camh
Centre for Addiction and Mental Health

Krembil Centre for Neuroinformatics

Using big data, artificial intelligence and brain modelling to fundamentally change our understanding of mental illness.

SUMMER SCHOOL 2020

Day 2

Applied Ethics in Machine Learning and Mental Health Care

Part 1: Fairness and Health Equity in Machine Learning

Many ways to engage

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? 👍

(during sessions) Use the chat or the ask question!

You can always return to the session and re-watch the vidos after the session ends

come chat with us in KCNI Summer School Slack :)

virtually meet with us in gather.town

Tell us how the session went (post session survey):
https://forms.gle/ji18qLMZEZ9L16Ln6

KCNISchool@camh.ca

Today's Agenda

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Day 2:
Applied ethics in machine learning and mental health

9:00 am - 10:30 am	*An Introduction to AI and Ethics* Dr. Daniel Buchman
10:45 am - 12:15 pm	*Fairness and Health Equity* Dr. Laura Sikstrom
1:00 pm - 2:30 pm	*Workshop: Intersectionality* Dr. Laura Sikstrom and Dr. Marta Maslej
2:45 pm - 4:15 pm	*Workshop: Race/Ethnicity and Health Equity* Dr. Laura Sikstrom and Dr. Marta Maslej

Dr. Laura Sikstrom
CIHR Health System Impact Fellow, KCNI
Medical Anthropologist
Twitter: @laurasikstrom
Email: laura.sikstrom@camh.ca

OBJECTIVES

Objective 1:

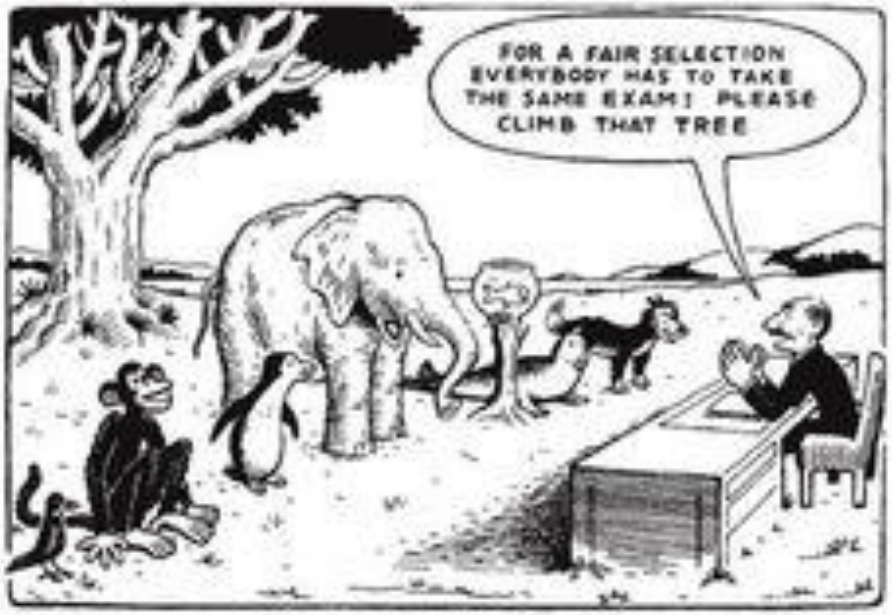
Define fairness and health equity;

Objective 2:

Learn key analytical frameworks used to understand health inequities;

Objective 3:

Identify invisible power structures and biases that get baked into datasets.



Critical Perspective

- How can I think about myself, my work and the world in new ways?

Criticism/Critical Thinking

- Finding fault with arguments, analyses or interpretations;
  - Assumes truth is generated when an analysis is rational, skeptical, unbiased and based on evidence considered factual.

Paradis et al. 2020. Critical Theory: broadening our thinking to explore the structural factors at play in health professions education. Acad Med; 95(6):842-45.
See also twitter tutorial: @MedEdModels

Key Terms

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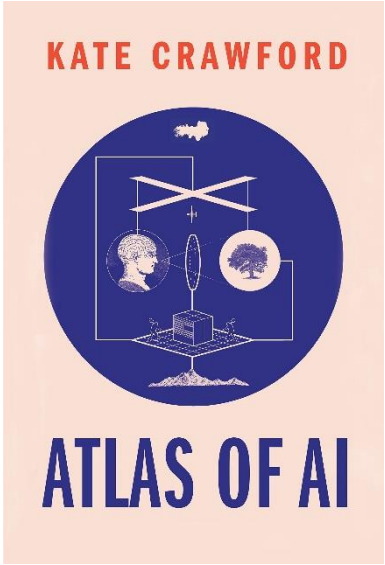
ALGORITHMIC SYSTEM
A sociotechnical assemblage composed of algorithms and *people*.

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING LIFE CYCLE
Research Design and Development
Data Collection and Analysis
Model Development and Validation
Deployment/Evaluation



Vondera, uA. Scaling the cloud: Making State infrastructure in Sweden. Ethnos, 84(4): 698-718.

You are all “Brads”

