

Cardiac Nuclear Imaging

Clinical Expert

Rita Redberg, MD, M.Sc., FACC

Disclosure

Any unmarked topic will be considered a "Yes"

	Potential Conflict Type	Yes	No
1.	Salary or payments such as consulting fees or honoraria in excess of \$10,000.		✓
2.	Equity interests such as stocks, stock options or other ownership interests.		✓
3.	Status or position as an officer, board member, trustee, owner.		✓
4.	Loan or intellectual property rights.		✓
5.	Research funding.		✓
6.	Any other relationship, including travel arrangements.		✓

If yes, list name of organizations that relationship(s) are with and for #6, describe other relationship:

	Potential Conflict Type	Yes	No
7.	Representation: if representing a person or organization, include the name and funding sources (e.g. member dues, governmental/taxes, commercial products or services, grants from industry or government).		X

If yes to #7, provide name and funding Sources: _____

If you believe that you do not have a conflict but are concerned that it may appear that you do, you may attach **additional sheets** explaining why you believe that you should not be excluded.

I certify that I have read and understand this Conflict of Interest Form and that the information I have provided is true, complete, and correct as of this date.

X Rita Redberg 9/5/13 RITA REDBERG, MD
Signature Date Print Name

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RITA F. REDBERG, M.D., M.Sc.

CURRICULUM VITAE

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Date of Birth: December 27, 1956

EDUCATION

1973-1977 Cornell University, College of Arts & Sciences
Ithaca, New York
B.A. in Biology

1977-1982 University of Pennsylvania School of Medicine
Philadelphia, Pennsylvania

1980-1981 London School of Economics, London, England
M.Sc., Health Policy and Administration
Master Thesis: *Technology Assessment—Cost-Effectiveness
Analysis of Heart Transplant Surgery in Great Britain and the U.S.*

POSTGRADUATE TRAINING

1982-1985 Internship and Residency in Internal Medicine
Columbia-Presbyterian Medical Center, New York, NY

1985-1987 Fellow in Cardiology
Columbia-Presbyterian Medical Center, New York, NY

1987-1988 Fellow in Non-Invasive Cardiology
Mount Sinai Medical Center, New York, NY

1990-1991 Cardiovascular Research Institute
UCSF Medical Center, San Francisco, CA

PROFESSIONAL APPOINTMENTS

1988-1989 Instructor in Medicine
Mount Sinai School of Medicine, New York, NY

1988-1990 Attending Cardiologist
Beth Israel Medical Center, New York, NY

1988-1990	Director, Cardiology Laboratory Beth Israel Medical Center-North, NYC
1989-1990	Assistant Professor of Medicine Mount Sinai School of Medicine, New York, NY
1991-1996	Assistant Clinical Professor of Medicine and Anesthesia, Assistant Director, Echocardiography Laboratory UCSF Medical Center, San Francisco, CA
1996-2001	Director, Research CORE, and Co-Director UCSF National Center of Excellence in Women's Health, San Francisco, CA
1994	Co-Founder, Women's Health Access, Department of Medicine UCSF Medical Center, San Francisco, CA
1996-2002	Associate Clinical Professor of Medicine UCSF Medical Center, San Francisco, CA
1998-2002	California Medical Review, Inc. - Member, Cardiovascular Cluster
1999-present	Cardiovascular Research Institute – CVRI Investigator
2002-present	Professor of Clinical Medicine UCSF Medical Center, San Francisco, CA
2002-present	Director, Women's Cardiovascular Services, San Francisco, CA
2003-2004	Robert Wood Johnson Health Policy Fellowship Office of Senator Orrin Hatch United States Senate Washington, D.C.
2008 - present	Adjunct Associate, Center for Health Policy/Center for Primary Care and Outcomes Research (CHP/PCOR), Stanford University
2011	Core Faculty Member, Philip R. Lee Institute for Health Policy Studies, San Francisco, CA

EDITOR-IN-CHIEF

2009 – present	Editor, JAMA Internal Medicine (former Archives of Internal Medicine)
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GRANT SUPPORT

PAST

1992-1994	Principal Investigator - Merck Co., Noninvasive Coronary Imaging - TEE and Ultrafast CT in Hypercholesterolemic Patients
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1992-1993 Principal Investigator - Radiology Research and Education Foundation, Noninvasive Coronary Imaging - Ultrafast CT

1993-1998 Principal Investigator, UCSF Medical Center Assessment of Cardioversion Using Transesophageal Echo (ACUTE) - multicenter trial

1993-1994 Principal Investigator - UCSF Academic Senate Grant, Effect of Exercise on Heart Disease in Women

1994-1998 Principal Investigator - National Heart, Lung and Blood Institute Grant R01 HL50772 Effect of Exercise on Heart Disease in Women

1994-1995 Principal Investigator - UCSF Medical Center - Berlex Multi-Center Study on the Efficacy of Levovist Injection in Inconclusive Echocardiographic Examination

1994-1995 Principal Investigator - Sonus Pharmaceutical Company grant on Effect of QW 3600 on Myocardial Transit Time

1994-1995 Co-Investigator - Atrioventricular Nodal Ablation Study, UCSF

1996-1999 Co-Principal Investigator for the UCSF National Center of Excellence in Women's Health, DHHS Contract #28296-0039

2003-2008 Robert Wood Johnson Health Policy Fellowship

2005-2007 Blue Shield of California Grant, Appropriateness of PCI in California

CURRENT

2002-2012 Co-Principal Investigator for National Center of Excellence in Flight Attendant Medical Research and Clinical Practice

2009-2011 PI on UCSF REAC grant CTA project

2012-2015 Principal Investigator for UCSF National Center of Excellence in Flight Attendant Medical Research and Clinical Practice

PROFESSIONAL SOCIETIES

American College of Cardiology - Fellow

American Heart Association - Fellow, Council on Clinical Cardiology

American Heart Association - Fellow, Council on Epidemiology and Prevention

American Heart Association - Fellow, Council on Nutrition, Physical Activity, and Metabolism

American Society of Echocardiography

California Academy of Medicine

Council on Geriatric Cardiology - Fellow

San Francisco Medical Society

NATIONAL & STATE COMMITTEES (AHA/ACC/ASE)

1993-1997 American Heart Association - Member, Executive Committee, Council on Clinical Cardiology

1993-1997 American Heart Association, Chair, Women in Cardiology Committee

1993-1997 American College of Cardiology, California chapter - Health Care Issues Committee, Nominating Committee

1994-1996 American College of Cardiology, California chapter - Guidelines for Optimal Cardiovascular Care in the State of California Committee

1994-1997 American Heart Association National Committee on Women & Minority Leadership

1996 American Heart Association Ad-hoc Committee on Guidelines for Cardiovascular Disease

1997 Chair, California Chapter Annual Meeting American College of Cardiology

1997-1999 American Heart Association, Women's Heart Disease and Stroke Task Force

1997-1999 American Society of Echocardiography, Program Committee

1997-2001 American College of Cardiology, Economics of Health Care Delivery Committee

1997-present American Heart Association, Public Affairs Committee

1997-2002 American College of Cardiology, California chapter – Government Relations Committee

1998 American Heart Association, Chair, Planning Committee, Women and Coronary Disease National Satellite Videoconference

1998-2001 American Society of Echocardiography, Public Relations Committee

1998-2001 Chair, California Chapter American College of Cardiology, Task Force on Women and Heart Disease

1999 Planning Committee, California American College of Cardiology Chapter Annual Meeting

1999 American Society of Echocardiography, Strategic Planning Task Force C

1999- 2001 American Heart Association, Post Graduate Committee

1999- 2001 American Heart Association, Credentials Committee

1999- present American Heart Association, Co-Chair, Science Advisory Panel on Women and Heart Disease

2001-2002 American Heart Association, Database Task Force

2001-2005 American Society of Echocardiography, Chair, Women's Health Advisory Group

2001-2005 American Heart Association, Scientific Publishing Committee

2001-present American Heart Association, Quality of Care and Outcomes Research Network of Experts

2001-present American Heart Association, Chair, Science Advisory Panel - Choose to Move Program

2001-present American College of Cardiology, Advocacy Committee

2001-present American Heart Association, Vice Chair, Membership/Credential Committee – Clinical Cardiology

2002 American Heart Association, Scientific Publishing Search Committee For Circulation Editor in Chief

2002-present American Heart Association, Diabetes and Cardiovascular Disease Working Group

2002-present American Society of Echocardiography, Patient Information Working Group

2002-present American College of Cardiology/American Heart Association, Task Force on Clinical Data Standards

2002-2004 American Heart Association, Executive Database Steering Committee

2003-2004 American Heart Association, Role of Cardiac Imaging in the Clinical Evaluation of Women Writing Group

2003-2006 American College of Cardiology, Advocacy/Evaluation and Management Committee

2003-2006 American College of Cardiology, Advocacy/Documentation Committee

2003-2007 American College of Cardiology, Advocacy/Disease Management Committee

2004-2006 American Heart Association, Council on Epidemiology and Prevention Leadership Committee

2004-2007 American Heart Association, Chair, Communications Committee

2004-present American College of Cardiology, Quality Directions Strategic Workgroup on Appropriateness Criteria

2005-2008 American Heart Association, San Francisco Division Board of Directors

2005-2008 American College of Cardiology Prevention of Cardiovascular Disease Committee

2005-2007 American Heart Association, Cardiology Liaison, Annual Program Committee for Quality of Care and Outcomes Research Interdisciplinary Working Group

2005-2006 American College of Cardiology Calcium Expert Consensus Document Writing Group

2006-2008	American Heart Association, Epidemiology and Prevention Council's Advocacy Committee
2006-2009	American College of Cardiology/American Heart Association Chair, Primary Prevention Performance Measures Writing Group
2006-2008	American Heart Association Quality Care and Outcomes Research Program Committee and Chair, Concurrent Subcommittee
2006-2008	America's Health Insurance Plans Advisory Panel
2007-Present	American Heart Association Writing Committee, "Reducing Risks and Improving Health Outcomes in Partnership with Patients and Families: American Heart Association Programs and Initiatives in Action".
2008-Present	American College of Cardiology Foundation Work Group "Incorporating Efficiency in the Multi-Modality Appropriateness Criteria Document"
2008-Present	American Heart Association Quality Care and Outcomes Research Program Committee and Chair, Plenary Session Subcommittee
2009	California Chapter of the American College of Cardiology, Women in Cardiology Workgroup
2011	American Heart Association Writing Group Approaches to Enhancing Radiation Safety in Cardiac Imaging
2011- Present	American Heart Association Quality Care and Outcomes Research Program Committee and Chair, Liason Member representing the AHA Council on Clinical Cardiology

NONPROFIT ADVISORY BOARD

2002-2012	WomenHeart, Scientific Advisory Board
2006-2010	Association for Women's Health Programs (AWHP)
2007-2009	Medical Advisory Board for HeartHealthyWomen.org
2007-2012	Society of Women's Health Research
2006-present	Center for Medical Technology Policy Advisory Board
2008-present	Advisory Board - Institute of Clinical and Economic Review
2010	Advisory Committee for Campaign for Effective Patient Care
2012	Robert Wood Johnson Foundation Health Policy Fellows 2012 Lifetime Achievement Award Selection Committee

GOVERNMENT SERVICE

1999-2001	Member of Center for Medicare and Medicaid Services Agency PRO Panel on Care of patients with Acute Myocardial Infarction - 6 th Scope of Work
2002	National Institutes of Health; NHLBI; Women and Ischemia Syndrome Evaluation Workshop on Women and Heart Disease, Program Committee
2003-2006	Department of Health and Human Services, Medicare Coverage Advisory Committee
2004	National Aeronautics and Space Administration (NASA) Cardiovascular Operations Panel
2004-2006	Medicare Coverage Advisory Committee (MCAC) Methodology Subgroup
2006	National Heart, Lung and Blood Institute Clinical Trials Review Committee, Adhoc Review
2007- Present	National Institutes of Health; NHLBI; Framingham Heart Study Laboratory Review Committee.
2007-	Agency for Health Care Research and Quality Evidence Review Panel
2007-	Expert Reviewer for the U.S. Preventive Services Task Force (USPSTF) draft Recommendation Statement

- 2008- Present Circulatory System Devices Panel of the Medical Devices Advisory Committee, Center for Devices and Radiological Health, Food and Drug Administration – consultant.
- 2008 FDA Workshop co-organizer and faculty; Exploration of Public Policy Development Regarding the Study and Analysis of Sex Differences in the Clinical Evaluation of Cardiovascular Medical Products
- 2008-2009 Consultant to General Accounting Office: GAO Study on Efficiencies in Medicare Physician Services
- 2008-2009 Clinical Advisor to WA State Health Technology Assessment Program on the usage of cardiac stents
- 2010 Advisor for NHLBI's Cardiovascular Outcomes Research Centers RFAs
- 2013 Clinical Advisor to WA State Health Technology Assessment Program on the usage of carotid stents

CONGRESSIONAL TESTIMONY

- 2011 Expert Testimony to House Energy and Commerce Health Subcommittee to Examine “Impact of Medical Device Regulations on Jobs and Patients” February 17, 2011
- 2011 Expert Testimony to Senate Special Committee on Aging on “FDA and the Reform of Medical Device Approval Process” April 13, 2011
- 2011 Expert Testimony to House Energy and Commerce Health Subcommittee to Examine “FDA’s Process for Approving Medical Devices” June 2, 2011
- 2011 Expert Testimony to Senate Special Committee on Aging on “Medical Device Innovation ” July, 2011

INSTITUTE OF MEDICINE COMMITTEES

- 2011 – 2012 IOM Learning Health Care Committee

TECHNOLOGY ASSESSMENT ORGANIZATIONS AND COMMITTEES

- 2003 – 2006 Medicare Evidence Development and Coverage Advisory Committee – voting member
- 2006 - Present Medical Policy and Technology Assessment Committee – Panel Member
- 2006 - Present Center for Medical Technology Policy – Consulting Cardiologist
- 2007 - Present California Technology Assessment Forum – Panel Member
- 2011 - Present Yale University Open Access Data Project Steering Committee
- 2012 – Present Technology evaluation Center (TEC) – Blue Cross and Blue Shield Association – Medical Advisory Panel
- 2012 - Present Medicare Payment Advisory Commission (MEDPAC) - Commissioner
- 2012 – Present Medicare Evidence Development and Coverage Advisory Committee (MEDCAC) - Chairperson
- 2012 – 2012 Agency for HealthCare Research and Quality (AHRQ) Community Forum - Member

BOARDS

Certified, Cardiovascular Specialty Boards

Diplomate, American Board of Internal Medicine
Diplomate, National Board of Medical Examiners

PROFESSIONAL AWARDS AND HONORS

1978	Congressional Intern - in the office of Rep. E. Holtzman (D-NY)
1978-1980	President, American Medical Student Association, Penn chapter
1979	Committee on Health Manpower at AMSA National Convention
1980	Selected as State Delegate to American Medical Association
1980	Walter Lewis Croll Scholarship
1980-1981	Thouron Anglo-American Exchange Fellowship
1982	American Medical Women's Association Scholastic Achievement Award
1982-1990	Thouron Fellowship Selection Committee
1987	Distinguished Alumnus Award, City-as-School
1988	White House Fellowship National Finalist
1992, 93, 96	Amer. Board of Internal Medicine-invited to write questions for Cardiovascular Boards
1992	Commendation from Director of UCSF Medical Center for outstanding patient care
1995	Young Investigator Award, American Heart Association - Scientific Conference on Hormonal, Metabolic and Cellular Influences on Cardiovascular Disease in Women
1997	Appointed to RAND's Expert Panel on Quality of Care for cardiopulmonary conditions, "Development of an Adult Global Quality Assessment Tool for Managed Care"
1999	Appointed to RAND's Expert Panel on Quality of Care for cardiopulmonary conditions, "Development of an Adult Global Quality Assessment Tool for Hypertension"
1999	AHA Five Year Service Recognition Award
2000-present	Who's Who in America?
2000	Pfizer Award for Contributions and Dedication to the Field of Women's Cardiovascular Health
2001	American Heart Association, Women's Legacy Award
2002	AHA Ten Year Service Recognition Award
2003	Robert Wood Johnson Health Policy Fellowship
2005	American Heart Association, Communications Award
2006-2011	America's Top Doctor, Castle Connolly Medical Ltd.
2008	Who's Who Among Executives and Professionals, Honors Edition
2009	UCSF 2009 Pathways to Discovery Mentor Award
2009	Bay Area American Heart Association Go Red For Women Honoree
2010	Aufses-Whitman Lecturer at Mount Sinai
2010	UCSF Purple Ribbon Award to Sanket Dhruva, mentoree
2011	President's Council of Cornell Women
2011	Women's Day Magazine Red Dress Award Honoree
2012	US News and World Report Top Doctor 2012 (top 1%)
2013	Women Heart Wenger Award for Medical Leadership
2013	Mayo Clinic Cardiology Visiting Professor of the Year

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO SERVICE

PRE UCSF

1988-1990 Chair, Code Committee, Beth Israel Medical Center – North, NY
1988-1990 Coronary Care Unit Committee, Beth Israel Medical Center – North, NY

DIVISION OF CARDIOLOGY

1992-1993 Research Activities Committee, Division of Cardiology, UCSF Medical Center, CA
1992-1993 Finance Committee – Division of Cardiology, UCSF Medical Center, CA
1993- 1996 Computer Priorities in Cardiology Committee, UCSF Medical Center, CA
2005-2006 Interview Fellowship Candidates
2010-2011 Interview Fellowship Candidates
2010-present Mentoring Facilitator, Division of Cardiology
2012-present UCSF Quality and Value Committee

DEPARTMENT OF MEDICINE

2002-2003 Medical Internship Selection Committee, UCSF
2008-current CVRI Internal Protocol Scientific Review Committee for Human Research, UCSF
2008-present Intern Interviews

CAMPUS

1993-1994 Leadership/Awards Committee, Women’s Faculty Assoc., UCSF Medical Center, CA
1993-present Women’s Health Access, Co-Founder, Medical Advisor, UCSF Medical Center, CA
Medical Advisory Board
1996-1997 Outpatient Clinical Trials Center, Planning Committee, UCSF
1997 Chancellor’s Advisory Committee on the Status and Advancement of Women, Liaison
from the Center of Excellence in Women’s Health, UCSF
1997-2003 Pharmacy & Therapeutics Committee, UCSF
1997-1998 Chancellor’s Steering Committee on Diversity – Subcommittee on Mentoring
1999- 2000 CPR Advisory Committee, UCSF CPR Center
2002-2003 Chair, Ad Hoc Search Committee for School of Pharmacy Faculty Position
2004-present Tobacco Education Center Advisory Board, UCSF
2005-2008 Committee on Academic Personnel (CAP), UCSF
2006-2007 Stewardship Review Committee (CAP), for Dean of Dental School
2001-present Flight Attendants Medical Research Institute Executive Committee
2007 Medical Staff Adhoc Committee (Case # 012507LH)
2007-2008 Chairperson, The Academic Senate Distinction in Teaching Awards Committee
2006-2009 Ad Hoc Committee to review the UCSF Stewardship Review Procedures
2012-present Industry Relations Advisory Group, UCSF

PUBLIC SERVICE

1994 UCSF, Women’s Health Access, Medical Advisory Board
1994-1997 Older Women’s League (OWL), Heart Disease Advisory Board
04/94 San Mateo Women’s Auxiliary – Taking Charge of Your Health
3/04/95 Women’s Health 2000 – Women and Heart Disease
10/18/95 Women’s Resource Center, UCSF – “Women and Heart Disease”
10/23/95 Panelist: Discussion of Women’s Health Issues for the Women’s Business and Professional
Leadership Forum of the Women’s Alliance – Sheraton Palace Hotel, San Francisco, CA

01/13/96 Senior Citizens Lecture, UCSF – “How to Have a Healthy Heart”

03/06/96 UCSF Brown Bag Lecture – “Women and Heart Disease”

03/09/96 Women’s Health 2000, UCSF – The Risk of Cardiovascular Disease in Women

01/09/97 UCSF Center of Excellence Community Retreat – Resolutions for the New Year

01/28/97 The Women’s Health Care Providers Network, “An Update on the Diagnosis and Treatment of Hypertension and Heart Disease in Women”

02/12/97 UCSF National Center of Excellence in Women’s Health – Women’s Researchers’ Retreat, Co-Chair

02/15/97 UCSF-Mount Zion Center On Aging, SF, CA Community Health Education Series “Heart Disease and the Older Woman: Risk Factors, Prevention and Management”

03/08/97 Women’s Health 2000, UCSF – “Heart Disease in Women: An Update”

03/29/97 Book talks for children and teens, Borders Books, Palo Alto, CA “How to be a Woman Cardiologist”

04/16/97 San Francisco Chapter of Hadassah, Pacific Coast Education Day, Issues of Concern for the Mature Woman – “Risk Factors for Heart Disease in Older Women”

03/21/98 Women’s Health 2000, UCSF – “Heart Disease: The Number One Killer of Women”

10/07/98 UCSF Cardiology Council, “Women and Heart Disease: New Approaches to Research”

03/20/99 Women’s Health 2000, UCSF – “Optimizing Your Health for the New Millennium”

11/05/99 UCSF Brown Bag Lecture – “Prevention of Coronary Heart Disease in Women”

02/17/00 McKesson Corporation Lecture – “Prevention of Coronary Heart Disease” San Francisco, CA

03/21/00 UCSF Women’s Health-Alternative Spring Break experience, UCSF mentor for program on the work life of female physicians, delivery of health to underserved communities

11/03/00 AHA 73rd Scientific Session Press Conference

03/31/01 Women’s Health 2020, UCSF - Heart Disease #1 Killer of Women

04/24/01 UCSF Cardiology Council Lecture - “Affairs of a Lady’s Heart: CVD in Women”

02/13/02 UCSF Brown Bag Lecture – “Lower Your Cholesterol the Natural Way”

3/22/03 Women’s Health 2020, UCSF – Heart Disease #1 Killer of Women

4/5/03 Women’s Health 2020 – “Cardiovascular Disease in Women”

5/1/03 Moderator, Professional Business Women of California, Session on Cardiovascular Disease in Women, San Jose, CA

5/9/03 American Heart Association, Medical Director, Women’s Legacy Luncheon. Foster City CA

6/18/03 American Heart Association – Medical Chair, “9th Annual Women and Heart Legacy Luncheon”

2/6/04 Red Dress Day Speaker, American College of Cardiology, Bethesda, MD

3/29/04 WomenHeart Advocacy Issues Meeting – Keynote Luncheon Speaker, Washington, D.C.

5/5/05 American Heart Association’s Go Red for Women Luncheon, Keynote Speaker - “Taking Your Heart To Heart.” Santa Barbara, CA.

5/18/05 UCSF Women’s Health – Mission Clinic – “Taking Your Heart to Heart.” San Francisco, CA.

5/18/05 UCSF Mini Med School – “The Healthy Heart: How do we get it? How do we keep it?”

5/18/05 UCSF National Center of Excellence in Women’s Health One-day Conference, “Women’s Health 2020,” – “Heart and Hormones: The Basics on Heart Health and Menopause.”

11/13/05 American Heart Association and MedEd Architects sponsored Educational Series “Advances in the Treatment of Cardiovascular Disease” – Webcast Interview

6/2006 University of Pennsylvania School of Medicine Reunion Committee

2007 Volunteer – Jackie Speier for Congress

1/09/08 Medical Services Speaker Series - Medical therapy versus PCI for Stable Coronary Disease

8/09/11 Interview with Julie McCoy, free-lance writer for Robert Wood Johnson Foundation profile.

9/21/2011 Go Red for Women Executive Leadership Team Breakfast, “Heart Disease and Women”, San Francisco, CA

10/19/2011 Speaker, Women Lead with Jackie Speier
2011 – 2013 Menlo School Connections Beyond the Classroom

MEDIA

06/93 KPIX-TV – Panelist on Women and Health, “Dr. Nancy Snyderman: On Call”
11/18/94 NY Times – Interviewed for article on Hormone Replacement Therapy (PEPI)
01/19/95 KCBS Radio – Interviewed for segment on Women’s Health
02/19/95 KGO-TV – Women and Heart Disease
02/95 KFSN-TV – Interviewed for show on Women and Heart Disease
04/13/95 KALW Radio NPR – Health, News and Views, Women and Heart Disease
06/13/95 KGO Radio, San Francisco – Interviewed regarding Cardiovascular Health Study
2/97 & 8/97 Wall St. Journal interview – Hormones and Heart Disease
09/10/97 NBC News and NBC News Night Side – Women and Heart Disease
11/14/97 PBS Broadcast “Speaking of Women’s Health” for the segment on “Women and Heart Disease” on KVIE – Sacramento, CA
01/98 Eating Well Magazine – Facing Heart Disease
03/15/98 Z-95.7 Radio – Women and Heart Disease
04/26/98 KGO Radio, San Francisco – Women and Heart Disease
05/13/98 Boston Globe Newspaper – “Synthetic estrogen is found promising”
06/10/98 NBC Today Show – HOT Study
07/16/98 KGO Radio, San Francisco – Heart Problems in the Heat
09/01/98 Better Homes and Gardens – Women and Heart Disease
09/02/98 KNBR Radio, San Francisco – AHA radio talk show
09/23/98 KRON, Ch4 News – Hypertrophic Cardiomyopathy”
09/28/98 KPIX, Ch5 News – “Women and Heart Disease”
02/10/99 KCBS Radio – Interviewed for segment on Women’s Heart Disease
02/11/99 The Independent Newspaper – Study: Female, male heart patients treated differently
02/19/99 Physician Practice Options – “How Cardiologists Help to Educate Patients”
02/22/99 KGO, Ch7 News – Ultra Fast CT Scan
02/26/99 KRON, Ch4 News – Hip/Waist Ratio as Predictor of Heart Disease Risk
03/02/99 KGO, Ch7 News – Interviewed re. Blood clots
03/05/99 KRON, Ch4 News – Waist/Hip Ratio Measurements and Their Relationship to Risk of Heart Disease in Women
03/19/99 KCBS Radio – Gender & Willingness to Undergo Invasive Procedures
05/03/99 Medcast Medical News – “New Guidelines to Prevent Heart Disease in Women”
05/10/99 WebMD – “Fighting a killer with estrogen: How hormone replacement therapy protects against heart disease”
05/19/99 America’s Health Network – “Relationship between Cholesterol and Heart Disease”
07/12/99 Web MD – Comment on NEJM article on Aortic Valve Sclerosis in Elderly People
08/06/99 Good Morning America (ABC) – What Happens Physiologically during Thrill-Seeking Events
10/12/99 KGO, Ch7 News - Heart Disease is the Leading Cause of Death in Women
10/25/99 Women’s Day – Quoted in article on Heart Disease
03/08/00 WPO-NorCal – “Caring for Women’s Hearts, Women’s Lives” UCSF-Laurel Heights Conference Center
03/20/00 Cited in UCSF’s Daybook, Estrogen Replacement, HERS trial
05/16/01 NBC News – Impact of New Cholesterol Guidelines
07/23/01 KPIX, Ch5 News – Hormone Replacement Therapy and Women’s Issues

08/08/01 KPIX, Ch5 News – Baycol Withdrawal, Comment on Vitamin E Anti-oxidant Study

08/20/01 Los Angeles Times – Statins

08/27/01 KPIX, Ch5 News – Pacemaker Infections

08/27/01 KPIX, Ch5 News – Air pollution and Heart Disease

08/28/01 Washington Post – “Premarin: Straight from the Horse’s What?”

08/28/01 KGO Radio, San Francisco – Air Pollution and Heart Disease

08/28/01 Tsing Tao Radio, San Francisco – Air Pollution and Heart Disease

10/07/01 Associated Press – Choose to Move

02/02/02 Shape Magazine – Choose to Move

02/06/02 KPIX, Ch5 News – Choose to Move

02/06/02 Houston Chronicle – Choose to Move

02/12/02 KRON, Ch4 News – Women and Cardiovascular Disease

02/13/02 San Francisco Chronicle – Viagra and Coronary Artery Disease

02/27/02 Asian Woman Magazine – Choose to Move, AHA Physical Activity Program for Women

03/01/02 Real Simple Magazine – Choose to Move, AHA Physical Activity Program for Women

03/13/02 San Jose Mercury News – Choose to Move, AHA Physical Activity Program for Women

03/14/02 KGO Radio, San Francisco – Choose to Move, AHA Physical Activity Program for Women

03/14/02 San Francisco Chronicle – Choose to Move, AHA Physical Activity Program for Women

07/15/02 KGO Radio, San Francisco – AHA Heart Attack and Stroke Prevention Guidelines

08/12/02 San Mateo County Times – Choose to Move, AHA Physical Activity Program for Women

09/09/02 Health Plan Magazine – Choose to Move, AHA Physical Activity Program for Women

10/08/02 KPIX Ch5 News – Stem Cell Research

10/25/02 Oakland Tribune – Hormone Replacement Therapy

1/15/03 KGO-TV - Interview with Dr. Dean Adell on C - reactive protein

2/4/03 UPI – Low Estrogen and Heart Disease in Premenopausal Women

3/3/03 WebMD – Hormone Replacement Therapy

9/1/03 Glamour Magazine – Benefits of Exercise for Your Heart

8/14/03 Oakland Tribune – LVAD as Destination Therapy

9/22/03 New York Times – Article on Calcium Scans

10/03 Internal Medicine News – EBCT and Coronary Calcium Scores

10/03 Glamour Magazine – Women and Heart Disease

4/25/04 PBS special on Women and Heart Disease: Getting to the heart of the Matter, St Paul, MN

5/16/04 Poughkeepsie Journal - Quoted in article, “Heart Program Tailored for Women”

8/5/04 KDAL Radio Station, Radio Interview with Duluth

9/15/04 WISR Radio Station, Butler, Pennsylvania, “Choose to Move”

9/2004 Today in Cardiology – Quoted, “Women May Need Different Treatment than Men: Exercise caution when prescribing GPIIb/IIa for Women”

1/1/05 Sunset Magazine – Quoted in, “Take the West to Heart: Stress and Heart Disease”

2/5/05 American Heart Association/KCBS Radio – “Cardiac Imaging in Women to Diagnose Disease”

3/1/05 Patient Care Magazine – Interviewed and quoted – “Cardiovascular Disease: Risk Stratification in Asymptomatic Patients.”

3/15/05 Safety Smart magazine – Interviewed and quoted, article “Like cars, people need maintenance”

4/1/05 San Francisco Magazine – Quoted in Article titled “The Heart Healthy Woman”

4/20/05 Radio broadcast interview with Joan Lunden – “How to Choose a Healthier Heart” about the American Heart Association Choose To Move Program.

5/18/05 KNBR Radio interview – “Mini Med School Series”

6/6/05 Health Day, www.healthday.com, article, "Low-Level jobs increase Cardiac Risk"

6/13/05 Multiple live radio interviews with Joan Lunden – Choose to Move for a Healthy Heart

7/22/05 Web MD – "Preventing Heart Disease" (Geared toward baby boomers)

9/8/05 Oakland Tribune – Interview for publication on Food and Cholesterol

11/2005 Today in Cardiology – Quoted in article, "Chocolate and Wine"

1/1/06 AARP Magazine, Interview on inflammation and heart disease

2/1/06 National Education Association Magazine – Quoted in article on heart disease

2/2/06 Bay Area Business Woman – Featured in the WonderWomen Column

2/3/06 UCSF Heart and Vascular Center, Go Red Day for Women, "The Truth About Heart Disease in Women: How You Can Decrease Your Risk," San Francisco, CA

3/3/06 Quoted in Associated Press, "Study: Lifting Weights Attacks Belly Fat"

3/3/06 Quoted in WebMD Weight Loss Clinic publication, "Fitness 101: The Absolute Beginner's Guide to Exercise; How to get started with an exercise program – and stick with it."

3/4/06 Yahoo! News – Quoted in, "Study: Lifting Weights Attacks Belly Fat."

3/25/06 KQED Radio, San Francisco – Guest on "Forum" with Michael Krasny – "Cholesterol Drugs"

4/19/06 General Mills Foods Website called, "Eat Better America" – comment regarding question, "Can Garlic Help My Heart?"

6/2006 Quoted in Smart Health Magazine, "Nurturing a New Leave: Cultivating Health Habits Takes Patience and Persistence."

7/25/06 Quoted in The Boston Globe, "Article Urging Heart Exams Shows Conflicting Interests."

7/28/06 The Gray Sheet – Quoted in article regarding usefulness of MDCT's

8/29/06 Yoga Journal – Interviewed regarding physical activity, nutrition and women's cardiovascular health

9/7/06 Natural Health-Interviewed regarding women's heart health

9/18/06 KCBS Radio, San Francisco – Guest of Mike Pulsipher – "AHA ACC joint advisory on flu shot"

12/11/06 Web MD- Anger and Heart Disease

1/31/07 Oakland Tribune – genetics and heart disease in women.

