CERVICAL CANCER SCREENING
MARCH 15, 2012

- The USPSTF and the ACS (in conjunction with ASCCP and ASCP) released updated cervical cancer screening recommendations
- Not a coincidence
- Independently developed
- Remarkably similar conclusions/guidelines
CERVICAL CANCER SCREENING

BACKGROUND
CERVICAL CANCER

- Histologic types
  - Squamous cell
    - 70% of all cases (primary target of cytological screening)
    - Arises at squamocolumnar junction (transformation zone)
    - Primary target of cytology screening
  - Adenocarcinoma
    - ~18%
  - Mixed adenosquamous and other
A reminder: squamocolumnar junction
CERVICAL CANCER MORTALITY (PER 100,000)

<table>
<thead>
<tr>
<th>Year</th>
<th>White</th>
<th>Non-white</th>
<th>Combined</th>
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</thead>
<tbody>
<tr>
<td>1950</td>
<td>10.2</td>
<td>18.0</td>
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<tr>
<td>(unadjusted)</td>
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<tr>
<td>2007</td>
<td>2.2</td>
<td>4.3</td>
<td>2.4</td>
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<tr>
<td>(adjusted)</td>
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This dramatic decline has been attributed to the implementation and dissemination of screening.
CERVICAL CANCER
INCIDENCE & MORTALITY

Figure 2  U.S. Age-Adjusted Incidence and Death Rates of Invasive Cervical Cancer By Age (SEER 2000–2008)
BURDEN OF ILLNESS

• SEER data:
  • “It is estimated that 12,710 women will be diagnosed with and 4,290 women will die of cancer of the cervix uteri in 2011.”
  • For comparison, for every woman who will die of cervical cancer
    • 5 will die of colon cancer
    • 8 will die of breast cancer
    • 15 will die of lung cancer
INADEQUATE SCREENING

• About half of all cervical cancer deaths are in women who have not been screened or who have had incomplete follow-up to screening and treatment.

• If we could assure adequate screening of the entire population, the residual preventable burden would be small.

• What goals should we have for a change in prevention strategy, whether immunization or a change in screening approach?
POSSIBLE GOALS FOR NEW CERVICAL CANCER PREVENTION STRATEGIES (INCLUDING IMMUNIZATION)

• Further reduction in mortality
  • Caveat: the elimination of cervical cancer and/or cervical cancer mortality is not a realistic goal of screening

• Reduction in the burden and/or harms of screening and treatment of screen-detected disease
Draft University of Missouri Department of Family Medicine updated clinical algorithm for cervical cancer screening

http://fcm-algo.umh.edu/Algorithms/CCS.htm
Screening → Evaluation of abnormal screen → Follow up post colposcopy
SCREENING

<table>
<thead>
<tr>
<th>Age under 21:</th>
<th>Do not screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 21-29:</td>
<td>Screen with cytology (&quot;Pap smear&quot;) every 3 years.</td>
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<td>Age 30-64:</td>
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<td>Age 65 and up:</td>
<td>Discontinue screening at 65 years of age in women with 3 negative cytology tests in a row (or 2 negative co-tests of Pap and HPV) within the past 10 years</td>
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</tbody>
</table>

Notes:
- Liquid and conventional cytology are equivalent
- These recommendations do not apply to the following groups: HIV, immunosuppressed, DES, previous treatment for CIN2,3
- Routine screening should continue at least 20 years after spontaneous regression or appropriate management of a high-grade precancerous lesion (CIN2 or worse)
- In women who have had a total hysterectomy for benign indications and have no prior history of CIN2 or worse, routine cytology testing should be discontinued
- History of HPV vaccination does not change screening recommendations
# Screening

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SCREENING

Age under 21: Do not screen
HPV INFECTION

• “It is well recognized that infection with oncogenic HPV types is a necessary, although not sufficient, cause of virtually all cervical cancer.”\(^{25}\)

• Results from a large international collection of cervical tumor specimens revealed the presence of HPV DNA in 99.7 percent of cases.\(^3\)
HPV INFECTION: NATURAL HISTORY

- From HPV infection to cervical cancer
  - HPV transmission,
  - Acute HPV infection,
  - Persistent HPV infection leading to precancerous changes, and
  - ICC. 45
HPV TRANSMISSION

• Primarily as a result of skin-to-skin or mucosa-to-mucosa contact
HPV INFECTION AND PERSISTENCE

- A high proportion of sexually active women become infected with HPV, but only a small proportion of HPV infections become persistent.

- 91 percent of prevalent HPV infections clear within 24 months (including infections with high risk subtypes).
PREVALENCE OF HPV INFECTION

Figure 4  Prevalence of High-Risk Human Papillomavirus By Age\textsuperscript{34}
WHY NOT SCREEN BEFORE AGE 21?

