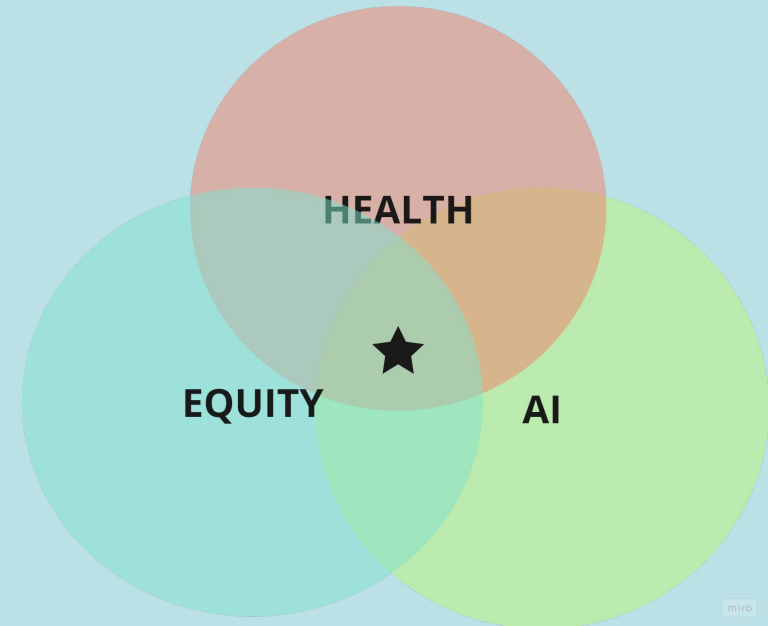**Turing Roche partnership**
Knowledge Share Event

Fairness in AI for Health
Leandra Bräuninger

April 2024

WHY fairness in AI for health?

▪ what is health AI?
  ▪ automated decisions (e.g. logistics, policy effect, diagnostics)

▪ why focus on the health domain?
  ▪ unfairness becomes a matter of life and death
  ▪ pulse oximeter example

HEALTH

EQUITY   AI

comment on wording: the words social bias/inequity/unfairness are
nuanced and different from each other but are used in this talk to mean
the same thing
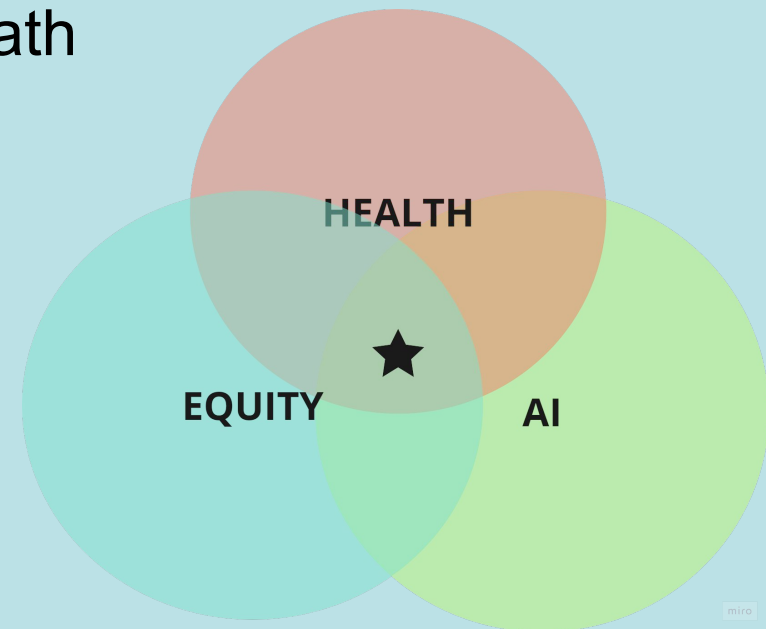
WHY fairness in AI for health?

