must at the very least be equal to the clinical standards.

All patients evaluated in the Centre will be scanned as part of a research protocol approved by the joint Ethics Committee process of the University of Alberta and the University of Alberta Hospital. All studies carried out in the Centre will require informed consent as approved by the Ethics Committee. All patients will be screened using the same screening forms that are used at the clinical scanners at the University of Alberta Hospital. Screening forms are available for research groups use within the Centre, and can also be downloaded from the Centre's website (<https://www.invivonmr.ualberta.ca/Resources/safety.php>)

All clinically relevant studies will be interpreted and archived in the same way as those scans performed on the clinical scanners within the University of Alberta Hospital. All clinical patient scans carried out in the Centre will be undertaken by a qualified MRI technologist. An agreement has been reached between the University of Alberta and the Department of Radiology & Diagnostic Imaging at the University of Alberta Hospital, for the University of Alberta Hospital MRI technologists to rotate through the Peter S. Allen MR Research Centre. MRI technologists will be available to the Peter S. Allen MR Research Centre during regular working hours. All clinical patients scanned in this Centre, will have their images interpreted, reported and archived in the same way as those patients scanned in the clinical scanners. Volunteers who are not clinical patients will not have their images interpreted or archived.

All clinical research patients will be screened by the investigator or his/her designate as well as by a qualified MRI technologist. The MRI technologist will be responsible for effectively performing the scan itself and ensuring that the images are archived in the electronic database.

The images will be interpreted by a qualified MRI radiologist. The current University of Alberta image and archiving method is PAC's. Images obtained on clinical patients in the Research Centre are transferred to and stored on the University of Alberta Hospital PAC's system. These studies will be interpreted and reports will be sent to the referring physician and will be kept on record at the University of Alberta Hospital. The imaging protocol used for all clinical studies will be approved by the MR Centre Research Committee, which includes the Scientific and Medical Directors of the Centre. Quality Control and Quality Assurance will be undertaken using the same protocols and standards as those applied to the clinical scanners at the University of Alberta Hospital. No patients with contraindications to MRI scanning will be imaged in the Peter S. Allen MR Research Centre.

## **2. MR TECHNICAL RESPONSIBILITIES/DUTIES:**

The patient's needs and requests are of primary importance. Every effort should be made to make the patient more comfortable.

### *Patient Responsibilities Prior to MR Examination:*

- Screening/patient surveys will be completed in order to avoid a situation that is contraindicated.
- An explanation of the procedure will be given, covering the noise factor and length of exam, etc.
- Answers to any questions will be provided.

### *Patient Responsibilities Between Sequences*

- Comfort of patient will be ensured.
- The length of next sequence will be explained.
- Patient's peace of mind will be confirmed.

### *Patient Responsibilities at the End of the Procedure:*

- Patient's peace of mind will be re-confirmed.

The technologist is also responsible for the following technical matters.

- The quality of the examination and the safety of the patient in the MR machine.
- Completing the screening checklist for all individuals.
- Confirmation of the patient's understanding of the procedure including the administration of MR contrast , if required.
- The changing of the patient into a hospital gown or scrubs.
- The recording of the patient information required for registration into the scanner operating system.
- The positioning of the patient on the MR table.
- Ensuring the operation of the intercom and volunteer emergency button systems
- The proper establishment of an intravenous line if required.
- Setup up of the examination scanning sequence.
- The starting of the exam.
- Scanning of the patient.
- Documenting of the parameters used for each scan.
- Viewing the images.

- Checking of images from the previous sequence to ensure that no errors have occurred.
  - Checking of the exam with the radiologist, if required.
  - Preparation of the next sequence.
  - Starting of the next sequence.
  - Completion of the archive transfer.
  - Providing any necessary assistance to the patient during his/her exit from the magnet room once the exam is complete.
  - The changing of the linen on the table.
  - The installation of the proper coils for the next exam.
  - The assumption of the console technologist responsibilities.
  - Cleaning/disinfection of all used equipment.
- It is important to note that the same technologist that screens a patient should also scan that patient.

### **3. SITE ACCESS**

The MR Centre has security door controlled access. The only people authorized to enter are the MR technologists plus authorized physicians and researchers. Anyone else has to receive authorization from the MR technologist.

