

THE UTILITY OF BRAIN MRI IN THE ED

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@JameelEM

NOTHING TO DISCLOSE



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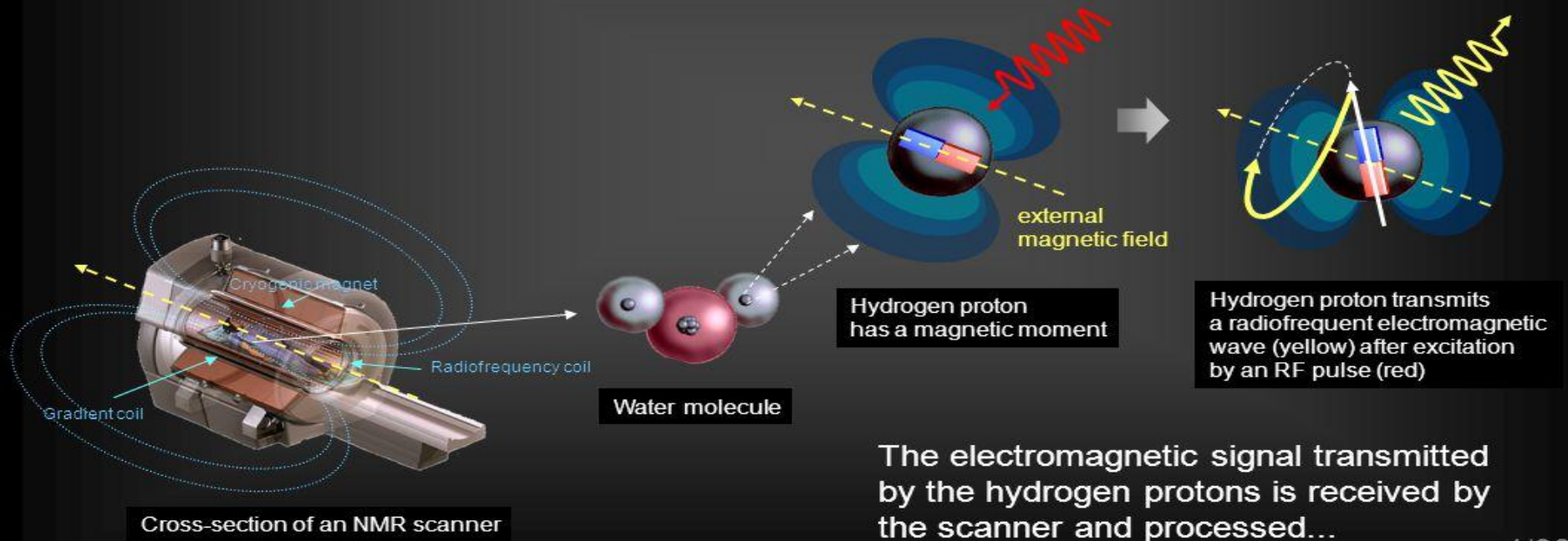
OBJECTIVES

