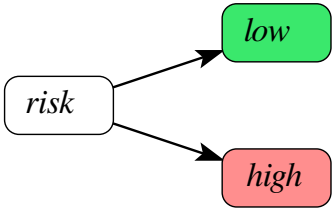
My risk model is super accurate so it will be useful for treatment decision making, right? Wrong!

Wouter van Amsterdam[1] Rajesh Ranganath[2]

[1]University Medical Center Utrecht [2]New York University

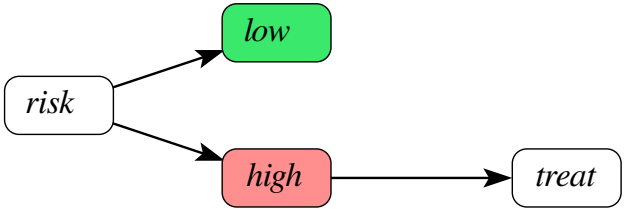
from risk model to treatment decision

risk estimate + decision rule = treatment decision



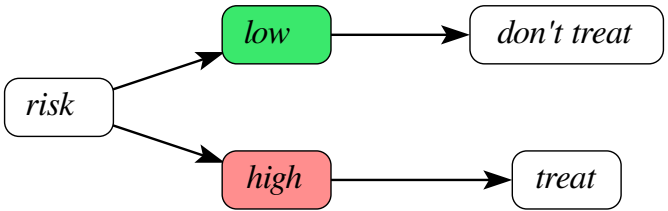
from risk model to treatment decision

risk estimate + decision rule = treatment decision



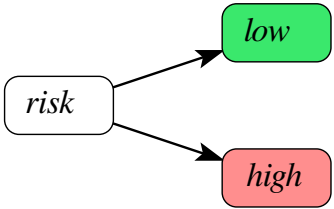
from risk model to treatment decision

risk estimate + decision rule = treatment decision



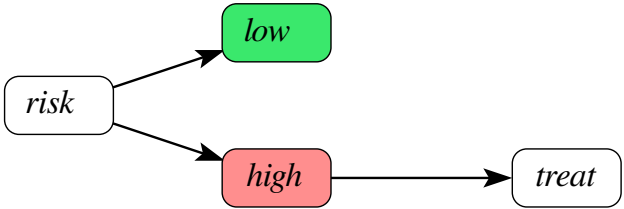
