Development and validation of the Polypharmacy Assessment Score:

Improving case finding in primary care using a machine learning approach

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Mrs Jones

'Now, which one shall I take today….?'

"I'm constantly taking medication, It feels like it takes over your life sometimes.

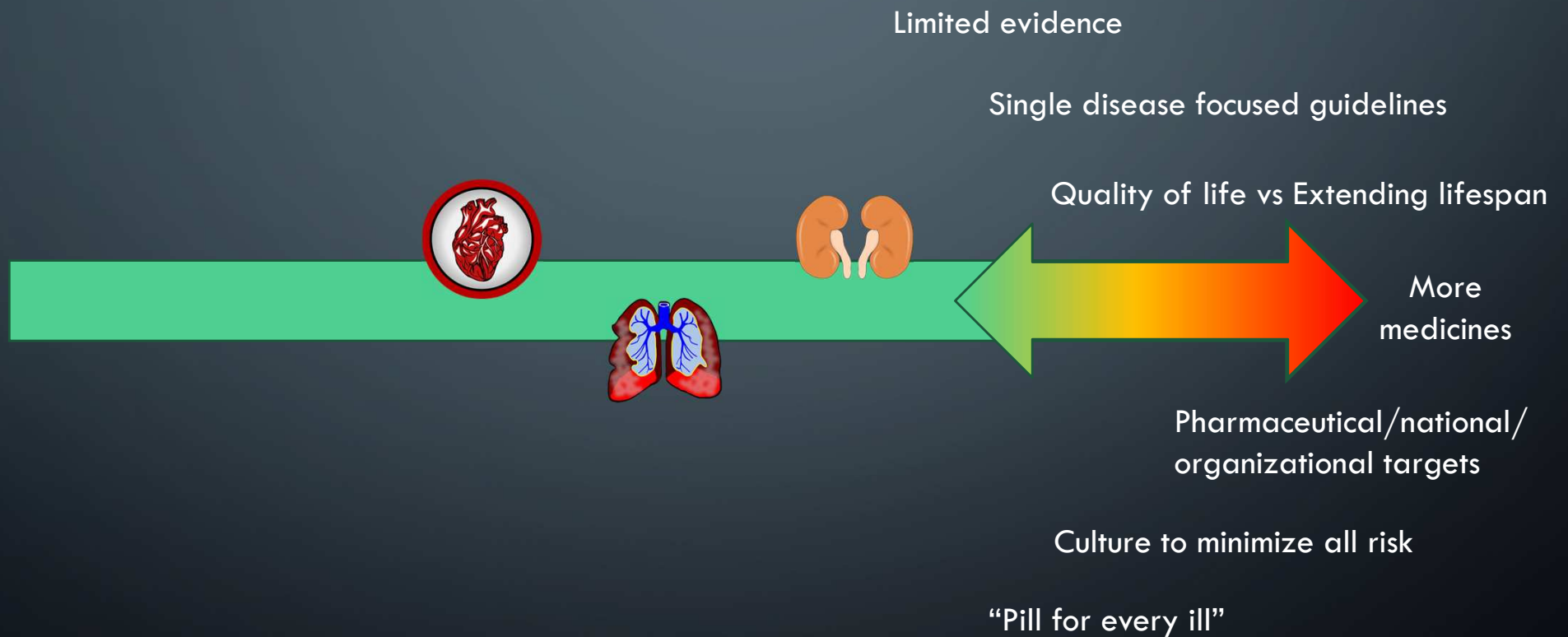*"I've had a couple of nasty side effects."*

"What worries me is what long term effects it might have on me"

Polypharmacy

- Multiple medications in a single patient

- Rapidly rising
  - Older people ≥5 meds: 12% ➔ 49%

- Linked to adverse consequences including:
  - High burden for patients
  - High Cost (>£1 billion/year)
  - Threats to patient safety

Medication Without Harm

WHO Global Patient Safety Challenge

World Health Organization

Targeting inappropriate polypharmacy is challenging…

Limited evidence

Single disease focused guidelines

Quality of life vs Extending lifespan

More medicines

Pharmaceutical/national/ organizational targets

Culture to minimize all risk

"Pill for every ill"

Limited approaches to identifying patients

1. ## Simple counts

   - People taking > 10 medicines

2. ## Individual populations

   - People in care homes
   - Severely frail

3. ## Narrow view

   - Prescribing criteria (e.g. patients on two anticoagulants)

Aim

To develop a Polypharmacy Assessment Score to identify a population at higher risk of inappropriate polypharmacy

Rationale

Score calculating the difference between the observed and prediction count of regular prescribed medications

- Identify people that are outliers in polypharmacy management
- Potential over- & under-prescribing