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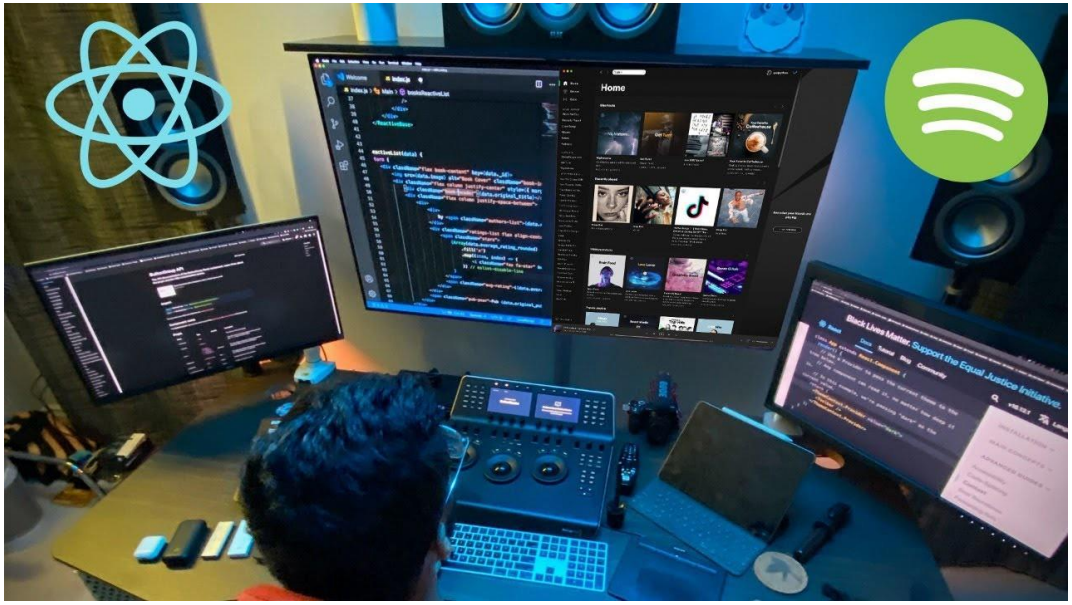
Brad and his colleagues are not strangers to the human lifeworld. Their countless little choices hold algorithms together; *they make algorithms responsive to the world…* In the world of music recommendation, these people often argue that their human sensitivity is, in fact, key to their systems’ success: *knowing things about music, caring about it… makes a programmer better at their job*, because such things shape their choices and their choices matter. The algorithmic fabric has a human weft, p. 378



Seaver, N. 2018. What should an anthropology of algorithms do? Cultural Anthropology, p. 375-85.

Care Transformed

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- Altering workflows and clinical encounters;
  - E.g. data collection, measurement based care etc.
- Incubating new delivery models;
  - E.g. Virtual Care
- Developing predictive tools;
  - E.g. Risk Assessments;
- Transforming what it means to be a doctor;

Mullainathan, S. 2017. The Algorithm Will See you Now: https://www.newyorker.com/magazine/2017/04/03/ai-versus-md

Topol, E. 2019. Deep Medicine: How AI can make healthcare human again. NY: Basic Books.

But…

- Algorithms inherit prejudices of previous decision makers;
- Featurization may reflect widespread societal biases;
- Disadvantaged groups are often erased;
  - E.g. “First nations or Inuit peoples”
- “Intrinsic opacity” makes it difficult to hold algorithmic systems accountable.

“*We shape our tools and thereafter our tools shape us*” – Culkin on McLuhan

Benjamin, R. 2019. Race After Technology; O’Neill, C. Weapons of Maths Destruction; Eubands, V. 2018. Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor. NY: Picador.

Mathematical Fairness

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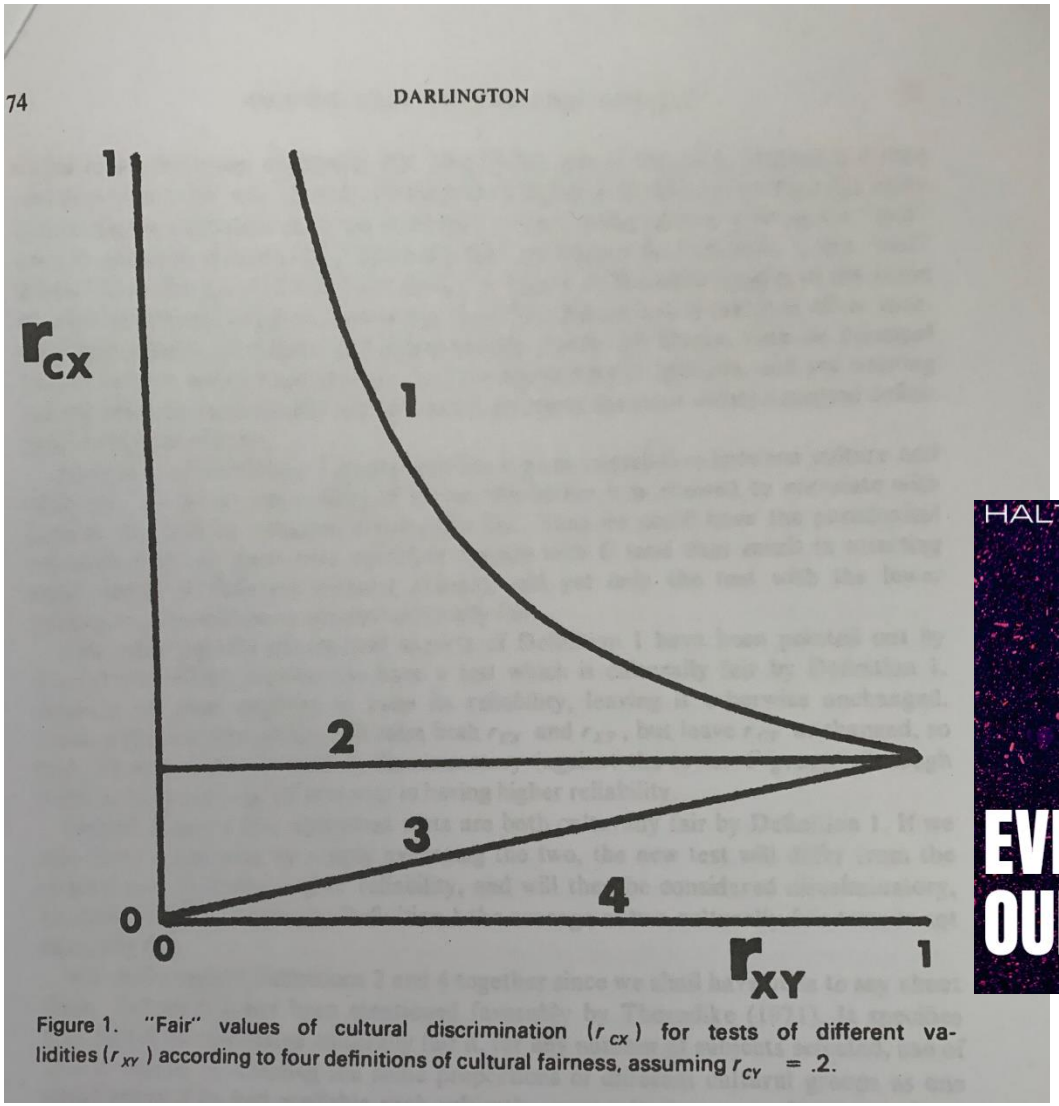
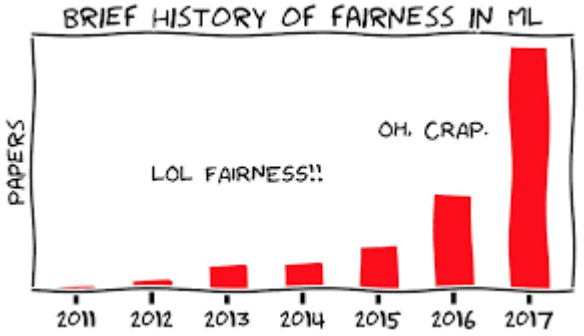
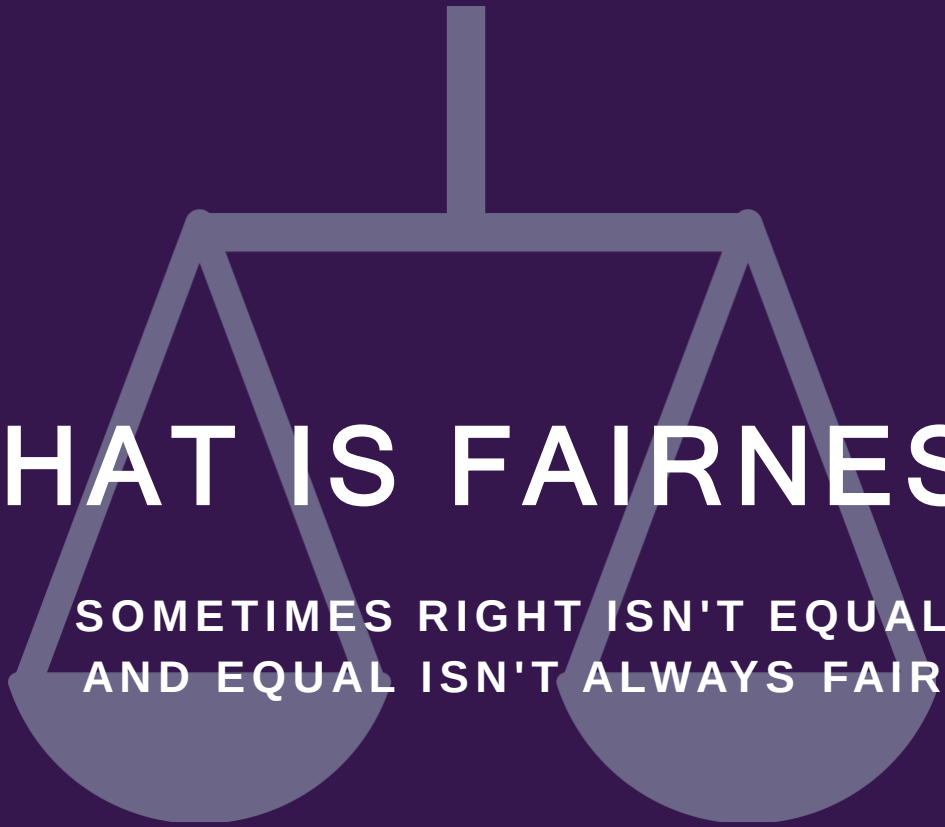


