Institute and Faculty of Actuaries

IFoA Life Conference

C6: Reclassifying Mortality Risk:

How Wearable-Driven Mortality Modelling Reshapes Risk Stratification in Life Insurance Underwriting

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Executive Summary

01

A mortality model has been developed using UK biobank data to enhance risk stratification, integrating wearable and lifestyle data

02

The results show significant potential to reclassify individuals into alternative categories

03

More accurate and precise prediction can be made than through approaches that are currently used in UK market

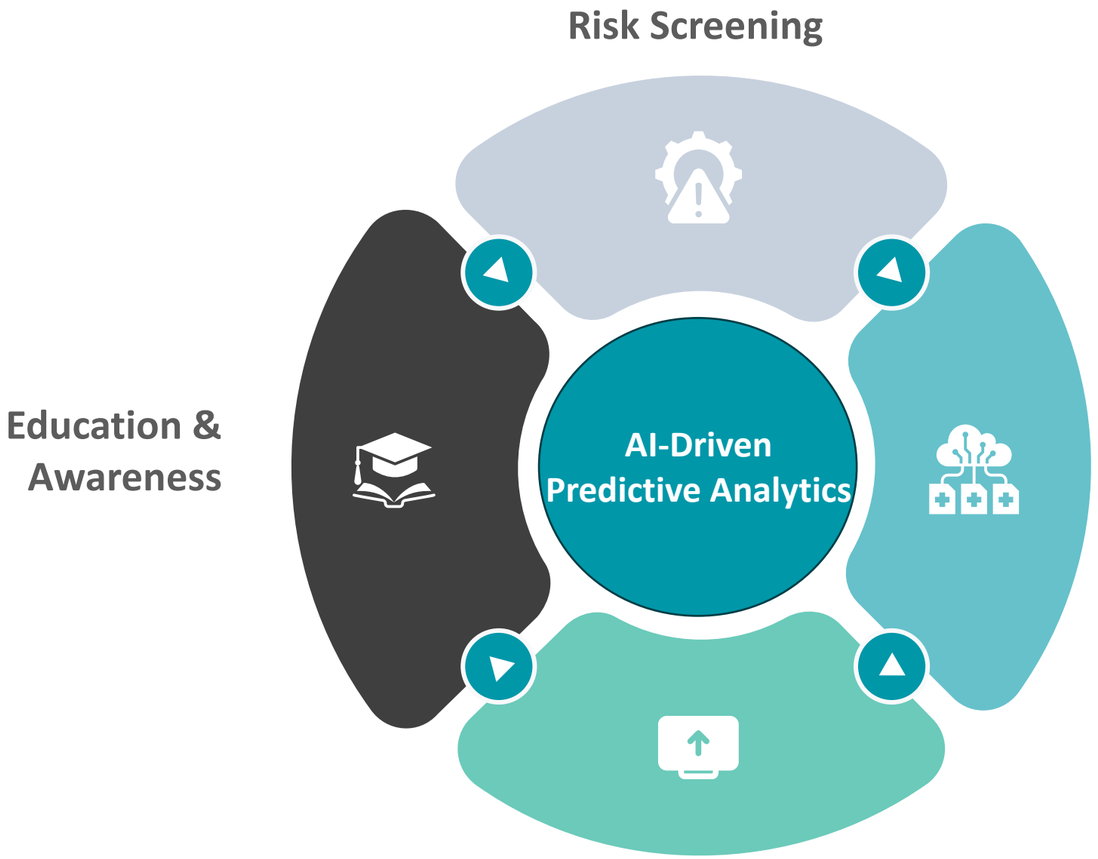
04

The outputs of the model show the key drivers of the risk and link to potential ways to modify risk in the future enabling seamless transition into targeted policy benefits

About Klarity

Klarity is a UK-based health data analytics firm that provides preventative health solutions. Its proprietary mortality and morbidity risk prediction models leverage advanced data sources like wearables, electronic health records, and blood biomarkers.

Klarity empowers insurers, brokers, and employers to improve risk stratification, early detection of chronic diseases, and personalized health insights for their customers.