- Physics
- Justifications
- Definitions/Types
- Utility
- Home messages

PHYSICS

The use of MRI: basic principle

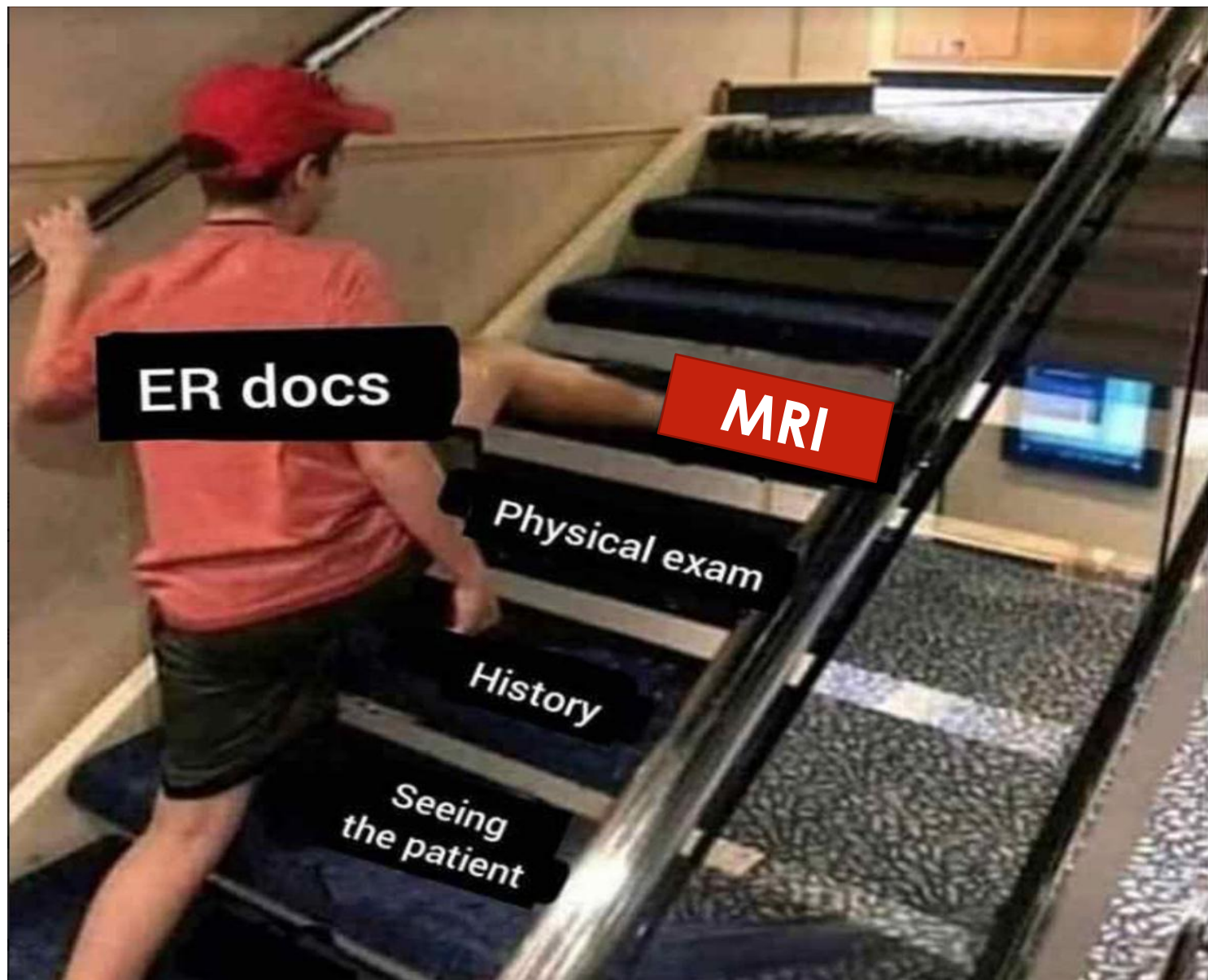
Conventional magnetic resonance imaging (MRI) is based on the radiofrequency signal that is transmitted from the atomic nucleus of hydrogen atoms placed in a magnetic field and after they have been excited by a radiofrequent electromagnetic pulse.





JUSTIFICATIONS

- Choosing the right imaging modalities
- MRI: Costly choice, however; sometimes MOST appropriate
- Availability (24/7, business hours, weekends)
- Cautions/Contraindications



ER docs

MRI

Physical exam

History

Seeing
the patient



Common ED MRI indications

Central Nervous System

Spinal cord compression

Dural venous sinus thrombosis

Arterial dissections - carotid or vertebral

Meningoencephalitis and vasculitis evaluation
(possible)

Subarachnoid hemorrhage (possible)

Cerebral ischemia - TIA/Stroke

Spinal cord/surrounding structure disease or
trauma - epidural abscess, cauda equina syndrome,
cord/nerve trauma

Pregnant patients with abdominal pain
(concern for appendicitis)

