

## **Safety Management on MRI Services Within Radiology Unit**

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**Abstract :** *Health services have been growing very rapidly, knowledge about the disease and technological innovation become a major challenge for the health care industry to be able to run the latest clinical procedures or the latest high-tech equipment to the management system to assure the safety of patients, staff and the environment. One of the latest technology in the field of radiology is Magnetic Resonance Imaging (MRI), which is a diagnostic tool that uses a powerful magnetic field in the process of making the radiological picture. Large magnetic field has the potential hazards that must be managed properly, to prevent accidents in the process of MRI examinations. This study aimed to get an overview of the implementation of safety manajamen on MRI services at the hospital's radiology unit in Indonesia, so we can formulate a recommendation for compliance with safety standards in accordance with the guidelines MRI safety practice. This study used a qualitative approach through observation, review of documents and interviews, which consists of pilot interviews and the depth interview. From the results of this study found that MRI safety management of hospital services in Indonesia has not been referred to the safety guidelines and risk reduction strategy is based on the danger owned facilities and infrastructure. By maximizing the supervision of staff in carrying out the strategy prepared by management, the implementation of the strategy can be done well by all the staff involved, thereby increasing the performance of radiology unit. Quality radiology service, is a service that can provide assurance of safety for patients, staff and the environment.*

**Keywords -** *Patient safety, the risk of MRI, magnetic field.*

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### **I. Introduction**

MRI frequently referred as “the safe modality.” In a profession focused on ionising radiation risks, MRI’s exclusive use of non-ionising magnetic fields and radiofrequency energies makes it an appealing alternative to many x-ray based imaging modalities, particularly for young and repeating imaging patients. However, the absence of ionising radiation in MRI does not equate to an absence of risks to patients or radiographers. MRI accidents or injuries: from cryogenics, magnetically-induced projectiles, or burns. The lack of knowledge of the actual risks of MRI, and the diminution of the validity of retold accounts of accidents, stem from a lack of data about MRI accidents.

However, the risks of projectiles, burns, or hearing damage are inherent to the proper operation of the MR scanner equipment. Widely acknowledged to be profoundly under-representative of the actual number of MRI accidents and injuries, regulatory reporting remains our best resource for assessing the effectiveness of safe MR practices.

Data for MRI accident and injury, comes from the U.S. Food and Drug Administration (FDA) (Gilk, 2015). Accident data suggests that, over a 13-year period, MRI accident rates in the U.S. have plateaued at a rate that has grown nearly five times the rate for overall utilisation from the year 2000. While generalised MRI accident growth should be a cause for alarm in the industry, it is the nature of the specific accidents that reveals the keys to prevention.

With regard to accident prevention, MRI accidents and injuries reported in the United States are exceedingly rarely attributable to the MRI equipment malfunctioning. Like any machine, When evaluating two years of FDA MRI device injury accident reports, it was discovered that more than 85% fall reported injuries stemmed from RF burns, ferromagnetic projectiles, and hearing damage This is further complicated when an accreditation organisation simultaneously serves as a professional society for radiologists who have ownership interests in imaging facilities, equipment, and practices. The standards of practice described in the four-times published American College of Radiology’s guidance Document on MR Safe Practices (Expert Panel on MR Safety 2013) are not (as of the date of this publication) requirements of the ACR’s own MR accreditation programme. Prevention, Professionals and Credentialing.

During the scanning process, patient will be exposed to three MRI magnetic field, which are primary magnetic field, gradient magnetic field and radio frequency magnetic field, with each particular impact to body subject to respective power of magnetic field, and so the safety practices are formulated based of the type of the

magnetic field (Hong, 2003). All personnel involved in MRI services must be trained about MRI safety practices. Standardized adverse events report system must be formulated and executed, as well as the availability of patient screening procedure that is easy for the screening interview staff to read and to understand. The guidance and procedure of MRI must be read by all personnel with access to MRI services; there are guidance with information concerning supervised area, person in charge and the authorized personnel, whose execution must be periodically supervised and audited. MRI rooms must be equipped with alert signs for patient, personnel and people.