Racial and Ethnic Discrepancy in Pulse Oximetry and Delayed Identification of Treatment Eligibility Among Patients With COVID-19

Ashraf Fawzy, MD, MPH[1]; Tianshi David Wu, MD, MHS[2,3]; Kunbo Wang, MS[4]; et al

≫ Author Affiliations | Article Information

JAMA Intern Med. 2022;182(7):730-738. doi:10.1001/jamainternmed.2022.1906
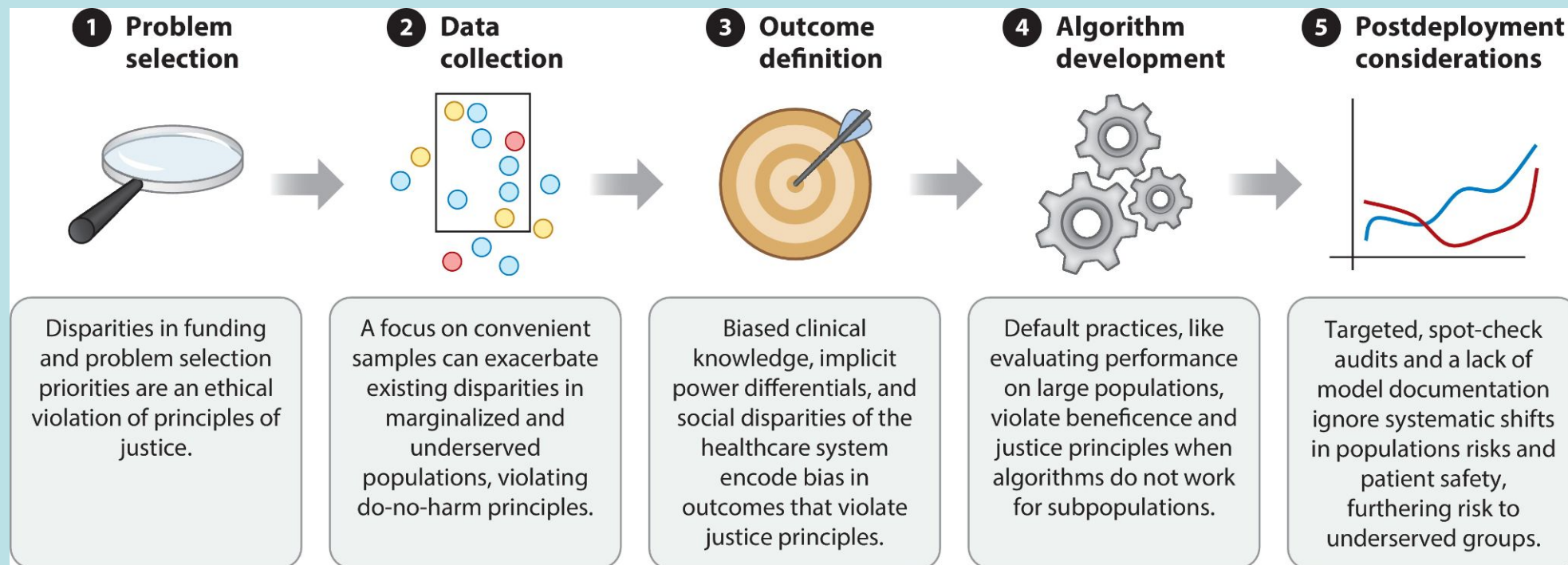
WHY fairness in AI for health?

- what is health AI?
  - automated decisions (e.g. logistics, policy effect, diagnostics)

- why focus on the health domain?
  - unfairness becomes a matter of life and death
  - pulse oximeter example

HEALTH

★

EQUITY   AI

comment on wording: the words social bias/inequity/unfairness are nuanced and different from each other but are used in this talk to mean the same thing