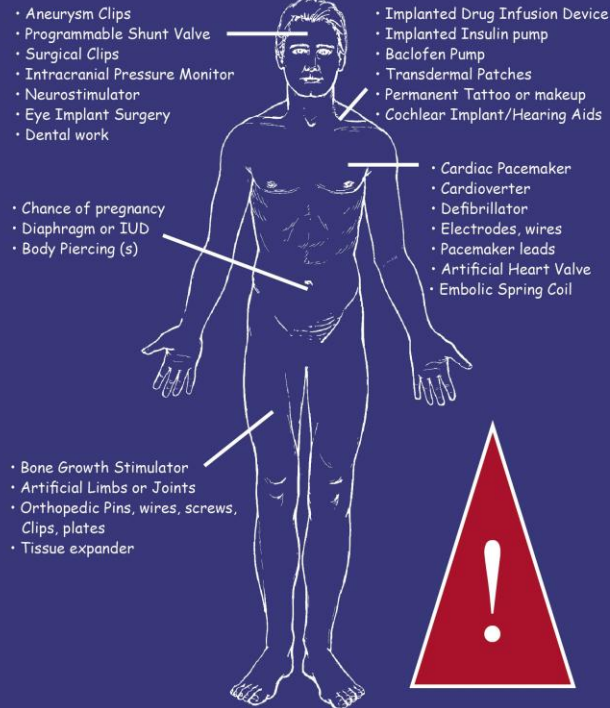
Children with abdominal pain
(concern for appendicitis)

Musculoskeletal infections

Orthopedic trauma

MRI Safety Screening Information

The following items may be hazardous or may interfere with the MRI Examination



You must remove all metallic objects including dentures, partial plates, hearing aids, keys, beeper, cell phone, eye glasses, hairpins, barrettes, body piercing jewelry, watch, safety pins, paperclips, money clip, wallet, credit cards, magnetic strip cards, coins, pens, pocket knife, fire arms, nail clippers, and all clothing with metallic threads or fasteners.