from risk model to treatment decision

risk estimate + decision rule = treatment decision



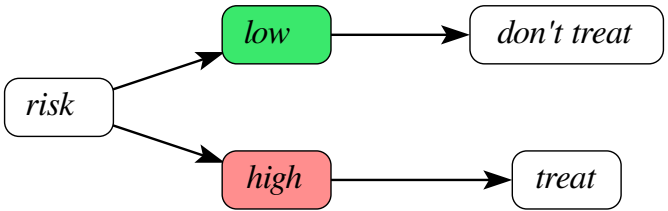
from risk model to treatment decision

risk estimate + decision rule = treatment decision



from risk model to treatment decision

risk estimate + decision rule = treatment decision

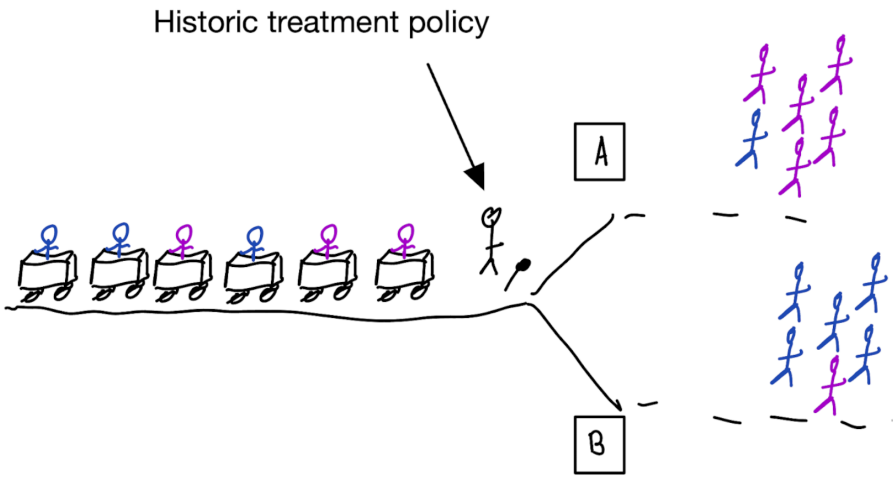


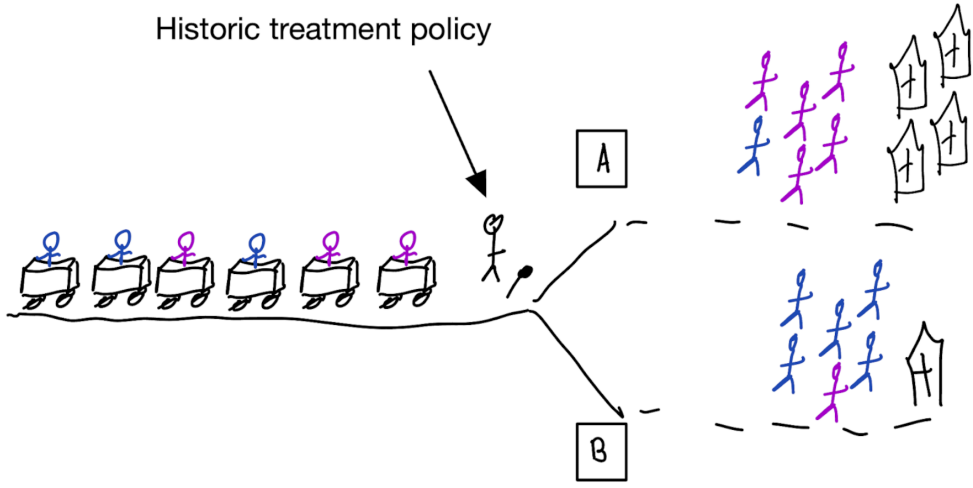
Value(Treatment)

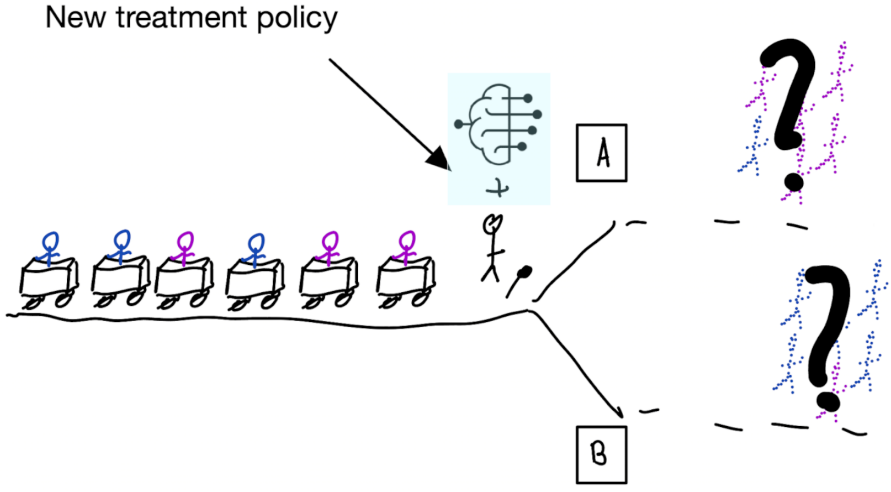
$$\text{Value}(\text{Treatment}) = \frac{\text{Outcomes}}{\qquad\qquad}$$

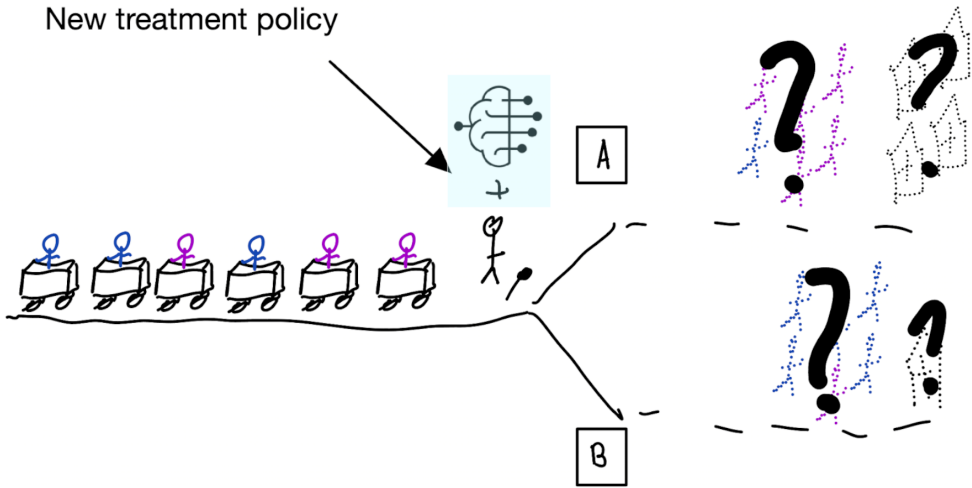
$$\text{Value}(\text{Treatment}) = \frac{\text{Outcomes}}{\text{Treatment harm}}$$

