Using Predictive Modeling to Improve Outcomes

For Children in Allegheny County
Key Partners

**Research Team**
- Rhema Vaithianathan, Auckland University of Technology
- Emily Putnam-Hornstein, USC
- Irene de Haan, University of Auckland
- Marianne Bitler, UC Irvine
- Tim Maloney, Auckland University of Technology
- Nan Jiang, Auckland University of Technology

**Ethics**
- Tim Dare, University of Auckland
- Eileen Gambrill, UC Berkeley

**Evaluators**
- **Process**
  - Hornby-Zellar Associates
- **Impact**
  - Stanford University

**Technology**
- **Implementation**
  - Deloitte
14,121 Referrals to Child Welfare

53% Screened Out

47% Screened In
Today: Using Integrated Data to Inform Decision-Making

In Allegheny County, rich data are available to case workers to help inform initial maltreatment screening decisions at the child protection hotline, but

- No standardized protocols for using these data to make referral screening decisions
- No method for systematically weighting this information in an equitable manner across all referrals
- No understanding of what information is correlated / predicts future adverse outcomes for children
Developing a Screening Score

- The **screening score** is from 1 to 20
- The **higher the score, the higher the chance of the future event** (e.g., abuse, placement, re-referral) according to the data

![Screening Score Diagram]

**1 in 20 calls receive a score of 1** (bottom 5% of risk)

**1 in 20 calls receive a score of 20** (top 5% of risk)
Researchers built a screening model based on information that we already collect.

They identified more than 100 factors that predict future referral or placement.

To test if the model might improve the accuracy of screening decisions, we scored thousands of historical maltreatment calls and then followed the children in subsequent referrals to see how often the model was correct...
The Results: Re-Referrals

1 in 10 children with a score of 1 were re-referred within two years of the call.

9 in 10 children with a score of 20 were re-referred within two years of the call.
The Results: Out-of-Home Placements

1 in 100 children who received a score of 1 were placed out-of-home within 2 years of the call.
The Results: Out-of-Home Placements

1 in 2 children who received a score of 20 were placed out-of-home within 2 years of the call.
Under current practice:

27% of highest risk cases were screened out — of these, 1 in 3 are re-referred and placed within 2 years of the initial screened out call.

48% of lowest risk cases were screened in — and yet only 1.4% of those are placed within 2 years.
Children’s Hospital Validation

• Allegheny County entered into a research agreement with Children’s Hospital of Pittsburgh of UPMC into order to study relationships between the child welfare risk modeling and injury data.

• Child welfare referrals were matched with hospital event data (including emergency department visits and in-patient admissions) from February 3, 2002 to December 31, 2015.
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- Over a broad range of injury types there is a positive correlation between the scores\(^1\) at call referral and the rate of hospital events.

\(^1\) maximum placement risk score ever received for each child in the referral data
Preparing for Implementation
Ethics Assessment

• Tool independently reviewed by ethicists from University of Auckland and UC Berkeley

• Concluded that there would be “significant ethical issues in not using the most accurate risk prediction measure.”

• Among key opinions:
  • The tool does not access any data that workers were not already able to utilize in decision-making
  • It is likely more accurate and more transparent than existing decision-making processes
  • The tool may reduce burdens of stigmatization by allowing for more effective targeting of services

(cont.)
Ethics Assessment

Among key opinions (cont.):

• Racial disparities are already present in data at many decision points, and continued vigilance will be required to avoid reinforcement of past biases. However, the writers note that:
  • The *predicted* designation of risk is designed to prompt further in-depth investigation into the family’s *actual* risk status; and
  • The resulting potential interventions are designed to assist families.
• Training and ongoing monitoring will be key to ensuring and maintaining effectiveness
• While identifying at-risk families more effectively, it is further ethically required that the eventual services offered are effective
Implementing and Evaluating Predictive Modeling

The Allegheny Family Screening Tool
Family Screening Tool Appearance
Monitoring Performance

• 7 months of data through end of February
• Frequent internal monitoring and support activities:
  o Bi-monthly leadership meetings with updated data analyses
  o Tool modifications, functionality fixes as needed
  o Auto-generated weekly support reports regarding “high scores” screened-out
  o Informal interviews with screeners, supervisors
  o Ongoing support activities for contracted process and impact evaluations
Early Scores Differed from Expectations

As data accrued and trends materialized, the first months of the tool yielded:

• More “No Scores” than expected, including a disproportionate impact on referrals involving newborns or other very young children

• Fewer “High” scores than expected

In response to this, made an alteration of the tool to:

• Relax the tool’s requirement for a child to have a prior MCI (instead allowing for a score if any individual is known)

• Implemented client-matching functionality to gather data from duplicate IDs
November 29th Improvements

This tool modification went live on November 29th, and changed the relative prevalence of GPS scores in intended ways:

- The rate of “Mandatory” referrals roughly doubled from 4% to 9%
- Referrals generating no scores dropped roughly in half
- “High” scores have become the most common score range, supplanting “Medium”

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- Since implementation, overall screening rates have remained stable with the prior year’s same period
- Generally, referrals with higher scores are being screened-in more frequently

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Referral data from 8/1/2016 through 3/6/2017
Score Demographics

- **Racial disparities** have been a monitoring priority at all stages of research and implementation.

- Race was not explicitly invoked in the algorithms, but the outputs of the tool nevertheless showed a tendency for black children to receive higher scores than white children. To date this has borne out in practice as well.

- The impact evaluation will be assessing racial disparity in greater detail to see if the introduction of the tool made any positive or negative changes to biases at call screening.

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Impact Evaluation

The impact evaluation is underway, and will be focusing on:

• Accuracy of decisions
• Reduction in unwarranted variation in decision-making
• Reduction in disparities
• Overall referral rates and workload

Outcomes assessed will include:

• Overall rate of screen-ins
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• Likelihood of screen-ins not being accepted for services
• Unwarranted variation in screening decisions
• Disparity in screening decision
Process Evaluation Findings

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- In the early weeks of the tool, 69% reported “occasionally,” “almost always,” or “always” consciously using the tool to inform recommendations.

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As soon as the birth is registered we could assign a needs score between 1 and 20

Predicting a child protection case opening by age 3

- Vision would be to prioritize high needs births for upstream early intervention support in the hopes of preventing the need for later child protection involvement
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Of those who received a risk score of 20, 40% of them resulted in an open case by age 3.
Opportunities for Prevention

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Note: age of children is restricted to between 7 and 17 for self-inflicted injuries.
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The purpose of the Family Screening Score is to use information collected by DfS and other partners to inform screening decisions. The Family Screening Score is calculated by integrating and analyzing hundreds of data elements on each person related to the referral to generate an overall Family Screening Score. The score predicts the long-term likelihood of re-referral, if the referral is screened out without an investigation, or home removal, if the referral is screened in for investigation.

If the Family Screening Score meets the threshold for “mandatory screen-in,” the call must be investigated. In all other circumstances, the Family Screening Score provides additional information to assist the Call Screening Unit in making a call screening decision and should not replace clinical judgement.

The Family Screening Score is only intended to inform call screening decisions and is not intended to be used in making investigative or other child welfare decisions.
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