2/13/07 San Francisco Chronicle – beneficial cardiac effects of naps.

2/14/07 KQED Forum – napping and heart health.

4/4/07 San Francisco Chronicle – effects of estrogen on women's cardiovascular health.

5/10/07 CVN - Interview with Dr. Rumsfeld, was regarding Disparities in Outcome of Women with Coronary Heart Disease: Prejudice or Predisposition?

6/11/07 San Francisco Chronicle – Coffee and Women's Health.

6/20/07 KPIX Television CBS Inc. – Estrogen and Calcium.

7/3/07 KPIX Television CBS Inc. – The Benefits of Chocolate

7/4/07 San Francisco Chronicle – Health Benefits of Chocolate

7/19/07 KQED Public Radio, San Francisco – Health Dialogues: Heart Disease

10/2/07 theheart.org - Defibrillators and Disparities

10/2/07 Web MD - Defibrillators and Disparities

10/2/07 insider.com - Defibrillators and Disparities

10/2/07 Baltimore Sun - Defibrillators and Disparities

10/2/07 KPIX Television CBS Inc., San Francisco - Defibrillators and Disparities

10/18/07 U.S. News.com – Women's Health – Listen To Your Heart

11/7/07 Heart Insight - Women and Heart Disease

11/18/07 Baltimore Sun – In medical trials, lack of diversity can kill

12/22/07 San Francisco Chronicle - Staying heart-healthy through the holidays

1/14/08 amednew.com – Women with coronary calcium found at risk for heart attack

1/16/08 Cardiology News – Calcium Supplements and Heart Risk in Older Women

1/25/08 MedPage Today – Interviewed on participants in trials used in CMS coverage decisions

1/29/08 Reuters Health – Interviewed Clinical trial data and relationship to Medicare beneficiaries

1/29/08 Heart Insight – Interviewed for The Female Heart

2/01/08 Glamour Magazine – Bush family and improvements in America’s Heart Health

2/1/08 Heart Insight – The Female Heart

2/11/08 Business Week – Medicare: The Trials of Cardio Coverage

2/23/08 Baltimore Sun – Popular Heart Test Questioned: Critics see CT risks, with profits trumping science

3/1/08 Cardiology Today – Focus on Women and Heart Disease

3/21/08 San Francisco Chronicle, interview for article “Early warning system for drug dangers sought”

4/21/08 WebMD - Death Gap: Life Expectancy Falls for Some

4/22/08 Interviewed for WebMD – article on Cordaptive up for FDA Review

5/19/08 KTVU / Fox TV Channel 2, KQED radio, KGO, KLIV, KPIX/CBS, KGO/ABC, KSTS/Telemundo -- AHA Go Red For Women, “San Francisco Bay Area Ranks Among Top 3 in Nation On New List of Heart Friendly Cities for Women”

5/20/08 US News - Listen to Your Heart: Most women at risk of cardiovascular disease don't know it

5/27/08 Cardiology News - regarding a study published in BMJ entitled "Vascular events in healthy older women receiving calcium supplementation: randomized controlled trial".

6/29/08 NYTimes – quoted and photographed for front page Sunday Times article on cardiac CTA

8/01/08 Cardiology News - AHA/ACCF sleep apnea/cvd statement

9/21/08 EverydayHealth.com article on healthy heart snacking

9/22/08 Cardiology Today and Endocrine Today, comment on “Exercise training reduces hepatic fat in type 2 diabetes: A randomized, controlled trial”

10/1/08 Associated Press, interview regarding published study, “Reduced disability and Mortality among Aging Runners. A 21-year longitudinal study.”

10/3/08 Family Circle, interview on heart healthy lifestyles for the whole family

10/7/08 Wall Street Journal, interview on Pfizer marketing of gabapentin

10/10/08 Milwaukee Journal Sentinel, “Some angioplasties done without stress tests, study says”

10/14/08 U.S. News and world report, interview “Heart docs often fail to order tests before angioplasty”

10/14/08 Reuters, “U.S. Doctors often skip key test before surgery”

10/14/08 MedPage Today, “Stress test often bypassed before elective angioplasty”

10/14/08 Doctor’s guide personal edition, “Most patients do not undergo recommended stress test to confirm need for elective angioplasty”

10/14/08 Bloomberg.com, “Heart patients don't get tests before treatment, study says”

10/24/08 Current Science interview on CT technology

11/21/08 Baltimore Sun, NEJM CT study cardiac CTA ABC in MA

11/24/08 ABC (in MA), NEJM CT study cardiac CTA

11/24/08 HealthDay, NEJM CT study cardiac CTA

11/25/08 www.theheart.org, NEJM CT study cardiac CTA

11/25/08 Reuters News Service, NEJM CT study cardiac CTA

11/25/08 Wall Street Journal, "Subtle Science: Heading Off Heart Attacks in Women"

2/6/09 Current Science, “Over Exposed” interviewed for article re: CT scan benefits vs. cost

2/20/09 Bottom Line/Women’s Health, article on angioplasty and heart tests

3/04/09 KPIX channel five CBS interview, Clopidogrel and PPI Interaction

3/11/09 KPIX channel five CBS interview, Neck Circumference as a Novel Measure of Cardiometabolic Risk

3/23/09 KPIX channel five CBS interview, ‘Other’ Red Meat a Leaner Option for Meat Eaters

- 4/16/09 www.TheHeart.Org interview and quote, "CCTA should be routine for assessing suspected CAD patients"
- 4/28/09 Radio interview for www.reachmd.com by Tony Millard
- 5/28/09 Synapse, UCSF newspaper "Heart Association Honors Redberg"
- 6/8/09 Wall Street Journal, "Use of diabetes drugs and devices fuels doubts --- U.S. study adds to simmering debate on pricey therapies" by Keith J. Winstein
- 7/10/09 US News and World Report, "Cost of Medicine: Are High-Tech Medical Devices and Treatments Always Worth It? Many expensive medical tools are valuable but arguably overused," by [Katherine Hobson](#)
- 7/27/09 Healthcare Journal of Northern California, "The new face of feminism. UCSF's Rita Redberg leads the charge for women's health," by Jessica Kelson
- 8/11/09 Good Housekeeping magazine article on CT scans, by Melody Petersen
- 8/26/09 New York Times "Study Finds Radiation Risk for Patient," by Alex Berenson
- 8/27/09 KCBS radio interview, "CT Radiation", by Ted Goldberg
- 8/28/09 The Baltimore Sun "Radiation Tests are Questioned," by Stephanie Desmon
- 9/4/09 AARP Bulletin Today. "Americans May Be Getting Too Many Imaging Tests. Radiation risks increases as CT and heart scans become increasingly common," by [Charlotte Huff](#)
- 9/14/09 www.TheHeart.org interview, "ICD-benefit disparity in women," by Steve Stiles
- 9/16/09 US News and World Report, "Defibrillators in Women with Heart Failure" by Deborah Kotz
- 10/15/09 [Family Practice News](#), "Performance Measures Assess Cardiovascular Risk" by [Elizabeth Mechcatie](#)
- 12/11/09 Web MD, "Are CT scans sometimes too risky?" by Kathleen Doheny
- 12/14/09 Reuters, "Radiation from CT scans may raise cancer risks," by Julie Steenhuyzen
- 12/15/09 KPCC AirTalk with Larry Mantle, "Radiation from CT scans may raise cancer risk"
- 12/15/09 USA Today, "Radiation from CT scans linked to cancers, deaths" by Liz Szabo
- 12/15/09 MSNBC Dr. Nancy Snyderman Show, "JAMA - Radiation CT scan story"
- 12/15/09 Wall Street Journal, "CT Scans Linked to Cancer" by Shirley S. Wang
- 12/16/09 The Diane Rehm Show, "Radiation and CT scans"
- 12/17/09 theheart.org "Thousands of new cancer diagnoses predicted, due to soaring use of CT" by Roxanne Nelson
- 12/29/09 Associated Press, "Studies: FDA approval process falls short" by Carla Johnson
- 12/29/09 Reuters, "FDA Clears Cardio Devices on Weak Research: Study" by JoAnne Allen
- 12/30/09 Bloomberg News, "Medical Device Studies Lack Scientific Rigor, Researchers Find" by David Olmos
- 12/30/09 Fox News Radio, "FDA approval of heart devices" by Jennifer Keiper
- 12/30/09 theheart.org, "[Studies show cardiovascular devices often earn FDA approval without high-quality clinical data](#)" by [Reed Miller](#)
- 1/4/10 MassDevice.com, "Researchers take on the FDA" by Brian Johnson
- 1/4/10 Medical Tribune, "Researchers question evidence used for FDA approval of cardiovascular devices" Radha Chitale
- 1/6/10 The Gray Sheet, "Research backlash: Does FDA have a PMA problem?" Jessica Bylander
- 1/13/10 Bottom Line/Personal "Heard By Our Editors" an interview with Mark J. Estren
- 1/19/10 WebMD, "Heart Attacks Becoming More Common Among Middle-Aged U.S. Women" by Charlene Laino
- 2/8/10 theheart.org "Zero means nothing: "Gatekeeper" role of calcium scoring questioned" by Reed Miller
- 2/9/10 Elsevier's "The Pink Sheet", "FDA has widened recommendations for Crestor" by Emily Hayes
- 2/9/10 CBS News/Radio "FDA's initiative: reduce radiation exposure from imaging" by Barry Bagnato

2/10/10 Reader's Digest, "CT scan/cancer study" by Neena Samuel

2/17/10 Associated Press, "Use of CT, MRI and PET scans Tripling from 1996 to 2007" by Mike Stobbe

2/23/10 Bloomberg News, "Ethics of clinical trials: TIDE" by Rob Waters

3/1/10 KCBS Radio, "Interview with Dr. Kim on lifestyle, heart disease, and the President's health"

3/8/10 NPR, "Do as Obama Says On Health, Not Necessarily As He Does" by Scott Hensley

3/11/10 KGO-TV, "New Federal Guidelines for Medical Radiation" by Tim Didion

3/12/10 Associated Press, "Experts say US doctors Overtesting, Overtreating" by Lindsey Tanner

3/12/10 The Gil Gross Program KGO interview, "Doctors that Overtest and Overtreat."

3/12/10 Wisconsin Public Radio interview, "Obama testing and screening."

3/15/10 WCCO radio interview, "America being Overtreated" by Susie Jones

3/16/10 theheart.org's ACC Cardiology Show

3/21/10 KTSA radio interview, "Over Testing" by Chris Glasgow

3/29/10 Time Magazine, "Women, Heart Disease: Do Statins like Crestor Work?" by Catherine Elton

4/9/10 WBZ Boston, "Doctors Wonder If Statins Really Help Save Lives (video)" Paula Ebben

4/14/10 CBS 4 Miami, "Doctors Wonder If Statins Really Save Lives (video)" Cynthia Demos

5/24/10 CBS 5 San Francisco, Dr. Kim Mulvihill, "Modern day bed of nails promises health benefits (video)"

6/28/10 SF Examiner, "Using statins in people with normal cholesterol divides heart doctors, confuses patients" by AP writer Carla K. Johnson

6/29/10 Associated Press, "Cholesterol drugs for the healthy still debatable" by Carla K. Johnson

6/29/10 KEPR Chicago, "Cholesterol drugs for the healthy still debatable" by AP writer Carla K. Johnson

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7/2/10 USA Today, "Are cholesterol drugs OK for healthy people?" by AP writer Carla K. Johnson

7/27/10 Bloomberg News, "Archives of Internal Medicine and the JUPITER trial" by David Armstrong

8/12/10 CBS 5 San Francisco, Dr. Kim Mulvihill, "Cholesterol and Menstrual Cycle (video)"
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8/19/10 theheart.org - quoted in article, "Can a Statin Neutralize the Cardiovascular Risk of Unhealthy Dietary Choices"

9/6/10 Thomson Reuters, an article, "Covering a study on patient perceptions of PCI."

9/14/10 TCTMD: www.tctmd.com, an interview with Caitlin Cox regarding "Recent population-based study of inferior vena cava filters"

9/27/10 Reuters Health, an interview with Lynne Peeples, "A new Radiology paper concerning CT scans and cardiovascular disease." <http://www.reuters.com/article/idUSTRE68R4OA20100928>

9/29/10 Bloomberg/Newsroom, an interview with David Olmos, "Transcatheter heart valves"

10/2/10 Bloomberg News; interview by Nicole Bostrow "JAMA on the three-fold increase in use of CT and MRI scans in ERs from 1998 to 2007"

10/8/10 Bloomberg News; an interview with David Olmos, "Medical Device Makers, U.S. Regulators Spar over Rule"
<http://www.bloomberg.com/news/2010-10-07/medical-device-makers-u-s-regulators-spar-over-tougher-review.html>

10/25/10 Reuters Health, an interview with Frederik Joelsing, "Medical groups push to expand heart x-ray

10/25/10 Cardiology News, an interview with Sherry Boschert.: "The update on the 2006 guidelines for cardiac CT imaging.

11/10/10 The heart.org, an interview with Reed Miller, "Automated surveillance to detect postprocedure safety signals of approved cardiovascular devices"

12/07/10 LivingHealthyNews.com, "Stay Heart-healthy this Holiday Season", by Deanna Lynn Sletten

12/29/10 WebMD, an interview with Tammy Worth, "6 Heart Health Myths"

2010 San Francisco Chronicle, "Antagonistic People Study", interviewed by Erin Allday

1/19/11 SmartMoney.com, "Ten Things the FDA Won't Tell You", an interview with Sarah Morgan

1/28/11 KCBS radio interview with Rebecca Corral, on "HEART for Women Act"

2/04/11 TriMed Media Group, an interview with Justine Cadet

2/14/11 Elsevier Business Intelligence "The Pink Sheet", an interview with Emily Hayes, "Doubts Linger over Whether AVERROES Gives Any Advantage to Apixaban"

2/14/11 KCBS TV interview on "Benefits of a Fiber Diet"

2/24/11 CNNHealth.com, an interview with Elizabeth Landau, "Hot Flashes Don't Hurt Your Heart, and May Help"

2/25/11 Healthy Day News, an interview with Steven Reinberg, "Heart Devices Not Tested Enough in Women"

3/1/11 Reuters Health, an interview with Frederik Joelving on CT Scans and Heart Disease

3/14/11 Medical Imaging Technology, an interview with Elly Earls, "The Bigger Picture"

4/3/11 USA Today, "New Heart Valve Holds Promise and Stroke Risk", article by Steve Sternberg

4/5/11 MedWire News, "Risks Associated with Medical Imaging", a report on American College of Cardiology Conference Session 2011, by Helen Albert

4/11/11 HealthDay: ACP Interview by Beth Gilbert

5/26/11 New York Times Op-Ed "Squandering Medicare's Money" by Rita Redberg, MD

8/18/11 Elsevier Business Intelligence, "The Gray Sheet", an interview with Jessica Bylander

8/19/11 AARP Bulletin, an interview with Michael Haederle

9/20/11 KCBS interview "Air Pollution and CV Disease"

10/3/11 New York Times "How to Steer Toward the Path of Least Treatment" by Roni Caryn Rabin

11/16/11 MSNBC.com "Heart testing bill requires unnecessary tests" by Rochelle Sharpe

11/29/11 Associated Press interview by Lindsey Tanner

12/29/11 Politico.com "PCORI Keeps Low Profile As It Preps Markers" by Brett Norman

1/22/12 Charlotteobserver.com "Heart Procedure to be a Gamechanger" by Karen Garloch

1/23/12 Wall Street Journal "Should Healthy People Take Cholesterol Drugs to Prevent Heart Disease" by Rita Redberg

1/23/12 theheart.org "To prescribe or not to prescribe: That is the statin question, experts debate" by Michael O'Riordan

2/06/12 Washington Post "Why do cardiologists often pass up safe, low-tech treatments for chest pain?" by David Brown

2/09/12 Thomson Reuters.com "Gauging hype during Heart Month: 5 Tests You Might Not Need" by Frederik Joelving and Genevra Pittman

2/27/12 Fortune "Rethinking the war on cancer" by Brian Dumaine

2/28/12 patientpov.org "Metal-on-Metal Hips: A tale of harm, weak medical device-approval, and lax post-market scrutiny" by Laura Newman

2013 KPIX/CBS Health Watch "Beta Blockers might be linked to lower dementia risk" 2013
<http://sanfrancisco.cbslocal.com/video/8141200-healthwatch-beta-blockers-may-be-linked-to-lower-dementia-risk/>

2013 KPIX/CBS Health Watch "Beta Blockers might be linked to lower dementia risk" 2013
<http://sanfrancisco.cbslocal.com/video/8141200-healthwatch-beta-blockers-may-be-linked-to-lower-dementia-risk/>

2013 WebMD.com "6 Symptoms of Women's Heart Attacks" <http://www.webmd.com/heart-disease/features/womens-heart-attack-symptoms>

2/12/13 Newoldage.blogs.nytimes.com "Debate over Brain Scans and Alzheimer's" <http://newoldage.blogs.nytimes.com/2013/02/12/debate-over-brain-scans-and-alzheimers/>

2/24/13 Trends-in-medicine.com, "MEDCAC Rejects Beta-Amyloid Pet Imaging

2/26/13 Sfgate.com, "Mediterranean Diet Benefits Confirmed" Interview for the San Francisco Chronicle

4/02/13

KPIX/CBS Health Watch "Say No to Unnecessary Medical test"

<http://sanfrancisco.cbslocal.com/2013/04/02/healthwatch-saying-no-to-unnecessary-medical-tests/>

EDITORIAL BOARDS

1993-1994 Heart Disease and Stroke
1994-1998 Journal of the American College of Cardiology
1994-present American Heart Journal
2000-2008 Preventive Cardiology
2001-2005 Journal of the American College of Cardiology
2003-present Cardiosource Clinical Trials
2004-Present Today in Cardiology, Preventive Cardiology section
2004-2008 The American Journal of Geriatric Cardiology
2005-2008 Physicians' Information and Education Resource (PIER), Editorial Consultant
2006-2009 American Heart Association- MyAmericanHeart, Associate Editor
2007-Present Editorial Advisory Board of Cardiology News
2008-2012 Circulation: Cardiovascular Quality and Outcomes

LICENSURE

California – current

Drug and Enforcement Administration Number - current

MANUSCRIPT REVIEWER

American Heart Journal
American Journal of Cardiology
American Journal of Medicine
Canadian Medical Association Journal
Cardiology
Circulation
Cleveland Clinic Journal of Medicine
Disease Management & Health Outcomes
Health Affairs
Heart
Heart Disease and Stroke
International Journal of Cardiology
Journal of Cardiopulmonary Rehabilitation
Journal of Clinical Epidemiology
Journal of Critical Illness
Journal of Heart & Lung Transplantation
Journal of the American College of Cardiology
Journal of the American Medical Association
Journal of the American Society of Echocardiography
Journal of Women's Health
New England Journal of Medicine

INVITED EXPERT REVIEWER (PROFESSIONAL DOCUMENTS)

American Heart Association Medical/Scientific Statement, "Coronary Artery Calcification: Pathophysiology, Epidemiology and Clinical Implications" Circulation 09/96

American Heart Association Medical/Scientific Statement, "Cardiovascular Disease in Women" Circulation 09/97

American Heart Association Medical/Scientific Statement, "Hormone Replacement Therapy" Circulation 09/01

NASA Grant Review 11/29/04

American College of Cardiology / American Heart Association, "Clinical Performance Measures for Adults with ST-Elevation and Non-ST-Elevation Myocardial Infarction" 8/16/07 – 9/16/07

American College of Cardiology EP Data Standards 4/26/06

American Heart Association Medical/Scientific Statement, "Recommendations and Considerations Related to Preparticipation Screening for Cardiovascular Abnormalities in Competitive Athletes."

Blue Cross draft TEC assessment for Statins in the Elderly

Core Cardiology Training Symposium, "Training in Preventive Cardiovascular Medicine."
American College of Cardiology/American Heart Association Practice Guidelines, "Focused Update Pilot Project: ST Elevation Myocardial Infarction."

American College of Cardiology/American Heart Association Practice Guidelines, "Focused Update Pilot Project: PCI."

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American College of Cardiology, "Task Force 10: Training in Preventive Cardiovascular Medicine". 03/12/07

U.S. Preventive Services Task Force, review on screening with resting ECG or exercise treadmill testing for either the presence of severe coronary artery stenosis or the prediction of coronary heart disease events in adults at low risk for CHD events. 04/19/10

The BCBSA, "Technology Evaluation Center Special Report on Cardiovascular Pharmacogenetics".
Institute of Medicine: Committee on Women's Health Research, Board on Population Health. "Women's Health Research: Progress, Pitfalls, and Promise." May 2010.

ABSTRACT REVIEWER

1993, 1995, 1997, 1998, 1999, 2002	American Society of Echocardiography
1994, 1996, 2000, 2002- 2004, 2007, 2008	American Heart Association Scientific Sessions
1994, 1996, 1998, 2004, 2007-2010	American College of Cardiology
2004	American Heart Association, Women's Conference Review
2006, 2007, 2010	American Heart Association, Quality and Outcomes
2007	Cardiovascular Research Foundation and the Society for Cardiovascular Angiography & Interventions
2011-2013	American College of Cardiology's 60 th Annual Scientific Session
2011-2013	American Heart Association, Quality of Care and Outcomes Research in Cardiovascular Disease and Stroke

PUBLICATIONS

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- 56A. Mora S, Cui Y, **Redberg RF**, Whiteman MK, Flaws JA, Blumenthal RS. Exercise capacity is a powerful predictor of overall mortality in a healthy cohort of women. *Circulation* (suppl 2002)
- 57A. Mora S, Redberg RF, Cui Y, Whiteman MK, Flaws JA, Blumenthal RS. Exercise treadmill testing predicts cardiovascular risk beyond Framingham Risk Score in asymptomatic individuals. *Circulation* (suppl 2002)
- 58A. Hsu PYF, Dulbecco FL, **Redberg RF**, Fleischmann KE, Schiller NB. Doppler Pulmonary Vascular Resistance Response During Supine Exercise in Healthy Subjects. University of California, San Francisco, San Francisco, CA. *Journal of the American Society of Echocardiography*, (May suppl 2004).
- 59A. Boden WE, Elkoustaf RA, Dada M, Roe T, Peterson ED, Newby LK, Milford-Beland S, **Redberg RF**, Hochman JS, Diercks DB, Gibler WB, Smith SC and Ohman M. Sex Related Differences in In-Hospital Clinical Outcomes Among High-Risk Non-ST-Segment Elevation Acute Coronary Syndrome Patients Undergoing Percutaneous Coronary Intervention: Results from the CRUSADE Quality Improvement Initiative. *Circulation* 2005 (Suppl no. 1611).
- 60A. Blauwet LA, Hayes SN, McManus D, **Redberg RF** and Walsh MN. Sex Specific Results Are Not Reported in Cardiology Trials. *Circulation* 2005 (Suppl no. 3608).
- 61A. Alexander KP, Chen AY, Roe MT, Newby LK, Gibson CM, Schwartz J, Hochman JS, **Redberg RF**, Ohman EM, Gibler B and Peterson ED. Sex Differences in Glycoprotein IIb/IIIa Inhibitor Dosing and Bleeding in Acute Coronary Syndromes: Results from CRUSADE. *Circulation* 2005 (Suppl no 2092).
- 62A. Boden WE, Dada M, Lundbye J, Roe MT, Peterson ED, Newby LK, Milford-Beland S, **Redberg RF**, Hochman JS, Diercks DB, Gibler WB and Ohman EM. Sex Specific Results Are Not Reported in Cardiology Trials Aggressive Pharmacotherapy and Better In-Hospital Outcomes: Results from the CRUSADE Quality Improvement Initiative. *Circulation* 2005 (Suppl no. 3470).
- 63A. Lin GA, **Redberg RF**, Dudley RA. The Cascade Effect Leads to Percutaneous Coronary Intervention in Patients with Stable Coronary Artery Disease. *Academy Health* 2007 (suppl).
- 64A. Redberg, **RF**. Frequency of stress testing prior to elective percutaneous coronary interventions in a Medicare Population. *Circulation* 2007 (suppl).
- 65A. Lin GA, Dudley RA, **Redberg RF**. Not just evidence-based: Physician decision making regarding percutaneous coronary interventions for stable coronary artery disease. *Circulation* 2007 (suppl).
- 66A. Lin G, Dudley RA, **Redberg RF**. Focus group exploration of potential causes for the rapid increase in use of elective percutaneous coronary interventions. *J Gen Intern Med* 2007.
- 67A. Lin GA, Dudley RA, Woodward A, Beachy J, Dey S, **Redberg RF**. Prevalence of Obstructive Coronary Artery Disease in Patients Undergoing Diagnostic Cardiac Catheterization: Analysis of National Cardiovascular Database Registry Data. American College of Cardiology 2008 Scientific Sessions, Presentation 1026-130. March 31st 2008.
- 68A. D'Amore SA, Blumenthal RS, Sharrett AR, **Redberg RF**, Rexrode KM, Mora S. Prospective Study of Exercise-Induced Hypertension and Future Cardiovascular Mortality in 6,578 Asymptomatic Individuals. American College of Cardiology 2008 Scientific Sessions, Presentation 817-5. April 1st 2008.

- 69A. Dhruva S, Bero L, **Redberg RF**. The Quality of Study Evidence Examined By the FDA in Premarket Approval of Stents, TCT AJC 2009.
- 70A. Chen C, **Redberg RF**. Inclusion of Roll-in Patients in Pre-FDA Approval Cardiovascular Device Trials, ACC March 16, 2010.
- 71A. Marcus GM, Chan D, **Redberg RF**. Pain Due to Inappropriate Versus Appropriate ICD Shocks. May 2010
- 72A. Lieber, SB, **Redberg RF**, Blumenthal, RS, Ghandi, A, Robb, KJ, Mora, S: A National Interactive Web-Based Physical Activity Intervention in Women: An Evaluation of the American Heart Association Choose to Move Program 2006 - 2007. *Circulation* 2010 (suppl).
- 73A. Dhruva S, **Redberg RF**. Study Modifications and Primary Endpoint Reinterpretations Prior to FDA Approval of High-Risk Cardiovascular Devices, JACC Supplement 2011, Presentation TCT PCI Outcomes and American Heart Association Scientific Sessions, November 2011.
- 74A. Borden WB, Spertus JA, Mushlin AI, Roe MT, Kaltenbach LA, **Redberg RF**. Hospital Characteristics Associated with Providing Optimal Medical Therapy for Percutaneous Coronary Intervention Patients, March 2012
- 75A. Borden WB, Spertus JA, Mushlin AI, Roe MT, Kaltenbach LA, **Redberg RF**. Association between Use of Anti-Anginal Medications for Stable Coronary Disease and Rates of Percutaneous Coronary Intervention, March 2012
- 76A. Borden WB, Spertus J, Mushlin AI, Roe MT, Kaltenbach LA, **Redberg RF**. Hospital Characteristics associated with providing Optimal Medical Therapy for Percutaneous Coronary Intervention Patients. ACC 2012 Abstract
- 77A. Sylwestrzak G, Rosenberg A, White JT, Redberg RF. New Onset Heart Failure and Adverse Ischemic Events Associated with Amiodarone and Dronedarone Use Among Atrial Fibrillation Patients. AHA Quality of Care and Outcomes Research 2013 Scientific Session. May 15-17, 2013.
- 78A Barron J, Li CH, Sylwestrzak G, Kasravi B, PowerT, Redberg RF. Impact of Coronary Artery Calcium testing on Downstream Imaging, Interventions and Adverse Ischemic Events. *J Am Coll Cardiol*. 2013;61(10_S):. doi:10.1016/S0735-1097(13)61488-6

PROGRAM CHAIR/PARTICIPATION - International Meetings

- 1993 American College of Cardiology - (Program Co-Chair) The Usefulness of Transesophageal Echocardiography in the Operating Room
- 1993 American Society of Echocardiography (Faculty) Annual Scientific Sessions
- 1994 American College of Cardiology (Program Co-Chair) Transesophageal Echocardiography, Cardioversion, and Emboli.
- 1994 American Heart Association - (Moderator) Council on Clinical Cardiology - "How to Negotiate" luncheon
- 1994 American Society of Echocardiography (Faculty) TEE Case Review with Experts, Poster Moderator
- 1995 American College of Cardiology -
Fireside Panel - Estrogen and the Coronary Artery, 03/19/95

Abstract Program Co-Chair: Evaluation of the Thoracic Aorta by Transesophageal Echocardiography, 03/20/95

1995 American Heart Association (Moderator) Council on Clinical Cardiology - "Gender Communication" luncheon

1996 American College of Cardiology - Luncheon Panel - "Superwoman and Other Myths"

American Heart Association 69th Scientific Sessions - 1996

Chair - Women in Cardiology Perspectives from Academics, Private Practice and Industry"

American Society of Echocardiography - 1996 (Faculty)

Endocarditis: TEE in abscesses and fistulas

American College of Cardiology Extramural Program – 1997 (Program Director)

Director - "Heart Disease in Women, Where Are We Now? Where Are We Going?" 3/15/97

Presenter - "Diagnostic Testing for CAD in Women (Noninvasive): When to Use? Which Stress Test Should I Choose? How Do Costs and Efficacy of Each Test Compare?"

RAND Health Meeting -1997

Expert Panel on Quality Care for Cardiopulmonary Conditions, 09/29/97

American College of Cardiology, California Chapter, Executive Committee Meeting, 12/5/97

National Institutes of Health, Office of Research on Women's Health and The Office of Education, Office of the Director, "Beyond Hunt Valley: Research on Women's Health for the 21st Century,"

Invited Attendee – 1997

American College of Cardiology Extramural Program – 1998 (Program Director)

Director - "Heart Disease in Women, Where Are We Now? Where Are We Going?" 3/28/98

Presenter - "Diagnostic Testing for CAD in Women (Noninvasive): When to Use? Which Stress Test Should I Choose? How Do Costs and Efficacy of Each Test Compare?"

American College of Cardiology 47th Annual Scientific Sessions - 1998

ACCEL Audiotape - "Diagnostic Testing for CAD in Women: Noninvasive - Stress or Electron Beam CT?" 3/29/98

American College of Cardiology/National Heart, Lung, and Blood Institute/American Heart

Association-1998 "How to become a clinical cardiovascular investigator"

Lecturer - "Women in Academic Medicine," 6/5/98

American Heart Association - "Women and Coronary Artery Disease" Moderator -Videoconference

Washington, D.C., 9/16/98

American Heart Association - 10/26-28, 1998 (Faculty and Writing Committee Member)

Prevention Conference V, "Beyond Secondary Prevention: Identifying the High-Risk Patient for Primary Prevention," San Francisco, CA

American Heart Association - "Women and Heart Disease," poster reception, AHA Annual

Sessions, Dallas, TX, 11/8-12/98

American College of Cardiology - 1998 (Faculty)

Should every post-menopausal woman receive hormone replacement therapy?

American Society of Echocardiography - 1998 (Faculty)

TEE Case Review with Experts, Presenter, Poster Moderator

American College of Cardiology Extramural Program – 3/6/99 (Program Director)

Director - "Heart Disease in Women, Where Are We Now? Where Are We Going?"

Presenter- "Coronary Prevention in Women: What Do the New Guidelines Tell Us?"

American College of Cardiology 48th Annual Scientific Sessions – New Orleans, LA, 3/8/99 (Faculty)

"Gender-Specific Issues in Evaluation of Chest Pain: Treadmill Exercise Testing,"

"Controversies in Cardiology"

American College of Cardiology – 1999 Health Policy Forum

Moderator, Cardiovascular Atlas – "Variations in the Delivery of Cardiovascular Healthcare"

American College of Cardiology, California Chapter – San Francisco, CA, October 1999 (Faculty)

"California Medicare Quality Initiatives Related to Cardiology"

American College of Cardiology, California Chapter – Carmel, CA, October 2000 (Faculty)

"Cardiology Update 2000"

Presenter – "Should Post Menopausal Women receive Hormone Replacement Therapy?"

American Geriatric Society Annual Scientific Sessions – Chicago, IL, May 2000

Presenter – "Diagnosing and assessing coronary artery disease in the older women: treadmill testing, stress echo, nuclear or catheterization"

American College of Cardiology – San Francisco, CA, August 17, 2001 (Faculty)

"Critical Care Cardiology Conference – Acute Coronary Syndrome"

American College of Cardiology – Bethesda, MD, October 5, 2001 (postponed)

Invited Participant – "Preventive Cardiology: How can we do better?"

