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Safety in Magnetic Resonance Imaging

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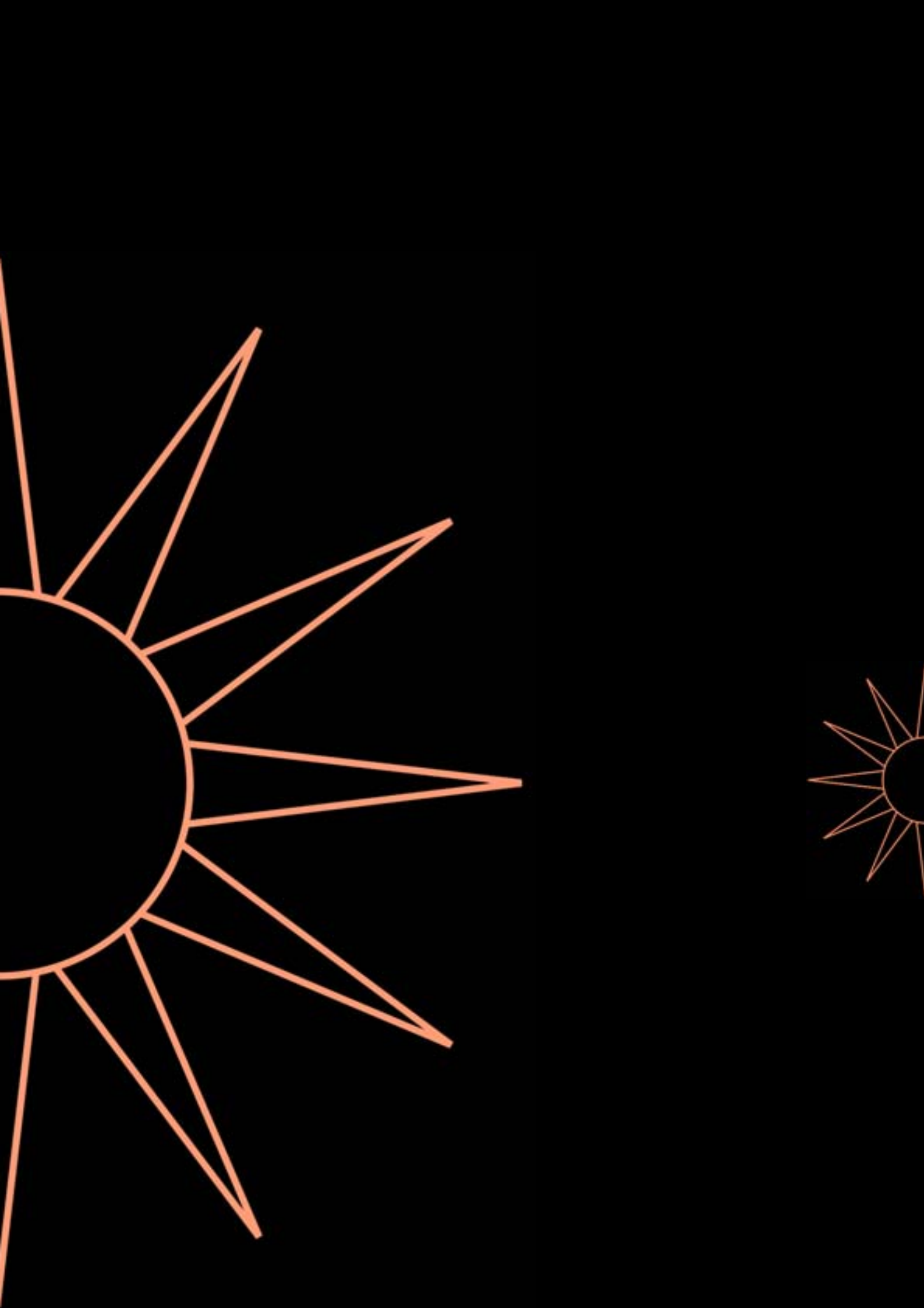

Safety in Magnetic Resonance Imaging

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1. Rationale

1.1 This guidance and advice document overviews safety issues in Magnetic Resonance Imaging (MRI) and whilst not claiming to be all-inclusive it provides direction on where appropriate information can be found. All members of the workforce who are working, or intending to work in the field, are recommended to read the literature listed in the references to gain a more in depth appreciation of the issues involved.

1.2 The purpose of this document is to:

- Increase awareness and reiterate safety issues which are uniquely associated with Magnetic Resonance (MR);
- Increase the awareness of professional responsibilities in ensuring safe practice in MR;
- Offer practical advice for the development of MR safety policies.