There are a lot of threat in MRI safety practices, and how to solve it is related to the management, facility design, and the joint of interdisciplinary science. Danger in MRI room is classified to three groups which are observation process, clinical, and facility design, and each mentioned group of danger has different solution. In observation system, effective screening process is necessary to ensure the inexistence of ferromagnetic materials inside the magnetic field. For design and facility, it is recommended to limit the access to magnetic field room within 4 working zone subject to the power of magnetic field and caused effect. Arch et al (2007) recommendation for the clinical, safety practices are prioritized to the patient with implants. For magnetic field is a non ionizing radiation, there must be a protocol about how to take care of patient with implants so this patient may be observed using MRI securely.

MRI has the risk not only for the patient but also to the radiographer (Gilk 2015). The existing risks are projectile effect, tissue heating, or audio disorder and to minimize accident in MRI services there are things to concern which are; standard as subject to enforced rules, licenses, accreditation program or audit from the authority. As an anticipation, there must be an authorized person in charge to the patient as well as MR safety duties having proper knowledge concerning MRI safety. Well-arranged and documented clinical credential for radiographer, radiology specialist doctor as well as medical physics expert with responsibility to MRI safety among patient.

According to Erriksson (2016) there are three components of MRI system that may cause potential danger with regard to the power of the magnetic field. During MRI scanning process, patients are put in the center of the magnetic field around the bore and exposed by radio frequency (RF) that cause impact to human body. Before conducting MRI observation, patient must be informed about things they may face during observation. Screening process to the patient is conducted using interview and form of question so before the process conclusion will be made upon the necessity of anesthesia. Erriksson also recommended separation of region within MRI rooms to four working zone with regard to respective power of magnetic field as well as the activity within.

Based on safety practices MRI that seen in previous studies of safety practices MRI and a lot of research in the science of safety management in MRI services. Hong Kwang Ng et al (2003) conducted a study of the scanner and magnetic fields described ketubuh and effects that can occur. Through this research recommended safety practices based on the strength of the magnetic field. Arch et al (2007) conducted a study on MRI safety practices related to the management, facility design and related professions in it. MRI recommended design of the room into four work zones. Frech (2012) examines the strength of the magnetic field associated with the construction design of the building. Lipton (2013) recommend about MRI safety practices, which requires no attendant (duty officer) responsible for the safety of the practice of MRI. Gilk (2015) on the study recommends there should be a process credentials in determining staff who are competent to carry out MRI examinations. The officer involved is radiographer, radiology specialist physicians and expert medical physicists. Errikson (2016) recommended the division of the area in the MRI room into four work zones, according to the strength of the magnetic field and the activities within it, as well as the interview process in a screening process metal

Overviewing the procedure of safety management system within MRI services as recommended by experts within their research, obviously there is a gap between safety practices on MRI services in hospitals in Indonesia, particularly to prevent magnetic field danger. Some researchers recommended limitation of access to MRI personnel and other staff with connection to MRI services process. Limitation of access may become personnel screening or providing access card or key to enter magnetic field area. Same treatment goes to the procedure of emergency treatment, where there is a separation of zone as stipulated based on the power of magnetic field. By these gaps the writer is intended to qualitatively analyze and explore deeper concerning the implementation of safety management of MRI services in hospital in Indonesia.

## **II. Literature Review**

### **1. Regulation and guideline concerning MRI safety**

According to the national audit hospital accreditation committee, direction a basic regulation that provide the direction about how to do something, so it is an important thing that become foundation to determine and conduct an event while guidance is an instruction about something. Definition may be provided that direction regulates few things while guidance covers only one event. Therefore, to ensure that the

direction/guidance can be well and correctly implemented, regulation concerning standard operational procedure is necessary.