Figure 1. "Fair" values of cultural discrimination (r_{cx}) for tests of different validities (r_{xy}) according to four definitions of cultural fairness, assuming r_{cy} = .2.



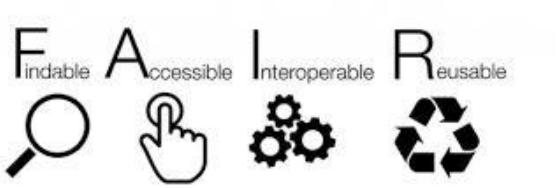
https://www.youtube.com/results?search_query=21+definitions+of+fairness
Darlington 1971;
https://www.youtube.com/watch?v=p5yY2MyTJXA&t=2411s



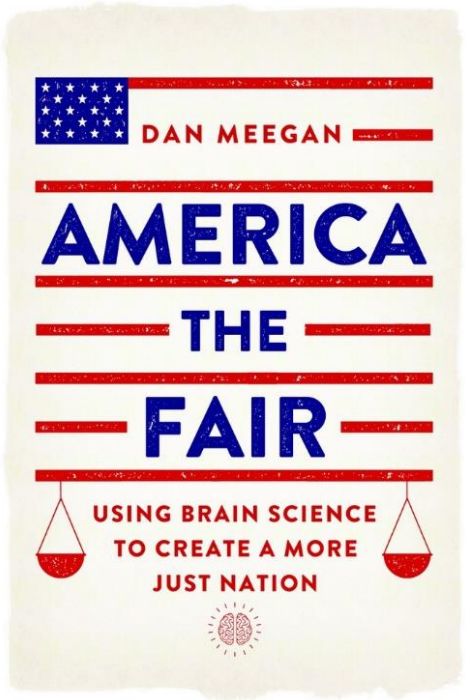
WHAT IS FAIRNESS?

