Predictive Risk Modeling:
A Tool for Child Protection?

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Children's Data Network @ USC

Thanks.

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*Partnership w/ CA Child Welfare Indicators Project
   [California Department of Social Services, UC Berkeley, & Stuart Foundation]

*Invitation to join the discussion today

The power of linked records
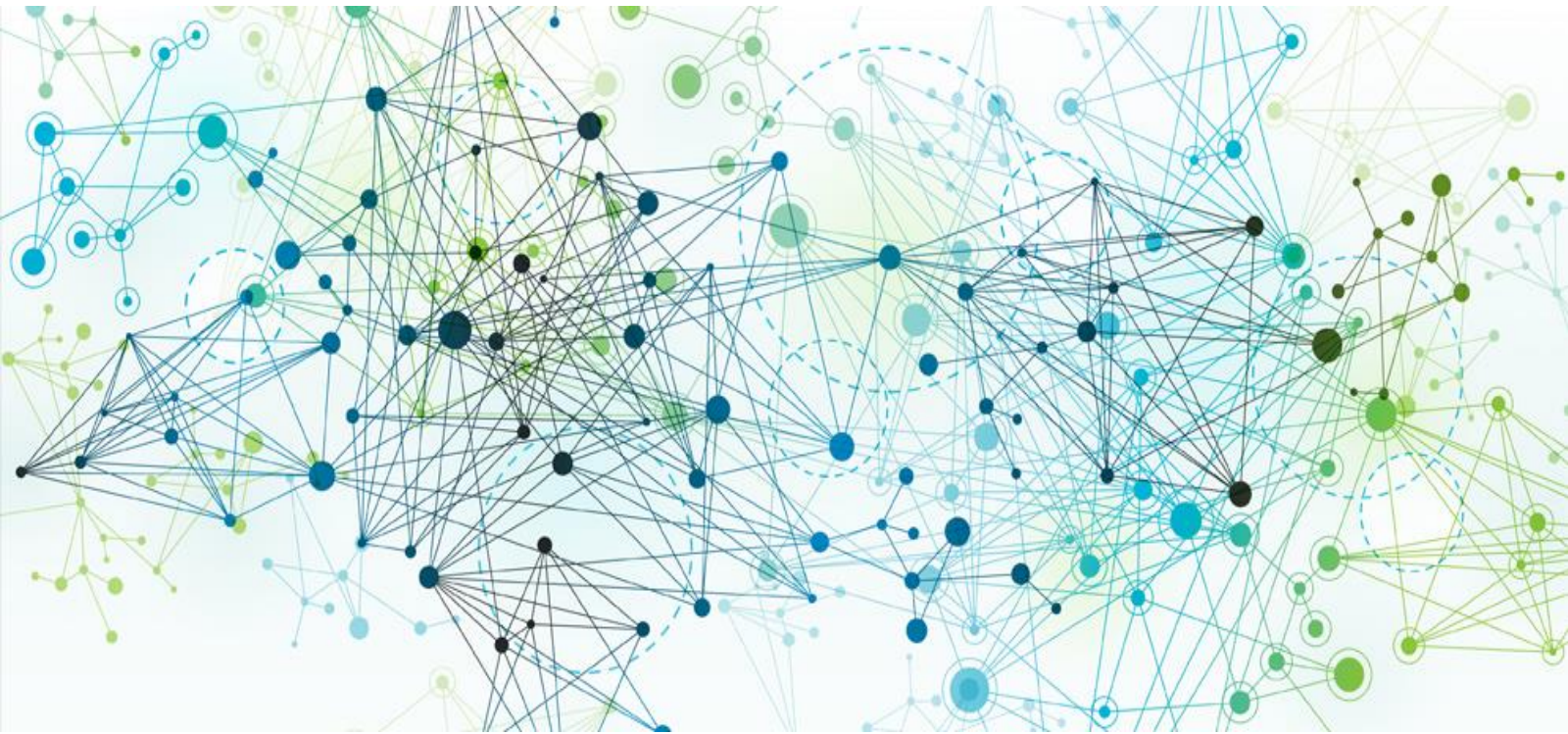
1. A population, longitudinal framing
2. Objective indicators of risk
3. Engaging cross-system partners
4. Relevant, actionable knowledge
5. Preventive analytics / decision aids
6. Research and evaluation

Why? What?

What is the context for a renewed interest in statistical decision-making tools?

What is meant by PRM? How is this approach different than other tools?

Renewed interest

1. Wider availability of high quality data…big, small, structured, unstructured

2. Advances in technology and analytic capabilities – not just retrospective analyses

3. Growing appreciation that current tools are inadequate, clinicians are poor at weighting factors (and time is scarce!)

4. Opportunities to reduce costs / improve performance by identifying high service utilizers /

Example: Academic support

Big Data Helps Marist College Predict, Prevent Poor Student Performance

In an innovative effort to help more of their undergraduates complete their degrees, over 150 U.S. universities are currently applying predictive analytics to massive stores of historic student performance data to better understand the qualities and behaviors that correlate with student success. With this information, the schools hope to identify those students "likely to fail" certain courses, and alert their professors to the risk. Professors can then provide meaningful interventions aimed at helping these students succeed.[1]

Example: Health care

- Risk scoring at hospital discharge
- Score indicates risk of re-hospitalization within 365 days
- Score emailed to family physician
- Case review high risk patients
- Current evaluation

1. Relatively advanced – growing with increased reliance on electronic medical records

2. Forecasting which patients are likely to experience an adverse outcome (e.g., re-admission to the hospital after discharge)

3. Population health management through risk stratification (e.g., case finding to identify high risk patients for targeted intervention)

* Panattoni, L. E., Vaithianathan, R., Ashton, T., & Lewis, G. H. (2011). Predictive risk modelling in health: options for New Zealand and Australia. *Australian Health Review*, 35(1), 45-51.
Vaithianathan, Rhema, Nan Jiang, and Toni Ashton. *A Model for Predicting Readmission Risk in New Zealand*. No. 2012-02. 2012. Melbourne Institute.

