Impact of Implementation of Appropriateness Criteria in the Ordering Algorithm of Myocardial Perfusion Imaging - Our Institutional Experience

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Introduction

- Coronary artery disease (CAD) is caused by atherosclerotic plaque build up along the inner walls of the coronary arteries which narrows the arteries and reduces blood flow to the heart.

- Coronary heart disease (CHD) encompasses the clinical manifestations of CAD including angina pectoris, myocardial infarction, silent myocardial ischemia, and CHD mortality.

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Introduction

- CHD is a major cause of mortality and disability in advanced countries including the USA. In fact it is the leading cause of death in adults in the USA, accounting for about one-third of all deaths over age 35.

- Annually about 935,000 Americans have a heart attack. Of these, 610,000 are a first heart attack and 325,000 are repeat heart attack (CDC, 2013a).

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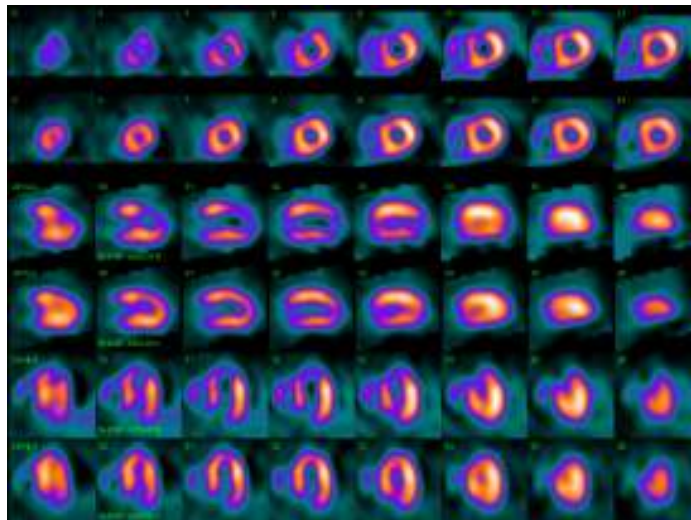Knowledge that will change your world

Introduction

- Despite CHD being the leading cause of death in the USA, a 24-50% reduction in the mortality rate has been observed since 1975 attributed to therapy improvements and risk factor interventions.

- Early detection and management of CHD plays a significant role in reducing the mortality and morbidity.

- Single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI) is an important diagnostic and prognostic tool in the evaluation and management of patients with known or suspected CHD.

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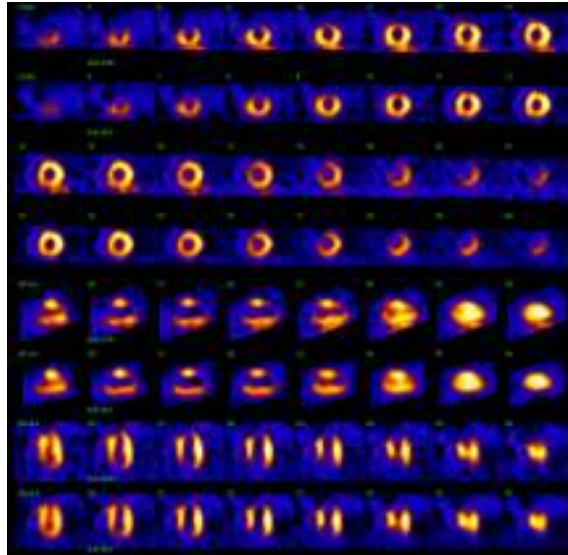Knowledge that will change your world

Introduction

- The use of diagnostic cardiovascular imaging has dramatically increased over the past decade as a consequence of rapid developments in technology, increased availability, and the perception that imaging can meaningfully affect medical decision-making.

- Several imaging modalities for cardiovascular diagnosis and treatment utilize ionizing radiation including SPECT MPI.

- In the United States, nuclear cardiology procedures have grown from about 7 million procedures in 1999 to about 11 million in 2005.

