Developing the Predictive Model
A risk-stratified analysis of individual patient data from 32 clinical trials including a reanalysis of Diabetes Prevention Program (DPP) Study (Figure 1) showed:
• Heterogeneity of treatment effect, i.e., not all patients will receive average absolute risk reduction.
• Wide and highly skewed distribution of risk for developing diabetes within 2 years.

The predictive model was implemented in 2 health systems, Premier Medical Associates and Mercy Health, using Allscripts and Epic, respectively.

Methods
Design: Pre-implementation study 2008–2009
Population studied: 5,000 patients with prediabetes, 30 pilot primary care clinics, 40 providers, 2 health systems.

Adaptations: Predictive model adaptive for EHR use via Optum data
• Removed variables like waist-to-hip ratio, see Table 1 for complete list of 11 variables and Figure 2 for patient prototype;
• Calculated coefficients for missing variables. Table 1 lists three required variables.

Surveys: Pre-implementation focus groups and surveys with patients & providers
Evaluation: Measures for Reach, Adoption, Maintenance (RE-AIM) (Figure 3); Pre/post implementation surveys

Both have pre-diabetes. Who is at greatest risk for diabetes?

• 38-year-old female
• BMI: 34
• HbA1c: 5.8
• SBP: 121
• HbA1c: 6.1
• BMI: 22
• HbA1c: 5.8
• BMI: 36

Conclusions
• A predictive model, embedded in the EHR, that predicts individual patient risk for developing diabetes at the point of care improves treatment for patients with prediabetes.
• Use of individual risk estimates resulted in prioritization of treatment for patients at greatest risk of developing type 2 diabetes.

Implications
• Only 3.7% of patients with prediabetes receive metformin; even fewer enroll in the DPP. Change is needed to engage patients and empower providers with tools to increase shared decision making around treatment choices.
• Providers and systems need to help patients with prediabetes identify resources to increase patient treatment, referral, and adherence through more targeted and tailored treatment recommendations.
• Potentially to impact the ~96 million people in the US, in one or three adults, with prediabetes. Most are undiagnosed and therefore untreated.
• Cost savings estimated at $17,500 per patient averted or delayed diabetes for 5 years.

References
1. PCORI grant # 1IP2PI000722
4. Anastassios Pittas, MD, MS, Jason Nelson, MPH, MA;1 Jason Nelson, MPH, MA;1 Jill Powellson, RN, DrPH, MBA;1 Carolyn Koenig, MD, Francis Colangelo, MD, MS-HQS, FACP;3
5. AMGA, Alexandria, Virginia;3 Predictive Analytics and Comparative Effectiveness Center, Tufts Medical Center, Boston, MA;1 OptumLab1 Visiting Fellow, Cambridge, MA;3 Mercy Clinic East Cincinnati, St. Louis, MO;1 Premier Medical Associates, Monroeville, PA

 site #1
Automated process
2104 patients with prediabetes
68% received risk tool
50% received risk tool
730 patients with prediabetes
49% received risk tool

Table 1. Diabetes Risk Calculator

<table>
<thead>
<tr>
<th>ERVs</th>
<th>Value</th>
<th>Required</th>
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<tbody>
<tr>
<td>Age (yr)</td>
<td>M</td>
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<tr>
<td>Gender</td>
<td>F</td>
<td>Yes</td>
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<tr>
<td>Race</td>
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<td>Ethnicity</td>
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<tr>
<td>Hypertension</td>
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<tr>
<td>AI (%)</td>
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<tr>
<td>EPA (mg/dL)</td>
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<tr>
<td>Total cholesterol (mg/dL)</td>
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<td>Yes</td>
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<tr>
<td>LDL cholesterol (mg/dL)</td>
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<tr>
<td>HDL cholesterol (mg/dL)</td>
<td>32</td>
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</table>

Figure 2. Heterogeneity of Treatment Effect: DPP Study

Table 2. Pre/Post-intervention referrals to DPP or metformin Rx among high-risk patients, by site

<table>
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<tr>
<th>Organization</th>
<th>Pre-intervention</th>
<th>Post-intervention</th>
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<tr>
<td>Premier</td>
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<td>Manual process</td>
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<td>Mercy</td>
<td>DPP Lifestyle</td>
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<td></td>
<td>Manual process</td>
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</table>

Figure 3. Patients identified and treated,* by risk level

Figure 4. Provider confidence survey question

How confident are you in your ability to estimate the average risk of diabetes progression for your patients with prediabetes?