то	RIGINAL RESEARCH PAPER EVALUATE THE RISK FOR PATIENT DERGOING MRI AND TO OBSERVE THE	Radiodiagnosis
ADTOEN CO	MPLIANCE TO SAFETY GUIDELINES IN A TIARY CARE HOSPITAL	KEY WORDS:
Dr Krishnakumar K M	Junior Resident, MGM INSTITUTE OF HEALTH S MUMBAI	CIENCES, KAMOTHE, NAVI
Dr Ashutosh Chitnis*	Professor, MGM INSTITUTE OF HEALTH SC MUMBAI.*Corresponding Author	IENCES, KAMOTHE, NAVI
Ms. Shreya Nityanand Nadumuriyal		

Introduction

Magnetic resonance (MR) imaging helps to generate critical diagnostic and anatomic information without the use of ionizing radiation, but it has safety risks because of the large static and changing magnetic fields, high-powered radio frequency coil systems.

It is very important for the patient to understand these risks and how to protect themselves from any sort of harm and to know the safety regulations at MR imaging sites.

Fundamental learning of MR imaging material science and equipment is essential for radiologists to comprehend the beginning of wellbeing guidelines and to keep away from normal misinterpretations that could bargain security.

Every one of the segments of the MR imaging unit can be a factor in wounds to patients and staff. Dangers incorporate translational power and torque, shot damage, over the top explicit retention rate, consumes, neuro-stimulation, associations with dynamic inserts and gadgets, and acoustic damage.

Extra specialized and security strategies identify with paediatric, oblivious, debilitated, or pregnant patients and pregnant imaging staff.

Division of the MR imaging condition into four unmistakable, obviously marked zones—with dynamic confinement of section and expanded supervision for higher zones—is a compulsory and key angle in shirking of MR imaging-related mishaps.

All MR imaging offices ought to have a reported arrangement to deal with crises inside zone IV, including cardiac arrest or code, magnet quench,

The expanding clinical interest for Magnetic Resonance Imaging (MRI) with its better delicate tissue differentiate thought about than other radiological imaging modalities and potential physiological and utilitarian applications has added to the establishment of very nearly 30,000 MRI scanners around the world. In this way, increasingly more medicinal services experts should be prepared in MRI security to shield patients and other social insurance labourers from the potential dangers of MRI [1,2]

It is additionally essential that radiologists, alluding doctors and MR technologists can assess MRI wellbeing and similarity of therapeutic gadgets and inserts since they are frequently the principal social insurance experts who will converse with a patient around a MRI test, potential dangers, and MRI security [3] Radiologists are very much prepared about MRI suitability criteria however they require support from alluding doctors to evaluate the dangers and advantages of MR imaging techniques [4].

Particularly alluding doctors who know subtleties of a patient's therapeutic history can improve the MRI wellbeing screening process when they know about the dangers of a MRI examine by pre-screening their patients before a MRI test [5]. This is especially imperative in high-hazard patients and in patients with new embeds that have not yet been tried for MRI similarity [6,7].

A specialist board has built up the American College of Radiology (ACR) Guidance Document for Safe MR rehearses [8].

The accompanying segments will audit potential bio-impacts and dangers of the attractive fields that collaborate with patients and human services experts in a MRI suite [9].

There are three major magnetic fields in an MRI suite that that have potential safety risks which are static magnetic field, radiofrequency magnetic field and magnetic field gradients [10].

Aim

The aim of this study is to understand the safety of the patient related to magnetic resonance imaging and to observe the compliance to safety guidelines in a tertiary care hospital.

Objective

- To determine the health effects and safety issues related to MRI environment for the patient.
- To know the safety precautions to be taken before and during the MRI examination.
- To study the steps to be taken in case of emergency situations.
- To implement the safety guidelines in the MRI environment.

MAGNETIC RESONANCE IMAGING

MRI, or resonance imaging, uses strong magnetic fields to vary the spin of atoms in our bodies.

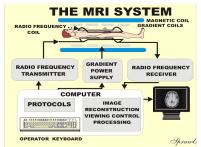
Radio signals detect these tiny changes. MRI computers process this information and construct images of sentimental tissues inside the body, from the brain to blood vessels.

An advantage of MRI is it's virtually harmless to the patient because, unlike CT scanners, MRI doesn't generate radiation. The spinning atom effect is understood as nuclear resonance

(NMR). It was first observed during the late 1930s, but medical applications weren't found for the NMR technique until the 1970s.

He varied the strength of the magnetic flux , which varied the signals from different atoms from which he could build an image .

In 1971 he discovered that MRI might be used for diagnosis . Cancer tumours had different signals compared to healthy tissue. Damadian built the primary whole-body MRI scanner in 1977, which he called the 'Indomitable'.



MRI magnets

The most commonly used magnet in an MRI machine is superconducting magnet.

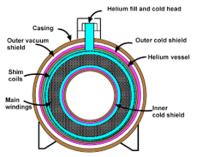
Superconductive MRI magnets use a solenoid-shaped coil made from alloys like niobium/titanium or niobium/tin surrounded by copper.

These alloys have the property of zero resistance to electrical current when cooled down to about 10 kelvin. The coil is kept below this temperature with liquid helium.

The power supply is connected on either side of a short heated segment of the coil and the current to the coil is gradually increased over several hours until the desired magnetic field is reached.

The heated segment is allowed to cool to superconducting temperature and the power supply removed and taken away.