miro
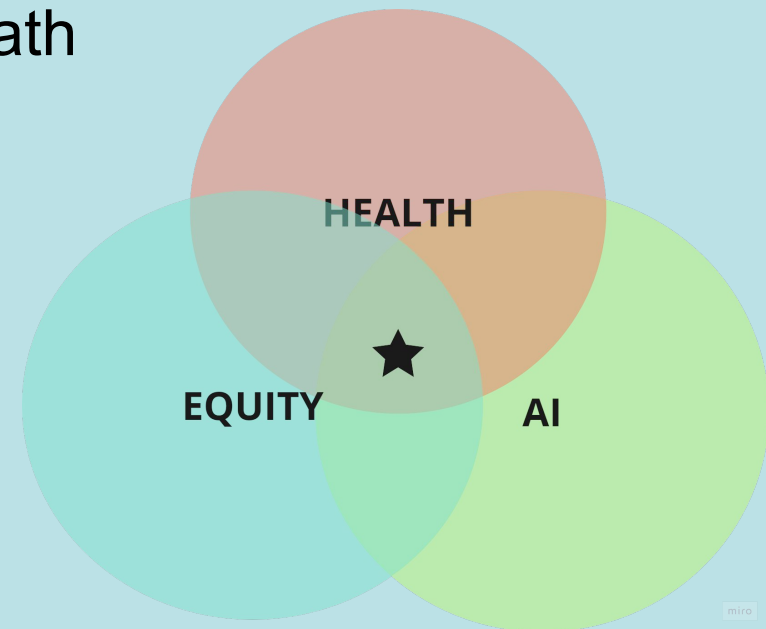
HOW fairness in AI for health?

- model development pipeline (Chen et al. (2021)

Chen IY, et al. 2021
Annu. Rev. Biomed. Data Sci. 4:123–44

HOW fairness in AI for health?
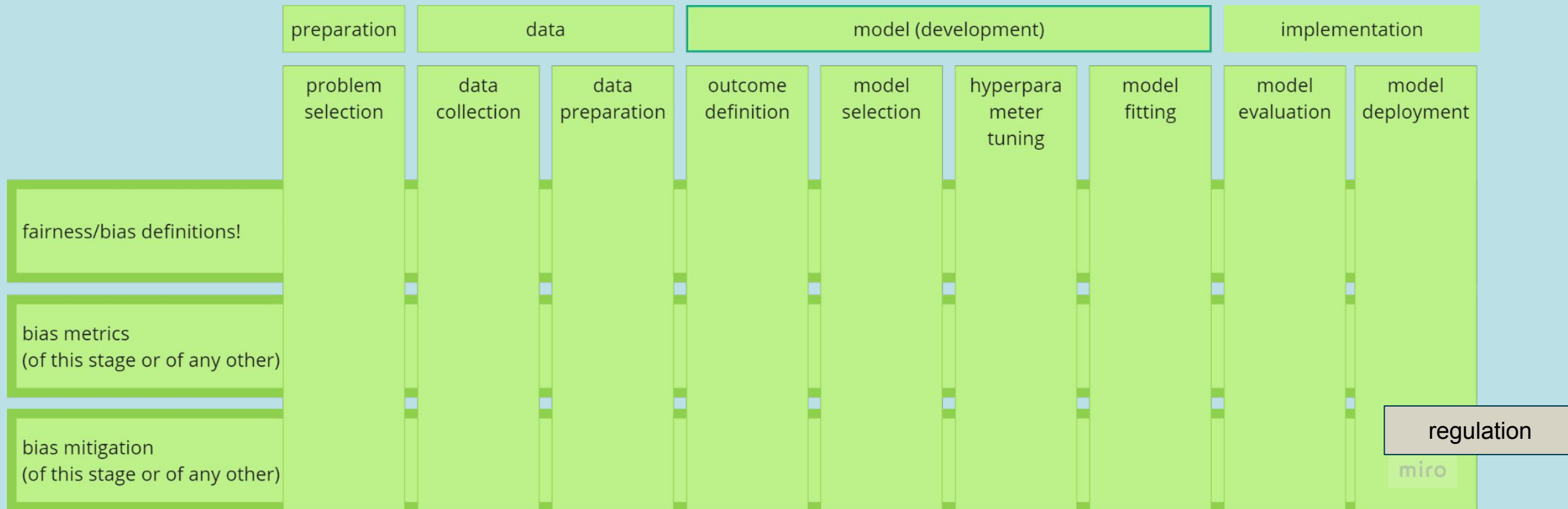
define - measure - mitigate

- the three pillars are intertwined!
- context-awareness

fairness/bias definitions!

bias metrics
(of this stage or of any other)

bias mitigation
(of this stage or of any other)

miro

define - measure - mitigate

- equity vs equality
- group fairness vs individual fairness

fairness/bias definitions!

