

# Management & Role in MRI Safety

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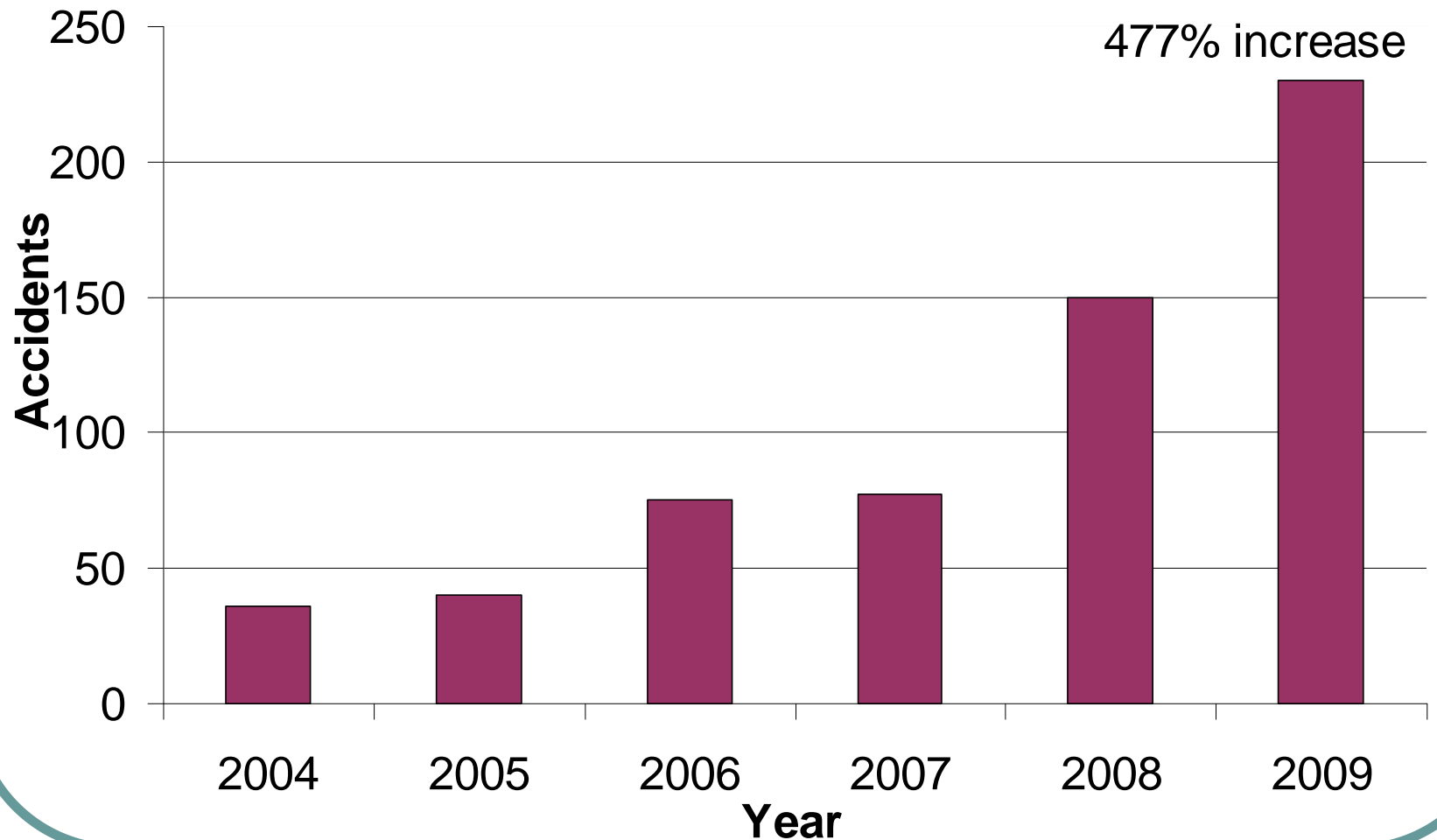
# MRI SAFETY - Agenda

- Introduction and Background
- Objectives
- MRI Accidents
- MRI Physics
- Root Cause Analysis
- ACR and JACHO Guidelines
- Near Misses

# MRI Accidents in U.S.

- 30 million scans performed in U.S. in 2010
- 92 scans/1000 in U.S.
- 43 scans/1000 in Europe
- 230 accidents in U.S. in 2009 - .000008%
- Adjustment  $230 \times 5 = 1150 = .00004\%$

# How Safe is MRI ?



Source: MAUDE LNH

# Basic Review of MRI Physics

3 Components of the MRI Environment:

- Static Magnetic Field
- Gradient Magnetic Field
- RF Field

# STATIC MAGNETIC FIELD

- Aligns hydrogen protons
- Measured in Tesla (T) - represents strength of scanner . 1.5T, 3T, etc
- Earth's magnetic field is .000006 Tesla
  - 1.5T scanner is 30,000 X stronger
  - 3T is 60,000 X stronger
- Always on !!!