1.3 In this document considerations are given to areas relating to hazards, safety and responsibility of MR staff and patients. It is not comprehensive, as other documents are available, but is designed to be a quick reference guide and pointer in order for staff to be able to find and access information in busy MR units. The Society and College of Radiographers (SCoR) and the British Association of Magnetic Resonance Radiographers (BAMRR) recommends that all departments have an up to date copy of The MHRA publication Guidelines for Magnetic Resonance Equipment in Clinical Use[1].

1.4 This guidance follows, updates and replaces the previously released guidance document produced by SCoR and BAMRR in 1998[2]. SCoR is grateful to Chris Kasap, President Elect of BAMRR and for all who were involved in the writing of this document.

2. Defining the areas of safety and responsibility within the MRI department

'Guidelines for Magnetic Resonance Equipment in Clinical Use'[1] defines the areas of safety and responsibility within the MRI department as follows:

- Day-to-day responsibility for MR safety in the MRI Centre is given to a specified Responsible Person. He/she is required have training in, and a good working knowledge of, MRI training and safety.
- The Responsible Person consults with MR Advisors, who are conversant with MR safety issues and in contact with safety committees and relevant professional bodies.
- Access to a controlled area is given only to an Authorised Person (MRI Centre and external staff with access to scanners).
- An Authorised Person will include the MR Operator, who will be skilled in operating the MR scanner.
- There must be a list of Authorised Persons together with details of their training and certification available to the Responsible Person and the MRI advisor.
- Unauthorised persons, including carers escorting patients and the general public, must be accompanied by an Authorised Person, who is responsible for them whilst in the controlled area, must be screened, and have been authorised to enter the controlled area.

For definitions of above terms – see glossary on page 15.

3. Static magnetic field (Bo)

3.1 Definition

Static magnetic field (Bo) is dependent on the field strength of the magnet. The static magnetic field and the shielding define the controlled area, which is that area falling within the 5 Gauss line. Ideally the limit of the 5 Gauss line should be marked out on the floor as a safety guide for staff.

1 Tesla = 10,000 Gauss 5 Gauss = 0.5mT

The controlled area is where the static magnetic field, Bo, may exceed 0.5 mT (5 Gauss)[1].

3.2 Bio-effects

The interaction of the static magnetic field (B0) with the body and its functions, may result in the creation of electrical potentials, currents generated by body movements and the possible displacement of naturally generated currents within the body by (B0). Electrical potentials and related effects during physical movements within static magnetic field gradients may induce sensations of vertigo, nausea, phosphenes and a metallic taste in the mouth[3]. The 1991 NRPB report[4] concluded that the acute exposure to humans to static magnetic fields below 2.5T is unlikely to have any effect on health. The 2004 International Committee on Non-Ionising Radiation – Medical Magnetic Resonance (MR) Procedures[5] concludes that there is no indication of serious adverse health effects from whole body exposure up to 8T in literature research. However, currently no epidemiological studies have been performed to assess possible long term effects in patients, workers or volunteers.

3.3 Projectile and attractive forces

The potential hazard of the projectile effect of ferro-magnetic material in a strong magnetic field must be taken very seriously. Patient fatalities have occurred and a number of ‘near misses’ have occurred with oxygen facilities being inadvertently allowed into the MR room[6]. Extreme caution must be employed, and strict screening protocols in place and adhered to, to ensure ferromagnetic items do not enter the controlled area. Loose metallic objects can reach considerable velocities. Extreme caution should be exercised when assessing equipment for patient support in the MR environment.

Due to the hazards of the static magnetic field, resuscitation of patients should take place outside the controlled area and local rules should reflect this.

4 Time varying (gradient) magnetic fields (dB/dt)

4.1 Time varying magnetic field gradients in MR systems provide position dependent variation in magnetic field strength. The gradients are pulsed and the faster the sequence of imaging the greater the gradients fields change rate. The main concerns with time varying magnetic fields are biological effects and acoustic noise[4]. The biological effect is currently the subject of some dispute, as are the limits for workers as outlined in the new European Union Electro-Magnetic Forces Physical Agents Directive (PAD) 2004[7], which may seriously impact on working practices in MRI. The International Commission on Non-Ionising Radiation Protection (ICNIRP)[5] has given evidence and updates will be published on the SCoR and BAMRR website when available.

4.2 Biological effects

4.2.1 Subjecting the human body to time-varying electromagnetic fields leads to induced electric fields and circulating currents in connective tissues. At frequencies above 1MHz, a reactive element begins to be significant and at frequencies above 30 MHz, the wavelength begins to influence the electric field and current distribution (ICNIRP[5]). Induced electric currents can be sufficiently large to interfere with normal function of nerve cells and muscle fibres. An example of this is the sensation of flashes of light caused by induced currents stimulating the retina. A more serious response is that of ventricular fibrillation.

