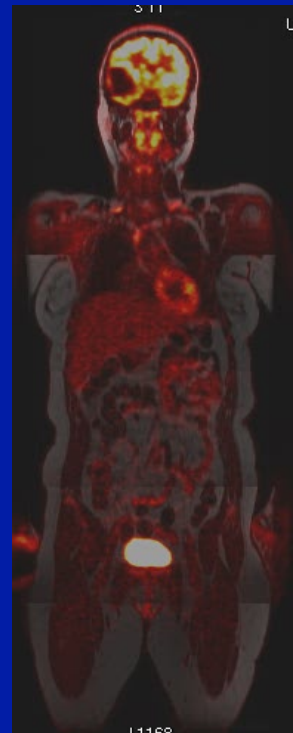
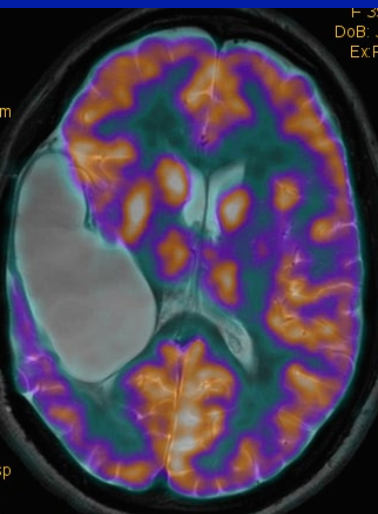


# Maximizing the Utility of Integrated PET/MRI in Clinical Applications

Spencer Behr, MD

Department of Nuclear Medicine & Abdominal Imaging  
University of California, San Francisco



# PET/MR at UCSF

**Device:** GE's SIGNA PET/MR

- Concurrent System
- 3 Tesla MRI (750w system)
- PET
  - Silicon based PMT
  - TOF

# From PET/CT to PET/MR: Considerations

1. Protocol/Workflow
2. Reporting
3. Technologists

# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

1. Clear indications for both PET & MRI
  - Not by **tumor type**, but **study type**

# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

## PET/MR

### Neurology

- Brain

### Oncology

- Brain, Liver, Pelvis

Cardiac

# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

Order	Study	Protocol
PET/MR Brain	Brain MRI with FDG	Seizure Protocol
		Tumor Protocol
	Brain MRI and Amyvid PET	Dementia Protocol
PET/MR WB with Brain	Brain MRI with WB PET	Screening MR brain
PET/MR WB with Liver	FDG PET and liver MRI	WB + Eovist Liver
		WB + Gadavist Liver
PET/MR WB with pelvis	FDG PET and pelvis MRI	WB + Rectal protocol
		WB + Uterine protocol

# Clinical PET/MR: FUTURE PROTOCOLS

## HEAD AND NECK

Challenge: MR protocol

Time: 2 to 3 months

## CARDIAC

Challenges:

