How to Incorporate Noninvasive Imaging Modalities Into Clinical Practice

Improving Risk Management in High Risk Population

Seoul National University Bundang Hospital

Goo-Yeong Cho
2005 WHO

Cardiovascular disease

- 16.6 million deaths
  - 7.2 million Ischaemic heart disease
  - 5.5 million Cerebrovascular disease
  - 3.9 million Other heart conditions

- 20 million survivors
  - Long-term, continued costly care
  - Poor patient quality of life
  - Family burden

Largely preventable
Large inequalities

Early detection and management of risk factor

Reduction in sickness and premature death
2010 사망원인 통계청

사망원인순위, 2010

1위 144.4 암
2위 53.2 뇌혈관질환
3위 46.9 심장질환
4위 31.2 고의적자해(자살)
5위 20.7 당뇨병
6위 14.9 폐렴
7위 14.2 만성기도질환
8위 13.8 간질환
9위 13.7 운수사고
10위 9.6 고혈압성질환

사망률(인구10만명당)
2010 사망원인, 통계청

사망/10만 명

뇌혈관질환
심장질환
고혈압
CHD risk assessment in Asx adults

Global risk assessment in all asymptomatic adults

Low risk (~35% of patients)
- Low risk FRS
- No major CHD risk factors
- Reassurance and retest in 5 yr

Intermediate risk (~40% of patients)
- >one major RF
- Global risk est.: 0.6-2.0/yr
- Benefit from non-invasive testing

High risk (~25% of patients)
- Established CHD
- Type 2 DM
- High FRS
- Intensive risk intervention
- Non-invasive test is not required

Greenland P. circulation 2001;104:1863-67
## Major risk factors and protective factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modifiable risk factors</td>
<td>Hypertension</td>
</tr>
<tr>
<td></td>
<td>Dyslipidemia</td>
</tr>
<tr>
<td></td>
<td>Cigarette smoking</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td>Abdominal obesity</td>
</tr>
<tr>
<td></td>
<td>Excess alcohol</td>
</tr>
<tr>
<td></td>
<td>Sedentary lifestyle</td>
</tr>
<tr>
<td>Non-modifiable risk factors</td>
<td>Increasing age</td>
</tr>
<tr>
<td></td>
<td>Male gender</td>
</tr>
<tr>
<td></td>
<td>Family history of premature CVD</td>
</tr>
<tr>
<td>Protective factors</td>
<td>Daily consumption of fruit and vegetables</td>
</tr>
<tr>
<td></td>
<td>Regular moderate alcohol consumption</td>
</tr>
<tr>
<td></td>
<td>Regular physical activity</td>
</tr>
</tbody>
</table>
Managing risk factors

- High risk approach?
- Population based approach?
Pictorial representation of risk for CV disease

- ~5% Low risk factor level
- ~70% Average risk factor level
- ~25% High risk factor level

Population approach: Shift Entire distribution

Individual risk of CHD

High risk approach: Identify and treat high risk patients

Distribution of cases according to risk-factor level
High risk vs. population based?

• Most CV events do not occur in the small number of high-risk individuals, but rather in much larger population in the low-to-moderate risk stratum
  – 75% of stroke: occur among normal BP

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individualized high risk approach</td>
<td>Easy to motivate the patient</td>
<td>Limited potential for impact</td>
</tr>
<tr>
<td></td>
<td>Provides high risk: benefit ratio</td>
<td>Weak predictive power</td>
</tr>
<tr>
<td>Population approach</td>
<td>Radical</td>
<td>More CVD cases among the large numbers at low-medium risk</td>
</tr>
<tr>
<td></td>
<td>Large potential benefit for impact by reducing the number of those at risk</td>
<td>Small benefit to the individual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficult to motivate the patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk: benefit ratio unknown</td>
</tr>
</tbody>
</table>
Global Risk Management

CARDIOVASCULAR RISK MANAGEMENT

- 38% of all death: CV disease
- Death in Maori
  - 4 times higher than Pakeha
  - 33% lost between 45-64
Heart Foundation 2011-12