4.2.2 *Peripheral nerve and muscle stimulation*
At low frequencies, induced currents can produce stimulation of nerve and muscle cells, (Ham, Engels and Van de Weil et al[8]). The body is most sensitive at up to about 5 KHz. Extreme cases can result in limb movement or ventricular fibrillation. Reference to exposure limits should be made and can be found in the MHRA guidelines[1].

4.3 Acoustic noise

Acoustic noise caused by the gradient coils switching on and off during the scan can reach unacceptable levels. In general, the higher the field strength, the higher the acoustic noise level[1], but this effect is not exponential and is also dependent on sequence. It is recommended that ear defenders, ear plugs or other means of hearing protection is used (Health and Safety Executive[9]). It should be noted that maternal exposure to noise, may affect foetal hearing ability[1]. See also section 8.

5. Radio-Frequency Radiation (B1)

5.1 Biological effects

Exposure to radio-frequency (RF) radiation results in increased oscillation of molecules and generation of heat. Dissipation of this heat occurs through the dilatation of blood vessels and increased blood flow. Avascular structures are therefore less efficient in removing this heat. Certain patients may encounter problems due to such a temperature rise (approx 0.5°C). Those who are of particular concern include pregnant patients, patients with marked hypertension, neonates and patients on vasodilators[1]. However good practice should mean that RF deposition should be minimised in all patients. An accurate patient weight should be entered into the scanner and manufacturer software will alert scanner operators to high specific absorption ratio's (SAR) for sequences. All patients should be weighed at time of scanning.

It should be ensured that a good airflow is passing through the MR scanner whilst patients are in situ.

5.2 Induced current burns

Burns may occur when patients are positioned in such a way to create a conductive loop pathway, as an example where thighs meet. Poor positioning of the patient and associated leads and sensors are the cause of many burns. Care should be taken to ensure that cables should be correctly positioned and avoid them touching patients. The cables should not be crossed, looped or allowed to lie diagonally across patients. Ideally cables should lie parallel and as close to the centre of the bore as possible, and should not touch the bore of the magnet at any point. Patient skin should be insulated from the bore of the magnet.

6. Cryogen hazards

Cryogens should only be handled by authorised and trained cryogen suppliers.

6.1 Venting in superconducting magnets

Superconducting magnets offer a potential cryogen hazard. Adequate attention should be paid to the provision of the venting of the cryogens, including ensuring that the external vent pipes are of the correct dimensions and in the case of a quench, able to withstand pressures above that recommended by the manufacturers, as outlined in the Medical Devices Agency (MDA) Hazard warning of 2003[10]. External vent pipes should also be designed and fitted so that there is no ingress of rain, or other detritus and they should have a regular maintenance schedule.

6.2 Quench hazards in superconducting magnets

There should be no hazards from cryogens for MR scanning staff, visitors and patients, provided adequate attention has been paid to the provision of venting directly to the air outside the unit. In the event of a quench, low temperature liquefied gases, designed to keep the magnet close to absolute zero (-273°C) expand and boil off to the outside. In order to detect any unplanned leakage of helium into the scanner room, suitable low oxygen warning alarms should be placed in the MR room and be regularly checked and maintained. If, for any reason, the gases should enter the room, instead of exiting to the outside, there will be the hazard of asphyxiation, due to the displacement of oxygen, hypothermia and frostbite. There may also be over pressurisation in the room due to the rapid expansion of the liquid gas and this may make it difficult to enter the MR room.

If the low oxygen monitor alarms, or a quench should occur, the MR room should be evacuated immediately. Appropriate local emergency procedures should be in place and included in the training programme for all authorised personnel.

7. Implantable medical and non medical objects

7.1 Active devices

Mechanically, electrically and magnetically operated devices may malfunction in the presence of this strong magnetic field. This malfunction may not be obvious at the time of examination but may have serious consequences subsequently. An example of this may be programmable ventriculo-peritoneal (VP) shunts, cochlear implants, and Neuro-Stimulators[1]. Advances in medical science continues to advance in these areas and great caution must be exercised. Up to date information can be found on the MR Safety website supported by F Shellock[11] or for information on cardiac implants, reference should be made to The National Heart Registery at the Hammersmith Hospital[12].

Cardiac pacemakers are contra-indicated in MRI. Field strengths as low as 10 Gauss may be sufficient to cause deflection, programming changes or to close reed switches. Even patients where the pacemaker has been removed may have remaining pacemaker wires which can act as antenna and cause induced currents which will cause cardiac fibrillation[1].

