

Vulnerable children:

Can administrative data be used to identify children at risk of adverse outcomes?

Centre for Applied Research in
Economics

University of Auckland



Economists:

Rhema Vaithianathan (lead), PhD
Associate Professor
Director, CARE
Department of Economics
University of Auckland

Tim Maloney, PhD
Professor and Head Department
of Economics
AUT University

Nan Jiang, PhD
Lecturer
Department of Economics
AUT University

Child Protection:

Irene De Haan, PhD
Lecturer
Department of Social Work
University of Auckland

Claire Dale, PhD
Research Fellow
Department of Economics
University of Auckland

Emily Putnam-Hornstein, PhD
Assistant Professor
School of Social Work
University of Southern California

Ethics:

Tim Dare, PhD
Associate Professor
Department of Philosophy
University of Auckland

Editorial Assistance:

David Thompson
Independent consultant
david.j.thompsonnz@gmail.com

BACKGROUND

What is Predictive Risk Modeling?

Automatic risk scoring tool
which generates a risk score
for an adverse event based
on large administrative
dataset

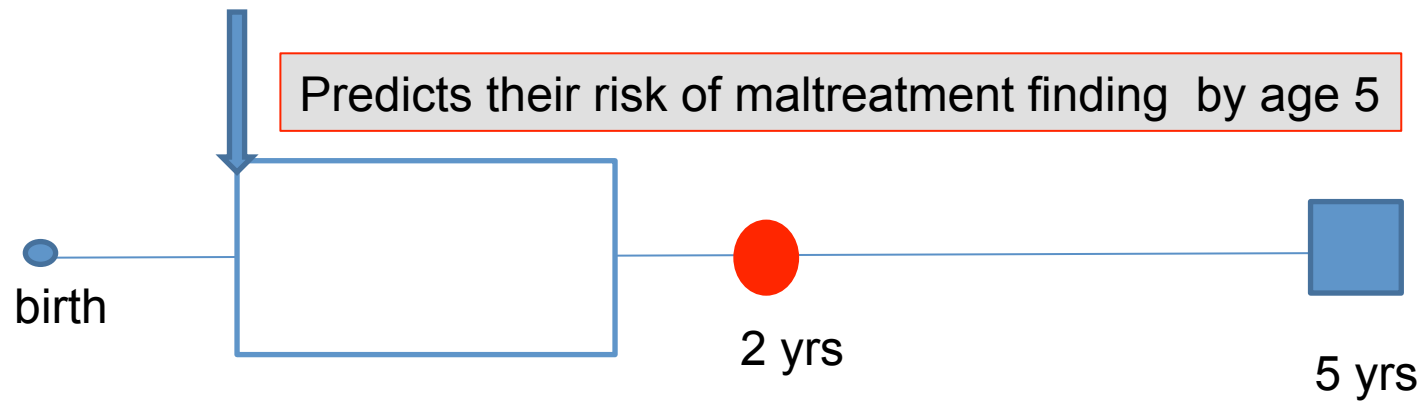
Objective of this Project

Can PRM be used to identify children (and pre-births) at high risk of a finding of maltreatment?

What are the practical issues to doing this?

Core Risk Scoring Algorithm

Applied at start of a spell
for child under 2 years



Maltreatment is a substantiated **finding** of

EMOTIONAL
NEGLECT
PHYSICAL or
SEXUAL ABUSE

By age 5

Finding is only a subset of actual incidence due to under-reporting

Baseline

5.4% of all children (born between 2003 and 2006) are maltreated by age 5

Of children **seen on a benefit** by age 2, 13% are maltreated by age 5

Of children **never seen** on a benefit by age 2, 1.5% are maltreated by age 5

Baseline

Of children **seen on a benefit** by age 2

What proportions were neglected, physically or sexually abused, emotionally abused

By age 5?

Baseline

Percentage neglected	Percentage emotionally abused	Percentage physically/sexually abused
5.6%	9.4%	1.7%

Baseline

Percentage neglected	Percentage emotionally abused	Percentage physically/sexually abused
5.6%	9.4%	1.7%

***10 times the
risk of breast
cancer in
women aged
50-60****

CAPTURE RATE

Is the benefit net wide enough?



Baseline

Of all children born between 1/03 and 06/06
who were **maltreated** by age 5

→ 83% are seen on benefits

before age 2



✓ Capture rate very high

UNDERSTANDING SPELLS

A family comes on the benefit

→ there is a <2-year-old child in the family

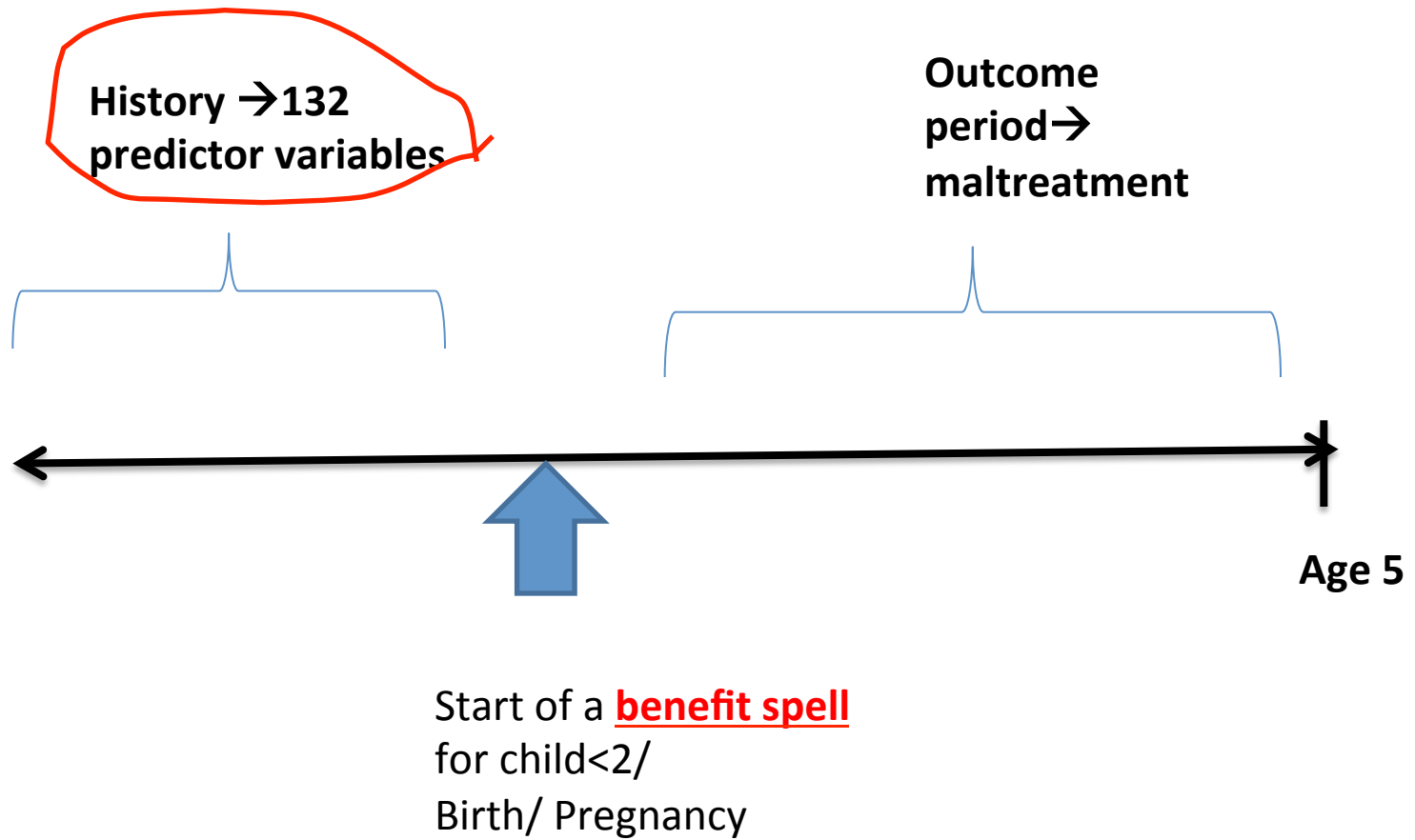
That **night** the system harvests

Work and Income history:

- ✓ Demographics of Primary Caregiver
- ✓ Demographics of Partner
- ✓ Previous benefits

CYF History

- ✓ Was Caregiver themselves abuse victim or known to CYF care and protection or youth justice services?
- ✓ Previous children with CYF contact?
- ✓ Previous children taken into care?



Generates a risk
score

Risk Score in Decile 10 ?



