The Connection Between HPV and Cancer

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What is Human Papillomavirus?

How common is HPV?

How is HPV transmitted?

Can we prevent HPV?

Why is HPV complicated?

What does HPV cause?
What is Human Papillomavirus?

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What is Human Papillomavirus?

• Species-specific virus

• ~200 different types of HPV; ~40 sexually transmitted
  – Type 1 vs Type 16

• Largely asymptomatic

• Common to have more than one type of HPV
What is Human Papillomavirus?

HPV Anogenital Types: Phylogenetic Tree
(Schiffman et al, 2005)
What is Human Papillomavirus?  
How common is HPV?  
How is HPV transmitted?  
Can we prevent HPV?  
Why is HPV complicated?  
What does HPV cause?
How common is HPV?

Most common sexually transmitted infection worldwide and in the United States

In the US:
~80 million people are infected with HPV
>14 million people will acquire HPV each year

How common is HPV?

• Nearly **all** people who have sex will get at least one type of genital HPV infection at some time in their lives.

• Average lifetime probability of acquiring HPV with only 1 sexual partner of the opposite sex:
  – 85% Females
  – 91% Males

How common is **ORAL** HPV?

In men: 11.5%
In women: 3.2%

More common among:

- People in their 30’s and 50-60’s
- Males
- Smokers
- Heavy drinkers
- Higher number of sexual partners

How common is ORAL HPV?

- 11.5% = 1 in 9 men have oral HPV
- Higher rates of infection
- May acquire HPV infection more easily
- More persistent infections (don’t clear as easily)
- Women may have a stronger immune response (greater resistance to subsequent infections)

How is HPV transmitted?

**Primary**
- Skin-to-skin contact with HPV-infected area
- Sexual transmission (vaginal, anal, and oral)

**Secondary**
- Perinatal transmission in pregnancy and childbirth (very rare)

**Hypothesized**
- Some studies suggest:
  - Autoinoculation
  - Open-mouthed kissing
  - Fomite
What about Oral Sex?

• Cohort study of 18-25 year olds (N=409)
  
  – Risk for **oral HPV infection** increased with recent number of oral sex partners among men
  
  – Risk for **oral HPV infection** not associated with recent number of oral sex partners among women

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What does HPV cause?
What does HPV cause?

Can Cause
Genital Warts
(Low Risk)
Approximately 360,000 genital warts cases occur each year

Can Cause
Cancer
(High Risk)
Approximately 33,000 HPV-related cancers occur each year

Centers for Disease Control and Prevention.
Background: HPV & Cervical Cancer

• HPV is a necessary cause of cervical cancer
  – Association of cervical neoplasia with sexual activity
  – Strong, consistent associations between HPV and cervical cancer (OR=9 to >100)
  – HPV infection precedes onset of disease
  – ~50% of cervical tumors contain HPV 16 DNA, and an additional 30% of tumors contain HPV 18, 31, and 45 DNA
Natual History of High-Risk HPV Infection and Potential Progression to Cervical Cancer

- Transient Infection (≤1 Year)
- Persistent Infection (>2 Years)
- Low-Grade Dysplasia CIN 1 (2-5 Years)
- High-Grade Dysplasia CIN 2/3 (4-5 Years)
- Invasive Cancer (9-15 Years)

Cervical Cancer

Normal

Cancer

Low-grade CIN

High-grade CIN
# Cervical Cancer

## Prevalence

<table>
<thead>
<tr>
<th>Cervical Cancer</th>
<th>United States</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>52,293</td>
<td>2,274,000</td>
</tr>
</tbody>
</table>

## Annual Incidence

<table>
<thead>
<tr>
<th>Cervical Cancer</th>
<th>United States</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Incidence</td>
<td>10,370</td>
<td>510,000</td>
</tr>
</tbody>
</table>

## Annual Mortality

<table>
<thead>
<tr>
<th>Cervical Cancer</th>
<th>United States</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Mortality</td>
<td>3,710</td>
<td>288,000</td>
</tr>
</tbody>
</table>

## Deaths per day

<table>
<thead>
<tr>
<th>Cervical Cancer</th>
<th>United States</th>
<th>Worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths per day</td>
<td>~10</td>
<td>~789</td>
</tr>
</tbody>
</table>

- **U.S.:** cervical cancer is the 11\textsuperscript{th} most common cancer among women.
  - The 2\textsuperscript{nd} leading cause of cancer death among women 20-39 years old.