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ABNORMAL SPECT MPI EXAMPLE DEPICTING LAD ISCHEMIA

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Reversible perfusion defect in the mid to distal anterior & apical myocardium from LAD ischemia

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ABNORMAL SPECT MPI EXAMPLE DEPICTING LAD SCAR

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Fixed perfusion defect in the mid to distal anterior and apical myocardium from a LAD scar/infarct

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Introduction

- Given concerns of possible overutilization, the potential for complications related to stress testing and unnecessary radiation from the imaging, Appropriate Use Criteria (AUC) were formulated by the major professional societies interested in cardiac imaging (ACCF, ASNC, ACR, AHA, ASE, SCCT, SCMR, and SNM) in 2009.

- However, little data exists on the actual impact of these criteria on patient outcomes.

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Purpose

- Guided by the published Appropriate Use Criteria for Cardiac Radionuclide Imaging, beginning in January 2013 we implemented appropriate use criteria in the ordering algorithm of MPI at our institution.

- The purpose of this project was to assess the impact of such an initiative to the ordering process for SPECT MPI and expected patient care.

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AUC tailored for our Institution

- Chest pain
- Shortness of breath
- Syncope
- New onset of CHF
- Ventricular tachycardia
- Asymptomatic and high risk for CAD
- Asymptomatic with high calcium score
- Abnormal treadmill stress test
- Abnormal EKG
- Prior MI
- Coronary artery disease

- To evaluate ischemia within 3 months of ACS and no prior angiogram
- Assessment post PCI if there is incomplete revascularization
- Assessment post CABG if there is incomplete revascularization
- Greater than 5 years post CABG
- Pre-op before vascular surgery
- Pre-op before intermediate risk noncardiac surgery
- Preoperative evaluation for renal & liver transplants
- Troponin elevated without ACS

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Methods

- Retrospective study

- After obtaining Institutional Review Board approval

- Reviewed orders for 1645 Stress SPECT MPI examinations conducted in our institution between November 2012 and March 2013.

- Orders reviewed were for examinations done two months before (November and December 2012) and after (February and March 2013) the implementation of appropriate use criteria in January 2013.

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Methods

- Patients charts were reviewed for the results of SPECT MPI.
- Data collected was stratified by
  - Indication: Appropriate versus Inappropriate
  - Stressor type
  - MPI results: Normal versus Abnormal
- Abnormal studies were further characterized for the extent and type of abnormality including:
  - Ischemia
  - Scar/Infarct
  - Mixed defect
- Charts of patients with abnormal MPI's were reviewed for coronary angiography and interventions including PCI, CABG or medical management.
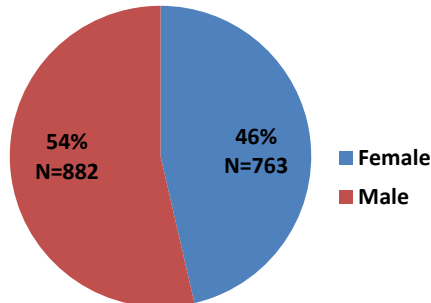
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Results: Stressor types and Appropriate versus Inappropriate

	November 2012-December 2012	February 2013-March 2013
Total number of SPECT MPI exams	819	826
Exercise stress	240	229
Pharmacologic Stress	579	597
Appropriate exams	769	818
Inappropriate exams	50	8

Table depicts SPECT MPI exams done before and after incorporation of appropriateness criteria in the ordering algorithm and the choice of stressor used
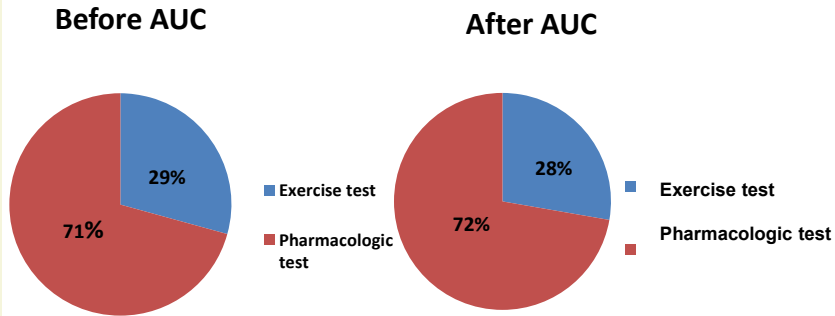
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Results: Gender

