Creating a Better Diagnosis: Can we improve cervical cancer screening with limited resources?

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What’s Cervical Cancer?

Global Statistics

• 570,000 new cases and 311,000 death in 2018
The Disparity of Cervical Cancer

~90% in low- and middle-income countries

Global Cancer Statistics 2012

Screening, Diagnosis and Treatment

- Very treatable if diagnosed early
  - 5-year survival rate: ~100% at pre-cancerous stage,
    12% at invasive stage

Screening Performances

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pap smear</td>
<td>44 – 78%</td>
<td>90-99%</td>
</tr>
<tr>
<td>HPV test</td>
<td>34-100%</td>
<td>31-94%</td>
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HPV vaccination, screening, and treatment reduced the incidence and death rates in developed countries.


www.cervivor.org

Shalini L Kulasingam, et al, Evidence Syntheses, No. 86s, 2011
JA Tidy, et al, BJOG. 2013 Mar;120(4):400‐10; discussion 410‐1
In Developing Countries

Low vaccination rate
- HPV vaccination: $390 to $450

Low screening rate (<5%) & High death rate
- Dedicated clinic visits for specimen collection
- Follow-up and treatment
- A pathology lab
- Skilled staffs
- Expensive

Screen-and-Treat Strategy

- ACCP screen-and-treat strategy in the developing world:
  - Visual inspection with acetic acid (VIA), or
  - VIA with low power magnification (VIAM)
  - Combined with cryotherapy
- VIA sensitivity as good as Pap smear
- Significantly low specificity (40-60%)
  → high false positive
  → unnecessary follow-up and treatment.
- Urgent to improve the specificity of VIA/VIAM.

Our Solution: SmartME

Locate lesions with VIA

Image transfer using SmartME

Remote server for diagnosis
**Optical spectroscopy**:
- Diffuse reflectance
- Measures tissue total hemoglobin contents (THC), saturation (SO2), and scattering property ($\mu_s$)

**Fiber-bundle imaging**:
- High-resolution fluorescence imaging
- 3 micrometer resolution
- Nucleus-to-cytoplasm ratio (N/C)

**Patient ID: 012345; Site 01**

**THC = 13.5 $\mu$M, SO2 = 82.3%, $\mu_s' = 13$ cm$^{-1}$**

**Prelim Results from Normal Oral Tissues**

**How to Use the SmartME**

- VA
- Smarthe - No
- CIN2 +?}

- Normal at CIN 1
- Normal
- Cryotherapy / LEEP
- Optical hyperthermia and Chemotherapy / Radiotherapy
How Can We Improve Screening Rate?

- VIA: 40-60% Sp, >40% unnecessary biopsies
- VIA + SmartME: 85% Sp, <15% unnecessary biopsies
- Additional cost: $2.50/procedure
- 240 unnecessary biopsies prevented in 1,000 patients
- $72,500 saved, screen another 1,000 patients

What’s Next?

- 300 patients study
- Determining the sensitivity and specificity
- Algorithm training
- FDA approval

Summary

- Cervical cancer disproportionately affects women in poor areas and current screening methods are inaccurate, unaffordable, and inaccessible.
- We are using multiple engineering tools to create a SmartME that is portable, affordable and globally connected.
- The SmartME may improve the screening rate and accuracy in resource-poor areas.
- Things you can do to help:
  - Raising awareness of cervical cancer
  - Participating in research
  - Support NGOs, e.g., ACCP, WHO, Bill & Melinda Gates Foundation, etc.
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THANK YOU!