Economic Evaluation of an Automated Retinal Image Analysis in Australian Aboriginal and Torres Strait Islander populations for detection of Diabetic Retinopathy

Jeromie Ballreich, MHS, PhD Candidate
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Partners

Contributing Authors: Jeromie Ballreich\textsuperscript{1}, Anthea Burnett,\textsuperscript{2,3} Arthur Ho,\textsuperscript{2,3} Luke Arkapaw,\textsuperscript{2} Andrew Kleinert,\textsuperscript{2} Kevin D. Frick\textsuperscript{4}

\textsuperscript{1}Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, USA
\textsuperscript{2}Brien Holden Vision Institute and Vision CRC, Public Health, Level 4 North Wing, Rupert Myers Building, Gate 14 Barker St, Sydney, NSW, Australia
\textsuperscript{3}School of Optometry & Vision Science, Rupert Myers Building, Gate 14 Barker St, UNSW, NSW, Australia
\textsuperscript{4}Johns Hopkins Carey Business School, Baltimore, Maryland, USA
Public Health Problem (1/2)

• Indigenous Australians are $3x$ more likely to have diabetes$^1$

• Only $20\%$ of Indigenous Australians receive annual retinal examination$^2$

• Indigenous Australians have $6x$ rate of blindness compared to mainstream Australian population$^3$
Source: Australian Bureau of Statistics, 2007
Automated Retinal Image Analysis (ARIA)

- Uses algorithm to *automatically* assess presence of Diabetic Retinopathy (DR)
- Can be operated by Aboriginal Health Worker (AHW)
- Cheaper than traditional cameras

Cotton wool spots (red and purple), hemorrhages (yellow and green). Source: Abramoff
Evaluate the net economic benefit of ARIA compared to standard screening methods for Indigenous Australians under varying technical assumptions?

- Gradeability
- Sensitivity
- Specificity
Approach

• One-off deterministic decision tree comparing screening cost of ARIA with SoC

• Overlay one-off model results onto a receiver operating characteristic (ROC) curve

• Conduct one-way sensitivity analyses and discuss results
Model Assumptions (1/2)

- Australian Department of Health perspective
- Single-cycle screening
- 100% Coverage (Indigenous Australians aged 40+ years with self-reported diabetes, n=45,197)
- Each Aboriginal health center has camera (189 cameras)
- SoC Screening pathway was adopted from Cost to Close the Gap Report[^5]
# Model Assumptions (2/2)

## Key Probabilities

<table>
<thead>
<tr>
<th>Probability</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of DR</td>
<td>0.297</td>
</tr>
<tr>
<td>Performance of ARIA</td>
<td>0.9</td>
</tr>
<tr>
<td>Sensitivity of ARIA</td>
<td>0.8</td>
</tr>
<tr>
<td>Specificity of ARIA</td>
<td>0.7</td>
</tr>
<tr>
<td>Ophthalmology treatment</td>
<td>0.344</td>
</tr>
<tr>
<td>Sensitivity of Optometrist</td>
<td>0.898</td>
</tr>
<tr>
<td>Specificity of Optometrist</td>
<td>0.951</td>
</tr>
</tbody>
</table>

## Key Costs (per screened patient)

<table>
<thead>
<tr>
<th>Cost</th>
<th>Value (AUS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIA Camera Cost*</td>
<td>$2,000</td>
</tr>
<tr>
<td>ARIA Operating cost</td>
<td>$76.20</td>
</tr>
<tr>
<td>Transport Cost (Opt/GP)</td>
<td>$19.15</td>
</tr>
<tr>
<td>GP Screen</td>
<td>$71</td>
</tr>
<tr>
<td>Opt Consult (includes VOS)</td>
<td>$325</td>
</tr>
<tr>
<td>Treatment Cost</td>
<td>$761.18</td>
</tr>
</tbody>
</table>
Decision Tree (ARIA branch)
Decision Tree (SoC branch)
One-off Model Results (1/2)

• ARIA screening cost: $354.35
• SoC screening cost: $586.10
• Net Difference: $232.15
• 1 point increase in Sensitivity (ARIA): +$1.91
• 1 point increase in Specificity (ARIA): -$1.50
• 1 point increase in Performance (ARIA): -$3.00
• ARIA cost $16 million, SoC cost $26.5 million
One-off Model Results (1/2)

• ARIA detected 81.1% of True DR
• SoC detected 89.9% of True DR
• 1,176 missed cases
• $8,929 per missed case
One-off Model Tornado Diagram

Model is most sensitive to Optometrist Consultation cost
Benefits of ROC Curve

- ROC curve reflects **co-varying combinations** of sensitivity and specificity
- Better reflects **modifications to the go-no-go threshold** for DR
- Provides guidance to developers on ways to “tune” diagnostics to achieve best outcomes
Implications

ARIA

• ARIA is less effective but cost-saving
• Low-cost will allow for greater deployment
• Greater coverage improves population health

Project

• Provides an analytic framework for evaluating diagnostic devices
References


Questions?
Thank you!

Contact: Jeromie Ballreich, MHS, PhD Candidate
JBALLRE2@JHU.EDU