SOMETIMES RIGHT ISN'T EQUAL AND EQUAL ISN'T ALWAYS FAIR

Corb Lund, The S Lazy H



Fairness is a *"strategically deployable shifter."*



Silberg and Manyika 2019

The Impossibility Theorem

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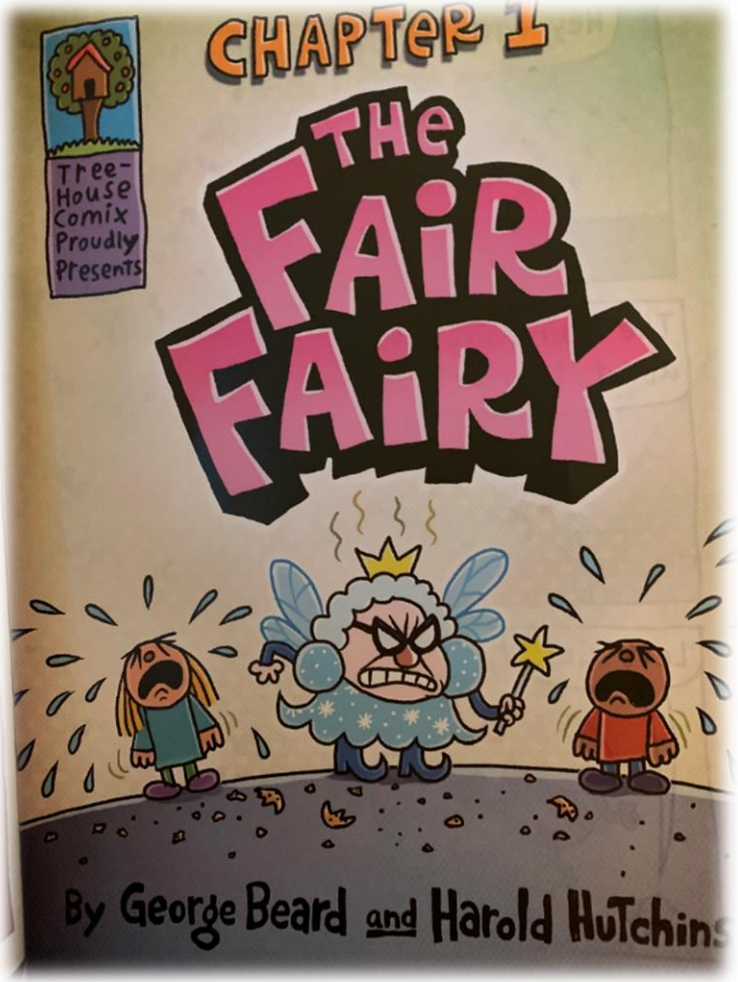
Fairness cannot be reduced to a single mathematical equation;



Friedler, S.A. et al. 2021. The Iim)possibility of Fairness: Different Value Systems Require Different Mechanisms for Fair Decision Making, https://cacm.acm.org/magazines/2021/4/251365-the-impossibility-of-fairness/fulltext

The Impossibility Theorem

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Humans must make decisions about the relative importance of *different criteria* and equity goals

e.g. individual vs group fairness

"Sometimes I worry that we *prioritize* getting patients through long wait lists quickly, rather than really trying to make sure each patient has the right clinician for their needs."

- Psychiatrist, CAMH

Friedler, S.A. et al. 2021. The Iim)possibility of Fairness: Different Value Systems Require Different Mechanisms for Fair Decision Making, https://cacm.acm.org/magazines/2021/4/251365-the-impossibility-of-fairness/fulltext

The Three Pillars

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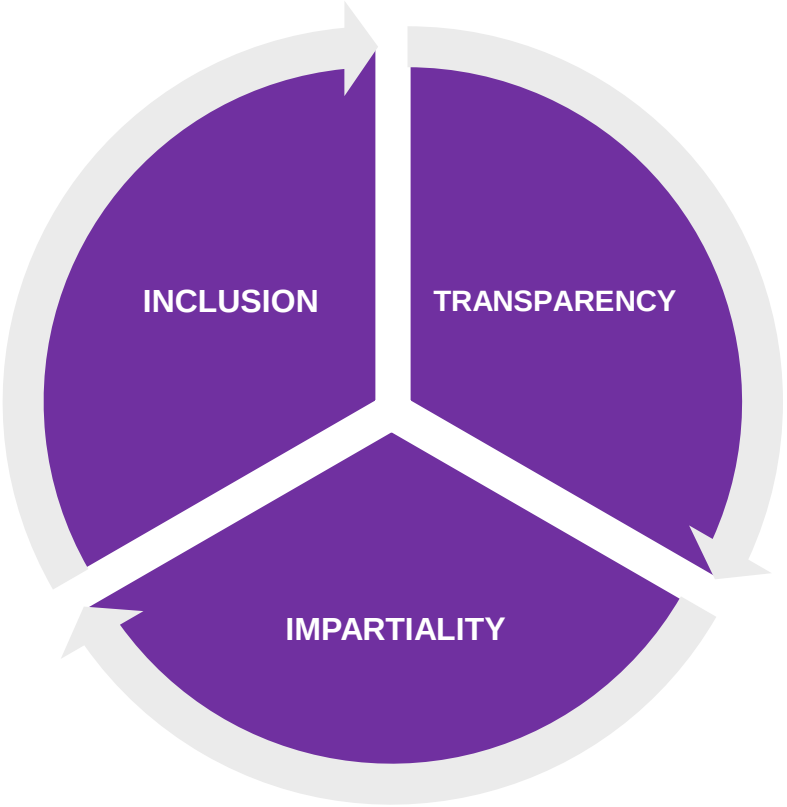
Fairness **is the social, political and technical process required to achieve** ***equitable health outcomes.***



What is Health Equity?

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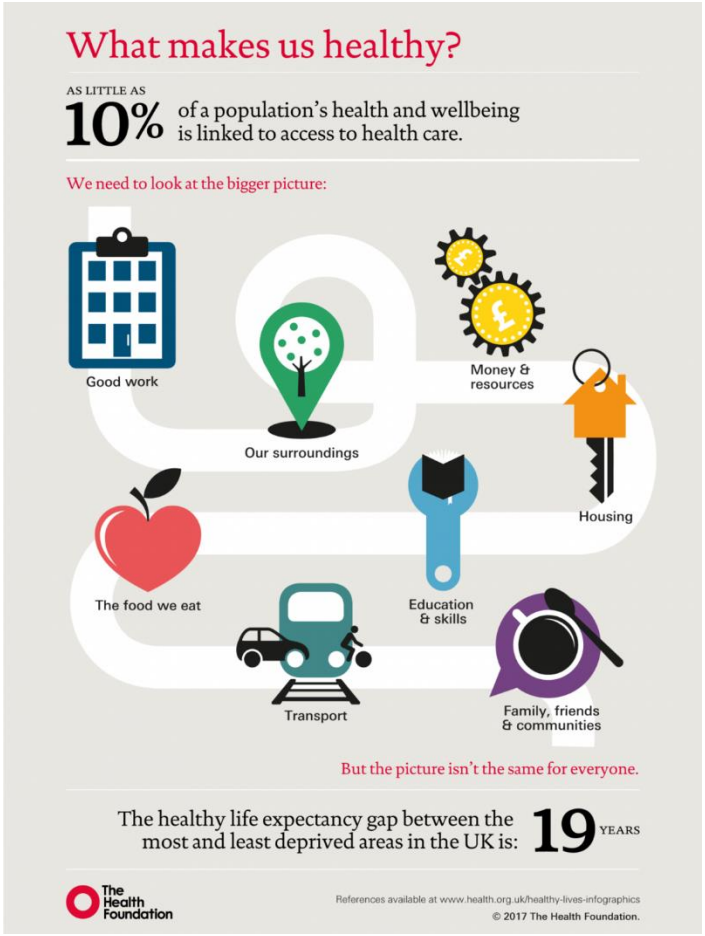
Everyone has a *fair* and just opportunity to be healthier.