Relevance to child protection

"One might conceptualize child welfare agencies as social service agencies, but that would be incorrect. In reality, child welfare agencies are gate-keepers and the workers decision makers."

(Gelles & Kim, 2008)

hotline call · investigation · disposition · services
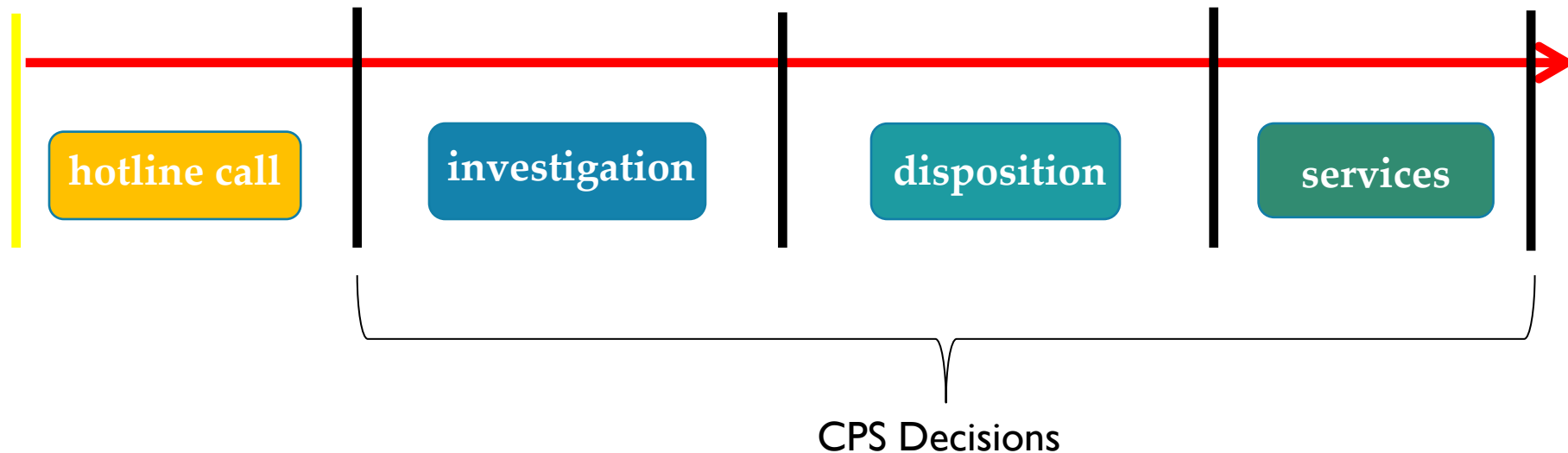
CPS Decisions

Decision-making tools / aids*

1. <u>Consensus based assessment tools</u> *(not great)*

2. <u>Actuarial risk assessment tools</u> *(operators distort inputs to get the outcomes they want, not validated on local populations, expensive to administer…)*

3. <u>Predictive risk modeling (?)</u>
   a) *Vast amounts of high quality administrative data (we are just beginning to explore what is possible)*
   b) *No new data entry required by front-line workers (no "gaming" the tool, focus on client engagement, cost-effective)*
   c) *Advances in technology / computer science (very feasible, methods advancing, updated easily)*

*clinical judgment can never be replaced, but can it be improved?

Potential applications

- **Primary Prevention:** **"proactive model"**
  - *requires an upstream data system which captures a sufficiently rich set of variables to support risk classifications & an adequate proportion of children who will later be maltreated*
  - *could be used to prioritize children for early intervention and maltreatment prevention services*

- **Secondary Prevention:** **"reactive model"**
  - *could be deployed at different child protection decision-points to support hotline screenings, investigations, etc.*
  - *linkages with other data could be used to provide a more accurate/complete assessment of present and future risk*
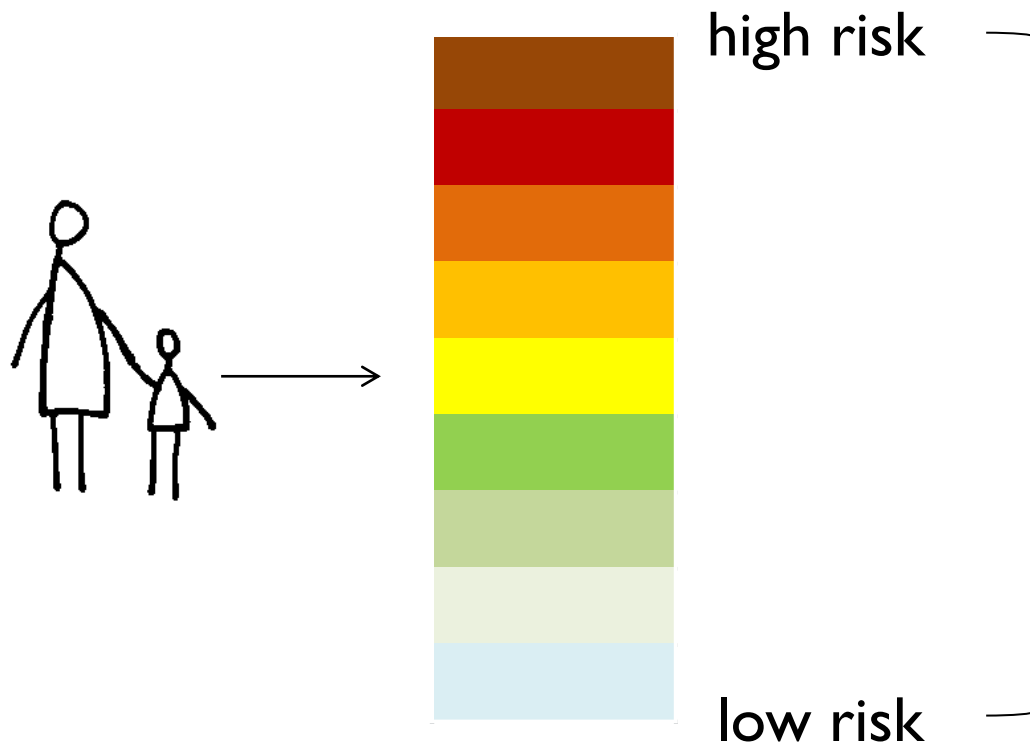
- **Tertiary Prevention:**
  - *may lend itself to a more effective and efficient means of minimizing negative consequences of child abuse or neglect*
  - *empirical basis for tailoring services (vs. "one size fits all") – "precision medicine…"*