• Systemic assessment of the ‘at risk’ population, and effective management of high risk or living with heart disease

Know Your Numbers
EPA-cardio project

Improving Cardiovascular Prevention and Risk Management in European Primary Care

Project Report for the conference on 18 – 19 June 2009 in Berlin

Michel Wensing, Jan van Lieshout, Stephen Campbell, Sabine Ludt, Eckhard Volbracht, Richard Grol

• Retrospective cross-sectional
Cardiovascular prevention in patients at high risk

- 5,106 medical records from 10 countries (without diagnosis of CVD)
  - Comprehensives recording of CV risk factors?
    : None of countries
  - Lifestyle intervention?
    : mixed figures
<table>
<thead>
<tr>
<th>Country</th>
<th>Smoking status recorded</th>
<th>Smokers of those with a record of the smoking status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>215 (72 %)</td>
<td>59 (27 %)</td>
</tr>
<tr>
<td>Belgium</td>
<td>181 (74 %)</td>
<td>72 (40 %)</td>
</tr>
<tr>
<td>England</td>
<td>517 (97 %)</td>
<td>264 (51 %)</td>
</tr>
<tr>
<td>Finland</td>
<td>93 (63 %)</td>
<td>39 (42 %)</td>
</tr>
<tr>
<td>France</td>
<td>193 (66 %)</td>
<td>47 (24 %)</td>
</tr>
<tr>
<td>Germany</td>
<td>336 (77 %)</td>
<td>37 (11 %)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>149 (53 %)</td>
<td>38 (26 %)</td>
</tr>
<tr>
<td>Slovenia</td>
<td>695 (82 %)</td>
<td>181 (26 %)</td>
</tr>
<tr>
<td>Spain</td>
<td>602 (36 %)</td>
<td>602 (100 %)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>221 (62 %)</td>
<td>61 (28 %)</td>
</tr>
</tbody>
</table>

### Risk of SBP ≤ 140 mmHg

<table>
<thead>
<tr>
<th>Country</th>
<th>% per country</th>
<th>Lowest – highest value per practice (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>54</td>
<td>20–88</td>
</tr>
<tr>
<td>Belgium</td>
<td>69</td>
<td>0–100</td>
</tr>
<tr>
<td>England</td>
<td>52</td>
<td>13–93</td>
</tr>
<tr>
<td>Finland</td>
<td>44</td>
<td>0–100</td>
</tr>
<tr>
<td>France</td>
<td>71</td>
<td>13–100</td>
</tr>
<tr>
<td>Germany</td>
<td>43</td>
<td>7–86</td>
</tr>
<tr>
<td>Netherlands</td>
<td>45</td>
<td>20–71</td>
</tr>
<tr>
<td>Slovenia</td>
<td>56</td>
<td>33–91</td>
</tr>
<tr>
<td>Spain</td>
<td>36</td>
<td>n.a.</td>
</tr>
<tr>
<td>Switzerland</td>
<td>57</td>
<td>26–90</td>
</tr>
</tbody>
</table>

### Risk of LDL ≤ 2.5 mmol/l

<table>
<thead>
<tr>
<th>Country</th>
<th>% per country</th>
<th>Lowest – highest value per practice (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>14</td>
<td>0–30</td>
</tr>
<tr>
<td>Belgium</td>
<td>21</td>
<td>0–67</td>
</tr>
<tr>
<td>England</td>
<td>28</td>
<td>0–67</td>
</tr>
<tr>
<td>Finland</td>
<td>23</td>
<td>0–67</td>
</tr>
<tr>
<td>France</td>
<td>86</td>
<td>0–100</td>
</tr>
<tr>
<td>Germany</td>
<td>9</td>
<td>0–58</td>
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<tr>
<td>Netherlands</td>
<td>14</td>
<td>0–33</td>
</tr>
<tr>
<td>Slovenia</td>
<td>15</td>
<td>0–41</td>
</tr>
<tr>
<td>Spain</td>
<td>36</td>
<td>n.a.</td>
</tr>
<tr>
<td>Switzerland</td>
<td>13</td>
<td>0–39</td>
</tr>
</tbody>
</table>
# CV risk management in patients with CHD