1. Technical development
2. Indication (ischemia, sarcoid, etc)

Time: To be determined

# What is going to be largest volume?

## PET/MR Abdomen and pelvis

- Large volume already
- Surgical planning

## PET/MR Head and Neck

## PET/MR BRAIN

- Epilepsy
- Dementia
- Amyloid

} Current low clinical PET Volume



# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

1. Overlapping PET & MRI study types

2. Total Examination Time

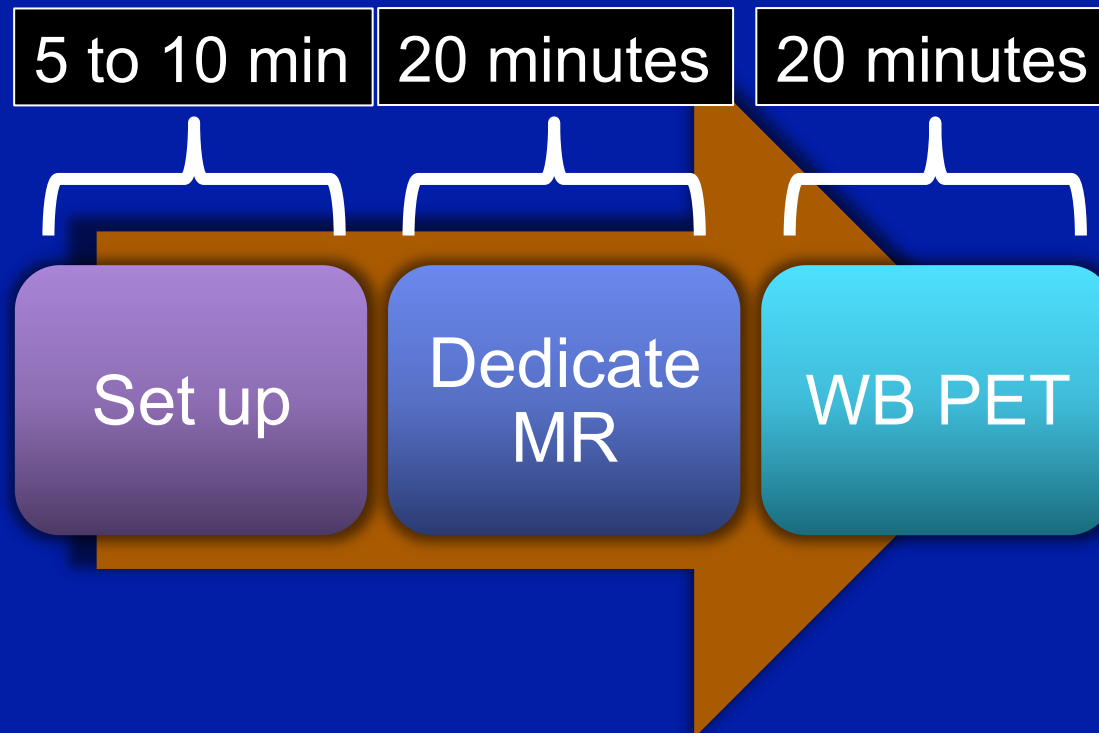
**Challenge:** MR protocols

# PET/MR:

## Clinical Examination Times

Currently: 90 minutes

Goal: 60 minutes

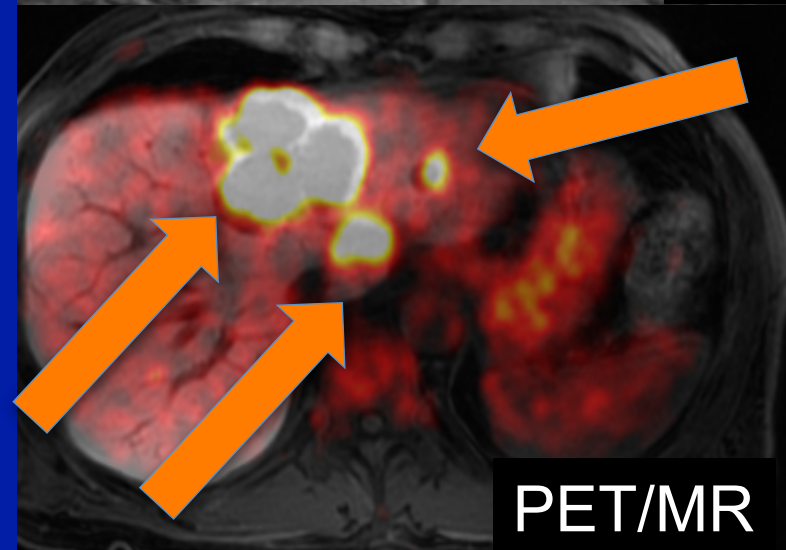
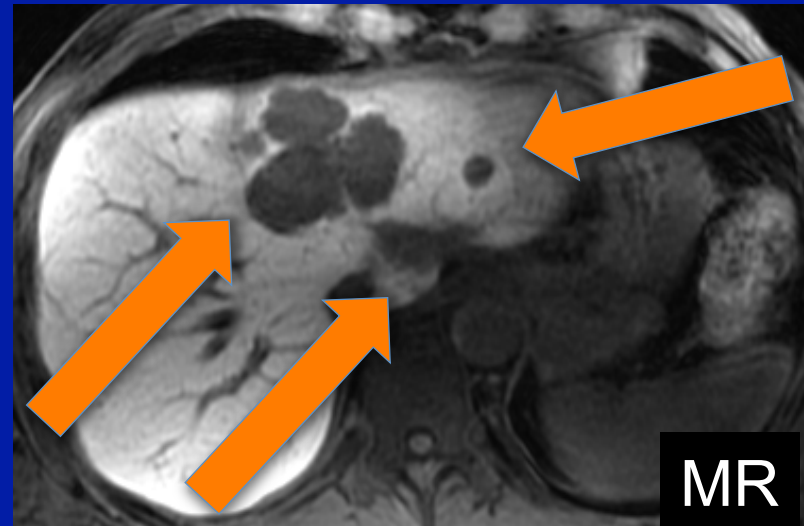
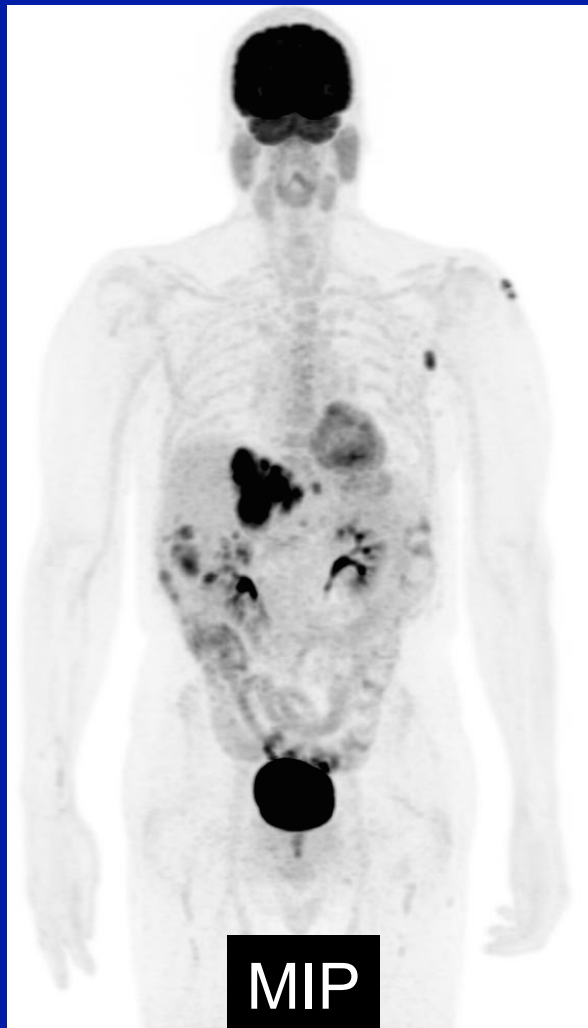


# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

1. Overlapping PET & MRI study types
2. Total Examination Time
3. Protocols

# 1<sup>st</sup> Clinical PET/MR: Metastatic Prostate Cancer

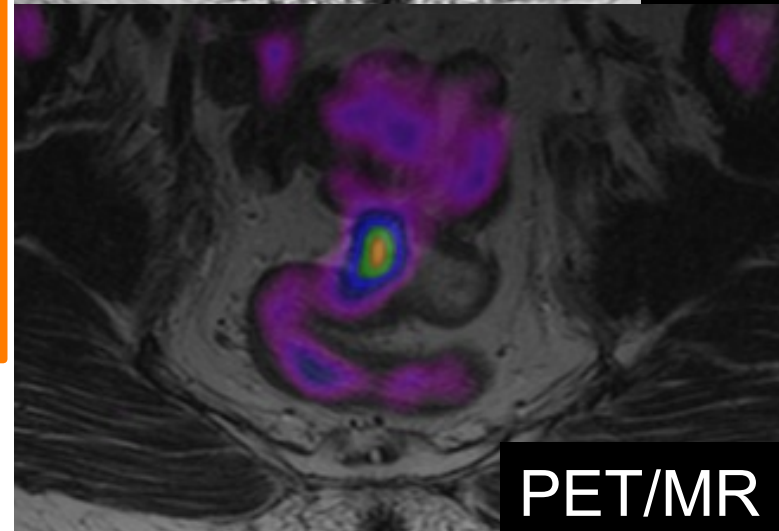
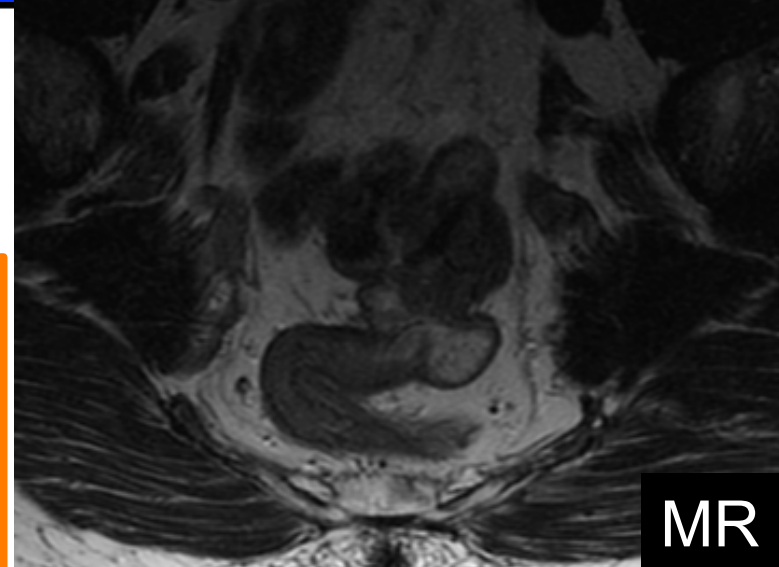
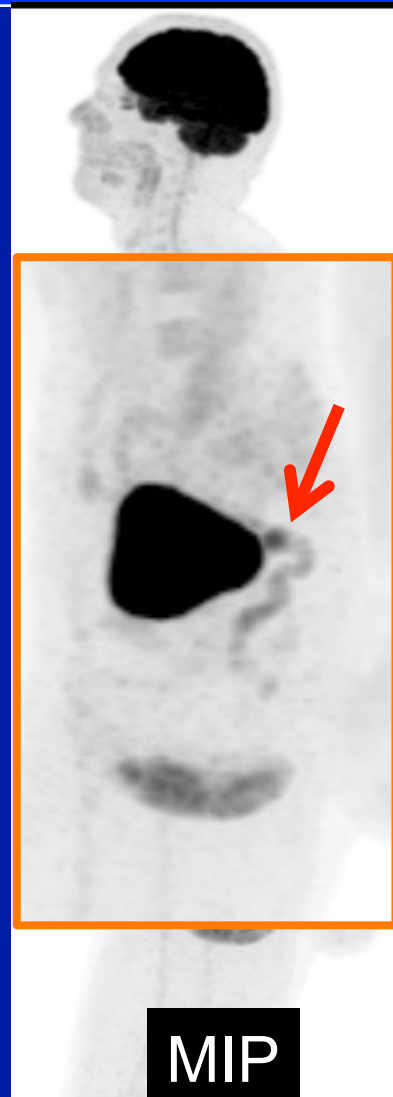


