Identifying At-Risk Mothers for Targeted Interventions

The Eric & Wendy Schmidt Data Science for Social Good Summer Fellowship

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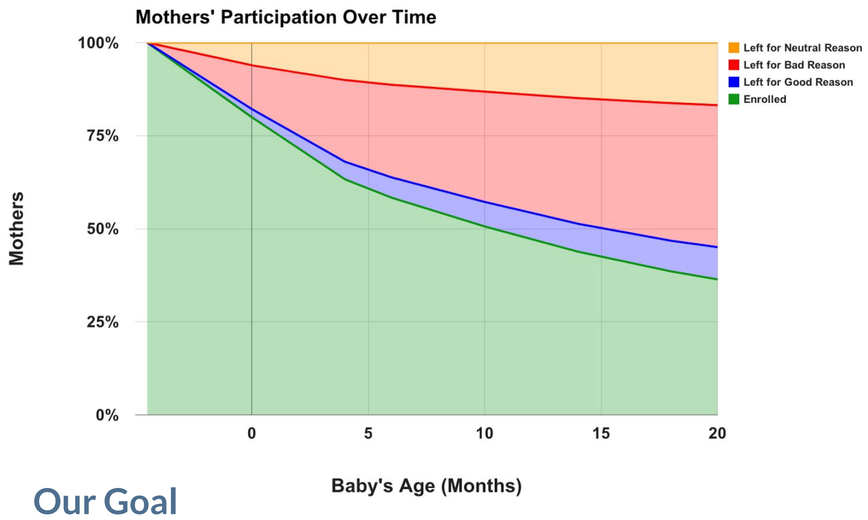
Abstract

Nurse-Family Partnership (NFP) is a national nonprofit that pairs first-time, low-income mothers with registered nurses. The nurses visit mothers' homes regularly for 2.5 years and work to improve the health and economic self-sufficiency of mother and child. Our work uses NFP's extensive operational database to identify mothers who are likely to leave the program before completion or at risk of not reaching program goals. By giving nurses individualized risk profiles for mothers, we help nurses identify key areas to target for intervention.

The Problem

NFP has demonstrated through multiple randomized controlled trials that its program improves outcomes for mothers and children. However, less than 40% of mothers complete the voluntary program. The following graph illustrates mothers' participation over time in the NFP program.

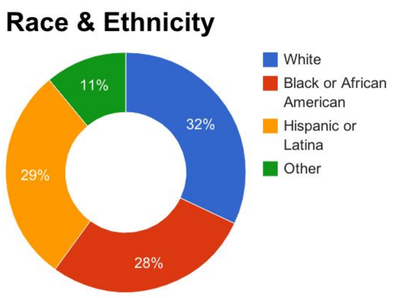


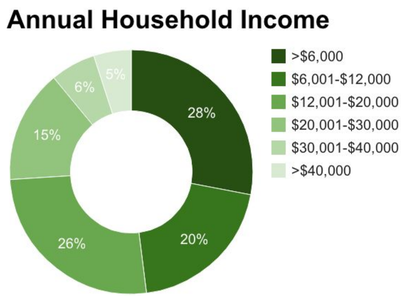
Our Goal

Identify mothers who are at risk of leaving the program before completion or not reaching program goals, such as high school graduation and breastfeeding, so nurses can intervene early.

Data

- 36,523 mothers
  - 2007-2010 cohort
  - 125 intake variables
  - 87 progress variables
- 1,033,596 visits
- 1,568 nurses
  - 254 agencies
  - 44 states

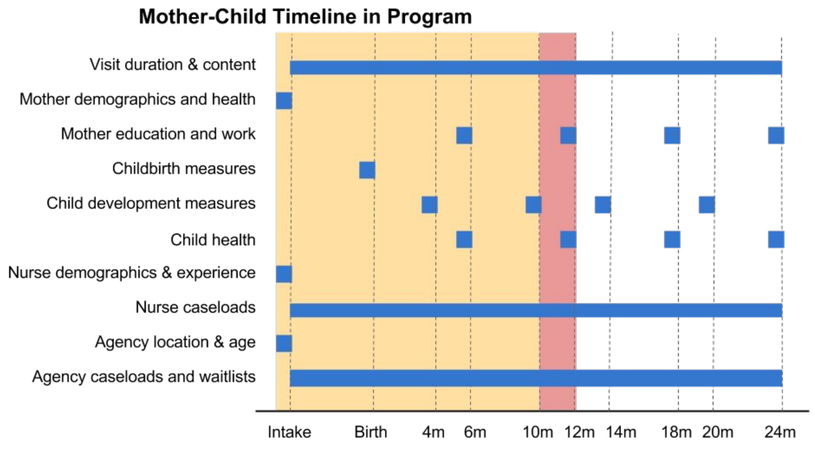




Modeling Approach

An effective system would allow nurses to know as early as possible the risks faced by the mothers they serve. Thus, we developed two types of models:

1. using only the information available at intake and
2. updating throughout the program with the latest information, as illustrated by the graph below.