All visitors and patients should be adequately screened prior to entering the controlled area and no-one should be allowed to enter within the area if there is any doubt regarding the compliancy of any implants. Reference for this compatibility can be made to a number of agencies[9, 11–13], or manufacturer's literature. Robust local rules should contain guidance for MR staff.

The field strengths at which specific implants have been tested should be noted when assessing the safety of implants. Safety at one field strength may change at another.

7.2 Non active devices

There is a risk that implanted ferromagnetic devices will undergo attractive forces, such that they can dislodge, causing serious injury or discomfort to the person concerned. Great care must be taken with regard to recent implants or clips, which are not anchored into bone, before they become embedded with fibrous tissue. Local rules should specify the time which should elapse prior to scanning but should **not** be less than six weeks. A comprehensive account of safety in MRI and implantable medical devices can be found in the MHRA's Guidelines for Magnetic Resonance Equipment in Clinical Use[1], and in other useful reference books by F Shellock and M Benedicta-Edwards as well as the website www.MRIsafety.com[11–13]. Those objects, such as bone screws or joint replacements which are firmly anchored, may safely be scanned, but should be monitored carefully because the object may be subject to temperature rise and scanning should be discontinued if discomfort occurs. Image quality around the site will, in any case, be seriously degraded and examination may not be of diagnostic quality.

7.3 Other

Non medical objects such as piercing, and make-up which have high iron oxide content may cause burning and, wherever possible, should be removed both for patient safety and diagnostic image quality. Some tattoos also have a high ferrous content and patients should be counselled regarding the possibility of local burns and asked to report any discomfort immediately and scanning stopped. Patients should also be questioned regarding bullets, shrapnel, etc and appropriate caution exercised.

Intra orbital foreign bodies (IOFB) are of particular concern and any patient, carer or volunteer who give a history of any possibility of an IOFB should have plain x-rays of orbit to exclude a metallic foreign body in the eye prior to entering the controlled area.

8. Pregnancy

8.1 Although there is no evidence that mammalian embryo's are sensitive to the magnetic fields and the acoustic noise encountered in medical MRI systems, it is prudent to exercise caution. In the first trimester (considered to be weeks 0-13), the embryo is regarded as being particularly sensitive to raised temperatures. Adverse effects on embryo or foetal development will be avoided if temperatures in tissues do not exceed 38°C[4,5].

8.2 **Pregnant patients**

The MHRA[1] recommends that a decision to scan should be made at the time between the referring clinician, an MRI radiologist and the patient, based on the information above about the risks weighed against the clinical benefit to the patient. This decision should be recorded in the patient's notes and on any Hospital Information System (HIS) or Radiology Information system (RIS). The main concerns for the foetus would be heat deposition, during scanner especially in the first trimester as organogenesis takes place during this period, and from acoustic noise after about 24 weeks[14] when it is considered that the hearing mechanism of the foetus has developed. There has been no conclusive research into this but caution should be employed[15] and when possible quieter sequences should be used. With regard to contrast, gadolinium compounds are known to cross the placenta and enter the foetal bloodstream and current guidelines would not recommend their use. However, The European Society of Radiology has issued a guideline discussing gadolinium use during pregnancy. Their conclusion is that gadolinium is probably safe during pregnancy, as excessive quantities are not expected to cross the placenta or to be toxic to the foetus if they do[16].

8.3 **Pregnant Staff**

The MHRA[1] recommend that each site should undertake a risk assessment analysing staff movement and location in relation to levels of the magnetic field and the time that they will be exposed. However in the case of pregnant personnel (including Authorised Persons) they should be given the option of not entering the controlled area (within the 5 Gauss line) during their first trimester (considered to be weeks 0 to 13). Throughout their pregnancy it is advisable that staff do not remain in the scan room whilst scanning is underway.

Pregnant women should not routinely be exposed to fields above 2.5T[1].

9. Contrast media

9.1 A variety of contrast media can be employed in the MR environment including water in the gut, and a variety of chelates.

9.2 Contrast media injections should only be undertaken if clinically indicated and at the request of the supervising MRI Radiologist or Radiographer who is appropriately trained and is authorised by the Clinical Director or Lead Radiologist. This authorisation should be documented in the local rules. Radiographers are permitted, under law, to supply and administer prescription only medicines (including contrast media) under patient group directions (PGDs) and therefore MRI departments should have PGDs in place. If the drugs being administered are not prescription only medicines, then PGDs are not required in law, although they are considered good practice. If an intravenous (IV) injection is to be given by a Radiographer, that Radiographer should be trained and competent in IV administration[17]. A register of contrast administration should be kept.

9.3 Patient consent should be sought in line with departmental protocols and all staff should be conversant with local emergency procedures.