American Heart Association Annual Scientific Sessions – Anaheim, CA, November 2001

Moderator – "New Frontiers in Aortic Valve Disease"

Presenter – "Prevention VI: Diabetes and Cardiovascular Risk"

Mentor – "Early Career Development Program: How to be an Effective Teacher in a Clinical Environment"

American College of Cardiology – San Francisco, CA, December 14, 2001 (Faculty)

"The 18th Advances in Heart Disease"

Presenter – "EBCT – Uses and Limitations"

American College of Cardiology, Extramural Program – Atlanta, GA, March 16, 2002 (Program Director)

Director - "Heart Disease in Women, Where Are We Now? Where Are We Going?"

Presenter – "Acute Coronary Syndromes in Women"

American College of Cardiology Scientific Sessions – Atlanta, GA, March 20, 2002 (Chair)

"Update on Heart Disease in Women: What Are the Differences? What Should Be Done?"

National Institutes of Health; National Heart, Lung, and Blood Institute; Women and Ischemia Syndrome Evaluation Workshop – Washington, DC, October 2-4, 2002
 Session Chair – “Stable Ischemia: Pathophysiology versus Gender”

American College of Cardiology –34th Bethesda Conference, 10/7/02 – Bethesda, MD,
 Can Atherosclerosis Imaging Techniques Improve the Detection of
 Patients at Risk for Ischemic Heart Disease?” Task Force Co-Chair – “What is the spectrum of
 Current and Emerging Techniques for the Measurement of Atherosclerosis?”

American College of Cardiology – Cardiology Update 2002, Carmel, CA. October 10-12, 2002 (Faculty)
 “Do Women with Coronary Artery Disease Receive the Same Treatment as Men?”

American College of Cardiology, 19th Annual Symposium Cardiology for the Practitioner, Yosemite, CA.
 October 20, 2002 (Faculty). “Cardiovascular Disorders in Women: Evaluation and
 Management (Including the New HERSH Data)”

American College of Cardiology, Extramural Program - Chicago, IL. March 29, 2003 (Program Director)
 “Heart Disease in Women: Where Are We Now? Where Are We Going?”

American Heart Association, Cardiovascular Diseases and Diabetes – Chicago, IL. July 30th 2003 “Non-
 Invasive Screening-Diagnosis Procedures”.

American College of Cardiology, Extramural Program - New Orleans, LA. March 6, 2004. (Program
 Director and Faculty) “The Sixth Heart Disease in Women: Where Are We Now? Where Are
 We Going?” Presenter - “Acute Coronary Syndromes in Women”

American College of Cardiology, 53rd Annual Scientific Sessions – New Orleans, LA, March 8, 2004.
 (Faculty Moderator) “Update on Women and Heart Disease Trials 2004”

American Heart Association, Scientific Sessions 2004 – New Orleans, LA, November 8, 2004. (Invited
 Moderator) “Heart Disease in Women.”

Flight Attendant Medical Research Institute’s Annual Symposium 2005 – Miami Beach, Florida, May 12-
 13, 2005. (Representative for UCSF’s FAMRI Center of Excellence.)

American Heart Association Extended Learning (ACCEL) Scientific Sessions 2005 – Dallas, TX, November,
 2005. (Interviewee) “Updated Guidelines on the Role of Cardiac Imaging in the Clinical
 Evaluation of Women”

American Heart Association Scientific Sessions 2005 –Dallas, TX November 12, 2005. Program committee
 member, “Heart Disease in Women: Where are we now, Where are we going?” and speaker,
 “Gender differences in acute management: invasive vs. conservative approach”

American College of Cardiology, 55th Annual Scientific Sessions – Atlanta, GA, March 14, 2006. (Chair)
 “Treatment Issues in Prevention.”

American Heart Association, Quality and Outcomes Meeting - Washington DC, May 5-7, 2006, Presenter,
 Soapbox Session – Should Cost be included in Medicare Coverage Criteria?

Think Tank, Improving Quality of Care for Women with Heart Disease – Arlington, VA, 2007 (Co-Director with Pam Douglas and for this meeting of 120 experts).

Center for Medical Technology Policy; Cardiac Computed Tomographic Angiography Workgroup Meeting – Denver, CO, March 14, 2007.

American College of Cardiology, Chairperson, Session; Appropriateness and You – New Orleans, LA, March 27, 2007.

American College of Cardiology, The Heart of Women’s Health – Washington DC, January 26-27, 2007. Program Director.

American Heart Association, Quality and Outcomes Meeting - Washington DC, May 5-7, 2007, Moderator, Plenary Session – Conflict of Interest in Medicine

American Heart Association, Scientific Sessions 2007 – Orlando, FL, November 3, 2007. Invited Moderator “Heart Disease in Women: Where Are We Now, Where Are We Going?”

American Heart Association, Scientific Sessions 2007 – Orlando, FL, November 3, 2007. Invited presenter – Improving the quality of care of women with heart disease.

American College of Cardiology, The Heart of Women’s Health – Washington DC, February 8-9, 2008. Program Director.

IOM Roundtable workshop, Engineering a Learning Healthcare System: A Look at the Future – Washington DC, 2008.

American Heart Association, Scientific Sessions 2008-New Orleans, LA, November 11, 2008, Moderator. “The ABCs of Primary and Secondary Prevention and Implementation”

American Heart Association, Scientific Sessions 2008-New Orleans, LA, November 12, 2008, Moderator. “Selecting Optimal Patients for Revascularization: Opportunities to Improve Quality, Costs and Patient Outcomes”

Co-Chair, ACC.09 Annual Scientific Session Program Committee: Antiplatelet Therapy: Gender-Specific Differences?

Co-Chair, ACC.09 Annual Scientific Session Program Committee: Ethnic and Gender Disparities in the Treatment of Arrhythmias and Heart Failure

American College of Cardiology, The Heart of Women’s Health – Washington DC, January 30-31, 2009. Program Director.

American College of Cardiology, Medical Directors Institute- Invited Participant

Transcatheter Cardiovascular Therapeutics (TCT) San Francisco, CA September 22-25, 2009.

American College of Cardiology, “The Asymptomatic Intermediate-Risk Person Should Not Undergo Calcium Scoring” ACC Spotlight entitled Integrated Imaging Spotlight: Patient-Centered Imaging: Rapid Fire Debates -- The Asymptomatic Patient and Cardiac Testing? Atlanta, GA March 14, 2010.

American College of Cardiology, Panelist, ACC Meet the Experts entitled Utilization and Appropriateness of Cardiovascular Tests and Procedures. Atlanta, GA March 15, 2010.

American College of Cardiology, Cardiologists as Leaders in the Reform Environment. Atlanta, GA March 15, 2010.

American College of Cardiology, Poster Discussant, Sex Differences in Evaluation, Treatment and Outcomes in Patients with Acute Coronary Syndromes Atlanta, GA March 15, 2010.

American College of Cardiology Late-Breaking Clinical Trials IV Atlanta, GA March 16, 2010.

Institute of Medicine (IOM) expert reviewer "Women's Health Research: Progress, Pitfalls, and Promise". May 21, 2010.

Institute of Medicine (IOM) workshop Review of FDA's 510(k) clearance process, Expert Presenter. Washington, DC, July 28, 2010.

Transcatheter Cardiovascular Therapeutics (TCT) Invited Lecturer in Controversies in Interventional Cardiology, San Francisco, CA November 11, 2011.

American Heart Association, Scientific Sessions 2011, Presenter, "Challenges in Management of Patients with Stable CAD" Orlando, FL, November 16, 2011.

9th Global Cardiovascular Clinical Trialists Forum, Paris, France. Presented Lecture "Comparative effectiveness studies. How they may help decision makers and support utilization in clinical practice?" November 27, 2012.

5th International Cardio Event 2013, Florence, Italy. Presented Lecture "Less is More – Examples from Cardiology Practice" January 18, 2013.

ACC 62nd Annual Scientific Session, San Francisco. Session: Controversies in Imaging: The Geriatric Patient – Presented Lecture: Con. CTA and Calcium Scoring Should Not Be Done To Diagnose CAD and Risk Stratify the Very Elderly Patient with Chest Pain, March 9, 2013. Presented Lecture: Quality of Care and Outcomes Assessment Oral Contribution, March 10, 2013.

AHA Quality of Care and Outcomes Research Scientific Session. Baltimore, MD May 15-17, 2013

Invited Presentations

NATIONAL

Controversies and Advances in the Treatment of Cardiovascular Disease – Beverly Hills, CA, October 4-5, 2007. Invited Presenter "CT Angiography Should be Used Routinely as a Screening Tool"

19th Annual National Symposium on Cardiac Rhythm Management – San Francisco, CA, October 4-6, 2007. Invited presenter "General Session: Women and Heart Disease"

The Queen of the Valley Conference – 5th Annual Regional Heart Center Symposium: Optimizing Strategies in Cardiac Care – Napa, CA, October 6, 2007. Invited Presenter “The Heart of Women’s Health – Preventive Guidelines”

24th Symposium: Cardiology for the Practitioner – Yosemite National Park, California, October 22-24, 2007. Faculty and Invited Presenter “Selected Topics of Clinical Importance in Cardiology”

FDA Workshop – Silver Spring, MD, June 2, 2008. Speaker and Moderator “Exploration of Public Policy Development Regarding the Study and Analysis of Sex Differences in the Clinical Evaluation of Cardiovascular Medical Products”

AHIP Workshops –Washington DC, June 18, 2008. Speaker and Moderator “AHIP Evidence Policy Update”

25th Symposium: Cardiology for the Practitioner – Yosemite National Park, California. October 20-22, 2008. Invited presenter, “Exercise: a cardiac diagnostic and therapeutic tool”, “Antagonist: Role of cardiac imaging modalities (echo, cardiac CT, CT angio, and cardiac MRI) in CV risk assessment”, “Are newer therapies and cardiac interventions worth the price?” and “How to evaluate and manage CVD in women?”

American Heart Association, Scientific Sessions 2008. New Orleans, LA. November 11, 2008. “Cholesterol: How low do we push LDL and triglycerides?”

American Heart Association, Quality of Care and Outcomes Research April 24, 2009 Washington DC. Plenary session, “Prevention: Will Promise Ever Become Practice?” faculty

American Heart Association, Quality of Care and Outcomes Research April 24, 2009 Washington DC. Plenary session, “Health care reform” moderator

Transcatheter Cardiovascular Therapeutics (TCT) San Francisco, CA September 22-25 2009. “Percutaneous Coronary Intervention (PCI) Guidelines and Appropriateness Criteria: A Critical Review” and “Case Presentations: A Woman with Atypical Symptoms”

American College of Cardiology, 59th Annual Scientific Session. March 14th 2010. Participant, ACC Spotlight: Integrated Imaging Spotlight: Patient-Centered Imaging: Rapid Fire Debates -- The Asymptomatic Patient and Cardiac Testing?

American College of Cardiology, 59th Annual Scientific Session. March 15th 2010. Co-Chair, ACC Symposium, Cardiologists as Leaders in the Reform Environment: Comparative Effectiveness.

American College of Cardiology, 59th Annual Scientific Session. March 15th 2010. Panelist, ACC Meet the Experts: Utilization and Appropriateness of Cardiovascular Tests and Procedures.

Controversies and Advances in the Treatment of Cardiovascular Disease The Tenth Series. Debate: “FDA Evaluation and Approval of New Devices and Drugs: Too Lax and Needs to be More Aggressive”, Irvine, CA October 7, 2010

27th Annual Symposium Cardiology, for the Practitioner, Yosemite National Park, California October 25-27, 2010

FDA/CDRH presentation for Medical Devices Town Hall, San Francisco, CA, September 22, 2011

NPA Sixth Annual Conference, "Leading the Way to Health in Our Communities" Invited Panelist, Washington, DC, October 1, 2011

Cleveland Clinic "Shaping the Future of Cardiovascular Care: Progress and Controversies", Invited Speaker, Cleveland, OH, October 6, 2011

Controversies and Advances in the Treatment of Cardiovascular Disease the Eleventh Series.
Debate: "FDA Evaluation and Approval of New Devices and Drugs: Too Lax and Needs to be More Aggressive", Beverly Hills, CA October 13, 2011

CMTP/CER Second Annual National Leadership Summit, Invited Speaker, Baltimore, MD, October 26, 2011

ASLME Conflicts of Interest in the Practice of Medicine: A National Symposium, Invited Speaker Pittsburgh, PA, October 27, 2011

FDA/IDEAL Frameworks Public Meeting, FDA Conference Center, Facilitator, Silver Spring, MD, December 2, 2011

Northwestern University, Seventh Annual Heart Failure Holiday Symposium, Invited Keynote Speaker, Chicago, IL, December 3, 2011

Women's Cardiovascular Health Conference, Los Angeles, February 2010. "Controversies Re Aspirin & Lipid Lowering Therapies in Women", presenter.

Institute of Medicine (IOM) Roundtable on Value and Science-Driven Health Care. Value Incentives Learning Collaborative, Washington DC, June 15 2012

Penn Medicine AAMC Meeting – Host Committee, November 4, 2012

Providence St. Vincent Medical Center and Providence Portland Medical Center – Presented Lecture "How 'Less is More' Can Increase Value in Health Care: Concrete Examples from Cardiology". December 17 and 18, 2012.

Columbia University Medical Center, New York – Cardiology Grand Rounds Lecture, January 22, 2013.

Mayo Clinic, Rochester, MN – Cardiology Grand Rounds Lecture, April 24-26, 2013

Health Policy Committees

2008 Institute for Clinical and Economic Review (ICER) Cardiac CT Evidence Review Group

2009 Institute for Clinical and Economic Review (ICER) Atrial Fibrillation Evidence Review Group

PROGRAM CHAIR - UCSF Continuing Medical Education

Co-Chair, "Women's Health Issues: Bridging the Gender Gap" - 10/9/93

Co-Chair, "Congenital Heart Disease in the Adult: Clinical and Noninvasive Correlations" - 6/94

Chair, "Heart Disease in Women: Where are we now? Where are we going?" - 12/1/99

Heart Disease in Women - The Magnitude of the Problem

Coronary Prevention in Women - What do the New Guidelines Tell Us?

Diagnostic Testing for CAD in Women - What are the Best Tests for Women?

Chair, "Heart Disease in Women: Where are we now? Where are we going?" - 9/21-9/22/01

Heart Disease and Women - The Magnitude of the Problem

Diagnostic Testing for CAD in Women - What are the Best Tests for Women?

UCSF CME-LECTURES

LOCAL

OB/GYN Grand Rounds - "Pregnancy and Rheumatic Heart Disease" - 10/11/91

Controversies in Women's Health - Management of Women with Heart Disease," SF
12/3/93

UCSF Cardiology Grand Rounds: "Echocardiographic Evaluation of Patients with
Suspected Embolism" - 6/14/95

UCSF Cardiology Grand Rounds: "Diagnosis of Coronary Artery Disease in Women: A Meta
Analysis and Cost-Effective Approach" - 2/06/97

SFGH Cardiology Grand Rounds: "Coronary Heart Disease in Women: Noninvasive
Diagnosis Strategies" - 2/18/97

SFGH Medical Grand Rounds: "Noninvasive Diagnosis Strategies" - 2/28/97

UCSF Medical Grand Rounds: "Evaluation of Cardiovascular Disease in Women" - 3/27/97

UCSF-Medical Grand Rounds: "CAD and Women" - 11/25/97

UCSF Cardiology Grand Rounds: "Noninvasive Diagnosis of Coronary Disease, Stress
Testing or Electron Beam computed Tomography?" - 3/11/98

UCSF Cardiology Grand Rounds: "Predictive Value of Coronary Calcium for Cardiac Events
in an Asymptomatic Population (EBCT)" - 1/19/00

UCSF Annual Review in Family Medicine: "Coronary Disease in Women" 3/30/00

UCSF Obstetrics, Gynecology and Reproductive Sciences CME Program: "Cardiovascular
Disease and Hormone Replacement Therapy" 4/11/02

UCSF Cardiology Grand Rounds, "Health Policy and the 108th Congress: A View from a RWJ
Health Policy Fellow in the US Senate," San Francisco, CA 10/3/04

UCSF Medical Grand Rounds, "Health Policy 2004: A View from the US Senate," San
Francisco, CA 11/4/04

SFGH Grand Rounds, "The 109th Congress and Health Care: A View from a Robert Wood
Johnson Health Policy Fellow in the US Senate," San Francisco, CA 2/15/05.

UCSF Excellence in Heart and Vascular Care Case Managers Conference, "The Truth About
Heart Disease in Women - How You Can Decrease Your Risk." San Francisco, CA 5/10/06.

UCSF Anesthesia Grand Rounds, "American Heart Association/American College of Cardiology
Guidelines and Data from the CARP trial" San Francisco, CA 6/21/06.

UCSF Controversies in Women's Health, "Clinical Strategies in Women's Health I / New Guidelines
for Prevention and Treatment of Heart Disease in Women" San Francisco, CA 12/7/07

UCSF Cardiology Grand Rounds, "Comparative Effectiveness Research in Cardiology: Examples and
Opportunities" San Francisco, CA 12/2/09

UCSF Medical Grand Rounds, "Less is More" San Francisco, CA 6/3/10
UCSF "Publishing Your Research: Tips from editors, reviewers, and mentors" San Francisco, CA 10/28/2010
UCSF "Spurious Data to Salami Science: Research Ethics Pitfalls and How to Avoid Them." 12/01/2010
UCSF Geriatric Grand Rounds, "Less Is More" San Francisco, CA 11/30/11
UCSF Cardiology Grand Rounds, "Less Is More" San Francisco, CA 12/7/11

UCSF ACADEMIC TEACHING SEMINARS

UCSF "Publishing Your Research: Tips from editors, reviewers, and mentors" San Francisco, CA 10/28/2010
UCSF "Spurious Data to Salami Science: Research Ethics Pitfalls and How to Avoid Them." San Francisco, CA 12/01/2010
UCSF "WHO Elective" San Francisco, CA 10/12/2010
UCSF "Women and Heart Disease" San Francisco, CA 06/01/2010
UCSF "Women and Heart Disease: Less is More" San Francisco, CA 02/02/2011

REGIONAL

Advances in Internal Medicine - "Advances in Echocardiography" - 6/21/93
Women and Heart Disease - "Diagnosis of Heart Disease in Women," SF, 10/9/93
Congenital Heart Disease in the Adult: Clinical and Non-Invasive Correlations, San Francisco, 6/12/94; - "Non-Complex Congenital Heart Disease (ASD, VSD, PDA)"
UCSF-Fresno Special Lecture: "Women and Heart Disease" - 4/23/97
Advances in Internal Medicine: "Diagnostic Strategies for Evaluating Coronary Artery Disease in Women" - 5/18/98
UCSF Board Review: Atrial Fibrillation - 9/17/98
UCSF Women's Health Grand Rounds: "Evaluation of Heart Disease in Women: Are There Gender Differences?" - 1/06/99
UCSF 17th Annual "Cardiology for the Practitioner" Symposium: "Controversial Aspects of HRT and the Alternative Therapies in Post Menopausal Women." And "Practical Aspects of Cardiovascular Disease in Women" Yosemite National Park, CA. 10/17-18/00
UCSF Nineteenth Annual "Cardiology for the Practitioner" Symposium: "Cardiovascular Disorders in Women: Evaluation and Management (Including the New HERSII Data)" And "How to Diagnose Vascular Disease in the Asymptomatic Individual: EBCT, MRI, Carotid Scan, Stress Test, Ankle/Brachial Index?"
UCSF Women's Health Clinical Research Center "Exercise Stress Testing in Women: Background and Meta-Analysis" San Francisco, CA 3/10/03
UCSF 10th Annual Women's Health Conference 2020 "Heart Disease: The #1 Killer of Women" San Francisco, CA 3/22/03
UCSF Advances in Internal Medicine, "Diagnosis of CAD in Women - Is It Any Different?" San Francisco, CA 6/16/03
UCSF Twenty-first Annual "Cardiology for the Practitioner" Symposium. "An Update on CV Disorders in Women: How to Close the Gender Gap?" Yosemite, CA 10/20/04.
UCSF Twenty-first Annual "Cardiology for the Practitioner" Symposium. "Quality Indicators in High Tech Era: What Do They Mean and How to Make Them Work for You: Direct Insights from the US Capital." Yosemite, CA 10/20/04.

UCSF Advances in Internal Medicine, "Gender Differences in the Diagnosis and Treatment of Heart Disease," San Francisco, CA 5/25/05
UCSF Advances in Internal Medicine, "Gender Differences in the Diagnosis and Treatment of Heart Disease," San Francisco, CA 6/22/05
UCSF Twenty-second "Cardiology for the Practitioner" Symposium. "CVD Prevention in Women: What's New and What to do?" Yosemite, CA 10/18/05.
UCSF Twenty-second "Cardiology for the Practitioner" Symposium. "How to Navigate the Maze of Diagnostic Tests in Cardiology: Treadmill, Echo, Nuclear, Fast CT, EBCT, etc." Yosemite, CA 10/19/05.
SPRC Research Conference "The Use of Cardiovascular Clinical Trials in Medicare Decision-Making: Is Data Applicable to Medicare Beneficiaries?" Palo Alto, CA 4/25/07

Cardiovascular Conference of the Cascades 2008 (lecture and breakout sessions)
Spectrum Medical Device Symposium at the Li Ka Shing Center for Learning and Knowledge, "A Total Product Lifecycle Approach to Medical Device Development: Responsibilities and Opportunities" Stanford University, CA 9/28/10

"Less is More", Kaiser Oakland Center, Oakland, CA, 10/1/10

Controversies and Advances in Treatment of Cardiovascular Disease, "Too Lax and Needs to be More Aggressive", Town Hall Discussion with the Director of CDRH, Irvine, CA, 10/7/10

Bay Area Clinical Research Symposium, Presenter, San Francisco, CA, 11/4/11

SELECTED OTHER LECTURES

Breary School, NY. - "Health Careers for Women," 12/13/89

Beth Israel Hospital, North, NY - Medicine Grand Rounds "The Usefulness of Echocardiography in Internal Medicine," 12/21/89

Beth Israel Hospital, New York, NY - Cardiology Grand Rounds, "Noninvasive Imaging of the Coronary Arteries," 9/91

American College of Chest Physicians - "Mechanism of Blood Flow in Cardiopulmonary Resuscitation" - Resort at Squaw Creek, CA - 9/22/92

American College of Cardiology- Cardiology Update 1992 -
"Changing Role of TEE in Cardiology," Quail Lodge, CA. 10/2/92

Cardiology Grand Rounds, John Muir Hospital, Walnut Creek, CA -
"Noninvasive Imaging of the Coronary Arteries" - 2/11/93

UCSF Update in Transesophageal Echocardiography: 1993 - San Francisco, CA. 2/18-19/93
"Usefulness of TEE in Resuscitation," "TEE Imaging of the Coronary Arteries,"
"Use of Multiplane TEE Imaging in Mitral Regurgitation" - Palo Alto, CA

Cardiology Hawaii III, Queens Heart Institute - "Coronary Heart Disease in Women: Clinical Syndromes and Diagnostic Testing" - 2/25/93

Mid-Valley Cardiovascular Symposium - "Echocardiography in Ischemic Heart Disease" - Modesto, CA, 03/19/93

Alta Bates Hospital, Oakland, CA - Anesthesiology Grand Rounds - "Emerging Applications of Transesophageal Echocardiography," 04/11/93

American College of Cardiology Learning Center: Conference in Interventional Echocardiography: Transesophageal, Exercise, Pharmacologic and Intravascular - 1) Uses of Contrast in Echocardiography, 2) Imaging the Atherosclerotic Aorta, 3) Coronary Artery Imaging, Heart House, Bethesda, MD 10/93

Primary Care Cardiology Conference, "Women and Heart Disease," Sutter Health, Jackson, CA 11/93

American College of Cardiology Learning Center: Conference in Interventional Echocardiography: Transesophageal, Exercise, Pharmacologic and Intravascular - "Imaging and Pharmacologically Stressing the Coronary Artery Tree with TEE: Is This Technique Ready for Your Hospital?" Heart House, Bethesda, MD, 9/94

Medicine Grand Rounds, Presbyterian Medical Center, "Heart Disease in Women," SF, CA, 5/94

University of Southern California, School of Medicine: Postgraduate program "Health Issues Facing Women" - "Cardiovascular Disease in Women: Assessment and Management," 10/01/94

Cardiac MRI Symposium: "Is Cardiac MRI the Next Great Opportunity in Imaging or Is It Just Another Interesting Technology for Researchers and a Few Select Institutions?" - "State of the Art: Echocardiography," 10/21/94

American Heart Association, San Antonio Chapter - Hormones and Heart Disease, 12/8/94

Cardiology Primary Care Conference, Oregon State University, Corvallis, OR - 01/20/95 "When is Echocardiography Needed in Cerebrovascular Disease?" "Evaluation of Systolic Murmur"

Permanente Medical Group, Oakland, CA; Omniplane TEE teleconference; 03/08/95

Mercy General Hospital, Sacramento: Lecture for Community Outreach program and "Time to Take Notice: Women and Heart Disease" - 05/17-18/95

Young President's Organization, Mountain View, CA - "Maintaining a Healthy Heart" - 05/25/95

American College of Cardiology, Nineteenth Annual Cardiology Update 1995, Carmel, CA - "Do Gender Differences in Coronary Artery Disease Alter Management?" - 10/05/95

Cardiology Grand Rounds, California Pacific Medical Center, SF, CA "Thromboembolic Events: An Echocardiographic Approach" - 04/17/96

American College of Physicians, San Francisco, CA: Women's Health 1996 "Diagnosis and Therapy of Coronary Artery Disease" - 04/27/96

Los Gatos Community Hospital, Los Gatos, CA: UCSF Lecture for Community Hospital Outreach Program "Primary Prevention of Coronary Disease in Women" - 5/16/96

Fall Obstetrics and Gynecology Update, Burlingame, CA: "Special Considerations for Treating Women with Hypertension and Cardiac Disease" - 11/14/96

UCSF The Women's Health Care Provider's Network "An Update on the Diagnosis and Treatment of Hypertension and Heart Disease in Women" - San Francisco, CA, 1/28/97

UCSF - Fresno Special Lecture, "Women and Heart Disease" - Fresno, CA, 4/23/97

Legacy Portland Hospitals Lorenzen Series: Women Physicians' Forum, "Women and Heart Disease: The Untold Story" - Portland, OR, 9/10/97

Medicine Grand Rounds, California Pacific Medical Center, "Gender Differences in Diagnosis of Coronary Artery Disease: Choosing the Right Test for Your Female Patient," San Francisco, CA, 11/18/97

Disease Management Congress: Outcomes Measurement and Quality Improvement, "Preventing and Managing Heart Disease in Women" - Pasadena, CA, 2/12/98

Cardiovascular Disease and Women's Health Issues Conference, "Presentation of Epidemiologic Issues" - Santa Barbara, CA, 9/10/98

The Heart Institute of Spokane, "Coronary Heart Disease in Women: Risk Factors and Diagnostic Testing" - Spokane, WA, 10/3/98

American College of Cardiology, 22nd Annual Cardiology Update 1998, Carmel, CA, 10/8/98

Older Women's Health and Wellness Summit, "Older Women and Heart Disease" - San Francisco, CA, 5/6/99

The North American Menopause Society, 10th Annual Meeting, "Prevention of CV Disease in Women" - New York, NY, 9/23/99.

Clinical Research Outcomes Conference, Emory Center for Outcomes Research, "Predictive Value of Coronary Calcium for Cardiac Events in an Asymptomatic Population (EBCT)" - Atlanta, GA, 12/10/99

CME Program, Seton Medical Center, "Coronary Prevention in Women: What do the New Guidelines Tell Us?" - Daly City, CA, 12/17/99

Cardiovascular Research Conference, UC Davis Medical Center, "Predictive Value of Coronary Calcium for Cardiac Events in an Asymptomatic Population (EBCT)" - Davis, CA, 1/7/00

Cardiology: 2000 The New Millennium Conference, Alta Bates Medical Center, Cardiology, Diagnostic Testing for Coronary Artery Disease in Women - "Gender Differences in Heart Disease" - Berkeley, CA, 2/25/00

Lenox Hill Hospital and American Heart Association CME Program Are Women Really Different.
"Electron Beam Computed Tomography "(EBCT), New York City, 2/29/00

7th Annual Women's Health Conference 2000 (UCSF) - Heart Disease: "#1 Killer of Women"
San Francisco, CA 3/18/00

Sierra Heart Institute's 11th Annual Conference "Trends in Cardiovascular Medicine: Cardiology for the
Primary Care Physician". "Diagnostic Testing for CAD in Women: When to Use? Which Test
Should I Choose? How Do Costs and Efficiency of Each Test Compare?" Reno, NV. 10/22/00

70th John J. Sampson Symposium: "Controversial Aspects of HRT and the Alternative Therapies in Post
Menopausal Women" San Francisco, CA. 6/23/01

California Pacific Medical Center, Medical Grand Rounds: "The Latest on Heart Disease in Women" San
Francisco, CA. 6/26/01

Obstetrics-Gynecology Grand Rounds, University of New Mexico: "Preventive Cardiology for Women"
Albuquerque, NM. 10/12/01

CME Program, Lovelace Clinic: "Menopause and Coronary Artery Disease" Albuquerque, NM. 10/12/01

2nd Annual Women's Health for Primary Care: "Cardiovascular Disease in Women" Albuquerque, NM. 10/13/01

My Health, My Life, My Future: A Health Event for Women: "Heart Health" Albuquerque, NM. 10/13/01

Obstetrics-Gynecology Grand Rounds, Stanford University: "Cardiovascular Disease and Hormone
Replacement Therapy" Stanford, CA. 2/4/02

Obstetrics-Gynecology Grand Rounds, El Camino Hospital "Cardiovascular Disease and Hormone Replacement
Therapy" Mountain View, CA. 3/25/02

Obstetrics-Gynecology Grand Rounds, Washington Hospital "Cardiovascular Disease and Hormone
Replacement Therapy" Fremont, CA. 4/10/02

Panel Member, Guidant: A Call to Action: Women and Heart Disease. St. Paul, MI 4/25/

CME Program, North Shore- Long Island Jewish Health System: "Heart Disease in Women: Continuing
Challenges". Long Island, NY. 1/11/03

Cardiology Grand Rounds, George Washington University Hospital: "Acute Coronary Disease in
Women." Washington DC. 10/22/03

Type 2 Diabetes, The Metabolic Syndrome, and Adult Obesity: Evolving the Paradigm: "Endothelial
reactivity, EBT-Coronary Calcium, Caratoid Intimal Media Thickness PET Imaging of Flow
Reserve" McLean, VA. 01/31/04

CME Program, Hartford Hospital: "Women & Heart Disease – Closing the Gender Gap" Hartford, CT.
2/4/04

Presentation, Institute of Medicine " The 108th Congress: A view from a RWJ Fellow in the office of Senator Hatch" Washington, DC. 4/30/04

Preventive Medicine/Public Health Grand Rounds, Johns Hopkins Bloomberg School of Public Health: "Politics and Public Health: Making Good Health Policy." Baltimore, MD. 5/5/04

Presenter, Coronary Heart Disease In Women: Recognize, Treat & Prevent. An Update from Washington: "Women and Heart Disease: A View from the Hill." NYC. 10/1/04.

Presenter, Senator Orrin and Mrs. Elaine Hatch's 20th Annual Utah Women's Conference, "Discovering the Diversity and Unity of Women", Question and Answer Session about Women's Health: "The Doctor Is In," Salt Lake City, Utah. 10/4/04.

Presenter, The Heart Institute of Spokane's 14th Annual Cardiovascular Update, "Cardiac Testing in Women," Spokane, WA. 10/15/04.

Presenter, Conflicts of Interest in Scientific Publication, Council of Science Editors Retreat, "Private Funder Perspective" (American Heart Association). Oak Brook, IL 10/30/04.

Medicine Grand Rounds, California Pacific Medical Center, "Women and Cardiovascular Disease". San Francisco, CA 11/3/04.

Presenter, UCSF Heart and Vascular Center and UCSF National Center of Excellence in Women's Health, Wear Red Day for Women, "Women and Heart Disease," San Francisco, CA 2/4/05.

Presenter, UC Davis Medical Center's Perspectives in Clinical Cardiology Conference, "Health Policy 2005: A View from the US Senate," Sacramento, CA. 4/29/05

Medicine Grand Rounds, Cottage Hospital, "Cardiac Disease Risk Factors: Gender Differences." Santa Barbara, CA. 5/4/05.