Patient safety in hospital is a system in which a hospital provides safer patient treatment. This system covers; risk valuation, identification and management of patient related issues, report and analysis of incident, learning ability from incidents and the followups, and the implementation of solutions to minimize the risk. This system is expected to avoid any casualty arising from execution of an action as well as failure to execute a required action. Hospital accreditation according to Minister of Health Regulation has the purpose to increase the patient safety and to increase the protection for patient, people, hospital personnel as well as hospital as an institution. National accreditation assessment is measured based on patient focused service, patient safety, and the development of the medical service quality. One standard in accreditation assessment is Facility and Safety Management (MFK) measuring facilities within hospital concerning safety, functional and effectivity to the patient, personnel, and other individual. This covers emergency awareness, security, safety, life preservation, medical equipment, utility system, hazardous materials, and waste management including assessment upon safety facility inside MRI rooms.

ACR Guidance Document on MR Safe Practices (2013) explained that with potential risks within, operating MRI system requires knowledge of safety practices whose function to minimize the possibility of risk that may harm the patient or operators as well as staffs on duty. For those concern, the following practices should be conducted and socialized among hospital personnel, patient, patient's relatives, and visitors. Within this guidance, recommendations are provided concerning division of working space, access restriction, availability of sign/information regarding danger of magnetic field, suitable supporting equipment, procedure and classification of patients using interview method.

## **2. Safety Management in MRI Services**

Work Health and Safety Management as a process of activity starting from planning, organizing, executing, and controlling with the purpose to habituate the Health, Safety and Security of Work (K3) in hospital. The purpose of patient safety is to bring the culture of patient safety into existence, to creating the accountability of hospital before patient and society, to minimize adverse events within hospital and the execution of preventive programs to avoid recurring adverse events. The subject of K3 management within hospital are the hospital itself, personnel, patient, and visitor.

Radiology services as a medical service that uses all radiation energy modality for diagnosis and therapy as well as imaging techniques, and the use of radiation emission and x-ray, radioactive, ultrasonography and electromagnetic radio frequency radiation. Radiology diagnostic services is a supporting service and therapy, using ionizing radiation and non-ionizing radiation, consist of radio diagnostic service, imaging diagnostic and interventional radiology to support a diagnosis of an illness. MRI is grouped within diagnostic imaging services group i.e. radiology services that perform diagnosis using ionizing radiation. MRI is an advanced diagnostic tool to observe and detect your body using large magnetic field and radio frequency wave, with neither surgery, x-ray usage nor radioactive materials.

Based on aforementioned explanation, safety management on MRI services can be defined as an effort, a process involving risk assessment, identification and management of aspect in relation to patient risk, report and analysis of incident, ability to learn from incident and the follow-ups, as well as implementation of solution to minimize risks in MRI services.

## **3. Hospital Strategies to Anticipate Risks in MRI Services**

According to Stoner (2001), strategy can be defined as program to determine and reach organizational goal and to implement its mission. Strategy is a pattern of reaction or organization's respond to its environment along the time. Motivation, ability and achievement as shown by an individual in effort to reach the purpose as targeted by the company.

According to Hartono (2002), strategy needs to be formulated in order to achieve the previously stated goal. In order to achieve a proper strategy, a hospital must conduct two steps of activity which are formulating the strategy concerning existing services by making decision about what to do with regard to existing services and to formulate development strategies of new services by deciding some developable new services and new market. According to David (2010), strategic management can be defined as art and science of formulating, implementing and evaluating interfunctional decisions that enables an organization to achieve its purpose. As described in this definition, strategic management is focused on effort to integrate management, marketing, finance/accounting, production/operation, research and development, as well as computer information system to achieve organizational success.

Identification of the source of danger, assessment and control of risk factor must be conducted by hospital. Kusumasuganda (2009) said that understanding about potential risks in MRI modality requires attention primarily by radiographer as well as other medical personnel which involved in MRI observation process, to ensure that MRI observation process to be conducted upon patient is a safe procedure. Risk that may

occur in MRI observation process using magnetic field with regard to the nature of respective magnetic field may occur as; magnetic torque/twisting effect, projectile effect, tissue heating, audio problems, medical devices malfunction, peripheral nerve stimulation.