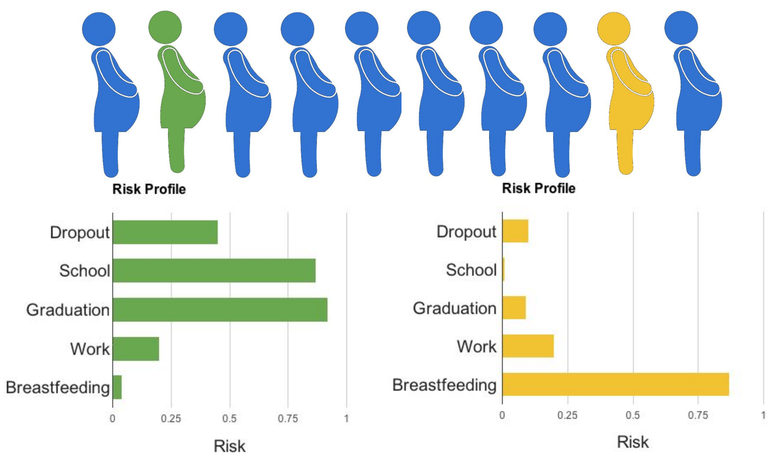


What We Predict	When We Predict
• Attrition • Breastfeeding • School enrollment • School graduation • Employment	Time after birth: • 6 months • 12 months • 18 months • 24 months

Model Validation

To mirror the actual use of the models, our cross-validation is built on sliding windows of time. We train our models on all data up to a certain date, and test on the next *n* months. This method repeats for all *n*-month windows, and the results are aggregated.

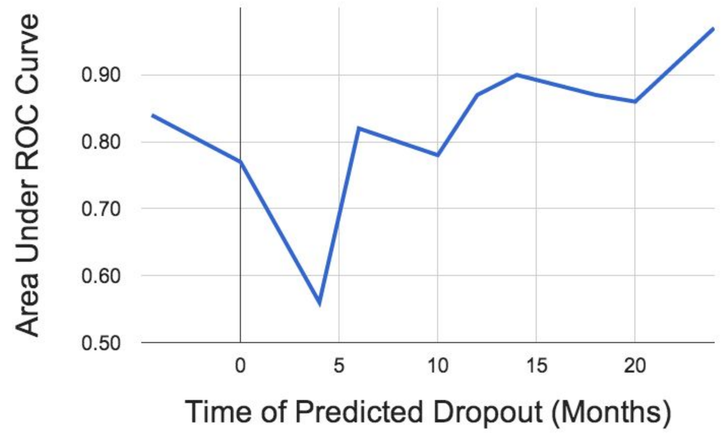
Mother Risk Profiles



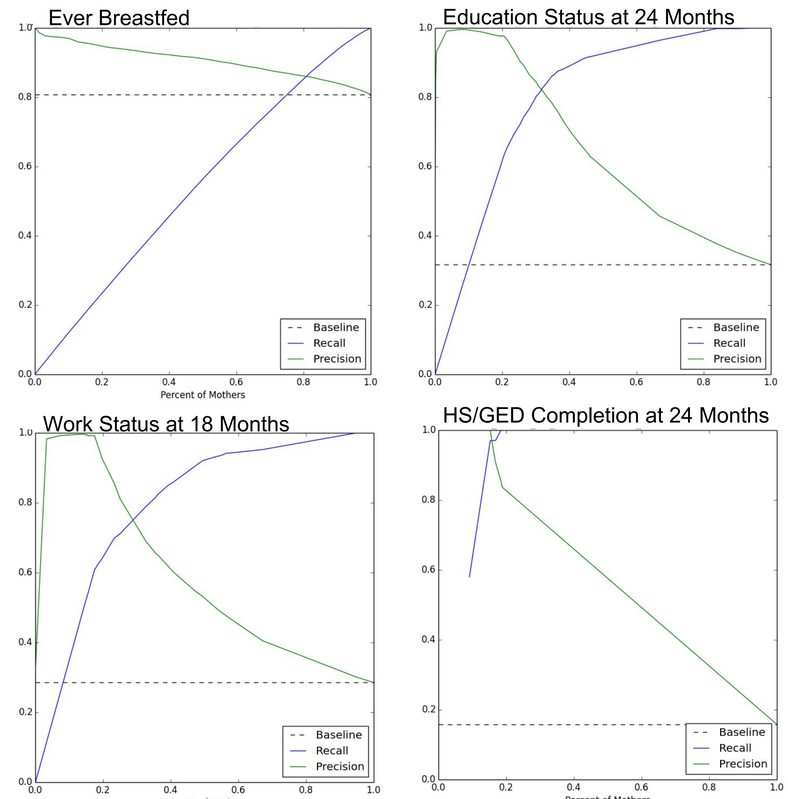
To generate a comprehensive risk profile for each mother, the predictions of each model can be combined to derive key features, which nurses can use as areas to target for intervention.

Results

Predicting when mothers leave the program



Predicting mothers' outcomes



Conclusions and Future Work

We are validating our models on more recent data. We will build an online demonstration of our risk profiles that NFP has expressed interest in piloting. The pilot will build trust in our predictions by letting nurses and administrators work with our predictions before integrating them into NFP's operations.

Nurse-Family Partnership
Helping First-Time Parents Succeed®

This work was done during the Eric & Wendy Schmidt Data Science for Social Good Fellowship at the University of Chicago.