2020 Gaps/Needs/Barriers

Overall Statement of Need

Radionuclide-based cardiac imaging studies, including myocardial perfusion imaging (MPI), play an important role in the diagnosis and management of patients with known or suspected heart disease. Today more than 5000 laboratories are performing an estimated 8 million myocardial perfusion studies of which 58% use pharmacological stress agents, either alone with exercise. [DAIC 2013] A large body of scientific evidence exists on the clinical value of MPI, based on studies performed on many thousands of patients. These studies are highly sensitive and specific for the diagnosis, prognosis, and treatment response of coronary artery disease, as well as for selection of patients who may benefit from other types of intervention, including revascularization and device therapy. The value and justification of MPI for risk assessment is based on large observational outcome studies. As a result of the recognized clinical value and cost-effectiveness of these studies, they have been incorporated into many ACC/American Heart Association (AHA)/ASNC clinical management guidelines.

Nuclear cardiology is an evolving field with continuing advances in software, instrumentation and radiopharmaceuticals to provide high quality clinically relevant information for patient care. These advances require those involved in the providing nuclear cardiology studies to be continuously updated to ensure that the procedures are used appropriately and safely and that recent clinical and technological advances are incorporated in a timely manner to continue to improve the image quality and interpretation to provide the best clinical care.

Overall Goal

ASNC2020 program will increase learners' competence in solving clinical, technical and practical issues facing nuclear cardiology imaging professionals in key areas: SPECT & PET Protocols, AUC Guidelines, Pharmacologic Stress Testing, New procedures and technology, radiation safety and multimodality imaging.

Needs & Gaps

I. Gap: SPECT MPI Utilization

1. Myocardial perfusion imaging is one of the most commonly used and effective methods to assess patients with known or suspected coronary artery disease. Data indicate that on average at least 14% of these studies are inappropriate resulting in unnecessary radiation exposure and cost to the healthcare system. [Gibbons 2008; Gibbons 2010; Gibbons 2011; Hendel 2010; Mehta 2008; Nelson 2012]

2. A report of utilization of MPI in two large healthcare systems showed that inappropriate studies constituted 22% and 16.6% of the studies performed. The number of inappropriate MPI studies ordered was influenced by the level of the practitioners training, as well as the specialty of the referring clinician. A small number of inappropriate indications accounted for the great majority of inappropriate MPI studies. [Nelson 2012]

3. A recent publication evaluated the prevalence of intermediate or high-risk stress SPECT-MPI results and subsequent revascularization in appropriate compared to inappropriate and uncertain studies. [Khawaja 2013]

4. Appropriate stress SPECT-MPI studies were more likely to have scores greater than zero compared with uncertain or inappropriate studies and were more likely to lead to subsequent revascularization than uncertain or inappropriate studies. Inappropriate stress SPECT-MPI studies rarely changed the clinical management of the patient, demonstrating the value of AUC

recommendations. The impact of AUC on the prognostic value of SPECT-MPI has also been shown. [Doukky 2013]
Need: *Nuclear cardiologists, nuclear medicine physicians, radiologists and nuclear imaging technologists need continuing education on the application of appropriate use of SPECT myocardial perfusion imaging in patient imaging studies.*