#### **4. Implementation**

Implementation of policy basically is the way by which a policy may reach its purpose. Van Meter and Van Horn (2008) defined implementation of policy as action based on previous decision. This actions are included efforts to change decisions onto operational actions in certain period of time as well as in order to continue efforts to gain major as well as minor change as stipulated by organizational policy and decision. Implementation of safety management at the service of MRI is to see the implementation of the strategy that has been made by the unit, if it is executed well by all staff involved in the service MRI. Compliance staff in carrying out the strategy that has been made by the unit, varied, to be seen whether the strategy is made quite easy to implement in the work unit, whether management provides the means to implement the strategy, and the most important of the implementation of the strategy is to return to private individuals themselves.

#### **5. Performance**

According to Rue and Byars (1982), performance can be understood as “the degree of accomplishment”, or sometimes is considered as level of achievement of organizational purpose. Assessment of a performance is a very important activity and is made as an input for a reparation to increase the organization performance in the future. According to Mac Donald and Lawton (1977), if an organization failed to result output in the form of any materials, performance is also considered as output measurement of organization’s result. These explanation is provided by Stodgil with regard to problems in organizational output.

According to Peter Jennergren (1981), the meaning of performance is the actual execution of duties while Osbord (1980) considered it as grade of achievement of organization’s mission. So it is concluded that performance is an event that is considered as the description of how far a task can be done following the organization’s mission. Performance is better than an MRI safety management services in the radiology unit can be seen from the results of a related report adverse incidents and accident reports in the MRI examination process. If there never was such, it can be said that the safety management of patients considered to have a good performance

### **III. CONCEPTUAL FRAMEWORK**

Regardless the facts showing that MRI services are sometimes considered as a secure diagnosis modality as well as no risk in comparison to other radiology observation such as conventional radiography, computed tomography (CT) scan, or nuclear medicine devices, MRI may cause serious injury to those who use implants and medical devices. MRI magnetic field actually has potential risks which are necessary and even must be paid strict attention, because any negligence to supervise the MRI safety procedure may cause injury and even severe casualty. MRI may bring potential danger to patient, personnel, and surrounding ecosystem. Furthermore, in this concept of theory, the researcher explained how a magnetic field may cause potential danger, what the potential risks that a magnetic field may cause are, how magnetic field may bring impact to body, how about the management and preventive procedure and anticipation as guided by any standard or policy if MRI safety practices covering some related aspects to MRI which are system, facility as well as the personnel. Regarding the rules, regulations, and guidance as stipulated by the authority, radiology unit must comply to such guidance or standard as recommended by the authority.

In order to apply MRI safety management, radiology unit is required to follow the enforced safety rule. Guidance of safety practice in MRI services existing nowadays are made by professional organization as well as international auditing organization such as JCI. Herein the researcher is intended to observe how far the implementation of MRI management system is, in correlation to regulation and guidance of MRI safety.

#### **Development propositions**

Based on documentary overview, interview as well as observation to MRI services propositions are built as follow.

**Proposition 1 :** There is a gap between safety management system on MRI services in hospitals and the regulation or guidance

In discussing safety management in the service of this MRI, can not be separated from a discussion of the magnetic field in an MRI air could pose a potential danger to patients, staff and the surrounding environment. How management manages all risk factors in the service of MRI, procedures for prevention and mitigation based on national and international regulations, guidelines, standards or policies related safety practices MRI covering several issues related to service MRI, namely systems, facilities and human resources.

Based on observations, as well as the review of documents, as well as the pilot interviews, researchers get a picture, preliminary data on how the implementation of safety management. The process is observed from the incoming flow of patients, method or manner of attendant did consent metal, Standard Operating Procedures (SOPs) MRI safety. By comparing the initial data obtained with MRI safety management system recommended by safety experts MRI, within the guidelines of ACR Guidance Document on Safe MR Practices: 2013