### **4. NURSING STAFF DUTIES / RESPONSIBILITIES**

#### 4.1 PERSONAL CHECK

Nursing staff must conduct a personal check to ensure the following items do not enter the scanning room:

- Pagers
- Pens
- ID badges
- Keys
- Personal items including, but not limited to:
  - Wallets
  - Jewelry
  - Cell phones

#### 4.2 VOLUNTEER / PATIENT CHECK

It is important that the MR Technologist and Nursing work together to ensure adequate patient screening and preparation. This includes:

- Review of the MRI screening form
- Patient is to change into appropriate attire (hospital gown or scrubs as provided by facility)
- Ensure the patient has removed any jewelry, including:
  - Watches
  - Body piercings
  - Other Jewelry of any sort
- The following items must not be taken into the scanning room:
  - Wallets
  - Credit or Debit cards

- Pencils or Pens
  - Brassiere
  - Hair accessories, including pins and wigs
  - Keys or coins
  - Make-up, particularly around the eyes
  - Cell phones
  - Certain undergarments may require removal (ie: Lululemon items may contain antimicrobial silver)
  - The patient may keep any prostheses (dental, hearing, visual) until he/she reaches the magnet room. However, these items must be removed before entering the magnet room.
- Nursing specific duties:
    - Saline lock IV lines to ensure that infusion pumps do not enter the scanning room
    - Remove ECG electrodes
    - The patient should be asked to urinate before going for the MRI examination
    - IF MRI contrast is indicated:
      - Check kidney function (creatinine / GFR values)
      - Monitor for possible sensitivity and reactions
      - Emergency Contrast Reaction Kit is kept in the patient prep room. Nursing staff will ensure medication supplies are adequate and expiration dates have not passed.
- Nursing Staff are to participate in the psychological preparation of the patient prior to the MRI exam. The quality of the information provided has a strong influence on the efficacy and resulting quality of the MRI examination
- Patient groups that may require monitoring and support during the MRI procedure:
    - Physiologically compromised patients
    - Pediatric patients
    - Sedated or anesthetized patients
    - Critically ill or high-risk patients
    - Physically or mentally unstable patients

## 5. STAFF EDUCATION

Those research groups from within and outside the hospital must be educated on the risk of injury due to projectiles and contraindications when being close to strong magnetic fields, when fulfilling their role, or potential role in MRI research projects. For example, the following procedures must be well known.

- Procedure for calling the cardiopulmonary resuscitation team.
- Access procedures in the event of a medical emergency in the magnet room.
- Access procedures in the event of an emergency outside of working hours.
- The situations that demand electronic cut off or activation of the Quench button.

- Procedures for transporting patients.
- Housekeeping procedures.

All researchers using the facility must complete a safety course (offered by the facility) which outlines all safety procedures.

#### 5.1 HOUSEKEEPING STAFF

Any equipment used must be NON-FERROMAGNETIC equipment, for example plastic mops and buckets. To avoid bringing ferromagnetic objects into the magnet area by mistake, a separate cleaning cart exists for MRI use only. No other objects should be placed on this cart and this cart should remain in the MRI area. When designated to cleaning duty in the control room and surrounding area the housekeeping staff should be educated on the hazards of MRI. This is particularly important for new staff.

It should be clearly understood that MRI Technology staff will clean the magnet room itself. Housekeeping staff will not be allowed into the magnet room for cleaning purposes.

#### 5.2 PORTERS

Porters entering the centre must be accompanied by one of the centre staff. Only non-ferromagnetic stretchers and wheelchairs will be used in the MRI unit. Because ferromagnetic equipment represents a high risk of injury, even in cases of emergency, patients must be transferred to non-ferromagnetic equipment. Any device used to transport a volunteer / patient into the magnet room must be clearly marked with either MRI Safe or MRI Compatible labeling, otherwise it should be assumed that it is unsafe and should not be taken into the magnet room. In-patients should be transported from the ward on the MR stretcher. If the patient arrives as an outpatient, they should be transferred to the MR stretcher or wheelchair upon arrival at the MR department and the original transportation mode should be left outside the MR unit.