# STATIC MAGNETIC FIELD

## SAFETY CONCERNS:

- Missile effect . ferrous objects fly into the scanner
- Torsion danger . metal within the body attempts to align with magnetic field
- Translation danger . metal within the body attempts to leave the body
- Infection control danger . MRI equipment not cleaned as often as it should be - MRSA

# GRADIENT MAGNETIC FIELD

- Allows us to choose area to scan
- Responsible for noise in MRI
- Intermittent



# GRADIENT MAGNETIC FIELD

## SAFETY CONCERNS:

- Implant malfunctions . induced currents can interfere with pacemakers, stimulators
- Burns . electrical currents created in external wires and conductors may burn patient's skin
- Hearing damage . noise levels can reach dangerous levels

# RF FIELD

- Supplies energy to tissue . creates a signal from patient's tissue
- Causes patient to heat up . excess energy dissipated as heat
- Intermittent

# RF FIELD

## SAFETY CONCERNS:

- Tissue burns . excess RF energy may build up in external wires and burn patient's skin
- Implant malfunctions . excess RF energy can interfere with pacemakers, stimulators
- Heating issues . patient's core body temp may rise

# The Colombini Accident

- In 2001, Michael Colombini died when an O2 bottle flew into his MRI scanner
- Accident focused attention on MRI safety
- Root Cause Analysis (RCA) . majority of blame falls on management for this tragedy

# The Colombini Accident - RCA

- Technologists' culpability . both techs left the area - this should never happen
- Management's culpability . everything else
- Conflicts of authority . hospital owned MRI scanner but subcontracted its operation to imaging group

# The Colombini Accident - RCA

- Inadequate policy and procedures .  
conflict of authority between hospital and imaging group
- No requirement for MRI training regarding MRI staff or ancillary staff
- No access control limiting entry into MRI suite

# The Colombini Accident - RCA

- No requirement to have only MRI-safe O2 canisters in area
- O2 depleted at wall . No mechanism for staff to report this
- No policy written for low O2
- Previous staff complaints of low O2 not addressed
- O2 in MRI not tied into engineering - regulatory requirement
- 2<sup>nd</sup> source of O2 not working

# ACR and JACHO GUIDELINES

- Training
- Restrictive Zones
- Ferrous Detectors
- Staffing



# TRAINING

- MRI staff . all MRI technologists should receive annual safety training
- Ancillary staff . all ancillary staff should receive annual safety training

# RESTRICTIVE ZONES

- Zone I            open access
- Zone II           semi-restrictive access
- Zone III          restrictive
- Zone IV          highly restrictive

# ZONE I

- Areas Freely Accessible to Public
- Outside MRI Environment

## ZONE II

- Interface Between uncontrolled Zone I and tightly controlled Zones III and IV
- Patients under supervision of MR personnel
- Medical histories, insurance questions, etc

# ZONE III

- Restricted access to general public
- Door locks
- Controlled entrance of ferromagnetic equipment
- Non MRI personnel under direct supervision of MRI personnel

# ZONE IV

- Highly restrictive
- Location of MR scanner
- Ferromagnetic objects prohibited
- Non MRI personnel under direct supervision of MR personnel at all times

# FERROUS DETECTORS

- Proper utilization . use it all the time
- Understand how it works . location of ferrous objects will be revealed
- Educate others . make sure all staff know how it functions

# STAFFING

- Except for emergent coverage, minimum of two MR technologists at all times
- For emergent situations, level II trained employee must be readily available
- Codes in MRI very dangerous



# NEAR MISSES

- Valuable experience- surviving a near miss in MRI can be a valuable teaching tool
- Real Life experience . sharing an actual close call instead of a what if scenario tends to be more impactful
- Near misses in my career . 3 near misses I have experienced and what we can learn

# MRI Jeopardy

- Category . things I wished I had in my previous MRI departments
- Answer first . when this happens
- Question . When would it be nice to have \_\_\_\_\_

# Scenario 1

- Answer . When the Bellevue Police show up at 2 a.m.
- Question . A Lock

## Scenario 2

- Answer . When your patient is carrying a six inch knife
- Question . A Ferrous Detector

## Scenario 3

- Answer . When an O2 bottle is stuck to the side of your scanner
- Question . Restrictive Zones

# DOUBLE JEOPARDY

- Answer -  $5 \frac{1}{2}$
- Question . How many individuals does it take to remove an O2 canister from a 1.5T magnet?

# What does MRI stand for?

**M      MORE**

**R      RADIOLOGY**

**I      INCOME**

# SUMMARY

- MRI usage is increasing . population aging @ 65 2 ½-3 x more likely to have MRI
- Emergent/Trauma . MRI usage is increasing in the ED
- Image guided procedures . interventional MRI is increasing
- Reimbursements are declining . more procedures need to be done to offset