Gap: AUC Guidelines
1. Multimodality AUC have been published describing the use of seven tests for detection and risk assessment of stable ischemic heart disease. [Wolk 2014] The new AUC document reviews the use of exercise ECG, stress radionuclide imaging, stress echo, stress cardiac magnetic resonance imaging (CMR), calcium scoring, coronary computed tomography angiography (CCTA), and invasive coronary angiography, side by side, across different clinical indications. These include patients with signs and/or symptoms and/or various levels of risk for coronary disease; patients undergoing follow-up for prior test results or coronary revascularization; patients scheduled for noncardiac surgery, and patients with an exercise prescription or referral to cardiac rehabilitation. Each test, in each indication, is ranked as "appropriate," "may be appropriate," or "rarely appropriate." Understanding the appropriate use of the multiple imaging tests available is critical to providing optimized patient-centered care and reduced radiation exposure. [Depuey 2012; Einstein 2014]
2. In a recent publication, results from FOCUS (Formation of Optimal Cardiovascular Utilization Strategies), a Web-based community quality improvement instrument, developed to increase the feasibility of measuring and improving practice patterns based on the appropriate use criteria were published. [Saifi 2013] Between April 2010 and December 2011, 55 centers voluntarily collected data through the FOCUS radionuclide imaging performance improvement module (PIM). Over this period, the proportion of inappropriate cases decreased from 10% to 5% ($p < 0.0001$) demonstrating the value of educational intervention for improving the use of appropriate testing. Rare appropriate testing usually occurs in patient being evaluated for non-cardiac surgery and for risk assessment in asymptomatic patients (or patients with stable symptoms) with a prior history of known coronary disease or prior abnormal stress imaging. [Singh 2014]
3. Results from case-based polling at ASNC meetings continue to demonstrate the need for ongoing education on Appropriate Use Criteria. At the ASNC 2014 meeting in Boston, a satellite symposium was held on Appropriate Use Criteria two questions were posed to the participants prior to the presentations and these same questions were asked after the presentations. One question addressed the appropriateness of a myocardial perfusion study in a female patient with a history of hypertension, diabetes, prior cerebrovascular accident, and stage 4 CKD and poor functional capacity. Clearly this is an appropriate study but **only 75%** of the program participants answered this question correctly at the beginning of the program. When asked again, >**90%** were able to answer the question correctly. When asked to identify the most appropriate indication for a SPECT myocardial perfusion study from a list of 4 patients typically seen in routine clinical practice, 50% identified the appropriate indication at the beginning and only 60% after the program. These data indicate an ongoing need for education on the appropriate use of myocardial perfusion imaging. By education nuclear cardiology healthcare professionals on the appropriate use of cardiac imaging has the added benefit of resolving differences in professional opinions regarding the choice of test.
4. AUC will play an important role in controlling the growth of healthcare costs. The Protecting Access to Medicare Act of 2014. [H.R. 4302] makes permanent changes to how physicians who perform advanced imaging services are paid by connecting it to appropriate use criteria. By November 15, 2015, the Secretary of Health and Human Services, in consultation with stakeholders, will choose which AUCs will be included in the program with the goal to identify patients who will most appropriately benefit from a procedure, thus resulting in a more effective

and equitable allocation of healthcare resources. AUCs, which must be created or endorsed by national medical specialty societies will be implemented in 2017. ASNC remains a leader in developing and updating the appropriate use of nuclear cardiology procedures.
NEED: *Nuclear cardiologists, nuclear medicine physicians, radiologists and nuclear imaging technologists need continuing education on the application of appropriate use of myocardial perfusion imaging and other nuclear cardiology procedures – the right person, the right test at the right time - to improve the quality of patient care delivered to patients.*