Summary of Cautions and Limitations of MRI Use

Lack of availability

Cost

Exam completion time

Claustrophobia

Patient's inability to lie still

Implanted medical devices

Metallic foreign bodies

Obesity

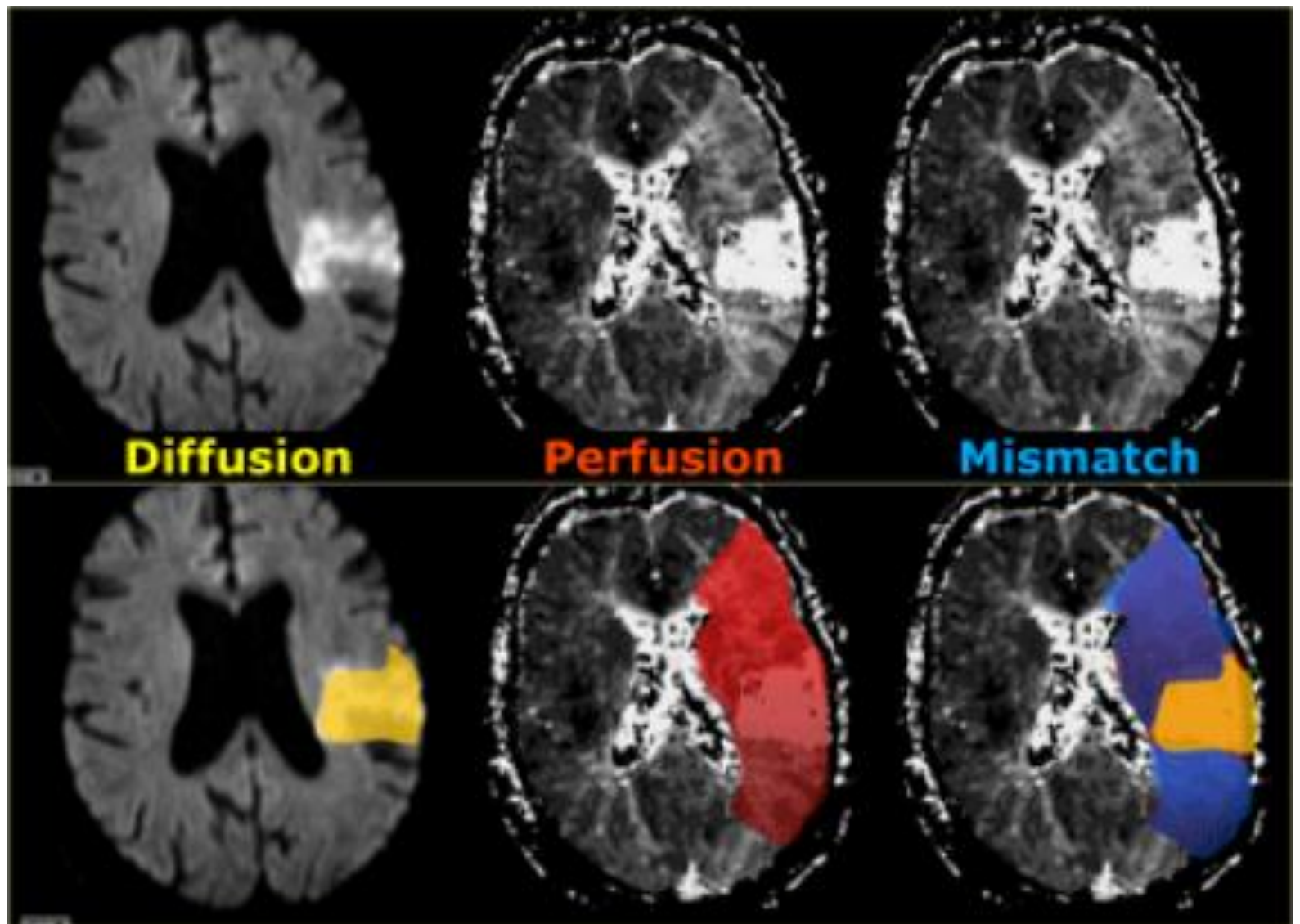
Hearing damage

Pregnancy

Pediatric patients (the developing brain)

Nephrogenic systemic fibrosis due to gadolinium-based contrast agents

Neuroimaging Modality	Advantages	Disadvantages
Parenchyma		
Noncontrast CT	Fast acquisition time, widely available, sensitive to hemorrhage	Limited sensitivity to infarct size, location of early ischemia
Diffusion-weighted MRI	Sensitive to early ischemia, fast acquisition time, high conspicuity of lesion	Lack of availability, patient contraindications (eg, metals, claustrophobia), long acquisition time
Vasculature		
CT angiography	Quantify vascular disease burden (eg, degree with stenosis, length of clot, characteristics of plaques), fast acquisition time	Potential renal toxicity, allergy to contrast agents; radiation exposure; provides no information on direction or velocity of flow
Magnetic resonance angiography	No contrast	Overestimates stenosis, sensitive to motion and other technical artifacts, long acquisition time, patient contraindications (eg, metals, claustrophobia)
Ultrasound (carotid or transcranial Doppler)	Flow data, portable, low cost	User dependent, time consuming, technical constraints
Tissue Perfusion		
CT perfusion	Fast acquisition time	Potential renal toxicity, allergy to contrast agents; radiation exposure; qualitative
Magnetic resonance perfusion	Good spatial resolution	Qualitative; patient contraindications (eg, metals, claustrophobia), requires gadolinium
Positron emission tomography (PET)	Gold standard for cerebral blood flow measures, provides quantitative measures of physiologic parameters (oxygen extraction fraction and metabolism)	Requires multiple radiotracers with very short half-lives, thus impractical in acute settings; low resolution, limited availability





BRAIN MRI

- There is no standard imaging protocol for the evaluation of acute stroke or TIA beyond head CT noncontrast
- The goal of neuroimaging:
 - Provide rapid information
 - Increase providers' decision-making with regards to reperfusion therapy without causing harm from delays

BRAIN MRI

- MRI has a significantly greater detection rate for acute ischemic infarction than CT (*particularly in an early setting*)
- CT Sen 73-88% (12hrs) Vs MRI Sen 93-100% (few mins)
- Not all Acute strokes require interventions (tPA/IR), so MRI might not be indicated emergently.

BRAIN MRI

- The American College of Neuroradiology, the American College of Radiology, and Society of NeuroInterventional Surgery have made a **joint statement** with regards to the imaging of acute stroke and TIA When determining whether endovascular therapy should be considered
- They have found that:
 - Noncontrast CT with digital subtraction angiography
 - **Noncontrast CT with CTA (availability)**
 - MRI with MRA

Are equivalent options for clinicians

[West J Emerg Med](#). 2017 Aug; 18(5): 780–784.

