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Pediatric Dyslipidemias:
Screening, Diagnosis, and Management in the Primary Care Setting

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Director of Pediatric Preventive Cardiology
May 19, 2021

Title of course: Pediatric Dyslipidemias: Screening, Diagnosis, and Management in the Primary Care Setting

Presenter: Brenda Mendizábal, MD, MS

Date and location: May 19, 2021–Webex–Recorded live and available to view virtually thereafter

Time: Noon – 1 p.m. (includes presentation and Q&A session)

Target audience: Doctors (Family practice/pediatricians), nurses, and staff

Course director(s): Johanna Vidal-Phelan, MD, MBA, FAAP; Debra Zeh, RN, BSN; and Andrea Sweeney, RN

Moderator: Andrea Sweeney, RN

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Goals

- Identify children at greatest risk for accelerated atherosclerosis
- Formulate a plan for how to manage children with dyslipidemias
- Recognize the role of the pediatric preventive cardiologist

Scope of Pediatric Preventive Cardiology

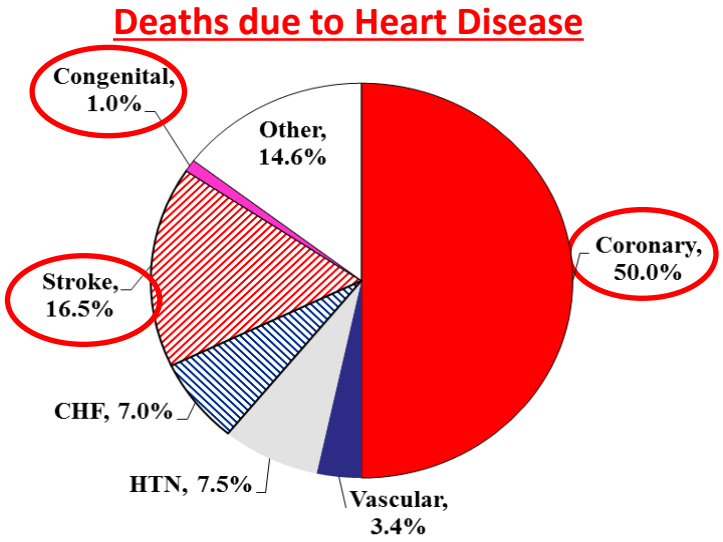
Primary Risk Factor Identification and Management

- Obesity
- Dyslipidemia
- Systemic Hypertension

Nutrition counseling, encouragement of PA, avoidance of tobacco use, and management of other comorbidities (i.e. DM, OSA, mental health).

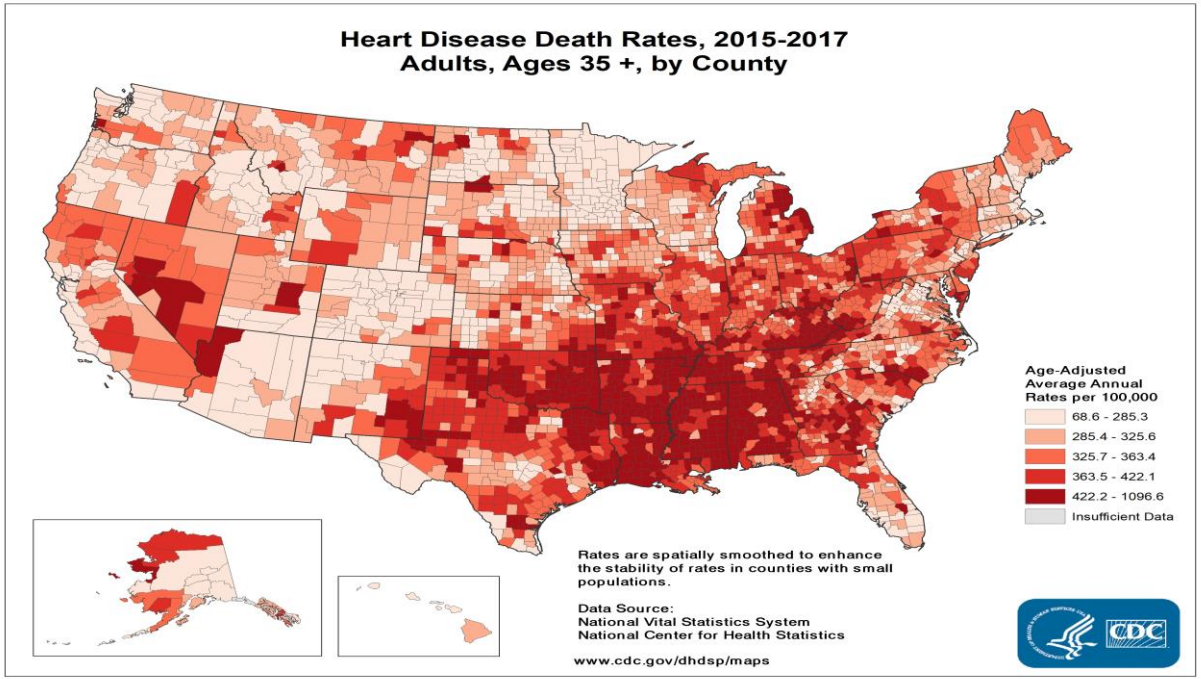
Why Should we Care About
Atherosclerotic Heart Disease?

- CVD account for 37% of all cause mortality…*even in Africa*
- By 2030, 41% of the U.S. population is projected to have some form of CVD
- Total direct medical costs of CVD are projected to triple ($309 → $834 *billion!*)
- 150,000 deaths < 65 years old
- >800,000 CV deaths/year… *only 3,400 for congenital heart disease*



WHO World Health Statistics 2013; Rosamond Circ 2007; figure = Roger Circ 2012

Cardiovascular Disease Landscape in the US



cdc.gov;nytimes.com

Prevalence of Risk Factors for CVD

- 20-40% of children with unhealthy weight/obesity
  - 4-6% of children with severe obesity
  - 2-5 years: 13.9%; 6-11 years: 18.4%; 13-17 years: 20.6%
  - Hispanic (25.8%) and non-Hispanic Blacks (22%) vs non-Hispanic Whites (14.1%) and non-Hispanic Asians (11%)
- 14-15% of children with elevated BP and 4-5% with systemic HTN
- 1/200 persons with familial hypercholesterolemia (FH)

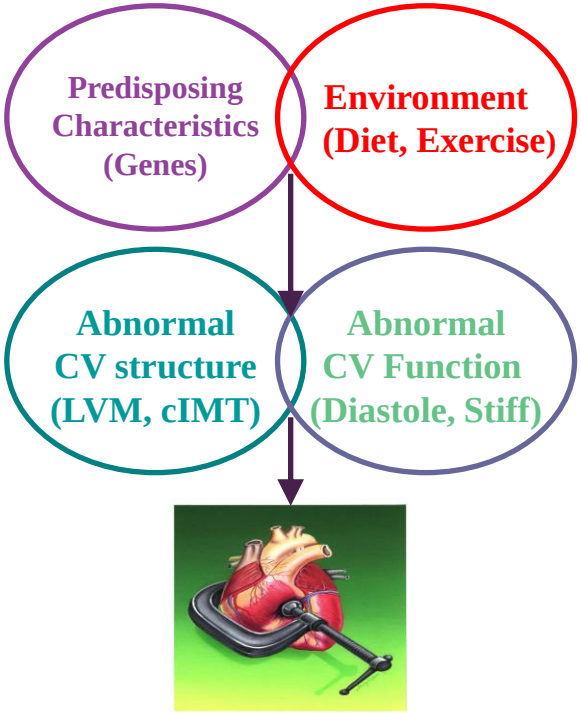
What Are Risk Factors for CVD?

Modifiable

- Obesity
- HTN
- Dyslipidemia
- Insulin Resistance
- Inactivity
- Poor diet
- Smoking

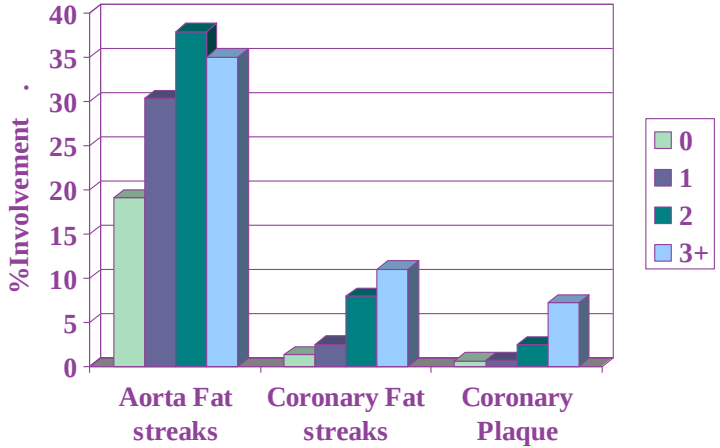
Non-Modifiable

- Genetics/Family Hx
- Gender/Hormones
- Psychosocial stresses



What is Proof that CVRFs *Cause Atherosclerosis in Youth?*

The Bogalusa Heart Study
1972 – 2017



Coronary Arteries
Sudan 3 stain:
Obese Young Smoker with High Cholesterol

- Longitudinal study of CVRFs starting in Youth
- Autopsies on subjects who died from external causes
- *Clustering* of CV Risk Factors measured in youth →
  - Greater fatty streaks & fibrous plaques,
  - Thicker renal arteries