90 out of 100
children will
have lower
risk



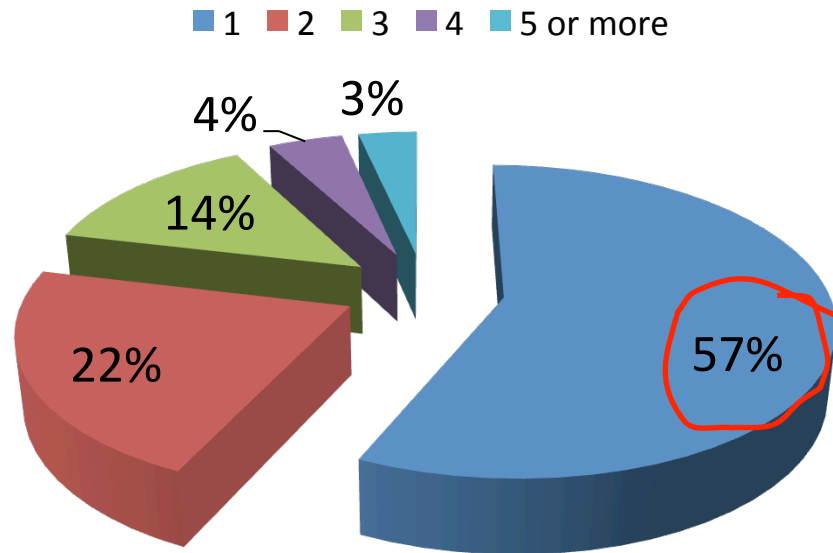
A child's risk can change when a new spell starts