Presenter, St. Jude's Medical Center's Clinical Applications & Beyond Training Seminar, "Gender Differences in the Diagnosis and Treatment of Heart Disease in Women," San Francisco, CA. 6/9-11/05

Presenter, St. Jude's Medical Center's Clinical Applications & Beyond Training Seminar, "Gender Differences in the Diagnosis and Treatment of Heart Disease in Women," Las Vegas, NV. 7/14-17/05

Presenter, Medtronic's Women Physicians in Electrophysiology Program, "Healthcare Policy 2005: Where are we and where are we going?" San Francisco, CA. 10/7/05

Speaker, Los Altos Morning Forum, "The Healthy Heart: How Do We Get It, How Do We Keep It?" Los Altos, CA. 11/1/05

Speaker, GROW – Women's CV Health Symposium, "Risk Factors and Diagnostic Testing for CVD in Women" Phoenix, AZ. 1/27-28/06

Speaker, Reed Medical Education, "Perspectives in Women's Health" 10/11/06.

Speaker, "Cardiovascular Disease in Women" Baltimore, MD 11/3/06.

Presenter, "Faculty Review Process: Appointment and Promotion" UCSF Office of Academic Affairs, Faculty Development and Advancement. Faculty Information and Welcoming Week. San Francisco, CA 9/16/09

Society for Cardiovascular Magnetic Resonance, "Cost-Effectiveness Research and Outcomes Related to Cardiovascular Imaging" Phoenix, AZ 1/22/2010

Speaker, Johns Hopkins University Cardiology Grand Rounds, Baltimore, MD 1/5/11

Speaker, University Hospitals Case Medical Center Department of Medicine Grand Rounds, "Less Is More: How Less Health Care Can Sometimes Be Better For You", Cleveland, OH 3/7/11

Speaker, St. Luke's and Roosevelt Hospitals Cardiovascular Grand Rounds, "Medical Device Approval: Balancing Safety and Innovation, Are We Getting It Right?", New York, NY 3/23/11

INTERNATIONAL INVITED LECTURES

Inter-American Conference in Cardiology, Caracas, Venezuela, 4/94
Hypertension and Left Ventricular Mass, Hypertension in Women

6th International Noninvasive Cardiology Conference, Jerusalem, Israel, 12/20-23/98
"Screening for Heart Disease in Women"

63rd Annual Scientific Meeting of the Japanese Circulation Society, Tokyo, Japan, 3/27-29/99
"Latest technology on Echocardiography"

International Society of Cardiology Symposium, Cordoba, Argentina, 10/99
"Characteristic Features of Cardiovascular Disease in Women"

3rd International Congress in Gender Medicine, Stockholm, Sweden 9/12-14/2008
"Symptoms and diagnostics in CAD"

American Heart Association Scientific Sessions, "Selecting Optimal Patients for Revascularization: Opportunities to Improve Quality, Costs and Patient Outcomes" 11/12/2008

Lancet/JACC 1st Asia Pacific Cardiovascular Summit, Hong Kong, China 7/8-10/2011

COMMUNITY ACTIVITIES

1993-1996 Precept Bay Area high school students in a Cardiology elective
1996 Mentor, Enterprise Program - Ms. MacKencie Geidt
1997 Center of Excellence Internship Program - Edward Chan, Shelley Tanner

1998	Center of Excellence Internship Program - Grace Chen Medical Explorers
2000-2003	Baywood Science Fair
2001-2003	Baywood School Site Council
2001-2005	Baywood School Arts and Science Day Teacher Menlo School Association- Executive Board
2002-Present	Sunday Sandwich Hevre – for Samaritan House – Peninsula Temple Beth El
2006-2008	Beth El Women Board member
2010	University of Pennsylvania, School of Medicine – Host for visiting student, Lindsay Uribe

TEACHING EXPERIENCE

Masters Committee

2006-Present Grace Lin, MD

Clinical Teaching

Cardiology Ward & Consult Attending – supervision of four medical residents, four medical interns and two to three medical students, and two to three pharmacy students in the care of medical inpatients – one to two months per year

Coronary Care Unit Attending – supervision of four medical residents, four medical interns and two to three medical students, and two to three pharmacy students in the care of medical inpatients – over two months per year (1992 – present)

Attending Physician Cardiology Consult Service – supervision of one cardiology fellow, one medical resident and two to three medical students in the consultative care of patients on medical, surgical, cardiac surgical, obstetrical and psychiatric services – one month per year (1992 – present)

ECG Reading with the Cardiology Fellow on rotation (1997 – present).

Treadmill Supervision with Cardiology Fellows and Medical Residents (1997 – present).

Classroom Teaching

1993 – 2000	Medicine 111 Mechanisms of Disease Lecture and guided discussion with third year medical students on Problems in Cardiology IDS 140.22A Medical Problem Solving – Lecture and guided discussion with fourth year medical students on Stress Cardiac Echo and Doppler
1995	Introduction to Clinical Medicine OB/GYN Lecture to 2 nd year medical students on Women's Health
1996 – 1998	Core Curriculums in Cardiology Lecture to medical housestaff, students and fellows on Pericardial Disease
1996	Present Introduction to Clinical Medicine, Medicine – Discussion group for 2 nd year medical students in Cardiology
1996	Management of Valvular Disease Primary Care Residents
1997	Introduction to Clinical Medicine, Medicine Cardiovascular physical examination class for the 1 st year medical students

10/98, 10/99 Pathology 101 Adult Heart Workshop 2nd year Medical Students
 3/1999 OB/GYN Core Lecture Series to medical residents on “Women and Coronary Disease”
 4/1999 – present CCU Lectures: “Screen for Coronary Artery Disease: Use of Electron Beam CT”
 (monthly lecture)
 9/1999 UCSF Housestaff Noon Conferences: “Evidence Based Choices for Diagnostic Testing for CAD”
 4/2000 UCSF Student Enrichment Seminar Series Women in Life Sciences regarding work investigating the issues related to recruitment of women into research studies
 8/2000 Women in Medicine – Professional Issues for Women in Cardiology
 8/2000 ICM Cardiology Small Group Sessions
 9/2001 Categorical Residents Retreat Panel Discussion
 10/2001 Medical Students III Intersession: Clinical Simulation
 2000-02 UCSF Housestaff Noon Conferences: “Cardiovascular Disease in Women,” Moffitt Hospital, San Francisco General Hospital, San Francisco Veteran Affairs Medical Center
 11/23/04 Women’s Health Organization (WHO): Women’s Health Elective, UCSF School of Pharmacy
 4/05, 4/06 Medical Students III Intersession: Healthy Policy Course
 4/28/05 Technology Assessment Panel, Large Group
 11/06, 11/07 Women’s Health Organization (WHO): Women’s Health Elective, UCSF School of Pharmacy
 9/19/07 Primary Care Residents’ Invited Discussant “Journal Club” the COURAGE trial
 12/1/09 Lecture, “Cardiovascular Disease in Women” Women’s Health Elective, UCSF School of Pharmacy
 6/1/10 Lecture, “Women and Heart Disease” Cardiovascular Disease Epidemiology, UCSF School of Nursing
 8/27/10 Lecture, “Cardiac Stress Testing” Department of Medicine Internal Medicine Residents, UCSF School of Medicine
 10/25/11 Clinical and Translational Research Journal Club

Preceptor/Mentor

Mentoring Panel on Rewards and Challenges of Being a Mentor 02/04/07

Dates	Name	Program or School	Faculty Role	Current Position
11/1999-06/2000	Pamela Bates	UCSF, Nurse Practitioner student	Mentor	
1/02 – 3/02	Jennifer De Joya	Nurse Practitioner student	Mentor	
2003- present	Debbie Crabbe	NHLBI Minority KO1 Mentored Development Award Advisory Committee	Mentor	Assistant Professor, UCSF
2005-2008	Grace Lin	UCSF General Medicine Fellow	Mentor	Assistant Professor, UCSF
2006-2007	Sanjiv Singh	UCSF Medical Student	Mentor	-
2006- present	Sanket Dhruva	UCSF Medical Student	Mentor	UCSF Resident
2007-2008	Manisha	UCSF Medical	Mentor	Harvard

	Bahl	Student		School of Public Health
2008-2009	Christian Okoye	UCSF Medical Student, Pisces Program	Mentor	Residency
2008-present	Derrick Chan	FAMRI	Mentor	SUNY Medical Student
2009- present	Rajesh Jaganath	UCSF Medical Student	Mentor	UCSF Medical Student
2009- present	Connie Chen	UCSF Medical Student	Mentor	UCSF Medical Student
2009- present	Ryan Padrez	UCSF Medical Student	Mentor	UCSF Medical Student
2011	Sofia Shames	Columbia University Medical Center	Mentor	Residency

Cardiac Nuclear Imaging

Order of Scheduled Presentations

	Name	Representing
1.	James Caldwell, MD	Professor of Medicine & Radiology University of Washington
2.	Neal Perlmutter, MD	American College of Cardiology

Disclosure

Any unmarked topic will be considered a "Yes"

	Potential Conflict Type	Yes	No
1.	Salary or payments such as consulting fees or honoraria in excess of \$10,000.		X
2.	Equity interests such as stocks, stock options or other ownership interests.		X
3.	Status or position as an officer, board member, trustee, owner.		X
4.	Loan or intellectual property rights.		X
5.	Research funding.	X	
6.	Any other relationship, including travel arrangements.		X

If yes, list name of organizations that relationship(s) are with and for #6, describe other relationship:

Astellas Pharmaceutical: UW investigator as part of multicenter Phase 4 trial of regadenoson plus exercise.

	Potential Conflict Type	Yes	No
7.	Representation: if representing a person or organization, include the name and funding sources (e.g. member dues, governmental/taxes, commercial products or services, grants from industry or government).	X	

If yes to #7, provide name and funding Sources:

Director Nuclear Cardiology U of Washington Medical Center

If you believe that you do not have a conflict but are concerned that it may appear that you do, you may **attach additional sheets** explaining why you believe that you should not be excluded.

I certify that I have read and understand this Conflict of Interest Form and that the information I have provided is true, complete, and correct as of this date.

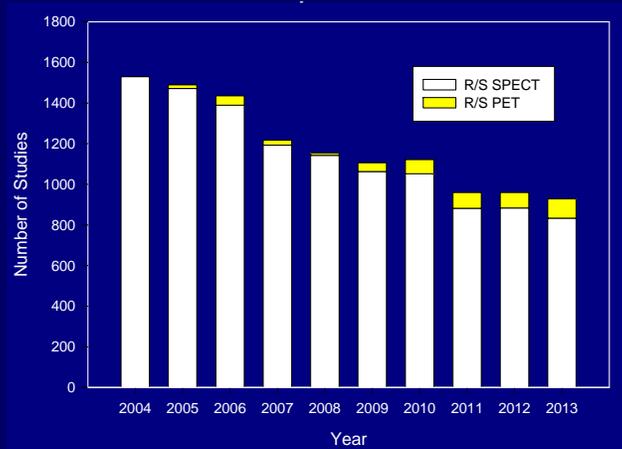
X James H. Caldwell, MD Digitally signed by James H. Caldwell, MD
DN: cn=James H. Caldwell, MD, o=University of Washington, ou=Cardiology, email=jcald@uw.edu, c=US
Date: 2013.08.31 16:50:10 -0700

Signature Date Print Name

For questions contact: Christine Masters
Health Technology Assessment
PO Box 42712
Olympia, WA 98504-2712
360-725-5126

Appropriate Use Criteria Work

UW Med Center All Rest/Stress MPS

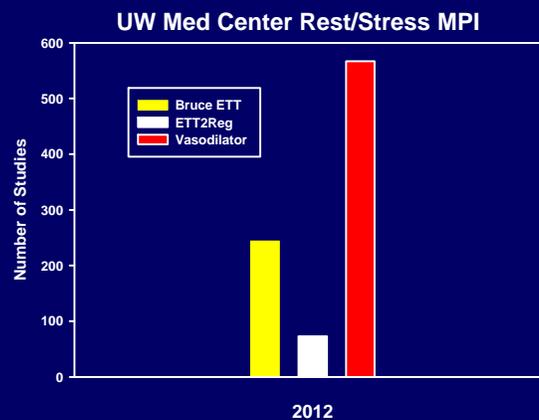


2013 projected based on 6 month data

Caldwell 09/2013

Decision Analytic Model

♥ *“assumed that all patients are fit enough to undergo exercise stress”*



ETT2Reg = “on the fly” conversion from ETT to a vasodilator stress

Caldwell 09/2013

Decision Analytic Model

- ♥ *“All patients are able to complete each test (**exercise patients achieve target heart rate**, stressor infusion is successful, there are no technical failures)”*
- ♥ 23% of UW nuclear ETT's didn't reach target
 - ♥ If were an ETT echo study, then = non-diagnostic
 - ♥ Nuclear with regadenoson
 - ♥ Conversion on treadmill and diagnostic test
 - ♥ + physiologic info (ECG/hemodynamics/duration) for referring provider

Caldwell 09/2013

Decision Analytic Model

- ♥ *“ICA is assumed to have sensitivity and specificity of 100% (i.e., the “gold” standard)”*
- ♥ *“The use of angiography as the gold standard for functional tests such as those under consideration here has been called into question, however, as the mere presence of stenosis has been found to correlate poorly with that of “functionally significant” lesions, especially at moderate levels (e.g., 50-70%) (Tonino, 2010).” CNI Final page 3*
- ♥ *“evidence of test accuracy to detect functionally-significant ischemia is quite limited and not available for all testing strategies of interest.” CNI Final page 124*

Caldwell 09/2013

Decision Analytic Model PET Costs

Table 12. Cost information for treatments considered.

Procedure, CPT Code (Description)	Total Costs	Source
PET 78492 (Heart Image PET, Multiple) J2785 (Regadenoson Injection) A9526 (Ammonia N-13, Per Dose)	\$3,309	Washington HCA

Table 16. Results from patients with intermediate risk (30%) of CAD.

	ECHO	ETT	SPECT	PET	ETT → ECHO	ETT → SPECT	ETT → PET
Total costs/patient [excluding all f/u costs, \$]	2201	1674	2636	4640	1374	1594	2613

- ♥ **Costs high because of low volume**
 - UW: \$1,000 / d for sterility/other safety testing (FDA required)
 - Independent of # of studies / d
 - PET perfusion tracers short $T_{1/2}$ (< 10 min) so no central pharm source

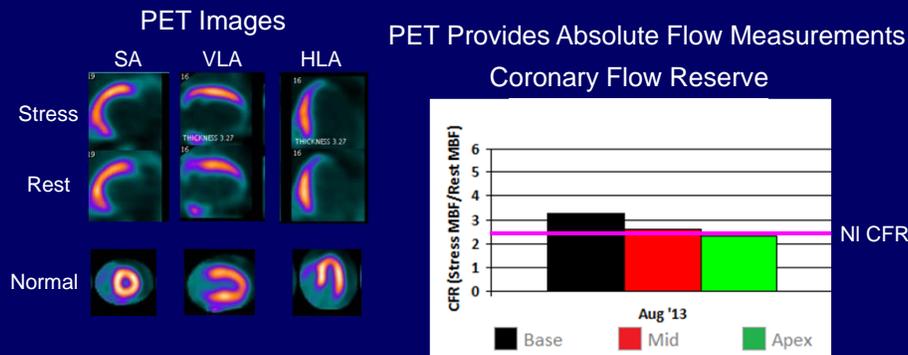
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Decision Analytic Model Fails

- ♥ 58 y/o m
- ♥ Known CAD, atypical CP
- ♥ Implanted Defibrillator
- ♥ Recurrent VT
- ♥ Chronic kidney disease (III)
- ♥ Ejection Fraction 25%
- ♥ All myocardial walls hypo- or akinetic
- ♥ ? Is CP and VT a result of ischemia

Caldwell 09/2013

Rest/Stress PET



CFR = coronary flow reserve = 1/Fractional Flow Reserve

Caldwell 09/2013

Summary

- ♥ **CNI data review appropriate and thorough**
- ♥ **Application of *Appropriate Use Criteria* is decreasing utilization**
- ♥ **Assumptions of *Decision Analytic Model* have significant limitations**
 - Limit applicability of results
- ♥ **Decision by HTA to specify specific test modality should be avoided**
 - Until randomized trials proposed by CNI are completed
 - Decision algorithms developed and validated

Caldwell 09/2013

Disclosure

Any unmarked topic will be considered a "Yes"

	Potential Conflict Type	Yes	No
1.	Salary or payments such as consulting fees or honoraria in excess of \$10,000.		<input checked="" type="checkbox"/>
2.	Equity interests such as stocks, stock options or other ownership interests.		<input checked="" type="checkbox"/>
3.	Status or position as an officer, board member, trustee, owner.		<input checked="" type="checkbox"/>
4.	Loan or intellectual property rights.		<input checked="" type="checkbox"/>
5.	Research funding.		<input checked="" type="checkbox"/>
6.	Any other relationship, including travel arrangements.		<input checked="" type="checkbox"/>

If yes, list name of organizations that relationship(s) are with and for #6, describe other relationship:

	Potential Conflict Type	Yes	No
7.	Representation: if representing a person or organization, include the name and funding sources (e.g. member dues, governmental/taxes, commercial products or services, grants from industry or government).	<input checked="" type="checkbox"/>	

If yes to #7, provide name and funding Sources:

Washington Chapter, American College of
Cardiology - no funding sources involved

If you believe that you do not have a conflict but are concerned that it may appear that you do, you may attach additional sheets explaining why you believe that you should not be excluded.

I certify that I have read and understand this Conflict of Interest Form and that the information I have provided is true, complete, and correct as of this date.

X Neal S. Perlmutter 8/30/13 Neal S. Perlmutter
Signature Date Print Name

For questions contact: Christine Masters
Health Technology Assessment
PO Box 42712
Olympia, WA 98504-2712
360-725-5126

360-586-3545

Cardiac Nuclear Imaging

State Agency Utilization & Outcomes

*Kerilyn K. Nobuhara MD MHA
Senior Medical Consultant
Health Care Authority
September 20, 2013*

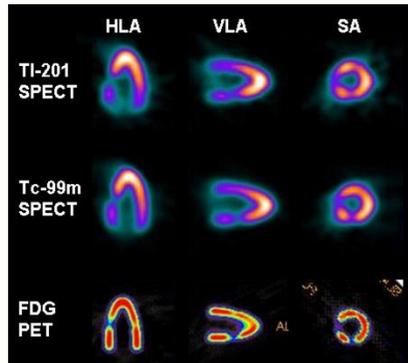
Cardiac Nuclear Imaging: Background



- Noninvasive assessment of myocardial perfusion
- Spatial and temporal resolution continues to advance
- Widely utilized
- Myocardial perfusion scans:
 - SPECT
 - PET
 - Hybrid
- Comparator selection challenging
 - Stress echo
 - Functional evaluation
 - Coronary angiography
 - Anatomic evaluation

2

Cardiac Nuclear Imaging: PET vs. SPECT



- SPECT scanning more widely available
- SPECT does not provide a quantifiable estimate of blood flow
- SPECT scanning subject to attenuation artifact
- PET imaging higher resolution
- PET scan and radiotracer higher cost

3

Cardiac Nuclear Imaging: Background

- **Risk of Coronary artery disease for asymptomatic adults**
 - Low
 - Intermediate
 - High
- **Multitude of scoring systems**
 - Framingham Global Risk assessment scoring: age, sex, total cholesterol, HDL cholesterol, smoking, SBP, DM
 - SCORE: age, sex, total-HDL cholesterol ratio, smoking, SBP
 - PROCAM (men): Age, LDL, HDL cholesterol, smoking, SBP, family history, diabetes, triglycerides
 - Reynolds (women): Age, HbA1C, DM, smoking, SBP, total/HDL cholesterol, CRP, parental history of MI at <60 years of age

"2010 ACCF/AHA Guideline for Assessment of Cardiovascular Risk in Asymptomatic Adults," JACC 56:25, 350-103, 2010.

4

Cardiac Nuclear Imaging: Background

- 2009 American College of Cardiology Foundation/
American Society of Nuclear Cardiology/
American College of Radiology/American Heart
Association/American Society of Echocardiography/
Society of Cardiovascular Computed Tomography/
Society for Cardiovascular Magnetic Resonance/
Society of Nuclear Medicine
 - Appropriate use criteria
- Risk assessment: Framingham (asymptomatic), Diamond,
Forrester, ATP III

"2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging," Circulation; 119:2009.

5

State Agency Utilization

Agency/Year	2009	2010	2011	2012	4 year Overall Total
PEBB**					
Average Annual Members	210,501	213,487	212,596	212,684	
Non-emergent care					
Patients	4510	4115	3940	3826	13,727
Encounters	4866	4405	4194	4145	17,610
Total Paid	\$3,569,485	\$2,483,458	\$2,502,694	\$2,277,985	\$10,833,622
Average Paid/Encounter	\$734	\$564	\$597	\$550	\$615
Average Paid, Primary	\$1,232	\$991	\$1,083	\$1,036	\$1,304
Average Encounters/Patient	1.1 (1.8)	1.1 (1.7)	1.1 (1.7)	1.1 (1.9)	1.3 (2.7)
Max Encounters / Patient	7	5	5	7	12

6

State Agency Utilization

Agency/Year	2009	2010	2011	2012	4 year Overall Total
Medicaid FFS Population	463,966	474,676	473,356	477,727	
Non-emergent care					
Patients	2331	1796	2313	1959	7841
Encounters	2483	1908	2450	2073	8914
Total Paid	\$811,951	\$746,114	\$933,608	\$639,626	\$3,131,299
Average Paid/Encounter	\$327	\$391	\$381	\$309	\$351
Average Paid, Primary	\$332	\$441	\$543	\$494	\$438
Average Encounters/Patient	1.1 (1.7)	1.1 (1.7)	1.1 (1.7)	1.1 (1.8)	1.1 (2.2)
Max Encounters / Patient	5	6	6	6	11

7

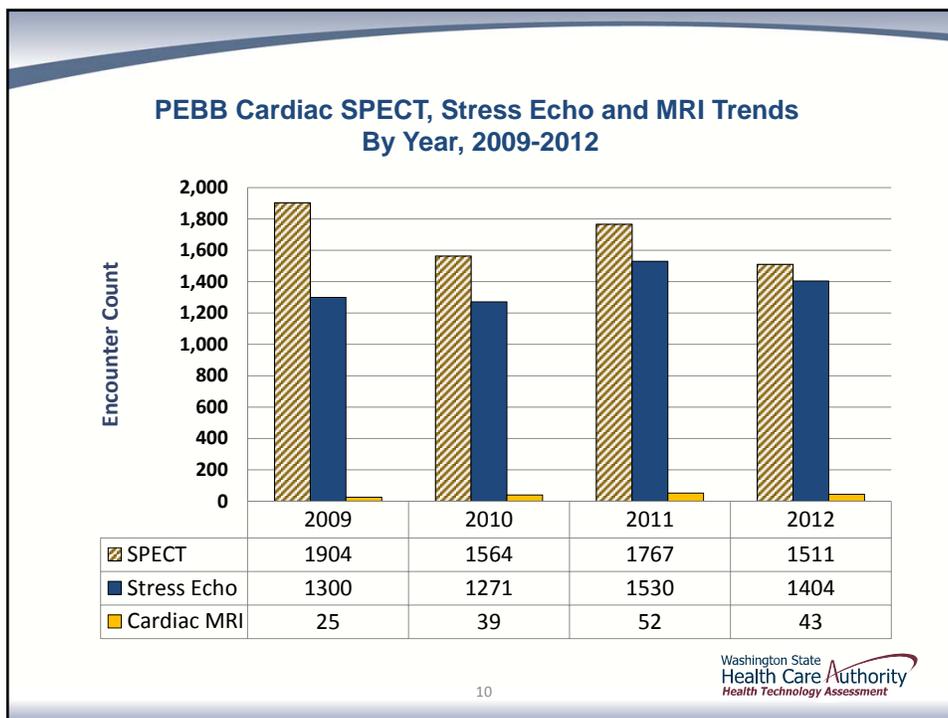
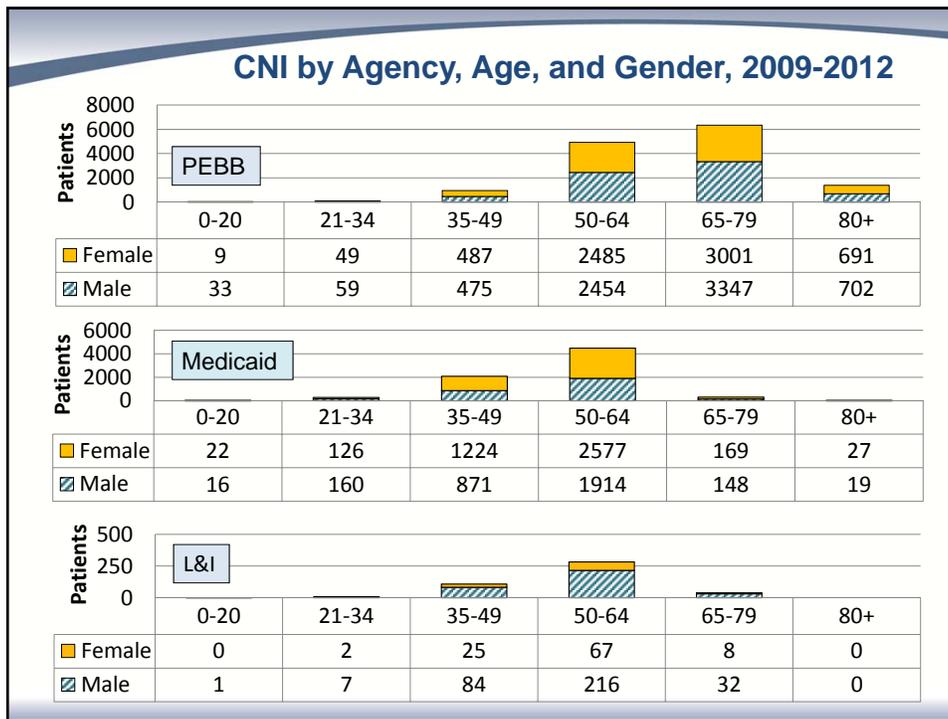
Washington State
Health Care Authority
Health Technology Assessment

State Agency Utilization

L&I					
L&I Annual Claims	125,611	122,712	121,043	121,660	
Non-emergent care					
Patients	145	118	98	82	429
Encounters	151	123	105	87	466
Total Paid	\$187,232	\$118,810	\$100,913	\$77,500	\$484,456
Average Paid/Encounter	\$1,240	\$966	\$961	\$891	\$1,040
Average Encounters/Patient	1(1.4)	1(1.4)	1.1(1.6)	1.1(1.5)	1.1(1.7)
Max Encounters / Patient	2	2	2	2	3

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Repeat SPECT Procedures, 2009-2012

PEBB

Number Images	Number Patients (n=13,727)	Average Days Between Imaging Procedures
2	2,200	492.8
3	604	373.2
4	180	306.4
5	41	236.6
6	16	217.4
7	6	170.8
8	1	100.3

Medicaid

Number Images	Number Patients (n=7841)	Average Days Between Imaging Procedures
2	562	328.0
3	77	273.6
4	24	172.6
5	11	123.9
6	5	110.1
7	2	67.4
8	6	137.8
11	1	64.9

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Current State Policy

CPT	Description	UMP	DOC	Medicaid	LNI
78451	Myocardial perfusion imaging, tomographic (SPECT), at rest or stress	PA	PA	PA	PA
78452	SPECT, multiple studies, at rest and/or stress and/or redistribution	PA	PA	PA	PA
78453	Myocardial perfusion imaging, planar, at rest or stress	PA	PA	PA	PA
78454	Multiple studies, at rest and/or stress and/or redistribution	PA	PA	PA	PA
78491	Myocardial imaging, PET, perfusion; single study at rest or stress	PA	PA	NC	PA
78492	Myocardial imaging, PET, perfusion; multiple studies at rest and/or stress	PA	PA	NC	PA
78499	Unlisted cardiovascular procedure, diagnostic nuclear medicine	PA	PA	PA	PA
93350	Echocardiography, during rest and cardiovascular stress	PA	PA	C	C
93351	Including performance of continuous ECG monitoring, with supervision by a physician	PA	PA	C	C

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NCD for Cardiac Nuclear Imaging

- **National Coverage Determination 220.12 (10/1/2002)**
 - Local contractor discretion
 - In the case of myocardial viability, FDG PET may be used following a SPECT that was found to be inconclusive. However, SPECT may not be used following an inconclusive FDG PET performed to evaluate myocardial viability.
 - Presently under review
- **National Coverage Determination 220.6.8 (4/18/2005)**
 - Medicare covers FDG PET for the determination of myocardial viability as a primary or initial diagnostic study prior to revascularization, or following an inconclusive SPECT. Studies performed by full and partial ring scanners are covered.

[http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=67&NcaName=Positron+Emission+Tomography+\(FDG\)+for+Myocardial+Viability&NCDId=331&ncdver=3&IsPopup=y&bc=AAAAAAAAAAAA%3d%3d&](http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=67&NcaName=Positron+Emission+Tomography+(FDG)+for+Myocardial+Viability&NCDId=331&ncdver=3&IsPopup=y&bc=AAAAAAAAAAAA%3d%3d&)

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Myocardial Perfusion Imaging (L31072)

- Abnormal ECG with a high likelihood of coronary artery disease (CAD) based on multiple risk factors or strongly suggestive symptoms.
- Interpretation of a standard exercise test inaccurate because of cardiac medications
- Abnormal standard stress test or non diagnostic/inaccurate standard stress test and further evaluation is medically necessary
- Determine the significance or the extent of myocardial ischemia or to assess myocardial viability
- History of cardiovascular reperfusion and perfusion imaging is being done to evaluate the effectiveness of the intervention when the patient is symptomatic
- Functional capacity is being assessed when adequate information is not available from the clinical assessment
- Ventricular wall motion abnormality demonstrated by another imaging modality, and perfusion imaging is needed to further evaluate the abnormality
- Aid in diagnosis of hypertrophic or dilated cardiomyopathy, or to differentiate ischemic from non ischemic cardiomyopathy
- Evaluate a patient receiving chemotherapeutic drugs which are potentially cardio toxic
- Risk assessment of an intermediate-risk CAD patient prior to high-risk surgery
- Known CAD with a new onset/significant change in symptoms.
- Previously documented silent ischemia where further therapeutic or clinical management decisions are expected
- Silent ischemia is considered highly probable
- Post heart transplant for assessment of coronary arteriopathy or ventricular dysfunction
- Select patients presenting with chest pain to the Emergency Department
- Previous diagnosis of intermediate coronary syndrome, (unstable angina) who is "medically stable," may be a candidate for nuclear imaging, typically to ascertain whether or not angiography is warranted

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AMDG Workgroup Perspective

Primary Criteria Ranking: Initial

Safety = Medium

Efficacy = Medium

Cost = High

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Cardiac Nuclear Imaging Agency Key Questions

Safety = Medium concern

- Radiation exposure
- Repetitive testing
- Downstream effect on appropriateness of referral to coronary angiography

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Cardiac Nuclear Imaging Agency Key Questions

Effectiveness = Medium concern

- Comparative value of ETT vs. Echo vs. SPECT vs. PET imaging
- Does adherence to radionuclide clinical guideline improve clinical outcomes as well as decrease rates of utilization ?

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Cardiac Nuclear Imaging Agency Key Questions

Cost = High concern

- High volume of utilization
- Widespread use

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Agency Considerations

- Higher quality of evidence supporting comparative value of SPECT vs. PET for myocardial perfusion imaging
- Vendor report supports Appropriate Use Criteria for most targeted populations EXCEPT for:
 - Asymptomatic patients at high risk of CAD for diagnosis
 - Ranked as appropriate by joint technical panel
- Limited evidence available addressing use of PET as primary study vs. SPECT imaging

AHRQ, "Noninvasive Technologies for the Diagnosis of Coronary Artery Disease in Women: Future Research Needs," Future Research Needs Paper Number 41, February 2013.

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Agency Recommendations: Myocardial Nuclear Imaging

SPECT

Cover with conditions:

- Symptomatic patients at low, intermediate and high risk of coronary artery disease
- Patients with known coronary artery disease who have worsening in symptoms

Not covered:

- Screening for patients with known coronary artery disease with no changes in symptoms
- Screening for asymptomatic patients at low, intermediate and high risk of CAD

PET

Cover with conditions:

- SPECT scan inconclusive or not technically feasible

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Questions?

