Health Inequalities in ED Attendance Data

Measurement Session - MAN

George MacDonald
Data Scientist
University Hospitals of Leicester

May 29, 2025

Context

- Health Inequalities often fall off the list of priorities when budgets are constrained.
- From a data-oriented perspective, why? Can we do better?
  - Health inequalities analysis often looks a lot like (a) splitting and then (b) aggregating data to identify differences.
  - Two problems with this:
    - Easy to miss subgroups when splitting data.
    - It's not really health "inequalities" analysis but health "differences" analysis.

Today

- I will try to make some progress on the latter concern and leave the former for another day.
- Methodology-focused intro to quantifying the magnitude of inequality in a provider dataset.
- Three key tools:
  - Lorenz Curves
  - Gini Coefficients
  - Theil indices and decompositions
- Stolen primarily from the income inequality literature in economics but readily transferrable to health inequality (or any outcome with an ordinal measurement variable!).

Health Differences (Ethnicity)

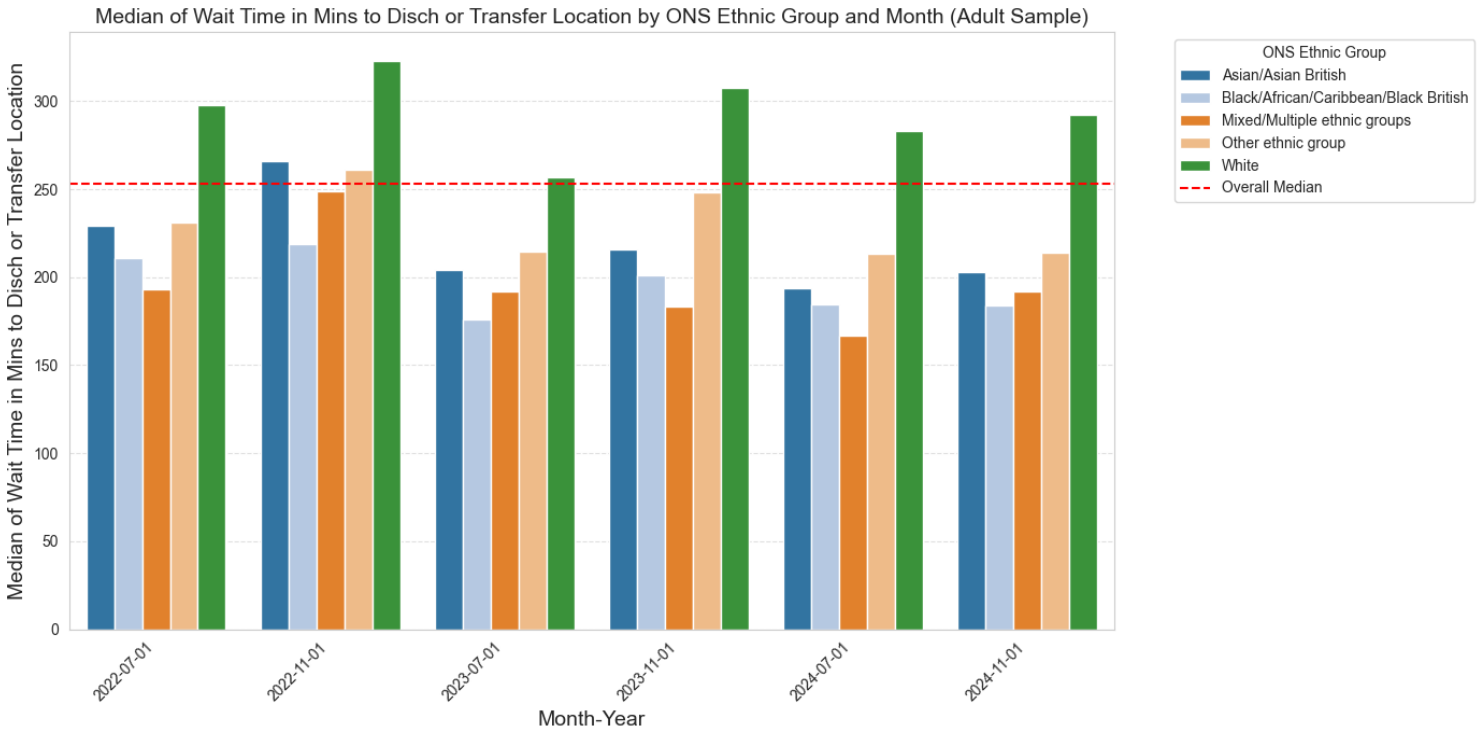


Figure: Differences by Ethnicity

Health Differences (Deprivation)

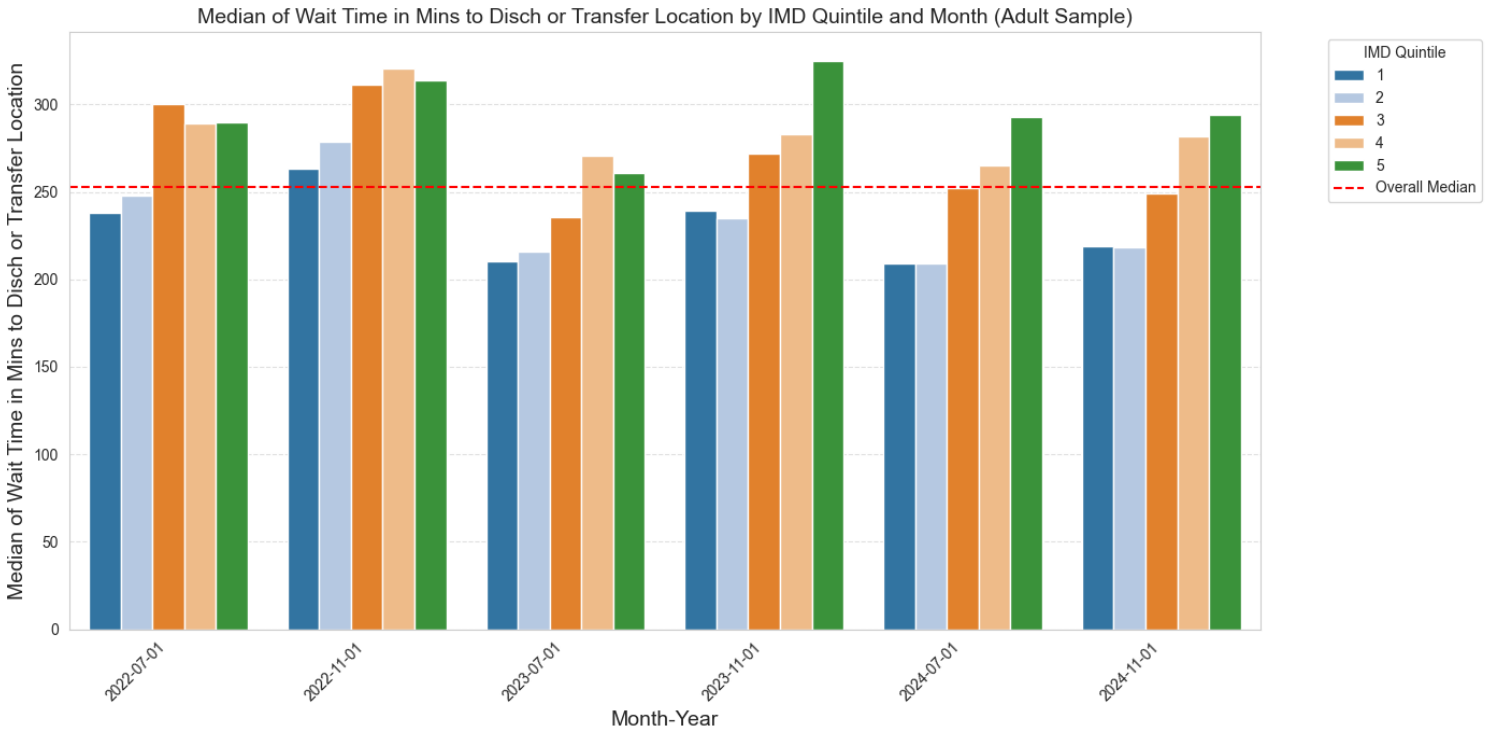


Figure: Differences by Deprivation

Focus of these tools

- ”How unequal”
- ”If I solve this particular problem, how much of the overall problem will I actually have solved?”