**P≤0.01 for trend, N = 204, 2-39 years; Berenson, NEJM 1998.*

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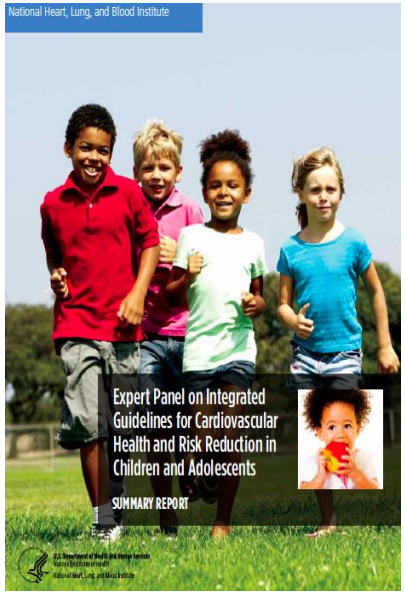
How do we *evaluate CV Risk Factors?*



- NIH appointed expert panel to develop evidence-based CV health guidelines that address all the major CV risk factors together
- Addresses 3 types of Prevention
- Provides an integrated age-appropriate CV Health Schedule

http://www.nhlbi.nih.gov/guidelines/cvd_ped/

Risk Factor	Birth-1 year	1-4 years	5-9 years	9-11 years	12-17 years	18-21 years
Family History	**Obtain at each visit.**	Update	Update	Update	Update	Update
Smoking	**Anti-smoking**	Same	Same	Same	Same	Same
Physical Activity	**Parents as model**	**Active play, nmt 2/d screen**	**Moderate activity 1/d**	**Activity history**	Same	**Lifelong activity**
Diet	**Breast-feeding.**	**Low fat milk.**	**CHILD 1 diet**	Same	Same	Same
Obesity	**Explain healthy wt/ht.**	**Calculate BMI.**	**Obese: Family wt pgm**	**Obese: Clinical wt prg**	**Orlistat or Bariatric Surgery.**	Same
Lipids	No Rec.	**Selective Screening**	Same	**Screen all.**	Same	**Re-screen**
BP	**Measure if high risk**	**Measure BP yearly**	Same	Same	Same	**Use JNC 7**
DM	No Rec.	No Rec.	No Rec.	**Fasting glucose**	Same	Same

Family History of Early CVD

- Determine if there is a Positive Family Hx for ***early*** CVD *(Grade B Strongly Recommend)*
  - Parent, grandparent, aunt, uncle or sibling with CVD <55 years for males or 65 for females
  - (CVD = Heart attack, stroke, sudden cardiac death, angina, or any re-vascularization procedure such as coronary stent, angioplasty or bypass)

- Evaluate for other CV Risk factors in patient and family *(Grade B Strongly Recommend)*

Risk Factor	Birth-1 year	1-4 years	5-9 years	9-11 years	12-17 years	18-21 years
Family History	**Obtain at each visit.**	Update	Update	Update	Update	Update
Smoking	**Anti-smoking**	Same	Same	Same	Same	Same
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Tobacco History

- When to take it: Initial and all subsequent visits

- What to do with it:
  - Promote smoking cessation at pre-natal visit (*Grade A: Strongly Recommend*).
  - Promote smoke free home for Toddlers (*Grade B: Strongly Recommend).*
  - Take smoking history, teach danger of smoking in pre-teens *(Grade C: Recommend)*
  - Provide smoking cessation aids to teens and above *(Grade B: Strongly Recommend)*

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BP	**Measure if high risk**	**Measure BP yearly**	Same	Same	Same	**Use JNC 7**
DM	No Rec.	No Rec.	No Rec.	**Fasting glucose**	Same	Same

Physical Activity

- When to evaluate it: Initial and all subsequent visits

- INFANTS: *(Grade D: Recommend)*
  - Promote parental exercise as role model.
- TODDLERS: (*Grade D: Recommend).*
  - Promote active play
  - Limit screen time to ***No More Than 2hr/day***
- CHILDREN/ADOLESCENTS: (*Grade A: Strongly Recommend).*
  - Moderate activity 1 hr/d
  - Vigorous 3 d/week
  - Limit screen time to ***No More Than 2hr/day***

Risk Factor	Birth-1 year	1-4 years	5-9 years	9-11 years	12-17 years	18-21 years
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DM	No Rec.	No Rec.	No Rec.	**Fasting glucose**	Same	Same

Nutrition

- When to evaluate it: Initial and all subsequent visits

- INFANTS: (*Grade B: Strongly Recommend).*
  - Breast feed to 6 months or 12 months if possible
- TODDLERS: *over 1 year age*
  - Less than 4 oz/day juice (*Grade D: Recommend).*
  - Only unflavored, LOW FAT milk (*Grade A: Strongly Recommend).*
  - No sugar sweetened beverages *(Grade C: Recommend).*

Nutrition

- CHILDREN & ADOLESCENTS:
  - Encourage high fiber (age + 5 grams/day) *(Grade B: Recommend)*
  - Consider DASH style diet (low Na, rich in fruit & vegetables *(Grade D: Recommend)*
- CHILD-1 diet for all

Age	Recommendation	Grade
Older than 1 year	(AHA Step 1) Table food with NTM:	*Recommend*
	• 30% calories from fat	Grade B
	• 10% calories from saturated fat	Grade B
	• 20% of calories from mono- & poly-unsaturated fat	Grade D
	• <300mg of cholesterol	Grade B
	• Avoid trans fat	Grade D
	• Limit sugar-sweetened beverage (NMT 4 oz/d juice)	Grade B
	• Limit Na, consider DASH style	Grade D
	• Portions based on activity level	

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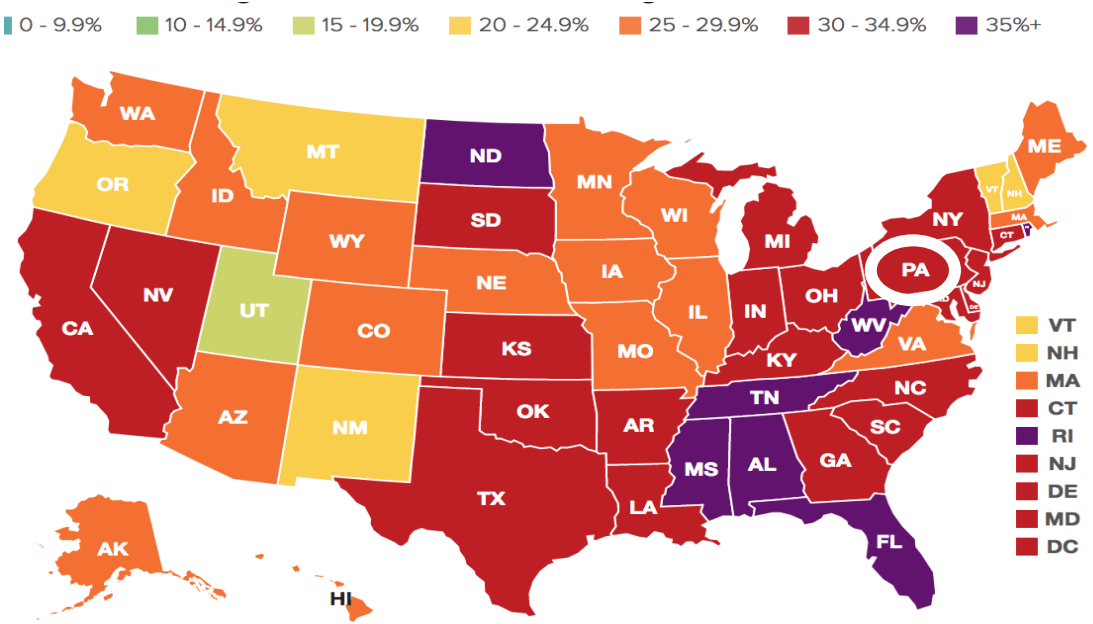
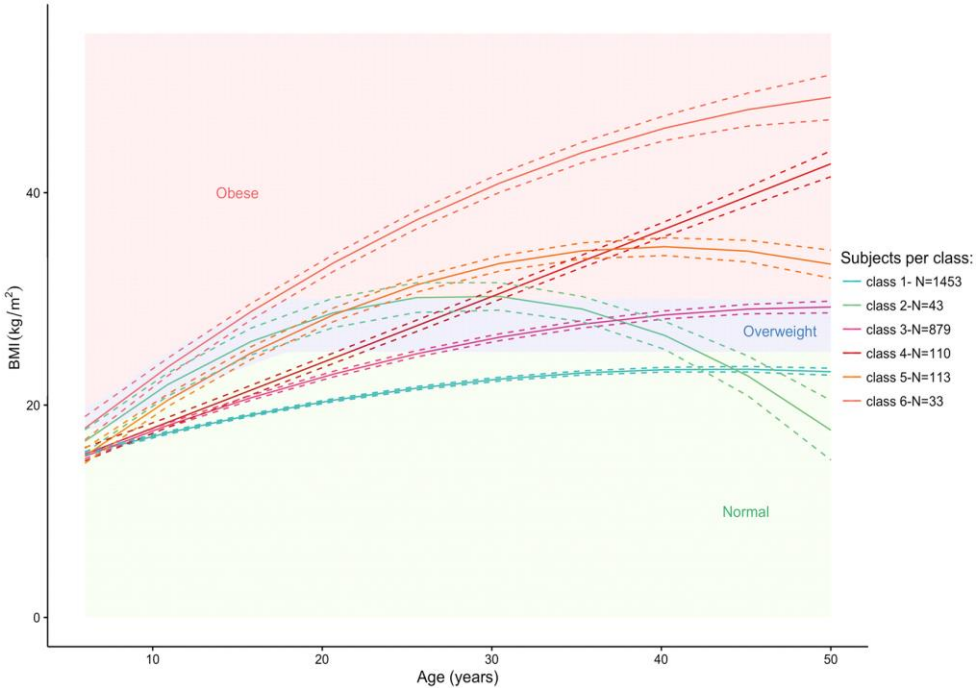
Overweight & Obese Children (2016)