▪ There were 763 females and 882 males with ages ranging between 13-90 years who underwent SPECT MPI during these four months.
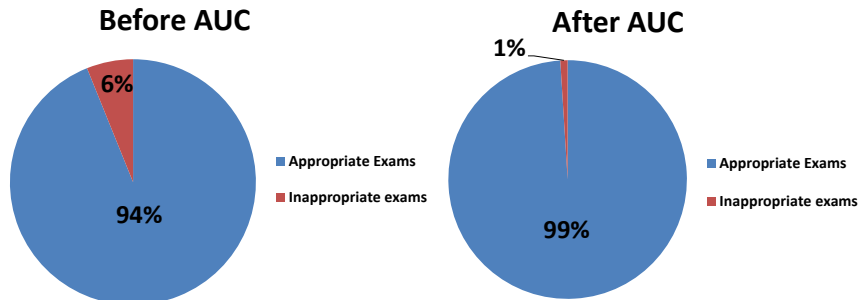

54%
N=882

46%
N=763

■ Female
■ Male

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Results: Stressor Types

- The stressor types include exercise and pharmacologic (Dobutamine and Regadenoson) as tabulated below.

Before AUC

29%

71%

- Exercise test
- Pharmacologic test

After AUC

28%

72%

- Exercise test

- Pharmacologic test

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Results: Appropriate versus Inappropriate

- The numbers of inappropriate SPECT MPI before (50/819, 6.1%) and after (8/826, 0.96%) implementation of appropriate use criteria in the ordering algorithm indicate a significant decrease in the inappropriately ordered SPECT MPI examinations.
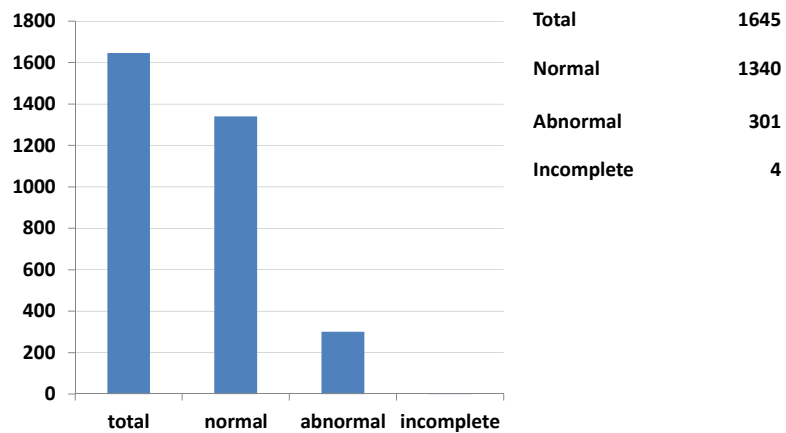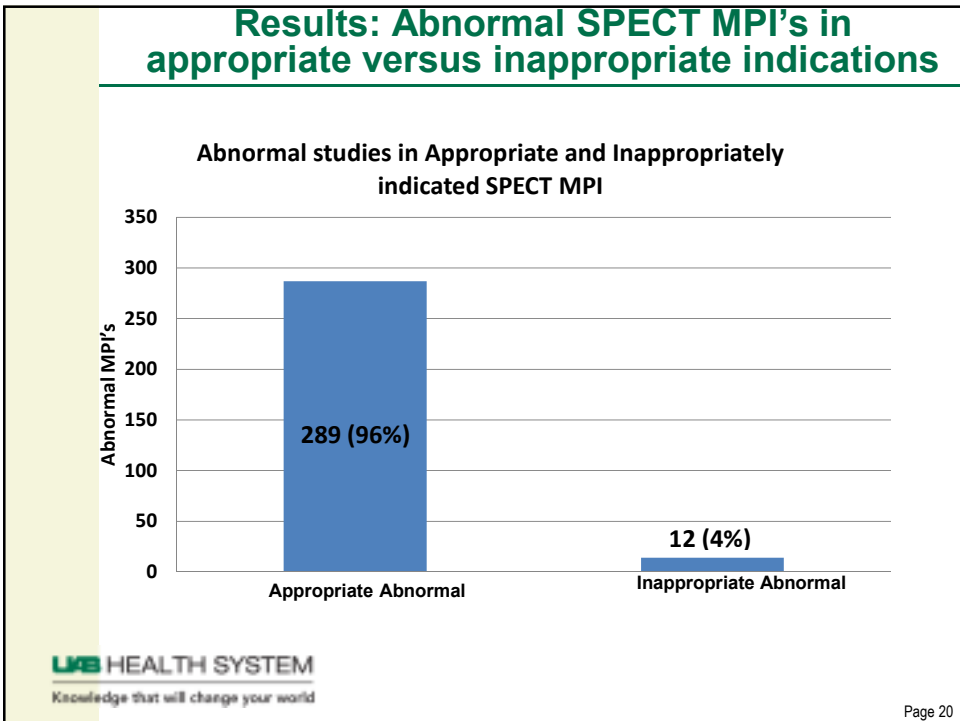
Before AUC