<table>
<thead>
<tr>
<th></th>
<th>SBP ≤ 140 mmHg</th>
<th></th>
<th>LDL ≤ 2.5 mmol/l</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>% per country</td>
<td>Lowest-highest per practice (%)</td>
<td>% per country</td>
<td>Lowest-highest per practice (%)</td>
</tr>
<tr>
<td>Austria</td>
<td>70</td>
<td>41–100</td>
<td>43</td>
<td>0–91</td>
</tr>
<tr>
<td>Belgium</td>
<td>71</td>
<td>0–100</td>
<td>42</td>
<td>0–85</td>
</tr>
<tr>
<td>England</td>
<td>78</td>
<td>57–100</td>
<td>54</td>
<td>13–87</td>
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<tr>
<td>Finland</td>
<td>49</td>
<td>0–80</td>
<td>62</td>
<td>0–100</td>
</tr>
<tr>
<td>France</td>
<td>75</td>
<td>50–100</td>
<td>83</td>
<td>0–100</td>
</tr>
<tr>
<td>Germany</td>
<td>72</td>
<td>25–100</td>
<td>25</td>
<td>0–53</td>
</tr>
<tr>
<td>Netherlands</td>
<td>55</td>
<td>25–92</td>
<td>63</td>
<td>13–100</td>
</tr>
<tr>
<td>Slovenia</td>
<td>69</td>
<td>25–100</td>
<td>31</td>
<td>0–67</td>
</tr>
<tr>
<td>Spain</td>
<td>64</td>
<td>n.a.</td>
<td>64</td>
<td>n.a.</td>
</tr>
<tr>
<td>Switzerland</td>
<td>70</td>
<td>41–100</td>
<td>35</td>
<td>0–79</td>
</tr>
</tbody>
</table>
For improving risk management in high risk patients,

Role of imaging???
Do traditional risk factors based screening identify the vulnerable patient?
Trends in Age-standardized Mortality & Incidence of Acute MI (NHANES)

Per 100,000 Person

Acute MI Mortality
- 1971-1982: 30.4
- 1982-1992: 18.6

Acute MI Incidence
- 1971-1982: 49.7
- 1982-1992: 49.2
Preventing Myocardial Infarction in the Young Adult in the First Place: How Do the National Cholesterol Education Panel III Guidelines Perform?

Kwame O. Akosah, MD, Ana Schaper, PhD, Christopher Cogbill, BA, Paul Schoenfeld, MD

La Crosse, Wisconsin

J Am Coll Cardiol 2003;41:1475–9
Trends in Age-standardized Mortality & Incidence of Acute MI (NHANES)

Per 100,000 person-yr

![Graph showing trends in age-standardized mortality and incidence of Acute MI (NHANES). The graph displays the incidence rate (no. of cases/100,000 person-yr) from 1999 to 2008 for MI, Non-STEMI, and STEMI.](image)
Low diagnostic yield of elective coronary angiography

- Non-invasive testing
  - ECG
  - Echocardiography
  - CT
  - Stress test

83.9%
Better strategies for risk stratification are needed.
Evidence supporting the use of non-invasive imaging tests to screen for CAD is gradually accumulating.

“Future image-guided interventions will enable ...to detect critical illnesses at their most curable stage ...before any symptoms or signs are noticeable. The practice of medicine will shift ... to one of prediction and prevention in asymptomatic, at-risk populations.”

