Fact #1:
Diabetic retinopathy (DR) can cause irreversible blindness

Fact #2:
If detected early enough, vision loss can be reduced by 90%
Fact #3:
In parts of North Carolina, less than 3% of diabetic patients are evaluated for DR.

Fact #4:
With improved access to eye care, vision can be saved.
Diabetes Worldwide

- Global epidemic
- Prevalence: 9% of all adults (WHO, 2014)

http://www.who.int/mediacentre/factsheets/fs312/en/

Diabetes Nationwide

- National epidemic
- Prevalence:
  9.3% of all American adults = 29.1 million (CDC, 2014)


Diabetes Statewide

- Top ten "diabetes hot spots" where burden of diabetes will be greatest in next 10 years
- Prevalence:
  10.3% of all adults (CDC, 2012)
  >1 million

CDC Census data, 2012
**Diabetic Retinopathy (DR)**

- Most common microvascular complication of diabetes
  - In U.S., leading cause of new cases of blindness
  - In U.S., cases of DR
    - 4.06 million in 2000
    - 7.7 million in 2010
    - Projection: 14.6 million by 2050
  - 4.2 million (28.5%) > 40 yrs of age*
  - 655,000 (4.4%) with advanced DR
  - that could lead to severe vision loss*

*Zhang, JAMA, 2010

* http://www.who.int/mediacentre/factsheets/fs312/en/

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**Diabetic Retinopathy (DR)**

- Most common cause of blindness in North Carolina
- Economic burden of vision problems of North Carolinians > 40 years of age
  > $4 billion

Prevent Blindness America, 2013

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**DR is preventable**

With timely intervention, laser therapy can reduce risk of severe vision loss by

>90%

Public Health Challenge

• Standard screening recommendations → annual retinal evaluation for all persons with diabetes

• In the U.S., average screening rate <50% due to barriers:
  – Socioeconomic
  – Geographic
  – Lack of patient education
  – Minorities: Language and cultural

Public health solution: Telemedicine

efficient and cost-effective way to deliver health care services over large geographic regions to all populations

ADA: Standards of Medical Care in Diabetes—2009

“Examinations can also be done with retinal photographs (with or without dilation of the pupil) read by experienced experts. In-person exams are still necessary when the photos are unacceptable and for follow-up of abnormalities detected. This technology has great potential in areas where qualified eye care professionals are not available and may enhance efficiency and reduce costs when the expertise of ophthalmologists can be utilized for more complex examinations and for therapy.”
Digital retinal imaging with remote interpretation

- Overcome barriers to access
- Improve adherence to screening guidelines
- Decrease transportation, geographic, economic barriers

Pilot Study at UNC

Purpose:
1. Evaluate effectiveness of telemedicine on DR screening rates at busy primary care practice
2. Examine clinical patient characteristics for predictors of DR in diverse population

Pilot Study at UNC

- Methods:
  - Remote classification by severity of retinopathy
  - Electronic report sent to PCP within 24 hours
    - Images and diagnosis for each eye with level of retinopathy
    - Recommended management plan
      - No/Minimal DR = repeat follow-up photos in 1 year
      - Mild/Moderate NPDR = repeat follow-up photos in 6 months
      - Follow-up with retinal specialist:
        » CSME
        » Severe NPDR or PDR
        » Ungradable images
UNC Family Medicine Pilot Study

- Results:
  - Recruited 1000 patients in 1 year
  - Improved screening rate from 32% to 71%
  - Ongoing initiative

<table>
<thead>
<tr>
<th>Predictor of DR</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-white race</td>
<td>2.2 (1.2 to 4.1)</td>
</tr>
<tr>
<td>HbA1c</td>
<td>1.5 (1.3 to 1.7)</td>
</tr>
<tr>
<td>Duration of DM</td>
<td>1.5 (1.3 to 1.7)</td>
</tr>
</tbody>
</table>


North Carolina Diabetic Retinopathy Telemedicine Network

Preliminary Results
Nov. 2013 – Nov. 2015

- 1788 patients
  - 110 Type 1; 1678 Type 2
  - 1122 women; 666 men
- Ethnic minorities
  - 31% of the NC DM population
  - 65% of NC DR TM
Referral if: Severe NPDR, PDR, CSME or unreadable image

97 patients required a referral to an ophthalmologist.

61% have attended a follow-up appointment.
Section 2: Program Implementation, Common Challenges and Shared Successes

North Carolina Diabetic Retinopathy Telemedicine Network

Remote, Mobile Image Management
Camera Technology

- Carl Zeiss VisuCam 200
- CenterVue dRS
- Cost: ~$25,000

Patient Education
Create a cohesive, robust network!

Site Infographics

Challenges to Sustainability

- Successful follow-up care for all patients
- Patients attend appointments with ophthalmologist
- Proper reporting of results and referrals to PCPs
- Financial feasibility
  - Coding, billing, and reimbursement

<table>
<thead>
<tr>
<th>CPT Code</th>
<th>Description</th>
<th>Reimbursement/Technical Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>92250</td>
<td>Fundus photography with interpretation and report</td>
<td>~$74/25</td>
</tr>
<tr>
<td>92228</td>
<td>Remote retinal imaging for monitoring and management of active retinal disease with physician review, interpretation and report, unilateral or bilateral</td>
<td>~$15</td>
</tr>
<tr>
<td>92227</td>
<td>Remote retinal imaging for detection of retinal disease with analysis and report under physician supervision, unilateral or bilateral</td>
<td>~$14 (PFS Relative Value File RVU14AR January 2014)</td>
</tr>
</tbody>
</table>
Conclusion

DR screening via ocular telemedicine in primary care setting is a public health imperative:

- PCP provide prevention, screening and monitoring of a blinding disease
- Increase DR detection and surveillance rates
- Targeted referrals to Ophthalmology
- Better patient education
- Reduce socioeconomic disparities, increase access to care
- Higher reimbursement for primary care clinics
- Decreased costs to health care system and society overall

Conclusion

Diabetic retinopathy can be a blinding disease

Conclusion

Vision loss is preventable with Appropriate screening and timely intervention
Our Network Partners

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Section 3: Emerging Camera Technology
Camera Technology

- Carl Zeiss Visucam 200
  - Nonmydriatic
  - Table-top fundus camera
- CenterVue dRS
  - Nonmydriatic
  - Miniature table-top fundus camera with built-in screen

Fundus Photography Developments

- Modern Table-Top Fundus Cameras
  - iCam: Optovue, Inc.
  - EasyScan: iOptics
  - 3nethra: Forus Inc.
  - TRC-NW8 Plus: Topcon

Fundus Photography Developments

- Modern Table-Top Fundus Cameras
  - Limitations
    - Weight and size of the product
    - Little to no portability options
    - Patients must be seated upright
    - Cost prohibitive to primary care practices
**Fundus Photography Developments**

- Integrated Adaptor-Detector-Based Hand-Held Ophthalmic Cameras
  - **VersaCam**: Nidek Co.
  - **Pictor Plus**: Volk
  - **Smartscope**: Optomed

**Limitations**

- No comparison reports in clinical trials
- Higher quality and increased quantity of camera operator training, patient imaging and dedication
- Image transfer or sharing is less accessible

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**Fundus Photography Developments**

- Smartphone-based Ophthalmic Cameras
  - **iExaminer**: WelchAllyn
  - **D-eye System**
  - **Portable Eye Examination Kit (PEEK)**