e.g. new spell due to partner leaving who had a history of neglect →

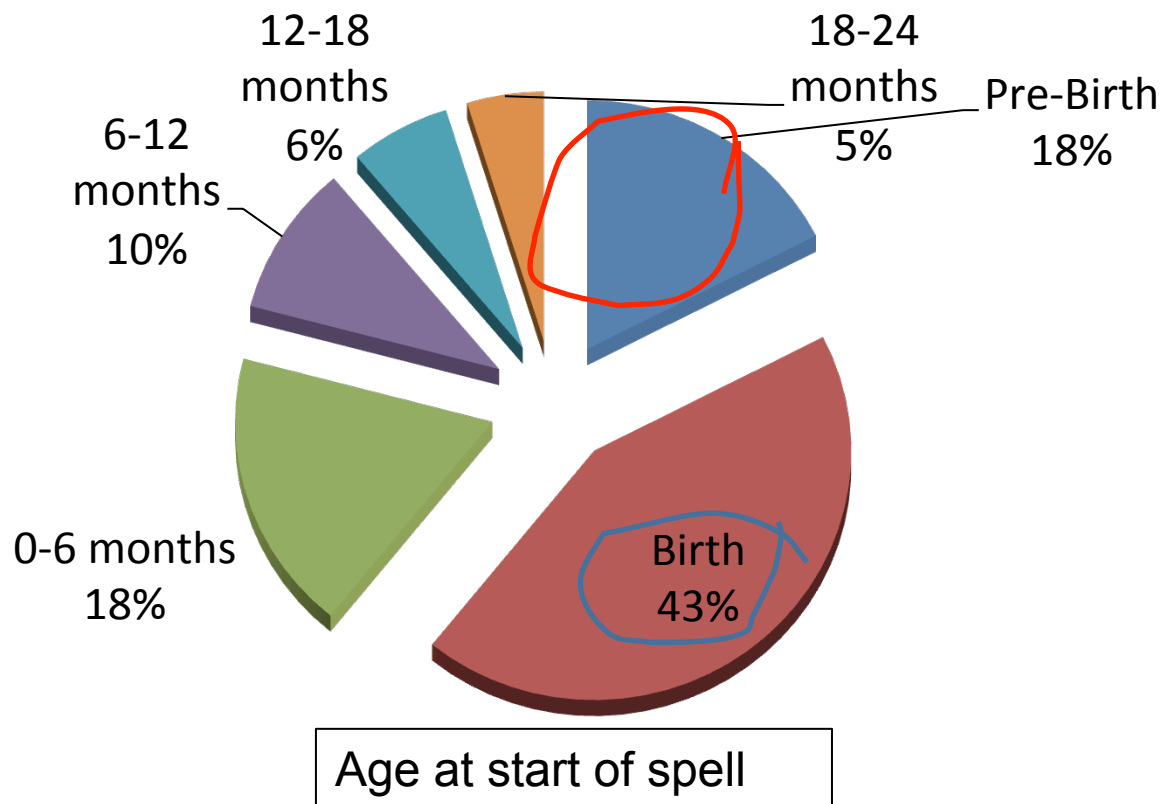
Risk score could fall dramatically

**Of those who start their spell before
age 2...**

children by number of spells



**Most children
have only 1
spell**

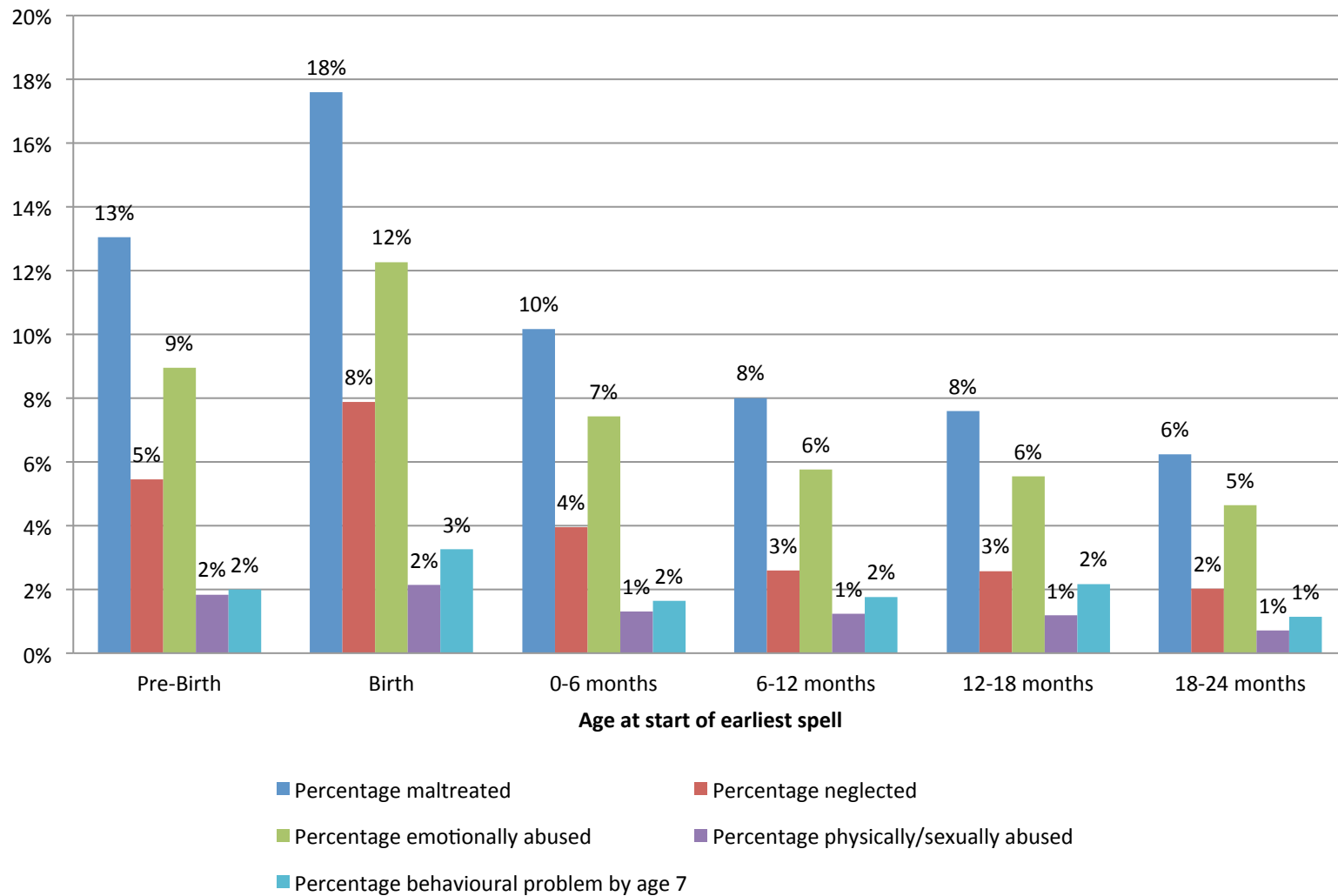


Most start their spell at or before birth

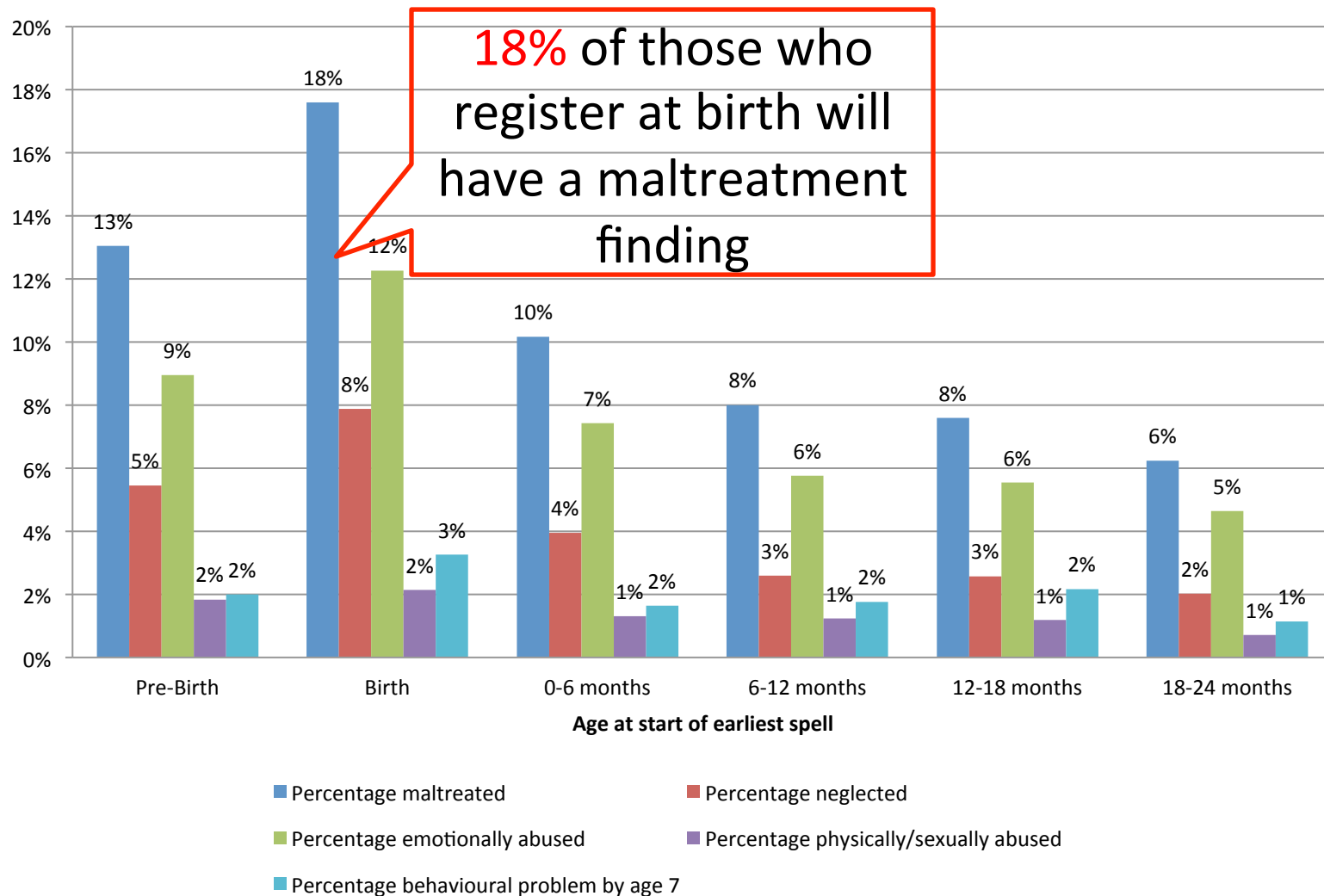
Children who start their spell at or before birth...

tend to be **higher** risk

Child's age at start of earliest spell and outcomes



Child's age at start of earliest spell and outcomes



... of all children maltreated by age 5

61% arrived

...on the benefit at birth or pre-
birth

DEVELOPING THE ALGORITHM

Data

103,397 lines of data (80% sample)

Each line is a new spell for a child (aged under 2)

Restricted to children born January 2003 to June 2006

Represents 57,986 children because some children have multiple spells

Outcome for Core Model

Substantiated

- Emotional abuse
- Neglect or
- Physical or Sexual abuse

By age five

Predictor Variables

The algorithm is a set of predictor variables and weights attached to each variable

We have a set of 224 predictor variable

We use stepwise probit to choose 132 variables

Develop model using 70% sample

Test on 30% sample

PREDICTIVE POWER

the bottom line...

Deciles of the first spell equal to or greater than...	Maltreatment finding by age 5 amongst all New Zealand children	Proportion of all New Zealand children seen on a benefit by age 2
1	83%	33%
2	82%	29%
3	79%	25%
4	75%	22%
5	71%	18%
6	66%	15%
7	58%	12%
8	49%	9%
9	37%	5%
10	21%	2%

33% of an annual birth cohort are on a benefit by age 2

the bottom line...

Deciles of the first spell equal to or greater than...	Maltreatment finding by age 5 amongst all New Zealand children	Percentage of all children born in New Zealand aged under 2
1	83%	33%
2	82%	29%
3	79%	25%
4	75%	22%
5	71%	18%
6	66%	15%
7	58%	12%
8	49%	9%
9	37%	5%
10	21%	2%

5 % of a birth cohort
will be identified in
the top 20% of risk

And end up having
37% of all
maltreatment

How Good is the Algorithm?

Does it predict strongly?

Is it correlated with other adverse events?

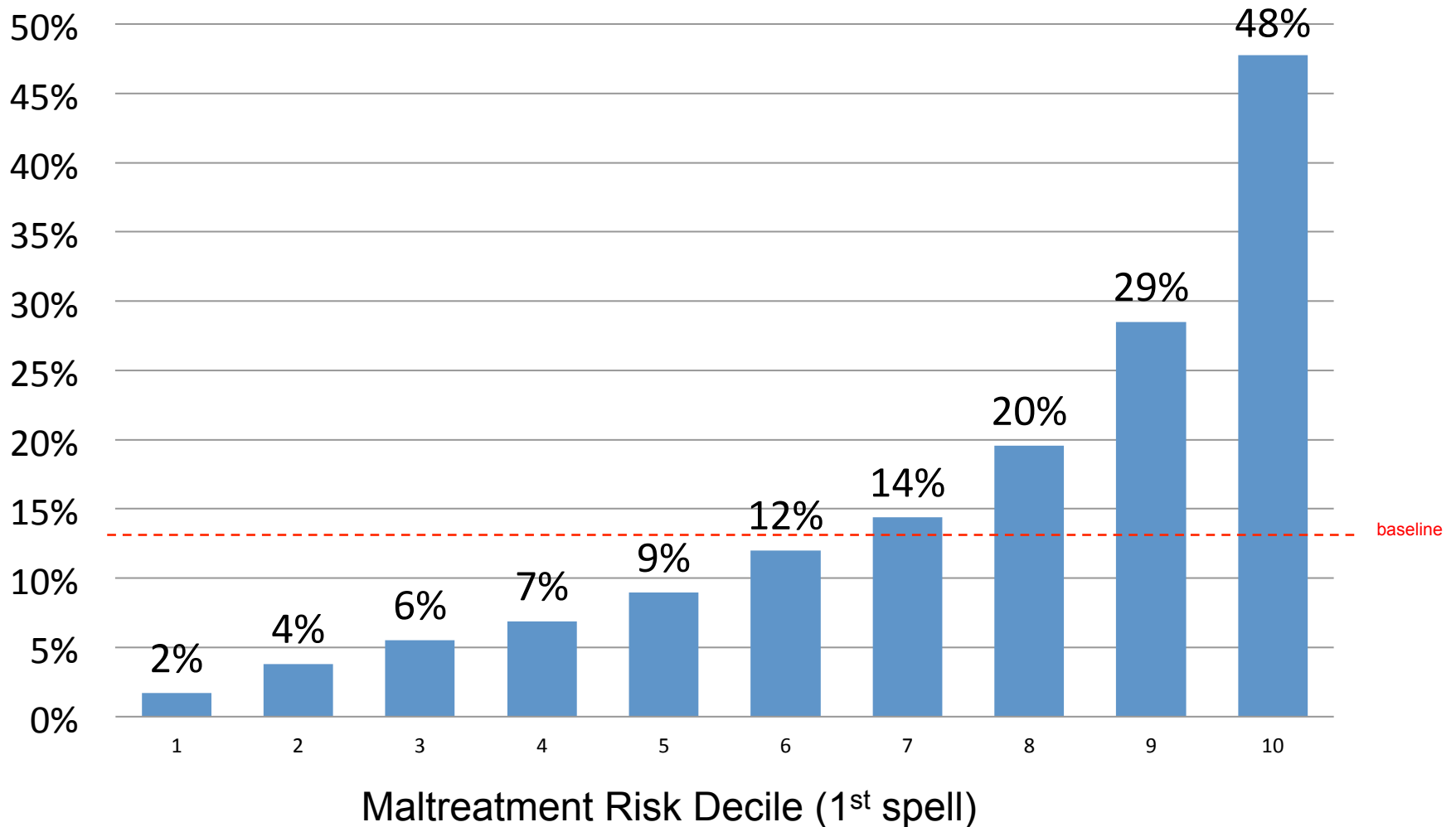
NNT (Numbers Needed to Treat)