$$\text{Value(risk model)} \stackrel{?}{=} \text{Accuracy}$$


Historic treatment policy
A
B


Historic treatment policy
A
B

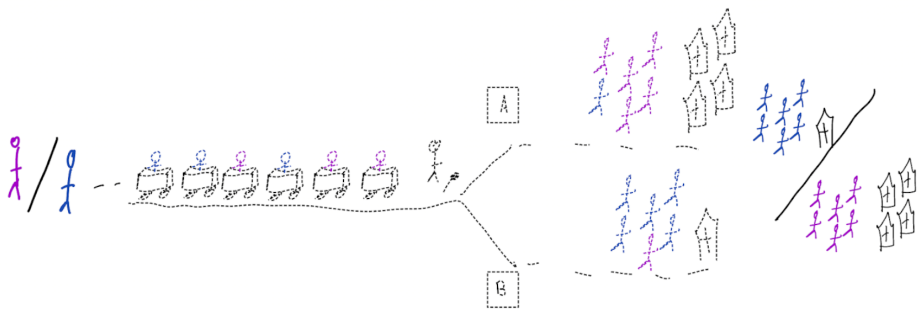

New treatment policy
A
B


New treatment policy
A
B

$$\text{Value(risk model)} = \frac{\text{Outcomes}}{\text{Treatment harm}}$$

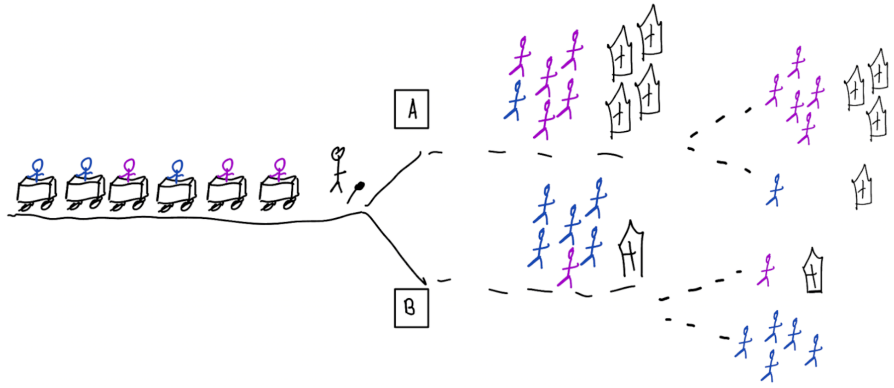
Treatment-naive risk models

Treatment-naive risk models

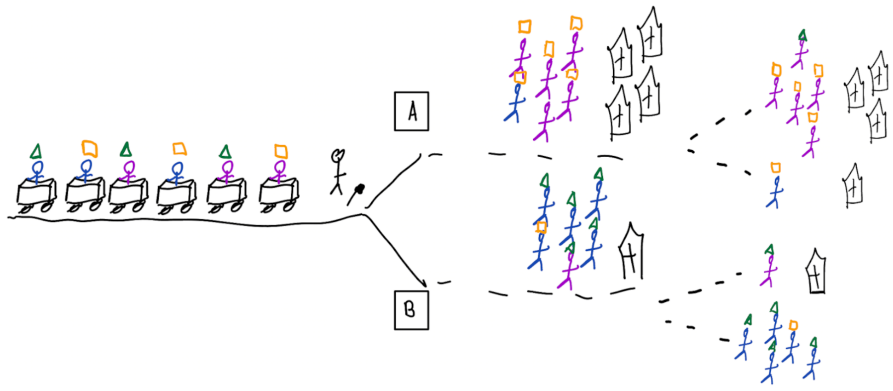


can be accurate but still cause harm when used for treatment decisions

Other risk models: condition on given treatment and traits



Other risk models: condition on given treatment and traits



unobserved confounding (hat type) leads to wrong treatment decisions

Recommended validation practices do not protect against harm

because they do not evaluate the policy change

Guideline › Ann Intern Med. 2015 Jan 6;162(1):55-63. doi: 10.7326/M14-0697.

Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD): the TRIPOD statement

Gary S Collins, Johannes B Reitsma, Douglas G Altman, Karel G M Moons

PMID: 25560714 DOI: 10.7326/M14-0697

Recommended validation practices do not protect against harm

because they do not evaluate the policy change

Guideline > Ann Intern Med. 2015 Jan 6;162(1):55-63. doi: 10.7326/M14-0697.

Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD): the TRIPOD statement

Gary S Collins, Johannes B Reitsma, Douglas G Altman, Karel G M Moons

PMID: 25560714 DOI: 10.7326/M14-0697

> CA Cancer J Clin. 2016 Sep;66(5):370-4. doi: 10.3322/caac.21339. Epub 2016 Jan 19.