Greene, D. 2021. The Promise of Access: Technology, Inequality and the Political Economy of Hope. MIT Press. Birn, AE. 2005. Gates's grandest challenge: transcending technology as public health ideology, The Lancet.

Case Study: Diabetes/Depression

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- Indigenous peoples living in Canada have higher rates of chronic diseases than non-Indigenous peoples;
- Highest risk populations for diabetes and related complications;
  - E.g. 17% vs. 5%
- Highest risk populations for cardiovascular disease;
  - E.g. 76% higher for First Nations women compared to non-Indigenous populations).

SYNDEMIC: A syndemics-based focus goes beyond common medical concepts of comorbidity and multimorbidity because it concerns the health consequences of identifiable disease interactions and the social, environmental, or economic factors that promote such interactions and worsen disease (Singer et al. 2017).

Rock. M. 2003. Sweet Blood and Social Suffering: Rethinking Cause-Effect relationships in diabetes, distress and duress. Medical Anthropology, 22(2): 131-174. Anand, SS., et al. 2019. Explaining the variability in cardiovascular risk factors in First Nations communities in Canada: a population-based study. The Lancet, 3(12): E511-E520. Singer, M. 2017. Syndemics and the Biosocial conception of health. The Lancet, 389(10072): 941-950.

What about Brian?

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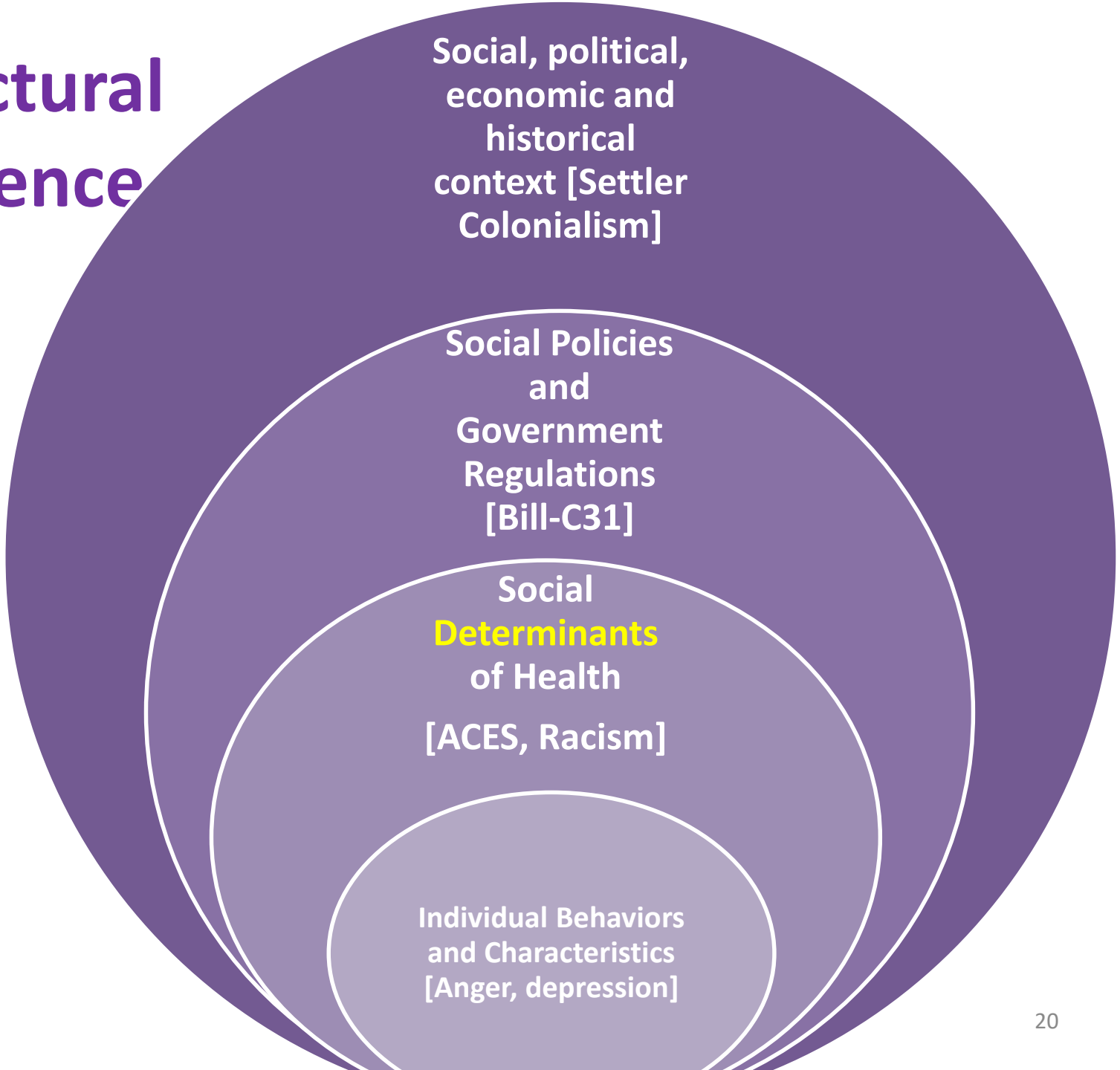
Case Study: The Gift of Diabetes