- Cervical cancer is rare in the younger age group.

<table>
<thead>
<tr>
<th>Age-Group</th>
<th>White</th>
<th>Non Hispanic</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-04</td>
<td>0</td>
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<tr>
<td>05-09</td>
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<tr>
<td>10-14</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>15-19</td>
<td>0.1</td>
<td>0.2</td>
<td>0.1</td>
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<tr>
<td>20-24</td>
<td>1.5</td>
<td>1.9</td>
<td>1.5</td>
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<tr>
<td>25-29</td>
<td>14.5</td>
<td>15.1</td>
<td>14.5</td>
</tr>
<tr>
<td>30-34</td>
<td>28.9</td>
<td>18.0</td>
<td>28.9</td>
</tr>
</tbody>
</table>

Per 100,000 women
WHY NOT SCREEN BEFORE AGE 21?

• HPV infection is common and results in transient abnormalities of the cervix

• Detection and Rx of those abnormalities leads to harm
WHAT ABOUT SEXUAL HISTORY?

• Young women with multiple sexual partners are the most susceptible to the harms of screening

• The possibility of benefit is vanishingly close to zero

• *Just say no to screening for cervical cancer before age 21.*
**SCREENING**

- **Age under 21:**
  - Do not screen

- **Age 21-29:**
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SCREENING INTERVAL FOR CYTOLOGY IN WOMEN AGE 21-65

• RCTs of screening programs at different intervals never exist
  • e.g. no one has done an RCT comparing colonoscopy for colon cancer screening every 5 years to every 10 years or 20 tears (decided to leave in the typo)

• Task Force has used modeling
WHAT OUTCOME, PARTICULARLY FOR HARMs?

- False positives
- Colposcopies
- CIN 2-3
- Cancer cases, cancer deaths
HARMS: COLPOSCOPIES

- Pain, bleeding
- Sentinel measure for downstream harms
  - Similar to using number of colonoscopies as sentinel measure of harm in modeling of colon cancer screening
HARMS: OVER-DIAGNOSIS

• CIN2 can/does regress – over-diagnosis and over-treatment are real risks
• CIN3 can also regress
• Standard of care currently to Rx all CIN2+
TREATMENT OF CIN2+

- Common treatments include LEEP or cervical conization
  - Short term harms of pain (67%), bleeding (87%), discharge (63%)
- Increased risk of adverse pregnancy outcomes
  - Perinatal mortality, preterm delivery, low birth weight
- Evidence on specific procedures is incomplete and retrospective
Table 8. Sensitivity Analysis Showing Expected False-Positives, Colposcopies, CIN2-3 Cases, Cancer Cases, and Cancer Deaths Associated With Screening Beginning at Age 15 Years and Increased in 1-Year Increments to Age 25 Years, Among Women Followed for a Lifetime*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Age 15</th>
<th>Age 16</th>
<th>Age 17</th>
<th>Age 18</th>
<th>Age 19</th>
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<th>Age 21</th>
<th>Age 22</th>
<th>Age 23</th>
<th>Age 24</th>
<th>Age 25</th>
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<tr>
<td><strong>Cytology with repeat cytology for ASC-US</strong></td>
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<tr>
<td>q5</td>
<td>False Positives 220.74 223.01 220.20 217.50 214.84 211.69 213.97 211.17 208.49 205.85 201.88</td>
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<tr>
<td>q3</td>
<td>False Positives 367.97 362.65 352.67 358.93 353.61 343.65 349.92 344.62 333.82 328.80 323.33</td>
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<tr>
<td>q2</td>
<td>False Positives 542.21 529.73 533.19 520.72 524.19 511.74 515.26 501.94 494.23 480.77 472.93</td>
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<tr>
<td>q1</td>
<td>False Positives 1002.73 994.17 985.63 977.09 966.58 960.13 951.45 931.62 911.68 891.64 871.61</td>
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<td>Colposcopies 481.05 492.49 487.71 483.13 473.74 471.99 483.36 478.44 473.65 469.01 461.00</td>
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<td>q5</td>
<td>Colposcopies 776.54 766.76 746.04 767.48 757.65 736.59 758.16 748.16 725.97 717.04 706.79</td>
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<td>q3</td>
<td>Colposcopies 1,110.92 1,085.93 1,101.89 1,076.87 1,097.75 1,087.65 1,083.52 1,057.27 1,042.80 1,016.43 1,001.77</td>
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<td>q2</td>
<td>Colposcopies 1,982.10 1,973.54 1,884.96 1,956.35 1,947.67 1,939.00 1,931.00 1,892.74 1,854.45 1,816.09 1,777.71</td>
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<td>q1</td>
<td>Colposcopies 67.38 66.10 66.66 67.12 67.56 67.36 66.01 66.39 66.64 66.81 66.25</td>
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<td>CIN 2-3s 80.55 80.87 79.80 80.53 80.80 79.81 80.21 80.30 78.88 79.22 79.03</td>
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<td>q5</td>
<td>CIN 2-3s 88.01 87.64 88.00 87.59 87.86 87.35 87.52 86.85 86.89 86.05 85.92</td>
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<td>q3</td>
<td>CIN 2-3s 62.14 62.14 62.11 62.04 61.91 61.72 61.50 61.25 60.94 60.56 60.08</td>
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<td>q2</td>
<td>CIN 2-3s 12.70 12.67 12.65 12.66 12.73 12.70 12.69 12.69 12.74 12.85 12.89</td>
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<td>q1</td>
<td>CIN 2-3s 8.45 8.47 8.66 8.45 8.48 8.62 8.50 8.55 8.73 8.70 8.82</td>
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<td>Cancer Cases 5.73 5.73 5.73 5.73 5.73 5.75 5.77 5.80 5.84 5.93 6.01 6.14</td>
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<tr>
<td>q5</td>
<td>Cancer Cases 2.41 2.41 2.41 2.41 2.42 2.44 2.47 2.50 2.56 2.65 2.75 2.86</td>
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<tr>
<td>q3</td>
<td>Cancer Cases 5.31 5.31 5.31 5.31 5.31 5.32 5.32 5.33 5.35 5.37 5.40</td>
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<tr>
<td>q2</td>
<td>Cancer Cases 3.01 3.01 3.01 3.01 3.01 3.02 3.02 3.03 3.05 3.07 3.10</td>
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<td>q1</td>
<td>Cancer Cases 1.54 1.54 1.54 1.54 1.54 1.54 1.55 1.55 1.56 1.60 1.62</td>
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</table>