The current continues within the closed-loop system of the coil for years without significant decline. A resulting property is that the magnetic field is always present.



MRI Zones

Four different zones are suggested round the MRI scanner. The access to these zones is restricted in MRI facilities and hospitals and the boundary of each zone in this four-zone safety system is defined by its purpose and distance from the MRI scanner. Some zones may extend into other areas or floors of the facility due to the three dimensional extend of the magnetic field.

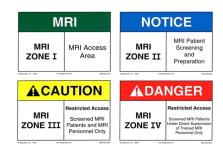
Zone I includes all areas freely accessible to the general public where the magnet field poses no hazards, such as the entrance to the MR facility.

Zone II is located between Zone I and the more restrictive
28

Zone III. In Zone II patients are under supervision of MR personnel. Zone II often includes the reception area, dressing rooms and MRI screening rooms.

Zone III is access-restricted by physical barriers such as doors with coded access. Inside Zone III, only the approved MR personnel and patients that have undergone MRI screening are allowed. The MR control room is in Zone III.

Zone IV is the room where the magnet is located. Access to Zone IV should only be possible by passing through Zone III. Zone IV is meant so the walls of magnet room contain the five 0.5 mT line (or 5 Gauss) line of the perimeter field of the magnet.



MRI safety zones

MRI implants

MRI devices use strong magnets, metal implants pose the precise risk of potential migration of implants and radiofrequency (RF)-induced heating of the implants, which can cause damage to the encompassing tissue.

Metal implants can result in image artefacts that cause misinterpretation of results. Advances in technology can minimize image distortion by modifying resonance pulse sequences and optimizing scanning parameters. When deciding whether patients should undergo MRI, physicians must consider both the advantages of imaging and the possibility of image distortion due to implants.

Titanium is a paramagnetic material that is not affected by the magnetic field of MRI. The risk of implant-based complications is extremely low, and MRI are often safely utilized in patients with implants. The titanium plates used in the craniofacial area, however, are made of alloys. More precise research is needed because the effects of MRI depend on the proportion of the constituents of the alloy.



MRI compatible metals:

Titanium

Orthopaedic surgeons often use titanium implants for their strength and compatibility with body tissues. Titanium has nonmagnetic properties which makes it compatible for use with an MRI as well. Joint replacements, surgical screws, bone plates and pacemaker cases all of these use titanium. In addition, doctors can use surgical tools made of the metal in MRI rooms.

Cobalt-Chromium

Even though cobalt has magnetic properties, implants such as coronary stents made of cobalt-chromium alloy have tested safe during an MRI. The alloy also tests safe for larger items, such as knee and hip replacements.

Copper

Researchers have tested intrauterine contraceptive devices (IUDs) for MRI safety. Some of these have a small copper coil. The magnetic field didn't move the IUD at field strengths up to 3 teslas, nor did the copper heat up. Some metal objects become warm during an MRI, even if the magnetic field doesn't pull at them. Copper wiring for pacemakers is also tested safe for an MRI.

Stainless Steel

Some stainless steel alloys have a very low reaction, or susceptibility, to magnetic fields. Medical supply companies sell stainless steel tools and accessories that can be easily used by the staff in the MRI room. Stainless steel items such as dental braces can distort MRI images, however. If the metal interferes too much with the MRI image, the doctor may recommend you have your braces removed.

Metal detectors used in MRI:

- A metal detector is a device which is used for detection of the presence of metal objects.
- They are used for locating metal objects present externally on a patient.
- Metal or ferromagnetic detectors are now available which are simple to work with and are capable of detecting very small ferromagnetic objects.
- It should be made sure that the use of metal detector is not meant to exchange a thorough screening process.
- Metal detection systems are supposed to be highly effective as a good quality assurance tool in verifying the proper screening and identifying metal objects which were not found by normal screening method.
- It is important that the use of metal detectors is done in the screening process in zone II.
- Many new metal detectors are capable of being situated within zone III, which is at the door to the magnet room.
- These types of metal detectors which are located at the doors are called wall mounted metal detectors.

Magnetic field interactions acting on a highly ferromagnetic object brought too close to the magnet of the scanner can become so substantial as to be unstoppable by human effort. Items such as a steel gas cylinders and fire extinguishers can enter a magnet at 30-40- mph, the same speed they would reach if dropped from a 40-foot building to the ground.

Two types of metal detectors are used for screening the patient before entering the MRI suite:

• Hand held metal detectors: a handheld unit with a sensor probe which can be swept over the patient to be screened. If the sensor of the metal detector comes near a piece of metal this is indicated by a changing tone.



Wall mounted metal detectors:

These are types of metal detectors which are fixed at the door of the magnet room.



MRI burn prevention:

Provide the bore padding. Once you have a patient within the bore confirm there's a minimum of 1 cm of air space or www.worldwidejournals.com padding that keeps that patient from touching the transmitting RF coil element.



MRI accidents:

If a ferromagnetic item is brought into the space this item will become a projectile and attract towards the magnet with tremendous force

- This item will fly toward the middle of the magnet and take anything in its path with it
- Ex: If a patient comes in with an unsafe wheelchair, the wheelchair will fly to the middle of the magnet with the patient within the chair
- There are many MRI accidents since MRI was introduced within the 1980's
- Examples include, but aren't limited to: Patient having an MRI Unsafe aneurysm clip within the brain, leading to the death of the patient
- Six year old boy struck with an oxygen tank, leading to his death
- Patient having nail clippers in his pocket. When being sent into the scanner, the clippers flew out of the pocket and struck the patient within the eye. As a result, this patient lost his eye.