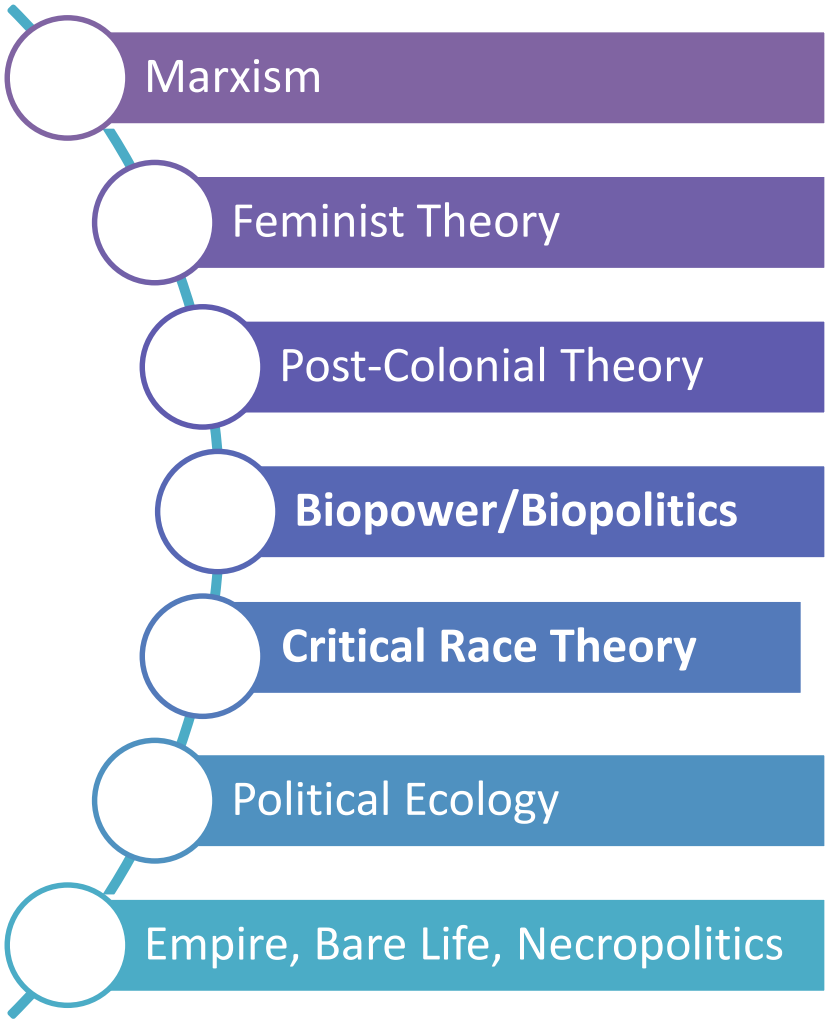
Structural Violence



BRIAN

David (Agency) vs Goliath (Structures)

Structures vs. Agency



Suffering is 'structured' by historically given (and often economically driven) processes and forces that conspire – whether through routine, ritual or… the hard surfaces of life – to **constrain** human agency [individual choices and opportunities].

- Paul Farmer, p. 40.

AGENCY

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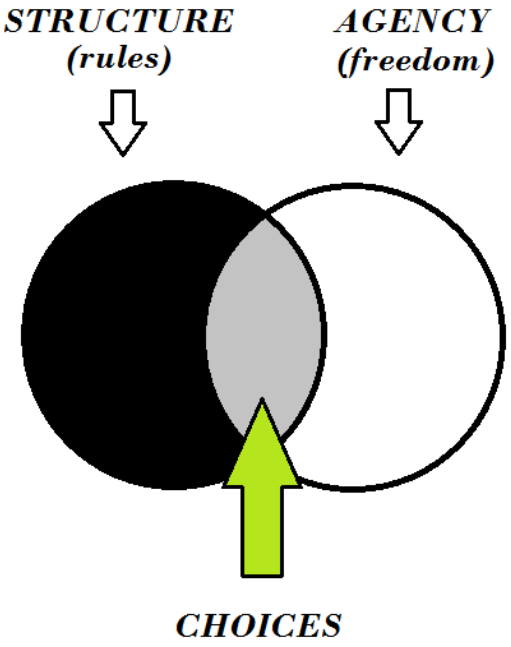
Like freedom, but more accurately: freedom for meaningful action and to make one's own choices, within the pragmatic constraints (*structures*) of society);

- Marriage, geography, religion, workplace, gender ideologies etc.



Greene, D. 2021. The Promise of Access: Technology, Inequality and the Political Economy of Hope. MIT Press. Birn, AE. 2005. Gates's grandest challenge: transcending technology as public health ideology, The Lancet.

A Conundrum

People Resist! (passive, active and negative agency)

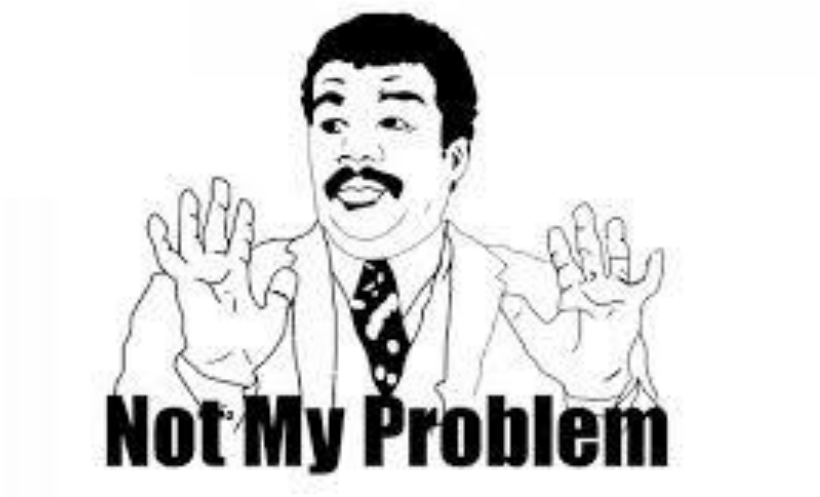
Diffuses Responsibility (Why bother?)

Does not explain why unjust systems persist

What about all the Brads?

"In computer science, diffusion of responsibility often revolves around discussion of what is and isn't '*out of scope*'"

- Hooker 2021: 3



An Invitation

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"Is there a truly a disconnect between "studying the brain" and studying the "societal causes of mental illness", so long as one isn't confused for the other?"