Pediatric Obesity: Tracks into Adulthood

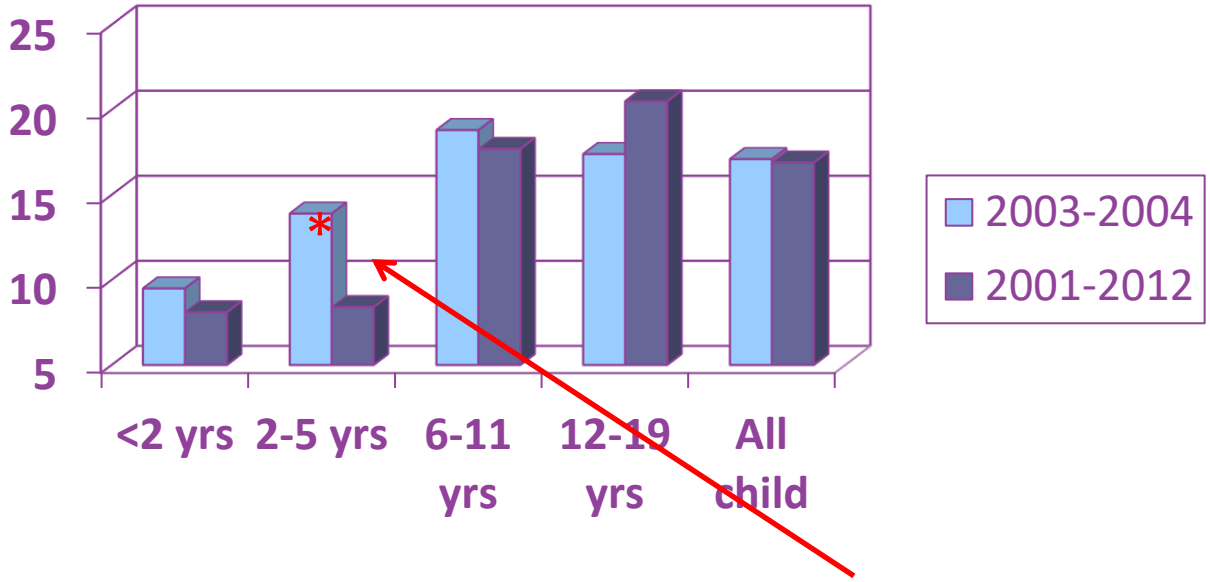


Relationship between life-course BMI trajectories and adult risk for CVD

- Trajectories of persistent or worsening obesity associated with increased CVD risk outcomes in adulthood (24-49 years of age) (RRs>15, p<0.05 compared with stable normal group)

Buskot MJ et al. Eur Heart J. 2018

Trends in Obesity



- Significant decrease in obesity among 2-5 year-olds (13.9% to 8.4%; P = .03)
- Overall, there have been no significant changes in obesity prevalence in youth or adults between 2003-2004 and 2011-2012.

Ogden, JAMA. 2014;311(8):806-814. doi:10.1001/jama.2014.732

Obesity

- INFANTS: Educate family on healthy diet
- TODDLERS:
  - Identify patients at risk for obesity due to rapid increase in BMI (*Grade D: Recommend).*
  - Family oriented treatment if BMI > 95th% *(Grade B: Strongly Recommend)*
- CHILDREN:
  - Weight Management clinic treatment program if BMI > 95% *(Grade A: Strongly Recommend)*
- ADOLESCENTS:
  - Weight Management clinic treatment for BMI> 95%
  - Consider Bariatric surgery if BMI > 35 with other CV risk factors *(Grade C: Optional)*

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Lipid Screening

- INFANTS: *no recommendations (Grade C)*

- TODDLERS & CHILDREN: *(Grade B: Recommend)*
  - Only screen patients age 2 to 9 years if strong positive Fam Hx early CVD or *significant CV risk factors*.

- PRE-ADOLESCENTS: *(Grade B: Strongly Recommend)*
  - Age 9-11 years, do *non fasting* lipid panel.
    - If **non-HDL** (= TChol – HDL-C) is ≥ 145 mg/dl, obtain *fasting* lipid panel.
    - If **Tchol** > 200 mg/dl, obtain *fasting* lipid panel.

- ADOLESCENTS: *(Grade B-C: Recommend)*
  - Screen if not done previously and re-screen at 18-21 years

CV Risk Factors

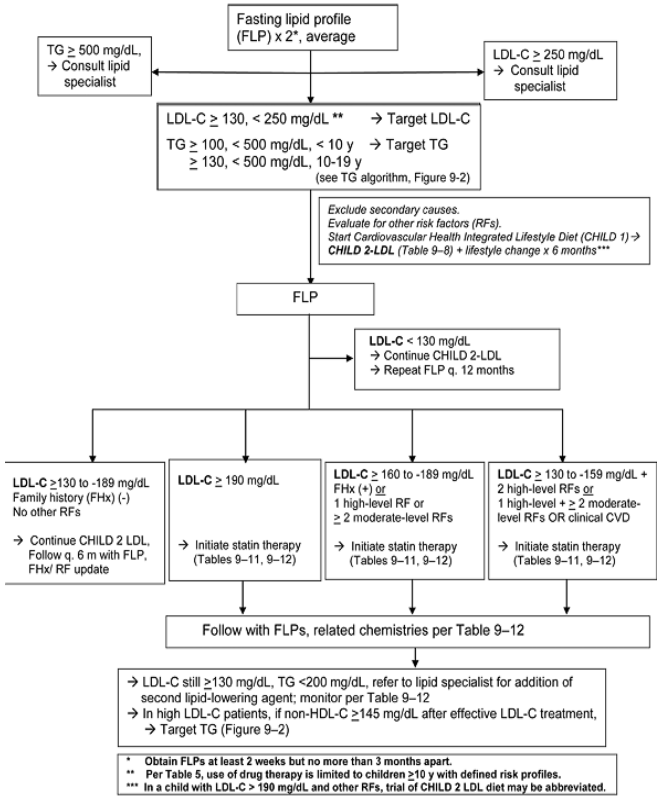
- Hypertension
- Dyslipidemia
- Diabetes
- Metabolic syndrome
- Inflammatory state*
- Physical inactivity/sedentary lifestyle
- Diet/food preferences
- Obesity
- Cigarette smoking/Vaping

Normal Cholesterol Levels for *Children and Adolescents*

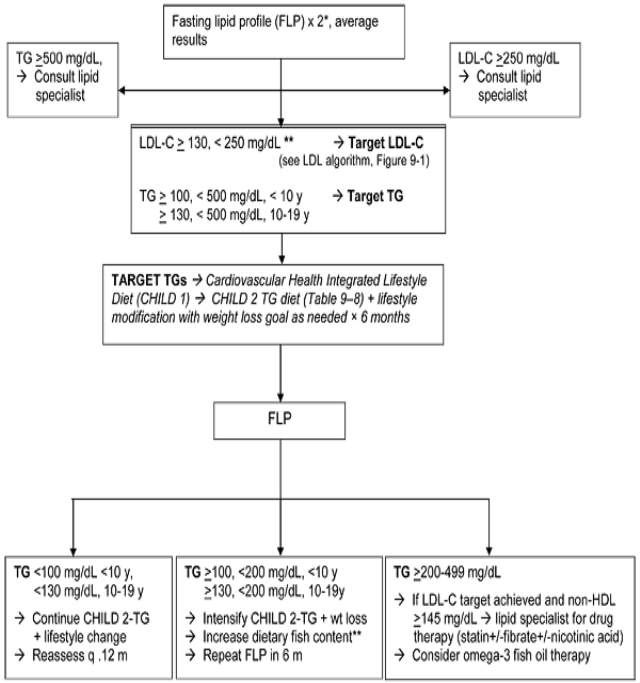
Screening at age 9-11 allows evaluation prior to puberty (drop in LDL)