# Clinical PET/MR: Rectal Cancer

1. FDG PET
2. Rectal MR

## FINDING:

- T2 disease
- No LN or Mets



# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

## 1. Dual Readout

- a. Nuclear Medicine
- b. Specific Section for MR

## 2. Two separate reports

- a. PET specific
- b. Dedicated MR

# Clinical PET/MR:

Protocols/Workflow-Reporting-Technologists

Need at least one NM technologist

## 2 Technologists

- 1 NM
- 1 MRI

## 1 Technologist

- Trained in both NM&MR
- Not common training
- Solution:
  - NM tech with onsite MR training

# PET/MR Challenges

## Acceptance of PET/MR

- Imagers
- Referring Physicians



MODALITY	ATTENUATION CORRECTION
PET Only	Emission
PET/CT	CT Attenuation Map
PET/MR	Atlas Segmentation Sequences

# PET/MR Challenges:

Imagers-Referrers

## Q: How reliable is PET Quantification?

Accurate PET quantification essential

- Staging, treatment response, restaging

Several papers have found SUV mean/max comparable between PET/MR and PET/CT

- Except lung, bone and mediastinal blood

For MRAC, bone currently ignored

- ↓ standard uptake value (SUV)

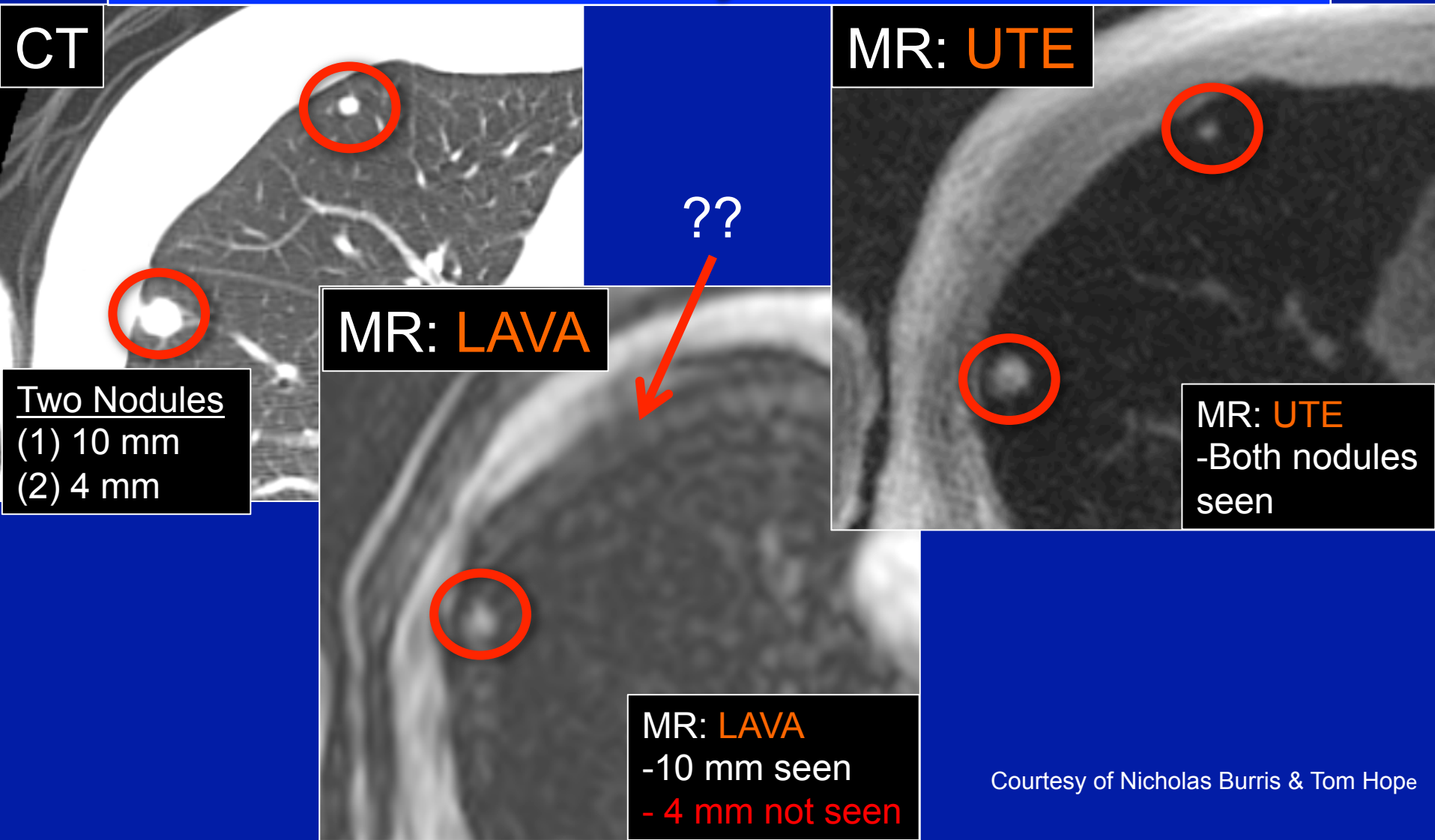
# MR Bone: Cortical Bone/AC Maps

- Conventional MR sequences too short
- Ignored in most MRAC
- **Solution:**
  - Bone Mu maps (atlas), Zero Echo Time (ZTE)

# MR Lung: Pulmonary Nodules

- CT method of choice for pulmonary nodules
- Studies have shown that MR and CT detect pulmonary nodules at a similar rate
  - 3D Dixon-based, dual-echo GRE
- Similar findings at UCSF with Ultra-short Echo Time (UTE)

# MR Lung: Pulmonary Nodules



# PET/MR Challenges:

Imagers-Referrers

Hesitant to change current clinical practice

- PET/CT → CT chest for pulmonary nodules
- PET/MR → Seen as experimental
- Perception of full body MR
- Scant clinical data comparing current standard-of-care imaging

# PET/MR Challenges:

Imagers-Referrers

- Uncertainty of how to integrate PET/MR into the current clinical practice
  - Epilepsy:
    - Ictal studies
      - In hospital
      - SPECT with EEGs on

# What have we learned?

## Take away:

1. Clinical PET/MR is gaining momentum
2. Need to be patient
  - PET/MR is still young and developing
  - Similar to PET/CT, PET/MR needs to find its fit compared to SOC imaging



# What have we learned?

## Take away:

3. Imagers and referrers have to work together
  - a. Expectations and education
    - a. Referrers
    - b. None PET readers
4. MR and PET imagers need to work closely
  - a. MR pulmonary nodule evaluation
  - b. Compare PET/MR to SOC imaging

# PET/MR: Future

Determine PET/MR role in clinical environments:

- Multisite trials
- Cost effectiveness

Refine MR bone/lung sequences

Refinement of MRAC and workflow

Reimbursement