*Screening intervals of every 1 (q1), 2 (q2), 3 (q3), and 5 (q5) years are compared. Cases are per 1,000 women.
### CYTOLOGY STARTING AGE 21, FOLLOWED FOR LIFE (PER 1000)

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>q5</th>
</tr>
</thead>
<tbody>
<tr>
<td>False positives</td>
<td>951</td>
<td>515</td>
<td>350</td>
<td>214</td>
</tr>
<tr>
<td>Colposcopy</td>
<td>1931</td>
<td>1084</td>
<td>758</td>
<td>483</td>
</tr>
<tr>
<td>CIN 2-3</td>
<td>91</td>
<td>88</td>
<td>80</td>
<td>66</td>
</tr>
<tr>
<td>Cancer cases</td>
<td>2.5</td>
<td>5.8</td>
<td>8.5</td>
<td>12.7</td>
</tr>
<tr>
<td>Cancer deaths</td>
<td>0.3</td>
<td>0.9</td>
<td>1.5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

**Quote from Task Force member:** “All models are wrong, some are useful.”
OBSERVATIONAL STUDY

- Lancet Oncology, vol 12, July 2011
- “Cervical cancer risk for women undergoing concurrent testing for human papillomavirus and cervical cytology: a population based study in routine clinical practice”
- Katki et al followed 313,818 women in Kaiser Permanente Northern California
OBSERVATIONAL STUDY ON INCIDENCE

- 319,177 (96.2%) of women had normal Pap at baseline
- CIN3+ at:
  - 3 years 0.17%,
  - 5 years 0.36%
- Risk of invasive cancer at five years after normal cytology was 7.5 per 100,000 women (0.0075%)
SCREENING INTERVAL FOR CYTOLOGY IN WOMEN AGE 21-65

• Cytology every 3 years demonstrates a good balance of benefits and harms

• “Pap smears every three years are safe and effective at reducing cervical cancer, while minimizing the risks of false positive results and the harms associated with treating disease that will go away without treatment.”
SCREENING

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WHAT IS THE ROLE FOR HPV TESTING IN SCREENING?