bias metrics
(of this stage or of any other)

bias mitigation
(of this stage or of any other)

miro

define - measure - mitigate

- focus of the algorithmic fairness community

fairness/bias definitions!

bias metrics
(of this stage or of any other)

bias mitigation
(of this stage or of any other)

miro

define - measure - mitigate

- goal step
- based on prior definition & metric of bias

fairness/bias definitions!

bias metrics
(of this stage or of any other)

bias mitigation
(of this stage or of any other)

miro

Use-Case

Uncertainty Quantification with Conformal Prediction as a Tool for Fairness in Genomic Medicine

Leandra Bräuninger[1], Tapabrata Chakraborti[2], Christopher R. S. Banerji[2], Ariane Marandon-Carlhian[2], and Brieuc Lehmann[1,2]

[1] Department of Statistical Science, University College London, London, UK
[2] The Alan Turing Institute, The British Library, London, UK

bias metrics
(of this stage or of any other)

miro

Use-Case: Conformal Uncertainty for Fairness in Transcriptomics

- breast cancer: clinical decision on whether to treat breast cancer with hormone therapy
- biological differences -> different efficacy of treatment for different people
  - transcriptomic score (OncotyeDX)
- public data from the cancer genome atlas program (TCGA)
  - transcriptomic profiles
  - ethnicity category
- question: are the scores equally certain for all subpopulations?

bias metrics
(of this stage or of any other)