More Information:

<http://www.hta.hca.wa.gov/nuclear.html>

Cardiac Nuclear Imaging

An Assessment of Comparative Clinical Effectiveness & Comparative Value

Presented to the Washington State Health Care Authority by
Daniel A. Ollendorf, MPH
September 20, 2013



Overview

- Project Scope, Comparators, Outcomes of Interest
- Systematic Review of Published Evidence
- Comparative Value
- Evidence Ratings
- Clinical Guidelines
- Payer Coverage Policies
- Summary

2



Background

- Coronary artery disease (CAD) in the U.S.
 - Affects over 16 million adults
 - ~1 million acute coronary events & 400,000 deaths annually
- Diagnosis/risk stratification of CAD
 - Anatomic evaluation: presence or absence of physical stenosis
 - Standard: invasive coronary angiography and its associated risks (e.g., trauma, stroke)

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Background

- Diagnosis/risk stratification of CAD
 - Functional assessment: identification of location of defects of myocardial perfusion (blood flow to the heart)
- Correlation of anatomic and functional data quite weak:
 - Obstructive lesions are often not “functionally important” except when blockage is nearly complete
 - Anatomic findings from angiography still used to guide many treatment decisions despite findings from recent studies

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Non-invasive Functional Testing

- Multiple techniques to test for presence of ischemia
- Common tests: stress electrocardiogram (or exercise treadmill test [ETT]), stress echocardiogram (stress ECHO)
 - ETT: abnormal electrical signals indicative of ischemia
 - Stress ECHO: abnormalities in wall motion
- Cardiac nuclear imaging tests developed to directly measure myocardial perfusion

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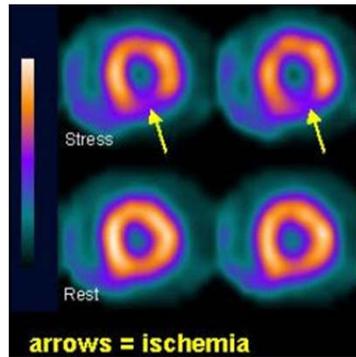
Tests of Interest

- Most widely used test: single photon emission computed tomography (SPECT)
 - Emerging technology: positron emission tomography (PET)
 - 3-D imagery of myocardial perfusion
 - Stress-only and Stress/rest protocols
 - Treadmill, bicycle or pharmacologic stressors
 - Radioactive tracers
 - Technical considerations: EKG gating, attenuation correction

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Test Results (Example)



- Cross-sectional images of multiple areas of myocardium
- Rest vs. stress images illustrate differential uptake of radioactive tracer during periods of exertion

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Medscape (2013). Available at: <http://emedicine.medscape.com/article/2114292-overview>.
 Courtesy of Philipp A Kaufmann, MD, and Oliver Gämperli, MD, University Hospital Zurich.



Other Tests

- Coronary Computed Tomography Angiography (CCTA)
 - Currently provides anatomic data only; CCTA-based perfusion studies currently under investigation
 - Washington HTA decision on CCTA in 2008
- Cardiac magnetic resonance (CMR)
 - Newly emerging technology
- Hybrid imaging
 - SPECT or PET combined with CCTA or MRI technology
 - Perfusion and anatomical information fused into single report

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Policy Context

- Increased utilization of cardiac nuclear imaging
 - 1999: 7 million tests → 2005: 11 million tests¹
- Declining rates of abnormal findings²
 - 1991-1995: 40.9%
 - 2006-2009: 8.7%
- Differences in cost, risks and availability among diagnostic strategies
- Interest in understanding their comparative effects

1: IMV Medical Information Division, 2011; 2: Rozanski A, et al. *J Am Coll Cardiol.* 2013 ;61(10):1054-1065.

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Key Questions

- 1) **How do SPECT, PET, and relevant hybrid imaging modalities compare to other non-invasive functional tests in their ability to guide the management and improve the outcomes of:**
 - A. Asymptomatic patients at high risk of CAD due to existing comorbidities?
 - B. Patients at (1) low-to-intermediate or (2) high risk of CAD who have symptoms suggestive of myocardial ischemia?
 - C. Patients with known CAD who have changes in symptoms?
 - D. Patients with known CAD who have no changes in symptoms?
- 2) **What are the risks associated with these tests, including contrast and radiotracer reactions, patient anxiety, and radiation exposure?**

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Key Questions

3) What is the impact on the comparative benefits and risks of these tests of differences in:

- A. Patient age, sex, race or ethnicity, and comorbidities (e.g. obesity)
- B. Clinical setting (e.g. emergency department vs. outpatient)
- C. Selection of test by primary care vs. specialty physician
- D. Scan vendor, type of assessment (i.e., quantitative vs. qualitative), type of radioisotope, and type of stressor (e.g., adenosine, exercise)

4) What are the costs and the incremental cost-effectiveness of these testing options when used within patient populations that vary by underlying prevalence of CAD and other patient characteristics?

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Project Scope

Population:

- Asymptomatic high-risk patients
- Symptomatic patients at low, intermediate or high risk
- Patients with known CAD to guide treatment selection as well as post-procedure or post-event monitoring

Tests:

- SPECT
- PET
- Hybrid tests e.g. PET/MRI, PET/CCTA and SPECT/CCTA

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Project Scope

CAD Risk:

- Based generally on considerations of “pretest probability” as first defined by Diamond and Forrester
 - Low: <10%
 - Intermediate: 10-90%
 - High: >90%
- Based on age, sex, and type of chest pain
- Often overestimates actual underlying prevalence, particularly in women
- Other risk classification systems used, data abstracted on system employed where available

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Project Scope

Comparators:

- ETT
- Stress ECHO

Outcomes:

- Cardiovascular-related and all-cause mortality
- Incidence of major cardiovascular events (e.g., MI, stroke, revasc)
- Health-related quality of life
- Referral for subsequent testing
- Clinical impression and/ or decision making

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Literature Search

- Published studies Jan 1996 – Feb 2013
- Comparative studies only:
 - Different groups receiving different tests
 - Single group receiving multiple tests
 - Comparisons to “no-test” strategies
- Diagnostic accuracy studies abstracted in detail if “functional reference standard” used (e.g., FFR)

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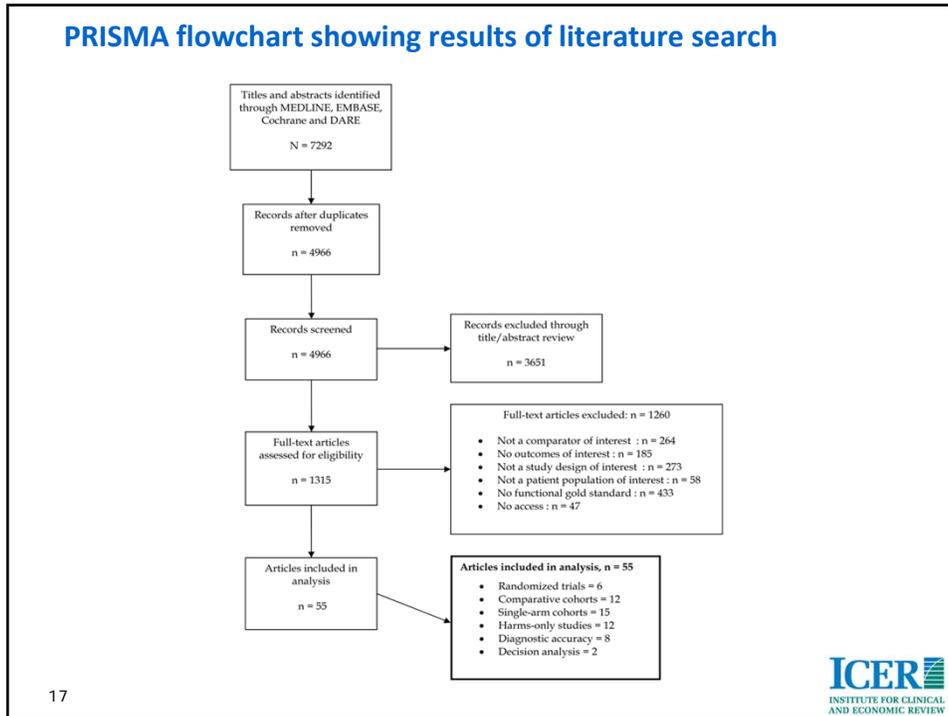


Quality & Strength of Evidence

- Quality of Individual Studies:
 - RCTs/Cohorts: USPSTF Criteria
 - Diagnostic Accuracy Studies: QUADAS-2
- Overall Strength of Evidence:
 - Risk of bias: study design and quality
 - Consistency: direction and magnitude of findings
 - Directness: direct comparison of major interventions and/or direct measurement of key outcomes
 - Precision: confidence interval around estimates of intervention effect

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Findings

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Quality & Type of Evidence

- 14 RCTs and comparative cohorts with clinical outcome data:
 - 3 good-quality, 8 fair-quality
 - Data on PET extremely limited
 - No comparative studies of asymptomatic patients with known CAD
- 10 of 14 in “mixed” populations (e.g., symptoms, risk, inclusion of known CAD)
- Heterogeneity of study populations and comparators precluded meta-analyses of data

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KQ1: Impact on Patient Management and Outcomes

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Asymptomatic patients at high CAD risk (1 RCT; N=1,123):

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND RISK OF CARDIOVASCULAR EVENTS			
SPECT	No Screening	Low	No differences
PET	<i>No studies</i>		
Hybrid Tests	<i>No studies</i>		
DOWNSTREAM TESTING AND CLINICAL DECISION MAKING			
SPECT	No Screening	Low	SPECT: higher rate of referral to angiography No screening: higher rate of downstream stress testing (Mixed evidence)
PET	<i>No studies</i>		
Hybrid Tests	<i>No studies</i>		
HEALTH-RELATED QUALITY OF LIFE			
<i>No studies</i>			

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Symptomatic patients at low-intermediate risk (1 RCT, 3 Cohorts, N=24,458):

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND RISK OF CARDIOVASCULAR EVENTS			
SPECT	ETT, angiography, ECHO, stress vs. stress-rest	Moderate	Mixed evidence vs. ETT; no difference vs. ECHO
PET	<i>No studies</i>		
Hybrid	<i>No studies</i>		
DOWNSTREAM TESTING AND CLINICAL DECISION MAKING			
SPECT	ETT	Low	Mixed (>repeat testing for SPECT; >crossover for ETT)
PET	<i>No studies</i>		
Hybrid	<i>No studies</i>		
HEALTH-RELATED QUALITY OF LIFE			
SPECT	ETT	Low	No differences

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Symptomatic patients at high risk (1 RCT, 3 Cohorts, N=4,279):

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND RISK OF CARDIOVASCULAR EVENTS			
SPECT	ETT, angiography, ECHO, stress vs. stress-rest	Moderate	Reduced revasc rate vs. ETT; no difference vs. ECHO; mixed evidence vs. PET and CCTA
PET	SPECT or CCTA	Insufficient	
Hybrid SPECT/CCTA	Matched vs. unmatched images	Insufficient	
DOWNSTREAM TESTING AND CLINICAL DECISION MAKING			
SPECT	ETT, PET or CCTA	Low	Reduced rate of unnecessary angiography vs. ETT; mixed evidence vs. PET and CCTA
PET	SPECT or CCTA	Insufficient	
Hybrid SPECT/CCTA	Matched vs. unmatched images	Insufficient	
HEALTH-RELATED QUALITY OF LIFE			
<i>No Studies</i>			

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INSTITUTE FOR CLINICAL AND ECONOMIC REVIEW

Patients with known CAD (2 Cohorts, N=5,098):

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND RISK OF CARDIOVASCULAR EVENTS			
SPECT	Angiography sequence, by tracer	Insufficient	
PET	<i>No studies</i>		
Hybrid	<i>No studies</i>		
DOWNSTREAM TESTING AND CLINICAL DECISION MAKING			
SPECT	<i>No studies</i>		
PET	Patient management before/ after PET	Insufficient	
Hybrid	<i>No studies</i>		
HEALTH-RELATED QUALITY OF LIFE			
<i>No studies</i>			

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ICER
INSTITUTE FOR CLINICAL AND ECONOMIC REVIEW

Mixed populations (2 RCTs, 6 Cohorts, N=5,439):

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND RISK OF CARDIOVASCULAR EVENTS			
SPECT	ECHO, ETT, PET, CMR, angiography	Moderate	Mixed evidence vs. ECHO and PET; better prediction of mortality vs. ETT
PET	SPECT	Low	PET superior to SPECT for revasc; no other differences
Hybrid SPECT/CCTA	Matched vs. unmatched images	Insufficient	
DOWNSTREAM TESTING AND CLINICAL DECISION MAKING			
SPECT	ECHO, CMR, angiography, ETT	Low	No difference vs. ECHO, CMR, angiography; superior to ETT for angiography referral
PET	SPECT	Insufficient	PET superior for angiography referral
Hybrid	<i>No studies</i>		
HEALTH-RELATED QUALITY OF LIFE			
SPECT	ECHO, CMR, angiography	Low	No differences
PET	<i>No studies</i>		
Hybrid	<i>No studies</i>		

Diagnostic Accuracy

- 8 studies identified assessing accuracy of SPECT or PET using functional reference standard
 - Primarily in populations w/history of CAD
- FFR the most common reference standard:
 - Thresholds varied
 - In some studies, FFR or anatomic stenosis defined positivity
- Wide reported range of sensitivity/specificity:

Measure (%)	SPECT	PET
Sensitivity	58 – 90	76 – 95
Specificity	50 – 100	83 -- 91

KQ2: Risks of Testing

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Risks of Testing (2 RCTs, N=1,670)

TEST	COMPARATOR	ADVERSE EFFECT	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
SPECT	ETT vs. SPECT with no stressor	Chest pain	Low	No differences
SPECT	ETT vs. SPECT with no stressor	Dyspnea	Low	No differences
SPECT	ECHO/MRI/angiography vs. SPECT with adenosine as stressor	Chest pain	Low	No differences

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Radiation Exposure

Radiation exposure scenario	Approximate effective dose (mSv)
Chest x-ray	0.02
Round-trip flight, New York-Seattle	0.06
Low-dose CT colonography	0.5-2.5
Lumbar spine x-ray	1.3
Head CT	2.0
Single-screening mammogram (breast dose)	3.0
Annual background dose caused by natural radiation	3.0/yr
CCTA	2.0-14.0
Cardiac PET Imaging	2.0-14.0
Invasive coronary angiography	5.0-7.0
Adult abdominal CT scan	10.0
Cardiac SPECT Imaging	7.0-30.0
Typical dose to A-bomb survivor at 2.3 km distance from ground zero Hiroshima	13.0
Annual radiation worker annual exposure limit	50.0/yr
Annual exposure on international space station	170.0/yr

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KQ3: Differential Impact of Nuclear Imaging in Key Subgroups

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Comparative Evidence in Key Subgroups (3 Cohorts, N=20,819)

TEST	COMPARATOR	STRENGTH OF EVIDENCE	DIRECTION OF EFFECT
MORTALITY AND CARDIOVASCULAR EVENTS			
Patient Demographics: Sex			
SPECT	Stress vs. stress rest. Sub group: Men vs. Women	Insufficient	
Patient Demographics: Age			
SPECT	Stress vs. stress rest Sub group: Age <65 vs. Age>65	Insufficient	
Patient Demographics: Comorbidities			
SPECT	Stress vs. stress rest Sub groups: Obesity (<30 kg/m ² vs. >30 kg/m ²), Diabetes	Insufficient	
Clinical setting			
SPECT	Stress vs. stress rest Subgroup: Inpatient vs. Outpatient	Insufficient	
Scan vendor, tracer type, stressor type			
SPECT	Tetrofosmin vs. sestamibi Subgroup: Tetrofosmin vs. sestamibi	Moderate	No differences
SPECT	Stress vs. stress and rest: Subgroup: Exercise vs. pharm. Stress	Insufficient	

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Comparative Evidence in Key Subgroups

- Available subgroup data from studies of *individual* tests suggest comparable performance by age, sex, and certain comorbidities (e.g., diabetes, hypertension)
 - SPECT performance comparable in obese, overweight, and normal-weight populations
- Analyses of SPECT ordering vs. appropriate use criteria suggest inappropriate ordering more common among nonspecialists:
 - Most inappropriate ordering occurs in women, asymptomatic individuals, and younger patients

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KQ4: Economic Impact of Cardiac Nuclear Imaging

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Economic Impact of Cardiac Nuclear Imaging: Prior Published Evidence

- Asymptomatic, high risk:
 - Single decision analysis (published before 2009 RCT) suggests one-time SPECT, ECHO, and ETT screening all slightly more effective (~10 quality-adjusted days of survival gained over lifetime) and slightly more costly vs. no screening
 - Benefits of repeat screening at intervals <10 yrs were minimal and additional costs substantial
- Symptomatic, low-to-intermediate risk:
 - Findings from RCTs and cohort studies suggest that ETT-first strategies may be cost-saving or cost-neutral vs. SPECT-first
- Mixed populations
 - Comparative cohort study suggests lower costs for PET vs. SPECT due to fewer unnecessary referrals for angiography

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Economic Impact of Cardiac Nuclear Imaging: Decision-Analytic Model

- Target Population:
 - Patients with stable symptoms of ischemia (e.g., chest pain, dyspnea) with suspected or known CAD
- Strategies:
 - SPECT, PET, ETT, and ECHO as stand-alone tests
 - ETT→SPECT, PET, or ECHO
 - Definitive diagnosis provided by angiography
- Costs
 - Based on HCA payment data

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Economic Impact of Cardiac Nuclear Imaging: Decision-Analytic Model

- Outcomes (per 1,000 tested):
 - Diagnostic results of testing, referrals to angiography, angiography-related deaths, extracardiac findings, radiation exposure
 - Generated for patients at low (10%), intermediate (30%), and high (50-70%) underlying CAD prevalence
- Key assumptions:
 - Ability to exercise, target heart rate achieved
 - Anatomic data drives angiography results (and ultimate treatment decisions)
 - Functional data used where available in sensitivity analyses
 - PET analyses considered exploratory given limited evidence of impact on patient outcomes

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Economic Impact of Cardiac Nuclear Imaging: Model Results (50% CAD Prevalence)

Result (per 1000 tested)	ECHO	ETT	SPECT	PET	ETT→ ECHO	ETT→ SPECT	ETT→ PET
TP	437	365	416	464	320	305	340
FP	163	194	130	111	64	51	43
TN	336	305	370	389	436	449	457
FN	61	133	82	34	178	193	158
Angio referral	603	562	549	578	386	358	386
Angio negative	163	194	130	111	64	51	43
Angio death	4	3	3	3	2	2	2
Exposed to radiation	603	562	1000	1000	386	562	562
Incidental findings	57	0	8	8	32	5	5
Cost per patient	\$2538	\$1883	\$2987	\$5074	\$1737	\$1996	\$3204

Economic Impact of Cardiac Nuclear Imaging: Model Results (10% CAD Prevalence)

Result (per 1000 tested)	ECHO	ETT	SPECT	PET	ETT→ ECHO	ETT→ SPECT	ETT→ PET
TP	87	73	83	93	64	61	68
FP	293	350	233	199	115	91	78
TN	605	548	665	700	785	808	822
FN	12	27	16	7	36	39	32
Angio referral	383	425	319	294	180	153	147
Angio negative	293	350	233	199	115	92	78
Angio death	2	3	2	2	1	1	1
Exposed to radiation	383	425	1000	1000	180	425	425
Incidental findings	57	0	8	8	24	4	4
Cost per patient	\$1865	\$1464	\$2284	\$4206	\$1011	\$1191	\$2021

Economic Impact of Cardiac Nuclear Imaging: Model Summary

- Tradeoffs between tests vary depending on underlying prevalence of CAD:
 - Concerns with false-negatives increase with increasing prevalence
 - Differences in false-positive rates are magnified with decreasing prevalence
 - 2-test strategies perform best at lower prevalence levels
- Limited PET data on diagnostic accuracy suggest reduced false-positives and false-negatives, but at a substantially higher cost
- Radiation exposure and other tradeoffs also important to consider

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Integrated Evidence Ratings

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ICER Rating Matrix

<i>Comparative Clinical Effectiveness</i>	Superior: A	Aa	Ab	Ac
	Incremental: B ⁺ /B	B ⁺ a Ba	B ⁺ b Bb	B ⁺ c Bc
	Comparable: C ⁺ /C	C ⁺ a Ca	C ⁺ b Cb	C ⁺ c Cc
	Inferior: D	Da	Db	Dc
	Promising but Inconclusive: P/I	Pa	Pb	Pc
	Insufficient: I	I	I	I
		a High	b Reasonable/Comp	c Low

Comparative Value



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Evidence Ratings by Population

- Asymptomatic, High-Risk Individuals
 - SPECT vs. No Screening: Cc
 - SPECT vs. ETT or ECHO: I
 - PET vs. any Alternative: I
 - Hybrid vs. any Alternative: I
- Symptomatic Patients at Low-Intermediate CAD Risk:
 - SPECT vs. ETT: C+c
 - SPECT vs. ECHO: Cb
 - PET vs. any Alternative: I
 - Hybrid vs. any Alternative: I



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Evidence Ratings by Population

- Symptomatic Patients at High CAD Risk:

- SPECT vs. ETT: B+b
- SPECT vs. ECHO: Cb
- PET vs. any Alternative: I
- Hybrid vs. any Alternative: I

- Known CAD (with new symptoms)*:

- SPECT vs. ETT: I
- SPECT vs. ECHO: Cb
- PET vs. any Alternative: I
- Hybrid vs. any Alternative: I

*Evidence is "Insufficient" for asymptomatic populations with known CAD

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Clinical Practice Guidelines

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Practice Guidelines

- Sources:
 - Multi-specialty (ACCF, ACR, etc.) appropriate use criteria (2009) and guidelines for diagnosis and management of patients with stable ischemic heart disease (2012)
 - European Society of Cardiology guidelines for management of stable angina pectoris (2006)
 - National Institute for Health and Care Excellence (NICE) for chest pain of recent onset (2010)
 - Choosing Wisely Campaign (ongoing)

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Practice Guidelines

- Asymptomatic, high-risk:
 - Generally considered appropriate for detection of CAD or risk assessment in asymptomatic patients at higher CAD risk (e.g., diabetes)
- Symptomatic, low-to-intermediate risk:
 - Recommended for diagnosis in patients with intermediate pretest probability and uninterpretable EKG
 - Not indicated as an initial test in low-risk patients with interpretable EKG and ability to exercise

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Practice Guidelines

- Symptomatic, high-risk:
 - Recommended for diagnosis and/or risk stratification in patients at high risk and uninterpretable EKG or in high-risk individuals with low physical functioning even in presence of interpretable EKG
- Known CAD:
 - Recommended for risk assessment in patients who are candidates for revascularization of known coronary stenosis of unclear physiological significance or in those with deteriorating symptoms post-revascularization
 - Not recommended for asymptomatic patients post-revascularization unless at least 5 years post-CABG or with evidence of incomplete revascularization

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Choosing Wisely

American Society of Nuclear Cardiology

- “Don’t perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms unless high-risk markers are present.”
- “Don’t perform cardiac imaging for patients who are at low risk.”
- “Don’t perform radionuclide imaging as part of routine follow-up in asymptomatic patients.”
- “Use methods to reduce radiation exposure in cardiac imaging, whenever possible, including not performing such tests when limited benefits are likely.”

Society of Nuclear Medicine and Molecular Imaging

- “Don’t perform routine annual stress testing after coronary artery revascularization.”

American College of Cardiology

- “Don’t perform stress cardiac imaging or advanced non-invasive imaging in the initial evaluation of patients without cardiac symptoms unless high-risk markers are present. Stress cardiac imaging should only be conducted in patients who have diabetes and are >40 years, if patients have peripheral artery disease, or if yearly risk of cardiovascular events is >2%.”
- “Don’t perform annual stress cardiac imaging or advanced non-invasive imaging as part of routine follow-up in asymptomatic patients.”

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Payer Coverage Policies

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CMS

- SPECT (LCDs for coverage criteria):
 - Covered: (a) when stress test or EKG abnormal; (b) in symptomatic patients undergoing revascularization; (c) in patients with known CAD who have new or significant symptoms
 - Non-covered: (a) when no changes in medical management are anticipated; (b) in absence of changing clinical presentation; (c) as a screening test; (d) as routine follow-up following revascularization without clinical indications
- PET (NCD):
 - Covered when SPECT is inconclusive AND Rb-82 or N-ammonia-13 radiotracers are used

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Private Payers

- SPECT:
 - Generally covered for patients with known or suspected CAD with uninterpretable EKG and inability to exercise
 - Follow-up testing covered subject to time limits (e.g., >2 years following event or percutaneous intervention, >5 years post-CABG)
 - Not covered for asymptomatic, low-risk patients or in high-risk patients with hemodynamic instability
- PET:
 - Generally covered only when SPECT is inconclusive or in patients at risk of attenuation artifacts on SPECT (e.g., obese, women with dense breast tissue)
- Hybrid imaging:
 - Not covered (experimental/investigational)

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Summary

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Summary & Conclusions

- Comparative evidence generated to date suggests that SPECT:
 - Provides incremental diagnostic and prognostic information over ETT in symptomatic patients at any level of CAD risk
 - Performs comparably to stress ECHO in symptomatic patients
 - Is of lower or uncertain benefit in asymptomatic individuals at either high CAD risk (screening) or with known CAD (follow-up)
 - Important tradeoffs (e.g., costs, radiation exposure) to consider in comparisons of testing strategies
- Evidence on PET and hybrid imaging is currently insufficient to determine comparative clinical effectiveness or value

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Possible Areas of Focus

- Discussions with clinical experts highlighted areas of potential nuclear imaging overuse:
 - Serial imaging in asymptomatic patients
 - Ordered by nonspecialists
 - Initial testing in symptomatic patients at lower CAD risk who can exercise and have no clear contraindications to tests that do not involve radiation and are less expensive (stress ECHO, ETT)

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Appendix: Key Studies

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Author, Design and Setting	Comparator	Study quality, Population	Main results
Young LH (2009) Design: Randomized Trial (Multiple tested groups) Setting: Multicenter outpatient (DIAD study)	Group with screening + 5 yr follow-up Group without screening+5 yr follow-up Mean (SD) follow-up=4.8 (0.9) years	Good quality study Risk: NR Asymptomatic diabetic patients: 100% No known or suspected CAD Total n= 1,123	Revascularization <120 days No screening: 0.36% Screening: 1.6% p-value:0.03 Primary events, MI, cardiac death, secondary events, PTCA, CABG, All-cause death, stroke, HF, UA, revascularization in No screening group vs. screening group=NS Downstream tests: Additional stress test No screening:30% Screening: 21% (<0.001) ICA<120 days No screening:0.5% Screening:4.4% (p<0.001) Difference in medication use between groups at baseline and post 5 years=NS

Author, Design and Setting	Comparator	Study quality, Population	Main results
Shaw LJ (2011) Design: Randomized trial Setting: 43 cardiology practices (multiple tested groups)	ETT SPECT Follow-up: 24 months	Fair quality study Low-intermediate risk : Pre-test likelihood by ACC/AHA guidelines Intermediate risk: 100% Symptomatic :100% Suspected CAD: 100%	Downstream procedural use <ul style="list-style-type: none"> Follow-up exercise-ECG testing: ETT: 2 patients SPECT: 1 patient Crossover to SPECT or repeat SPECT: ETT: 17.7% SPECT: 9.3% p<0.0001 Referral to angiography: ETT: 6.4% SPECT: 7.3% no p-value reported Follow-up coronary revascularization: ETT: 1.0% SPECT: 2.2% p=0.16 No additional diagnostic testing: ETT: 81% SPECT: 89% p<0.0001 HRQoL in report
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Author, Design and Setting	Comparator	Study quality, Population	Main results
Sharples L (2007) Design: Randomized Trial (Multiple tested groups) Setting: Tertiary cardiothoracic referral center	SPECT MRI stress-ECHO ICA (controls) Follow up:18 months	Fair quality Mixed risk Pryor Risk assessment High: 69% in all groups Symptomatic:% NR Known CAD: NR	CABG SPECT and stress-ECHO:13% MRI: 11% ICA:10% PCI SPECT: 18% MRI and stress-ECHO: 23% ICA: 25% Cardiac death SPECT:0.02 % MRI:0,01% stress-ECHO:0.004 % ICA: 0.01% Other Cardiovascular death SPECT:0 % MRI:0.01% stress-ECHO:0.008 % ICA: 0% Referral to ICA SPECT:88% MRI:80% stress-ECHO:75% HRQoL
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Author, Design and Setting	Comparator	Study quality, Population	Main results
<p>Sabharwal NK (2007) Design: Randomized trial (Multiple tested groups) Setting: Outpatients, Hospital chest pain clinic</p>	<p><u>ETT:</u> <u>Stress SPECT:</u> • Tc-99m sestamibi • Exercise, dipyridamole, or dobutamine stress</p> <p><u>Follow-up:</u> 24 months</p>	<p>Fair quality</p> <p>Symptomatic, high-risk, Pre-test likelihood by ACC/AHA guidelines</p> <p><u>Pretest likelihood:</u></p> <ul style="list-style-type: none"> • Low: 11% • Intermediate: 71% • High: 18% <p>Symptomatic: 100%</p> <p>Suspected CAD: 100%</p>	<p>Referral to revascularization ETT:38% SPECT:66% (p<0.005)</p> <p>Referral to other imaging (Incl. ICA) ETT:71% MPI:16% (p<0.0001)</p> <p>Referral to ICA ETT:47% MPI:16% (p<0.0001)</p>

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Author, Design and Setting	Comparator	Study quality, Population	Main results
<p>Merhige M (2007) Design: Prospective Cohort (Multiple tested groups) Setting: Outpatient</p>	<p><u>SPECT</u> •99.Tc-Sestamibi</p> <p><u>PET</u> •Rubidium-82</p> <p>Follow-up:1year</p>	<p>Good quality study</p> <p>Risk: NR</p> <p>Symptomatic: NR</p> <p>Known CAD: SPECT: 44% PET: 49%</p>	<p><u>PTCI rate</u> SPECT:0.029 PET:0.028 (p=NS)</p> <p><u>Cardiac Mortality rate</u> SPECT:0.02 PET:0.008 (p=NS)+H78</p> <p><u>Acute MI rate</u> SPECT:0.029 PET:0.011 (p=NS)</p> <p><u>Revascularization rate</u> SPECT:0.114 PET:0.06 (p<0.01)</p> <p>CABG rate SPECT:0.07 PET:0.03 (p<0.01)</p>

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Author, Design and Setting	Comparator	Study quality, Population	Main results
Siegrist PT (2008) Design: Prospective Cohort (Same cohort, multiple strategies tested) Setting: NR	Patient management before PET results Patient management after PET results	Quality evaluation : N/A Risk: NR Symptomatic: NR Known CAD:79% Suspected CAD:8% Suspected small-vessel disease: 13%	% patients referred to ICA Decision Before PET results:62 Decision after PET:0 % patients referred to PCI Decision Before PET results:6 Decision after PET:20 % patients referred to CABG Decision Before PET:3 Decision after PET:3 % patients referred for Transplant Decision Before PET:1 Decision after PET:1 % patients referred to Med therapy Decision Before PET:15 Decision after PET:58 No treatment After PET:18 Patient management influenced in 78% population

Author, Design and Setting	Comparator	Study quality, Population	Main results
Hachamovitch R (2012) Design: Prospective registry design (Multiple tested groups) Setting: 41 different centers (SPARC study)	<u>SPECT</u> <u>PET</u> <u>CCTA</u> Follow-up:90 days	Good quality Pre-test likelihood by ACC/AHA guidelines Intermediate to high likelihood=100% Symptomatic :89% Suspected CAD: 100%	<u>Frequency of CAD after ICA</u> SPECT: 54.2% PET:67.2% CCTA:61.5% (P=0.51) <u>Positive index test, no CAD on ICA</u> SPECT: 39.1% PET:28.3% CCTA:16.9% (SPECT vs. PET, p=NS, SPECT vs. CCTA, p=0.049) <u>Negative test, index test, CAD on ICA</u> SPECT: 0% PET:3.3% CCTA:20.8% (SPECT vs. PET, p=NS, SPECT vs. CCTA, p=0.006) <u>Multivariable Modeling results</u> •Variable:CCTA vs. SPECT p-value:<0.0001 Odds Ratio(95% CI) :14.92(3.52-63.27) •Variable:PET vs. SPECT p-value:0.045 Odds Ratio:5.03(1.04-24.43)

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Other Appendices

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Quality Ratings: USPSTF criteria and QUADAS-2

Outcome Studies:

- **“Good”:**
 - Comparable groups with no or low attrition; intent-to-treat analysis used in RCTs
 - Reliable and valid measurement instruments used
 - Clear description of intervention and comparator(s)
 - All important outcomes considered
 - Attention to confounders in design and analysis
- **“Fair”:**
 - Generally comparable groups, some differential follow-up may occur; intent-to-treat analysis used in RCTs
 - Acceptable measurement instruments used
 - Some but not all important outcomes considered
 - Some but not all potential confounders are accounted for
- **“Poor”:**
 - Noncomparable groups and/or differential follow-up; lack of intent-to-treat analysis for RCTs
 - Unreliable or invalid measurement instruments used (including not masking outcome assessment)
 - Key confounders given little or no attention

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Quality Ratings: USPSTF criteria and QUADAS-2

QUADAS-2 (Diagnostic Accuracy Studies):

- Designed to rate risk of bias and applicability in 4 key domains:
 - Patient selection
 - Index test
 - Reference standard
 - Flow and timing
- Rated in terms of % of studies with levels of bias risk or applicability concerns that are:
 - Low risk/concern
 - High risk/concern
 - Unclear

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Quality of Evidence

Population	Study Design				Study Quality		
	RCT	Obs (2+ Groups)*	Obs (2+ Tests)†	Other	Good	Fair	Poor
Asymptomatic, high-risk	1 SPECT/No test				1		
Symptomatic, low-to-intermediate risk	1 SPECT/ETT	2 SPECT/angiography Rest/Stress	2 SPECT/ECHO SPECT-CCTA hybrid/SPECT/angiography			2	1
Symptomatic, high-risk	1 SPECT/ETT	2 SPECT/PET/CCTA SPECT Tracers	3 SPECT/ECHO SPECT/CCTA (2)		1	2	
Known CAD		3 Routine/Selective Testing SPECT before/after angiography SPECT Tracers	1 Before PET / After PET				3
Mixed‡	2 SPECT/MRI/ECHO SPECT/PET	2 SPECT/PET Rest/Stress	6 ECHO/SPECT(3) SPECT- CCTA/SPECT/ CCTA ETT/SPECT/angiography ETT/SPECT		1	1	2
Diagnostic Accuracy				8° SPECT: 5 PET/PET- CT: 3		N/A	
TOTAL	5	9	12	8	3	8	3

*Observational study comparing 2 or more distinct groups of patients.
 †Observational study comparing results of 2 or more tests in a single group of patients (quality not rated for these studies).
 ‡Mix of pretest probability and/or known vs. suspected CAD.
 °Per study entry criteria, represents studies of nuclear imaging tests that used a functional reference standard.
 CCTA: coronary computed tomography angiography; ECHO: echocardiography; ETT: exercise treadmill test; PET: positron emission tomography; SPECT: single photon emission computed tomography

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Specific Study Results in Mixed Populations (Good- and Fair-Quality Studies)

Study	Design	CAD Risk	% w/ Symptoms	% Known CAD	Comparison	Main Findings
Sharples 2007 (n=898)	RCT	High: 69%	NR	NR	SPECT vs. ECHO/MRI/angiography	SPECT ↑ vs. ECHO for readmission
Merhige 2007 (n=2,261)	Comparative Cohort	NR	NR	49	SPECT vs. PET	PET ↑ for CABG/total revasc
Basic 2006 (n=51)	Single Cohort	NR	100	NR	SPECT vs. ECHO	No differences
De Lima 2003 (n=126)	Single Cohort	Intermediate to High	NR	58	SPECT vs. ECHO	No differences
Hoque 2002 (n=206)	Single Cohort	NR	100	NR	SPECT vs. ECHO	SPECT ↑ for MI/angina, ECHO ↑ for mortality/CHF
Fiechter 2012 (n=62)	Single Cohort	NR	50	NR	SPECT/CCTA	Matched results ↑ for revasc
Pattilo 1996 (n=732)	Single Cohort	NR	100	NR	SPECT vs. ETT vs. angiography	SPECT ↑ ETT and angiography

↑ indicates (a) reduced rates of mortality or adverse CV events; or (b) better ability to predict mortality or adverse CV events

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Diagnostic Accuracy Using Functional Reference Standards

Study	Test	CAD Risk	Stressor	Reference Standard	Sensitivity	Specificity
DeBruyne 2001 (n=107)	SPECT	100% Prior MI	Adenosine	FFR <0.75	82%	87%
Melikian 2010 (n=67)	SPECT	100% Known CAD	Adenosine	FFR <0.80	66%	50%
Oraby 2002 (n=38)	SPECT	NR	Dipyridamole	ECHO	58%	100%
Yanagisawa 2002 (n=165)	SPECT	70% Prior MI	Dipyridamole	FFR <0.75	90% (DM+) 71% (DM-)	70% (DM+) 74% (DM-)
Yanagisawa 2004 (n=245)	SPECT	100% Known CAD	Adenosine	FFR <0.75	83% (DM+) 79% (DM-)	75% (DM+) 83% (DM-)
Danand 2013 (n=120)	PET PET/CCTA	High	Adenosine	FFR ≤0.80 or Stenosis ≥50%	76% 76% (H)	83% 92% (H)
Kajander* 2010 (n=107)	PET PET/CCTA	30-70%	Adenosine	FFR ≤0.80 or Stenosis ≥50%	95% 95% (H)	91% 100% (H)

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Literature Search

Primary data and systematic reviews (Jan 1996 to Feb 2013):

➤ Medline, EMBASE, Cochrane, DARE

Inclusion	Exclusion
<ul style="list-style-type: none"> • Studies involving symptomatic patients with known or suspected CAD, or asymptomatic patients at higher risk of CAD (e.g., screening, post-procedure or post-event monitoring) • Comparative studies (i.e., comparing multiple testing strategies or test to “no-test” strategies) • For diagnostic accuracy studies: <ul style="list-style-type: none"> ○ Functional reference standard (e.g., FFR) ○ Patient level data available ○ Time between index and reference not more than 3 months 	<ul style="list-style-type: none"> • Studies that included only asymptomatic, low risk patients • Studies that included only patients undergoing preoperative evaluation for noncardiac surgery • Studies with less than 30 patients

FFR: Fractional flow reserve

HTCC Coverage and Reimbursement Determination Analytic Tool

HTA's goal is to achieve better health care outcomes for enrollees and beneficiaries of state programs by paying for proven health technologies that work.

To find best outcomes and value for the state and the patient, the HTA program focuses on three questions:

1. Is it safe?
2. Is it effective?
3. Does it provide value (improve health outcome)?

The principles HTCC uses to review evidence and make determinations are:

Principle One: Determinations are Evidence-Based

HTCC requires scientific evidence that a health technology is safe, effective and cost-effective¹ as expressed by the following standards²:

- Persons will experience better health outcomes than if the health technology was not covered and that the benefits outweigh the harms.
- The HTCC emphasizes evidence that directly links the technology with health outcomes. Indirect evidence may be sufficient if it supports the principal links in the analytic framework.
- Although the HTCC acknowledges that subjective judgments do enter into the evaluation of evidence and the weighing of benefits and harms, its recommendations are not based largely on opinion.
- The HTCC is explicit about the scientific evidence relied upon for its determinations.

Principle Two: Determinations Result in Health Benefit

The outcomes critical to HTCC in making coverage and reimbursement determinations are health benefits and harms³:

- In considering potential benefits, the HTCC focuses on absolute reductions in the risk of outcomes that people can feel or care about.
- In considering potential harms, the HTCC examines harms of all types, including physical, psychological, and non-medical harms that may occur sooner or later as a result of the use of the technology.
- Where possible, the HTCC considers the feasibility of future widespread implementation of the technology in making recommendations.

¹ Based on Legislative mandate: See RCW 70.14.100(2).

² The principles and standards are based on USPSTF Principles at: <http://www.ahrq.gov/clinic/ajpmsuppl/harris3.htm>

³ The principles and standards are based on USPSTF Principles at: <http://www.ahrq.gov/clinic/ajpmsuppl/harris3.htm>

- The HTCC generally takes a population perspective in weighing the magnitude of benefits against the magnitude of harms. In some situations, it may make a determination for a technology with a large potential benefit for a small proportion of the population.
- In assessing net benefits, the HTCC subjectively estimates the indicated population's value for each benefit and harm. When the HTCC judges that the balance of benefits and harms is likely to vary substantially within the population, coverage or reimbursement determinations may be more selective based on the variation.
- The HTCC considers the economic costs of the health technology in making determinations, but costs are the lowest priority.

Using Evidence as the Basis For a Coverage Decision

Arrive at the coverage decision by identifying for Safety, Effectiveness, and Cost whether (1) evidence is available, (2) the confidence in the evidence, and (3) applicability to decision.

1. Availability of Evidence:

Committee members identify the factors, often referred to as outcomes of interest, that are at issue around safety, effectiveness, and cost. Those deemed key factors are ones that impact the question of whether the particular technology improves health outcomes. Committee members then identify whether and what evidence is available related to each of the key factors.

2. Sufficiency of the Evidence:

Committee members discuss and assess the evidence available and its relevance to the key factors by discussion of the type, quality, and relevance of the evidence⁴ using characteristics such as:

- Type of evidence as reported in the technology assessment or other evidence presented to committee (randomized trials, observational studies, case series, expert opinion);
- The amount of evidence (sparse to many number of evidence or events or individuals studied);
- Consistency of evidence (results vary or largely similar);
- Recency (timeliness of information);
- Directness of evidence (link between technology and outcome);
- Relevance of evidence (applicability to agency program and clients);
- Bias (likelihood of conflict of interest or lack of safeguards).

Sufficiency or insufficiency of the evidence is a judgment of each clinical committee member and correlates closely to the GRADE confidence decision.

⁴ Based on GRADE recommendation: <http://www.gradeworkinggroup.org/FAQ/index.htm>

Not Confident	Confident
Appreciable uncertainty exists. Further information is needed or further information is likely to change confidence.	Very certain of evidentiary support. Further information is unlikely to change confidence

3. Factors for Consideration - Importance

At the end of discussion a vote is taken on whether sufficient evidence exists regarding the technology's safety, effectiveness, and cost. The committee must weigh the degree of importance that each particular key factor and the evidence that supports it has to the policy and coverage decision. Valuing the level of importance is factor or outcome specific but most often include, for areas of safety, effectiveness, and cost:

- Risk of event occurring;
- The degree of harm associated with risk;
- The number of risks; the burden of the condition;
- Burden untreated or treated with alternatives;
- The importance of the outcome (e.g. treatment prevents death vs. relief of symptom);
- The degree of effect (e.g. relief of all, none, or some symptom, duration, etc.);
- Value variation based on patient preference.

Medicare Coverage and Guidelines

(From pages 73/74 in evidence report)

Centers for Medicare and Medicaid Services (CMS)

SPECT

National Coverage Determination Link: [NCD Link](#)

Local Coverage Determination Link: [LCD Link](#)

In 2002, Medicare established a National Coverage Determination (NCD) for SPECT allowing for contractor discretion with respect to clinical indications and limitations of coverage. The only restriction placed was that SPECT may not follow an inconclusive PET scan for myocardial viability. The policy is currently under review. A Local Coverage Determination (LCD) focused on Washington State provides the following indications of coverage for SPECT perfusion imaging:

- Abnormal EKG, stress test or inability to complete a standard stress test; OR
- Patients who are symptomatic following cardiovascular reperfusion; OR
- Intermediate-risk patients undergoing high-risk surgery; OR
- Patients with known CAD with new or significant symptoms; OR
- Evaluation post-cardiac transplant

SPECT is considered medically unnecessary when no changes in medical management are anticipated, in absence of a changing clinical presentation, or in asymptomatic patients of low-intermediate risk with

first-degree atrioventricular block. SPECT is also not covered for screening of coronary disease or as a routine follow-up test following revascularization without clinical indications.

PET

National Coverage Determination Link: [NCD Link](#)

An original NCD provided coverage of PET imaging for perfusion assessment in patients with known or suspected CAD. An NCD specific to myocardial perfusion PET was made in 2005, providing coverage for testing meeting the following requirements:

- PET imaging is done with rubidium-82 or ammonia N-13 radiotracers; AND
 - Rest or rest/stress imaging is not conducted in addition to SPECT; OR
 - PET scan follows an inconclusive SPECT image

As with the NCD on SPECT, this policy is also under review. There are no available LCDs issued for the use of PET myocardial perfusion imaging.

Clinical Guidelines & Accreditation Standards

(From pages 67-73 of evidence report)

Major guideline statements as well as competency and/or accreditation standards regarding cardiac nuclear imaging can be found in the sections that follow below. Statements from the “Choosing Wisely” campaign are also provided where relevant. Documents are organized by patient population where feasible.

Asymptomatic, High Risk

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Cardiac Radionuclide Imaging Appropriate Use Criteria (2009)

<http://content.onlinejacc.org/article.aspx?articleid=1139755>

- Cardiac radionuclide imaging is considered appropriate for use in detection of CAD or risk assessment in asymptomatic patients at high risk (based on ATP III criteria).

Symptomatic Low-Intermediate Risk

ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease (2012)

<http://circ.ahajournals.org/content/126/25/e354.full.pdf+html>

- Exercise stress nuclear perfusion imaging is not indicated as an initial test in low risk patients who have an interpretable EKG.
- Exercise stress nuclear perfusion imaging is recommended for diagnosis of patients with intermediate pre-test probability of ischemic heart disease, uninterpretable EKG, moderate physical functioning or no disabling co-morbidity. It is reasonable in patients with interpretable EKG.

- Pharmacologic stress nuclear perfusion imaging is not recommended for diagnosis and risk stratification in patients with interpretable EKG, at least moderate physical functioning, or no disabling co-morbidity.

NICE Guidelines for Chest Pain of Recent Onset-2010

<http://www.nice.org.uk/nicemedia/live/12947/47931/47931.pdf>

- When the estimated likelihood of CAD is 30-60 % and stable angina cannot be diagnosed, non-invasive functional tests such as SPECT are recommended.

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Cardiac Radionuclide Imaging Appropriate Use Criteria (2009)

<http://content.onlinejacc.org/article.aspx?articleid=1139755>

- Cardiac radionuclide imaging is inappropriate in patients with a low pretest probability of CAD, an interpretable EKG, and the ability to exercise.
- Cardiac radionuclide imaging is considered appropriate for all other combinations of pretest probability, EKG interpretability, and ability to exercise.

Guidelines on the Management of Stable Angina Pectoris: The Task Force on the Management of Stable Angina Pectoris of The European Society Of Cardiology (2006)

<http://www.escardio.org/guidelines-surveys/esc-guidelines/guidelinesdocuments/guidelines-angina-ft.pdf>

- There is reasonable evidence suggesting stress SPECT can be used as an alternative to exercise EKG in patients with low probability of CAD, such as women with atypical chest pain.

Symptomatic, High-Risk

ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease (2012)

<http://circ.ahajournals.org/content/126/25/e354.full.pdf+html>

- Exercise stress nuclear perfusion imaging is recommended for diagnosis of patients with an intermediate-to-high pre-test probability of ischemic heart disease, uninterpretable EKG, at least moderate physical functioning, or no disabling co-morbidity. Nuclear perfusion imaging is also considered a reasonable option in patients meeting the above criteria who have an interpretable EKG.
- Pharmacological stress nuclear perfusion imaging is recommended in patients with an intermediate-to-high pre-test probability of ischemic heart disease and are incapable of at least moderate physical functioning, or have a disabling comorbidity.

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Cardiac Radionuclide Imaging Appropriate Use Criteria (2009)

<http://content.onlinejacc.org/article.aspx?articleid=1139755>

- Cardiac radionuclide imaging is considered appropriate in patients with an intermediate or high pretest probability of CAD, regardless of whether EKG is interpretable or the patient is able to exercise.

Guidelines on the Management of Stable Angina Pectoris: The Task Force on the Management of Stable Angina Pectoris of The European Society Of Cardiology (2006)

<http://www.escardio.org/guidelines-surveys/esc-guidelines/guidelinesdocuments/guidelines-angina-ft.pdf>

- SPECT is recommended for diagnostic assessment in patients with inconclusive EKG, whose diagnosis is still not determined.
- SPECT is recommended for risk stratification in patients with intermediate to high probability of CAD.

Known CAD

ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease (2012)

<http://circ.ahajournals.org/content/126/25/e354.full.pdf+html>

- Stress nuclear perfusion imaging is recommended for risk assessment in patients who are candidates for revascularization of known coronary stenosis of unclear physiological significance.

ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Cardiac Radionuclide Imaging Appropriate Use Criteria (2009)

<http://content.onlinejacc.org/article.aspx?articleid=1139755>

- Cardiac radionuclide imaging is inappropriate or of uncertain appropriateness in any individual with known CAD who is asymptomatic or has stable symptoms and has not had a prior revascularization procedure.
- In patients with new or worsening symptoms, cardiac radionuclide imaging is considered appropriate in patients with an abnormal angiography or prior stress imaging study.
- Cardiac radionuclide imaging is appropriate within 3 months of an acute coronary syndrome in patients who are hemodynamically stable, have no recurrent chest pain symptoms or signs of heart failure, and have not had prior angiography.
- Such imaging is considered inappropriate in patients who:
 - Have had prior percutaneous intervention with complete revascularization;
 - Are hemodynamically unstable, have signs of cardiogenic shock or mechanical complications;

- Are candidates for evaluation post-PTCA or CABG prior to discharge; OR
- Are entering cardiac rehabilitation (as a stand-alone indication).
- Cardiac radionuclide imaging is appropriate following PTCA or CABG in patients who have new symptoms, or in asymptomatic patients with evidence of incomplete revascularization or who are at least 5 years post-CABG.
- Cardiac radionuclide imaging is considered inappropriate or of uncertain appropriateness in patients who:
 - Are less than 5 years post-CABG;
 - Are post-PTCA, regardless of duration; OR
 - Are entering cardiac rehabilitation (as a stand-alone indication).

Guidelines on the Management of Stable Angina Pectoris: The Task Force on the Management of Stable Angina Pectoris of The European Society Of Cardiology (2006)

<http://www.escardio.org/guidelines-surveys/esc-guidelines/guidelinesdocuments/guidelines-angina-ft.pdf>

- It is reasonable to perform SPECT for localization of ischemia in patients with prior revascularization.
- There is evidence suggesting stress SPECT is reasonable for risk stratification in patients with deteriorating symptoms post-revascularization.

Choosing Wisely

American Society of Nuclear Cardiology

<http://www.choosingwisely.org/doctor-patient-lists/american-society-of-nuclear-cardiology/>

- “Don’t perform stress cardiac imaging or coronary angiography in patients without cardiac symptoms unless high-risk markers are present.”
- “Don’t perform cardiac imaging for patients who are at low risk.”
- “Don’t perform radionuclide imaging as part of routine follow-up in asymptomatic patients.”
- “Use methods to reduce radiation exposure in cardiac imaging, whenever possible, including not performing such tests when limited benefits are likely.”

Society of Nuclear Medicine and Molecular Imaging

<http://www.choosingwisely.org/doctor-patient-lists/society-of-nuclear-medicine-and-molecular-imaging/>

- “Don’t perform routine annual stress testing after coronary artery revascularization.”

American College of Cardiology

<http://www.choosingwisely.org/doctor-patient-lists/american-college-of-cardiology/>

- “Don’t perform stress cardiac imaging or advanced non-invasive imaging in the initial evaluation of patients without cardiac symptoms unless high-risk markers are present. Stress cardiac imaging should only be conducted in patients who have diabetes and are >40 years, if patients have peripheral artery disease, or if yearly risk of cardiovascular events is >2%.”
- “Don’t perform annual stress cardiac imaging or advanced non-invasive imaging as part of routine follow-up in asymptomatic patients.”

Accreditation Standards

Intersocietal Accreditation Commission for Nuclear/PET Accreditation

<http://www.intersocietal.org/nuclear/standards/IACNuclearPETStandards2012.pdf>

Requirements for Medical Staff

The interpreting medical staff members should be board certified (or board eligible within two years of finishing training) in one of the following specialties:

- Nuclear Cardiology with a 4 month formal training in nuclear cardiology OR
- Nuclear medicine OR
- Cardiology with at least one year full time experience with independent interpretation of at least 800 nuclear cardiology studies
- Radiology with at least 4 months of nuclear cardiology training /1 year of nuclear cardiology practice with independent interpretation of at least 800 nuclear cardiology studies OR
- Any other medical specialty recognized by American Board of Medical Specialties, American Osteopathic Association, Royal College of Physicians and Surgeons of Canada or Le College des Mediciens du Quebec with one year full time experience in nuclear cardiology/nuclear medicine/PET practice with independent interpretation of at least 800 nuclear cardiology studies.
- Continuing Medical Education (CME): All interpreting physicians must obtain at least 15 hours of AMA category 1 CME relevant to nuclear medicine, every 3 years.

Requirements for Nuclear Medicine Technologists

- All nuclear medicine technologists must have an appropriate credential in nuclear medicine technology and a current BLS (Basic life support certification).
- Continuing Education (CE): At least 15 hours of accredited CE relevant to nuclear medicine every 3 years.
- American College of Radiology: Nuclear Medicine/PET accreditation Program Requirements
- <http://www.acr.org/~media/ACR/Documents/Accreditation/Nuclear%20Medicine%20PET/Requirements.pdf>

Requirements for Physicians interpreting or supervising nuclear medicine examinations:

- a) Nuclear medicine physicians should be board certified in radiology/diagnostic radiology/nuclear radiology/ nuclear medicine by American Board of Radiology/ American Board of Nuclear Medicine/ American Osteopathic Board of Radiology /American Osteopathic Board of Nuclear Medicine/ Royal College of Physicians and Surgeons of Canada/ Le College des Mediciens du Quebec.
- b) Physicians trained prior to 1975 are accepted if they have interpreted an average of 50 scintigrams per month in last 10 years.
- c) Non-nuclear medicine physician or radiologist interpreting nuclear images should be board certified in cardiology by American Board of Internal Medicine/American Osteopathic Board of Internal Medicine/ Royal College of Physicians and Surgeons of Canada/ Le College des Mediciens du Quebec. OR
- d) Complete a general nuclear medicine program (includes 200 hours in radiation physics, 500 hours preparation in instrumentation, radiochemistry, radiopharmacology, radiation dosimetry, radiation safety, protection and quality control)and 1000 hours training in general nuclear medicine approved by Accreditation Council of Graduate Medical Education.
- e) Continuing experience: Upon renewal, Read a minimum of 200 studies every 3 years OR meet Maintenance of Certification (MOC) in Radiology or Nuclear.
- f) Continuing Education: Upon renewal, meet MOC requirements by American Board of Radiology or American Board of Nuclear Medicine OR complete 150 hours in 36 prior months OR complete 15 hours CME in prior 36 months specific to imaging modality or organ system.

Requirements for Nuclear Medicine Technologists

- a) Qualification: American Registry of Radiologic Technologists or registered equivalent state license for nuclear medicine technology or complete a training program in nuclear medicine.

Continuing Education: Registered Technologists must be compliant with the CE requirements of their certifying organization. State-licensed technologists must complete 24 hours of CE every 2 years.

HEALTH TECHNOLOGY EVIDENCE IDENTIFICATION

Discussion Document: What are the key factors and health outcomes and what evidence is there?

Safety Outcomes	Safety Evidence
Chest pain	
Dyspnea	
Radiation exposure	
Efficacy – Effectiveness Outcomes	Efficacy / Effectiveness Evidence
Diagnostic accuracy	
Mortality/risk of cardiovascular events	
Downstream testing	
Clinical Decision Making	
Health related quality of life	
Special Population / Considerations Outcomes	Special Population Evidence
Sex	
Age	
Comorbidities	
Clinical setting	
Scan vendor	
Tracer type	
Stressor type	
Obesity	
Diabetes	
Hypertension	
Cost	Cost Evidence
Cost	
Cost-effectiveness	

Clinical Committee Evidence Votes

First Voting Question

The HTCC has reviewed and considered the technology assessment and information provided by the administrator, reports and/or testimony from an advisory group, and submissions or comments from the public. The committee has given greatest weight to the evidence it determined, based on objective factors, to be the most valid and reliable.

Is there sufficient evidence under some or all situations that the technology is:

	Unproven (no)	Equivalent (yes)	Less (yes)	More (yes)
Effective				
Safe				
Cost-effective				

Discussion

Based on the evidence vote, the committee may be ready to take a vote on coverage or further discussion may be warranted to understand the differences of opinions or to discuss the implications of the vote on a final coverage decision.

- Evidence is insufficient to make a conclusion about whether the health technology is safe, efficacious, and cost-effective;
- Evidence is sufficient to conclude that the health technology is unsafe, ineffectual, or not cost-effective
- Evidence is sufficient to conclude that the health technology is safe, efficacious, and cost-effective for all indicated conditions;
- Evidence is sufficient to conclude that the health technology is safe, efficacious, and cost-effective for some conditions or in some situations

A straw vote may be taken to determine whether, and in what area, further discussion is necessary.

Second Vote

Based on the evidence about the technologies' safety, efficacy, and cost-effectiveness, it is

_____ Not Covered _____ Covered Unconditionally _____ Covered Under Certain Conditions

Discussion Item

Is the determination consistent with identified Medicare decisions and expert guidelines, and if not, what evidence is relied upon.

Clinical Committee Findings and Decisions

Next Step: Cover or No Cover

If not covered, or covered unconditionally, the Chair will instruct staff to write a proposed findings and decision document for review and final adoption at the following meeting.

Next Step: Cover with Conditions

If covered with conditions, the Committee will continue discussion.

- 1) Does the committee have enough information to identify conditions or criteria?
 - Refer to evidence identification document and discussion.
 - Chair will facilitate discussion, and if enough members agree, conditions and/or criteria will be identified and listed.
 - Chair will instruct staff to write a proposed findings and decision document for review and final adoption at next meeting.

- 2) If not enough or appropriate information, then Chair will facilitate a discussion on the following:
 - What are the known conditions/criteria and evidence state
 - What issues need to be addressed and evidence state

The chair will delegate investigation and return to group based on information and issues identified. Information known but not available or assembled can be gathered by staff ; additional clinical questions may need further research by evidence center or may need ad hoc advisory group; information on agency utilization, similar coverage decisions may need agency or other health plan input; information on current practice in community or beneficiary preference may need further public input. Delegation should include specific instructions on the task, assignment or issue; include a time frame; provide direction on membership or input if a group is to be convened.

Efficacy Considerations:

- What is the evidence that use of the technology results in more beneficial, important health outcomes? Consider:
 - Direct outcome or surrogate measure
 - Short term or long term effect
 - Magnitude of effect
 - Impact on pain, functional restoration, quality of life
 - Disease management
- What is the evidence confirming that use of the technology results in a more beneficial outcome, compared to no treatment or placebo treatment?
- What is the evidence confirming that use of the technology results in a more beneficial outcome, compared to alternative treatment?
- What is the evidence of the magnitude of the benefit or the incremental value
- Does the scientific evidence confirm that use of the technology can effectively replace other technologies or is this additive?
- For diagnostic tests, what is the evidence of a diagnostic tests' accuracy
 - Does the use of the technology more accurately identify both those with the condition being evaluated and those without the condition being evaluated?
- Does the use of the technology result in better sensitivity and better specificity?

- Is there a tradeoff in sensitivity and specificity that on balance the diagnostic technology is thought to be more accurate than current diagnostic testing?
- Does use of the test change treatment choices

Safety

- What is the evidence of the effect of using the technology on significant morbidity?
 - Frequent adverse effect on health, but unlikely to result in lasting harm or be life-threatening, or;
 - Adverse effect on health that can result in lasting harm or can be life-threatening.
- Other morbidity concerns
- Short term or direct complication versus long term complications
- What is the evidence of using the technology on mortality – does it result in fewer adverse non-fatal outcomes?

Cost Impact

- Do the cost analyses show that use of the new technology will result in costs that are greater, equivalent or lower than management without use of the technology?

Overall

- What is the evidence about alternatives and comparisons to the alternatives
- Does scientific evidence confirm that use of the technology results in better health outcomes than management without use of the technology?

From: Andy McKinley [<mailto:amckinley@asnc.org>]
Sent: Thursday, September 05, 2013 9:44 AM
To: Morse, Josiah (HCA)
Cc: 'liz.mcquillin@diag.bracco.com'
Subject: ASNC PET document for HTA meeting 9/20

Dear Director Morse:

I have attached ASNC's "hot off the presses" PET Model Coverage Policy. I hope you find it useful for the 9/20 meeting on Cardiac Imaging.

Please feel free to contact ASNC if you have additional questions.

Sincerely,
Andy McKinley

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ASNC POLICY STATEMENT

ASNC Model Coverage Policy: Cardiac positron emission tomographic imaging

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INTRODUCTION

Description of Policy

This document is intended as a model coverage policy for cardiac positron emission tomography (PET) imaging studies and delineates under which clinical situations such a study is indicated. This document examines a variety of patient clinical indications and symptoms which support the use of cardiac PET by cross-referencing the indication with the appropriate use criteria (AUC) for radionuclide studies developed by the American College of Cardiology (ACC)/American Society of Nuclear Cardiology (ASNC) in 2005 and subsequently revised in 2009.¹ In addition, the use of cardiac PET in patients with the indications delineated in the policy is supported by references to an abundance of the literature in the provided scenarios. Finally, we have provided the International Classification of Diseases (ICD)-9 codes which correlate to each of the indications to demonstrate which codes, or ranges of codes, are appropriate for each clinical indication.

Purpose of Policy

The purpose and intent of this policy is to provide updated information with the goal to streamline the

process by which payers provide coverage for cardiac PET procedures. This document provides a list of clinical indications when the use of cardiac PET procedures is medically necessary and indicated. The intent of this policy is also to serve as an educational tool to the ASNC members, the cardiology community as a whole, referring physicians, and patients regarding the use of cardiac PET studies and the identification of the correct ICD-9 codes for those clinical indications. This model policy will serve as a scientific and literature-based guide for payers on how these clinical indications and ICD-9 codes interface with the AUC.

Policy Disclaimers

The model coverage policy for cardiac PET will serve as a guide for clinicians and payers; however, it should not be used as a finalized comprehensive tool. This model coverage policy will change as technologies and best practices evolve over time. In addition, clinical decision-making regarding the application of cardiac PET for a given patient should, first and foremost, remain with the physician treating the patient and should be based on the current ACC/ASNC AUC. It is our position that in cases where patients present with indications under either the “A” (appropriate) or the “U” (uncertain) categories of the AUC, these studies should be universally covered by Medicare contractors, Medicaid programs, and private payers. Typically, only studies that fall into the “I” (inappropriate) category should be considered for denial of payment. However, there may be situations in which a study appears to fall into the “I” category initially, but upon comprehensive review it becomes apparent that the study is appropriate and should be covered by the insurer. The information provided in this document is focused on the typical patient’s clinical indications, and there may be patients who present with indications or symptoms not captured within this model coverage policy. In those cases, it is our expectation that physicians will adhere to literature-based guidelines and provide the payer with as much

From the University of Connecticut,^a Farmington, CT; University of Ottawa Heart Institute,^b Ottawa, ON; Merlino Healthcare Consulting Corp.,^c Magnolia, MA; Montefiore Medical Center,^d New York, NY; MidOhio Cardiology and Vascular Consultants,^e Columbus, OH; Brigham and Women’s Hospital,^f Boston, MA; University of Miami Miller School of Medicine,^g Miami, FL; Hartford Hospital,^h Hartford, CT; Saint Luke’s Cardiovascular Consultants,ⁱ Kansas City, MO; and Saint Francis Hospital,^j Roslyn, NY

Endorsing Organizations This document has been endorsed by the Society of Nuclear Medicine and Molecular Imaging.

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clinical information as possible to support the use of performing a cardiac PET study.

American Medical Association Current Procedural Terminology (CPT)

CPT codes, descriptions, and other data only are copyright 2013 American Medical Association (or such other date of publication of CPT)/All Rights Reserved. Applicable FARS/DFARS Clauses Apply.

Centers for Medicare and Medicaid Services

Title XVIII of the Social Security Act, Section 1862(a)(1)(A). This section allows coverage and payment for only those services that are considered to be medically reasonable and necessary. Title XVIII of the Social Security Act, Section 1833(e). This section prohibits Medicare payment for any claim which lacks the necessary information to process the claim.

§4317(b), of the Balanced Budget Act (BBA), specifies that referring physicians are required to provide diagnostic information to the testing entity at the time the test is ordered.

42 Code of Federal Regulations (CFR) §410.32 and §410.33 indicates that diagnostic tests are payable only when ordered by the physician who is treating the beneficiary for a specific medical problem and who uses the results in such treatment.