"prediction is very difficult, especially if it's about the future,"
Niels Bohr

[Important to keep in mind!]

high risk

low risk

Preventing Maltreatment:

Can we move strategically upstream?

New Zealand?

A case study from the other side of the world…

Case study from New Zealand

- **Reality:** 83% of children substantiated as victims of maltreatment by age 5 could be found in an open public benefit case between birth and age 2

- **Question:** Could the country's integrated data system be used to develop a statistical model to predict which of these children would later become victims of maltreatment?

Prototype I*

Public benefit system (~33% of birth cohort)

Prototype II**

Birth registry (94% by 3m; 98% by 6m)

*Vaithianathan, R., Maloney, T., Putnam-Hornstein, E., & Jiang, N. (2013). Children in the public benefit system at risk of maltreatment: Identification via predictive modelling. *American journal of preventive medicine*, *45*(3), 354-359.

**Ministry of Social Development (2013) The feasibility of using predictive risk modelling to identify new-born children who are high priority for preventive services. Unpublished report. Wellington.

Modelling (prototype 1)

- Predictor variables – with weights attached to each variable (caregiver demographics, partner variables, previous benefits, child protection hx, criminal justice hx, refugee status)

- 224 predictors reduced to 132 variables using a stepwise probit model

- 70% model development; 30% test

- Public benefit spells from 2003 – 2006; 103,397 public benefit spells (57,986 unique children)