- **Globally:** the leading cause of death among women in developing nations.
### HPV-Related Cancers Among Men and Women

<table>
<thead>
<tr>
<th>Cancer</th>
<th>% Association with HPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical</td>
<td>&gt; 99%</td>
</tr>
<tr>
<td>Vaginal</td>
<td>75%</td>
</tr>
<tr>
<td>Vulvar</td>
<td>69%</td>
</tr>
<tr>
<td>Penile</td>
<td>63%</td>
</tr>
<tr>
<td>Anal</td>
<td>91%</td>
</tr>
<tr>
<td>Oropharyngeal</td>
<td>72%</td>
</tr>
</tbody>
</table>

Centers for Disease Control and Prevention (2014).
Routine visual and tactile examination
Risk Factors for Oral Oncogenic HPV

NHANES 2009-2012, 14-69 year olds (N=9,480)

MEN
- Prevalence: 6.6%*
- Prevalence increased:
  - Age
  - Current smoking
  - Lifetime number of sexual partners
- Per-sexual partner increase in prevalence was significantly stronger among men than among women

WOMEN
- Prevalence: 1.5%
- Prevalence increased:
  - Age
  - Current smoking
  - Lifetime number of sexual partners

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Annually # Cases Probably Caused by HPV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Cervical</td>
<td>-</td>
</tr>
<tr>
<td>Vaginal</td>
<td>-</td>
</tr>
<tr>
<td>Vulvar</td>
<td>-</td>
</tr>
<tr>
<td>Penile</td>
<td>700</td>
</tr>
<tr>
<td>Anal</td>
<td>1,600</td>
</tr>
<tr>
<td>Oropharyngeal</td>
<td>9,600</td>
</tr>
</tbody>
</table>

Centers for Disease Control and Prevention (2017).
HPV-Related Oropharyngeal Cancer

- **Increasing incidence of oropharyngeal cancers largely due to HPV-positive cancers**
- **Declining HPV-negative cancers similar to declines in smoking in the U.S.**

HPV-Related Oropharyngeal Cancer

- By 2020, the number of HPV-positive OPSCCs is expected to surpass the number of cervical cancers.

Evidence to support **improved survival** with HPV-related oropharyngeal cancers

Recent Studies – Oral HPV

- NHANES (2011-2014)
  - 18 to 69 years old

- Prevalence of oral HPV infection by gender

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral HPV infection</td>
<td>11.5%</td>
<td>3.2%</td>
</tr>
<tr>
<td>High-risk oral HPV</td>
<td>7.3%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Oral HPV 16</td>
<td>1.8%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

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Why is HPV complicated?

What does HPV cause?
Why is HPV complicated?

- Most HPV infections will go away in 8 to 13 months.
  - Some will not.

- HPV that does not go away can be *undetected* for years.

- This makes it difficult to know:
  - when people became infected
  - how long they have been infected
  - who passed the infection to whom

- It can’t be cured.
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Types of Prevention

- Primary
- Secondary
- Tertiary
Types of Prevention

- Vaccine
- Screening
- Minimize Negative Outcomes
Can we screen for **Genital HPV Infection**?

- **In women:**
  - HPV infection of the cervix can be screened in conjunction with a Pap test.

- **In men:**
  - There is currently **no** screening test of HPV infection.
Is there a test for me to find out if I have oral HPV?

“There is no FDA-approved test to diagnose HPV in the mouth or throat. Medical and dental organizations do not recommend screening for oral HPV. More research is needed to find out if screening for oropharyngeal cancers will have health benefits. Talk to your dentist about any symptoms that could suggest early signs of oropharyngeal cancer.”

CDC
Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™
Types of Prevention

Vaccine

Screening

Minimize Negative Outcomes
# The HPV Vaccine

## HPV Types Included in Vaccine

<table>
<thead>
<tr>
<th>HPV Types</th>
<th>6</th>
<th>11</th>
<th>16</th>
<th>18</th>
<th>31</th>
<th>33</th>
<th>45</th>
<th>52</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadrivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-valent</td>
<td></td>
<td></td>
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</tbody>
</table>

- **Bivalent**: Vaccines that target HPV types 6 and 11, which are associated with most cervical cancers.
- **Quadrivalent**: Vaccines that target HPV types 6, 11, 16, and 18.
- **9-valent**: Vaccines that target HPV types 6, 11, 16, 18, 31, 33, 45, 52, and 58, providing broader protection against HPV-related diseases.
The HPV Vaccine

Target Group:
- 11 to 12 year old girls and boys

Indications:
- Anogenital cancers
- Genital warts

Catch-Up Group:
- 13 to 26 year old males and females
Within 6 years of quadrivalent HPV vaccine introduction (2009-2012)

HPV Vaccination Program in US

• Delivered by healthcare providers:
  • Pediatricians
  • Family practice
  • OB/GYNs

• This is different than other countries

• This is why provider recommendation is essential
US HPV Vaccine Coverage, 2013

- Quadrivalent or bivalent vaccine


** Quadrivalent or bivalent vaccine

HPV vaccination is the best way to protect your children from cancers caused by HPV.

INFECTIONS WITH HPV TYPES THAT CAUSE MOST HPV CANCERS AND GENITAL WARTS HAVE DROPPED 71 PERCENT AMONG TEEN GIRLS.

6 OUT OF 10 parents are choosing to get the human papillomavirus vaccine for their children.
Final Remarks

• HPV is extremely common

• The HPV vaccine is a primary prevention strategy proven to be effective

• In the US, HPV vaccination uptake and completion is suboptimal

• Provider recommendation is essential

• This is a cancer preventive vaccine
What questions do you have?

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