MRI Safety Training and Emergency Procedures in an MRI Suite

All personnel working within the MR environment got to be trained with a comprehensive MRI safety course. For brand spanking new employees who will add the MR environment this course should be included within the employee orientation program and be repeated annually. The MRI safety training should have presentation of technical and medical background of MRI safety. Hands-on demonstrations of missile effects of ferromagnetic objects can help to raised understand and knowledge the risks in an MRI suite. Detailed screening procedures of patients with a questionnaire for metal objects, implants, devices, body piercing, allergies to MRI contrast agents, renal disorder , pregnancy, nursing and also the screening of patients that have a history injuries by a metallic foreign body like bullets, shrapnel, or other sort of metallic fragments help to avoid severe accidents in an MRI suite. A crucial topic to debate in an MRI safety course are severe burn wounds that were experienced by patients.

The patients were in direct contact with transmit RF coils of the MR systems or when skin-to-skin contact points were liable for these injuries. The security course must warn about high acoustic noise levels of the gradient system during an MRI scan and therefore the potential noise reduction with earplugs and headphones to avoid potential hearing damage. Videos from quenching magnets can help to know how powerful a sudden loss of the superconductivity of the magnet could be and emergency procedures during a quench should be discussed. It's important that medical personal entering the MRI scanner room to guide the patient, administer medications or interventions got to be trained in emergency procedures in an MRI suite. Healthcare professionals got to know which objects are often brought into the various MRI zones so as to stop fatal injuries and medical breakdown and the way to get rid of a patient from the MRI magnet room to resuscitate or treat the patient in emergency cases.

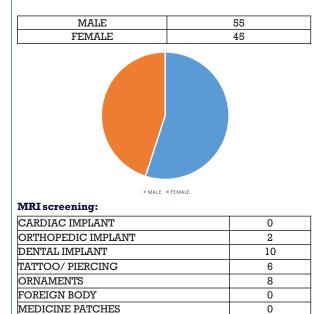
MATERIALS AND METHODS

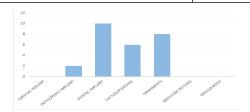
A descriptive study was conducted over a period of 8 months (2019-2020) on 100 patients about the safety protocols which was carried out before and during the MRI examination.

Data for the study was collected from 1.5 Tesla, Toshiba machine, model Excelart Vantage in MGM MEDICAL HOSPITAL, Kamothe, Navi Mumbai for evaluating the risk for patient undergoing MRI.

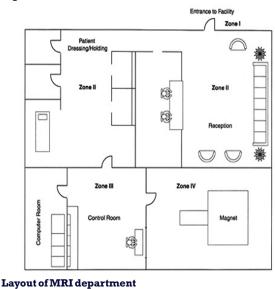
Unstable, claustrophobic patients, patients below the age of 18, patients with cardiac pacemakers and patients with implants which are not MRI compatible are not included in this study.

Observations:





Figures:



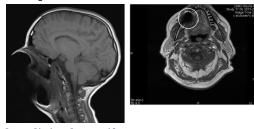


Awareness poster

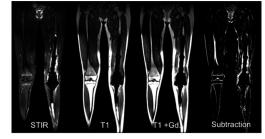
MR Item Classification System ratings MR Safe: Items pose no known hazards in all MR environments and are indicated by a green and white icon. MR Conditional: Items do not pose any known hazards in a specific MR environment with specific conditions of use. The icon consists of "MR" inside of a yellow triangle. MR Unsafe: Items such as any magnetic item, are unsafe in all MR environments. Here bine where use Withwinded C

item, are unsafe in all MR environments. Unsafe icon features a "MR" inside of a red circle with a bar through it.

Dental implant artifacts:



Orthopedic implant artifact:



MRI compatible items: MRI compatible trolley



MRI compatible oxygen cylinder



Results:

During a period of 8 months of the study, 100 patients who fulfilled inclusion criteria were studied, out of which 55 were male and 45 were female.

In the screening process which was done before the MRI scan, from total 100 patients, 10% had dental implants which were MRI compatible, 2% had orthopedic implants which were made of titanium. 6% had tattoo/ piercings and 8% patients had permanently fixed ornaments which were either made of gold or silver.

Screening with hand held metal detector was not done for 5% patients and red bulb indication which is situated at the door of the MRI magnet room was not switched on for 4% of the patients.

Discussion

All hospitals and medical centers must provide safe environment for patient and staff who are within the presence of the MRI scanner. They ought to establish, document and implement MRI safety protocol so as to avoid any incidents from occurring. MRI safety information could save lives, money and time. Such important issues are; information about the magnetic fields and their influence on ferromagnetic objects near them, implants and metallic foreign bodies.

Hence, the MRI environment is split into four safety zones designed to maximize safety restricting the flow of traffic through the world and to stop MRI-related incidents. Each boundary zone is defined by its purpose and distance from the MRI system. Radiology nurses and other staff working in hospitals or medical centers also as patients must exercise extreme caution and must remember of the powerful magnetic flux and its associated hazards. Also, it's imperative that radiology nurses and every one staff involved in MRI environment adhere to established safety guidelines information to stop metal objects and patients with ferromagnetic implants from entering the magnet room.