9.4 Up to date information on supply, administration and prescribing of medicines can be accessed from the members section of the website, www.sor.org.

9.5 Gadolinium containing agents are the most common contrast agents used in MR imaging. Recent research has shown that a rare but serious illness, nephrogenic system fibrosis, has been identified in patients in end stage renal failure.[18] Although a causal link has not been definitively established, caution should be exercised in patients with renal impairment.

10. The role of the radiographer

10.1 MRI science continues to make advances and research into bio-hazards and the hazards associated with implants or similar medical devices is being constantly updated.

10.2 In many instances, the potential hazards are only theoretical or, at the very least, based on isolated cases.

10.3 It is extremely difficult to legislate regarding the safe practice of MRI since the benefits of MR in some patients may far outweigh the risks, particularly when alternative imaging choices for those patients carry known risks of a more serious nature.

10.4 Risk/benefit decisions must be taken by the MRI team in consultation with the patient or their guardian. Before the patient is allowed to enter the controlled area the authorised person (usually the MR operator/radiographer) is responsible for ensuring that the risks are made clear and that the evidence provided is based on the most current and up to date literature.

10.5 Written documentation, normally in the form of a questionnaire, regarding the risk assessment for each patient should be completed by the patient, and checked through with them by the authorised person. Any discrepancies or queries should be discussed with the patient and the decision to scan should be made in conjunction with the local rules and employing authority policies.

10.6 The questionnaire should be signed and dated by the patient and countersigned as checked by MR operator. Specimen questionnaire forms can be downloaded from the BAMRR website or from www.MRIsafety.com[11]. (See appendix A and B)

10.7 There may be occasions when it is not possible for the patient to be able to answer the safety questionnaire directly, for instance, in the case of the unconscious patient, or clients who do not speak English.

10.8 In the case of the unconscious patient, close reference should be made to the patient notes and ideally the next of kin may be asked to complete the questionnaire. Reference should be made to employing authority policy on consent, and this should be reflected in the local rules. Any doubt about patient status with regard to MRI safety should be rigorously pursued; this may involve, for example, plain radiography to establish metallic intra-orbital foreign body (IOFB).

10.9 Patients who do not speak English as a first language, should be accorded the same information and confidentiality as any other patient. Problems regarding MRI safety has been outlined in 'Implications for MRI safety for patients who do not speak English', Gee and Kasap (August 2005)[19]. Ideally an Employing Authority Translation service, using an approved translator, should be utilised. This is enshrined in the department of Health document 'Better information, better choices, better health'[20]. This should ensure that the questions put to the patient, and the answers received are accurate and not changed. A translator may be booked in advance, or a phone translation service, approved by employing authority should be utilised. If the translator is present they should sign the form to confirm that they asked the patient all the questions listed, and that the answers noted are a true record of those received. If the translator is not present, a note of their name or identification code should be made on the form. The safety of the patient however, is the responsibility of the authorised person, usually the scanning radiographer. It should not be common practice to use a relative for translation purposes, and it is inappropriate for minors to perform this function.

10.10 Consent for MRI scanning in the case of minors should reflect employing authority policy. Advice and guidance on consent issues for children are given in The Child and the Law (SCoR 2005)[21].

10.11 The SCoR is currently updating advice and guidance on consent, and this will be available during 2007.

11. Practical advice and assistance

11.1 Sources of reference have been proposed by several professional organisations associated with MR imaging, namely:

- The British Association of MRI Radiographers (BAMRR)
- The Society and College of Radiographers (SCoR)
- The Institute of Physics and Engineering in Medicine (IPEM)
- The Medicines and Healthcare products Regulatory Agency (MHRA), formerly the Medical Devices Agency (MDA)
- The Royal College of Radiologists (RCR)
- Magnetic Resonance Radiologists Association (MRRA)
- The National Heart Registry at the Hammersmith Hospital. Telephone 0208 383 2264. Maria Benedica-Edwards, 25 years of Heart Valve Reporting

11.2 The following websites are useful for further information or for formulating departmental safety policies.

- British Association of MRI Radiographers www.bamrr.org
- Website hosted by Dr F G Shellock www.mrisafety.com
- The University of Nottingham Magnetic Resonance Group website at www.magres.nottingham.ac.uk
- Hazard notes and safety bulletins from the MHRA www.mhra.gov.uk
- International Commission for Non-ionising Radiation Protection (ICNIRP) www.icnirp.de
- Health and Safety Executive (HSE) www.hse.gov.uk

12. Additional sources of information

12.1 **Institute of Physics and Engineering in Medicine (IPEM)**
The Institute of Physics and Engineering in Medicine can provide a list of certified magnetic resonance advisors who will help departments to draw up their own safety policies and advise on specific safety issues.