#### 5.3 FIREFIGHTERS

For safety reasons there are strict controls in place for every person entering the MR area, internal or external, e.g. nurses or firefighters. Accordingly a “ban” on entering the magnet rooms applies to anyone with any of the contraindicated elements in this manual. Firefighters are to be informed that;

- due to the risk from ferromagnetic projectiles (e.g. airpicks, tools, oxygen masks) a ban exists on entering a magnet room.
- There is limited access card and key access.
- A quench of the magnet presents a risk of asphyxiation and severe cold injury.

#### 5.4 CODE TEAM

Code team members are to be made aware of the restrictions/ban on entering the magnet room. It is essential that they acknowledge the potential risks, due to contraindications from their equipment. They should be educated on the steps taken by the MR technologist in the event of a code. It will be the responsibility of the MR Technologist to remove the patient from the magnet room prior to initiation of treatment. For example, the patient will be put on an MR stretcher and moved to the patient preparation area for treatment. All staff are educated that once the patient has been moved from the magnet room, the door must be closed and locked to provide a secure barrier from exposure to the strong magnetic field.

#### 5.5 AMBULANCE STAFF

Ambulance staff may rarely be required to assist or transport a patient to an MRI unit. They must therefore be educated and trained in the potential risks they face due to contraindications from their equipment. They will be expected to transfer their patient to an MR wheelchair or stretcher upon arrival. The original transportation mode should be left OUTSIDE the MR unit. They must acknowledge and understand the safety restrictions placed on the magnet room. In the event that ambulance staff are requested to help transfer a patient into the magnet room, they must first be screened by an MR technologist. They should also be educated on the emergency procedure protocol from this manual.

#### 5.6 SECURITY STAFF

Security staff should be made aware of the 24 hour ban into the magnet room, as well as the after hours policy.

#### 5.7 MAINTENANCE STAFF

It may be required, on occasion, for maintenance staff to enter the magnet room. Therefore it is critical that they are educated on contraindications. Tools used in the magnet room must be non-ferromagnetic. Maintenance staff should also acknowledge and understand the mandatory screening/authorization policies, as set out in this manual. Maintenance staff should all be educated on quenches, and must also be made aware of the MR Centre after hour's policy, as set out in this manual.

#### 5.8 RESPIRATORY TECHNOLOGISTS

Respiratory technologists are to be made aware of the restrictions regarding the magnet room. It is critical that they acknowledge and understand the dangers from ferromagnetic projectiles. ( i.e. stretchers, O<sub>2</sub> cylinders, etc.). **NO** gas cylinders are allowed in the magnet room under any circumstances. Respiratory technologists should also be educated on the policies for emergency evacuation from the magnet room. Should they be required to assist with any emergency procedure, they will understand that it is first the responsibility of the MR technologist to remove the patient from the magnet room before any treatment can be initiated.

## 6. VIDEOS REFERENCES/INTERNET ACCESSIBILITY

A reference book on MR Safety is

- \*Reference Manual for Magnetic Resonance Safety Implants and devices By: Frank Shellock and Emanuel Kanal, 2016

The following videos are available and suggested viewing,

- Siemens MRI Principles
- Siemens The Magnetic Zone
- Siemens Understanding the MRI Adventure (for children)
- Siemens Understanding the MRI Examination (for adults)
- Siemens Magnetom Symphony
- Needle less IV AC System (at hospital library)

The following internet site is available for information on safety in MRI:

- [www.mrisafety.com](http://www.mrisafety.com)



- [www.IMRSER.org](http://www.IMRSER.org)
- (<http://kanal.arad.upmc.edu/safety/pregnancy.html#cjagbbgcdf>)

## 7. MR SAFETY

### EXPOSURE TO ELECTROMAGNETIC FIELDS

The Canadian Guidelines on exposure to electromagnetic fields in an MR environment were written more than 15 years ago using data published no later than 1986. However, the modality has developed substantially since 1986. For example, although commercial MRI systems operating at 3.0T are being sold in all countries following FDA approval in the U.S., the Canadian Guidelines still quote 2.0T as the maximum static field strength. In the list below we therefore include the advice of jurisdictions other than Canada, as well as that of the other Canadian Guidelines.