PMCID: PMC5576612

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PMID: [28874928](https://pubmed.ncbi.nlm.nih.gov/28874928/)

Magnetic Resonance Imaging Utilization in an Emergency Department Observation Unit

- Single center, Retrospective, 2013-15, (23K)
- 4,437 (19%) at least 1 MRI
- 2,730 (62%) brain, head, or neck
- 1,392 (31%) spine
- No significant difference between the median LOS
- **Limitations: Retro, Single, No C/O, No reason for orders, No Outcomes**

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Magnetic Resonance Imaging Utilization in an Emergency Department Observation Unit

- **How does this improve population health?**
- MRIs are regularly performed in observation units, and we should focus on determining **which MRIs** are appropriate and which can be **done as outpatient** tests instead.

MRI for Emergency Clinicians

*Indications, Cautions, and Helpful Hints
Sure to “Resonate” with Your Practice*

Freshta M. Sahak, MD, and Michael D. Burg, MD

EMERGENCY MEDICINE ■ DECEMBER 2018

www.mdedge.com/emed-journal

- The 2018 guidelines for early management of patients with acute ischemic stroke:
 - CT, diffusion weighted MRI or MRI perfusion
 - Both recommended and considered equal (in patients selected for mechanical thrombectomy)
- This guideline was promulgated by:
 - The American Heart Association
 - American Stroke Association
 - Endorsed by the Society for Academic Emergency Medicine
 - Other professional organizations

Introduction of a Dedicated Emergency Department MR Imaging Scanner at the Barrow Neurological Institute

 M. Buller and  J.P. Karis



- Significantly reduced the number of CTs in the ED by providing a diagnostically superior and safer imaging alternative with a drastically improved turnaround time
- This was achieved by:
 - Altering the MR imaging workflow
 - Altering the existing scan protocols
 - With an emphasis on efficiency and patient throughput
- Increased confidence in clinical decision-making for the ED physicians
- MR imaging technologists and neurosurgery residents
- ? improved patient outcomes was not addressed