**Age 21-29:**
Screen with cytology ("Pap smear") every 3 years.

**Age 30-64:**
Screen with cytology every 3 years, or combination of Pap smear and **HPV** testing every 5 years (co-testing).
RECALL: PREVALENCE OF HPV INFECTION

Figure 4  Prevalence of High-Risk Human Papillomavirus By Age\textsuperscript{34}
HPV SCREENING BEFORE AGE 30

- Recommend against
  - Prevalence is high, therefore false positive rate is high
    - False positive does not mean the test is positive in someone who does not have HPV
    - False positive means identifying someone “in need of intervention” to prevent cervical cancer who does not need that intervention because her disease will regress spontaneously

**Just say no to screening for cervical cancer with HPV before age 30.**
HPV SCREENING FOR CERVICAL CANCER FOR AGE > 30 YEARS

- Multiple studies of varied design demonstrate that HPV testing is...
  - More sensitive than cytology for CIN2+
  - Less specific than cytology
- The Task Force had the challenge of being “moderately certain” about the balance of benefits and harms.
RCTS OF HPV SCREENING FOR CERVICAL CANCER

• EPC reviewed and presented the results of 6 European RCTs that included HPV in some way in the experimental group

• Inconsistent design, varying protocols, incomplete reporting and perhaps most importantly incomplete follow-up through two rounds of testing
DRAFT RECOMMENDATION

• Insufficient evidence to determine the balance of benefits and harms of HPV screening
POST DRAFT

• Two important publications
  • Completed follow-up of the second round of the RCT in the Netherlands
  • Kaiser observational data noted earlier in presentation
POBASCAM

- 44,938 women age 30-56 randomized to screening with conventional cytology vs. co-testing with HPV and conventional cytology
- Round two testing in five years – both groups received co-testing
- Complex protocol for referral for colposcopy – does not reflect current standard of care in the US
  - e.g. immediate referral only for HSIL
# POBASCAM RESULTS

<table>
<thead>
<tr>
<th></th>
<th>Cytology round one</th>
<th>Co-testing round one</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative CIN2</td>
<td>127</td>
<td>168</td>
</tr>
<tr>
<td>Cumulative CIN3</td>
<td>252</td>
<td>243</td>
</tr>
<tr>
<td>Round one cancer</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Round two cancer</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Cumulative cancer</td>
<td>20</td>
<td>16</td>
</tr>
</tbody>
</table>

Recall denominator in each group ~20,000
POBASCAM APPLICABLE TO US?

• We are more aggressive in use of colposcopy, so detection of CIN2+ likely to be higher

• Safe to conclude that co-testing every five years as good as (better?) than cytology every five years in an RCT
  • Reported harms (CIN2) modest
CYTOLOGY EVERY 3 YEARS VS CO-TESTING EVERY 5 YEARS

• Kaiser observational data
• Further exploration in the model to try to fill in gaps in evidence from POBASCAM and Kaiser
KAISER DATA

- Cumulative incidence of CIN3+ the same (0.17%) ...
  - *three* years after normal cytology and
  - *five* years after double negative co-testing
- Other analyses confirm increased sensitivity and decreased specificity of HPV testing relative to cytology
- Did not report total colposcopies
## MODEL DATA

<table>
<thead>
<tr>
<th></th>
<th>False positives</th>
<th>Colposcopies</th>
<th>CIN2-3</th>
<th>Cancers</th>
<th>Cancer deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cytology q3 years</strong></td>
<td>350</td>
<td>758</td>
<td>80</td>
<td>8.5</td>
<td>1.55</td>
</tr>
<tr>
<td><strong>Cytology q3 years until age 30 then co-testing q5 years</strong></td>
<td>255</td>
<td>575</td>
<td>84</td>
<td>7.44</td>
<td>1.35</td>
</tr>
</tbody>
</table>

Note: model assumed women with normal colposcopy immediately returned to usual screening
WHAT IS THE ROLE FOR HPV TESTING IN SCREENING?

Age 21-29:
Screen with cytology ("Pap smear") every 3 years.

Age 30-64:
Screen with cytology every 3 years, or combination of Pap smear and HPV testing every 5 years (co-testing).
SCREENING

**Age 65 and up:**
Discontinue screening at 65 years of age in women with 3 negative cytology tests in a row (or 2 negative co-tests of Pap and HPV) within the past 10 years.

**Notes:**
- Liquid-based cytology.
- These recommendations may change with treatment for cervical intraepithelial neoplasia (CIN).
- Routine screening with less than 10-year history of screening or appropriate suppression may be considered.
- In women who have had their last negative test more than 5 years ago, and worse, routine screening should be considered.
- History of HPV vaccination does not change screening recommendations.
AGE 65 YEARS OR OLDER

• Potential for benefit in those adequately screened in the past whose screening tests are normal is very low, potential for harm at least small
  • Note women who have had CIN2+ should continue to be screened for 20 years
  • Consider screening women who do not have a history of adequate screening
TWO IMPORTANT CHANGES

• USPSTF did not address management of abnormal results – but ACS/ASCCP did make two specific recommendations
  • ASCUS/HPV negative – Rx as normal
  • Negative Cytology/+HPV
    • Repeat in one year and colpo if either is positive, or...
    • Test for HPV 16/18 and colpo if positive
QUESTIONS?