#### *Static Magnetic Fields*

##### *Bore field strength*

Canadian Guidelines	$\leq 2.0$ T
USA FDA Guidelines	$\leq 3.0$ T for commercial clinical systems $\leq 8.0$ T for in-vivo human research systems
ISO/IEC Guidelines	$\leq 4.0$ T for first level of controlled operating mode for research systems $\geq 4.0$ T second level of controlled operating mode for research systems

##### *Operator peripheral field exposure*

Canadian Guidelines	0.03 T for 8 hours per day average over whole-body
US Industrial Hygienists	0.06 T for 8 hours per day average over whole-body
NRPB (UK) Guidelines	0.2 T for 8 hours per day average over whole-body

- Switched Magnetic Fields

- Although a switched magnetic field of itself does not adversely affect biological tissue, the electric field which is associated with it can stimulate nerve. To provide a safeguard, the guidelines are normally expressed in terms of a rate of change of magnetic field produced by the gradient coils. Switched fields of these magnitudes are only experienced in the magnet bore and do not extend to the region of the technologist.

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- Canadian Guidelines  $0.3 \text{ TS}^{-1}$
- ISO/IEC Guidelines  $2.0 \text{ TS}^{-1}$

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- Radiofrequency Fields

- Because the interaction of biological tissue with electromagnetic fields that oscillate at radiofrequencies can increase the temperature of that tissue, guidelines have been put in place that have the intent of limiting the rise in body temperature. These guidelines limit the transmitted r.f. power, so as to control the SPECIFIC ABSORPTION RATE (SAR) measured in  $\text{W kg}^{-1}$  of the exposed tissue.

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- Canadian Guidelines  $1 \text{ W kg}^{-1}$  averaged over 25% of whole body mass for >15 min.
- $2 \text{ W kg}^{-1}$  averaged over 25% of whole body mass for < 15 min
- ISO-IEC  $3 \text{ W kg}^{-1}$  averaged over head for 6 min
- $2 \text{ W kg}^{-1}$  averaged over whole body 6 min

- NCRP (USA) 3 W kg<sup>-1</sup> averaged over whole body

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***Pregnancy***

Even though there are no data available to demonstrate any harmful effects of undergoing an MR exam as a pregnant patient, it is the policy of the centre not to scan patients or volunteers who are pregnant or who think that they could be pregnant. Specific ethics approval is required of any research protocol in which pregnant women could be enrolled. Pregnant technologists may perform MR exams, enter room and attend to patients. However, they should limit exposure to static fields by leaving the room during scanning.

ACCIDENT RISK FROM PROJECTILES

Ferromagnetic objects, for example those containing Iron, Nickel or Cobalt or their metallic alloys such as steel, or magnetic insulators such as magnetite, must ***never*** be allowed in the magnet room. They will be catastrophically attracted to the magnet, thereby becoming a potentially lethal projectile to anyone standing in its path. In addition, the damage to the magnet caused by projectile impact could also be catastrophic by precipitating a magnet quench.

The safeguard against such an event is to prohibit the following objects from any magnet room.

***All*** gas cylinders are totally prohibited from the magnet room.

Stretchers, wheelchairs, anesthetic carts excluding any gas cylinder, I.V. poles, or ancillary medical equipment will not be allowed in any magnet room unless it is certified as totally constructed using **non-magnetic** materials.

***All*** necessary equipment for emergency resuscitation and intensive care of a patient must be ***stored*** and ***used outside*** the magnet room. (All MR personnel must be aware of the location of the resuscitation equipment and be able to transport a patient needing emergency aid speedily to this area.)

Potential magnetic projectiles that patients are totally banned from bringing into the magnet room include Canadian coinage, body piercings, pens/pencils, keys, pocket knives, hairpins/barrettes, and safety pins.

***All*** medical or paramedical personnel who are called upon to work in the magnet room **MUST BE** fully informed of these restrictions.

CONTRAINDICATIONS DUE TO MAGNETICALLY SENSITIVE IMPLANTS.

The following list includes some of the main items that are contraindicated in the MRI suite. This list is copied from the Patient Consent form, which is also attached.