Centers for Medicare and Medicaid Services

(CMS) Publication 100-04, Medicare Claims Processing Manual Chapter 4

– 200.8—Billing for Nuclear Medicine Procedures

CMS Publication 100-04, Medicare Claims Processing Manual Chapter 12

– 20.4.4—Supplies

CMS Publication 100-04, Medicare Claims Processing Manual Chapter 13

– 20—Payment Conditions for Radiology Services

– 50—Nuclear Medicine

– 60.4—PET Scans for Imaging of the Heart using Rubidium 82 (Rb 82)

CMS Publication 100-02, Medicare Benefit Policy Manual Chapter 15

– 60—Services and Supplies

– 60.1—Incident to Physician's Professional Services

– 80—Requirements for Diagnostic X-ray, Diagnostic Laboratory, and Other Diagnostic Tests

– 80.6—Requirements for Ordering and Following Orders for Diagnostic Tests

CMS Publication 100-03, Medicare National Coverage Determinations Manual Chapter 1

– 220.6—PET Scans

– 220.6.8—FDG PET for Myocardial Variability

INDICATIONS AND LIMITATIONS OF COVERAGE AND/OR MEDICAL NECESSITY

Extensive clinical evidence has documented the utility of myocardial perfusion imaging (MPI) in the evaluation of patients with known or suspected heart disease. Cardiac PET studies are techniques in which radioactive tracers are used to diagnose patients with suspected coronary artery disease (CAD) and provide important risk stratification of patients with known CAD. This test is also a valuable tool to assess myocardial viability, myocardial wall motion and ejection fraction, as well as cardiac sarcoidosis. For diagnosis, radionuclides are administered intravenously and distribute in proportion to the regional myocardial blood flow present at the time of injection. As compared to single-photon emission computed tomography (SPECT) MPI, cardiac PET provides more rapid imaging protocols, higher diagnostic accuracy, and in general lower radiation dose. Cardiac PET also has a superior ability to avoid attenuation artifacts due to higher photon energy (511 keV) and inherent attenuation correction.

Cardiac PET is a useful technique that allows a noninvasive evaluation of myocardial blood flow, function, and metabolism, using physiological substrates prepared with positron-emitting radionuclides, such as oxygen, nitrogen, fluorine, and rubidium. These radionuclides have half-lives that are considerably shorter than those used in SPECT. Positron-emitting radionuclides are produced either using a cyclotron, such as fluoro-2-deoxyglucose (F-18 FDG) with a 110-minute half-life, or nitrogen-13-ammonia (N-13), with a half-life of 9.8 minutes or a generator such as rubidium-82 (Rb-82) with a 75-second half-life. Because of availability, the most common PET blood flow tracer is rubidium-82.

The goal of cardiac PET perfusion imaging is to detect physiologically significant coronary artery narrowing. Results of the test should lead toward aggressive risk factor modification in order to delay or reverse the progression of atherosclerosis, alleviate symptoms of ischemia, and improve patient survival by either medical therapy or revascularization procedures such as bypass surgery (CABG) or percutaneous coronary intervention (PCI).

Stress and rest paired myocardial perfusion studies are commonly performed to assess myocardial ischemia

and/or infarction. Current Food and Drug Administration (FDA)-approved and Centers for Medicare and Medicaid Services-covered PET myocardial blood flow tracers are limited to Rb-82, F-18 FDG, and N-13 ammonia. Normal MPI implies the absence of significant CAD. Abnormal myocardial perfusion on stress imaging suggests the presence of significantly narrowed coronary arteries. If the stress regional perfusion defect is absent on the corresponding rest images, it suggests the presence of stress-induced myocardial ischemia. If the stress perfusion defect persists at rest, it suggests prior infarction. Imaging of myocardial perfusion can also be combined with myocardial metabolism imaging with F-18FDG for the assessment of myocardial viability in areas of resting hypoperfusion and dysfunctional myocardium.

The stress protocols are, for the most part, similar for all cardiac PET perfusion agents. The specific differences in acquisition protocols for Rb-82 and N-13 are related to the duration of uptake and clearance of these radiopharmaceuticals and their physical half-lives.

Cardiac PET provides important information pertaining to three critical aspects of cardiac diagnosis and management:

- (1) *Diagnosis* In patients suspected of having coronary disease because of chest discomfort, dyspnea, arrhythmias, cardiac risk factors, or other clinical findings, rest/stress cardiac PET is a highly sensitive and specific test for identifying CAD and it has improved diagnostic utility in comparison to SPECT. In patients presenting to the emergency department with acute chest pain, rest cardiac PET during symptoms is effective in diagnosing an acute coronary syndrome.
- (2) *Prognosis* In patients with known or suspected CAD, the extent of myocardial ischemia, infarction, and viability determined by cardiac PET correlates well with prognosis. Cardiac PET imaging allows separation of CAD patients into subgroups with low, intermediate, and high risk for cardiac events, thus helping to guide medical and interventional management.
- (3) *Response to therapy* In patients with known CAD and prior coronary revascularization, cardiac PET imaging provides important information regarding the adequacy of revascularization. In patients with known CAD on medical therapy, cardiac PET can evaluate the ability of the patient's medical regimen at reducing myocardial ischemia.

MPI SUMMARY

Cardiac PET MPI is a well-established and highly accurate technique for detecting hemodynamically

significant CAD. The ability to reduce attenuation artifact is useful in all patients, but particularly the obese. Similar to SPECT, PET ventricular function in the form of regional wall motion assessment and global ejection fraction provides important functional data. The short half-lives of PET radionuclides—10 minutes for ¹³N-ammonia and 75 seconds for ⁸²Rb—promote patient acceptance: Studies can be completed within 30-60 minutes.

OTHER CONSIDERATIONS FOR CARDIAC PET

Cardiac Sarcoidosis Assessment

F-18 fluorodeoxyglucose (F-18 FDG) is increasingly being used for the evaluation of cardiac sarcoidosis. Myocardial biopsy can be frequently unrevealing in cardiac sarcoidosis due to the patchy nature of the disease process. Hence, imaging is critical for the diagnosis of this disease. F-18 FDG is a highly sensitive test to diagnose cardiac sarcoidosis and provides the assessment of disease activity, assisting in management decisions.

Myocardial Viability Assessment with Cardiac PET

Myocardial viability assessment is an important part of cardiac PET to assist physicians to decide upon the best surgical or medical procedures. F-18 FDG imaging provides the unique ability to assess metabolic activity in an area of hypoperfusion. The presence of glucose activity by FDG imaging provides evidence of viability beyond perfusion by either PET or SPECT.

Viability assessments include resting PET perfusion and function, similar to SPECT. In selected patients, evaluation for inducible ischemia with stress PET perfusion, in addition to the resting perfusion and FDG PET, may provide important clinical information that may further guide therapeutic decisions.

Evaluation of Regional and Global Myocardial Blood Flow. Rubidium-82 and N-13 ammonia are documented as valuable agents for measuring either absolute or relative myocardial blood flow, an emerging aspect of PET imaging which is gaining clinical relevance. The presence of normal blood flow in the setting of normal perfusion reduces the likelihood of significant CAD beyond perfusion alone. Blood flow parameters have proven useful in detecting multi-vessel CAD and impaired vasodilator reserve in patients with chest pain and normal coronary arteries. Blood flow data also provide important risk stratification information in patients with and without CAD, beyond perfusion data.

Radiation Exposure from Cardiac Perfusion PET. In addition to cardiac PET having improved diagnostic utility compared with SPECT imaging, patient radiation exposure is significantly less with most PET perfusion radiotracers. While a standard 1-day rest (10 mCi) stress (30 mCi) Tc-99m sestamibi SPECT study exposes a patient to approximately 11.4 mSv of radiation, a recent study by Senthamizchelvan et al showed that for imaging with the PET tracer ⁸²Rb, a typical dose of 70-80 mCi for rest/stress resulted in a radiation exposure of approximately 2.0-2.5 mSv per patient, with an additional 0.3 mSv added by the low dose CT attenuation correction image portion. Similarly, PET perfusion imaging with 10 mCi of N-13 ammonia exposes the patient to only 1.5 mSv for both the rest and stress images. Thus, common cardiac PET perfusion protocols result in less radiation exposure than common SPECT protocols.

CODING GUIDELINES

ICD-9 Codes

ICD-9 codes must be coded to the highest level of specificity. For a complete list of medically necessary ICD-9 codes, see Table 1.

CPT/HCPCS Section & Benefit Category

Radiology
Drugs other than oral
Medical and surgical supplies
Medicine

Bill Type Codes for Hospital Use

Contractors may specify Bill Types to help providers identify those Bill Types typically used to report this service. The absence of a Bill Type does not guarantee that the policy does not apply to that Bill Type. Complete absence of all Bill Types indicates that coverage is not influenced by Bill Type and the policy should be assumed to apply equally to all claims.

Revenue Codes for Hospital Use

Contractors may specify Revenue Codes to help providers identify those Revenue Codes typically used to report this service. In most instances, Revenue Codes are purely advisory; unless specified in the policy, services reported under other Revenue Codes are equally subject to this coverage determination. The complete absence of all Revenue Codes indicates that coverage is

not influenced by Revenue Code and the policy should be assumed to apply equally to all Revenue Codes.

0340 Nuclear medicine—general classification
0341 Nuclear medicine—diagnostic procedure
0343 Nuclear medicine—diagnostic radiopharmaceutical
0404 Positron emission tomography
0482 Stress Test
0636 Drugs requiring detailed coding

Usage notes: (a) Charges for drugs and biological (with the exception of radiopharmaceuticals, which are reported under Revenue Codes 0343 and 0344) requiring specific identifications as required by the payer (effective 10/1/04). If Healthcare Common Procedure Coding System (HCPCS) is used to describe the drug, enter the HCPCS code in Form Locator 44. The specified units of service to be reported are to be in hundreds (100s) rounded to the nearest hundred (no decimal).

0960 Professional Fees—General Classification
0969 Professional Fees—Other Professional Fee
0982 Professional fees—Outpatient Services

CPT/HCPCS Codes

78491 Myocardial imaging, positron emission tomography (PET), perfusion; single study at rest or stress
78492 Myocardial imaging, positron emission tomography (PET), perfusion; multiple studies at rest and/or stress
78459 Myocardial imaging, positron emission tomography (PET), metabolic evaluation
78499 Unlisted cardiovascular procedure, diagnostic nuclear medicine
93015 Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring, and/or pharmacological stress; with physician supervision, with interpretation and report
93016 Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring, and/or pharmacological stress; physician supervision only, without interpretation and report
93017 Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous electrocardiographic monitoring, and/or pharmacological stress; tracing only, without interpretation and report
93018 Cardiovascular stress test using maximal or submaximal treadmill or bicycle exercise, continuous

Table 1. ICD-9 codes that support medical necessity

Clinical indication	Applicable ICD-9 code ^a
Diabetes mellitus	250.00-250.93
Overweight and obesity	278.00-278.01
Rheumatic aortic stenosis	395.2-395.90
Mitral valve and aortic valve diseases	396.0-396.9
Hypertension; benign	401.1
Hypertensive chronic kidney disease	403-403.9
Hypertensive heart and chronic kidney disease	404.0-404.9
Acute myocardial infarction	410-410.92
Other acute and subacute forms of ischemic heart disease	411
Old myocardial infarction	412
Angina pectoris; other and unspecified angina pectoris	413.9
Myocardial bridging	414.0
Coronary atherosclerosis	414.0-414.07
Aneurysm and dissection of heart	414.1-414.19
Aneurysm—chronic total occlusion of coronary artery	414.2
Chronic ischemic heart disease	414.8-414.90
Cardiomyopathy	425.0-425.9
Hypertrophic obstructive cardiomyopathy	425.11
Other hypertrophic cardiomyopathy	425.18
Conduction disorders; atrioventricular block	426.10-426.93
Conduction disorders; bundle branch block	426.20-426.50
Conduction disorder; unspecified	426.90
Cardiac dysrhythmias	427.00
Paroxysmal ventricular tachycardia	427.10
Paroxysmal tachycardia	427.20
Atrial fibrillation	427.31
Atrial flutter	427.32
Cardiac arrest	427.50
Arrhythmias	427.0-427.89
Heart failure	428.00-428.90
Myocarditis; unspecified	429
Myocardial degeneration	429.10
Cardiovascular disease; unspecified	429.2

Table 1 continued

Clinical indication	Applicable ICD-9 code ^a
Functional disturbances following cardiac surgery	429.40
Takotsubo syndrome	429.83
Carotid artery	433.1
Atherosclerosis of the extremities with intermittent claudication	440.21
Aortic aneurysm and dissection	441.0-441.9
Other aneurysm	442
Peripheral vascular disease	443.0-443.9
Kawasaki disease	446.1
Takayasu's disease	446.7
Chronic kidney disease	585.1-585.9
Anomalous coronary artery	746.8-746.89
<i>Symptoms</i>	
Difficulty in walking	719.7
General symptoms; alteration of consciousness; transient alteration of awareness	780.02
Syncope and collapse	780.2
Symptoms involving nervous and musculoskeletal systems—abnormality of gate	781.2
Palpitations	785.1
Symptoms involving respiratory system and other chest symptoms	786.05-786.09
Chest pain	786.50-786.59
Nonspecific (abnormal) findings on radiological and other examination of body structure; other intrathoracic organ	793.2
Abnormal cardiovascular study	794.30
Abnormal ECG	794.31
Adverse reaction to medications/anesthesia	995.20-995.29
Complications with heart valve surgery	996.71-996.72
Complications with heart transplant	996.83
Heart transplant	V42.1
Family history ischemic heart disease	V17.3/V17.41/V17.49
Heart valve surgery	V42.2/V43.3
Post-procedural status; aortocoronary bypass status	V45.81
Percutaneous transluminal coronary angioplasty status	V45.82
Long-term (current) drug use of other medications	V58.69

Table 1 continued

Clinical indication	Applicable ICD-9 code^a
Observation for suspected cardiovascular disease	V71.7
Preoperative cardiovascular evaluation	V72.80-72.84
Erectile dysfunction; with inhibited sexual excitement	302.72

^a ICD-9 codes must be coded to the highest level of specificity.

electrocardiographic monitoring, and/or pharmacological stress; interpretation and report only

G0235 PET imaging, any site, not otherwise specified

A9526 Nitrogen N-13 ammonia, diagnostic, per study dose, up to 40 mCi

A9552 Fluorodeoxyglucose F-18 FDG, diagnostic, per study dose, up to 45 mCi

A9555 Rubidium Rb-82, diagnostic, per study dose, up to 60 mCi

J0152 Injection, adenosine for diagnostic use, 30 mg

J1245 Injection, dipyridamole, per 10 mg

J1250 Injection, dobutamine hydrochloride, per 250 mg

J2785 Injection, regadenoson, 0.1 mg

GENERAL INFORMATION

- When performing both the rest and stress portions of the PET MPI for any one of the covered indications, a multiple study procedure code (78492) should be billed regardless of whether the imaging occurs on the same day or two different days.
- There are two types of studies as defined by the PET myocardial perfusion code descriptions, a rest study and a stress study. The rest and stress studies are each considered a “single” study for billing purposes. Both of these studies together are considered a “multiple” study for billing purposes. Providers choose the appropriate CPT code based on the number of studies performed. Scout and CT for more robust attenuation correction purposes are not

considered separate studies as they are inherent to the study; therefore, do not separately bill for scout or CT when used for attenuation correction only.

- Injection procedures are considered inherent to cardiac PET imaging studies. The edits in CMS’s current correct coding initiative list all the administration codes as component codes for CPT 78459, 78491-78492 and therefore they are not additionally reportable. This is true for most nuclear medicine imaging procedures.
- The HCPCS Level II codes describe the radiopharmaceuticals used for cardiac PET studies. Bill the number of doses administered as follows: If a single rest or stress study is done, bill one unit; if both a rest and a stress study are done, bill two units. Please note that HCPCS does not describe the quantity of a PET myocardial perfusion agent by mCi, but by “per study dose” regardless of the actual administered injected radioactive dose for each imaging study; the up to amount is a general guide, the billing unit of these HCPCS codes is the “per study dose” (PSD). Radiopharmaceuticals used for scout purposes are not separately billable as per study doses, and like the procedure are inherent to the study.
- When medically necessary, cardiovascular stress testing can be performed in conjunction with nuclear medicine procedures. To review related policies, please refer to the Cardiovascular Stress Testing CPT codes 93015-93018.
- Wall motion and ejection fraction and flow reserve are not inherent in the PET myocardial perfusion CPT codes, if performed for Medicare code G0235 due to the current exclusionary national coverage policy. For third-party payers, code 78499 unlisted cardiovascular procedures, diagnostic nuclear medicine. Check with local payers and the supply literature to support coding and billing for flow reserve, wall motion, and ejection fraction with cardiac PET studies.
- If other non-radioactive drugs are utilized, refer to the current Level II series HCPCS manual (typically J codes) for codes (e.g., adenosine, dipyridamole, regadenoson, etc.).

APPENDIX

See Tables 2, 3, and 4.

Table 2. Indications for PET for diagnostic purposes

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
As the initial test for symptomatic patients at increased risk for CAD, defined as having risk for hard cardiac events (cardiovascular death or non-fatal myocardial infarction)	<p>(1) Beanlands R, Dick A, Chow B, et al. CCS; CAR; CANM; CNCS; and CanSCMR Position Statement on Advanced Noninvasive Cardiac Imaging using Positron Emission Tomography, Magnetic Resonance Imaging and Multi-Detector Computed Tomographic Angiography in the Diagnosis and Evaluation of Ischemic Heart Disease. <i>Can J Cardiol.</i> 2007 Feb;23(2):107-19</p> <p>(2) Di Carli, MF, Dorbala, S, Meserve, J, El Fakhri, G, Sitek, A, & Moore, SC. Clinical Myocardial Perfusion PET/CT. <i>J Nucl Med.</i> 2007;48(5):783-793</p> <p>(3) Bateman TM, Heller GV, McGhie AI, et al. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT. <i>J Nucl Cardiol.</i> 2006;13:24-33</p> <p>(4) Sampson UK, Limaye A, Dorbala S, et al. Diagnostic accuracy of rubidium-82 myocardial perfusion imaging with hybrid positron emission tomography/computed tomography (PET-CT) in the detection of coronary artery disease. <i>J Am Coll Cardiol.</i> 2007;49:1052-1058</p> <p>(5) Nandalur KR, Dwamena BA, Choudhri AF, Nandalur SR, Reddy P, Carlos RC. Diagnostic performance of positron emission tomography in the detection of coronary artery disease: a meta-analysis. <i>Acad Radiol.</i> 2008;15:444-451</p>	413.9, 414.8-414.9, 786.05-786.09, 786.50-786.59	AUC indication(s) 3 and 4

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients who have non-atherosclerotic CAD, including coronary anomalies	<p>(1) Brunken RC, Perloff JK, Czernin J, Campisi R, Purcell S, Miner PD, Child JS, Schelbert HR. Myocardial perfusion reserve in adults with cyanotic congenital heart disease. <i>Am J Physiol Heart Circ Physiol.</i> 2005 Nov;289(5):H1798-806. Epub 2005 Jul 8. PubMed PMID: 16006539</p> <p>(2) Furuyama H, Odagawa Y, Katoh C, Iwado Y, Yoshinaga K, Ito Y, Noriyasu K, Mabuchi M, Kuge Y, Kobayashi K, Tamaki N. Assessment of coronary function in children with a history of Kawasaki disease using (15)O-water positron emission tomography. <i>Circulation.</i> 2002 Jun 18;105(24):2878-84. PubMed PMID: 12070117</p> <p>(3) Singh TP, Humes RA, Muzik O, Kottamasu S, Karpawich PP, Di Carli MF. Myocardial flow reserve in patients with a systemic right ventricle after atrial switch repair. <i>J Am Coll Cardiol.</i> 2001 Jun 15;37(8):2120-5. PubMed PMID: 11419897</p> <p>Hauser M, Bengel FM, Kühn A, Sauer U, Zylla S, Braun SL, Nekolla SG, Oberhoffer R, Lange R, Schwaiger M, Hess J. Myocardial blood flow and flow reserve after coronary reimplantation in patients after arterial Switch and Ross operation. <i>Circulation.</i> 2001 Apr 10;103(14):1875-80. PubMed PMID: 11294806</p> <p>(4) Bengel FM, Hauser M, Duvernoy CS, Kuehn A, Ziegler SI, Stollfuss JC, Beckmann M, Sauer U, Muzik O, Schwaiger M, Hess J. Myocardial blood flow and coronary flow reserve late after anatomical correction of transposition of the great arteries. <i>J Am Coll Cardiol.</i> 1998 Dec;32(7):1955-61. PubMed PMID: 9857878</p>	446.1, 446.7, 746.8-746.89	<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p> <p>Standardized reporting of radionuclide myocardial perfusion and function</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
As the initial test in patients with diabetes mellitus, with or without symptoms of suspected angina or coronary disease	<p>(1)Di Carli, MF, Dorbala, S, Meserve, J, El Fakhri, G, Sitek, A, & Moore, SC. Clinical Myocardial Perfusion PET/CT. J Nucl Med. 2007;48(5):783-793</p> <p>(2)Bateman TM, Heller GV, McGhie AI, et al. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT. J Nucl Cardiol. 2006;13:24-33</p> <p>(3)Sampson UK, Limaye A, Dorbala S, et al. Diagnostic accuracy of rubidium-82 myocardial perfusion imaging with hybrid positron emission tomography/computed tomography (PET-CT) in the detection of coronary artery disease. J Am Coll Cardiol. 2007;49:1052-1058</p> <p>(4)Grover-McKay M, Ratib O, Schwaiger M, et al. Detection of coronary artery disease with positron emission tomography and rubidium 82. Am Heart J. 1992;123:646-652</p> <p>(5)Demer LL, Gould KL, Goldstein RA, et al. Assessment of coronary artery disease severity by positron emission tomography: comparison with quantitative arteriography in 193 patients. Circulation. 1989;79:825-835</p>	780.02, 786.05-09, 786.50-59, 413.9	AUC indication(s) 3, 4, and 5

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with suspected coronary disease in whom an abnormal baseline ECG interferes with interpretation of exercise-induced ST segment deviations	<p>(1)Beanlands R, Dick A, Chow B, et al. CCS; CAR; CANM; CNCS; and CanSCMR Position Statement on Advanced Noninvasive Cardiac Imaging using Positron Emission Tomography, Magnetic Resonance Imaging and Multi-Detector Computed Tomographic Angiography in the Diagnosis and Evaluation of Ischemic Heart Disease. <i>Can J Cardiol.</i> 2007 Feb;23(2):107-19</p> <p>(2)Effects of left bundle branch block on myocardial FDG PET in patients without significant coronary artery stenoses. <http://www.ncbi.nlm.nih.gov/pubmed/10855620> Zanco P, Desideri A, Mobilia G, Cargnel S, Milan E, Celegon L, Buchberger R, Ferlin G. <i>J Nucl Med.</i> 2000 Jun;41(6):973-7</p> <p>(3)Myocardial perfusion, glucose utilization and oxidative metabolism in a patient with left bundle branch block, prior myocardial infarction and diabetes. <http://www.ncbi.nlm.nih.gov/pubmed/9476932> Zanco P, Chierichetti F, Fini A, Cargnel S, Ferlin G. <i>J Nucl Med.</i> 1998 Feb;39(2):261-3</p> <p>(4)ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASNC Committee to Revise the 1995 Guidelines for the Clinical Use of Cardiac Radionuclide Imaging). <http://www.ncbi.nlm.nih.gov/pubmed/14522503> Klocke FJ, Baird MG, Lorell BH, Bateman TM, Messer JV, Berman DS, O’Gara PT, Carabello BA, Russell RO Jr, Cerqueira MD, St John Sutton MG, DeMaria AN, Udelson JE, Kennedy JW, Verani MS, Williams KA, Antman EM, Smith SC Jr, Alpert JS, Gregoratos G, Anderson JL, Hiratzka LF, Faxon DP, Hunt SA, Fuster V, Jacobs AK, Gibbons RJ, Russell RO; American College of Cardiology; American Heart Association; American Society for Nuclear Cardiology. <i>J Am Coll Cardiol.</i> 2003 Oct 1;42(7):1318-33</p>	426.1, 426.2, 426.10 -426.93	AUC indication(s) 2, 4, 14, and 15

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Coronary flow reserve evaluation	<p>(1) Camici, P. G., Gistri, R., Lorenzoni, R., Sorace, O., Michelassi, C., Bongiorno, M. G., et al. (1992). Coronary reserve and exercise ECG in patients with chest pain and normal coronary angiograms. <i>Circulation</i>, 86(1), 179-186</p> <p>(2) Geltman EM, Henes CG, Senneff MJ, Sobel BE, Bergmann SR. Increased myocardial perfusion at rest and diminished perfusion reserve in patients with angina and angiographically normal coronary arteries. <i>J Am Coll Cardiol</i>. 1990 Sep;16(3):586-95</p> <p>(3) Masuda, D., Nohara, R., Tamaki, N., Hosokawa, R., Inada, H., Hikai, T., et al. (2000). Evaluation of coronary blood flow reserve by ¹³N-NH₃ positron emission computed tomography (PET) with dipyridamole in the treatment of hypertension with the ACE inhibitor (cilazapril). <i>Annals of Nuclear Medicine</i>, 14(5), 353-360</p> <p>(4) Ziadi MC, Dekemp RA, Williams K, Guo A, Renaud JM, Chow BJ, Klein R, Ruddy TD, Aung M, Garrard L, Beanlands RS. Does quantification of myocardial flow reserve using rubidium-82 positron emission tomography facilitate detection of multivessel coronary artery disease? <i>J Nucl Cardiol</i>. 2012 Mar 14. [Epub ahead of print]</p>	-	<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p> <p>Standardized reporting of radionuclide myocardial perfusion and function</p>
<p>Patients with an abnormal exercise stress ECG without angina symptoms, to further determine whether CAD is present</p> <p>For Example: Patients with an intermediate to high Duke treadmill score</p>	<p>(1) Dayanikli F, Grambow D, Muzik O, Mosca L, Rubenfire M, Schwaiger M. Early detection of abnormal coronary flow reserve in asymptomatic men at high risk for coronary artery disease using positron emission tomography. <i>Circulation</i> 1994;90:808-817</p>	794.30, 794.31	<p>AUC indication(s) 29, 38, and 39</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
All patients who are asymptomatic, or have low to intermediate probability of CAD, but have an occupation that places other individuals at risk if they suffer a coronary event	(1)Blair RE. Coronary Artery Disease in a Young USAF Pilot: Screening for Premature Atherosclerosis. <i>Military Medicine</i> 2010;175(9):688-690 (2)Houston S, Mitchell S, Evans S. Application of a Cardiovascular Disease Risk Prediction Model Among Commercial Pilots. <i>Aviat Space Environ Med</i> 2010;81:768-773 (3)2003 ACC/ASNC/AHA Guidelines for Clinical Use of Radionuclide Imaging. <i>J Am Coll Card</i> 2003;42:1318 (4)Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. <i>J Nucl Cardiol</i> 2011;18(1):3-15	414.0, 411, V71.7	AUC does not address this clinical scenario, but testing is supported by ACC/ASNC/AHA Guidelines The role of radionuclide MPI for asymptomatic individuals
Patients who have suspected CAD and who have a condition which would prevent them from achieving a diagnostically adequate level of cardiac stimulation (85% predicted maximum heart rate) on standard exercise ECG stress testing	(1)Beanlands R, Dick A, Chow B, et al. CCS; CAR; CANM; CNCS; and CanSCMR Position (2)Di Carli, MF, Dorbala, S, Meserve, J, El Fakhri, G, Sitek, A, & Moore, SC. Clinical Myocardial Perfusion PET/CT. <i>J Nucl Med</i> . 2007;48(5):783-793 (3)Bateman TM, Heller GV, McGhie AI, et al. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT. <i>J Nucl Cardiol</i> . 2006;13:24-33 (4)Sampson UK, Limaye A, Dorbala S, et al. Diagnostic accuracy of rubidium-82 myocardial perfusion imaging with hybrid positron emission tomography/computed tomography (PET-CT) in the detection of coronary artery disease. <i>J Am Coll Cardiol</i> . 2007;49:1052-1058 (5)Nandalur KR, Dwamena BA, Choudhri AF, Nandalur SR, Reddy P, Carlos RC. Diagnostic performance of positron emission tomography in the detection of coronary artery disease: a meta-analysis. <i>Acad Radiol</i> 2008;15:444-451	719.7, 781.2, 443.9, 440.21, 278.00, 278.01, along with the applicable chest pain codes 786.50-786.59	AUC indication(s) 2 and 4

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with cardiomyopathy	<p>(1) Buckley, O., Doyle, L., Padera, R., Lakdawala, N., Dorbala, S., Di Carli, M., et al. Cardiomyopathy of uncertain etiology: Complementary role of multimodality imaging with cardiac MRI and 18FDG PET. <i>Journal of Nuclear Cardiology</i>. 2010;17(2):328-332</p> <p>(2) Shikama, N., Himi, T., Yoshida, K., Nakao, M., Fujiwara, M., Tamura, T., et al. (1999). Prognostic utility of myocardial blood flow assessed by N-13 ammonia positron emission tomography in patients with idiopathic dilated cardiomyopathy. <i>American Journal of Cardiology</i>, 84(4), 434-439</p> <p>(4) Perrone-Filardi, P., Bacharach, S.L., Dilsizian, V., Panza, J.A., Maura, S., & Bonow, R.O. (1993). Regional systolic function, myocardial blood flow and glucose uptake at rest in hypertrophic cardiomyopathy. <i>American Journal of Cardiology</i>, 72(2), 199-204</p> <p>(5) Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. <i>J Nucl Cardiol</i> 2011;18(1):3-15</p>	412, 414.8-414.90, 425-425.9, 429, 429.83, 428.00-428.90	<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p> <p>Standardized reporting of radionuclide myocardial perfusion and function</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with hypertrophic cardiomyopathy in whom PET is performed to define microvascular disease or to evaluate prognosis in patients with hypertrophic cardiomyopathy	<p>(1)Timmer, S. A., Germans, T., Gotte, M. J., Russel, I. K., Lubberink, M., Ten Berg, J. M., et al. (2011). Relation of coronary microvascular dysfunction in hypertrophic cardiomyopathy to contractile dysfunction independent from myocardial injury. <i>American Journal of Cardiology</i>, 107(10), 1522-1528</p> <p>(2)Camici, P., Chiriatti, G., Lorenzoni, R., Bellina, R. C., Gistri, R., Italiani, G., et al. (1991). Coronary vasodilation is impaired in both hypertrophied and nonhypertrophied myocardium of patients with hypertrophic cardiomyopathy: A study with nitrogen-13 ammonia and positron emission tomography. <i>Journal of the American College of Cardiology</i>, 17(4), 879-886</p> <p>(3)Cecchi, F., Olivotto, I., Gistri, R., Lorenzoni, R., Chiriatti, G., & Camici, P. G. Coronary microvascular dysfunction and prognosis in hypertrophic cardiomyopathy. <i>New England Journal of Medicine</i>. 2003;349(11):1027-1035</p>	425.10, 425.0-425.9, 413.9, 786.5, 411, 786.05-786.09, 780.02	<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging Standardized reporting of radionuclide myocardial perfusion and function</p>
	<p><i>Pediatrics article:</i></p> <p>(1)Tadamura, E., Yoshibayashi, M., Yonemura, T., Kudoh, T., Kubo, S., Motooka, M., et al. (2000). Significant regional heterogeneity of coronary flow reserve in paediatric hypertrophic cardiomyopathy. <i>European Journal of Nuclear Medicine</i>, 27(9), 1340-1348</p>		

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with valvular heart disease in whom PET is performed to differentiate coronary vs non-coronary causes of chest discomfort	(1)Bateman TM, Heller GV, McGhie AI, Friedman JD, Case JA, Bryngelson JR, Hertenstein GK, Moutry KL, Reid K, Cullom SJ. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT (2)Nandalur KR, Dwamena BA, Choudhri AF, Nandalur SR, Reddy P, Carlos RC. Diagnostic performance of positron emission tomography in the detection of coronary artery disease: a meta-analysis. Acad Radiol 2008;15:444-451	395.2-395.90	AUC indication(s) 15
Patients with cardiac transplantation in whom PET is performed to evaluate the presence of transplant vasculopathy	(1)Wu YW, Chin YH, Wang SS et al. PET Assessment of myocardial perfusion reserve inversely correlates with intravascular ultrasound findings in angiographically normal cardiac transplant recipients. J Nucl Med 2010;51:906-912 (2)Preumont N, Beerkenboom G, Vachery JL, et al. Early alterations in myocardial blood flow reserve in heart transplant recipients with angiographically normal coronary arteries. J Heart Lung Transplantation 2000;19:53-544 (3)Allen-Auerbach M, Schoder H, Johnson J, et al. Relationship between coronary function by positron emission tomography and temporal changes in morphology by intravascular ultrasound in cardiac transplant recipients. J Heart Lung Transplantation 1999;18:211-219	996.83, V42.1	AUC indication(s) 15