NIH Fact Sheet ‘Image Guided Interventions’
CAROTID-ARTERY INTIMA AND MEDIA THICKNESS AS A RISK FACTOR FOR MYOCARDIAL INFARCTION AND STROKE IN OLDER ADULTS

DANIEL H. O’LEARY, M.D., JOSEPH F. POLAK, M.D., M.P.H., RICHARD A. KRONMAL, PH.D., TERRI A. MANOLIO, M.D., M.H.S., GREGORY L. BURKE, M.D., M.S., AND SIDNEY K. WOLFSON, JR., M.D.,
FOR THE CARDIOVASCULAR HEALTH STUDY COLLABORATIVE RESEARCH GROUP
Coronary Calcium as a Predictor of Coronary Events in Four Racial or Ethnic Groups

Robert Detrano, M.D., Ph.D., Alan D. Guerci, M.D., Diane E. Bild, M.D., Kiang, David A. Bli, Karol Watson, Jay Carr, M.D., M.S.C.E., Aaron R. Folsom, M.D., M.D., Dr.P.H., Russell Tracy, Ph.D., Richard A. Kronmal, Ph.D.

BACKGROUND
In white populations, computed tomographic measurements of coronary-artery calcium predict coronary heart disease independently of traditional coronary risk factors. However, it is not known whether coronary-artery calcium predicts coronary heart disease in other racial or ethnic groups.

METHODS
We collected data on risk factors and performed scanning for coronary calcium in a population-based sample of 6722 men and women, of whom 38.6% were white, 27.6% were black, 21.9% were Hispanic, and 11.9% were Chinese. The study subjects had no clinical cardiovascular disease at entry and were followed for a median of 3.8 years.

RESULTS
There were 162 coronary events, of which 89 were major events (myocardial infarction or death from coronary heart disease). In comparison with participants with no coronary calcium, the adjusted risk of a coronary event was increased by a factor of 7.73 among participants with coronary calcium scores between 101 and 300 and by a factor of 9.67 among participants with scores above 300 (P<0.001 for both comparisons). Among the four racial and ethnic groups, a doubling of the calcium score increased the risk of a major coronary event by 15 to 35% and the risk of any coronary event by 18 to 39%. The areas under the receiver-operating-characteristic curves for the prediction of both major coronary events and any coronary event were higher when the calcium score was added to the standard risk factors.

CONCLUSIONS
The coronary calcium score is a strong predictor of incident coronary heart disease and provides predictive information beyond that provided by standard risk factors in four major racial and ethnic groups in the United States. No major differences among racial and ethnic groups in the predictive value of calcium scores were detected.
Coronary calcium score

**Table 4. Risk of Coronary Heart Disease Associated with Coronary-Artery Calcium Score in Four Racial or Ethnic Groups.**

<table>
<thead>
<tr>
<th>Racial or Ethnic Group</th>
<th>Major Coronary Event*:†</th>
<th>Any Coronary Event</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Hazard Ratio (95% CI):‡</td>
<td>P Value</td>
</tr>
<tr>
<td>White</td>
<td>41</td>
<td>1.17 (1.06–1.30)</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>Chinese</td>
<td>6</td>
<td>1.25 (0.95–1.63)</td>
<td>0.11</td>
</tr>
<tr>
<td>Black</td>
<td>18</td>
<td>1.35 (1.16–1.57)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hispanic</td>
<td>24</td>
<td>1.15 (1.02–1.29)</td>
<td>&lt;0.025</td>
</tr>
</tbody>
</table>
Screening for Early Detection and Prevention of Heart Attack

Society for Heart Attack Prevention and Eradication (SHAPE)

Presented at the 2008 Annual Scientific Sessions of the American Heart Association
Screening for Atherosclerosis
Risk Factors vs Disease

Numerous Risk Factors
- High LDL
- Low HDL
- High BP
- Diabetes
- Smoking
- CRP
- Metabolic Syn
- Lp(a)
- Homocysteine
- Dense LDL
- Lp-PLA2
- ApoB/ApoA
- Family History
- Sedentary Life
- Obesity
- Stress

Over 200 risk factors have been reported.