Category		Acceptable	Borderline	High (or low)
Total Cholesterol		< 170	170-199	≥ 200
LDL-C		< 110	110-129	≥ 130
Non-HDL-C		< 120	120-144	≥ 145
ApoB		< 90	90-109	≥ 110
TG	0-9 years	< 75	75-99	≥ 100
	10-19 years	< 90	90-129	≥ 130
HDL-C		> 45	40-45	< 40
ApoA-I		> 120	115-120	< 115

Target LDL Algorithm



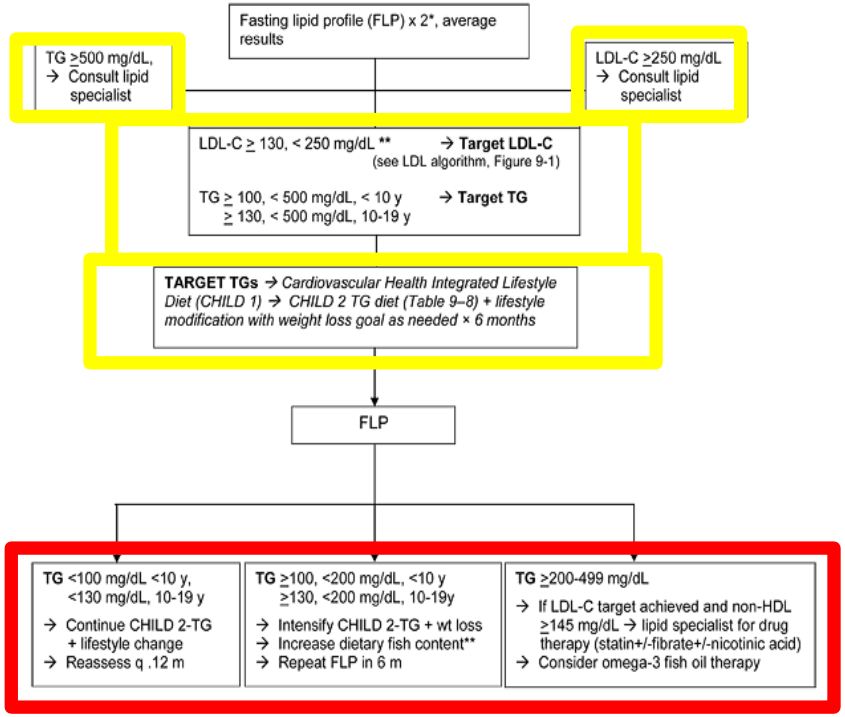
Target TG Algorithm



* Obtain FLPs at least 2 weeks but no more than 3 months apart.

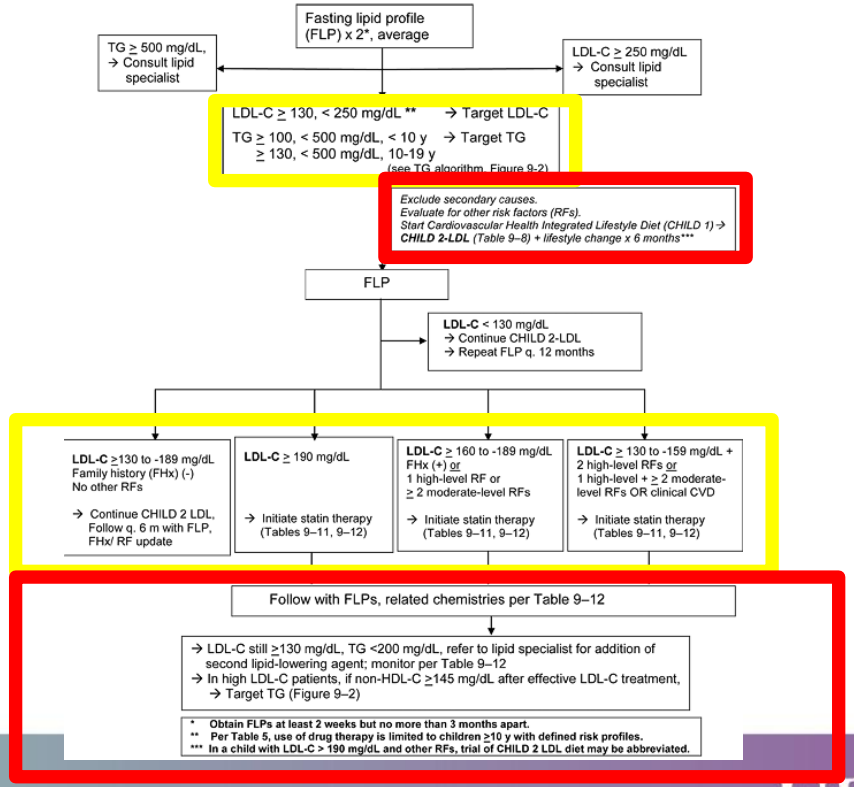
**The Food and Drug Administration (FDA) and the Environmental Protection Agency are advising women of childbearing age who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and shellfish and eat fish and shellfish that are lower in mercury. For more information, call the FDA's food information line toll free at 1-888-SAFEFOOD or visit http://www.cfsan.fda.gov/~dms/admehg3.html.

Dyslipidemia Algorithm: Target TG



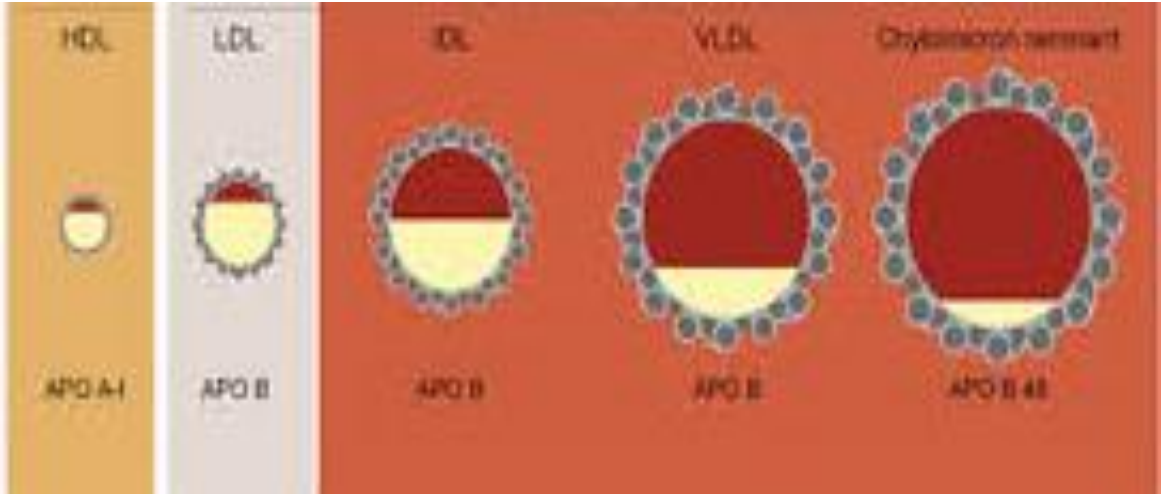
http://www.nhlbi.nih.gov/guidelines/cvd_ped/peds_guidelines_sum.pdf

Dyslipidemia Algorithm: Target LDL



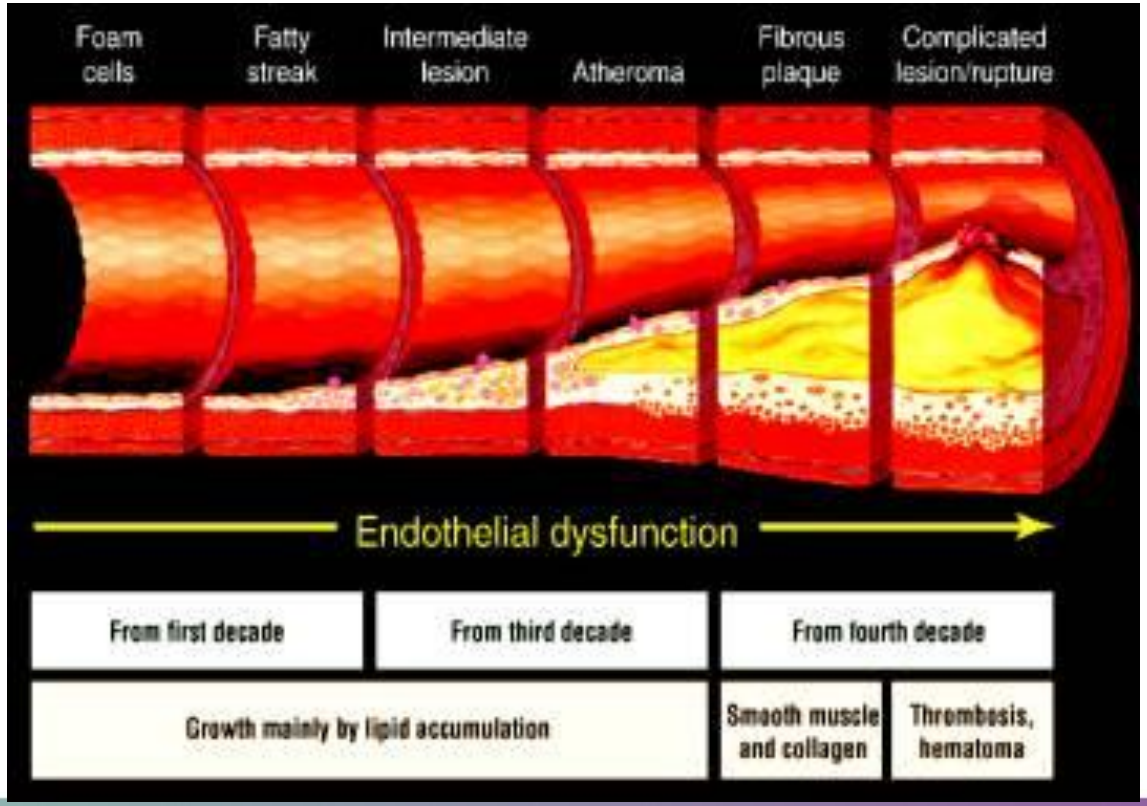
What is non-HDL-C?