Contact the IPEM on www.ipem.ac.uk or telephone 01904 610821.

12.2 **MagNET**
Based at Imperial College, London since 1988, MagNET evaluates MRI systems. They are part of the independent evaluation and quality assurance programme supported by the UK government's Centre for Evidence-based Purchasing (CEP).

They offer a number of services including training, acceptance testing, site plan inspection, tender evaluation, acoustic noise checks, Gauss line checks, MRI test object refilling and equipment hire for testing.

They can be contacted on www.magnet-mri.org or telephone 020 7594 6305.

12.3 **BAMRR**
The British Association of MR Radiographers is a special interest group and has several hundred members. The elected policy board meet 2-3 times annually and has a safety co-ordinator whose role it is to explore safety issues for the membership. They organise training courses in MR scanning and host meetings for those working, or having an interest, in the MR field.

Visit the BAMRR web site on www.bamrr.org or contact the professional team at the Society and College of Radiographers on 0207 740 7200. They will pass you on to the current BAMRR secretary.

12.4 **The Society and College of Radiographers**
The Society and College of Radiographers is the professional body which is responsible for providing support and information to the radiography workforce. The officer responsible for advice and guidance in MRI is Kate Garas (email: kateg@sor.org)

Glossary

Responsible Person
Delegated by the chief executive or general manager and who might most effectively be the clinical director, head of the department or superintendent radiographer in the MRI department.

Duties: To ensure adequate written safety procedures, ethical approvals, work instructions, emergency procedures are issued to all concerned after consultation with the MRI Advisors and authorised persons.

An MR responsible person should not take on the role of an MR safety advisor.

MRI advisors
Duties: Advise on safety aspects of clinical and scientific use of MRI scanners with reference to safety committees, local ethics committee, MRHA (Radiation Protection Division) and other professional bodies. To advise on training materials, consent forms, questionnaires, safety record sheets and ensuring appropriate screening for persons entering the controlled area for approval by the Responsible Person and the local ethics committee. They would need to be competent to cover the scientific aspects of the department and may be a physicist.

MR operator
An authorised person deemed to have sufficient experience and appropropriate training and is responsible for operating the scanner in a safe and appropriate manner. They are also responsible for the safety of patients and volunteers who are undergoing MR Imaging at all times, and also for ensuring that any equipment taken into the controlled area for the examination is compatible.

Authorised persons
MRI Centre personnel and certain external users with access to the scanner rooms. External users may be engineers, researchers or research assistants or cleaning and maintenance staff.

Duties: Day to day maintenance of the machines and rooms. To join the certified list of authorised personnel it will be necessary to read and understand the MRI Centre safety training materials, and to complete and pass a screening questionnaire annually.

An appropriate record of their MR training, and an annual screening of all authorised personnel is to be kept by the responsible person. All authorised personnel must satisfy themselves at all times they conform to the requirements of the screening process.

Additions to the authorised persons list can only be made by an MRI advisor and/or the responsible person, after appropriate training and screening processes have been completed.

Controlled Area
Anywhere within the 0.5mT (5 Gauss line), it will be accessed by an MRI compatible, self-locking door.

1 TESLA = 10,000 GAUSS 5 GAUSS = 0.5mT

MRI safe indicates a device, when used in the MRI environment, has been demonstrated to present to the patient no additional risk to the patient or any other individual, but may affect the quality of diagnostic information. The MRI conditions in which the device was tested should be specified.

MRI compatible indicates that the device is MRI safe when used in the MRI environment and has not been demonstrated to significantly affect the quality of the diagnostic information. Its operations are also not affected by the MRI equipment. The MRI conditions in which the device was tested should be specified.

Researcher
An authorised person, acting as an MR operater who will operate the scanner machine whilst undertaking work for a research unit. A researcher may be a radiographer already working in an MR department or a physicist attached to the unit.

Duties: to ensure all formalities are correctly completed and filed before a study is started.

Screening
Not to be confused with medical assessment, screening takes the form of verbal questioning, a written questionnaire and information about hazards signed by the individual and countersigned by the authorised and/or MR operator before entry to the controlled area is granted. Examples of appropriate screening forms can be obtained from BAMRR (www.bamrr.org) and from F Shellock Safety website, www.MRIsafety.com[11], or see appendix A and B

Unauthorised Persons
Carers and the general public

Duties: To remain under the control of an authorised and/or MR operator at all times in a Controlled Area.

Volunteer
A person who undergoes an MRI examination for purposes other than diagnosis.

Duties: All volunteers including staff participating in experimental trials should be screened before exposure and should have given informed consent. The scanning of volunteers requires approval from local ethics committees. It is recommended that all examinations are reported and suitable processes be in place for onward referral for those found to have abnormal scans.