E.g. Someone on 10 medications but expected to be taking 5, based on their age and health conditions, is likely to be overprescribed medications

METHODS

SAMPLE

❍ Clinical Research Practice Datalink (CPRD)

❍ Total 8,400,405 participants aged 40+ years

❍ Across 1495 practices

PREDICTION MODEL

❍ Zero-inflated negative binomial regression - predict medication count

❍ Age, gender, 37 diseases and their grouped interactions

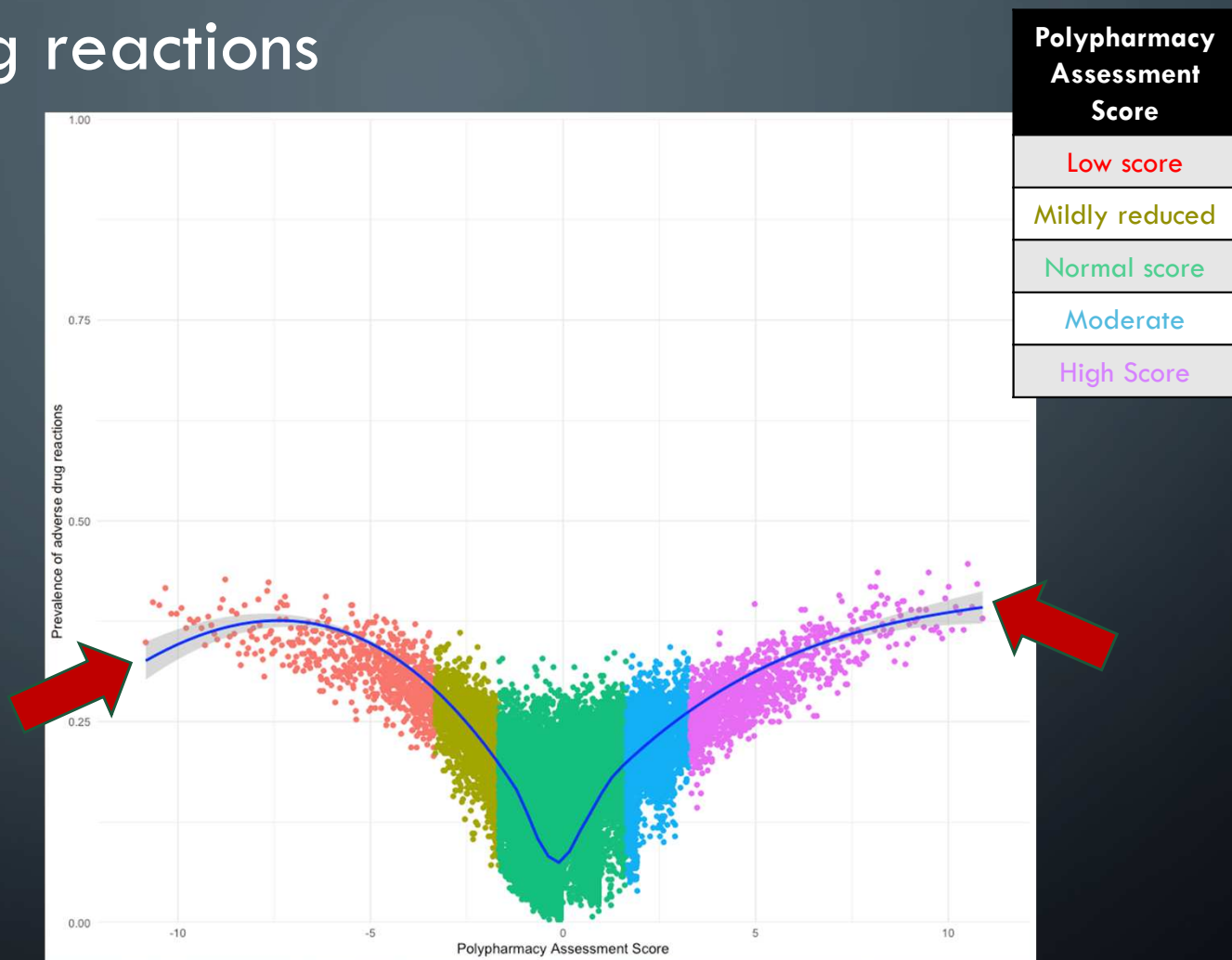❍ LASSO – variable selection and regularization

VALIDATION ANALYSES

❍ Clinical outcomes (adverse drug reactions, hospitalisation and death) – Cox regression