GOOD	BAD	ALL ATHEROGENIC LIPOPROTEINS

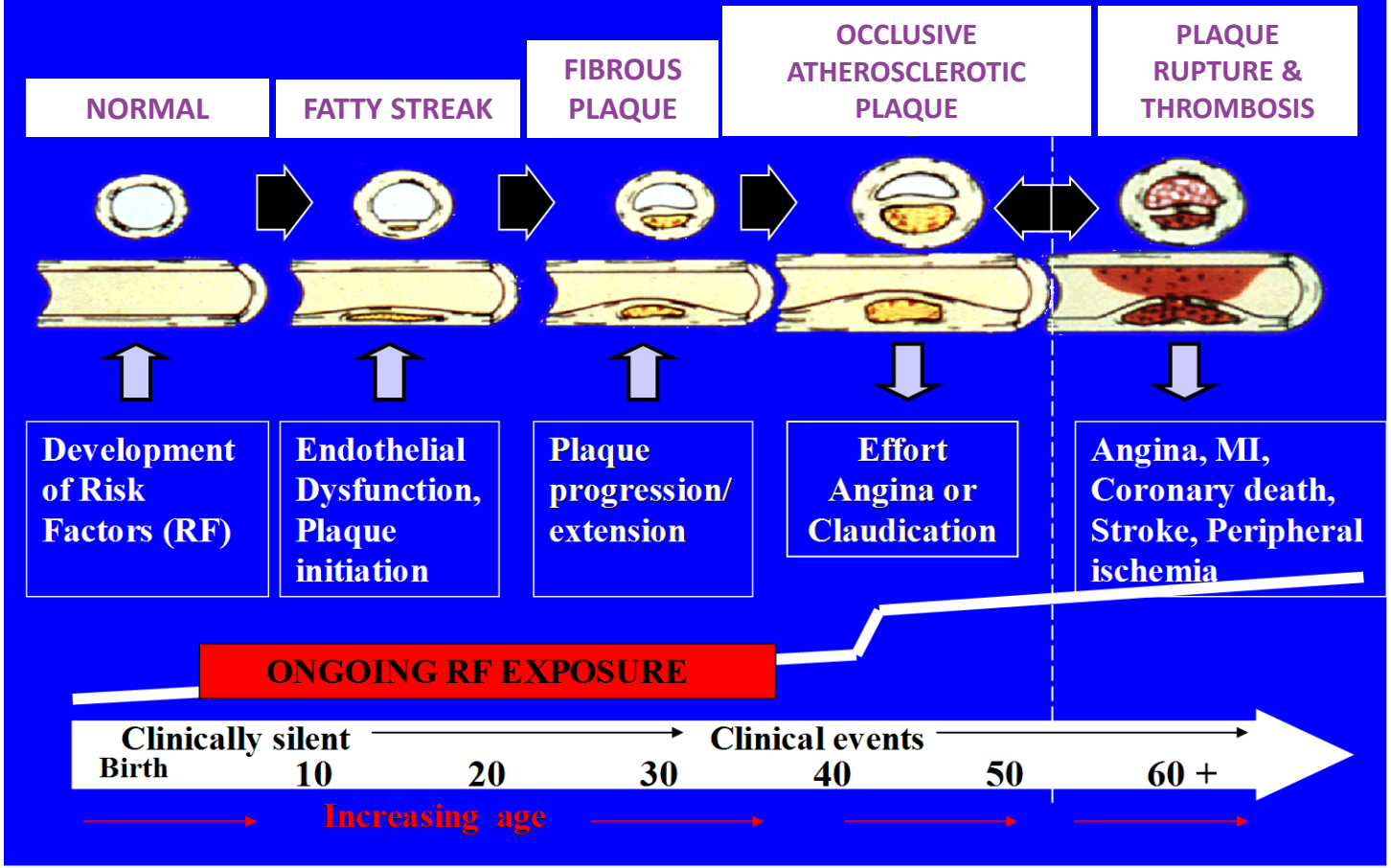


non-HDL-C = Total cholesterol – HDL-C

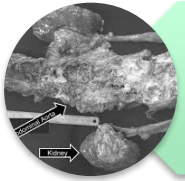
Atherosclerosis Timeline



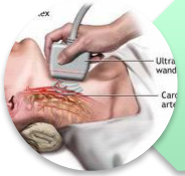
Atherosclerosis: A Progressive Process



Where's the Evidence?



Autopsies

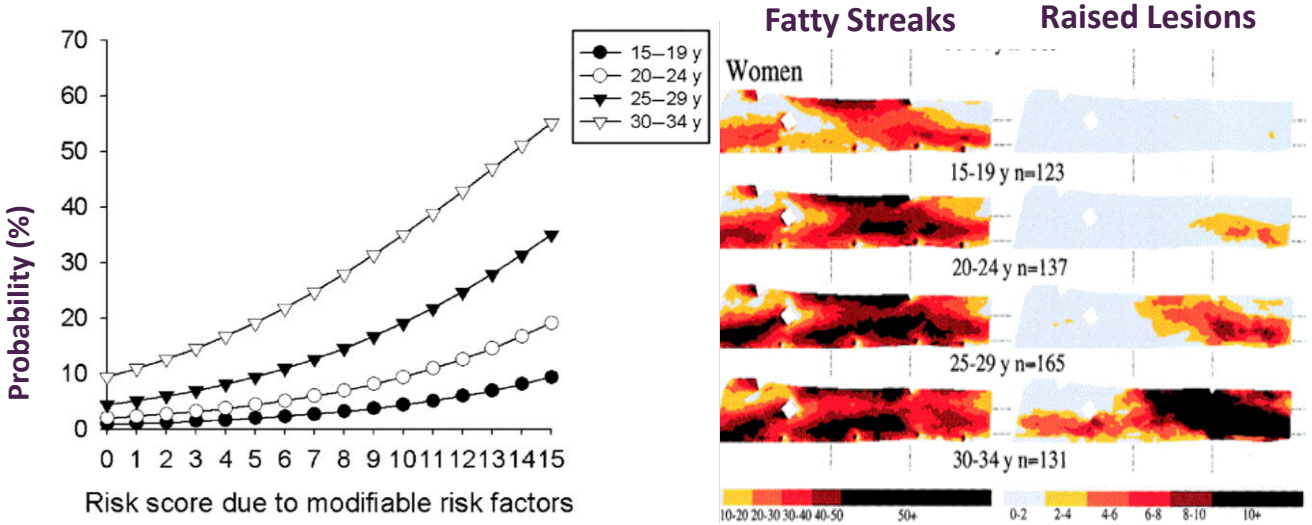


Vascular imaging studies

Epidemiologic studies

Risk Factors increase *Atherosclerosis* and *Vascular Age*

The PDAY Study



- Multi-center Autopsy study (15-34 yrs) showed % *Atherosclerosis increases* with age & *raised lesions increase* with CV risk factors
- 30 mg/dl increase non-HDL → 2 years vascular aging.