Having proper safety training for workers in situ is a huge potential to enhance safety in MRI environment. Safety training provides radiology nurses and other staff with the vital knowledge of the danger and hazards related to MRI and most significantly the way to prevent incidents from occurring. Staff development and training is one among the foremost vital components within the MRI department. Trained staff are going to be better equipped to handle patient inquiries and to tell the patients of the MRI procedure. Therefore, it's crucial to notice that staff during a safe work environment can focus better on their duties. This may eventually cause better work output and quality. Managers and team leaders at MRI unit must have safety educational program in situ and therefore the program should cover areas such as; accident prevention, safety promotion, safety compliance, safety practices, risk and hazards related to MRI.

Conclusion:

A thorough screening of patient should be done with metal www.worldwidejournals.com

detector before entering the MRI room.

The radiographic worker should have knowledge about any previous history or medical condition which the patient may have.

The patient should be well informed about the procedure to be done.

Proper training of the staff and the radiologist can minimize the risk of any disaster or accidents occurring in the MRI suite. Most of the accidents are caused by poor or lack of communication between the radiographic worker and the patient, therefore effective communication between the worker and the patient can benefit in enhancing the safety and preventing any sort of accidents.

						CARDINAL INFRANT	GRENCHENC MPULAT	DENTAL INFLANT	108065 8007	PETONES	Larrisol/ PERCNE	CRAMER'S	NAME OF VICTORS	NO SULS INDEXTOR	REQUISITION FORM	MS/RICED ARSA	CONSENT FORM	Martin Willia
,	BAROBAI Graduit	NUCCOM	65	FRONT	MUSIAN AND	ARENT	ARENT	ARSEN!	ABS(N)	AREN?	ABLENT	ARION	VATTRAT	¥85	165	18	785	MARKA METAL DETIC
2	GAUTAM Drimosi	1752487	60	MILE	ARCEAN ARCEAN ARCEANCH ARCEANCH ARCEANCH	ARENT	ARENT	MELON"	ABIENT	ABLENT	ABLERT	AB30NT	LAD-IN MILLS	VII	NES	- 16	785	10
,	SUBRA SADA AN	174675	50	reser	MICOPPOR	ABON	ARENT	ANSENT	ANKET	ABLE	4558	HOENT	SADIN MULK VEFA PATE	105	165	18	78	
	DEVENDEA NUMBER	176415	19	MAR	MUNET ION	ARKIN	ARENT	ARKENT	ABIERT	ARM BT	ARKENT	18101	54548	105	165			
8	BARRANE SAARTA	276264	10	PENDLA	MILL? SPOK.BBK	ARENT	ABLEN?	ABUEN!	ABUR!	ABLE DT	ABLERT	ARKIN!	SALAR SURVE ANT BUILDRE	101	165		785	n
•	International Party	174558		12010.0	MUSTINE	AREN	ARENT	PAULON	ANNE	ARKEN	ARKE	18201	BOOM TREAT	101	NEX.			
2	RANESH KADU	3071048	12	MILE	MILITIAL CONT	ARXIN	ARENT	ANSENT	ANKET	ANANT	ABLE	10201	VANTTALAY	-	NES	- 18	785	
•	jamagaj Milijaki	3862749	19	resour	MURTREADE	ABOVE	ABENT	ABSENT	ABSENT	ABENT	ABLENT	48504 ⁻	SA310N MULK	985	10	10	785	
	PRADELP MORE	JARANGE	41	MILX	MILIOCALAL SPINE	AREN	ABLEN?	ABLER!	ABLER!	ABUEN?	ABLERT	182017	VEH MITS	101	MEN		- 111	
**	RATAR REPORT	3685240	10	MH.8	MRI FETADOANM	ABENT	ABENT	ABSENT	ABSENT	ABSENT	MESEN1	ABSON!	SASAR SURVE	985	165	18	785	-
**	Samera .	1004213	- 12	rawnad	MUTURS	AREN	AREN	ANKE	Add at	ANAL	ARKEN	PROANT	AW/ B-UDM	101	165	- 18	185	+ .
18	NORMAN I	389405	4	MAR	MUSIAN CONTRACT	ARENT	AREN?	ARGENT	ARRENT	ABURT	ABLERT	18201	MATUR BANANE	vis	NES		m	-
**	LUBER'O BARAGET	2004/62	42	Mild .	MICHAN CONTRAST MICHT TACKLER	AREAS	MANANT	ABUERT	ABILE NT	ABUERT	ABLERT	18201	MATUR BRAMANE ANIT BOLDAR	100	NEX	- 18	785	-
14	ARCTINE BOCKM	17581AL	14	/ Barnel	MUSIAN PLAN	AREN	AREN?	ABLER!	Ables!	ABLEN?	ABLERT	182017	LAD-IN MULK	101	MEN		- 111	-