Lorenz Curves

Graphical representation of the distribution of income or wealth (or any other non-negative variable) in a population / sample of data. Helps to visualize the level of inequality.

Methodology

- *Wait Times:*
  1. Group data at the ethnicity / IMD decile level and calculate group total for wait times.
  2. Normalise Group Total Wait Time with respect to Population Total Wait Times. This gives the Share of Total Wait Time attributable to the group.
  3. Rank groups according to their Mean Wait Time.
  4. Calculate cumulative group shares for both the Population and the Wait Time share.
  5. Plot Cumulative Population and Wait Time Shares against one another.

Note on Gini Coefficients

- Effectively a measure of distance to the 45 degree line of perfect equality.
- Gini = (Area between 45 degree line and curve) / Entire Area below 45 degree line
- 0 = perfect equality; 1 = perfect inequality (1 group has 100% of wait time).

By Ethnicity

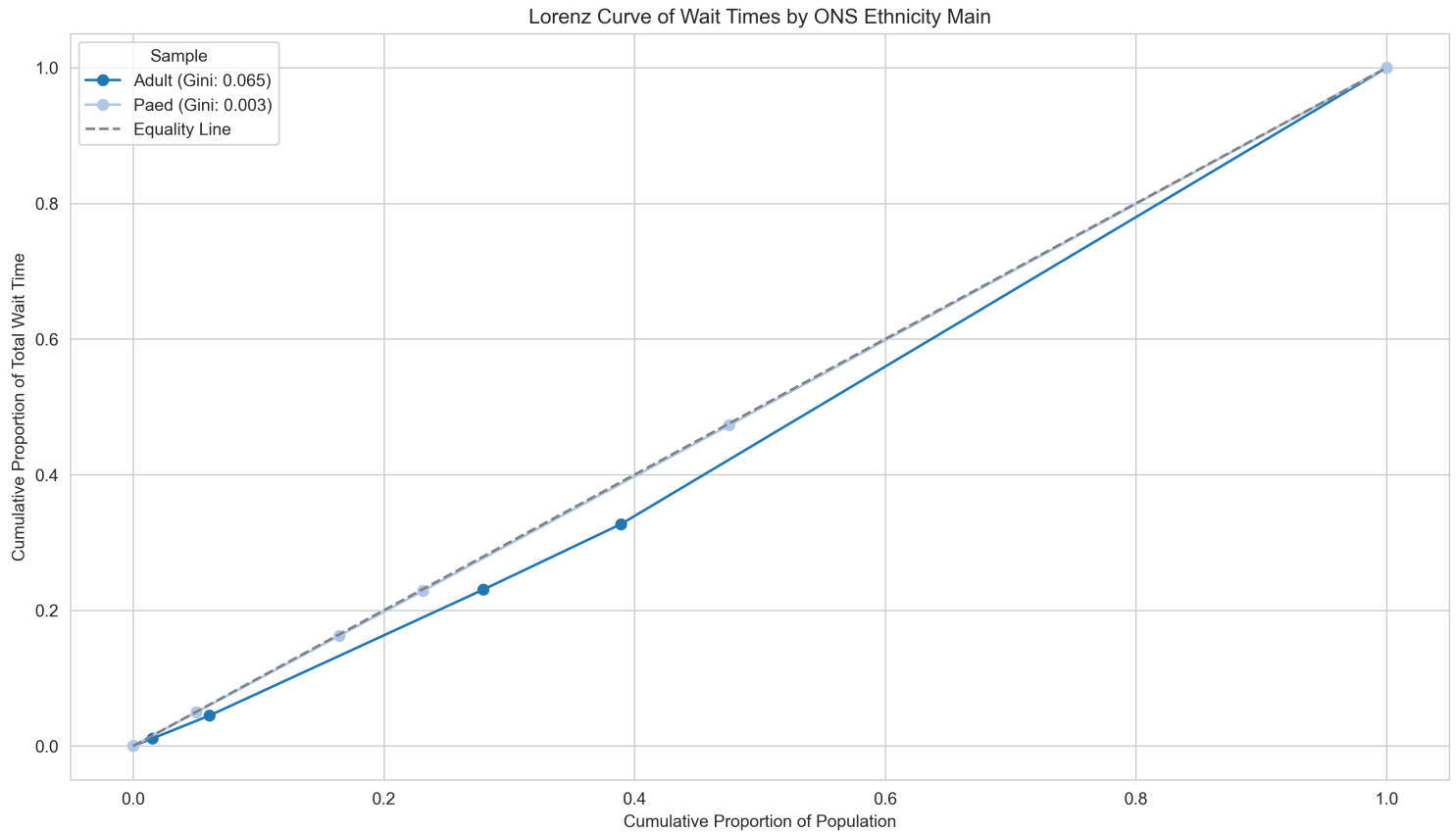


Figure: Lorenz Curves - Ethnicity Shares

By Deprivation

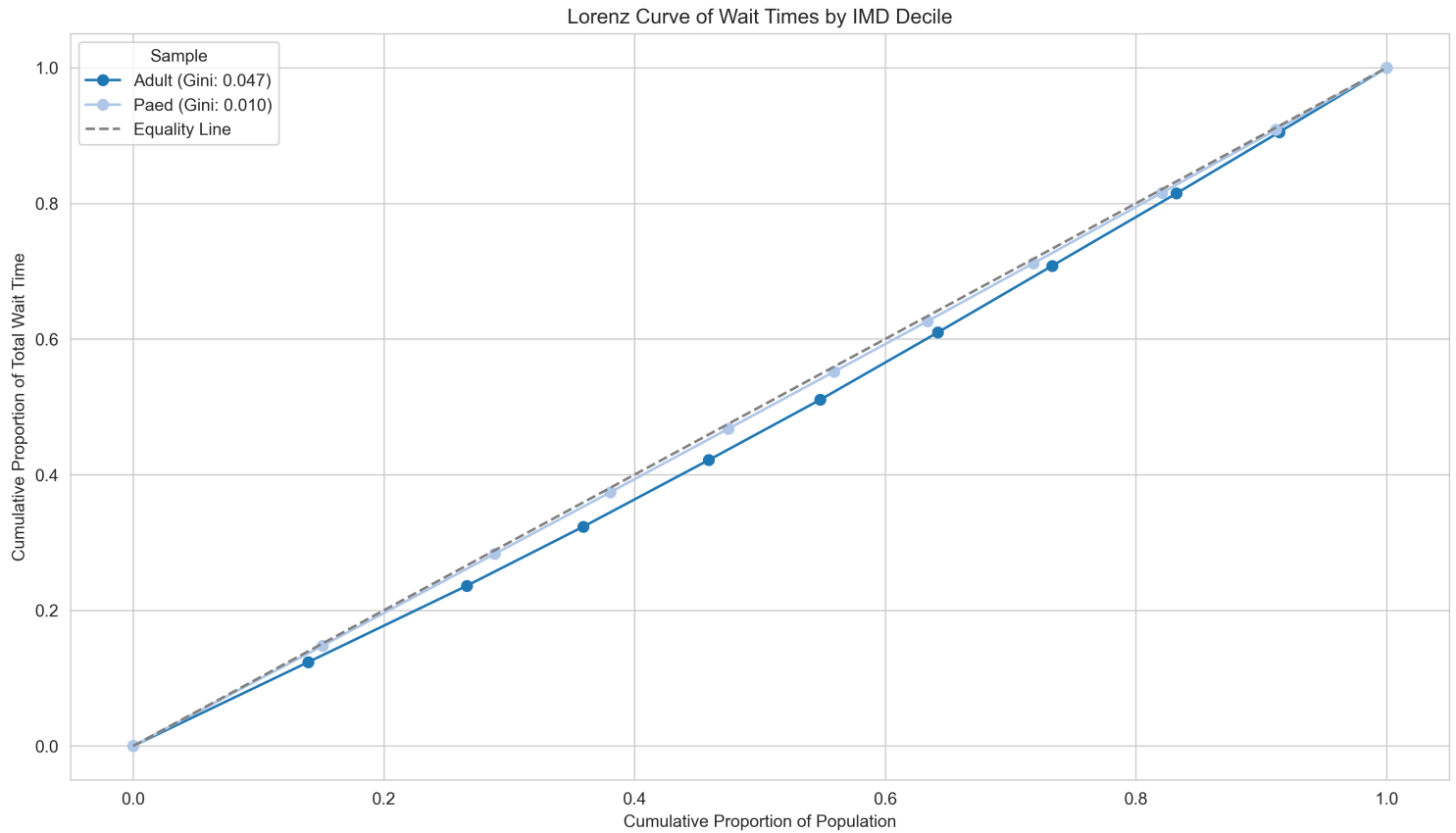