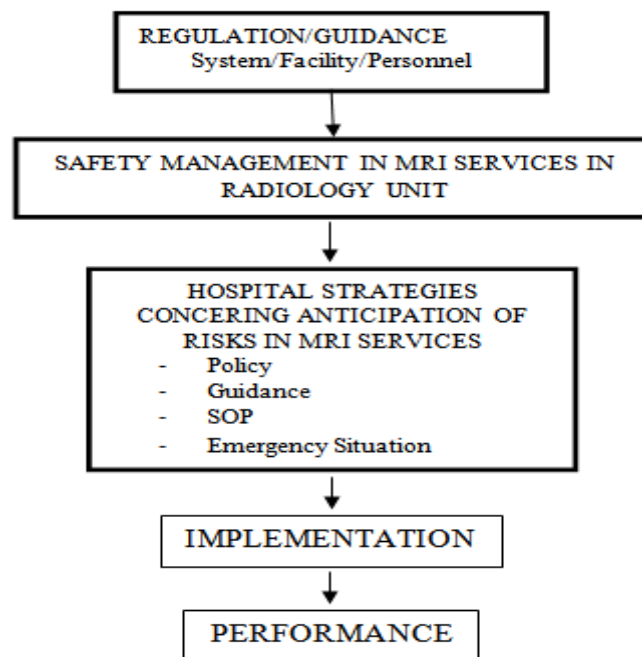
Proposition 2 : Arranged strategies of risk management system in services

To implement a safety management in MRI service, radiology unit should draw up an appropriate strategy. Strategies prepared and made by all parties involved in the service of MRI. The strategy covers everything from planning, implementation to the evaluation process. To implement an optimal service radiology, radiology unit has prepared a strategy that might be done with consideration of facilities, infrastructure and human resources available. From the start of the patient registration process, until the results of the specialist radiology expertise.

Proposition 3 Implementation of strategies which are made by hospital management are well executed by MRI personnel, by which the performance is good

Safety management at radiology service in its implementation requires a strategy, as the direction, guidance or guidelines for carrying out the MRI safety practice. The strategy includes how the planning of MRI safety management, what is the procedure for its implementation, to the evaluation process. This implementation show achievement radiologi departemen implementing the strategy that has been made by the hospital in safety practices MRI services. Observations on the implementation strategy of risk reduction is done in the Unit of Radiology to see the policies that have been implemented, is there a monitoring and maintenance, how the facilities and support equipment to service MRI, is there coaching and training of staff technologist for the services of MRI, so finally it can be seen how the implementation of safety practices MRI services in Radiology departemen. If the hospital implement a strategy that has been created, it can be ascertained performance in the radiology unit handling hazards MRI service is quite good. Performance management can be seen from the safety of unexpected events of accidents that occur in the service process MRI.

In general, conceptual framework of this research may be described in following chart:



Pic 1. Conceptual Framework

#### IV. Research Method

This research is conducted using qualitative method. Points to be discussed are; analysis unit, data collection technique, validity test, consist of construct validity, content validity, internal validity and external validity and reliability test. Observed aspects are safety management system in MRI services. This research was conducted at a radiology unit on June 2016. Analysis unit in this research are individuals consist of Medical Committee Chair, Medical Person Incharge of Radiology Unit, Head of Radiology Unit, Radiology Specialist Doctor, and MRI Radiographer. Data collection were conducted using three methods which are observation; direct observation, whereas researcher actively participated in observed situation; documentary overview; overviewed documents among others are metal screening completeness, calibration certificate of MRI devices as well as supporting devices, list of personnel's competence, and list of personnel training. Standard Operating Procedure of MRI observation and emergency procedure or blue code procedure. Interview consists of pilot interview, and in depth interview. Pilot interview is conducted to three informants; Head of Radiology Unit and Radiographer in MRI room while in depth interview to all remaining informants

### **1. Measurement**

First step is to conduct pilot interview to three informants which are Head of Radiology Unit and two radiology personnels. The criteria of choice are, head of Radiology unit is considered as personnel with enough understanding to provide preliminary information about MRI safety practices and to confirm any founding from previous observed data and documents, personnels having above two years of job experience has enough understanding about MRI services, especially safety practices. This number is considered sufficient to represent preliminary needs because this interview is just exploratory.

The purpose of this pilot interview among others are to figure out and relevances among variables to be used in analysis, to formulate questions reflecting the contents of this research, to examine whether the focused questions are easy to understand, to help building case study protocot and to introduce the research and to gain access to further informants. Beside to examine the content validity and construct validity, this pilot interview is conducted to build network. Based of facts from observation, documentary overview and pilot interview, a case study protocol was then built along with central questions concerning.