15	NTX GOUAN	375683	55	rest	MILL/ SPOLEDA	ABONT	ARENT	ABSENT	Able#T	ABENT	ABORT	48204	VACTORY	105	NS	18	18	-
18	BAD-IR KURME	370408	- 60	MAX	MUR? ANUE	AREASE	ABLEN?	ABLENT	ABLER!	ABLEN?	MEMONT	ABION?	VERN PATS	101	ME		мı	+
67	AND DESCRIPTION OF THE PARTY OF	574560	8	Mult	MUNP ON	ARXIV	ARENT	Addeb1	Add(#7	ABSENT	ABLE	1850	SAGAR	185	165	18	78	-
18	DARAS DARD	207423	- 10	renter	MICLIMEN.	ARK N	ABLENT	ABUR!	ABUENT	ABUERT	ABURT	18201	SASAR DANK BRANAR BRANAR BRANAR BRANAR BRANAR BRANAR BRANAR	100	NEX	- 18	185	+
29	CHERALKOUM	2742284	40	FEMALE	MATCHINE SPEE	AREN	AREN?	PAESEN'	ABUR!	ABU BT	ABU BT	AREN?	ANP BINDRE	165	785	185	185	
**	Million	3745563	- 18	TEMAX	MULTINA.	483047	ARENT	ABSENT	ABSENT	ABLENT	ABLE	AREN?	SSAT TABLE	165	18	185	15	+
п	2,803 (46)(8)	3348317	18	MAIR	MEXCENSION SPINE	ARENE	ABBN?	ABUER?	ABLENT	ABUEN?	ABLERT	AREN?	SHO-IN MULK	165	78	vm	105	
н	SOBARA	2762304	15	MAIL	SPINE SPINE SPINE	ARENE	AREN?	ABSENT	ABSENT	ABSENT	ABLERT	AREN!	SAGAR SARVE SERV. PUTA	165		185	105	
22	AVAILABLE AND CO	1753463	65	TEMAL	MELLUMBA UPM	49200	AREN!	ANURT	ANK N	ABURT	ABURT	AREN'	VEN PUTS	165	785	101	165	+
24	SADED-17 MAK	1983555	63	MAG	MELERACAL SPINE	12101	ARENT	Adda bi	Addate?	ABLE NT	ABLERT	AREN!	MATUR BRAMANE	165	- 78	185	15	+
25	00146432764	2785240	- 13	TEMAX	MELONIAN IPM MELONI	482047	AREN?	ABURT	ABILER?	ABUENT	ABURT	PEDANT	AAF BOOM	**		ves	165	t
ж	MAPES (READING	2762241	10	MALE	MELENEZ JOINT	A82047	ARENT	ABLERT	ABLENT	ABLENT	ABLERT	AREN?	USA/ TADAJ	165	765	VE	15	+
22	MARK DELAMURA DARGANEA KALANI	3765744	19	TIMAE	MERCOS	485047	48204	ABORT	Ablent	ABENT	ABORT	48201	104711847	165	785	16	16	1
28	DARBARA PIDERY	17040	50	FEMALE	MR307 G/R07 X08/7	ABOR	ABONT	MESON1	ABSCR1	ABEN?	ABLERT	ARXN	USA/ TADAJ	10	713	YB	10	+
29	2/848.94	38124	-1	MAIL	MARCH WRET KONT MARCHWEAK SPINE	ABOR	ABENT	ABLERT	ABLERT	ABER?	ABLERT	48.01	SEG PUSE	165	78	ves	10	+
м	KHEPPER	3784534	22	MAJE	METTON	ABION	AREN	ABURT	ABSENT	ABURT	ABURT	4825	SAGAR GARGE	165	785	18	16	1
31	Modelan Brichauf Talich Bachadi	3794(3)	30	MAIE	MEDICASAL SPINE MET/ENCOMM	ABION	AREN	ABSENT	ABSEN!	ABSEN?	ABLENT	AREN!	SADIN MUSK	165	78	95	15	+
ы		19610	28	PEMALE	METERODOM	ABION	AREN?	ANUNT	ABSENT	ABUEN?	ABLE B?	AREN?	SADIR MILK SADIR MILK	165	78	VE	165	1
**	YEAL SHORE AVER	3796534	10	MAG	MELET EME KONT METEROLIJEE KONT	ARKINE	ARENT	ABURT	ABNER!	ABUENT	ABURT	ARENT	VERA PUTE	165	788	VB	185	+
**	ACHINE SPIREAT	Rama	53	TIMAS	Keristales Kief	ABSON	ARXIV	ABURI	Ables	ANERT	ABLET	48.831	AMP BOODM	165	- 18	185	165	+
n	04040340549	17060	15	MAG	MRT/UMBAI 12ML	ARENE	ARENT	PRESERV	ABLERT	ABURT	ABUENT	ABONT	SAD-IN MULK	165	78	ves	105	+
н	SANDELP HAT'S	1713281	12	MAG	UPINE UPINE METERORI FLOR	ABSON	ARENT	ANURI	ABSER!	ANALI	ABLET	48.811	Upper Habits	165	785	185	165	+
Ð	KA102 DRCH	2794128	20	MALE	MERSON PLAN	482047	AREN?	ANUM	ABUERT	ABUENT	MEMONT	AREN'	1000/110243	165	785	185	165	+
*	AMON NO.	1717081	19	TEMALE	KARAT KNEL	42304	AREN	ARCENT	Add(#1	ABLENT	ABLERT	ARXN.	MARUR BILAMANE	165	78	185	165	\vdash
**	PERSONAL	371546	21	TEMALE	SHOLT EVEL	ABSENT	ABSENT	ABSONT	48504	ABSENT	ABSENT	ARENT	SECS PATE	96	16	18	785	+
41	CHINERAEL? KAMAA	194010	33	MAAI	WED CERTICAL SPINE	ABLE BT	ABLE NT	ABSON!	AB304	ABLEN?	ABLENT	AREN	EAGAB SARVE	MEX	165	18	985	+
41	ABHGET GADENN	DHAR	28	MALI	MELET KINEL XUNT	ABSERT	ABSENT	ABSON!	18200	ABLENT	ABSENT	AREN?	SAD-IN MULK	105	185	18	185	t