- Pace-makers
- Neurostimulators
- Aneurysm clips
- Metal fragments. Particularly those occasionally found in the eye of a welder. The absence of such fragments should be established by an x-ray examination.
- Epicardial electrodes
- Cochlear implants
- Magnetic ocular implants
- Penile implants
- Magnetic tissue expanders

- Some type of breast implants
- Magnetic orthopedic implants
- Magnetic dental implants
- Hearing Aids
- Intravascular implants, for example VCI filters, coils, stents
- Cardiac septum implants
- Ventricular bypass devices
- Items of a non-medical nature that a patient should be warned not to bring into the magnet room include
- Cosmetic body piercings.
- Some cosmetic materials, e.g. containing cobalt blue
- Jewelry and watch
- Wallet/money clip
- Magnetic striped cards, such as bank and credit cards.
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Dentures should also be removed before the patient enters the scan room.

Warning signs in the form of pictograms are posted near the changing rooms and on the door of the scan room.

#### Auditory Effects:

Rapid pressure noise occurs during the rapid switching of the gradient field currents. It can reach 93dB.

Accordingly either earplugs or ear protectors are to be provided to MR subjects. These should be provided to patients before they enter the magnet bore, making sure that instructions have been given and understood prior to fixing whatever ear guard is being used.

Used ear guards must be discarded.

#### Claustrophobia:

To minimize this occurrence, all aspects of the exam that could ultimately become a cause for patient concern must be explained, for example the length of the exam, the loud gradient induced noises, etc.

Additional steps that will mitigate the risk are,  
Maintenance of verbal contact.

Use of MR compatible headphones to provide calming music.

Positioning the patient prone or feet first if possible.

Provision of special mirrors to enable the patient to see out of the bore.

Illuminating the gantry quite brightly.

Insurance of adequate air movement through the bore.

Sedation of adult subjects may be used as a last resort and only under the supervision of a physician.. (1-2mg Ativan sublingual.)

#### THE USE OF IV CONTRAST AGENTS

The guidelines for IV contrast are as follows

- Specific ethics approval, and approval by a medical doctor, will be obtained for studies utilizing IV contrast in the Peter S. Allen MR Research Centre.

- There will be a qualified medical doctor present in the Centre when IV contrast is being given.
- IV contrast may be administered either by a medical doctor or under the supervision of a medical doctor by the appropriately qualified MRI technologist or a nurse.
- Emergency drugs and additional emergency supplies are available in the patient preparation area outside the magnet room.
- Gadolinium contrast material will not be administered to anyone with a known hypersensitivity to it.
- Gadolinium contrast material will not be administered to anyone with a history of renal failure. All patients undergoing a contrast MR study in the Centre must be asked about a history of renal impairment/failure and whether they are on dialysis. Patients at high risk for (i.e. over 60 years of age, diabetes) or with known renal impairment must have a serum creatinine drawn within two months of the research study and will have an estimated GFR calculated.
  - In patients with a calculated **GFR > 60**, either Magnevist or Gadovist may be used.
  - In patients with a calculated **GFR between 30-60**, Gadovist must be used instead of Magnevist.
  - In patients with a calculated **GFR < 30**, gadolinium based agents must not be administered.
  - If the patient has suspected or known nephrogenic systemic fibrosis (NSF), gadolinium based contrast must not be used. Patients on dialysis must not receive gadolinium agents.

The process for contrast injection will be as follows:

- Prior to the MR Scan an IV will be started by the nurse, technologist or medical doctor.
- The contrast injection will be carried out by the qualified medical doctor, nurse or technologist (certified in contrast injections).
- Magnevist or Gadovist may be given via a PICC line by nursing staff using slow IV push (injection) or via pump when the particular brand PICC line and connector supports pump injection.
- Flush PICC well with 5-10cc of preservative-free normal saline before and following injection of contrast.

Potential Reactions

- Life threatening reactions are less than 1 %
- Adverse reactions range from 2% to 4%
- Most common reactions are nausea, vomiting, hives, headaches, and local injection site symptoms
- The patient will be observed following the contrast injection.
- In the event of a contrast reaction, the patient will be removed from the bore and the magnet room immediately. Emergency procedures will be activated using the emergency supplies outlined in #5. Appropriate personnel will be alerted and CPR begun if necessary.