Psychiatry and Preclinical Psychiatric Studies - Review Article | Open Access | Published: 13 April 2020

Genetic and environmental factors of schizophrenia and autism spectrum disorder: insights from twin studies

Akira Imamura, Yoshiro Morimoto, Shinji Ono, Naohiro Kurotaki, Shinji Kanegae, Naoki Yamamoto, Hirohisa Kinoshita, Takahiro Tsujita, Yuji Okazaki & Hiroki Ozawa

Journal of Neural Transmission **127**, 1501–1515 (2020) | Cite this article

4701 Accesses | **4** Citations | **1** Altmetric | Metrics

How the Timing and Quality of Early Experiences Influence the Development of Brain Architecture

Sharon E. Fox, Pat Levitt, Charles A. Nelson III

First published: 04 February 2010 | https://doi.org/10.1111/j.1467-8624.2009.01380.x | Citations: 381

Post-traumatic stress disorder as a risk factor f dementia: systematic review and meta-analysi

Published online by Cambridge University Press: **15 September 2020**

Mia Maria Günak, Jo Billings, Emily Carratu, Natalie L. Marchant, Graziella Favarato and Vasiliki Orgeta

ELSEVIER

International Review of Neurobiology

Volume 150, 2020, Pages 77-105

Chapter Four - The impact of childhood poverty on brain health: Emerging evidence from neuroimaging across the lifespan

Alexander J. Dufford [a], Pilyoung Kim [a], Gary W. Evans [b]

Embodied Inequalities

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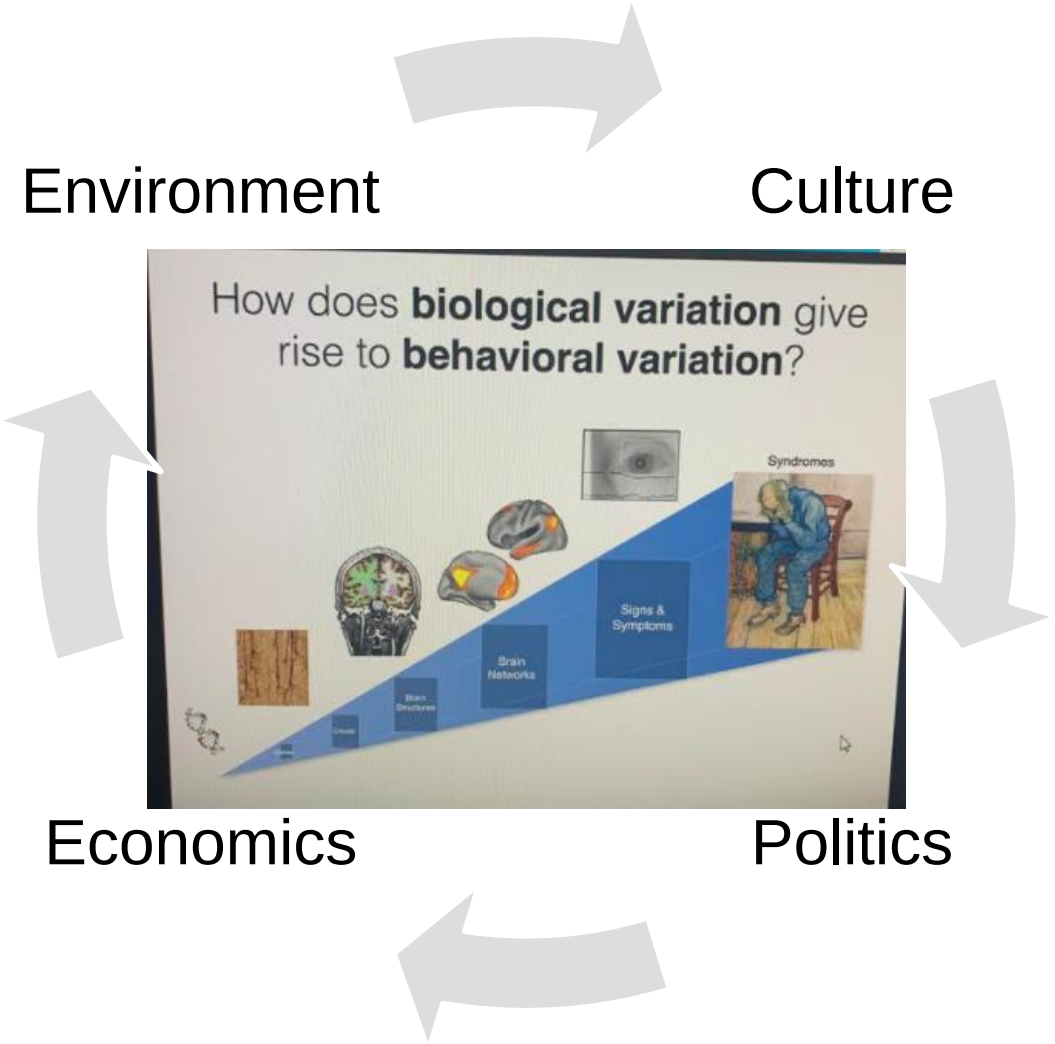
Our material and social worlds result in uneven population patterns of health and disease.
- Krieger 2011; Nguyen and Pechard 2003



Social Suffering

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- That socioeconomic and sociopolitical forces can at times cause disease;
- That social institutions, such as hospitals, can make suffering worse;
- That suffering extends outside the individual to include families and communities;

➢ Collapses the distinction between a health and a social problem.

Kent Monkman: Shame and Prejudice

Kleinman, A. 2010. The Art of Medicine: Four Social Theories for Global Health, 375: 1518-19.

Operationalizing Fairness

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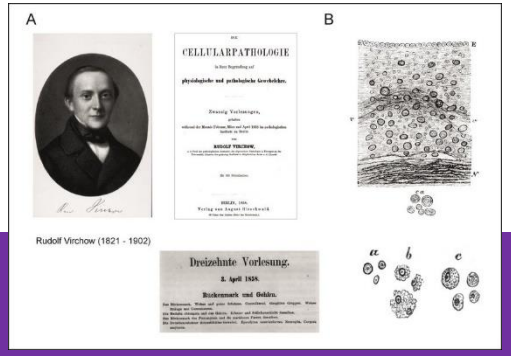
Fairness and *Health Equity* require that we collapse the distinction between a health and a social problem.