McGill. Arterioscler Thromb Vasc Biol 1997 & 2000; N=1443 age 15-34 years
McMahan C A et al. Pediatrics 2006;118:1447-1455

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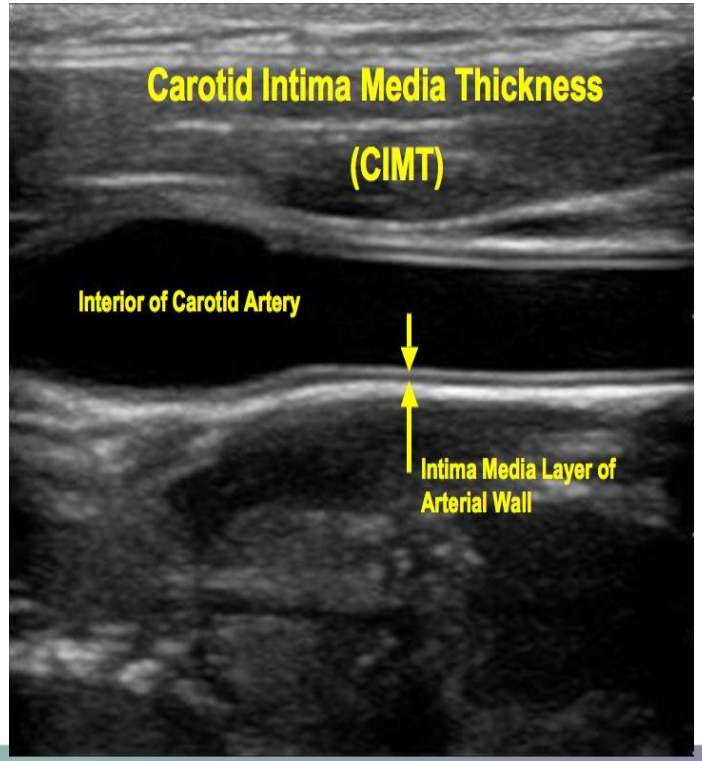
Carotid IMT



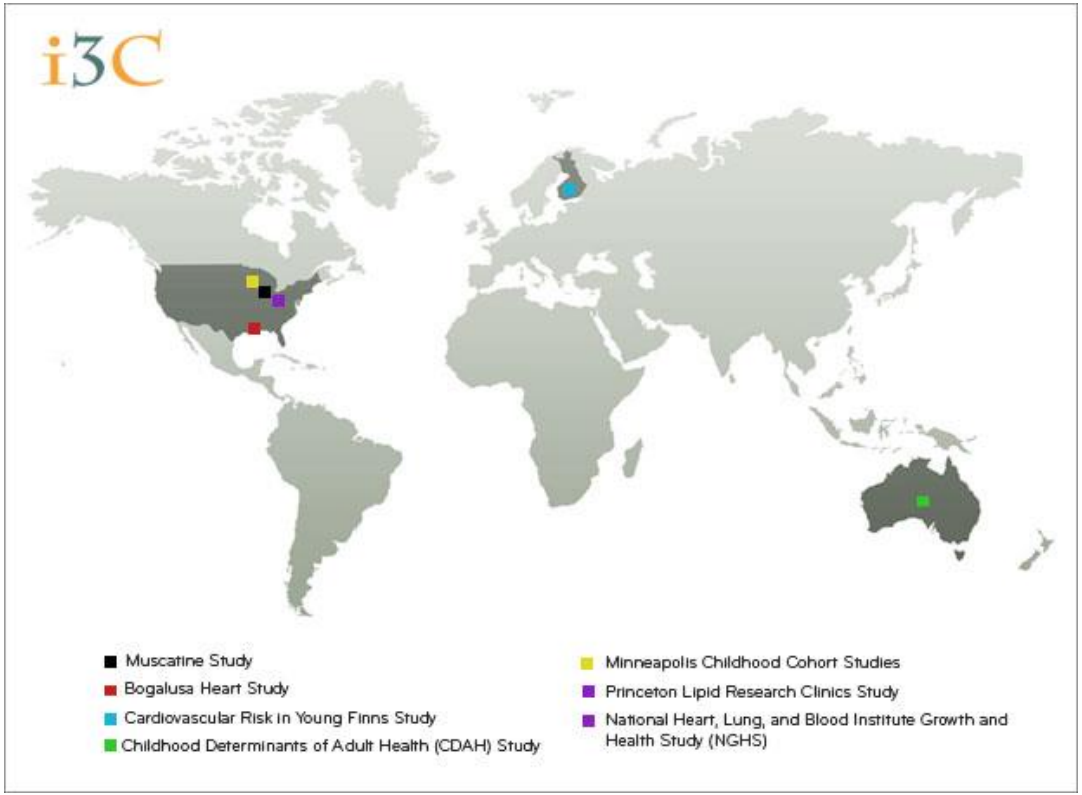
Non-invasive marker for early atherosclerotic changes

Reliable and predictive for later CVD

Changes seen as early as age 8.

i3C Cohorts

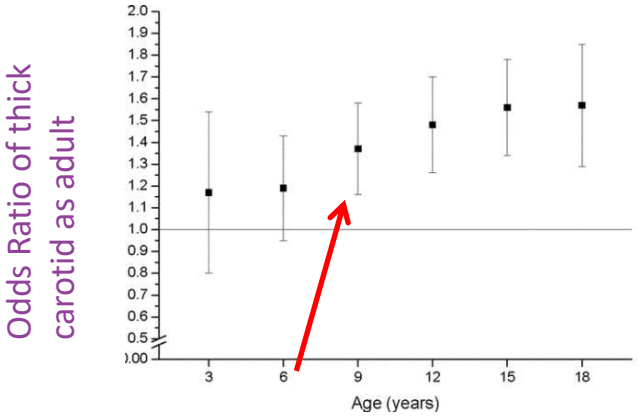
The i3C Consortium includes the only individual-level CV risk factor data prospectively collected from childhood for nearly 40 years to middle age when major CV event incidence increases (50-60s).



i3C Outcomes Study (2015-2020)

- Harmonized historical anthropometric and CV measurements, laboratory, medical and smoking history, diet and PA patterns, SES indicators (parental and participant education) and imaging (cIMT, LVM).
- Ascertained vital status (interview questionnaire or Nat'l Death index search) on 20,653 out of 40,709 cohort participants ~35 years post-childhood and adjudicated 769 true CV events.
- Data analyses demonstrate the need to begin preventive efforts early in life.

Childhood Risk Factors Predict
Sub-Clinical Atherosclerosis as Adults



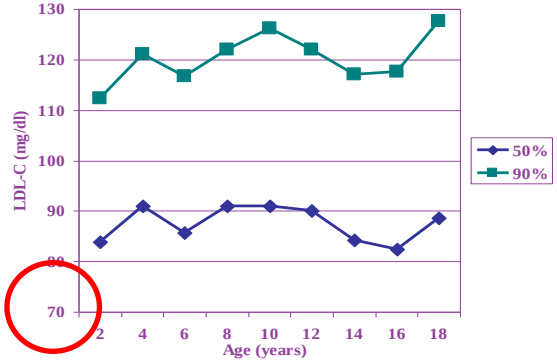
- i3C (Intl Childhood CV Cohorts) = Bogalusa, Muscatine, NGHS, Princeton, Minneapolis, Young Finns & CDAH.
- All started in late 1970s/early 80s collecting CV risk data in kids; repeat risk factor data were collected through adulthood & adult non-invasive imaging.
- Higher LDL as young as 9 years was independently associated with greater cIMT in adulthood (& cIMT associated with MI & stroke in adults)

Juonolo Circulation 2010:122(24):2514

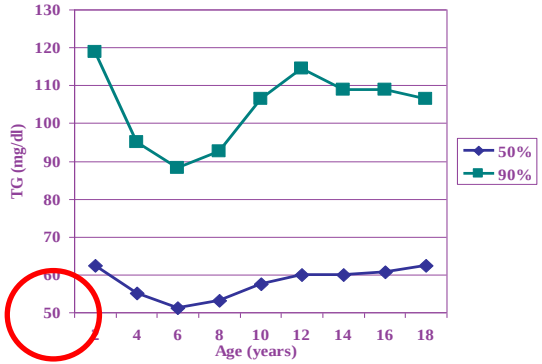
Tracking of CV Risk Factors

- Tracking for anthropometric variables, lipids, BP
- Risk of obesity as adult increased with level of adiposity as child.
  - Worse in the US vs Finish/Australian cohorts
- Overall, if obese as child, 63% risk of Class II/III obesity (BMI >35) as adult vs only 11% if not obese as child
- In longitudinal analyses, adults with thicker carotid arteries were significantly more obese as children even after adjustment for Chol and BP.
- Obese youth had higher BP and LVMI across the lifespan.
- BMI as child had effect on LVMI at age 25 years independent of adult BMI or SBP.
  - ½ subjects who were obese as child had LVH as an adult.