If a contrast reaction should occur an incident report should be completed.

Administration of gadolinium chelates to pregnant patients is strongly discouraged because Magnevist (and presumably Prohance and Omniscan) can readily cross the placental barrier.

Breast Feeding After an Injection of Gadolinium

Women who are breastfeeding will not be given Gadolinium contrast agents in the In-Vivo NMR Centre.

#### **A FIELD QUENCH:**

Activation of the Quench button in the control room (3T Prisma and 4.7T) or in the magnet room (3T Magnex) is designed to release the energy stored in the magnet coils, and result in the magnetic field coming to zero as rapidly as possible. This button is NEVER to be activated unless a person's life is threatened because they are pinned to the magnet by a ferromagnetic object and it is physically impossible to remove the object and the victim from the magnet or its vicinity. Upon activation of the Quench button, heat is produced and the liquid helium around the magnet coils is transformed into thousands of litres of helium gas. This process takes ~ 20 seconds for the 3T Prisma and 3T Magnex magnets, and ~ 3 minutes for the 4.7T magnet. If the emergency exhaust system were to malfunction, helium gas could quickly enter the magnet room, displace all the oxygen in the room and present an asphyxiation hazard. A related danger will occur during a spontaneous quench. Staff must be aware of both of these situations.

Following the rescue, medical attention should be obtained as soon as possible. For severely injured individuals it is recommended that the code team is called using the 33# protocol, while for those less severely injured, that they are taken immediately to the emergency unit in Level 1 above the MR Centre.

In the event of a quench in which the emergency exhaust system malfunctions, the following events could occur:

- Roaring sounds from inside the magnet room.
- Fog/mist appears inside the magnet room.
- Due to any release of helium gas, asphyxiation, and frostbite are potential risks.

#### **Precautionary Measures:**

- Cryogen levels must not be allowed to fall below 50%.
- An oxygen monitor with audible alarm is to be situated more than six feet from the ground in the magnet room. The alarm would sound if the oxygen level drops below 140 PPM. (Normal oxygen levels are 150ppm).
- In the event that the magnet room is filled with fog/mist resulting from a release of cold helium gas (activated or spontaneous magnetic field quench), entry into the magnet room is prohibited. Entry is only permitted under these conditions by trained members of Edmonton Fire Service. MR Centre staff are not authorized or permitted to perform rescues using breathing apparatus.

#### **Electrical Cable Hazard:**

- a) All cables entering the magnet bore must be straight and not twisted or looped and not in direct contact with the patient.
- b) Cables should be kept to the lowest part of the bore tube
- c) Checks are to be made for damage to any cable insulation, and if any are found they are not to place a patient in the magnet.

## **8. EMERGENCY PROCEDURES**

In an emergency situation, after calling for help, the patient must be transferred from the MRI table to a non-ferromagnetic stretcher and transported from the magnet room into the room designated for emergencies.

#### A. Catastrophic Quench

If a catastrophic quench occurs the following actions shall be taken:

- i. Shut down the electrical system by locating the intercom handset and pushing the red STOP button.
- ii. Do NOT press the Magnet Stop button on the wall.
- iii. Evacuate the MR room and any space in which helium gas could accumulate.
- iv. Once all persons have evacuated the magnet room, ensure the magnet room door is closed to contain the release of any helium gas.
- v. Inform the Senior Engineer Mr Karim Damji immediately
- vi. Inform Hospital Security and University Security.
- vii. Prevent persons from entering the area until oxygen concentrations have returned to normal.

#### B. Reaction to Contrast Media:

- i. Call for help.
- ii. Shut down the electrical system by locating the intercom handset and pushing the red STOP button.
- iii. Remove patient from the magnet, using non-ferromagnetic stretcher or wheel-chair,
- iv. Remove the patient from the magnet room,
- v. In the event of a contrast reaction, the patient will be removed from the bore and the magnet room immediately. Emergency procedures will be activated using the emergency supplies outlined in #5. Appropriate personnel will be alerted and CPR begun if necessary.
- vi. Keep the patient in the Peter S. Allen MR Research Centre until discharged by a medical doctor.
- vii. Make sure that any reaction is recorded on the patient's chart.