### **2. Result and Discussion**

Conducted in depth interview resulted that gap between safety management in MRI services in radiology unit and the MRI safety guidance whereas radiology unit doesn't provide separation of working zone, access restriction, availability of sign/information concerning magnetic field danger, minimum supporting tools, and patient clarification process. Regarding general procedure of the hospital, although this procedure is executed and socialized by person in charge of rooms to all radiology personnel, this procedure is not socialized to all personnel within hospital with interaction to MRI services. Existing procedure in radiology unit is limited to observation procedure made based of observed organs. Determination of authorized personnel to conduct MRI observation is just made through credential process, i.e. through assessment process observing ability and knowledge of the personnel by a team. This process complies to the standard as stipulated by the Committee of Hospital Accreditation In relation to the knowledge of radiology personnel concerning MRI observation process, the considered danger is just about magnetic field so that the anticipation was just limited to prevention of metal materials to enter MRI room.

Regarding division or separation of working zone within MRI room, radiology unit doesn't divide MRI working room to working zone as recommended under ACR Guidance Document on MR Safe Practices (2013). Minimum knowledge of the personnel concerning working zone and limitation of working areas causes separation working zone is just made based on activity in respective area. Access to MRI is not specifically limited. Every people may enter the MRI room although observation is still running. Personnel from any unit may enter MRI room without MRI personnel accompaniment. Should any emergency occur in MRI room, Radiology unit follows the hospital issued Blue Code Protocol. Emergency protocol is socialized and the personnel fully understand of what to do.

In effort to secure the safety in MRI services, radiology unit formulated a strategy based on modality, and available infrastructure for that purpose. For area limitation, the observation room become the facility covering all activity including pre observation before entering changing room. What the unit does is to maximize supervision upon MRI area to avoid unnecessary personnel because of limited infrastructure inside the observation room.

Running strategy concerning emergency procedure (blue code), are by performing aid inside changing room using manual bugging device until the patient is in good condition and followed by taking the patient out of observation room for an intensive care. Execution of the procedure, as made available by radiology unit, concerning MRI safety management are well executed by the personnel because of the well organized supervision from upper level to the lower, as well as the factor of MRI personnels obedience to follow the existing procedure.

Metal screening description become an obligation to ensure patient safety to enter the magnetic field.

Personnel obedience to implement the strategy of MRI safety management has increased the performance of the unit. Benchmark result against other hospital shows that the enforced safety management in MRI services in benchmarked hospital is better and more comply to safety requirement based on ACR Guidance Document on MR Safe Practices (2012) whereas radiology unit has implemented separation of working zone, access control inside zone 3 as well as blue code procedure in zone 3 area.

Within this research, whereas based on observation result, documentary overview as well as in depth interview, conclusion shows the existence of gap between guidance and implemented safety management of MRI services. Momentarily, conducted safety procedure in radiology unit is the safety procedure of hospital in general, whereas these procedures do not cover customized safety stages based on potential danger in room with large magnetic field. It is necessary to formulate a customized safety procedure covering safety in every stage of MRI observation. For the existing procedure itself, it is well conducted by all personnel within radiology unit.

Reviewing the existing process, whereas all process after patient register are centralized in the observation room, that is directly next to primary magnetic field, potential of accident is extremely huge, for all people including family, patient or even other hospital personnel may access the observation room without metal free screening. Rooms directly next to primary magnetic field is not provided with restricted access control. The process inside this room among others are; providing information to patient and family, patient changing room and metal release, and room for patient to move from bed to MRI table. Method of handing over the metal free consent form and letting patient or family to provide consent, less effectively ensure that patient is clear to attend MRI observation for it may cause misperception and data misfiling by patient because patients have different understanding skill concerning type of metal that may or may not enter MRI room.