- Risk scores of 1 to 10 generated for each child…

… predicts actual maltreatment rates well


Maltreatment Risk Decile (1st spell)
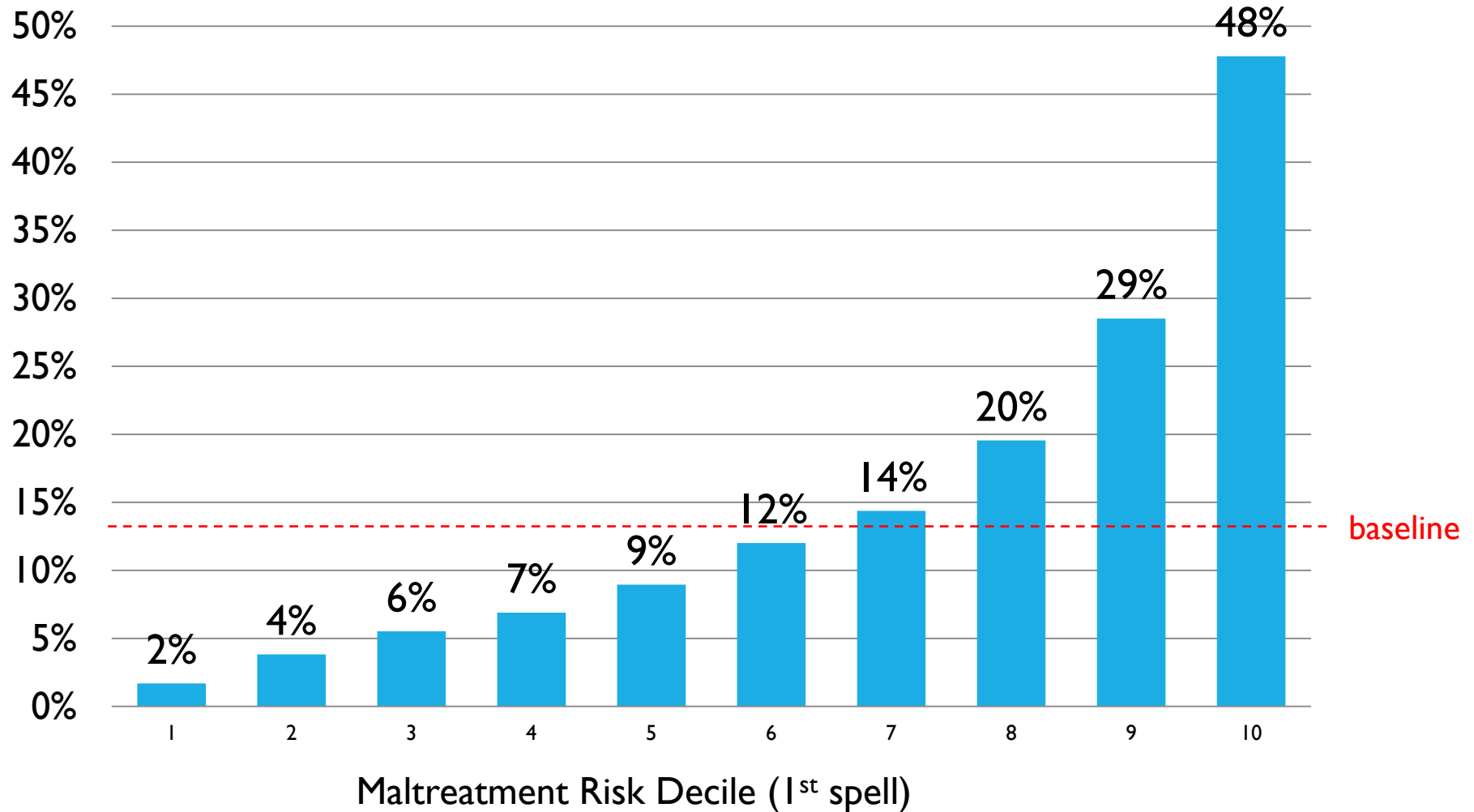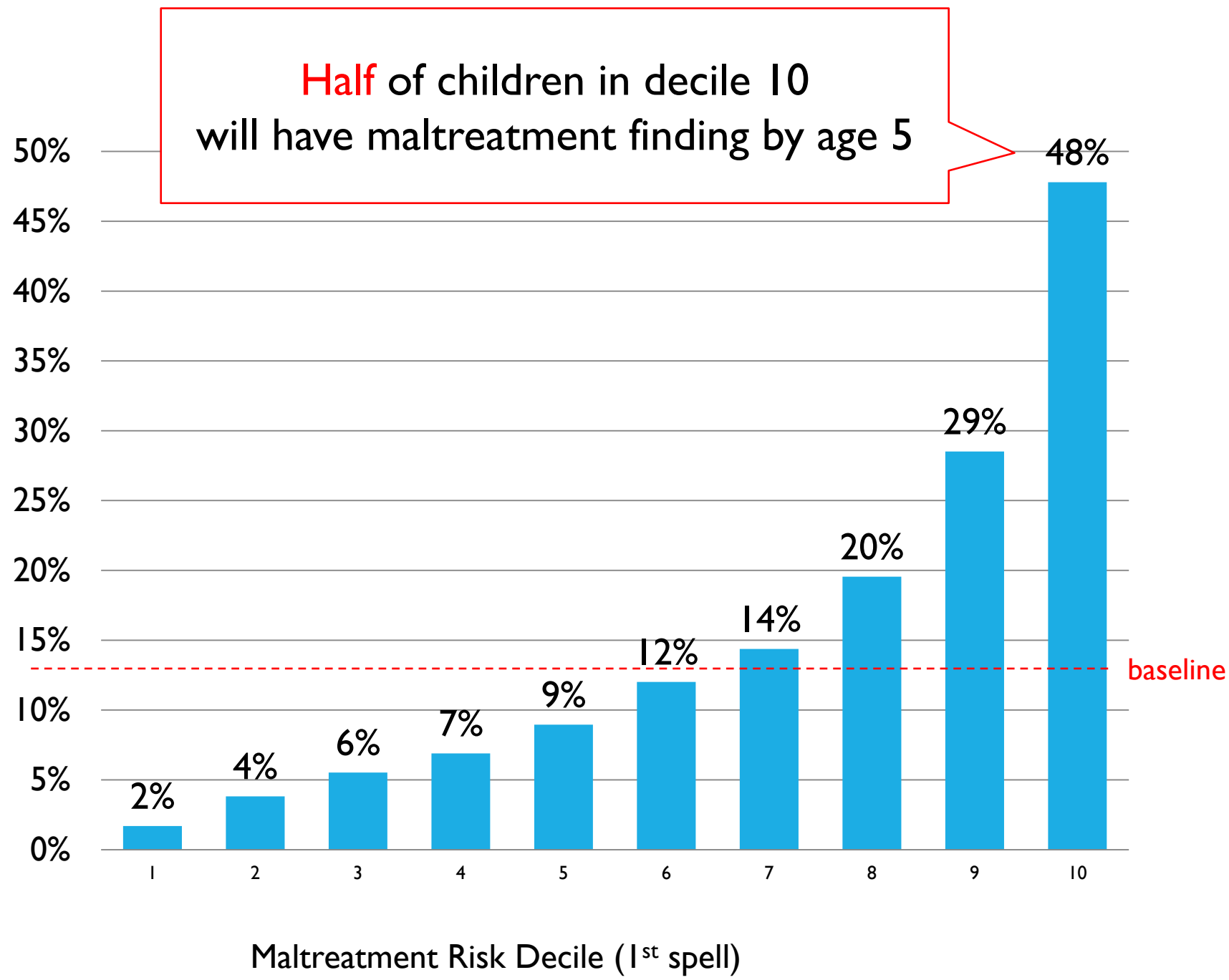