Examples of Arterial Structure Tests
- Carotid IMT and Plaque Measured by Ultrasound
- Aortic and Carotid Plaque Detected by MRI
- Coronary Calcium Score Measured by CT

Examples of Arterial Function Tests
- Ankle Brachial Index
- Brachial Vasoreactivity Measured by Ultrasound
- Vascular Compliance Measured by Radial Tonometry
- Microvascular Reactivity Measured by Fingertip Tonometry
The 1st S.H.A.P.E. Guideline
Towards the National Screening for Heart Attack Prevention and Education (SHAPE) Program

Conceptual Flow Chart

Apparently Healthy At-Risk Population

Step 1
Test for Presence of the Disease

Atherosclerosis Test

Negative
No Risk Factors
+ Risk Factors

Positive
<75th Percentile
75th-90th Percentile
≥90th Percentile

Step 2
Stratify based on the Severity of the Disease and Presence of Risk Factors

Step 3
Treat based on the Level of Risk

Lower Risk
Moderate Risk
Moderately High Risk
High Risk
Very High Risk
The 1st S.H.A.P.E. Guideline
Towards the National Screening for Heart Attack Prevention and Education (SHAPE) Program

Apparently Healthy Population Men > 45y Women > 55y

Step 1

Atherosclerosis Test

- Very Low Risk
  - CACS = 0
  - CIMT < 50th percentile
- Negative Test
  - No Risk Factors
- + Risk Factors

Positive Test
- CACS ≥ 1
- CIMT ≥ 50th percentile or Carotid Plaque

Moderate Risk
- CACS < 100 & < 75th%
- CIMT < 1mm & < 75th%
- No Carotid Plaque

High Risk
- CACS 100-399 or > 75th%
- CIMT ≥ 1mm or > 75th%
- ≥ 50% Stenotic Plaque

Very High Risk
- CACS > 100 & > 90th%
- ≥ 50% Stenotic Plaque

Step 2

- Exit
- All > 75y receive unconditional treatment

Step 3

- Lower Risk
  - LDL < 160 mg/dl
  - ABI < 0.9
  - CRP < 4 mg

Moderate Risk
- LDL < 130 mg/dl
- ABI < 0.9
- CRP Optional

Moderately High Risk
- LDL < 130 mg/dl
- ABI < 0.9
- CRP Optional

High Risk
- LDL < 100 mg/dl
- ABI < 0.9
- CRP Optional

Very High Risk
- LDL < 70 mg/dl
- ABI < 0.9
- CRP Optional

LDL Target
- < 160 mg/dl
- < 130 mg/dl
- < 130 mg/dl
- < 100 mg/dl
- < 70 mg/dl

Re-test Interval
- 5-10 years
- 5-10 years
- Individualized
- Individualized
- Individualized

1: No history of angina, heart attack, stroke, or peripheral arterial disease.
2: Population over age 75y is considered high risk and must receive therapy without testing for atherosclerosis.
3: Must not have any of the following: Chol > 200 mg/dl, blood pressure > 120/80 mmHg, diabetes, smoking, family history, metabolic syndrome.
4: Pending the development of standard practice guidelines.
5: High cholesterol, high blood pressure, diabetes, smoking, family history, metabolic syndrome.
6: For stroke prevention, follow existing guidelines.
Carotid-Wall Intima–Media Thickness and Cardiovascular Events

Joseph F. Polak, M.D., M.P.H., Michael J. Pencina, Ph.D., Karol M. Pencina, Ph.D., Christopher J. O’Donnell, M.D., M.P.H., Philip A. Wolf, M.D., and Ralph B. D’Agostino, Sr., Ph.D.

The maximum internal and mean common carotid-artery IMT both predict cardiovascular outcomes
According to the FRS, the net reclassification index was 1.8% (49 of 2686 participants) for participants without events, 5.8% (15 of 260 participants) for those with events, and 7.6% overall.