Business Case

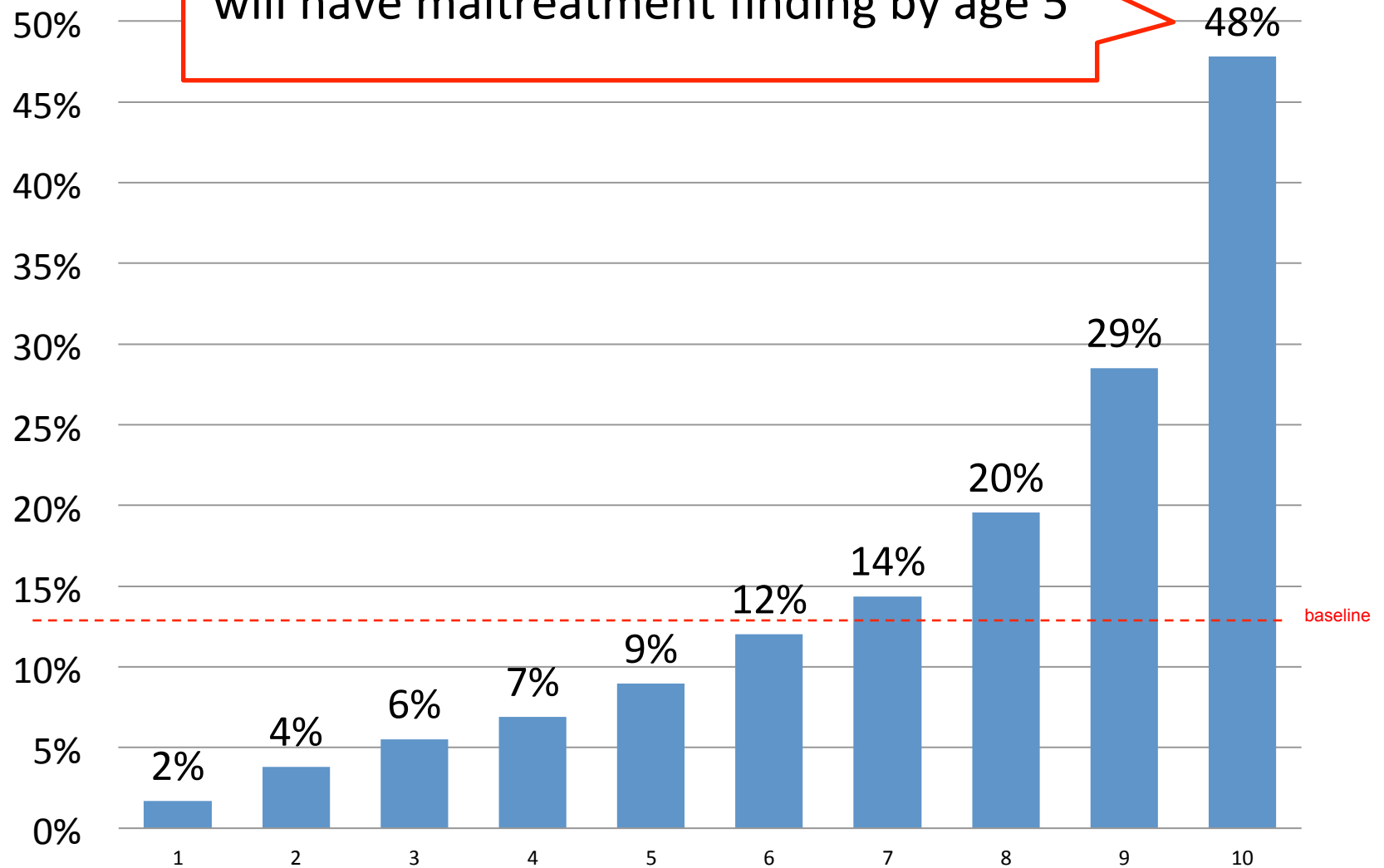
Strength of Prediction of Core Model is Good...

- Area under the ROC curve is 0.77
- 77% of the time, a maltreated child will have a higher score than a non-maltreated child
- Similar to predictive power of mammogram

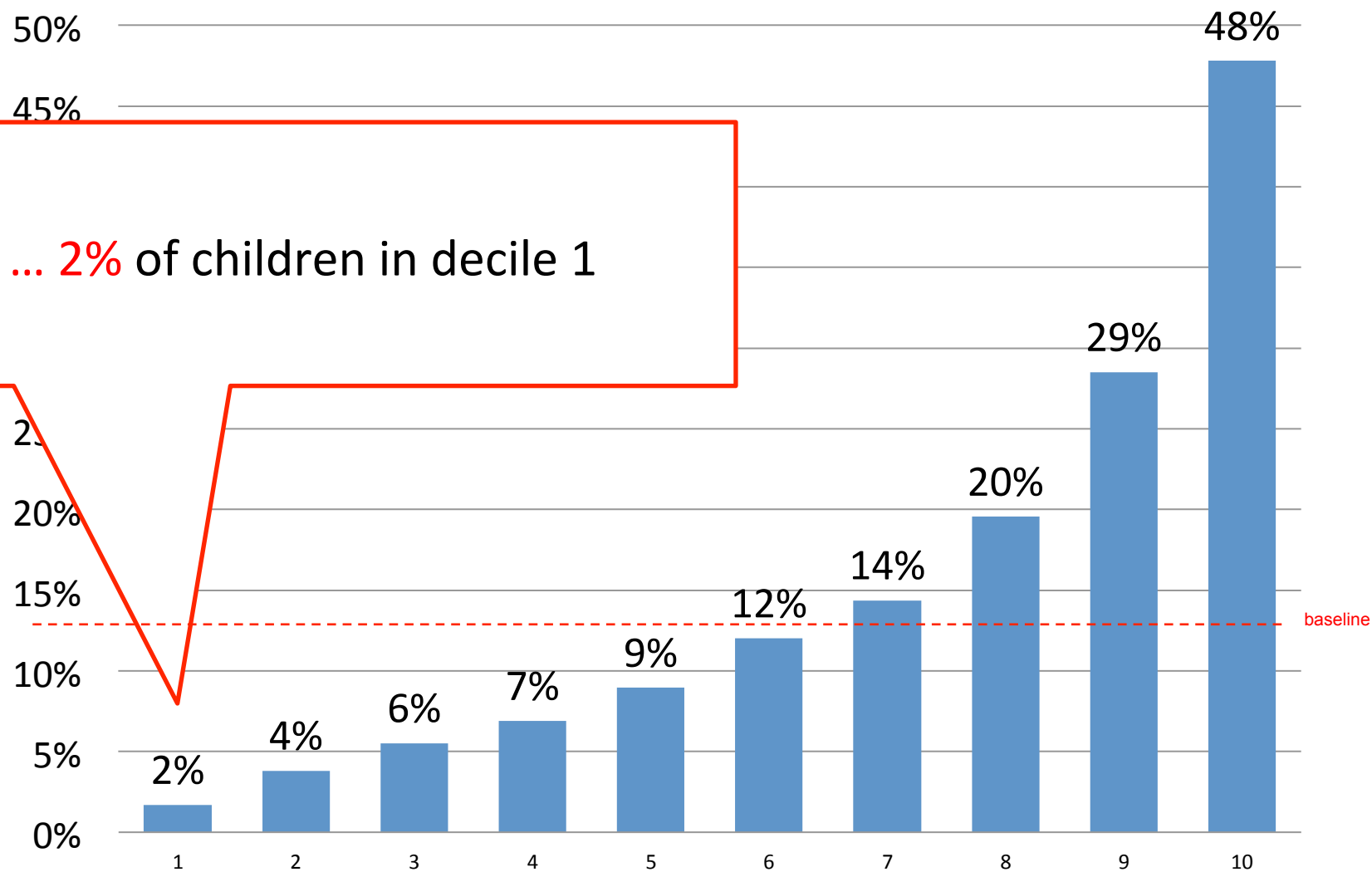
... predicts actual maltreatment rates well