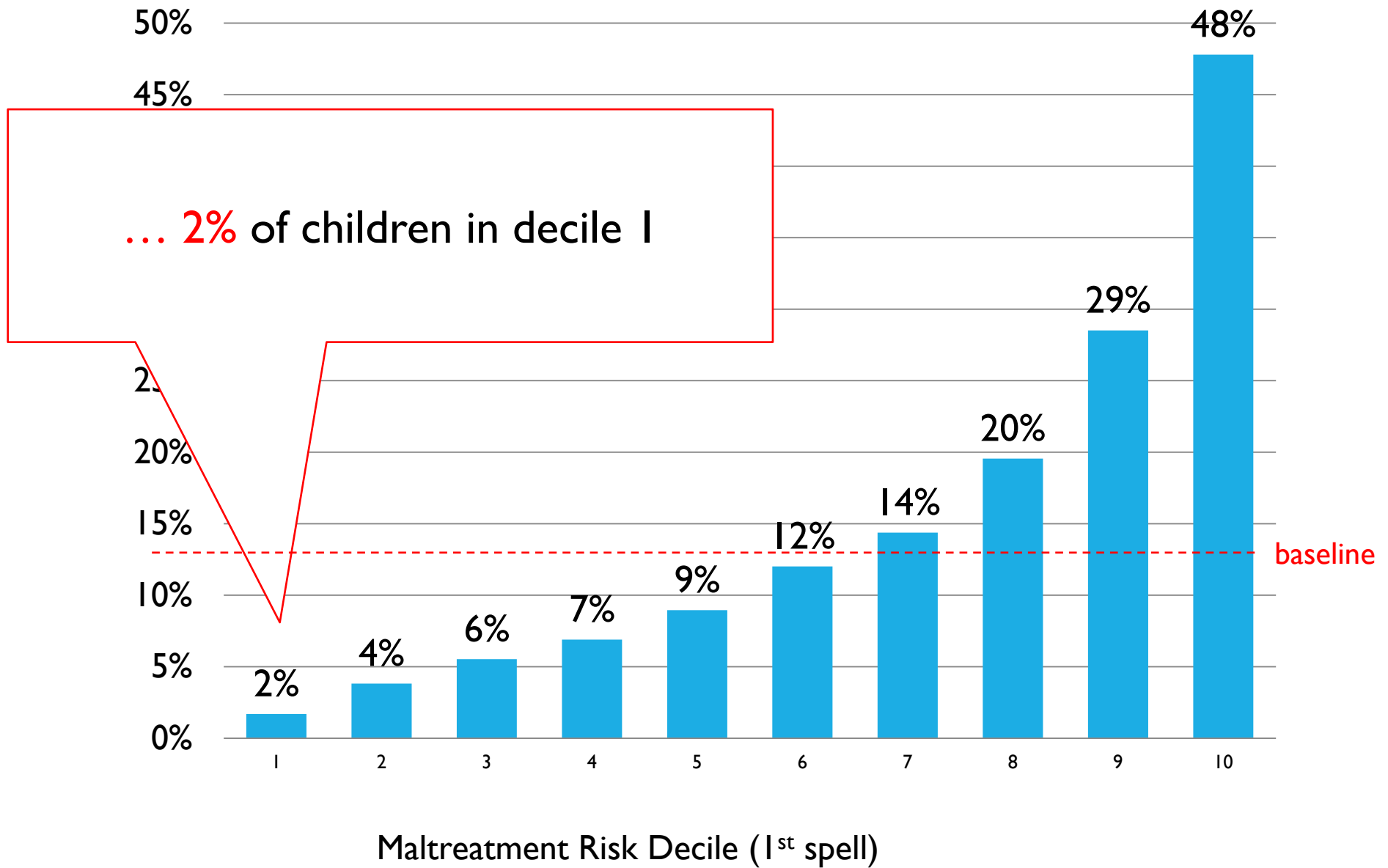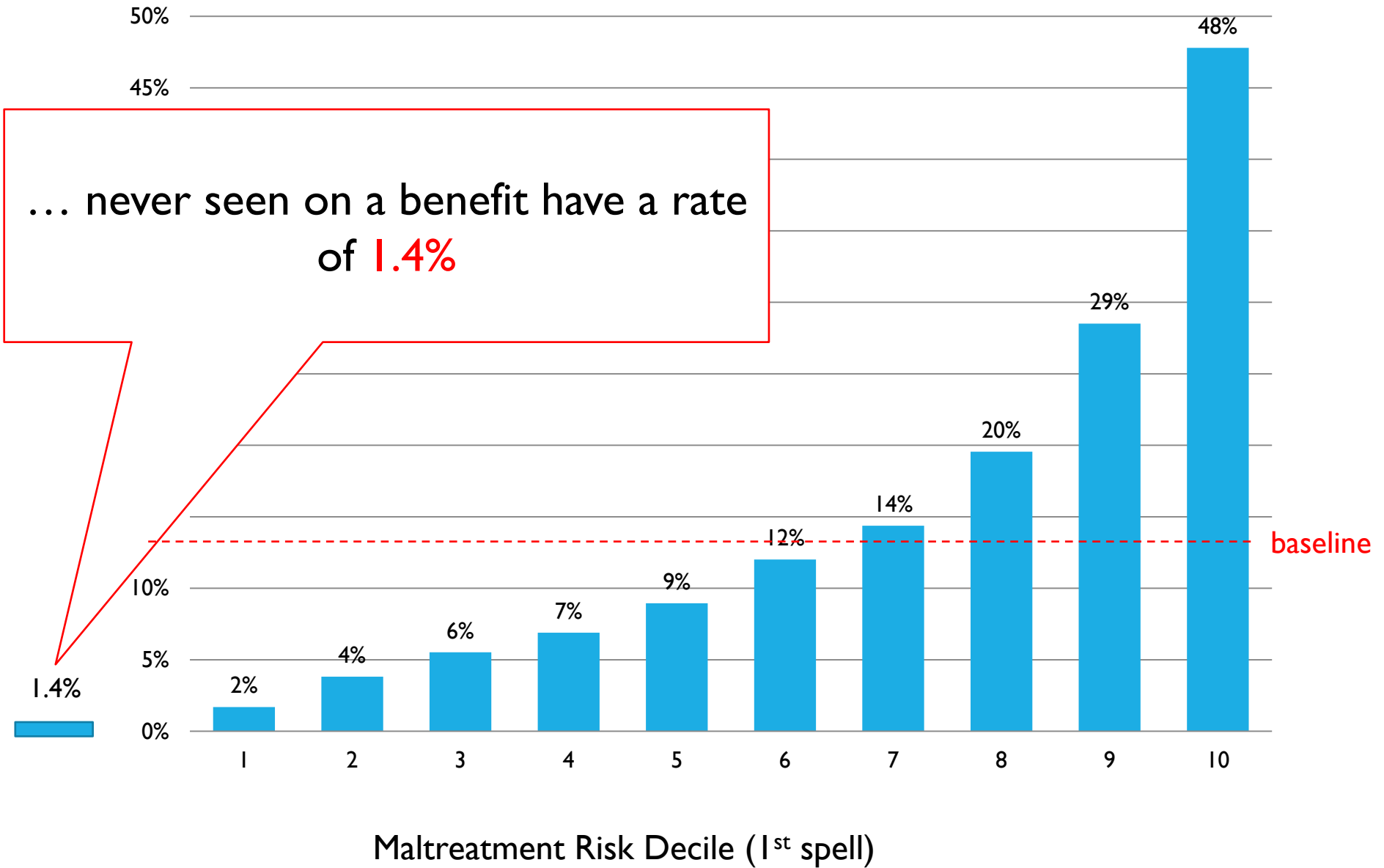
Other considerations?