American Joint Committee on Cancer acceptance criteria for inclusion of risk models for individualized prognosis in the practice of precision medicine

Michael W Kattan [1], Kenneth R Hess [2], Mahul B Amin [3], Ying Lu [4], Karl G M Moons [5], Jeffrey E Gershenwald [6], Phyllis A Gimotty [7], Justin H Guinney [8], Susan Halabi [9], Alexander J Lazar [10], Alyson L Mahar [11], Tushar Patel [12], Daniel J Sargent [13], Martin R Weiser [14], Carolyn Compton [15]; members of the AJCC Precision Medicine Core

Affiliations + expand

PMID: 26784705 PMCID: PMC4955656 DOI: 10.3322/caac.21339

what to do?

what to do?

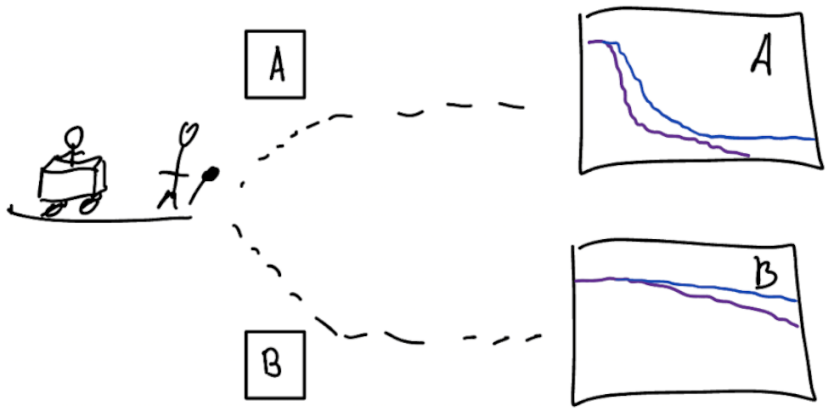
1. Evaluate policy change (cluster randomized controlled trial)

what to do?

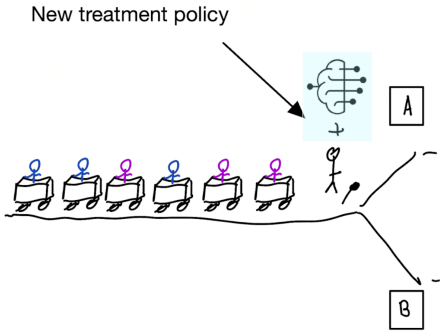
1. Evaluate policy change (cluster randomized controlled trial)
2. Build models that are likely to have value for decision making

Prediction-under-intervention models

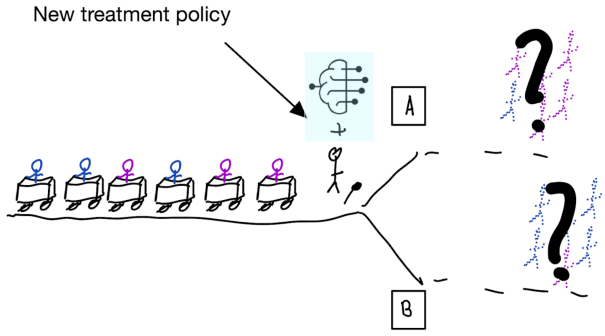
Predict outcome *under hypothetical intervention* of giving certain treatment



When developing risk models, always discuss:

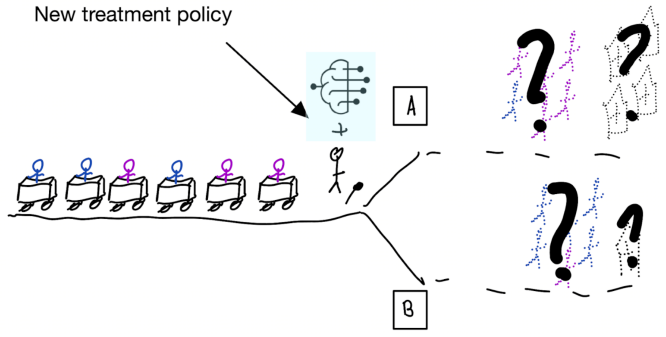


When developing risk models, always discuss:



1. what is effect on treatment policy?

When developing risk models, always discuss:



1. what is effect on treatment policy?
2. what is effect on patient outcomes?

Takeaway

Don‘t assume predicting well leads to good decisions, think about the policy change

Takeaway

Don't assume predicting well leads to good decisions, think about the policy change

Further reading:
https://arxiv.org/abs/2209.07397

Decision making in cancer: Causal questions require causal answers

Wouter A.C. van Amsterdam, Pim A. de Jong, Joost J.C. Verhoeff, Tim Leiner, Rajesh Ranganath

WvanAmsterdam