Gap: Pharmacologic Stress Testing
1. Pharmacologic stress represents approximately 59% of all stress myocardial perfusion imaging (MPI) studies. A recent ASNC survey indicates that 83% of these studies are performed with regadenoson. [Nuclear Cardiology 2013] Currently there are 3 agents approved but ease of administration, safety profile, agent half-life and dosing regimen can impact on the choice of agent. Intravenous dipyridamole, adenosine and regadenoson have shown similar diagnostic and prognostic data. [Iqbal 2012; Iskandrian 2007] A recent publication indicates that regadenoson induces similar and possibly larger perfusion defects than observed with adenosine in a quantitative analysis of the ADVANCE MPI trials in a heterogeneous patient population. [Mahmarian 2014] Understanding the appropriate use and potential risks of these agents is an important component of a high quality nuclear cardiology laboratory.
2. There is a large body of clinical data supporting the use of adenosine and dipyridamole in a variety of different clinical scenarios and the undesirable side effects are well documented. [Miyamoto 2007] Regadenoson, an A2A adenosine receptor selective pharmacologic stress agent was approved in 2008 and is widely used instead of adenosine and dipyridamole. [Al Jaroudi 2009; Al Jaroudi 2010; Ghimire 2013] However, despite wide scale use, at the 2014 NC Today meeting, only 70% of meeting participants identified the lower incidence of AV block as a significant advantage of regadenoson over adenosine.
3. Data on the use of regadenoson in a variety of patient types, with various protocols including with exercise and prognostic markers continue to emerge. Combining exercise and pharmacologic stress can provide challenges in the nuclear cardiology laboratory. Incorporating best practices will ensure the safe and effective use of radiopharmacologic agents in cardiac imaging studies. Submaximal heart rate response to exercise treadmill testing is common and can lead to reduced diagnostic accuracy by reducing the size and severity of the ischemic area. [Heller 1992, Hage 2011a, Hage 2011b, Thompson 2013, Partington 2012]
4, Best practices for the use of pharmacologic stress agents include a thorough understanding of the safety profile. The FDA issued a Drug Safety Communication warning to healthcare professionals concerning the rare but serious risk of heart attack and death with use of either regadenoson or adenosine. [FDA 2014] [Agarwal 2014, Rosenblatt 2014] As new data become available, healthcare providers need to be updated to ensure their laboratories are providing the best clinical practice when performing pharmacologic stress.
NEED: *Understanding the clinical benefits, logistical concerns and safety profile of pharmacologic stress agents so that they are used properly in clinical practice is critical providing the best clinical practice as well as appropriate and effective patient-centered imaging.*
NEED: *Nuclear cardiologists, nuclear medicine physicians, radiologists and nuclear imaging technologists need to understand the best practices for performing SPECT or PET pharmacologic stress tests.*

Gap: Advances in New Technology
1. Improvements in cardiovascular imaging technology and their application coupled with

increasing therapeutic options for detecting and managing cardiovascular disease have lead to an increase in its use. Advances in nuclear cardiology instrumentation and software offer the opportunity for improved diagnostic accuracy, laboratory testing efficacy and reduced radiation exposure. The ASNC member survey showed that only 27% of the participating laboratories reported using prone imaging or attenuation correction which reduces rates of breast and diaphragmatic attenuation enabling stress-only imaging that can reduce radiation exposure. [Duvall 2013; Einstein 2013; Slomka 2012]
2. Almost two-thirds of the participants do not have a high sensitivity SPECT camera and almost **60% indicated they do not use attenuation correction** with only 15% using attenuation correction routinely on all SPECT studies. [ASNC 2014]
3. The availability of new technologies that improve count efficiency, reduce noise, and /or improve spatial resolution of the SPECT camera offer the potential to maintain image quality and diagnostic accuracy while decreasing administered dose. [Slomka 2012]
4. Data from the ASNC member survey indicated that these new technologies are not being used. [Einstein 2013]
NEED: *All nuclear cardiology professionals need to understand emergent areas in the field in order to provide the best care to patients and improve their outcomes.*

Gap: Emerging Multimodality Cardiac Imaging
To further complicate matters, the growing sophistication of multimodality cardiac imaging procedures has served to further enhance the ability to diagnose and risk stratify patients with suspected coronary artery disease. The growth in testing and overall high cost burdens associated with treating cardiovascular disease have made the development of cost-effective strategies that serve to reduce unnecessary testing and replace more expensive tests with less costly options, a critical issue regarding future use of cardiac imaging procedures. Understanding multimodality imaging and the benefits it may bring to the care of patients is important for all clinicians involved in reducing radiation exposure, providing high quality information and controlling healthcare costs. [Wolk 2014]
NEED: *Nuclear cardiologists, nuclear medicine physicians, radiologists and nuclear imaging technologists need to recognize the strengths and weaknesses of their current instrumentation and software, evaluate and implement available options to upgrade their facilities and understand the latest advances in multimodality imaging that can improve the quality and value to their nuclear cardiology laboratory with the best available clinical practices.*

GAP: Radiation Exposure
Radiation exposure for patients and imaging professionals is a prominent safety issue of national concern. Most American laboratories are doing MPI imaging studies in ways that expose patients to substantial radiation. Only about 14% of US facilities met the quality benchmark of exposing patients to a median of no more than 9 mSv for the procedure as recommended by clinical guidelines compared to 32.6% of facilities in other countries. Dr. Einstein reports that for the same test, the US dose is 20% higher on average than in other countries.
NEED: All nuclear cardiologists need to know radiation risks to patients when performing nuclear imaging studies as well as emerging strategies and procedures that lower the radiation exposure to patients and the professionals performing the tests.