<table>
<thead>
<tr>
<th>Original Risk Category</th>
<th>Reclassification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Risk</td>
<td>Intermediate Risk</td>
</tr>
<tr>
<td><strong>Participants without cardiovascular events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>1125</td>
<td>31</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>85</td>
<td>1126</td>
</tr>
<tr>
<td>High risk</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td><strong>Participants with cardiovascular events</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>Intermediate risk</td>
<td>1</td>
<td>112</td>
</tr>
<tr>
<td>High risk</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
C-statistics

![Graph showing C-statistics for different clinical factors and combinations: Clinical Factor, Clinical Factor + ICA IMT, and Clinical Factor + plaque. The graph indicates that Clinical Factor + plaque has the highest C-statistic at 0.765, followed by Clinical Factor + ICA IMT at 0.755, and Clinical Factor at 0.745.]
CMR and SPECT for CAD (CE-MARC): a prospective trial

- CE-MARC is the largest, prospective, real world evaluation of CMR and has established CMR’s high diagnostic accuracy in CHD and CMR’s superiority over SPECT.
- It should be adopted more widely than at present for the investigation of CHD
Cardiovascular Risk Reduction Guidelines in Adults:
Cholesterol Guideline Update (ATP IV)
Hypertension Guideline Update (JNC 8)
Obesity Guideline Update (Obesity 2)
Integrated Cardiovascular Risk Reduction Guideline

Content

1. Overview
2. Timeline
3. Guidelines Development Approach
4. Background

Overview

The National Heart, Lung, and Blood Institute is leading the development of an integrated set of cardiovascular risk reduction guidelines for adults using state-of-the-art methodology. Cholesterol, hypertension, and obesity guidelines are being updated, and an integrated cardiovascular risk reduction guideline is being developed.

Timeline

- **Cholesterol Guideline Update (ATP IV)**
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012

- **Hypertension Guideline Update (JNC 8)**
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012

- **Obesity Guideline Update (Obesity 2)**
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012

- **Integrated Cardiovascular Risk Reduction Guideline**
  - Timeline TBD
### Treatment Categories, LDL-C Goals and Cutpoints: ATP-III

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>LDL-C Goal</th>
<th>Consider Drug Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD or CHD risk equivalent</td>
<td>&lt;100 mg/dL</td>
<td>≥130 mg/dL*</td>
</tr>
<tr>
<td>≥2 Risk Factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-yr risk 10–20%</td>
<td>&lt;130 mg/dL</td>
<td>≥130 mg/dL</td>
</tr>
<tr>
<td>10-yr risk &lt;10%</td>
<td>&lt;130 mg/dL</td>
<td>≥160 mg/dL</td>
</tr>
<tr>
<td>&lt;2 Risk Factors</td>
<td>&lt;160 mg/dL</td>
<td>≥190 mg/dL</td>
</tr>
</tbody>
</table>

* 100–129 mg/dL = after TLC, consider statin, niacin, or fibrate therapy
Goals for Therapy: 2004 Addendum

- NCEP ATP III guidelines for LDL Therapy
  - LDL-C <160 for 1 or less risk factors
  - LDL-C <130 for 2+ risk factors
    - < 100 is a therapeutic option
  - LDL-C <100 for CAD and CAD equivalents
    - <70 is option for very high risk patients
  1. CAD + multiple risk factors, especially diabetes
  2. CAD + severe or poorly controlled risk factor(s)
  3. CAD + metabolic syndrome
  4. Acute coronary syndrome
  5. CAD event despite baseline LDL-C < 100
Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel IV)

Expert Panel Membership

Expected Release Date: Fall 2011
Predictions for ATP-IV

1. The goals for LDL-C in primary prevention will be lowered.

2. There will be a stronger statement on hsCRP, but routine use in risk stratification or use as secondary target will not be specifically endorsed.

3. Non-HDL-C will remain the secondary lipid target, but optional use of apo B or LDL-P will be endorsed.

4. A new risk calculator providing lifetime risk estimates will be provided.
JNC 8

- Prediction of JNC 8
- JNC late or JNC wait
감사합니다.