42	BATSA 140E	1717256	42	TEMAIE	SPINE	ABSENT	ABSENT	ABION?	12335	ABSEN?	ABLENT	AREN?	VETA PATE	MB	165	18		\vdash
40	ONTIA MAR	3812447	10	MALE	MALTINEAU INC.	ABSENT	ABSENT	PROUNT	ARKIN!	ABSENT	Abst N	AREN'	Valet Habits	105	165	18	78	+
**	AND AND AND A	1010104	-	MALI	MELLINESS UPINE	ANNE	ABLERT	ABBENT	ARKIN'	ABLENT	ANNE	ARENT	VEN PUTE	101	165	185	185	+
ei	SHEN MEDICIE	1773342	27	remail	SHR MELET KMEL KONT	ARM NT	ARSENT	ARRINE	18201	ABLENT	ARRENT	ARENT	VANTINGAT	165	165	78	785	+
*	VARIANS NO.		- 6	remail	MELLINES.	ANNE	ABSENT	ABILIN	ARKIN!	ABLENT	PAULON	AREN	GAGAR	101	165	185	185	+
e	PERENAL AMBURLE	1012162	63	MALI	MRI L? ENEX	ABSENT	ABSENT	ARRENT	18800	ABLENT	ARKENT	ARENT	SALAR SARLY SAD-IN MULK	165	165	78	785	+
41	LARC/ DEBIGANE	MILLIN	53	FEMALE	NRI LIMEN	ABLENT	ABLENT	ABSON?	ABOY	ABLENT	ABLENT	AREN	MARUR BRAMANE	103	165	78	781	-
	PERMISSION CONTRACT		67	MARI	SINC SINCE SINCE SINCE SINCE SINCE	ANSENT	ARGENT	ABS(N)	4830N	ABLENT	ANEN	AREN	ANT BOOM	NES	165	- 18	785	-
	KINEA/H IMANI	1011107		MAAI	STAL STALL	ANY N	455.5	445/07	1000	ANIA	ANY N	and the	Second Second		185	18		+
11	AUDIERABICE	3013421	29	MAL	SHEET STRATEGY STRATE STRATEGY STRATEGY STRATEGY STRATEGY	AMENT	ABIEN'	ABION"	48300	ABLENT	ABIEN'	AREN!	SASAR GARAE SASAR SARSE	901	10		711	-
10	LATA MANDA	1717348	62	FEMALE	SPINE MRI DORSAL SPINE	ABM BT	ARKENT	ARBIN!	ARENC	ABLENT	ABUENT	PRESENT	SURVE AND Briveline	100	185		78	-
54	ASSESS TO A	1415.467	82	-	STINE STINE STINE	ANNE	ABLE	ABBONT	1000	ABLENT	ANKET	AREN	AND BOOM	105	165		185	+
54	SUNIL MARINGAN	1796128	- 11	MALI	STINE METTOMEN STINE	ARM NT	ARSENT	ARRINE	ARRING NO.	ABLENT	ARIENT	ARENT	BOIDM SERVICE	165	165		783	-
**	MALAMA DOWNER	1754867	- 11	remail	SPINE BOADER	ABSE BT	ABLERT	ABUINT	ARXIN:	ABLENT	ANK BT	ARENT	VEN PUTS	100	165	185	185	-
54	OCHINES SALVA	3830436	6	MAA1	WOADER WEI DOEGE UNNE	ABLE BT	ABIENT	ABS(N)	1000	ABLENT	ANKS!	AREN?	VERA PUTA	NES	165	18	185	-
57	VEPTA LAMAN	MILLIM	0	remain	1/102 5451174301 4107	ABSENT	A25087	ABSONT	48304	ABSENT	ABSENT	AREN	SADIN MULK	-	10	10	785	
-	MINEAR GADIER	3824204	25	MAL	KINT MELTERME KINT	AMENT	ABILS?	ABION"	48300	ABIEN"	AMEN'	AREN!	MULK SADIN MULK	MIL	10		781	
59	1513.44 (A)447	3814122	50	MAAT	KINT MILLT KMIT KINT	ANSENT	A85687	ABSONT	48304	AblenT	ABSENT	APRIL	MULK SADIM MULK	with	165	18	125	
	VALUE	1010104		raman	KINT MILLI MILLI KINT	AMENT	ANKE	(READ)	1000	ANIA	ANKE	2553451	MULK SADON MULK	101	185			-
41	Onzyan Jiotaan Sabanin	MUNIT	n	MAG	KINT MELET KNEL KINT	ARM BT	ADD N	ARRON'	18800	ARIEN?	ARM N	Amane	MULK ANT Briddel	80	165	10	781	-
	SAUNERE VETRALINERE	-	53	MAG	KONT MARK	ANKE	ANNE	ABBER	1000	ABLENT	ANKET	AREN	BUILDING	-	165		185	-
63	ASH DOB	3832483	19	MAL	MRLT BADW	AREN'	ARIENT	ABON	ARENC	ABLENT	ARIENT	AREN?	Voluting and	vis	165		vis	1
64	SUMPRADED	1997191	20	TEMALE	540 H110	ABLENT	ADDENT	ABION	1000	ABLENT	ABLENT	AREN	54548	10	16	10	70	1
-	MOND SORIA	MUMAD	10	MAD .	MUSICAN CONTRACT	ANENT	Ablent	A850%	1000	AblenT	MUNT	1000	SADAR SARAR SADAR	-	165	10	100	
64	SECRET SEARNER	MUNKS	32	TEMALE	CONTRACT MASSING CONTRACT	ABSENT	Ables!	ABS(N)	ABXIN!	ABSEN!	ABCN ¹	AREN	SAGAR SAGAR	10	16	10	75	1
	SAME AT SAME AN	Milles?	22	MAR	CONTRACT MELLY SPECIALIES	ABLE NT	mean	ABS(N)	1000	ABSEN!	ABLENT	AREN	SARVE MARKE BRAMANE	105	165	18	78	1
-	BANG/SN1	1764241	n	MALE	SOARS	ABLE BT	ABM BT	ABUDY!	ABRIN!	ABLEN!	ABNER!	ARENT	BRAMANE VIENA PUTA	MI	165	18	YB	