1. <u>What proportion of maltreatment victims will be identified by this model?</u>

   1. *If NZ targets the first spells in the top 2 deciles, the model will "capture" approximately 40-50% of all findings that occur to children on public benefits*

2. <u>Is there time to intervene with services before there is a substantiated maltreatment finding?</u>

   1. *Majority of maltreatment occurred more than 2 years after hitting the top 20% threshold*
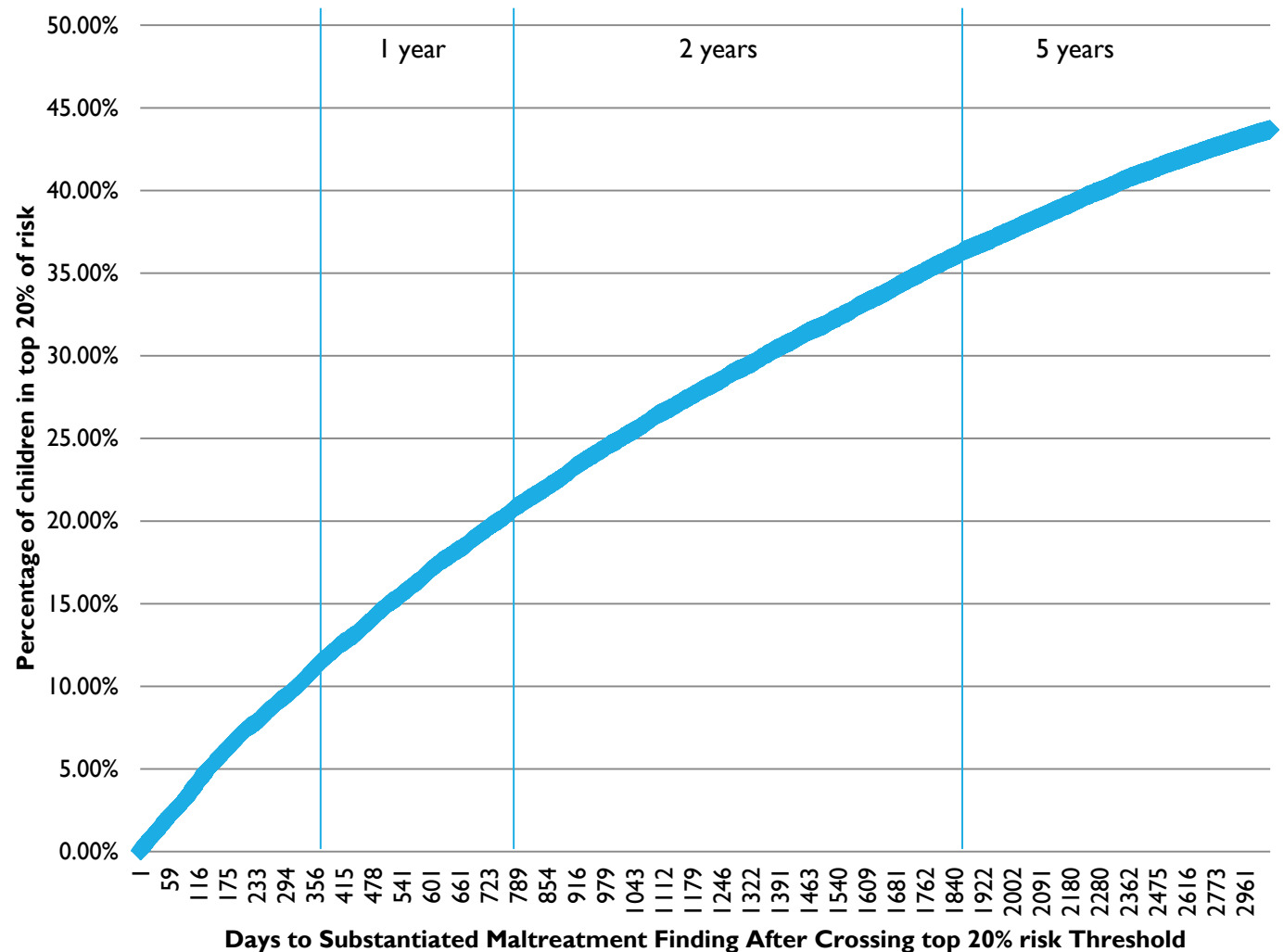
Parallel thought exercise in California…
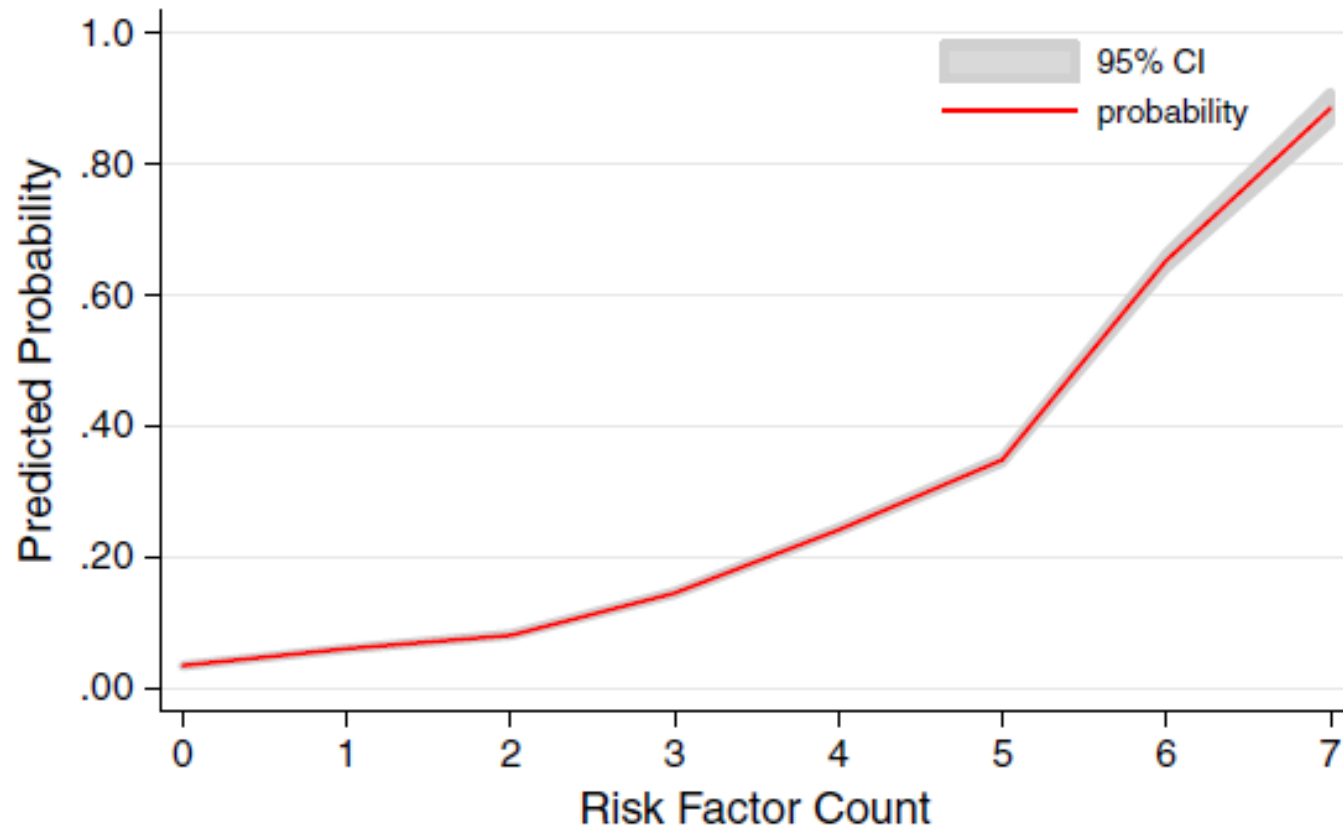
"back of the envelope calculation"

1. Young mother (<24 yrs)
2. Low birth weight
3. 3 or more children
4. No paternity
5. Late prenatal care
6. Medi-cal for US-born mother
7. HS degree or less

Upstream Prevention - a challenge

Officials of the Department of Homeless Services said they have offered support to families, but never in such a targeted way. The department is spending $2 million to hire 33 licensed social workers for a team that will be assigned to work with high-risk families and respond to their needs. It has also changed shelter intake procedures to gather more information about families and flag those deemed to be high risk for placement in 70 so-called Tier II shelters, which have more services such as on-site medical and social workers.

After 2 Deaths, New York City Adopts New Strategy to Protect Homeless Children

In an effort to spot problems, social workers are looking at histories and providing support for families in which children are considered at high risk for abuse and...

NYTIMES.COM | BY WINNIE HU

A fundamental problem with the city's focus on high-risk families, she said, is that even drawing on commonly recognized risk factors, "no list can predict 100 percent." She pointed out that some families can have none of the risk factors and still abuse their children, while others can have all of them and not hurt their children because they may have supportive family members or other resources.

"We prefer not to look at child abuse from the medical model of finding a sick person and treating them," Dr. Rosenzweig said. "We prefer the inoculation model of preparing families and communities to raise safe and healthy kids."

Decisions are already being made… can they be improved?

Can an algorithm predict child abuse?