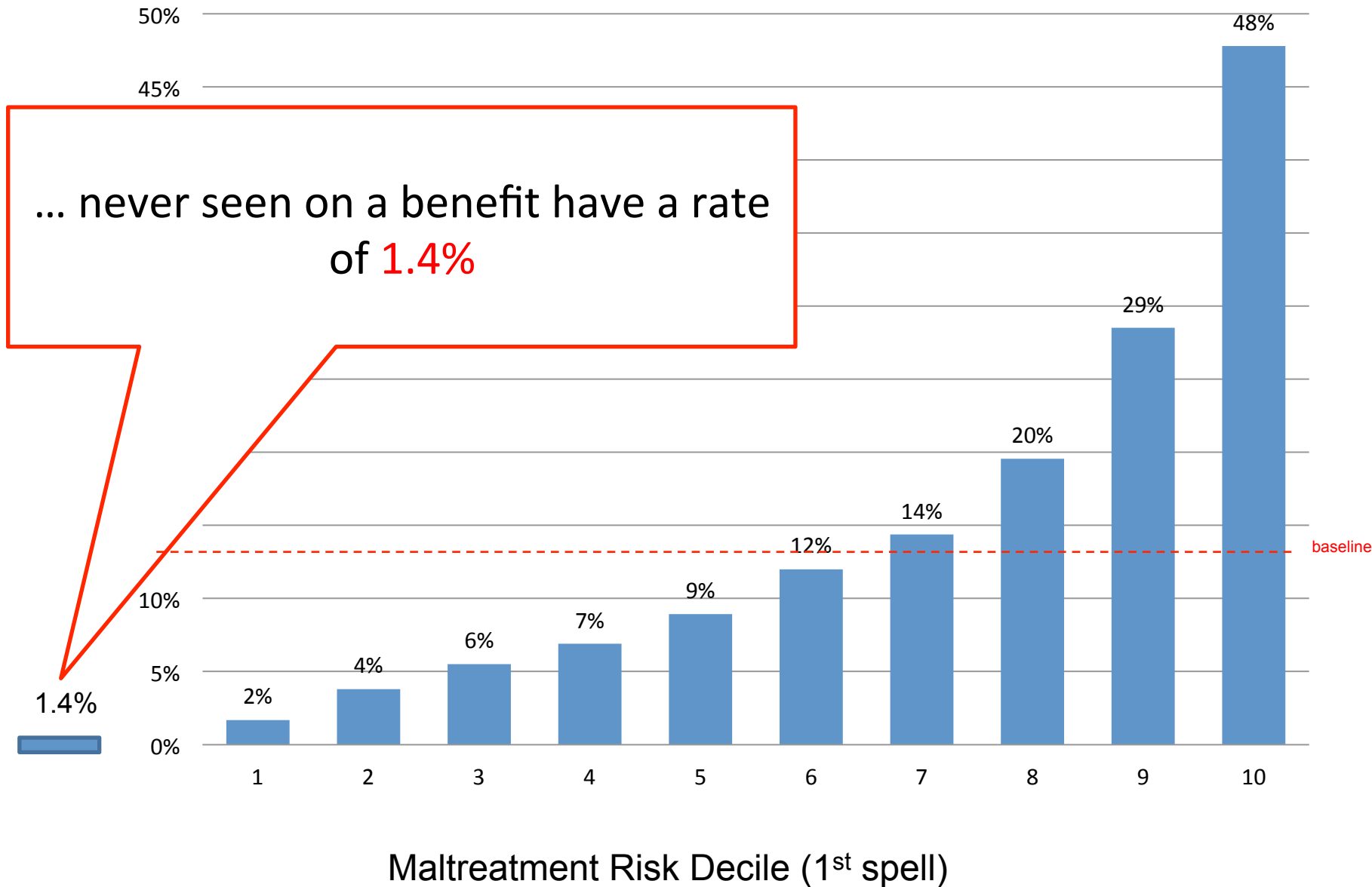
Half of children in decile 10
will have maltreatment finding by age 5



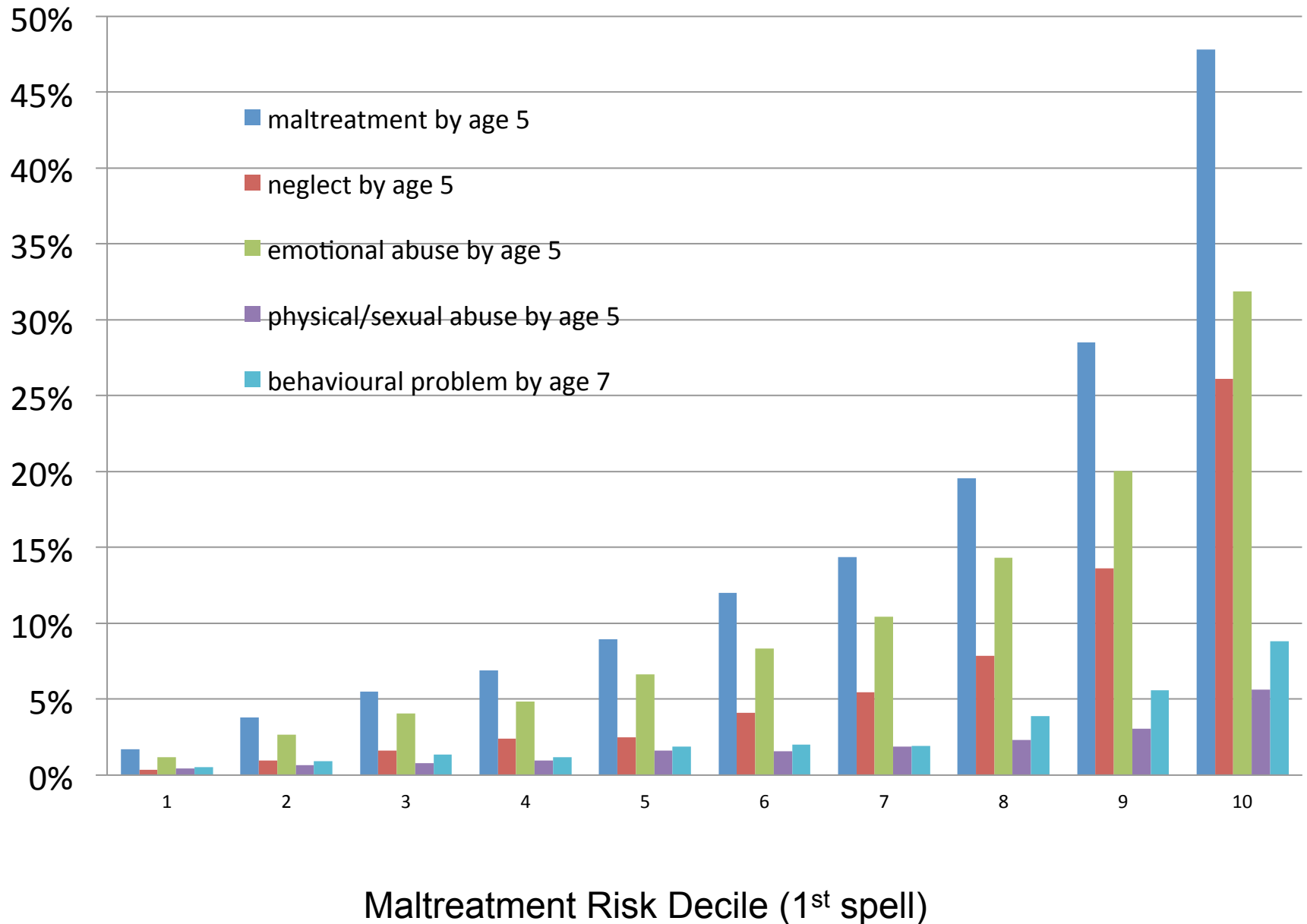
Maltreatment Risk Decile (1st spell)



Maltreatment Risk Decile (1st spell)



... and is correlated with other outcomes



what proportion of finding
will be “captured”?

(Based on risk score of the first
spell)

Targeting the first spells in the top 2 deciles capture about

40 - 50 % of all adverse findings that occur to children on the benefit

Decile equal to or greater than...	maltreatment by age 5	neglect by age 5	emotional abuse by age 5	physical/sexual abuse by age 5	behavioural problem by age 7
1	100%	100%	100%	100%	100%
2	99%	99%	99%	97%	97%
3	95%	97%	95%	92%	93%
4	91%	94%	91%	88%	87%
5	86%	90%	86%	82%	82%
6	79%	86%	79%	73%	75%
7	70%	78%	70%	64%	66%
8	59%	68%	58%	52%	58%
9	44%	54%	43%	39%	41%
10	25%	32%	23%	23%	21%

44% of children who are maltreated by age 5 and on a benefit by age 2 will have 1st spell in top 2 deciles

Deciles equal to or greater than...	maltreated by age 5	on a benefit by age 2	behavioural problem by age 7
1	100%	100%	100%
2	99%	99%	97%
3	95%	97%	92%
4	91%	94%	88%
5	86%	90%	82%
6	79%	86%	73%
7	71%	78%	64%
8	61%	68%	52%
9	44%	54%	39%
10	25%	32%	23%

Numbers Needed to Treat (NNT)

20,671 children start a spell aged less than 2 p.a.