65	OLETA AMOL TAMBI	367438	20	MAL	SPINE MRS (CROCAL Grant	ABSENT	A25EWT	A85047	48500	ABSENT	ABSENT	4825F	SETS PATE	16	16	18	78	1
70	VERNARA'N ROY	3490005	20	MALE	STINE MELTERS	AMENT	ABIEN!	ABION?	AB304	ABLEN!	ABLENT	AREN	VONTINGAU	MI	165	78	YB	-
71	ADV ABOULMON	10461112		MALE		ABLE BT	ABLE NT	ABUN	realso?	ABLENT	ABIER?	ABBNT	Valut Yaber	100	183		m	-
74	SPENAR STURAT	8843758	55	MAAI	SECONDAL STRE SECONDAL STRE	ABSERT	Ablant	ABBINT	ABUSIN'	ABLENT	ANUNT	10231	ANT BOOM	101	165		185	1
73	SUBIDIAR BALSUDE	MUNTI	70	TEMALE	SPINE SHO BLACK FLACK	ARM N	ABLE N	ABON	rease	ABLEN!	ABLENT	AREN	BOOM SADEN	10	165		m	1
74	BALSUDE CORADE CACENTY		- 10	MAL	MELETAR PLUR	ABILE BT	Abilite ¹	ABOIN!	NAME OF TAXABLE	ABIL!	ABUE!	AREN'	MULK GADON MULK	-	- 165		181	+
75	CHORMEY GARVA AGRAVE	Marine	30	meal	MARK CORNECTS	ANENT	Ablet	Abila?	NEXT!	ABLENT	Ables!	ARXN ²	MULK SACHIN MULK	-	165		78	+
~	Stopheng	3134875	42	TEMALE	1996 54517 (1985)	ABCN ¹	ADCR!	ABSON!	ABOVE	ABON'	ADDER!	AREN'	SASAR.	10	10	10	10	1
70	GRADOL GRADOLA THEORY	HINHI	34	TEMAL	MELETAN CONTRACT	ABLE NT	Able 87	recure!	HERN?	ABLENT	Able 87	ABEN?	SURVE SUSVE SUSVE	101	16	- 18		+
~	Abore Trans.	M11230	20	MAL	CONTRACT MAS IN KINES KONT	ABSENT	ABCR1	ABSON!	ABXNC	ABSEN!	Addem?	ARXN'	SERVICE PARE	10	18	10	10	1
78	SHIGHBOLLI EDECT		53	TEMASE	MALLY EVER	ARKENT	Able 81	ABSIN	ABSON!	ABLENT	Add(#1	PEDANT	VSAT TABAT	-	165		m	1
80	Admir SUMATION IN	MINT	29	TEMALE	XUN7 MELBOAR PLAN	ABLE NT	ABLE NT	AND	AREN'	ABLENT	ABIEN?	ARENT	Volution and Area	via	165		vis	1
	MÜRELINIK KR POTEAR			MAL	MELETAR ANGIO	ANENT	Ablest	ABSIN	18201	ABGENT	ANKE	10231	METS PATE	165	165	185	185	
82	NUMA NUMBER	ночи	19	TEMALE	ANGIO MRI BRAN CONTRAST	ABLENT	ABL:N	ABON!	reace	ABLEN!	ABLENT	AREN	VERN PATE	10	16		m	-
83	AMEN THEOR	3117348	N	TEMALE	CONTRACT MATTIMENT	ABLENT	ABICN'	ABION!	ABOY.	ABLEN!	ABLEN?	ABON!	SADIN MILK	10	16	10		-
	ABHEAD! SINCE	Mariala	25	MAL	SPINE SATUBLAR CONTANT	AMENT	ANKET	ABS(N)	reach.	ABLENT	ANK N	AREN	MULK SADON MULK	-	165	18	18	-
-	SAME AND A	MELT	10	MAR	CONTRACT SHEET COMPANY SHINE	ABLE NT	ABLE NT	ABION?	ABXIN!	ABSEN!	ABLENT	AREN	MULK SADIM MULK	10	16	10		1
	FANCERANG S	MUNH	70	MARI	SPINE SHITTEACH	ARKENT	Able 1	rection?	18300	ABLENT	ARIENT	AREN	MULK SASAR SURVE	10	165	18	785	-
10	APreline Table	HIDH		TEMALE	MARK TRA	ANENT	ABILIT	ABUDY!	ABUD!	ABLENT	ABILENT	ALC: NOT	SURVE VG0/YND42	100	165		785	1
	Serfia General	MILLIN	-	TEMAN	MER BLAR	ANGE	4211.01	1000	1000	Ablent	ANER	1020	VSAT TABAS					1
	MOMUTON	Martica	40 24		CONTRACT NULL TORIST	ADDERT	ADUR	ABUR	ARKING COLUMN		ADUR	ARXN:		-	10	16	10	1
	ALCONCION .		×	resolution						ABORT			STATE FOR THE ACT					L
*		3410014		TEMALE	MELENAR ANGE	ABSENT	ABSEN!	A850%	ABRONC	ABSEN?	ABSENT	AREN	VORT TABLE	98	10	10	70	Ē
**	AANEEDA" ORIGIIAANA	1745.062	30	M0.21	MATTIMAN UNK	ABSE BT	Ablest	ABSON?	ABSOC.	Ablent	ANNENT	ARENT	000110242	NES	165		785	t
	VENTLOOMENE	MIME	×	MAL	SHEET CAL	ABSENT	ADDEN!	ABSON!	ABOVE	ABSENT	ADDEN'	AREN	VOAT TREAS	ю	165	10	913	
92		8847345	- 60	TEMAL	MARKAN UPON	ANERT	AbiliteT	ABSON?	AB304	ABLENT	ANK N	HOINT	SADIW MULK	10	165	- 18	185	t
92 93	MANOGALAN LABLAR																	
82 94	REACOULD LIAILAA YOLESP MORE	мина	28	MAAI	NET BLACK VENCENN	Absent	ABSENT	ABSONT	ABXIN!	ABSENT	Ablen	AREN	SAGAB LUNKE	10	16	-18	78	
52 54 55		MARTAN MILINA MILINA	38 32 34	MART.	MERIDIAN VERSIONAL MERIDIAN PLAN	ABSERT ABSERT	ABSENT ABSENT ABSENT	ABIONT ABIONT PRODUCT	ABON ABON	ABIENT ABIENT	ABSERT ABSERT	AREN' AREN'	SAGAR LUKUE SADIRI MULK SADIRI MULK	98 90	16	18 18 18	15	

