Vitamin D - Testing

- **Laboratory Assessment**
  - 25 OH Vitamin D
    - (General Availability)
  - 1,25 (OH)$_2$ Vitamin D
    - Patient with Renal Disease (General Availability)
  - 25 OH Vitamin D – Bioavailable
    - (Research Availability)
  - 24,25 (OH)$_2$ Vitamin D
    - (Research Availability)
  - 1,24,25 (OH)$_3$ Vitamin D
    - (Research Availability)

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- **Laboratory Assessment**
  - Mass spectrometry
  - Competitive protein binding
  - Immunoassay
  - High performance liquid chromatography
  - Combined high-performance liquid chromatography

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- The sensitivity and specificity of these tests are unknown because of the lack of studies that use an internationally recognized reference standard.
- Variability between assay methods and between laboratories using the same methods may range from 10% to 20%, and classification of samples as “deficient” or “nondeficient” may vary by 4% to 32%, depending upon assay.

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Vitamin D - Testing

• USPSTF found that in clinical practice, standardization in laboratory testing has been problematic
• Lack of International Reference Standard" prior to 2009

Vitamin D - Epidemiology

• Overall prevalence rate of vitamin D deficiency ( < 20 ng/ml) was 41.6%
  – Whites (21.7%)
  – Blacks (70.6%),
  – Hispanics (44.2%)
  – Iranian Medical Students (99%)

Vitamin D - Epidemiology

• Overall prevalence rate of vitamin D insufficiency ( < 30 ng/ml) was 77%
Vitamin D - Epidemiology

- Risk Factors for low 25-(OH)D
  - Decreased synthesis
    - Decreased sun exposure
    - Darker skin pigmentation
    - Sunscreen Use
    - Routinely wearing clothing that prevents sun exposure
    - Living at high latitudes
  - Obesity
    - Fat Soluble Vitamin
    - Possible Increased Requirements

- Risk Factors for low 25-(OH)D
  - Decreased dietary vitamin D intake
    - Vit D Enriched Milk avoidance
  - Decreased absorption
    - Inflammatory bowel disease
    - Gastric bypass
  - Older age
  - Homebound or institutionalized adults

Vitamin D – Health Benefits

- Vitamin D - Definite
  - Bone Formation
    - Rickets
    - Osteoporosis
    - Osteomalacia
  - Endocrine Disorders
    - Secondary Hyperparathyroidism
Vitamin D – Health Benefits

• Vitamin D - Definite
  – Inflammatory Conditions
    • Osteoarthritis
    • Autoimmune Diseases
  – Reduce Dementia
  – Reduce Alzheimer’s Disease
  – Falls and Fractures in Elderly

Vitamin D - Health Benefits

• Vitamin D - Probable
  – Enhances Immune Function
    • Decrease Risk of Breast, Prostate and Colon Cancer
  – Muscle Strengthening
    • Fall Risk Reduction
    • Mortality Reduction after Heart Muscle Injury
  – Renal Disease in DM Type 1
    • Decreases Proteinuria

Possible Health Impacts

• Vitamin D – Possible
  – NFL Football Injuries
  – Hypertension
  – Multiple Sclerosis
  – Short Term Memory Loss
  – Depression
Treatment Risks

• Vitamin D + Calcium
  – Hypercalcemia
    • “No individual studies reported a significantly higher incidence of hypercalcemia; overall, 1.7% of treated participants versus 1.3% of control participants had hypercalcemia in trials that reported at least 1 case of hypercalcemia.”

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Vitamin D – Pediatric Intake

<table>
<thead>
<tr>
<th>Life Stage Group</th>
<th>Calcium - RDA</th>
<th>Calcium - Maximum</th>
<th>Vit D - RDA</th>
<th>Vit D - Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>1-3 Years</td>
<td>700</td>
<td>2500</td>
<td>400</td>
<td>2500</td>
</tr>
<tr>
<td>4-8</td>
<td>1000</td>
<td>2500</td>
<td>600</td>
<td>3000</td>
</tr>
<tr>
<td>9-18</td>
<td>1300</td>
<td>3000</td>
<td>600</td>
<td>4000</td>
</tr>
</tbody>
</table>

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Treatment Risks

• Vitamin D + Calcium
  – Renal Stones
    • “Seven trials reported on risk for kidney stones, 2 of which included treatment with vitamin D and calcium; none reported kidney stones in any participants.”
Vitamin D – Adult Intake

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Calcium RDA</th>
<th>Calcium Maximum</th>
<th>Vitamin D RDA</th>
<th>Vitamin D Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-50</td>
<td>1000</td>
<td>2500</td>
<td>600</td>
<td>4000</td>
</tr>
<tr>
<td>50-70</td>
<td>1200</td>
<td>2000</td>
<td>600</td>
<td>4000</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-70 Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

24 OH Vitamin D – Blood Level

<table>
<thead>
<tr>
<th>nmol/L**</th>
<th>ng/mL*</th>
<th>Health Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30</td>
<td>&lt;12</td>
<td>Associated with vitamin D deficiency, leading to rickets in infants and children and osteomalacia in adults</td>
</tr>
<tr>
<td>30-50</td>
<td>12-20</td>
<td>Generally considered inadequate for bone and overall health in healthy individuals</td>
</tr>
<tr>
<td>51 - 100</td>
<td>&gt;20</td>
<td>Generally considered adequate for bone and overall health in healthy individuals</td>
</tr>
<tr>
<td>&gt;125</td>
<td></td>
<td>Emerging evidence links potential adverse effects (Kidney Stones, Pancreatic Cancer, Increase Fall Risk, and Cardiovascular Disease)</td>
</tr>
</tbody>
</table>

** 1 nmol/L = 0.4 ng/mL

Vitamin D

- Summary
  - “Sunshine” Vitamin
  - Commonly Lacking (42%)
  - Multiple Health Impacts
  - Easy to Obtain / Correct
    - Sunshine
    - Dietary Supplements
    - Medication
  - Easy to Measure Current Status
Vitamin D

- References
  - http://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/
  - Institute of Medicine, *Dietary Reference Intakes for Calcium and Vitamin D*, 2010