Suppose we offered services to those in
the top three deciles

Decile equal to or greater than...	Number of children	True Positives	False Positives
8	5,398	1,624	3,773
9	3,284	1,211	2,073
10	1,425	681	744

Numbers Needed to Treat (NNT) (to avoid **one** maltreatment finding)

	Efficacy of the Intervention		
Decile equal to or greater than...	10%	25%	50%
8	33	13	7
9	27	11	5
10	21	8	4



NNT for statins as secondary prevention is around 30*

	Efficacy of the Intervention		
Decile equal to or greater than...	10%	25%	50%
8	33	13	7
9	27	11	5
10	21	8	4

*Source: J R Soc Med. 2004
October; 97(10): 461–464
Thompson and Temple.



Business Case

Consider a **Nurse Visitation Programme**

Nurse visits weekly for 1 hour for first 2 years of child's life

Evidence is that it reduces maltreatment risk by 46%

Assume 50% take-up

Suppose nurse paid \$75,000 p.a.

Does 5 visits per day

Has 4 weeks' holiday

10 weeks p.a. continuing education



We estimate a cost of \$8,210 per child over 2 years

Similar to cost of NFP in England (£3,000 p.a.)

We can show the cost-effectiveness of reducing maltreatment

Back of the envelope calculations

Warning: Illustrative only

46% efficacy offered to top 20% of spells

Average Maltreatment	37%
Number of children in a one-year birth cohort who would have received the program	1,642
Cost to Government for cohort	\$ 13,481,391
Costs p.a. to Government	\$ 6,740,695
Expected Maltreatment if no Intervention	606
Expected Maltreatment with intervention	325
Number of Maltreated Children Avoided	280
Cost per Maltreatment Avoided	\$ 48,089

A 46% effective program with a 50% take up targeted to the top 20%

reduces maltreatment amongst all under 5 years old children in New Zealand

by 8.3%

(at a cost of \$13.5m)

We also developed algorithms for each of the
specific outcomes....

And they performed well

But....

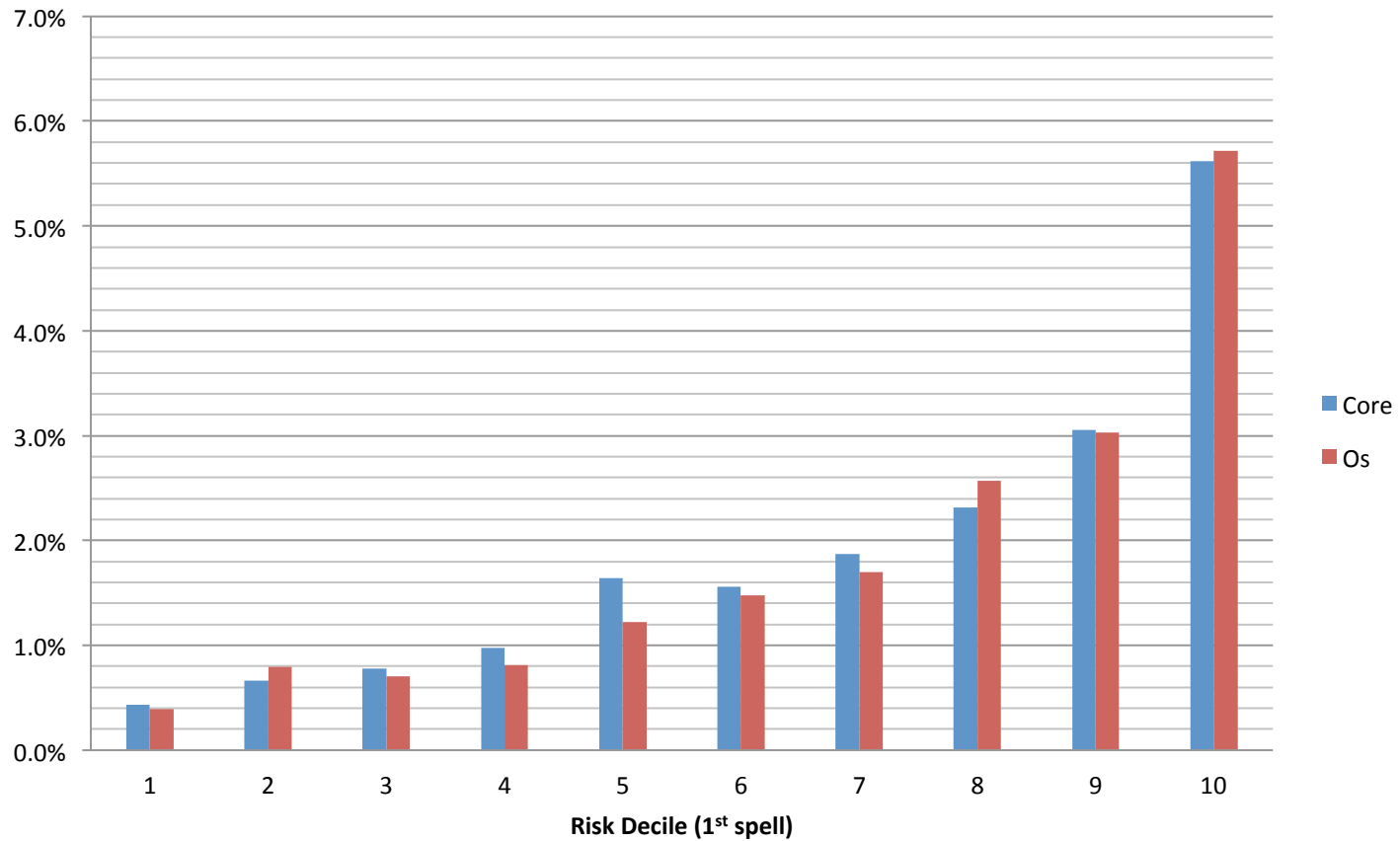
Do we need a **separate** algorithm
for each outcome?



For most findings

Outcome Specific and Core are very similar

Physical/sexual Findings



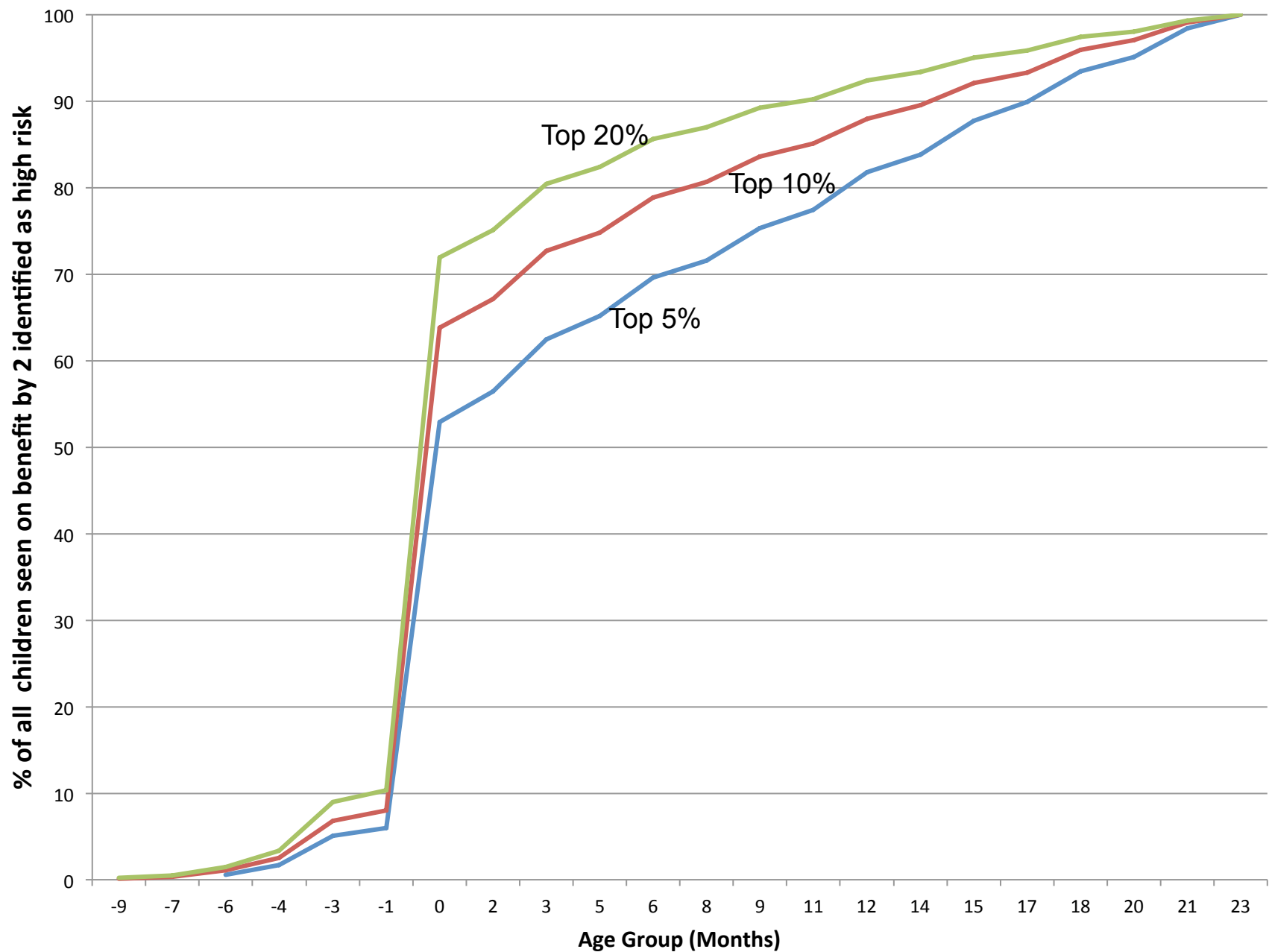
We conclude that the Core model sufficiently targets the specific outcomes