❍ High-risk prescribing (STOPP/START criteria) – logistic regression

Distribution of the Polypharmacy Assessment Score
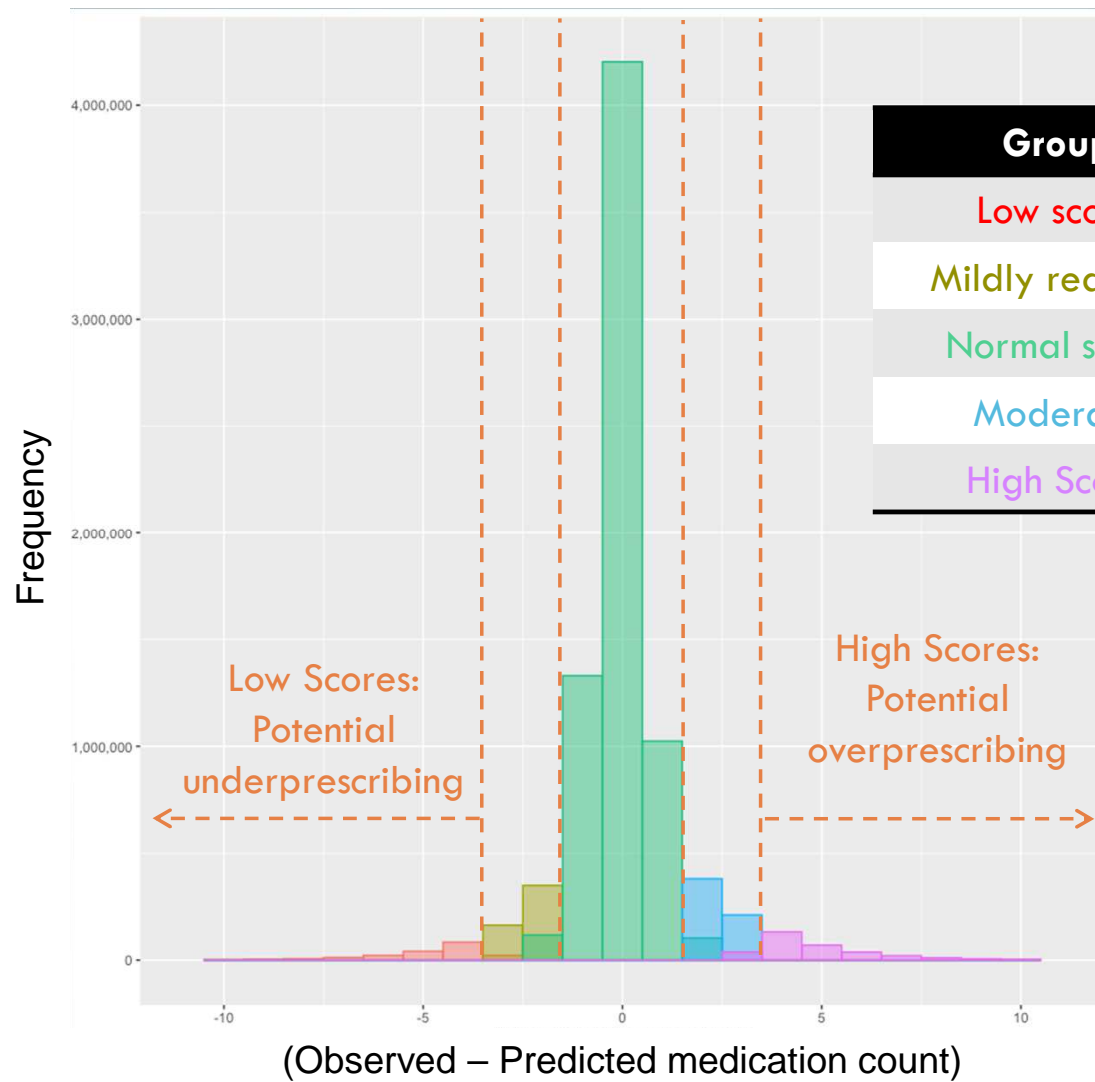
Group	Difference in O/E
Low score	-3.3
Mildly reduced	-1.7
Normal score	-0.01
Moderate	+1.7
High Score	+3.3

Low Scores: Potential underprescribing

High Scores: Potential overprescribing

Frequency

(Observed – Predicted medication count)