GAP: PET
Positron emission tomography enables imaging and evaluation of the cardiovascular system at multiple levels. In addition, PET in combination with other imaging modalities including contrast

tomography, may enhance clinical decision making. Today, almost 80% of nuclear cardiology laboratories do not have cardiac PET capabilities. Complex and not well understood protocols methodological complexity, high operating costs and lack of widespread availability limit the use of PET.

1. Incorporating PET into clinical practice can be challenging. Physicians have been cited for errors in PET imaging protocols and procedures including laboratory accreditation standards. [IAC 2012]
2. With improvements in instrumentation, software, tracer availability and new tracers in development, PET is becoming a more important part of cardiovascular imaging in the nuclear cardiology practice. [Heller 2013; Ohira 2013]
3. PET has been shown to have superior diagnostic accuracy for the diagnosis of coronary artery disease in comparison with SPECT and provides important prognostic value. The addition of absolute myocardial blood flow quantification increases sensitivity for 3-vessel disease and provides incremental functional and prognostic information. Metabolic imaging using $_{18}$Ffluorodeoxyglucose
can be used to guide revascularization in the setting of heart failure and also to
detect active inflammation in conditions such as cardiac sarcoidosis and within atherosclerotic plaque. [McArdle 2013]
4. A recent summit on PET imaging, sponsored by ASNC, identified a number of important benefits and explored critical issues limiting widespread acceptance of this technique. There is a need to clearly and effectively demonstrate the VALUE of PET and the importance of myocardial blood flow measurements, the high diagnostic accuracy, low radiation dose, and efficiency and minimization of downstream costs. The experts highlighted the need to dispel the myths about PET (cost, availability, etc.) in the medical community and to make available the necessary training and educational materials as well as guidelines and protocols. In addition, there is a need to establish best practices for those laboratories already performing cardiac PET imaging. [ASNC PET Summit notes]

NEED: *Nuclear cardiologists, nuclear medicine physicians, radiologists and imaging technologists need to understand PET protocols and procedures and to understand and incorporate PET technology and tracers into their laboratory to provide the best state-of-the-art patient care.*

GAP: Cardiac Sarcoidosis

1. CS remains an underdiagnosed condition. Diagnosis is challenging, and given the low yield of endomyocardial biopsy, there is no useful gold standard. Cardiac ^{18}F-FDG PET studies combined with perfusion imaging can differentiate the patterns of disease in the diagnostic work-up for CS. Clinicians need to understand how these studies are performed and reported to improve patient care.
2. 18F-F-FDG PET is part of the diagnostic algorithm for CS in the HRS criteria and is used for detecting cardiac involvement and assessing the presence and severity of myocardial inflammation. When performing cardiac ^{18}F-FDG PET for CS it is important to exclude the presence of significant coronary artery disease, prior myocardial infarction, resting ischemia, or hibernating myocardium. Clinicians need to understand the imaging protocols, and the importance of a resting perfusion study for an adequate diagnosis of CS.
3. Proper patient preparation is critical for a successful metabolic shift for the ^{18}F-FDG PET study for CS. Clinicians need to understand the importance of prolonged fasting, dietary manipulation, and possibly intravenous heparin administration to suppress physiologic myocardial glucose uptake in the assessment of intramyocardial inflammation.
4. Myocardial perfusion and cardiac ^{18}F-FDG PET images should be interpreted in the context of the patient's clinical presentation and other imaging studies. Both visual and quantitative interpretation

should be performed. Clinicians need to understand how to perform quantitative assessment of the ^{18}F-FDG PET images and integrate this information into the study report.

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