IMPLEMENTING THE CORE MODEL

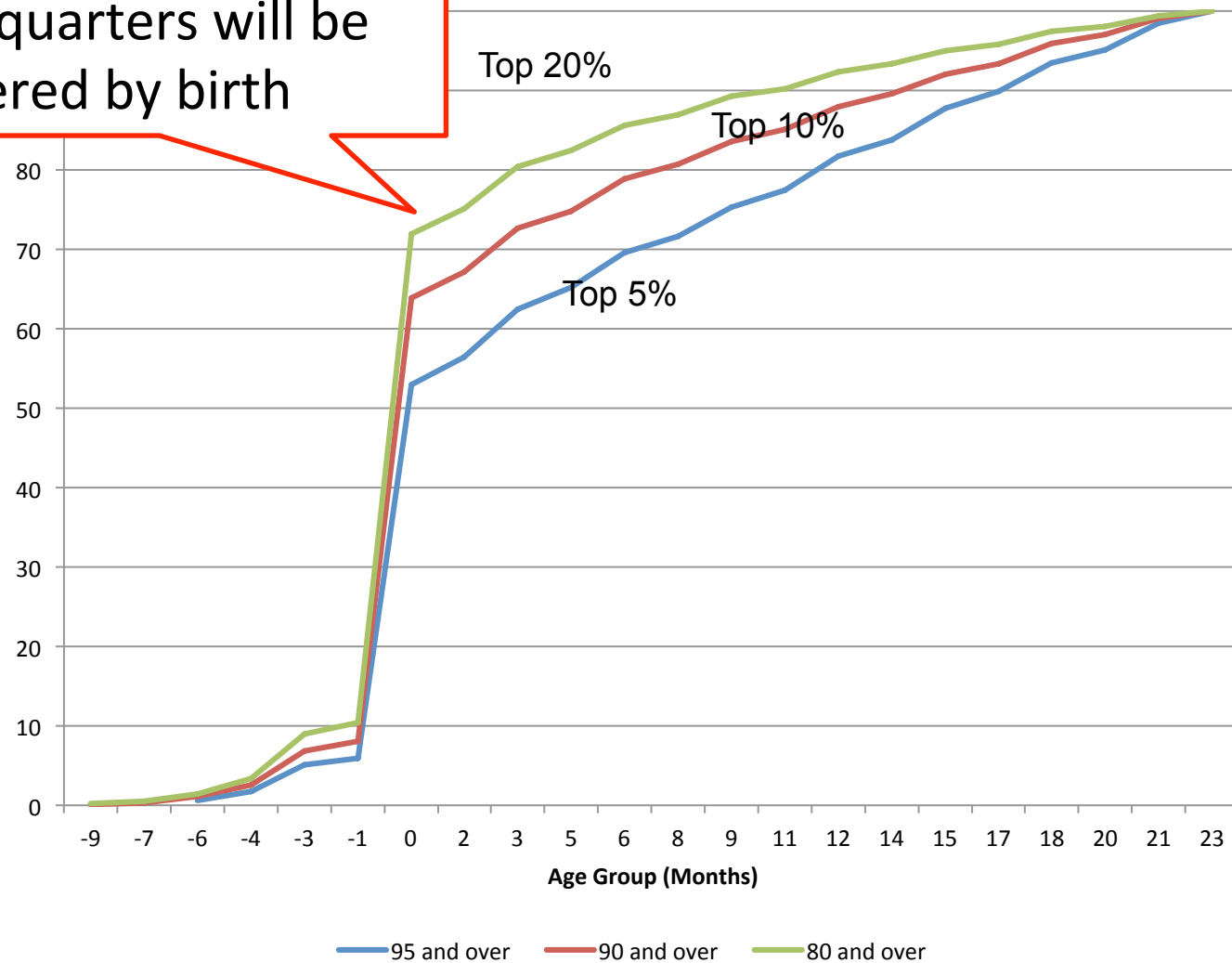
Suppose we were to offer services to children when they hit a risk score threshold

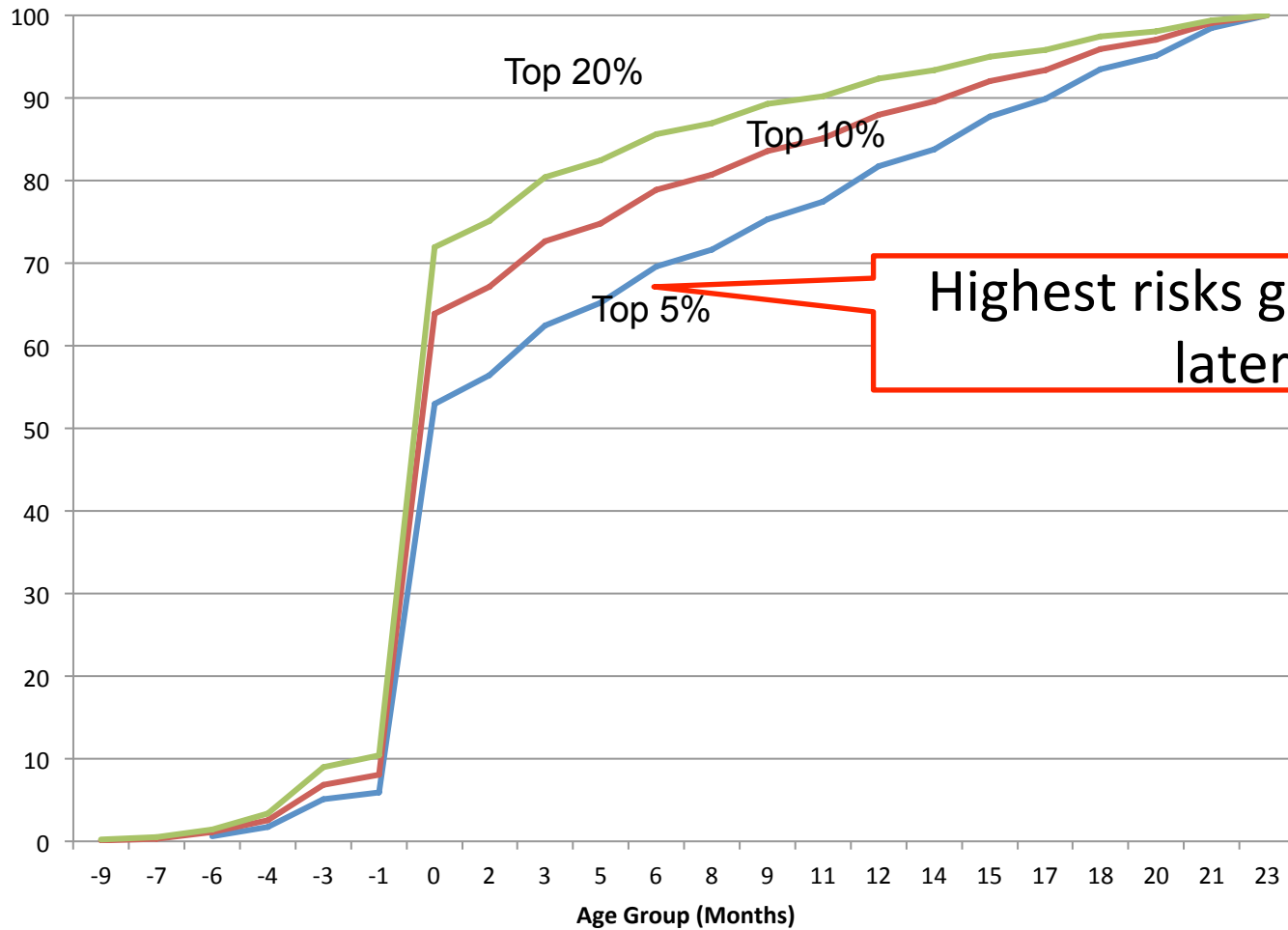
e.g. top 20%

at what age would they “hit”
the threshold?