#### C. CPR:

- i) Call for help.
- ii) Call CODE team using the beige hospital phone and the 33# protocol described on the red sign located in each Control Room
- iii) Shut down the electrical system by locating the intercom handset and pushing the red STOP button
- iv) Remove patient from the magnet, using non-ferromagnetic stretcher or wheel-chair.
- v) Remove the patient from magnet room.
- vi) Check ABCs (Airway, Breathing, Circulation).
- vii) Perform CPR (all staff should be trained in CPR).

#### D. Fire:

- i) Shut down the electrical system by locating the intercom handset and pushing the red STOP button.
- ii) Remove patient from the magnet and magnet room, using non-ferromagnetic stretcher or wheel-chair.
- iii) Ensure all doors are closed.
- iv) Activate fire alarm.
- v) Call Hospital Security – CODE RED.
- vi) Try to put the fire out (the In-vivo NMR Centre is equipped with non-ferromagnetic extinguishers).

- vii) In the event that evacuation through the main entrance to the MR Centre is not possible, follow the Alternate Exit Route signage around the perimeter of the Centre, and through the exit into the ABACUS area.

#### E. Patient or Staff Pinned to the Magnet:

The MR Centre staff must quickly assess the state of the victim.

1. Is the victim responding?
  - > Continue assessment
2. Is the victim's life imminently threatened?
3. Is it impossible to safely separate the ferromagnetic object causing the pinning by MR screened individuals?
4. Is entry into the MR environment unsafe for personnel?
  - > If YES to questions 2-3, a co-decided action can be made by two MR educated staff to initiate a quench.
  - > If YES to question 4, determine what is required to ensure safe entry to perform rescue
  - > If NO to all questions 2-4
5. If the pinning event were prolonged, does the victim's survival remain the same?
  - > If YES to question 5, alert and consult with the Safety Officer (Dr Chris Hanstock) and Senior Engineer (Mr Karim Damji) who, in consultation with Siemens, will evaluate whether an alternate approach can be employed to release the pinned victim. Constant monitoring of the victim must be maintained in the event that their condition deteriorates (see Question 2 above).

### **9. PATIENT SCREENING EXAMINATION FOR FERROMAGNETIC FOREIGN BODIES**

All patients, research subjects and volunteers must be screened for contraindications to MRI prior to entering the magnet room. The screening process must take place on every occasion that scanning will take place. All patients, research subjects and volunteers must change out of street clothing into hospital gowns prior to entering the magnet room.

Patient screening for magnetic foreign bodies may include Orbit X-rays and Lateral Chest X-ray for emergency (unconscious) or ICU patients. Radiographs on research subjects are only permitted if such screening is approved by the ethics board for the specific project. Subjects who cannot be adequately screened will not be placed in the magnet.

Orbit routine is one view -Modified Caldwell 25 degree Caudad.

Patients who have post-surgery implanted cardiac pacing wires may require a Lateral Chest X-ray.

The MR Technologist in consultation with a medically qualified researcher will decide on a case by case basis.

## **10. SEDATION**

Sedation will not routinely be given to patients in the Centre.

If sedation is deemed necessary, it is the responsibility of the research physician ordering the MR exam to prescribe the appropriate medication (usually Ativan 1-2mg sublingual). The research physician ordering the sedation must be present in the Centre for the duration of that procedure.

The patient will be advised not to drive and should be accompanied by an adult. The research project consent form should include consent to the medication being taken.

## **11. SCREENING PROCESS FOR RISK FACTORS**

A rigorous screening process is in place to eliminate the risk of a patient being seriously injured by exposure to any of the electromagnetic fields involved in an MR scan.

The screening questionnaire is attached.

The screening process may result in either of the preliminary x-ray examinations outlined in Sec. 8. Preliminary reports on these x-ray examinations are required before the MR scan can take place.

The screening questionnaire is available in the subject arrival areas of the Peter S. Allen MR Research Centre.

The list of risk factors is kept up to date and visible for all personnel in the Peter S. Allen MR Research Centre.