6%

94%

- Appropriate Exams
- Inappropriate exams

After AUC

1%

99%

- Appropriate Exams

- Inappropriate exams

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Results: Appropriate versus Inappropriate

	Before AUC	After AUC
Appropriate	769	818
Inappropriate	50	8
Total	819	826

P value <0.0001

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Results of SPECT MPI

Total	1645
Normal	1340
Abnormal	301
Incomplete	4

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Results: Normal and Abnormal MPI's before and after AUC

Before

Series1	Normal	Abnormal	Incomplete
	663	154	2

After

Series1	Normal	Abnormal	Incomplete
	677	147	2

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Results: Abnormal SPECT MPI's in appropriate versus inappropriate indications

Abnormal studies in Appropriate and Inappropriately indicated SPECT MPI

289 (96%) — Appropriate Abnormal

12 (4%) — Inappropriate Abnormal

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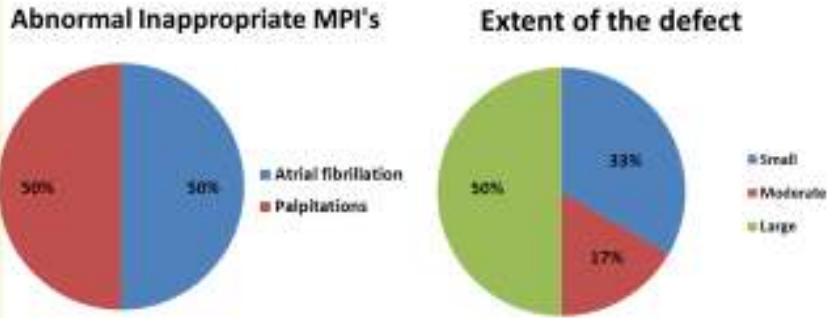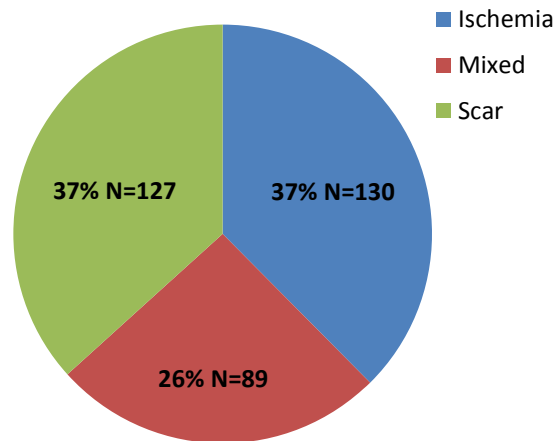## Results: Abnormal MPI's with inappropriate indications & extent