What to do with Fasting Lipid Results



- *Start evaluation if average 2 fasting measures of:*
  - LDL-cholesterol
    - > **190** for anyone
    - > **160** with +Fam Hx early CVD or multiple CVRFs
    - > **130** in high risk patient (DM, CRF)



- *Start evaluation if average 2 fasting measures of:*
  - Triglycerides
    - > **100** in children under 10
    - > **130** if over 10 years

LDL or TG >130 is well over 90th% for healthy child

*Adapted from Bogalusa Heart Study data (N=3352; 1987-91)

Lipids

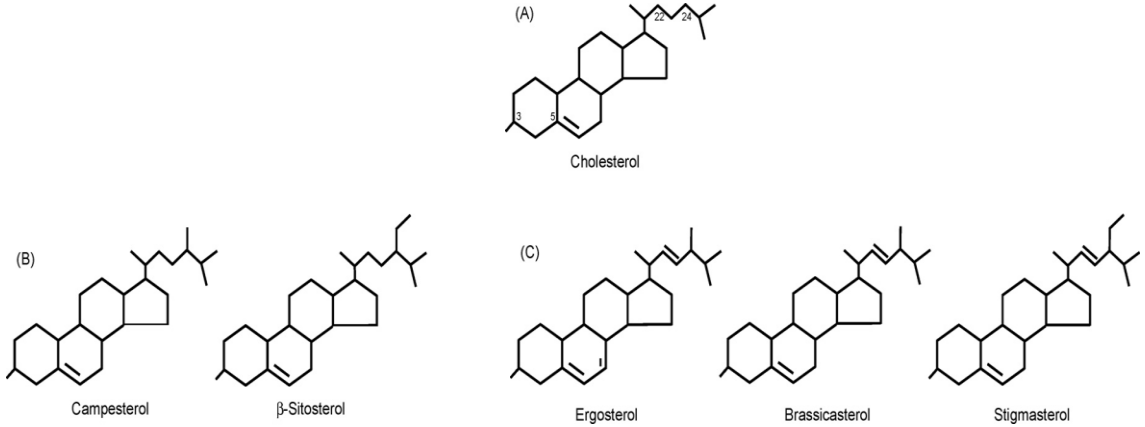
- Initial evaluation and management:
  - Exclude *secondary causes* (steroids, anti-psychotics, diuretics, BCP, hypoTFT, DM, PCOS, glycogen storage, nephrotic syndrome, anorexia, SLE)
  - Evaluate for other CV Risk Factors
  - Start Child-2 diet & lifestyle
  - Re-evaluate in no more than 6 months

- Advanced lipid testing only recommended if:
  - Lp(a) in child with stroke or FH
  - Apo B, A-I, Lp(a) in Parent with Heart Attack but no CV Risk factors

CHILD-2 diet

- Start for dyslipidemia in child *over 2 years of age*
- Consider referral to registered dietician
- FOR ALL: Drop to 25-30% calories from fat (CHILD-1 is 30%)
- For LDL:
  - Drop to 7% saturated fat (CHILD-1 is 10%)
  - Drop to < 200 mg/d cholesterol (CHILD-1 is 300 mg/d)
  - Plant sterols and/or plant stanol esters up to 2 grams per day
  - Add water soluble fiber psyllium (Metamucil)
- For TG:
  - Decrease sugar intake, no sugar sweetened beverages.
  - Replace simple carbs with complex carbohydrates
  - Increase dietary fish to increase omega-3 fatty acids

What are plant sterols & stanols?



- Similar in Structure to Cholesterol.
- Compete for absorption in the gut so that less harmful *animal* Cholesterol is absorbed from the diet.
- Commercially available in the US in a milk, margarine, orange juice, chew and pill form.

Drug Therapy

- Consider in child *over 8 years* with dyslipidemia in those *unresponsive to TLC after at least 6 months.*
- For LDL: *Statin, Bile acid binder, + Ezetimibe*
  - LDL ≥ 190 mg/dl
  - LDL ≥ 160 mg/dl and:
    - +Fam Hx early CVD
    - +1 high impact CVRF
    - +2 moderate CVRFs.
  - LDL ≥ 130 mg/dl and:
    - Child has High Risk condition (DM, CRF)
    - +2 High or 1 High and 2 Moderate CVRFs.
- For TG: *Rx fish oil, Fibrates, Niacin*
  - TG ≥ 400 mg/dl

Risk Definitions

	High Impact	Moderate Impact
CV Risk Factors	• HTN *on drug* • Smoker • *Severe* Obesity (BMI >97th %) • Has *high-risk condition*	• HTN *not* on drug • *Moderate* Obesity (BMI 95th - 97th%) • HDL <40 mg/dL • Has *moderate-risk conditions*
Risk Conditions	• T1DM & T2DM • CKD • s/p Tx (kidney, heart) • Kawasaki *with* coronary aneurysm	• Kawasaki disease *without* aneurysms • Inflammatory disease (SLE, JRA) • HIV • Nephrotic syndrome
Lipid Goals	• LDL ≤ 100 mg/dl • TG ≤ 90 mg/dl	• LDL & TG ≤ 130 mg/dl

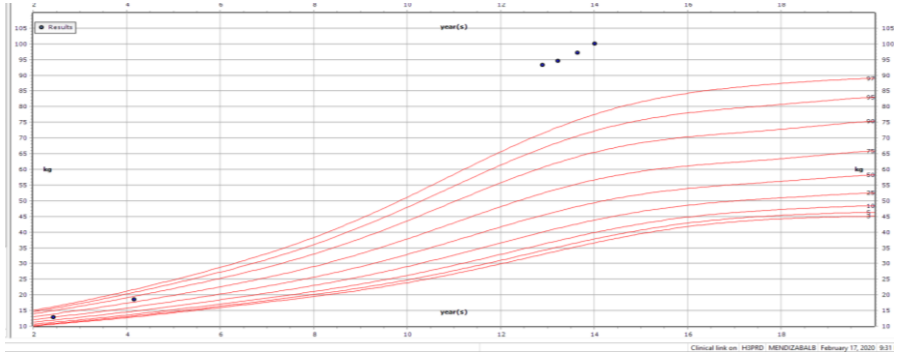
Case #1: Frank

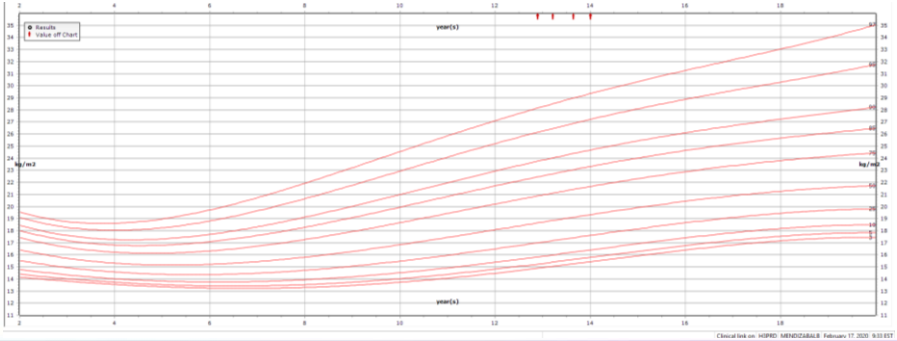
- 8 years old Caucasian male
- PMH: obese
- Family Hx: T2DM, no early CVD
- BMI >99th %-ile
- PE: mild acanthosis nigricans

Labs

- Lipid panel
  - TC **209** mg/dL
  - TG **173** mg/dL
  - HDL-C **33** mg/dL
  - LDL-C **145** mg/dL
  - Non-HDL **176** mg/dL
- Fasting glucose 89 mg/dL
- AST 11, ALT 27
- HbA1c 5.5%

Frank's Growth Charts





Combined Dyslipidemia of Obesity (CDO)

- Typically a *mixed* dyslipidemia
  - ↑LDL + ↓HDL + ↑TG
- Lifestyles and behavior modification are primary risk reduction approaches
- Long term benefits of drug therapy are not clearly defined

Combined Dyslipidemia of Obesity

- Obesity is a critical public health problem
  - Affects 16.9% of American children/adolescents
  - ¾ overweight children become obese adults
  - Long term sequelae includes metabolic syndrome, T2DM, premature CVD, early mortality
  - 50% of obese adolescents have at least one (10% have 3 or more) CVD risk factors, including HTN, dyslipidemia and insulin resistance
  - Prevalence of metabolic RFs increases with increasing severity of obesity
  - 39% of obese youth have some abnormal lipid value (typically high TG, low HDL)

Combined Dyslipidemia of Obesity

- Adiposity leads to highly atherogenic lipid phenotype
  - In these obese, insulin resistance children, increased FA levels stimulate overproduction of TG-rich lipoproteins in the liver, clinically manifested as high TG
  - Insulin resistance promotes LPL dysfunction, further elevating TGs.
  - At the cellular level, smaller, denser, more atherogenic particles (high LDL)

Combined Dyslipidemia of Obesity

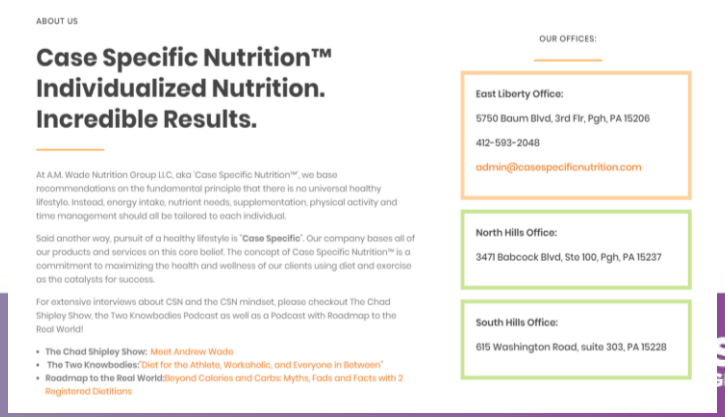
- CDO is strongly associated with other cardiometabolic RFs
  - Insulin resistance
  - Elevated BMI
  - Central obesity
  - HEALTHY study (2384 6th graders; 33% of overweight/obese with TG/HDL ratio >3 and 11% with non-HDL >145)
- CDO is strongly related to adult CVD and atherosclerosis markers in children
  - Princeton Follow up Study, CDO at 12 years of age predicted clinical CVD events at late f/u 3-4 decades later