Adverse drug reactions

Hospitalisation
and
Death

Potentially inappropriate
prescribing
(STOPP/START)
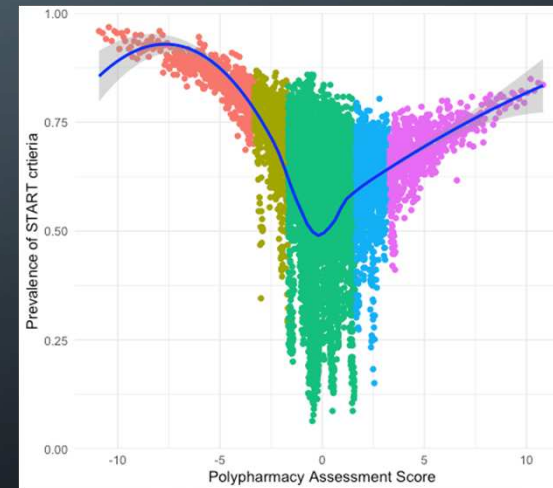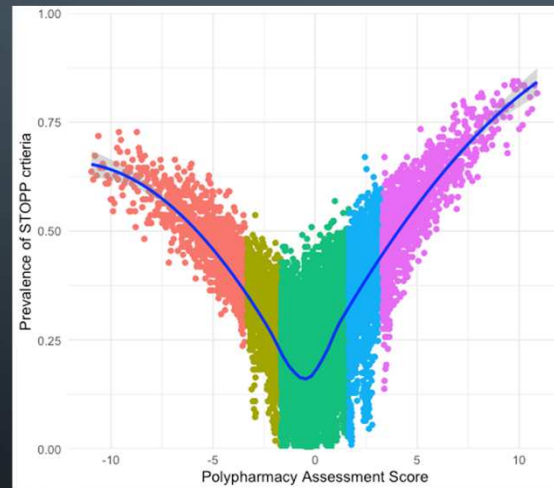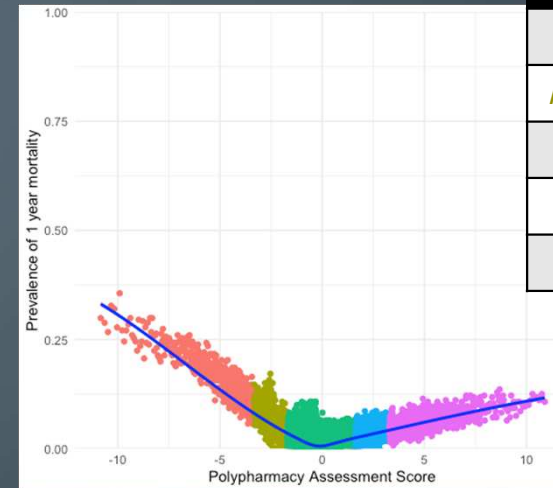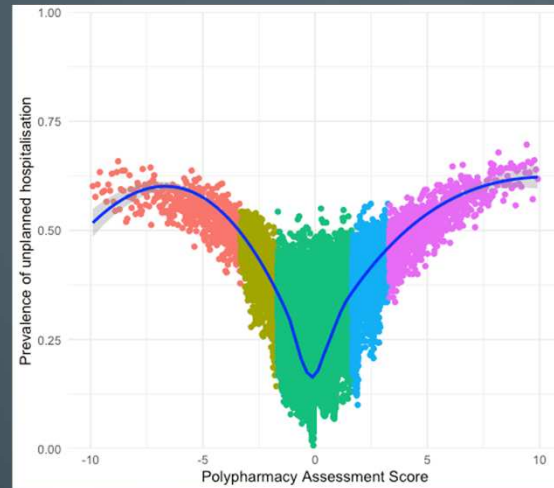
Polypharmacy Assessment Score

| Low score |
| Mildly reduced |
| Normal score |
| Moderate |
| High Score |

Multivariable analyses comparing 'High' Polypharmacy Assessment Scores to those without

	All sample (n= 8.4M)	People on 5+ medications (n=1.2M)	People on 10+ medications (n= 212k)
Adjusted hazard ratios [95% CI]			
Adverse drug reactions	1.44 (1.43-1.45)	1.25 (1.24-1.26)	1.08 (1.06-1.10)
Unplanned hospitalisation	1.52 (1.52-1.53)	1.36 (1.35 – 1.37)	1.16 (1.14-1.17)
Death (1 year)	1.25 (1.23-1.27)	1.26 (1.24-1.28)	1.14 (1.11 – 1.17)
Adjusted odds ratios [95% CI]			
STOPP criteria	2.42 (2.39 – 2.45)	1.67 (1.65 – 1.69)	1.25 (1.22 – 1.29)
START criteria	1.20 (1.19 – 1.21)	1.04 (1.02-1.05)	0.97 (0.94 – 1.01)

Limitations

- Does not account for over the counter or secondary care medicines

- Focussed on regular medications - excluding acute states and short-term medicines (e.g. antibiotics)

- Relies on accuracy of electronic health data (e.g. coding)

Conclusions

- The score stratifies populations with potential over and under prescribing that are at higher risks of adverse outcomes

- This is shift from existing approaches, expanding the focus beyond only the highest medication counts or the most unwell patients

- Our pragmatic approach adjusting for age, gender and long-term conditions to optimise explainability and implementability

Thanks for listening

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