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www.hpa.org.uk/radiation/understand/information_sheets/mri_ec_directive_2004_40_ec.htm

Appendix A

The MR safety questionnaire

The MR safety questionnaire should be designed to determine if there is any reason that the patient or individual would undergo an adverse safety incident if they were to undergo an MRI investigation.

The questionnaire should be designed to obtain information concerning:

- Relevant previous surgery;
- Prior injury from metallic foreign bodies;
- Pregnancy;
- Electrically, magnetically or mechanically activated devices.

Further consideration should be given to:

- Permanent colouring techniques;
- Body piercing;
- Previous reaction to contrast agent;
- Breast-feeding;
- Last menstrual period.

Included in this document is a BAMRR recommended MRI safety questionnaire. This is designed to reflect the minimum questions that each individual department should consider when designing their own screening form together with information from the suggested literature.

Disclaimer
The guidelines relating to MRI safety standards set out in the attached questionnaire have been prepared to the best of our knowledge and represent indicative guidelines of general application. They do not replace the need for specialist advice to meet your exact requirements. Nor should they be taken as such. Accordingly, none of the authors of these guidelines and the officers of the British Association of MR Radiographers can accept liability for the accuracy or applicability of these guidelines and any person using these guidelines does so at their own risk.

(If the safety questionnaire overleaf is used please ensure that the BAMRR heading is substituted with the appropriate MRI department and/or hospital name.)

BAMRR MR SAFETY QUESTIONNAIRE

Patient Name.....Date of birth.....

	YES	NO
Have you ever had a cardiac pacemaker?	❒	❒
Have you ever had any surgery to your heart?	❒	❒
If yes, give details.....		
Have you ever had surgery to your head, brain or eyes?	❒	❒
If yes, give details.....		
Have you ever had any metal fragments in your eyes?	❒	❒
If yes, give details.....		
Have you ever had any metal fragments in any other part of your body?	❒	❒
If yes, give details.....		
Have you ever had any operations involving the use of metal implants,plates, or clips?	❒	❒
If yes, give details.....		
Have you ever had any type of electronic, mechanical , or magnetic implant?	❒	❒
If yes, give details.....		
Have you had any surgery in any part of your body in the past two months?	❒	❒
If yes, give details.....		
Have you had a previous MRI scan?	❒	❒
If yes, give details.....		
LADIES ONLY		
Could you be pregnant?	❒	❒
Are you breast-feeding?	❒	❒

I confirm that I have been asked the above questions and the information is correct to the best of my knowledge.

Signature of patient.....

Signature of member of

staff.....Date.....

What is the patient's weight ?.....

Please remove all loose metallic objects, including metallic body piercing, hearing aid and dentures.

BAMRR Policy Board June 2005 To be reviewed June 2008

Appendix B

Magnetic Resonance (MR) Procedure Screening Form for Patients

Date ..... Patient Number .....

Name ..... Age ..... Height ..... Weight .....
Last name / First Name / Middle Initial

Date of Birth ..... ❒ Male ❒ Female Body Part to be Examined .....
Month day year

Address ..... Telephone (home) .....

City ..... Telephone (work) .....

State ..... Zip Code .....

Reason for MRI and/or Symptoms .....

.....

Referring Physician .....Telephone .....

1. Have you had prior surgery or an operation (eg arthroscopy, endoscopy, etc) of any kind ❒ No ❒ Yes

Date ..... Type of Surgery .....

Date ..... Type of Surgery .....

2. Have you had a prior diagnostic imaging study or examination (MRI, CT, Ultrasound, Xray, etc)? ❒ No ❒ Yes

If yes, please list	Body part	Date	Facility
MRI	.....	.....	.....
CT/CAT Scan	.....	.....	.....
Xray	.....	.....	.....
Ultrasound	.....	.....	.....
Nuclear medicine	.....	.....	.....
Other	.....	.....	.....

3. Have you experienced any problem related to a previous MRI examination or MR procedure? ❒ No ❒ Yes

If yes, please describe.....

4. Have you had an injury to the eye involving a metallic object or fragment (eg metallic slivers, shavings, foreign body etc ❒ No ❒ Yes

If yes, please describe.....

5. Have you ever been injured by a metallic object or foreign body (eg BB, bullet, shrapnel, etc)? ❒ No ❒ Yes

If yes, please describe.....

6. Are you currently taking or have you recently taken any medication or drug? ❒ No ❒ Yes

If yes, please list.....

.....

7. Are you allergic to any medication ❒ No ❒ Yes

If yes, please list.....