*0	Publik Coak	362(44)	20	N#4	SPAC	ABENT	1001	ABON	ABONT	4604	ABON	ABONT	voeshin,	46	WS	165	YB	WB.
	AMON PLANE	3051228		104041	VENDERAM	ABUNT	NUM	ABENT	ABENT	ABONE	ABOT	ABIENT	VON HIL	965	WEL	165	VEL	VEL
	participation of the	2011220	24	riberal	CONTRACT.	ABENT	ARK) I	ARENT	ARENT	ABONE	PROAM	ABGINT	Mater the Selat	16	WES	165	785	WES
100	54864 520	1103962	50	705441	SPEC	ARENT	1002	ARENT	ARENT	1802	48257	HEIST	Make table	85	96	16	YB	WB.

REFERENCES:

- Chakeres DW, de Vocht F. Static magnetic field effects on human subjects related to magnetic resonance imaging systems. Progress in biophysics and molecular biology. 2005;87(2–3):255–265. doi: 10.1016/j.pbio molbio. 2004. 08.012.
- Feychting M. Health effects of static magnetic fields--a review of the epidemiological evidence. Progress in biophysics and molecular biology. 2005;87(2-3):241-246. doi: 10.1016/j.pbiomolbio.2004.08.007.
- Hipp E, Sammet S, Straus C. MR Safety Standards for Medical Students Nationwide. Proceedings of the 19th Annual Meeting of ISMRM; Melbourne, Australia. 2012. p (abstract 2731)
- Shellock FG. Magnetic resonance procedures : health effects and safety. CRC Press; Boca Raton: 2001.
- Karpowicz J, Gryz K. Health risk assessment of occupational exposure to a magnetic field from magnetic resonance imaging devices. International journal of occupational safety and ergonomics : JOSE. 2006;12(2):155–167.
- ASTM F2052-00 Standard Test Method for Measurement of Magnetically Induced Displacement Force on Passive Implants in the Magnetic Resonance Environment. [Accessed November 8 2015];
- Sammet CL, Yang X, Wassenaar PA, Bourekas EC, Yuh BA, Shellock F, Sammet S, Knopp MV. RF-related heating assessment of extracranial neurosurgical implants at TT. Magnetic resonance imaging. 2013;31(6):1029–1034. doi: 10.1016/j.mri.2012.10.025.
- Expert Panel on MRS. Kanal E, Barkovich AJ, Bell C, Borgstede JP, Bradley WG, Jr, Froelich JW, Gimbel JR, Gosbee JW, Kuhni-Kaminski E, Larson PA, Lester JW, Jr, Nyenhuis J, Schaefer DJ, Sebek EA, Weinreb J, Wilkoff BL, Woods TO, Lucey L, Hernandez D. ACR guidance document on MR safe practices: 2013. Journal of magneticresonance imaging :JMRL2013;37(3):501–530. doi: 10.1002/ jmri.24011.
- Sammet S. Implementation of a Comprehensive MR Safety Course for Medical Students. Proceedings of the 20th Annual Meeting of ISMRM; Salt Lake City.2013.p (abstract 4071)
- Shellock FG, Kanal E. Magnetic resonance : bioeffects, safety, and patient management. 2. Lippincott-Raven; Philadelphia: 1996.