Abnormal Inappropriate MPI's

50% 50%

- Atrial fibrillation
- Palpitations

Extent of the defect

33%
17%
50%

- Small
- Moderate
- Large

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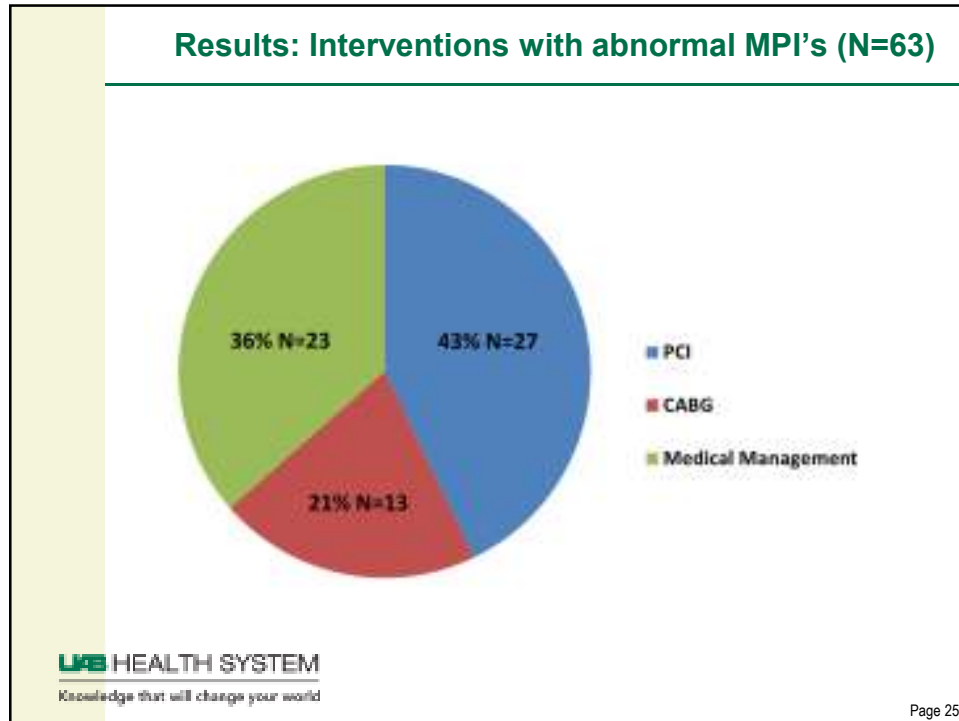## Results: Abnormal MPI's classified by the type of abnormality

Total number of vascular territory defects (n=346)

- Ischemia
- Mixed
- Scar

37% N=127   37% N=130

26% N=89

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Results: Extent of the abnormality quantified as Small <10%, Moderate 10-20% and Large >20%

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Results: Coronary Angiography in patients with abnormal MPI (N=119)

- Abnormal/Obstructive CAD
- Normal
- Non obstructive CAD
- Minimal Luminal irregularities
- Prior revasularization with patent stents and grafts

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Results: Interventions with abnormal MPI's (N=63)

- PCI
- CABG
- Medical Management

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Conclusion

- Incorporation of the AUC in the ordering algorithm for SPECT MPI studies resulted in a decreased number of inappropriate studies performed which should expectedly decrease patient radiation and improve resource utilization.

- 96% of the abnormal MPI's in our cohort were in patients with AUC suggesting that their implementation in our institution should directly translate into improved quality of patient care.

- However the total number of MPI's performed before and after incorporation of AUC did not change significantly. Additionally little data exists on the actual impact of the AUC on patient outcomes and further research is needed.

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Abbreviations

- ACS-Acute Coronary Syndrome
- AUC-Appropriateness Use Criteria
- CABG-Coronary Artery Bypass Grafting
- CAD-Coronary artery disease
- CDC-Center For Disease Control
- CHF-Congestive Heart Failure
- METS-Metabolic Equivalent
- MPI-Myocardial Perfusion Imaging
- PCI-Percutaneous Coronary Intervention
- SPECT-Single Photon Emission Computed Tomography

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Abbreviations

- ACCF-American College of Cardiology Foundation
- ASNC-American Society of Nuclear Cardiology
- ACR-American College of Radiology
- AHA-American Heart Association
- ASE-American Society of Echocardiography
- SCCT-Society of Cardiovascular Computed Tomography
- SCMR-Society for Cardiovascular Magnetic Resonance
- SNM-Society of Nuclear Medicine

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- Status of and trends in nuclear medicine in the United States. Delbeke D, Segall GM, Vanderbilt University Medical Center, Nashville, Tennessee, USA. J Nucl med 2011 Dec;52 Suppl 2:24S-8S. doi: 10.2967/jnumed.110.085688

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