8. Do you have a history of asthma, allergic reaction, respiratory disease or reaction to a contrast medium or dye used for an MRI, CT or Xray examination? ❒ No ❒ Yes

9. Do you have any anemia or any disease(s) that affects your blood, a history of renal (kidney) disease or seizures? ❒ No ❒ Yes

If yes, please describe.....

For female patients

10. Date of last menstrual period?..... Post Menapausal ❒ No ❒ Yes

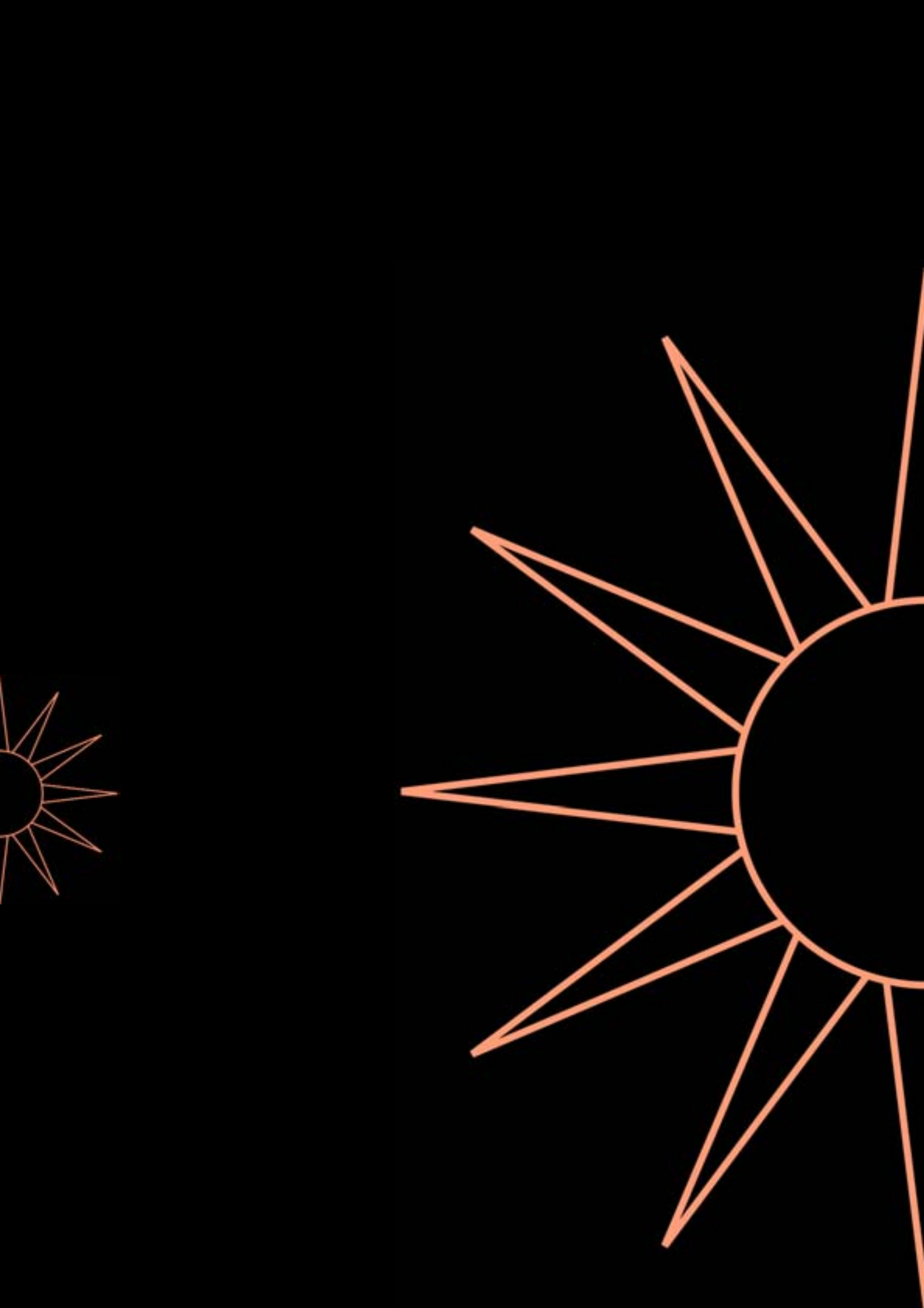
11. Are you pregnant or experiencing a late menstrual period? ❒ No ❒ Yes

12. Are you taking oral contraceptives or receiving hormonal treatment? ❒ No ❒ Yes

13. Are you taking any type f fertility medication or having fertility treatments? ❒ No ❒ Yes

If yes, please describe.....

14. Are you currently breast feeding? ❒ No ❒ Yes



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