DOIT: Dyslipidemia of Obesity Intervention Trial

- NHLBI study looking at the effect of Pitavastatin versus placebo in adolescents with excess adiposity (BMI>/= 85th %-ile) and CDO (high non-HDL-C + high TG/HDL-C ratio or low HDL-C)
  - Study outcomes:
    - vascular measures (PWV, C-IMT)
    - adverse events [LFTs, CK, muscle symptoms, markers of DM (glc, HbA1c), insulin sensitivity (insulin, C-peptide, HOMA-IR), ht velocity, prevalence of adverse events and participant reported symptoms]
    - Lipid measures (FLP, apolipoproteins, NMR spec)

Back to Frank

Date	Wt	TC	TG	HDL	LDL	AST	ALT	TSH/T4	Insulin	HbA1c
2018	93.4kg	208	167	33	151					
2019	97.15kg	210	86	38	153					
2020	100.2kg	209	173	33	145	11	27	normal	30	5.5



Case #2: Alyssa

- White female age 10 years:
  - Otherwise ‘healthy’
  - Comes to clinic for yearly ‘check-up’
  - BMI 19 kg/m^2 (85th %)
  - Universal lipid screening

Case #2: *Initial Evaluation*

Universal screening:

1) Family Hx negative for early CVD but positive for high cholesterol
2) BP 110/65 mmHg (95th% for Ht 50th% = 119/78 so this is Normotensive)
3) Active child, relatively healthy diet
4) Non-fasting Total Cholesterol = 260 mg/dl
5) Order fasting labs

Case #2:
Subsequent Evaluation

- Fasting lipids: Tchol 260, TG 103, HDL 45, LDL 210 mg/dl
- FBG 85 mg/dl, Since lean and no Fam hx of DM, did not order fasting insulin
- AST, ALT, GGT normal (perform at baseline in case ever needs to go on statin)
- TSH 1.33 (normal), hypothyroidism can affect cholesterol, though unlikely in Asx subject with normal height
- *Diagnosis: Familial hypercholesterolemia*

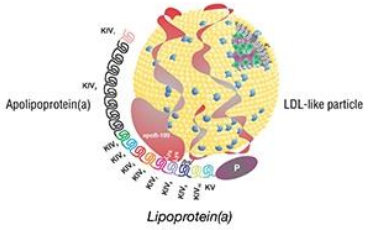
Familial Hypercholesterolemia

- Heterozygous FH: 1/200
- Homozygous FH: 1/300,000
- Cumulative risk of a fatal or non-fatal coronary event by the age of 60 without effective treatment >50% in men and >30% in women
- ¼ predicted cases diagnosed routinely; most remain undiagnosed until middle age

Familial Hypercholesterolemia (FH)

- Gene frequency thought to be 1/500, but may really be as common as 1/300
- Abnormality in liver LDL receptor
- 1,600 mutations accounting for about 85 to 90% cases
- Risk of premature coronary heart disease (CHD) is elevated about 20-fold in untreated FH patients
- Should be suspected in children with LDL above160 mg/dL; or non-HDL (non-fasting Tchol – HDL) over 190 mg/dL.
- Information for practitioners and patients at the National Lipid Association web site: *http://www.learnyourlipids.com/*

Lipoprotein (a)



- Also known as lipoprotein “little a”, Lp(a)
- Cholesterol carrying particle (similar to LDL) that at HIGH levels increases your risk for atherosclerosis, including CAD/MI, PVD, AS, thrombosis, CVA.
  - Especially for people with FH
- Levels of Lp(a) are reported in different units, either mg/dL or nmols/L.
  - Normal is <30 mg/dL or <75 nmols/L.
- Inherited from one/both parents.
- Little change in childhood and lifetime
  - In women, levels may increase with natural estrogen increases/decreases
- Diet and exercise have little-no impact on Lp(a) levels (no association with obesity)

Lipoprotein (a)

Lipoprotein a™ FOUNDATION

- Important to assess in patients with FH for overall risk assessment
- Risk for MI in those with high Lp(a) is increased ~3 times compared to those with lower levels
- Most important preventive treatment is to assure LDL is below goal (<130 or 100mg/dL).
- THERE ARE MEDICATIONS/TREATMENTS in current use to lower Lp(a)
  - Apheresis, Niacin, and PCSK9 inhibitors lower Lp(a) by also lowering LDL (must take into account side effects)
  - Statins have NO effect on Lp(a)
- May consider treatment *if* seen in children with <u>unexplained</u> stroke (very rare).

Case Scenario 1

Treatment

1 gm

0.4 gm

1.5 gm

0.9gm

0.4 gm

2-2.6g/3-4 chews

1.7gm

1.8g/4 tablets (2.7g/6 tabs)

Lowering Cholesterol with Plant Sterols and Plant Stanols

Plant sterols and stanols can help lower your cholesterol by blocking cholesterol from being absorbed into your blood. Small amounts are found in plant foods, but this is not enough to lower blood cholesterol levels.
Plant sterols and stanols are added to some food products to help lower blood cholesterol levels.

2-3 grams of plant sterols or stanols a day may help lower your blood cholesterol.

Foods with added plant sterols and plant stanols:

Food	Grams of plant sterols or stanols
Smart Balance® Buttery Spread with HeartRight™	**1.7 g per 1 Tbsp**
Promise Activ™ Spread Light Margarine	**1.7 g per 1 Tbsp**
Right Direction Cookies www.rightdirectioncookies.net	**1.3 g per cookie**
Minute Maid HeartWise™ Orange Juice	**1.0 g per cup**
Benecol Light Margarine	**0.85 g per 1 Tbsp**
Rice Dream HeartWise™ Drink	**0.65 g per cup**
Benecol Smart Chews (caramel) www.benecol.com	**0.65 g per chew**
Thomas' Hearty Grains Oatmeal and Honey English Muffin	**0.4 g per serving**
Kroger Active Lifestyle Fat Free Milk and Bread	**0.4 g per serving (milk or bread)**
Smart Balance® 1% Milk with HeartRight™	**0.4 g per cup**

The following supplements contain plant sterols and plant stanols.

Supplement	Grams of plant sterols or stanols
CholestOff (Nature Made) (available in most stores)	**0.9 g per 2 tablets**
Cholesterol Success™ (Twin Lab) www.twinlab.com/node/384	**0.9 g per 2 capsules**
Moduchol™ (not Moducare) www.moducare.com/prodmoduchol.asp	**1.3 g per 2 capsules**

Use of Statins

- Start with lowest dose
- Advise females of pregnancy risk
- Watch for drug interactions (Cyclosporine, Niacin, Fibrates, Erythromycin, Antifungal, HIV drugs)
- Check LFTs, CK at baseline (consider physical activity) in 6 weeks, then q 3-4 months
  - ALT/AST > 3 x up normal – stop drug
  - For muscle pain: stop medication, check CK: threshold > 10 x upper limit of normal
- After 6 weeks, if goal LDL not met (generally LDL < 130), increase dose or add another drug
- Monitor growth & development
- Continue to stress Diet, Exercise, Ideal Body Weight

Case #2: *Follow-up*

- LDL dropped to 170 mg/dl (below cut point for statin with negative Family Hx.)
- Lipids drop 10-15% early in puberty, often accelerated rise after puberty before true 'adult' phenotype demonstrated.
- Follow lipids every 6 months to 1 year.
- May need statin later in adolescence. Would need to be on birth control.
- Insufficient normative data to use vascular testing (carotid IMT, pulse wave velocity) to stratify risk in children at this time.

Case Scenario
Follow-up

- LDL dropped to 170 mg/dl (below cut point for statin with negative Family Hx.); Lp(a) was normal (10mg/dL)
- Lipids drop 10-15% early in puberty, often accelerated rise after puberty before true 'adult' phenotype demonstrated.
- Follow lipids every 6-12 months.
- May need statin later in adolescence.
  - Would need to be on birth control.
- Discussed potential need for genetic testing later in life; especially for a young female.

What kids get referred to
CHP Preventive Cardiology Clinic

- Children at risk for developing adult CVD
  - Dyslipidemias
  - Elevated BP
  - FHx early CAD without traditional RFs
  - High risk conditions
- Application of Ambulatory BP Monitoring to rule out *white coat hypertension*.
- Performance of echocardiography to look for *left ventricular hypertrophy.*
- Initiation *Therapeutic Lifestyle Changes* in patients with congenital heart disease.
- High-risk conditions
  - *DM, Heart Tx, Post-Kawasaki's with coronary aneurysm, William's, Turners, Family Hx of Early CAD*
- Initiation and monitoring of *drug Rx* as needed

Thank you!

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