Before attending MRI observation, patient must be well informed about events they will face during observation, whereas screening process to patient is conducted by interview and question form so before process decide may be made upon whether the process may proceed or not (Eriikson, 2016). In existing metal screening procedure, there is no procedure about what personnel may do if the patient is not sure about the operation record or the existence of any implant, regarding various condition of incoming patient to care. Lipton (2013) said that there must be certain attention on screening to ensure that ferromagnetic materials are not brought inside primary magnetic field. Unit must ensure that interviewing personnel as well as observing personnel are well trained and competent personnel to conduct MRI observation. Determination of such personnel competence in radiology unit has complied to credential method as recommended by national accreditation board. This assessment is done by reviewing personnel's capability by skill assessment as well as knowledge about radiology sciences by hospital credential team, and finally the personnel may be granted clinical authority by the management. For radiology unit personnel's knowledge concerning safety practices in MRI observation, personnel must be trained to increase the scientific knowledge about magnetic field danger for information regarding danger of magnetic field and its anticipation method are continuously developer and continuously informed by organizations of MRI safety worldwide.

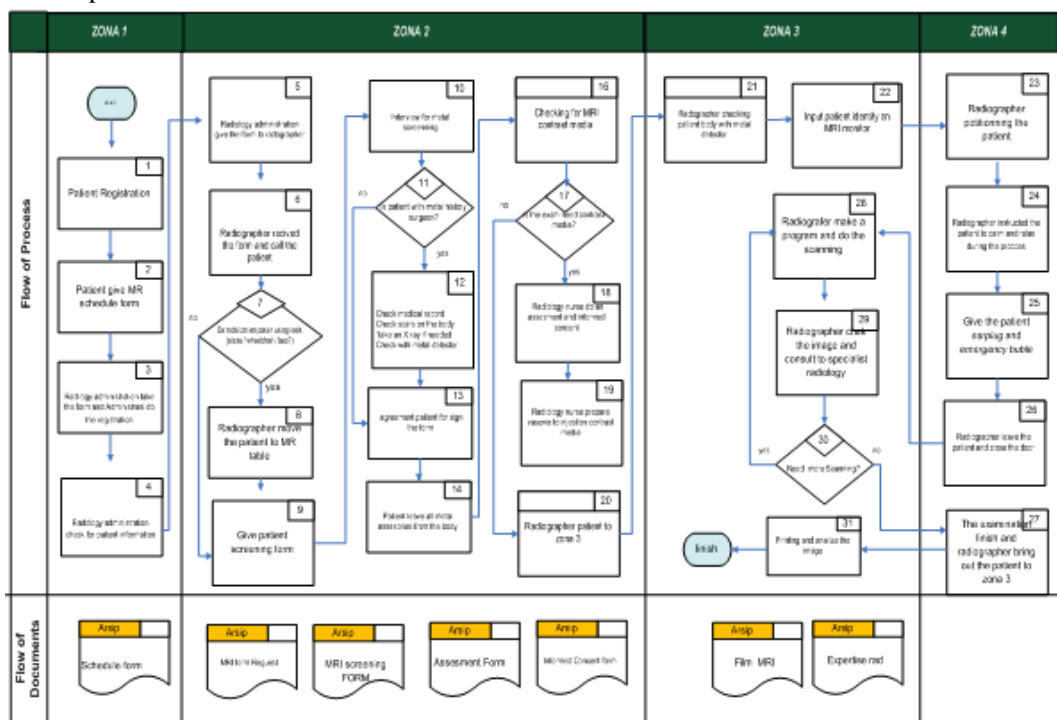
If any emergency occurs in MRI room, personnel must perform the blue code procedure, whereas the process is performed in observation room, using manual bugging procedure, until general condition of the patient is sufficient for further intensive care. This emergency treatment procedure will limit of personnel's movement in effort to provide maximum care to the patient. Because of limitation of magnetic field where all ferromagnetic materials are prohibited, provided care are just breath support using non metal tools. ACR Guidance Document on MR Safe Practices (2013) regulated that if any emergency event occurs, MRI table must be released from MRI machine and the patient must be brought to observation zone (zone 3) for immediate care by blue code team. For that reason, patient observation room in zone 3 must be equipped with emergency kit.