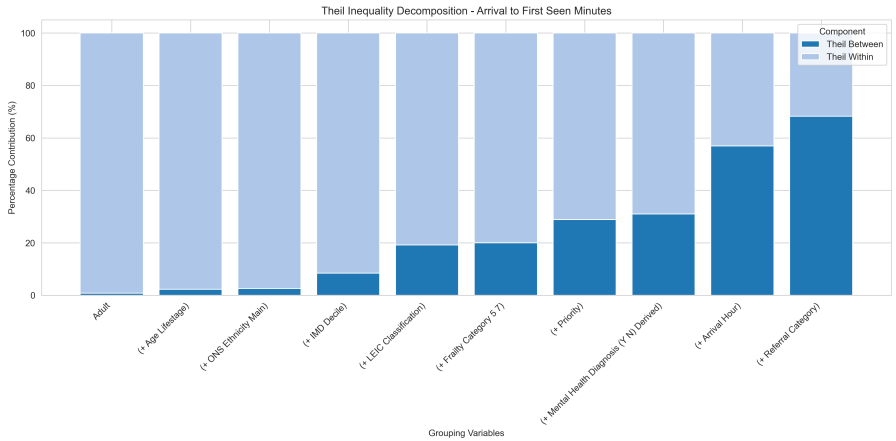


Figure: Lorenz Curves - Deprivation Shares

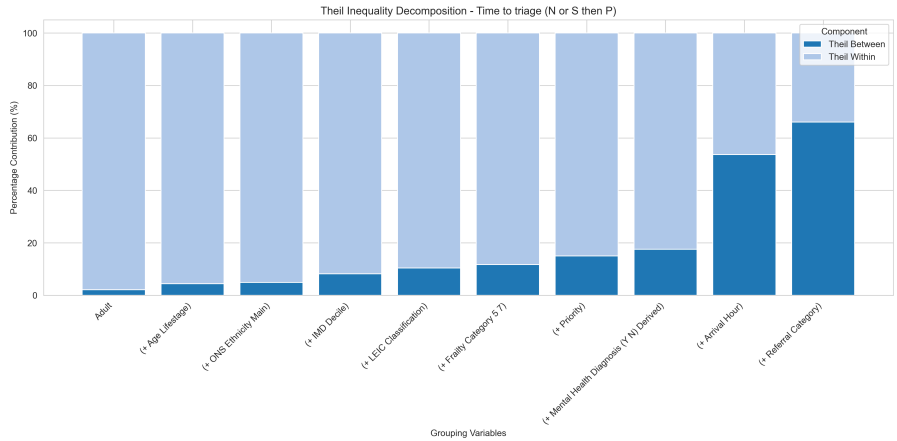
Method

- Calculate Theil Index as a measure of total inequality in the data.
- Decompose this measure of total inequality into:
  - Between group inequality
    - ★ Group data by some characteristic and calculate group size, group mean, relative group mean and the weighted contribution to between-group inequality.
  - Within group inequality
    - ★ Compute the theil index for each group, weight it by group size and aggregate across groups.