- Intersectoral;
- Interdisciplinary;
- Theoretically engaged;



"Medical statistics will be our standard of measurement: we will weigh life for life and see where the dead lie thicker, among the workers or among the privileged."
— **Rudolf Virchow**

Abebe, R, et al. 2020. Roles for Computing in Social Change. FAT*'20, 27-30.

Operationalizing Fairness

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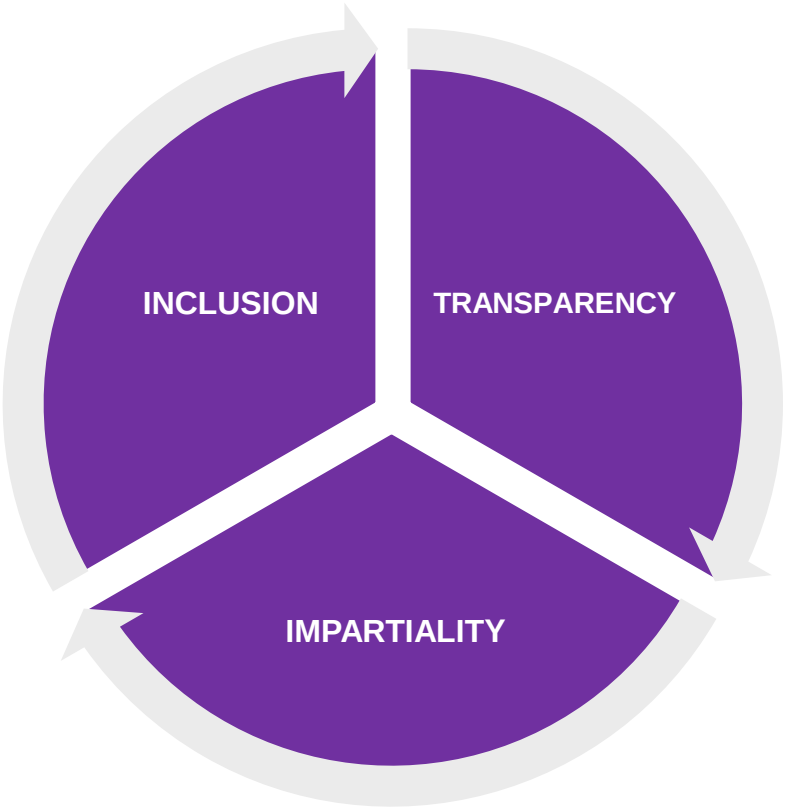
Three Pillars for Fairness.



1. Transparency

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Interpretability: A range of procedures and statistical techniques used to test, validate and analyze findings (e.g. peer review, FAIR, fairness metrics, audits and so on)

Explainability: The social and technical process of translating the purpose, relevance and limitations of an algorithmic system to clinicians, patients, their families and the general public.

Accountability: A set of procedures and governance structures that hold algorithmic systems accountable in a timely manner.

Neff et al. 2017; Samek et al. 2017; Rajkomar et al. 2018

2. Impartiality

Provenance:
Understanding the origins and limitations of any given dataset, very broadly defined.

Deployment: To what extent can a model be deployed into a clinical setting without reproducing and/or creating new health inequities?

Bowker and Star 1999; boyd and Crawford 2012; Neff 2019; Umoja Noble 2018; Engle 2016; Mullainathan 2019; Seaver 2015

3. Inclusion

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Completeness: Collect necessary data on marginalized groups to perform audits of model function (e.g. on race, gender).

Patient Engagement: Engage patients, their families and caregivers in the process of determining acceptable fairness standards.

"Specifically, I want to know what assumptions he's [psychiatrist] making based on that data. Right? *So quantities aren't of any value without qualitative scale.* And my qualitative scale is going to be different than his. So data is useful, as long as I'm looking at it through the same lens, and interpreting that data in the same way. And we can have communication regarding whether or not we agree on what this all means. Right, that closing the loop so to speak, bringing that back into view of both parties, I think is pretty crucial."

- Adam, 34yr old living with MDD

http://news.mit.edu/2018/study-finds-gender-skin-type-bias-artificial-intelligence-systems-0212

McKenzie et al. 2016 "The Case for Diversity"; Andrus, M., et al. 2021. What We Can't Measure We can't understand: Challenges to Demographic Data Procurement in the Pursuit of Fairness. FAT*21, 249-260.

Key Takeaways

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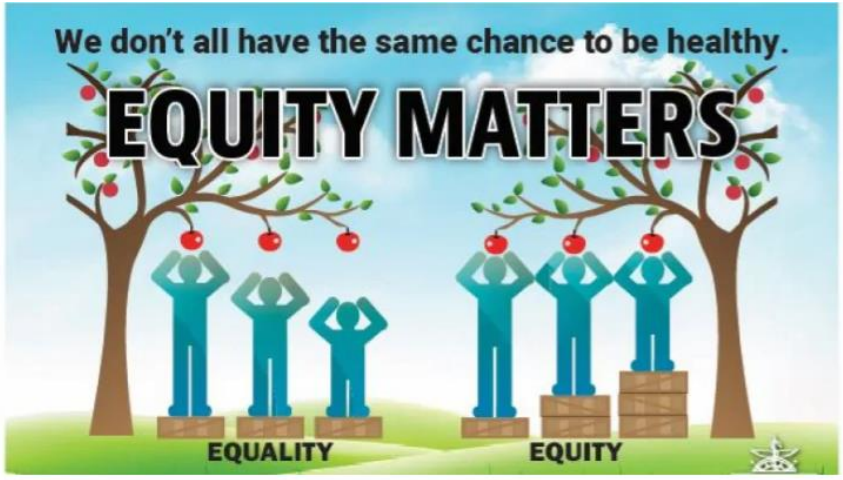
- Health problems are social problems; social problems are health problems;
- Advances in ML hold tremendous potential for supporting efforts to achieve health equity;
- These advances could also cause tremendous harm;
- *Fairness* is more than a good mathematical equation;
- *Fairness* is a social and political process that necessitates sustained dialogue;
- Collaborative, interdisciplinary and transparent science will facilitate uptake and effective use;



Officials at the Northwestern Health Unit are launching a two-year campaign to increase awareness and understanding of the social determinants that influence health. (Jon Begg / NWHU)