Three-quarters will be offered by birth





95 and over 90 and over 80 and over

Offering services for children who hit the top 20% at some point before they turn 2...

...will capture 45% of all New Zealand children maltreated by age 5

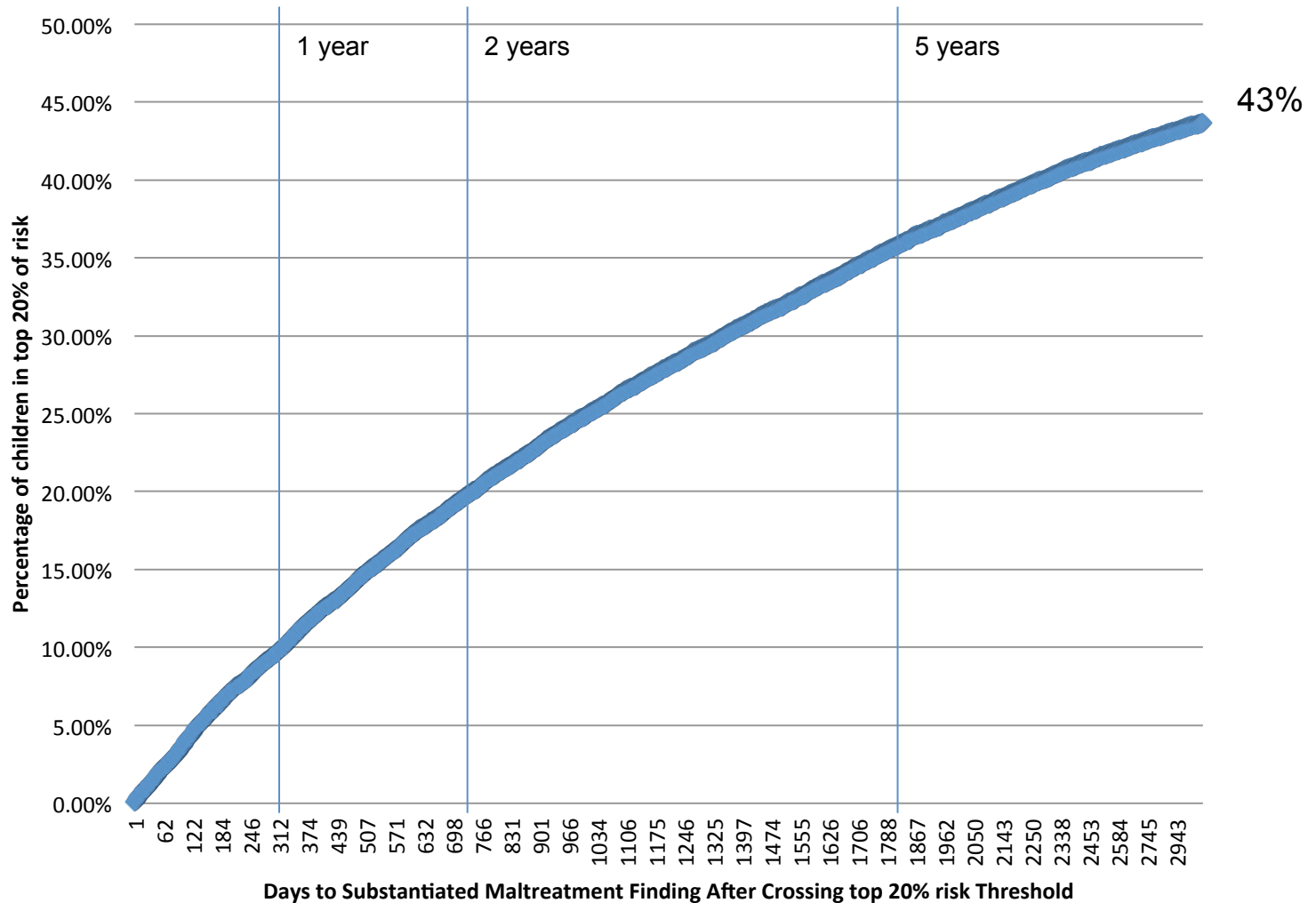
How **long** do we have

after they get the service offering

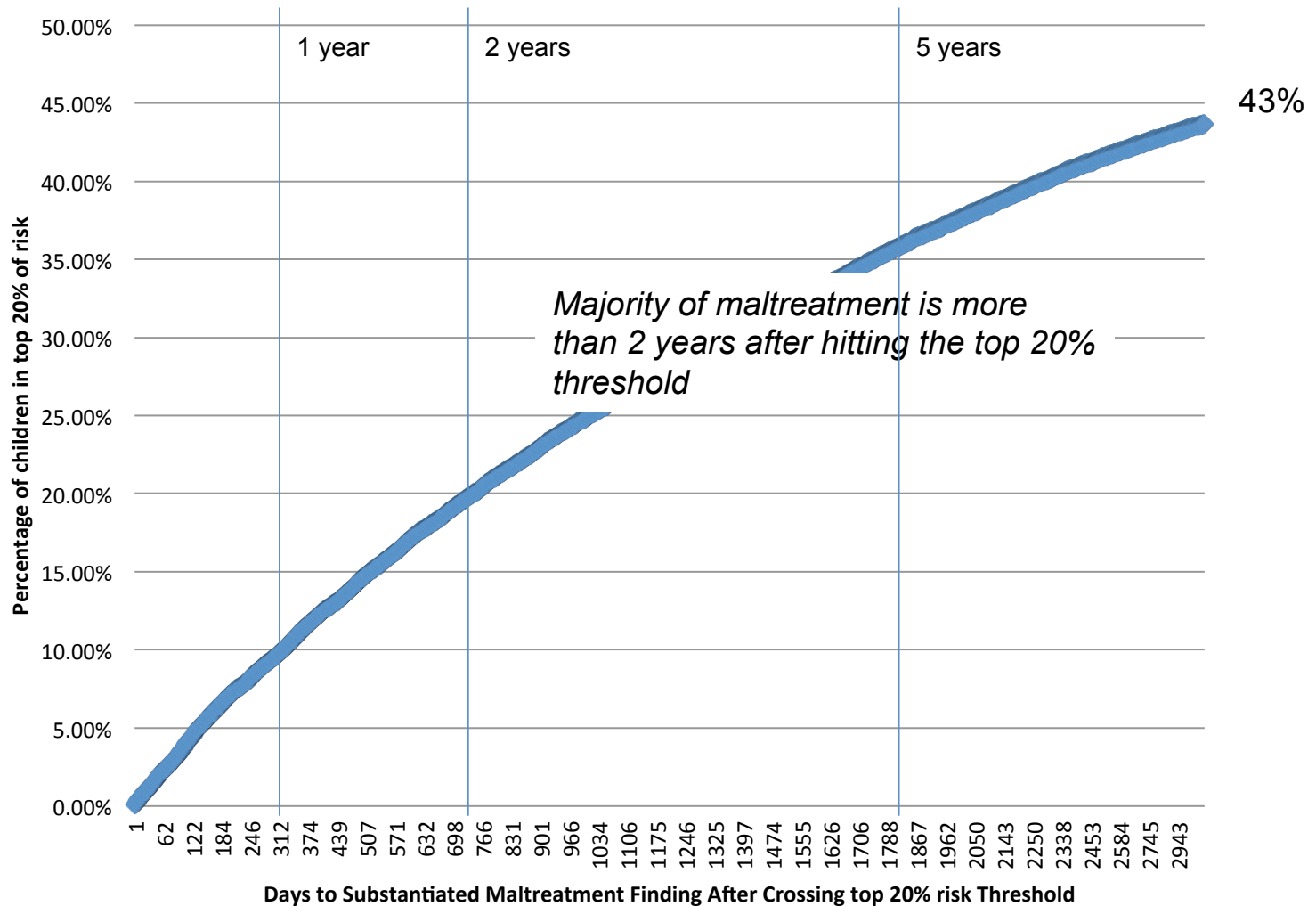
before there is a substantiated
finding?



Top 20% and days to maltreatment finding



Top 20% and days to maltreatment finding



Ethical

1. Ethical framework is needed
2. Stringent confidentiality, transparency and governance
3. Mandatory or imposed interventions should not be considered in response to predictive risk
4. Extend risk assessment to all children

Operational

1. Implementation must include frontline staff
2. PRM must help not hinder professional judgment
3. Graduated services offered at different levels
4. Allow frontline staff to “over-ride”

CONCLUSION

✓ Worth doing

✓ Can be done

(But)

Careful , deliberate & phased

implementation