#### Managerial Implications

This research discuss the factors in implementing safety management in MRI services in radiology unit of hospital in Jakarta, Indonesia covering process of receiving the patient up to accepting the result of MRI observation in the form of expertise made available by radiography expert doctor as well as the radiography film. Managerial implication to suggest is about the service flow of risk management in MRI room. In the existing flow, the process was made based on zone division regarding potential danger and activity in respective area. Zone 1 area is administration room, and then patient enters zone 2. This area must be equipped with sign and information concerning magnetic field danger. In zone 2 radiographer performs metal screening. Procedure must be conducted using metal screening interview, not only passing the form to the patient to read, so the process may run better. For patients who are uncertain with their medical history, personnel must perform the steps such as medical record investigation, body check to the patient for any cut, perform blank x-ray if necessary, and lastly checked using metal detector. For patients that are mobilized using bed, walking stick, wheel chair or other metal aid, radiographer shall remove patient from MRI bed. Before entering zone 3, MRI classified radiographer perform body check to patient using metal detector and accompany the patient to enter this zone. Zone 3 is the waiting room as well as observation room whereas bed inside this room is well prepared

to enter the MRI room. Nevertheless, this zone 3 must be complete pursuing standard as stipulated by Ministry of Health concerning qualification of facility management and safety whereas this room must be equipped with emergency trolley, oxygen, and walled suction as well as bed side monitor to evaluate patient's vital sign. It is prohibited to bring mobilization aid inside zone 3 area with exception to "MR Conditional" devices as informed within the label of respective devices as well as screening using metal detector. For light fire extinguisher, the MRI room may have it but only limited to MR conditional device. The existing extinguisher must be substituted by MR Compatible extinguisher as marked by green triangle sign. It is better to equip area 3 with access control, so only authorized personnel may enter zone 3. When the observation is ready to start, radiographer inputs data to MRI monitor and followed by escorting patient to zone 4 which is gantry room with strong magnetic field. Afterwards radiographer input set the position of MRI table and provide earplug as well as emergency bubble for emergency situation. If the personnel is required, patient may summon the personnel by pressing the emergency bubble. It is recommended to equip the door with indicator lamp (red light) signing that the observation is on process inside the room

If any blue code emergency happens in MRI room, the safety care must be performed in zone 3, not in gantry area or zone 4 because emergency treatment requires fast and immediate action and if it is conducted in gantry area, incident may occur for the risk of metal modality existence that may not enter the magnetic field. If blue code occur, personnel must immediately contact blue code team and that radiographer on duty must immediately evacuate patient to zone 4, by first releasing MRI table from the machine, and then evacuate to zone 3 for help.



Picture 2. Recommended flow of service in MRI Observation

### V. Conclusion

This research concluded that anticipation procedure of potential danger must be formulated based on the type of risk within to provide optimum prevention. Limitation of infrastructure is also an obstacle that is commonly found in MRI services of hospital in Indonesia, beside assumption that MRI observation is relatively safe comparable to other radiology observation. This limitation is anticipated by strict supervision by the involving personnel to ensure that the procedure is safely conducted. Nevertheless, this is not a guarantee that the running management system is totally safe to the personnel, patient, and society. Fulfilment of safety standard according to the guidance become an important thing to create patient safety oriented medical services. Fulfilment of the safety standard in MRI services is not just about prevention of ferromagnetic materials to enter MRI room but also to the entire service flow from the equipment, personnel and emergency action system.

#### 1. Limitation of Research

Limitation of this research may become a comparison for upcoming researches. This research is conducted only in one hospital in Jakarta with one additional hospital as benchmark, thereby this research is not able to provide the clear concept of MRI services system in Radiology Unit of hospital Indonesia nationwide.



Inexistence of national regulation and guidance concerning MRI also brings obstacle in complying to national standard of health services

## **2. Suggestion for Further Research**

This research is still limited for it just observed sample in one medical facility. For further research it is recommended to extend the sample of hospitals with available MRI services so hopefully the clear conception concerning safety management in MRI services in Indonesia may be made.

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