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
<p>Patients with suspected or known coronary disease being evaluated for cardiovascular risk prior to noncardiac surgery, who meet the recommendations for PET set forth in the clinical guidelines of the ASNC and the ACC. Patient undergoing intermediate risk noncardiac or vascular surgery, who is unable to exercise</p>	<p>(1)ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging— executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASNC Committee to Revise the 1995 Guidelines for the Clinical Use of Cardiac Radionuclide Imaging). <http://www.ncbi.nlm.nih.gov/pubmed/14522503</p> <p>(2)Klocke FJ, Baird MG, Lorell BH, Bateman TM, Messer JV, Berman DS, O’Gara PT, Carabello BA, Russell RO Jr, Cerqueira MD, St John Sutton MG, DeMaria AN, Udelson JE, Kennedy JW, Verani MS, Williams KA, Antman EM, Smith SC Jr, Alpert JS, Gregoratos G, Anderson JL, Hiratzka LF, Faxon DP, Hunt SA, Fuster V, Jacobs AK, Gibbons RJ, Russell RO; American College of Cardiology; American Heart Association; American Society for Nuclear Cardiology. J Am Coll Cardiol. 2003 Oct 1;42(7):1318-33</p> <p>(3)Beanlands R, Dick A, Chow B, et al. CCS; CAR; CANM; CNCS; and Can SCMR Position</p> <p>(4)Statement on Advanced Noninvasive Cardiac Imaging using Positron Emission Tomography, Magnetic Resonance Imaging and Multi-Detector Computed Tomographic Angiography in the Diagnosis and Evaluation of Ischemic Heart Disease. Can J Cardiol. 2007 Feb;23(2):107-19</p> <p>(5)Cerqueira MD, Allman KC, Ficaro EP, et al. ASNC Information Statement— Recommendations for reducing radiation exposure in myocardial perfusion imaging. J Nucl Cardiology 2010;17:709-18</p> <p>(6)ACC/AHA guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery. J Am Coll Cardiol. 2009 Nov 2;54:13-118</p>	<p>V72.80-72.84</p>	<p>AUC indication(s) 43 and 47</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients at intermediate or high risk of CAD with syncope to determine the presence and functional severity of potential coronary disease	(1)Hendel RC, Berman DS, MD, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. <i>J. Am. Coll. Cardiol.</i> 2009;53:2201-2229 (2)Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. <i>J Nucl Cardiol</i> 2011;18(1):3-15	780.2	AUC indication(s) 2 1
Patients presenting to the emergency department with acute chest pain, to evaluate the possibility of an acute coronary syndrome	(1)Di Carli, MF, Dorbala, S, Meserve, J, El Fakhri, G, Sitek, A, & Moore, SC. Clinical Myocardial Perfusion PET/CT. <i>J Nucl Med.</i> 2007;48(5):783-793	413.9, 786.50-786.59, 786.05-786.09	AUC indication(s) 6, 7, 8, and 9
Use of Cardiac PET in Women at intermediate or high risk for CAD	(1)Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT. < http://www.ncbi.nlm.nih.gov/pubmed/16464714 > Bateman TM, Heller GV, McGhie AI, Friedman JD, Case JA, Bryngelson JR, Hertenstein GK, Moutray KL, Reid K, Cullom SJ. <i>J Nucl Cardiol.</i> 2006 Jan-Feb;13(1):24-33	413.9, 414.8-414.9, 786.05-786.09, 786.50-786.59	AUC indication(s) 3, 4, and 5

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
To assess flow quantification and flow reserve in patients with known or suspected CAD	<p>(1)Uren NG, Melin JA, De Bruyne B, Wijns W, Baudhuin T, Camici PG. Relation between myocardial blood flow and the severity of coronary-artery stenosis. <i>N Engl J Med.</i> 1994 Jun 23;330(25):1782-8</p> <p>(2)Beanlands R, Muzik O, Melon P, Sutor R, Sawada S, Muller D, Bondie D, Hutchins GD, Schwaiger M. Noninvasive quantification of regional myocardial flow reserve in stenosed and angiographically normal vessels of patients with coronary atherosclerosis. <i>J Am Coll Cardiol</i> 1995;26(6):1465-1475</p> <p>(3)Muzik O, Duvernoy C, Beanlands RSB, Sawada S, Dayanikli F, Wolfe ER, Schwaiger M. Assessment of the diagnostic performance of quantitative flow measurements in normals and patents with angiographically documented CAD using [¹³N] ammonia and PET. <i>J Am Coll Cardiol</i> 1998;31:534-40</p> <p>(4)Parkash R, de Kemp RA, Ruddy TD, Kitsikis A, Hart R, Beauschene L, Williams K, Davies RA, Labinaz M, Beanlands RSB. Potential utility of perfusion quantification using rubidium-82 PET in patients with three-vessel coronary artery disease measured using rubidium-82 PET. <i>J Nucl Cardiol</i> 2004; 11(4):440-449</p> <p>(5)Anagnostopoulos C, Almonacid A, El Fakhri G, Curillova Z, Sitek A, Roughton M, Dorbala S, Popma JJ, Di Carli MF. Quantitative relationship between coronary vasodilator reserve assessed by ⁸²Rb PET imaging and coronary artery stenosis severity. <i>Eur J Nucl Med Mol Imaging.</i> 2008 Sep;35(9):1593-601</p> <p>(6)Hajjiri MM, Leavitt MB, Zheng H, Spooner AE, Fischman AJ, Gewirtz H. Comparison of positron emission tomography measurement of adenosine-stimulated absolute myocardial blood flow versus relative myocardial tracer content for physiological assessment of coronary artery stenosis severity and location. <i>JACC Cardiovasc Imaging.</i> 2009 Jun;2(6):751-8</p>		<p>AUC does not address this, but it is supported by ASNC guidelines.</p> <p>PET Myocardial Perfusion and Glucose Metabolism Imaging</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Value of PET in non-diagnostic SPECT MPI	<p>(1)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? J Am Coll Cardiol 2006 September 5;48(5):1029-1039</p> <p>(2)Bateman, T. M., Heller, G. V., McGhie, A. I., Friedman, J. D., Case, J. A., Bryngelson, J. R., et al. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: Comparison with ECG-gated Tc-99m sestamibi SPECT. Journal of Nuclear Cardiology. 2006;13(1):24-33</p>		<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p>
Value of PET imaging to determine multi-vessel disease	<p>(1)Demer LL, Gould KL, Goldstein R, et al. Assessment of coronary artery disease severity by positron emission tomography: comparison with quantitative angiography in 193 patients. Circulation 1989;79:825-835</p> <p>(2)Dorbala S, Hachamovitch R, Curillova Z. Incremental prognostic value of gated rubidium-82 positron emission tomography over clinical variables and rest left ventricular ejection fraction. J Am Coll Cardiol Img 2009;2:846-854</p> <p>(3)Sampson Uk, Dorbala S, Kwong R, Di Carli M. Diagnostic Accuracy of Rubidium-82 myocardial perfusion imaging with hybrid positron emission tomography/computed tomography in the detection of coronary artery disease. J Am Coll Cardiol 2007;49:1052-1058</p> <p>(4)Bateman TM, Heller GV, McGhie AI et al. Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: Comparison with ECG-gated Tc99m sestamibi SPECT. J Nucl Cardiol 2006;13:24-33</p> <p>(5)Parkash r, De Kemp RA, Ruddy TD, Beanlands RSB et al. Potential Utility of rubidium-82 PET quantification in patients with three-vessel coronary disease. J Nucl Cardiol 2004;11: 440-449</p>		<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p>

Table 2. continued

Appropriate clinical indications for conducting a cardiac PET study	Diagnostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
PET imaging in obese patients	<p>(1)Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT. <http://www.ncbi.nlm.nih.gov/pubmed/16464714> Bateman TM, Heller GV, McGhie AI, Friedman JD, Case JA, Bryngelson JR, Hertenstein GK, Moutray KL, Reid K, Cullom SJ. J Nucl Cardiol. 2006 Jan-Feb; 13(1):24-33</p> <p>(2)ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASNC Committee to Revise the 1995 Guidelines for the Clinical Use of Cardiac Radionuclide Imaging). <http://www.ncbi.nlm.nih.gov/pubmed/14522503> Klocke FJ, Baird MG, Lorell BH, Bateman TM, Messer JV, Berman DS, O’Gara PT, Carabello BA, Russell RO Jr, Cerqueira MD, St John Sutton MG, DeMaria AN, Udelson JE, Kennedy JW, Verani MS, Williams KA, Antman EM, Smith SC Jr, Alpert JS, Gregoratos G, Anderson JL, Hiratzka LF, Faxon DP, Hunt SA, Fuster V, Jacobs AK, Gibbons RJ, Russell RO; American College of Cardiology; American Heart Association; American Society for Nuclear Cardiology. J Am Coll Cardiol. 2003 Oct 1;42(7):1318-33</p> <p>(3)CCS/CAR/CANM/CNCS/CanSCMR joint position statement on advanced noninvasive cardiac imaging using positron emission tomography, magnetic resonance imaging and multidetector computed tomographic angiography in the diagnosis and evaluation of ischemic heart disease—executive summary. <http://www.ncbi.nlm.nih.gov/pubmed/17311116> Beanlands RS, Chow BJ, Dick A, Friedrich MG, Gulenchyn KY, Kiess M, Leong-Poi H, Miller RM, Nichol G, Freeman M, Bogaty P, Honos G, Hudon G, Wisenberg G, Van Berkomp J, Williams K, Yoshinaga K, Graham J; Canadian Cardiovascular Society; Canadian Association of Radiologists; Canadian Association of Nuclear Medicine; Canadian Nuclear Cardiology Society; Canadian Society of Cardiac Magnetic Resonance. Can J Cardiol. 2007 Feb;23(2):107-19</p> <p>(4)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? J Am Coll Cardiol 2006 September 5;48(5):1029-1039</p>		<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p>

Table 3. Indications for PET for prognostic purposes

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with high probability of CHD based on clinical findings and risk factors who are having PET to define the extent and severity of CAD for prognostic purposes	<p>(1)Dorbala S, Hachamovitch R, Curillova Z, Thomas D, Vangala D, Kwong RY, Di Carli MF. Incremental prognostic value of gated Rb-82 positron emission tomography myocardial perfusion imaging over clinical variables and rest LVEF. <i>J Am Coll Cardiol Img</i> 2009;2:846-854</p> <p>(2)Herzog BA, Husmann L, Valenta I, Gaemperli O, Siegrist PT, Tay FM, Burkhard N, Wyss CA, Kaufmann PA. Long-term prognostic value of ¹³N-ammonia myocardial perfusion positron emission tomography: added value of coronary flow reserve. <i>J Am Coll Cardiol</i> 2009;54:150-156</p> <p>(3)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. <i>Circulation</i> 2008;15;745-753</p> <p>(4)Cecchi, F., Olivotto, I., Gistri, R., Lorenzoni, R., Chiriatti, G., & Camici, P. G. Coronary microvascular dysfunction and prognosis in hypertrophic cardiomyopathy. <i>New England Journal of Medicine</i>. 2003;349(11):1027-1035</p> <p>(5)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? <i>J Am Coll Cardiol</i> 2006 September 5;48(5):1029-1039</p>	414.01	AUC indication(s) 15

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
<p>Selected asymptomatic high risk subgroups may also be candidates for PET; these include, but are not limited to, high risk diabetics, patients with chronic kidney disease, and patients with strong family history of CAD</p>	<p>Studies using cardiac PET to follow improvement of disease in high risk patients:</p> <p>(1)Gould KL, Martucci JP, Goldberg DI, Hess MJ, Edens RP, Latifi R, et al. Short-term cholesterol lowering decreases size and severity of perfusion abnormalities by positron emission tomography after dipyridamole in patients with coronary artery disease. A potential noninvasive marker of testing in coronary endothelium. <i>Circulation</i> 1994;89:1530-8</p> <p>(2)Coronary microvascular function in early chronic kidney disease. Chorytan DM, DiCarli MF. <i>Circulation Cardiovascular Imaging</i> 2010;3:66307</p> <p>(3)Dipyridamole cold pressor test and demonstration of endovascular dysfunction: a PET study of myocardial perfusion in diabetes. Kjoer A, Meyer C, Nielsen F, et al. <i>J Nucl Med</i> 2003;44:19-23</p> <p>(4)Reduced myocardial flow reserve in non-insulin dependent diabetes mellitus. Yokoyama F, Momomwia S, Ohtake T. et al. <i>J Am Coll Cardiol</i> 1997;30:1472-1477</p> <p>(5)Hendel RC, Abbott BG, Bateman TM, Blankstein R, Calnon DA, et al. ASNC Information Statement. The role of radionuclide myocardial perfusion imaging for asymptomatic individuals. <i>J Nucl Cardiol</i> 2011;18(1):3-15</p>	<p>414.01</p>	<p>AUC indication(s) 15</p>

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with an abnormal imaging stress test with new/worsening symptoms or with prior equivocal results who are having PET to determine the extent of ischemia to guide future therapy	<p>(1)What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? <http://www.ncbi.nlm.nih.gov/pubmed/16949498> Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin Szeto A, Aung M, Davies RA, Ruddy TD, Beanlands RS. J Am Coll Cardiol. 2006 Sep 5;48(5):1029-39. Epub 2006 Aug 17</p> <p>(2)Chow B, Al-Shammeri OM, Beanlands R, Chen L, deKemp RA, DaSilva J, Ruddy T. Prognostic Value of Treadmill Exercise and Dobutamine Stress Positron Emission Tomography. Can J Cardiol. 2009 Jul;25(7):e220-4</p> <p>(3)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? J Am Coll Cardiol 2006 September 5;48(5):1029-1039</p> <p>(4)Fukushima K, Javadi MS, Higuchi T, Lautamäki R, Merrill J, Nekolla SG, Bengel FM. Prediction of short-term cardiovascular events using quantification of global myocardial flow reserve in patients referred for clinical ⁸²Rb PET perfusion imaging. J Nucl Med. 2011 May;52(5):726-32</p> <p>(5)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. Circulation 2008;15;745-753</p>	414.0, 413.9, 414.8, 786.09, 786.50	AUC indication(s) 29 and 30

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with known CAD who have new onset of angina, angina equivalents, or significant change in symptoms	<p>(1)What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? <http://www.ncbi.nlm.nih.gov/pubmed/16949498> Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin Szeto A, Aung M, Davies RA, Ruddy TD, Beanlands RS. J Am Coll Cardiol. 2006 Sep 5;48(5):1029-39. Epub 2006 Aug 17</p> <p>(2)Chow B, Al-Shammeri OM, Beanlands R, Chen L, deKemp RA, DaSilva J, Ruddy T. Prognostic Value of Treadmill Exercise and Dobutamine Stress Positron Emission Tomography. Can J Cardiol. 2009 Jul;25(7):e220-4</p> <p>(3)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? J Am Coll Cardiol 2006 September 5;48(5):1029-1039</p> <p>(4)Fukushima K, Javadi MS, Higuchi T, Lautamäki R, Merrill J, Nekolla SG, Bengel FM. Prediction of short-term cardiovascular events using quantification of global myocardial flow reserve in patients referred for clinical ⁸²Rb PET perfusion imaging. J Nucl Med. 2011 May;52(5):726-32</p> <p>(5)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. Circulation 2008;115:745-753</p>	411.0, 412, 413.9, 786.50, 786.51, 786.59, 786.05	AUC indication(s) 4, 5, 30, and 31

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with a history of CAD and recent myocardial infarction in whom PET is performed to define the presence of post-MI ischemia, myocardium at risk, assess myocardial viability, and assess LV function (using gated PET techniques)	<p>(1)D'Egidio G, Nichol G, Williams KA, Guo A, Garrard L, deKemp R, Ruddy TD, DaSilva J, Humen D, Gulenchyn KY, Freeman M, Racine N, Benard F, Hendry P, Beanlands RS; PARR-2 Investigators. Increasing benefit from revascularization is associated with increasing amounts of myocardial hibernation: a substudy of the PARR-2 trial. <i>JACC Cardiovasc Imaging</i>. 2009 Sep;2(9):1060-8. PubMed PMID: 19761983</p> <p>(2)Beanlands RS, Nichol G, Huszti E, Humen D, Racine N, Freeman M, Gulenchyn KY, Garrard L, deKemp R, Guo A, Ruddy TD, Benard F, Lamy A, Iwanochko RM; PARR-2 Investigators. F-18-fluorodeoxyglucose positron emission tomography imaging-assisted management of patients with severe left ventricular dysfunction and suspected coronary disease: a randomized, controlled trial (PARR-2). <i>J Am Coll Cardiol</i>. 2007 Nov 13;50(20):2002-12. Epub 2007 Oct 10. PubMed PMID: 17996568</p> <p>(3)Gould KL, Yoshida K, Hess MJ, Haynie M, Mullani N, Smalling RW. Myocardial metabolism of fluorodeoxyglucose compared to cell membrane integrity for the potassium analogue rubidium-82 for assessing infarct size in man by PET. <i>J Nucl Med</i>. 1991 Jan;32(1):1-9. PMID: 1988610</p> <p>(4)Yoshida K, Gould KL. Quantitative relation of myocardial infarct size and myocardial viability by positron emission tomography to left ventricular ejection fraction and 3-year mortality with and without revascularization. <i>J Am Coll Cardiol</i>. 1993 Oct;22(4):984-97. PMID: 8409073</p> <p>(5)Maes A, Van de Werf F, Nuyts J, Bormans G, Desmet W, Mortelmans L. Impaired myocardial tissue perfusion early after successful thrombolysis. Impact on myocardial flow, metabolism, and function at late follow-up. <i>Circulation</i>. 1995 Oct 15;92(8):2072-8. PubMed PMID: 7554184</p>	414.0-414.07, 411, 410-410.92, 428.00-428.90	AUC indication(s) 50, 52, and 62

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Patients with acute coronary syndromes who have become stable on medical therapy and are undergoing PET to assess ischemic burden on medical therapy, and whether or not angiography and revascularization are indicated	<p>(1)Chow B, Al-Shammeri OM, Beanlands R, Chen L, deKemp RA, DaSilva J, Ruddy T. Prognostic Value of Treadmill Exercise and Dobutamine Stress Positron Emission Tomography. <i>Can J Cardiol.</i> 2009 Jul;25(7):e220-4</p> <p>(2)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? <i>J Am Coll Cardiol</i> 2006 September 5;48(5):1029-1039</p> <p>(3)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. <i>Circulation</i> 2008;15;745-753</p>	786.50-786.59, 414.0-414.07, 411	AUC indication(s) 50 and 52
Patients with poor functional capacity which is felt to be an independent marker of coronary risk to assess for presence of significant CAD	(1)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. <i>Circulation</i> 2008;15;745-753	786.05-786.09	AUC criterion(s) 15

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Risk assessment of patients with test results and/or known chronic stable CAD. (three subgroups listed below)	<p>(1)Chow B, Al-Shammeri OM, Beanlands R, Chen L, deKemp RA, DaSilva J, Ruddy T. Prognostic Value of Treadmill Exercise and Dobutamine Stress Positron Emission Tomography. <i>Can J Cardiol.</i> 2009 Jul;25(7):e220-4</p> <p>(2)Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin SA, Aung M, Davies RA, Ruddy TD, Beanlands RS. What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography? <i>J Am Coll Cardiol</i> 2006 September 5;48(5):1029-1039</p> <p>(3)Kirkeith Lertsburapa, Alan W. Ahlberg, Timothy M. Bateman, Deborah Katten and Lyndy Volker, et al. Independent and incremental prognostic value of left ventricular ejection fraction determined by stress gated rubidium 82 PET imaging in patients with known or suspected coronary artery disease. <i>Circulation</i> 2008;15;745-753</p>	410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 786.50-786.59, 794.30	AUC does not address this, but it is supported by ASNC guidelines PET myocardial perfusion and glucose metabolism imaging Standardized reporting of radionuclide myocardial perfusion and function
Subgroup 2: asymptomatic patients at least 2 years post-PCI	<p>(1)Van Tosh A, Garza D, Roberti R, Sherman W, Pompiano J, Ventura B, Horowitz SF. Serial myocardial perfusion imaging with dipyridamole and rubidium-82 to assess restenosis after angioplasty. <i>J Nucl Med.</i> 1995 Sep;36(9):1553-60. PMID: 7658209</p> <p>(2)Rimoldi O, Burns SM, Rosen SD, Wistow TE, Schofield PM, Taylor G, Camici PG. Measurement of myocardial blood flow with positron emission tomography before and after transmyocardial laser revascularization. <i>Circulation.</i> 1999 Nov 9;100(19 Suppl):II134-8. PubMed PMID: 10567292</p> <p>(3)Neumann FJ, Kósa I, Dickfeld T, Blasini R, Gawaz M, Hausleiter J, Schwaiger M, Schömig A. Recovery of myocardial perfusion in acute myocardial infarction after successful balloon angioplasty and stent placement in the infarct-related coronary artery. <i>J Am Coll Cardiol.</i> 1997 Nov 1;30(5):1270-6. PMID: 9350926</p>	410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 486.50-786.59, 794.30	AUC indication(s) 60

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
Subgroup 3: asymptomatic patients at least 5 years post coronary bypass surgery	(1)Marwick TH, Lafont A, Go RT, Underwood DA, Saha GB, MacIntyre WJ. Identification of recurrent ischemia after coronary artery bypass surgery: a comparison of positron emission tomography and single photon emission computed tomography. <i>International journal of cardiology</i> 1992;35:33-41	410-410.92, 411, 412, 413.9, 414.0-414.07, 414.8-414.90, 429.10, 786.05-786.09, 486.50-786.59, 794.30	AUC indication(s) 58
Patients with known coronary disease and left ventricular dysfunction who are having PET to identify the presence of myocardial viability and determine suitability for revascularization procedures	(1)Beanlands R, Dick A, Chow B, et al. CCS; CAR; CANM; CNCS; and CanSCMR Position Statement on Advanced Noninvasive Cardiac Imaging using Positron Emission Tomography, Magnetic Resonance Imaging and Multi-Detector Computed Tomographic Angiography in the Diagnosis and Evaluation of Ischemic Heart Disease. <i>Can J Cardiol.</i> 2007 Feb;23(2):107-19 (2)Schinkel, A. F., Poldermans, D., Elhendy, A., & Bax, J. J. (2007). Assessment of myocardial viability in patients with heart failure. <i>Journal of Nuclear Medicine</i> , 48(7), 1135-1146 (3)Eitzman, D., al-Aouar, Z., Kanter, H. L., vom Dahl, J., Kirsh, M., Deeb, G. M., et al. Clinical outcome of patients with advanced coronary artery disease after viability studies with positron emission tomography. <i>Journal of the American College of Cardiology.</i> 1992;20(3):559-565 (4)Abraham A, Nichol G, Williams KA, Guo A, deKemp RA, Garrard L, Davies RA, Duchesne L, Haddad H, Chow B, DaSilva J, Beanlands RS; PARR 2 Investigators. ¹⁸ F-FDG PET imaging of myocardial viability in an experienced center with access to ¹⁸ F-FDG and integration with clinical management teams: the Ottawa-FIVE substudy of the PARR 2 trial. <i>J Nucl Med.</i> 2010 Apr;51(4):567-74 (5)D'Egidio G, Nichol G, Williams KA, Guo A, Garrard L, deKemp R, Ruddy TD, DaSilva J, Humen D, Gulenchyn KY, Freeman M, Racine N, Benard F, Hendry P, Beanlands RS; PARR-2 Investigators. Increasing benefit from revascularization is associated with increasing amounts of myocardial hibernation: a substudy of the PARR-2 trial. <i>JACC Cardiovasc Imaging.</i> 2009 Sep;2(9):1060-8	410-410.92, 410.0-.410.9, 412.	AUC indication(s) 62

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
To define functional severity of known CAD by prior testing such as coronary angiography or coronary CTA	<p>(1)Kirkeeide R, Gould KL, Parsel L. Assessment of coronary stenoses by myocardial imaging during coronary vasodilation. VII. Validation of coronary flow reserve as a single integrated measure of stenosis severity accounting for all its geometric dimensions. <i>J Am Coll Cardiol</i> 1986;7:103-13</p> <p>(2)Gould KL, Goldstein RA, Mullani N, et al. Noninvasive assessment of coronary stenoses by myocardial imaging during pharmacologic coronary vasodilation. VIII. Feasibility of 3D cardiac positron imaging without a cyclotron using generator produced Rb-82. <i>J Am Coll Cardiol</i> 1986;7:775-92</p> <p>(3)Kajander S, Joutsiniemi E, Saraste M, Pietila M, Ukkonen H, Saraste A, Sipila HT, Teras M, Maki M, Airaksinen J, Hartiala J, Knuuti J. Cardiac positron emission tomography/computed tomography imaging accurately detects anatomically and functionally significant coronary artery disease. <i>Circulation</i> 2010;122:603-613</p>	746.8-746.89, 429.2, 414.8-414.90, 414.0-414.07	AUC indication(s) 32
Patients who have coronary calcification on CT scan which is quantified by an Agatston score greater than, or equal to, 100	<p>(1)Bybee KA, Lee J, Markiewicz R, Bateman TM. Diagnostic and Clinical Benefit of combined coronary calcium assessment and perfusion assessment in patients undergoing PET/CT myocardial perfusion stress imaging. <i>J Nucl Cardiol</i> 2010;17:188-196</p> <p>(2)Schenker mP, Dorbala S, Hong ECT, Hachamovitch R, Di Carli M. Interrelation of Coronary calcification, myocardial ischemia and outcomes in patients with intermediate likelihood of coronary artery disease. <i>Circulation</i> 2008;117:1696-1700</p> <p>(3)Fathala A, Alliefri A, Abouzied M. Coronary artery calcification by PET/CT as a marker of myocardial ischemia/ coronary artery disease. <i>Nuclear Medicine Communications</i> 2011;32:273-278</p>	414.01	AUC scores of 34, 35, and 36

Table 3. continued

Appropriate clinical indications for conducting a cardiac PET study	Prognostic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
To assess flow quantification and flow reserve in patients with known or suspected CAD	<p>(1)Tio RA, Dabeshlim A, Siebelink HM, de Sutter J, Hillege HL, Zeebregts CJ, Dierckx RA, van Veldhuisen DJ, Zijlstra F, Slart RH. Comparison between the prognostic value of left ventricular function and myocardial perfusion reserve in patients with ischemic heart disease. <i>J Nucl Med.</i> 2009 Feb;50(2):214-9</p> <p>(2)Herzog BA, Husmann L, Valenta I, Gaemperli O, Siegrist PT, Tay FM, Burkhard N, Wyss CA, Kaufmann PA. Long-term prognostic value of ¹³N-ammonia myocardial perfusion positron emission tomography added value of coronary flow reserve. <i>J Am Coll Cardiol.</i> 2009 Jul 7;54(2):150-6</p> <p>(3)Ziadi MC, deKemp RA, Williams KA, Guo A, Chow BJW, Renaud JM, Ruddy TD, Sarveswaran N, Tee RE, Beanlands RS. Impaired Myocardial Flow Reserve on Rubidium-82 Positron Emission Tomography Imaging Predicts Adverse Outcomes In Patients Assessed for Myocardial Ischemia. <i>J Am Coll Cardiol.</i> 2011 (in press)</p> <p>(4)Fukushima K, Javadi MS, Higuchi T, Lautamäki R, Merrill J, Nekolla SG, Bengel FM. Prediction of short-term cardiovascular events using quantification of global myocardial flow reserve in patients referred for clinical ⁸²Rb PET perfusion imaging. <i>J Nucl Med.</i> 2011 May;52(5):726-32</p> <p>(5)Murthy VL, Naya M, Foster CR, Hainer J, Gaber M, Di Carli G, Blankstein R, Dorbala S, Sitek A, Pencina MJ, Di Carli MF. Improved cardiac risk assessment with noninvasive measures of coronary flow reserve. <i>Circulation.</i> 2011 Nov 15;124(20):2215-24</p>		<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p> <p>Standardized reporting of radionuclide myocardial perfusion and function</p>

Table 4. Indications for PET to evaluate the effectiveness of medical therapy or revascularization

Appropriate clinical indications for conducting a cardiac PET study	Therapeutic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
PET to assess the efficacy of medical therapy for reduction of inducible myocardial ischemia	<p>(1)Gould KL, Martucci JP, Goldberg DI, Hess MJ, Edens RP, Latifi R, Dudrick SJ. Short-term cholesterol lowering decreases size and severity of perfusion abnormalities by positron emission tomography after dipyridamole in patients with coronary artery disease. A potential noninvasive marker of healing coronary endothelium. <i>Circulation</i>. 1994 Apr;89(4):1530-8. PMID: 8149518</p> <p>(2)Sdringola S, Nakagawa K, Nakagawa Y, Yusuf SW, Boccalandro F, Mullani N, Haynie M, Hess MJ, Gould KL. Combined intense lifestyle and pharmacologic lipid treatment further reduce coronary events and myocardial perfusion abnormalities compared with usual-care cholesterol-lowering drugs in coronary artery disease. <i>J Am Coll Cardiol</i>. 2003 Jan 15;41(2):263-72. PMID: 12535820</p> <p>(3)Gould KL, Ornish D, Scherwitz L, Brown S, Edens RP, Hess MJ, Mullani N, Bolomey L, Dobbs F, Armstrong WT, et al. Changes in myocardial perfusion abnormalities by positron emission tomography after long-term, intense risk factor modification. <i>JAMA</i>. 1995 Sep 20;274(11):894-901. PMID: 7674504</p> <p>(4)Huggins GS, Pasternak RC, Alpert NM, Fischman AJ, Gewirtz H. Effects of short-term treatment of hyperlipidemia on coronary vasodilator function and myocardial perfusion in regions having substantial impairment of baseline dilator reserve. <i>Circulation</i>. 1998 Sep 29;98(13):1291-6. PMID: 9751677</p> <p>(5)Yoshinaga K, Beanlands RS, deKemp RA, Lortie M, Morin J, Aung M, McKelvie R, Davies RF. Effect of exercise training on myocardial blood flow in patients with stable coronary artery disease. <i>Am Heart J</i> 2006 June;151(6):1324-1328</p>	414.0-414.07, 414.8-414.90	<p>AUC does not address this, but it is supported by ASNC guidelines</p> <p>PET myocardial perfusion and glucose metabolism imaging</p>

Table 4. continued

Appropriate clinical indications for conducting a cardiac PET study	Therapeutic literature supporting cardiac PET study	ICD-9 code	AUC which supports conducting a cardiac PET study
PET following coronary revascularization in patients with recurrent angina-like symptoms	<p>(1)Van Tosh A, Garza D, Roberti R, Sherman W, Pompliano J, Ventura B, Horowitz SF. Serial myocardial perfusion imaging with dipyridamole and rubidium-82 to assess restenosis after angioplasty. <i>J Nucl Med.</i> 1995 Sep;36(9):1553-60. PMID:7658209</p> <p>(2)Rimoldi O, Burns SM, Rosen SD, Wistow TE, Schofield PM, Taylor G, Camici PG. Measurement of myocardial blood flow with positron emission tomography before and after transmyocardial laser revascularization. <i>Circulation.</i> 1999 Nov 9;100(19 Suppl):II134-8. PubMed PMID: 10567292</p> <p>(3)Neumann FJ, Kósa I, Dickfeld T, Blasini R, Gawaz M, Hausleiter J, Schwaiger M, Schömig A. Recovery of myocardial perfusion in acute myocardial infarction after successful balloon angioplasty and stent placement in the infarct-related coronary artery. <i>J Am Coll Cardiol.</i> 1997 Nov 1;30(5):1270-6. PMID: 9350926</p>	413.9, 786.5, 411, 786.05-786.09, 780.02, 414.0-414.07, 414.8-414.90, V45.81, V45.82	AUC indication(s) 55
PET following coronary revascularization in asymptomatic patients deemed at high risk for restenosis, or who have had incomplete revascularization, or who have high risk coronary anatomy	<p>(1)Goldstein RA, Kirkeeide RL, Smalling RW, Nishikawa A, Merhige ME, Demer LL, Mullani NA, Gould KL. Changes in myocardial perfusion reserve after PTCA: noninvasive assessment with positron tomography. <i>J Nucl Med.</i> 1987 Aug;28(8):1262-7. PMID: 2956379</p>	413.9, 786.5, 411, 786.05-786.09, 780.02, 414.0-414.07, 414.8-414.90, V45.81, V45.82.	AUC indication(s) 56

Reference

1. Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 appropriate use criteria for cardiac radionuclide imaging. *J Am Coll Cardiol* 2009;53:2201-29.