New ED scan

Scale

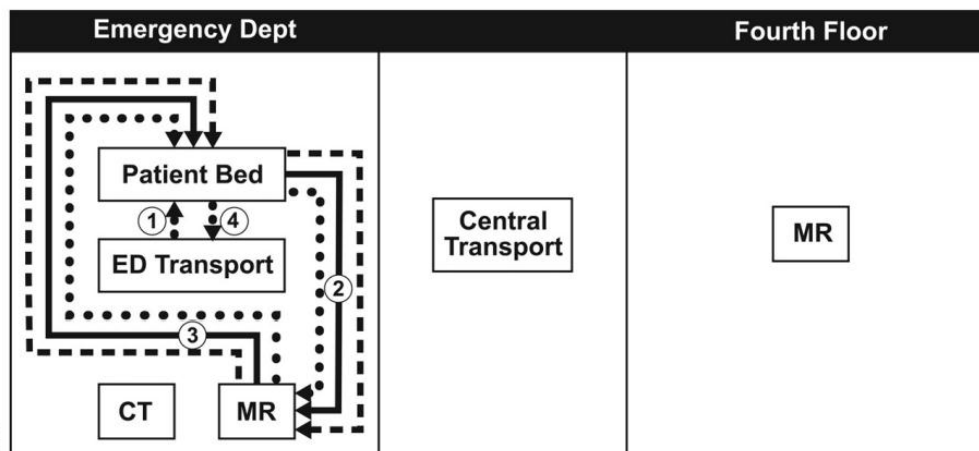
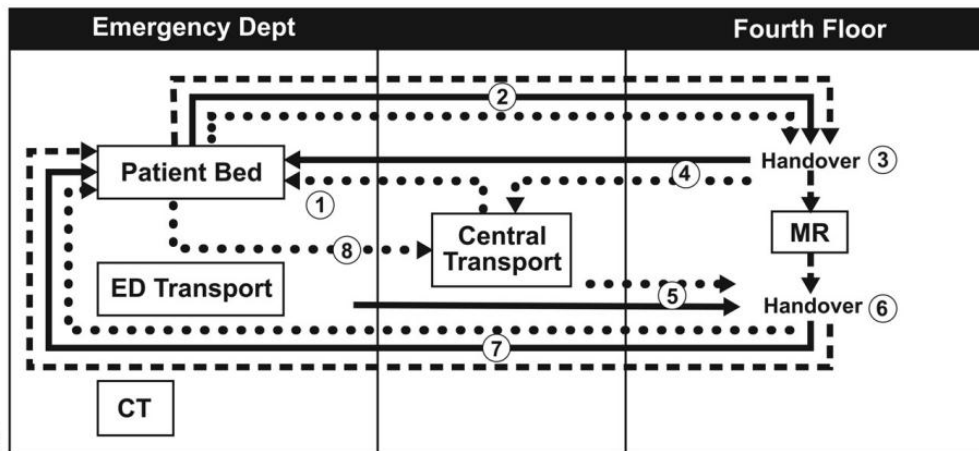
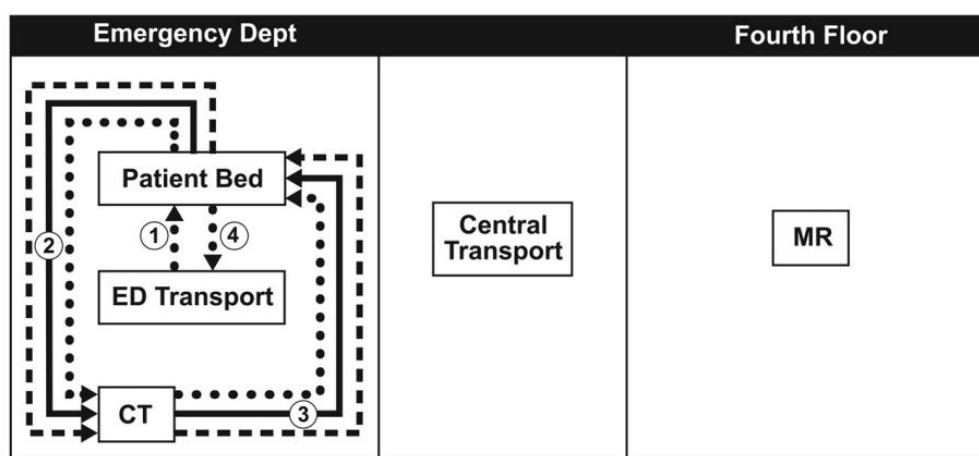
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mDixon T1

E, coronal T1

E, sagittal

head

ED MRI ORDERING GUIDE (NEURO)

ANATOMY	REASON FOR EXAM	CERNER ORDERABLE
Brain	Cognitive impairment Confusion Dementia Headache (non-SAH suspected) Mental status changes Seizures (children) Trauma	MRI Brain wo Contrast
	Focal neurologic signs/symptoms Anosmia Cranial nerve lesions Dizziness/vertigo Headache with focal symptoms IAC/hearing loss Infection Multiple Sclerosis Neurofibromatosis (other phakomatoses) Neurological deficits Pituitary lesion Seizures (adult new onset) Known tumor/mass/metastases/cancer Vascular lesions	MRI Brain wo+w Contrast
Brain-Shunt Failure	Assess ventricular size and configuration, peds or adult	MRI Brain Ltd. ("One Bang/Single Shot")
Brain-Stroke with Vascular Evaluation-with or without known mass (includes diffusion)	Stroke, CVA, TIA, dizziness/vertigo	1. MRI Brain w/wo Contrast 2. MRA Neck with Contrast 3. MRA Head with Contrast
MRA Brain Circle of Willis	Aneurysm AVM (arteriovenous malformation)	MRA Head with Contrast
MRA Neck	Vertebral/carotid dissection	MRA Neck with Contrast
MRV Neck	Venous outlet obstruction Venous thrombosis	MR Angio Neck Venous wo Contrast (MRV)
MRV Brain	Sagittal sinus thrombosis	MR Angio Head Venous wo Contrast (MRV)



HOME MESSAGES

- As the use of MRI by EMP increases steadily, it is critically important that we understand:
 - The basics of this imaging modality
 - Indications
 - Limitations
 - Cautions and contraindications



THANK YOU!

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