The Los Angeles Department of Children and Family Services is testing an algorithm that would tell social workers which children are most at risk of abuse.
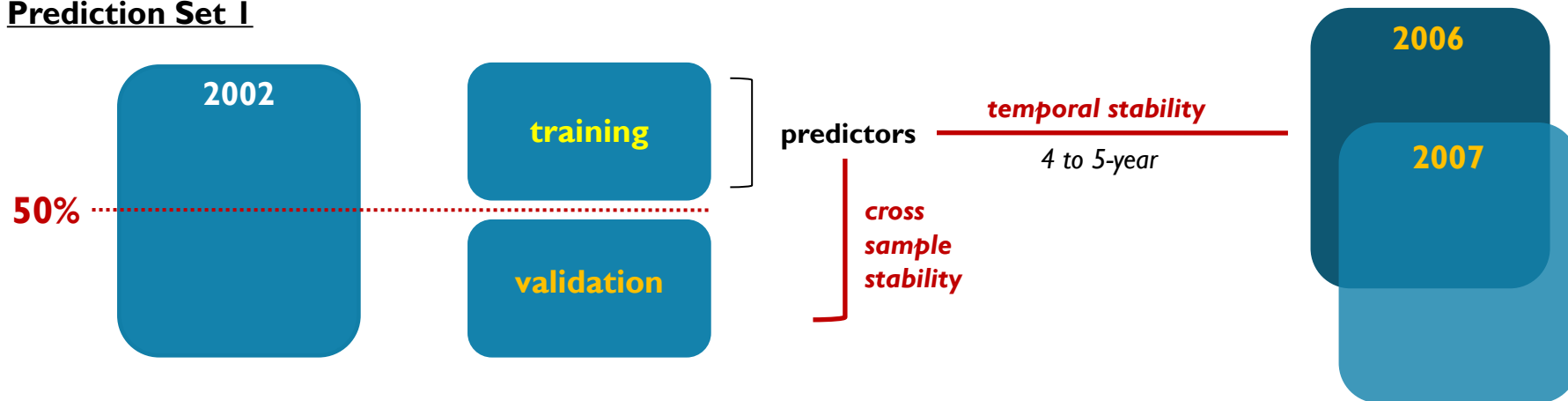
SCPR.ORG | BY SOUTHERN CALIFORNIA PUBLIC RADIO
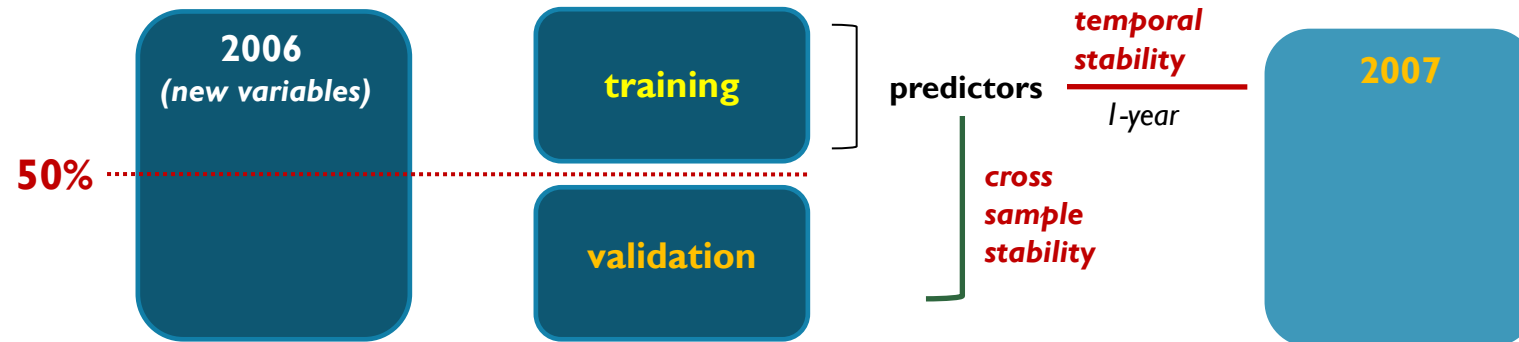
The outcome or event being modeled matters…

Testing the stability of predictors

Prediction Set 1

2002	training	predictors	temporal stability

50% · · · · · · · · · · · ·

validation

cross sample stability

4 to 5-year

2006
2007

Prediction Set 2

2006
(new variables)

training

predictors

temporal stability

1-year

50% · · · · · · · · · · · ·

validation

cross sample stability

2007

Challenges (a very partial list)

Ethical: Unknown whether risk tools will exacerbate racial disparities

"At least these risk-assessment instruments don't explicitly focus on race or poverty, unlike what might occur in a sentencing regime where judges are making risk assessments based on seat-of-the-pants evaluations," Christopher Slobogin, Vanderbilt Law School, 2014

Legal: Models may include age and sex – which employers are generally forbidden from including in hiring decisions

"If race, gender or age are predictive as validated by good empirical analysis, and we truly care about public safety while at the same time depopulating our prisons, why wouldn't a rational sentencing system freely use race, gender or age as predictor of future criminality?" US District Judge Richard Koph, Nebraska, 2014

Value / Impactability: Even if prediction algorithms can identify at-risk clients, intervening to change the outcome may be limited.

Accuracy of model: "essentially, all models are wrong, but some are useful" (George E.P. Box, 1987)

Implementation: must be efficient and simple to administer, agency must support (culture), workers/supervisors must "buy-in"

Challenges aside…

"…if there is a 50/50 chance that a newborn could get a communicable disease in the first 5 years of life based on known risk factors, public health professionals would jump at the chance of finding that newborn; they would not institute a generic public health preventative campaign at the community level in hopes that the newborn's family might see that campaign. Public health professionals would use information on an individual newborn to customize a preventative program for that newborn and their family." (Nguyen, 2014)

Questions?

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