miro

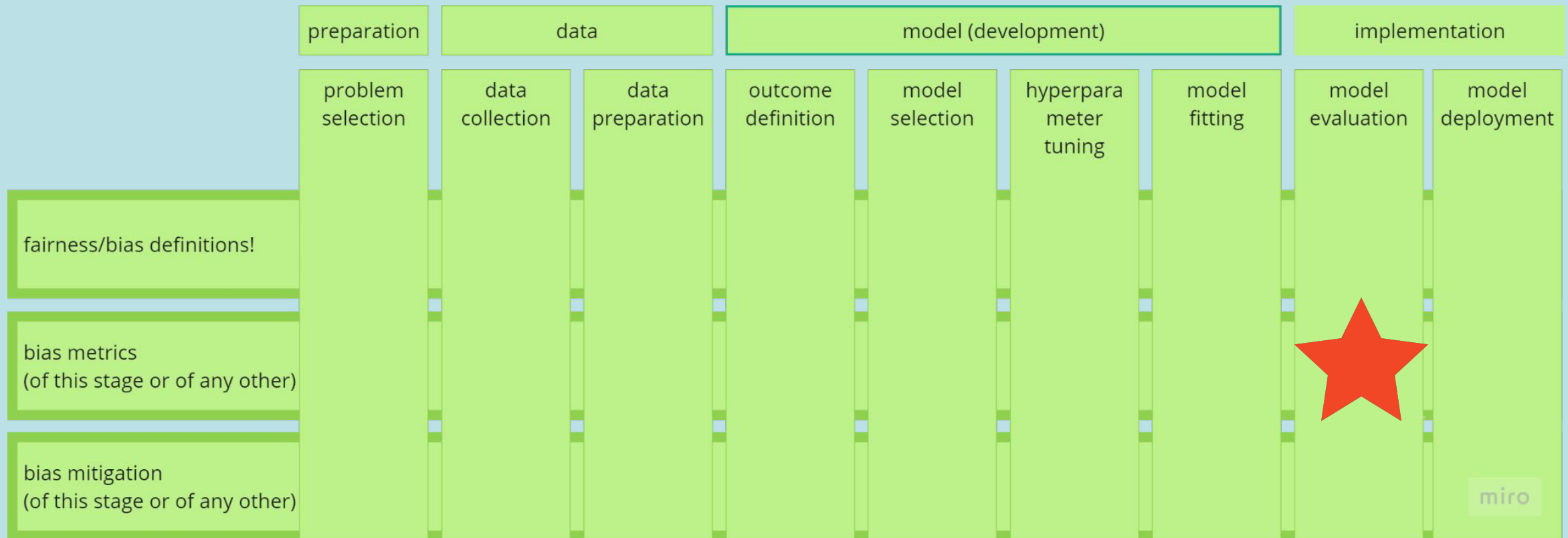# Use-Case: Conformal Uncertainty for Fairness in Transcriptomics
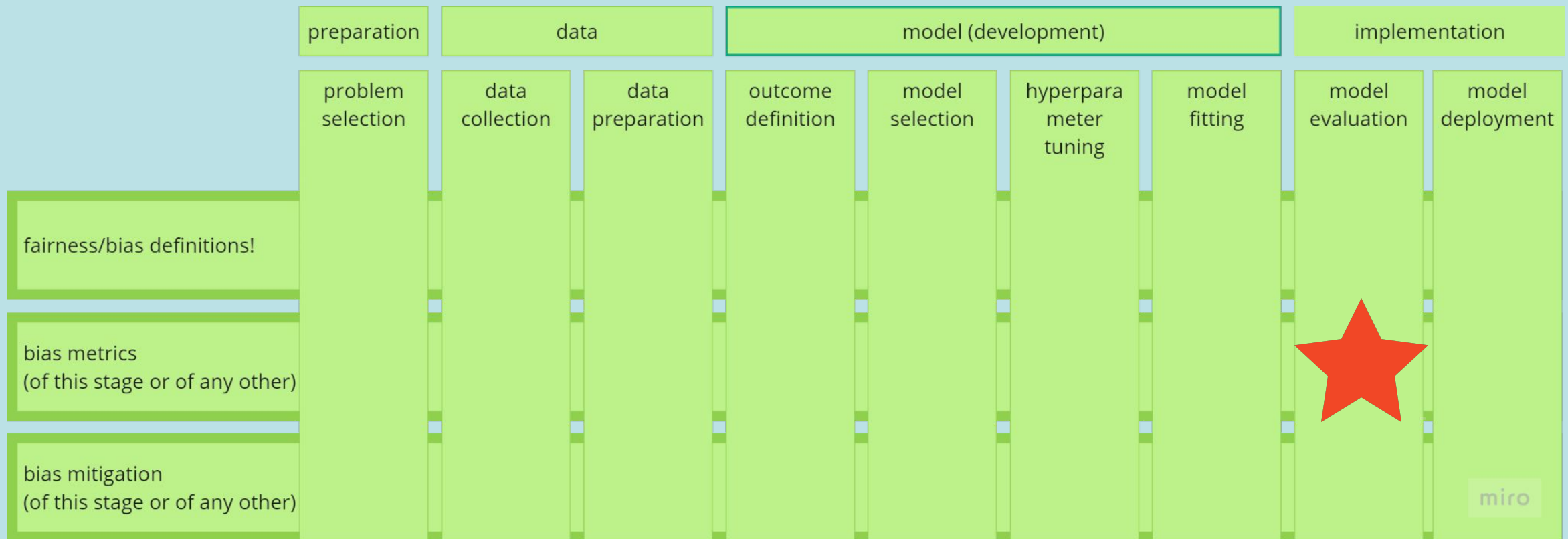
Individual Fairness via Conformal Uncertainty in transcriptomic predictions

- Results: slight differences across subpopulations
- model outputs: personalised prediction & personalised uncertainty
- support for clinician-in-the-loop systems -> doctor can decide to trust the output or not

- treating an imperfect world:
  - not enough representative training data, leading to decision-system-outputs that are less certain for underrepresented groups

- transparency of (un-)certainty:
  - post-hoc individualised uncertainty for OncotypeDX

bias metrics
(of this stage or of any other)

miro

Individual Fairness via Conformal Uncertainty in transcriptomic predictions

- quick & easy post-hoc metric for personalised medicine

- applicable to your problem & subpopulations

bias metrics
(of this stage or of any other)

miro

Systemic Solutions for Systemic Problems

preparation	data		model (development)				implementation	
problem selection	data collection	data preparation	outcome definition	model selection	hyperparameter tuning	model fitting	model evaluation	model deployment

fairness/bias definitions!

bias metrics (of this stage or of any other)

bias mitigation (of this stage or of any other)

Thank you very much

please feel free to reach out

ucaklbr@ucl.ac.uk

accessible on the Turing-Roche GitHub:
https://github.com/turing-roche
- conformal uncertainty report
- project code modifiable for your own project!