Wait Time Decompositions Visualised - Part 1



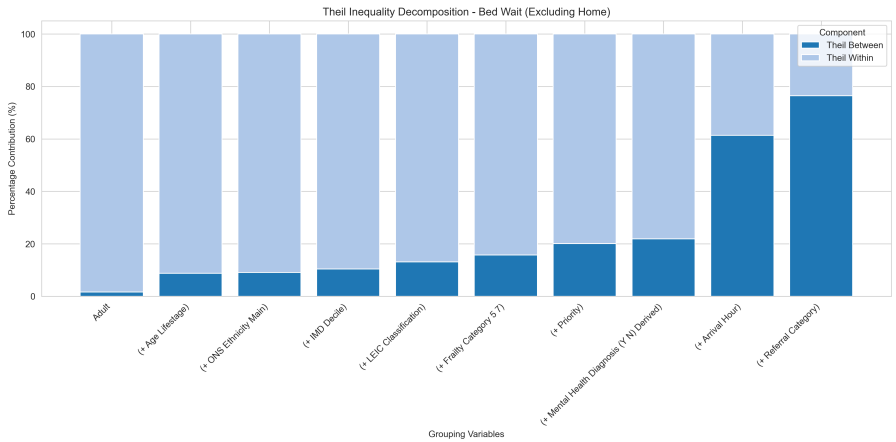
(a) Arrival to First Seen



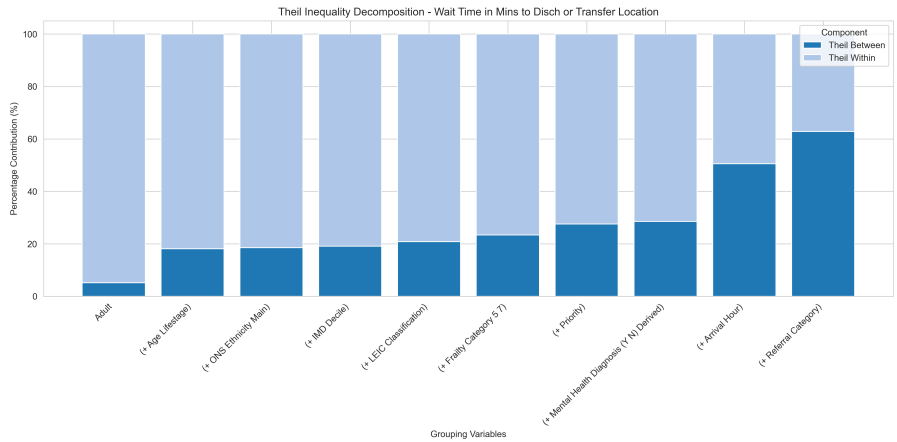
(b) Time To Triage (N or S then P)

Theil Inequality Decomposition

Wait Time Decompositions Visualised - Part 2



(a) Bed Wait (Excluding Home)



(b) Time To Discharge

Theil Inequality Decomposition

Summary

- Very generalisable approaches to the mapping of inequality across whole patient populations.
- In a sentence, we have learnt how to decompose total inequality into (a) differences between known characteristics and (b) differences within known characteristics.
- Sharpened our knowledge of what we do know and informed us about what we don't.
- Also provides us an evaluation criteria for whether our subgroups are any use.

Comments

- Since these are new tools we need to start using them in the context of healthcare to create benchmarks.
- Possible to do this ”within groups” i.e. as a systematic approach to assessing the role of frequent users.
- If we combine with population data, we can use to calculate inequalities in representation.
- For those who need to focus more on demand management, the approaches are basically equivalent with a difference in interpretation.