## **12. SCANNING OF ANIMALS IN THE CENTRE**

### **Ethics and Study Approval**

MR animal studies must be approved by the appropriate University of Alberta ethics board. All studies must also be approved by the Centre Research Committee to ensure adherence to Centre procedures for animal transport, preparation, containment and subsequent clean up.

### **Transport**

All animal deliveries to the Centre must be made to the east door (this door is opened from inside the Centre by the investigator), located to the right of the main entrance, 0A6.10X, and then left down corridor 0A6.40X, to the Centre wet lab room, 0A6.37. Animals must be transported to and from the magnet rooms within the Centre from the wet lab space via the corridors behind the magnets. At no time should human subjects have any visual or audible contact with animal subjects.

### **Preparation and Containment**

The goal of containment is to prevent hair, dander, or fluids from the animal from contaminating MRI coils, the scanner bore or the magnet room.



All in-Centre animal preparation must take place in the Centre wet lab, 0A6.37. Animals must be placed in an enclosed container (plexi-glass or similar material) that supports monitoring/heating/ventilation and radio-frequency coil access. Surface coils and volume coils that are to be housed within the animal container must be covered with a sealed plastic bag to ensure no contact with the animal. Animals must be placed on abdo-pads (absorbent waterproof pads) within these containers. Additionally, the patient bed should be covered with these pads before the animal container is placed on the patient bed. Air access holes will have a particulate filter.

## **Clean up**

*Scanner* – After completion of the scan the contained animal should be transported to the wet lab via the back corridors. The inside surface of the bore, the RF coil surface, the bed and bed controls should be disinfected using Metri-Guard surface disinfectant / decontaminant cleaner for a 5 minute contact before being wiped down with paper towels.

*Wet lab and Animal Container* – The animal preparation area and animal container will also be disinfected in the same fashion using Metri-Guard surface disinfectant / decontaminant cleaner and paper towels.

*Animal and Materials Removal* - Investigators must remove animals, using the same transport procedures outlined above, to the appropriate animal holding facilities outside of the Facility. No drugs used for animal preparation should remain in the Centre after completion of the study. All non-reusable material used for animal and coil containment and Facility cleaning should be placed inside a sealed bag for disposal and placed in the provided biohazard box. All needles, disposable glassware and other sharp materials must be contained using a puncture-proof labeled sharps container, which can then be disposed using the biohazard box.

Procedural and safety questions should be forwarded to the Centre Safety Officer, Dr. Chris Hanstock at [chris.hanstock@ualberta.ca](mailto:chris.hanstock@ualberta.ca) or 492-2542.

## **13. INCIDENT REPORTS**

All adverse reactions or incidents affecting the safety of patients, volunteers or staff of the –Peter S. Allen MR Research Centre must be immediately reported to the medical director. For incidents involving staff of the Alberta Health Services a workplace incident report must be filled out.

- A. Involving patient: Reporting Learning System (RLS)
  - b) Online: <http://insite.albertahealthservices.ca/1284.asp>
  - c) Phone: 1-877-338-3854
- B. Not involving a patient:
  - a. Notify your supervisor/manager immediately when an incident occurs and include:
    - When and where the incident occurred
    - Who was involved

What happened  
What controls were implemented

b. Notify Workplace Health & Safety as per current processes:

- Report using [MySafetyNet](#)
- For BBFE call 1.888.482.8550

#### **14. WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEMS (WHMIS)**

Users of the centre are to comply with all WHMIS policies of the University of Alberta Hospital. The policy manual and material safety data sheets are stored in the control room of the 3.0 Tesla Siemens Prisma magnet.

#### **15. INFECTION CONTROL MANUAL**

Users of the centre are to comply with the infection control policies of the University of Alberta Hospital. A copy of the infection control manual is stored in the control room of the 3.0 Tesla Siemens Prisma magnet.

#### **16. DISASTER RESPONSE MANUAL**

A copy of the University of Alberta Hospital Disaster Response Manual is stored in the control room of the 3.0 Tesla Siemens Prisma magnet.

#### **17. USER SATISFACTION**

All researchers, staff, patients, research subjects and volunteers are encouraged to contact the medical director and or the scientific director if they have any feedback or concerns with the workings of the centre.