UK biobank data overview

Over 500,000 lives and 37,000 deaths

Mainly age 40-70, with average period of 13.5 years to track health and mortality

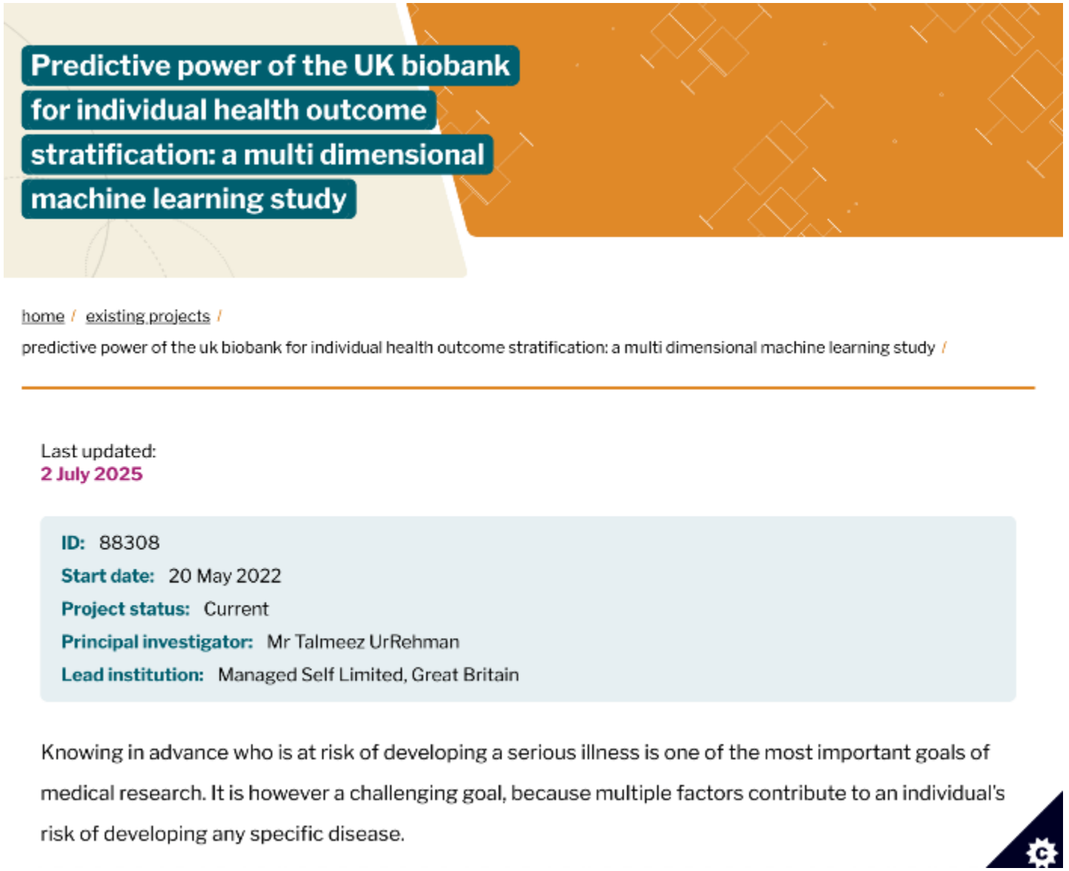
Lives recruited 2006-10 and first model built on data to end 2022

Over 6.1m life years of data, with ongoing access and analysis continuing

Multiple global research projects using data

UK Biobank Research

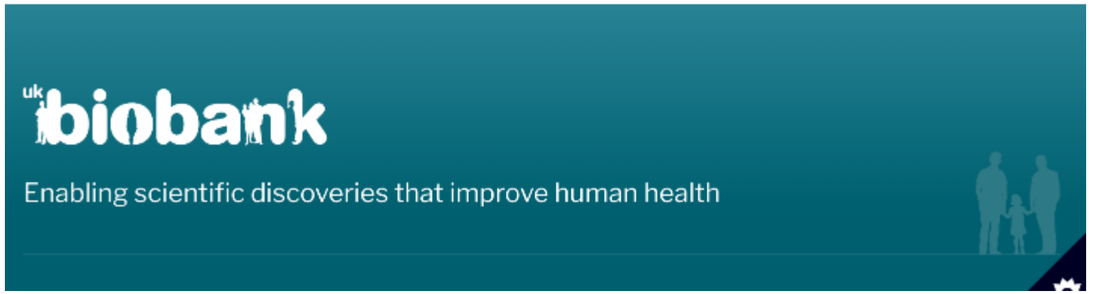
Scope of work



The UK Biobank is an excellent resource for trying to address this problem – a wide range of information is available about an enormous number of individuals. Using this information we aim to develop mathematical models to decide how great an individual's risk of developing certain common diseases (type 2 diabetes, cancer, myocardial infarction / stroke, chronic bronchitis/emphysema, and dementia) in the near future is. We will also try to understand what factors make developing common diseases more likely.

In this project in addition to personal information and medical history we will specifically study the effect of physical activity levels and blood test results on predicting future disease.

Once developed our models will be used in a public health education platform where any individual can input their own data and receive an approximate idea of their future health risk.



Modelling approach

Who?

- Work with local senior medical practitioners alongside modelling experts

How?

- Multiple efforts to find best approach to predict future from data
- Integrates traditional actuarial inputs with physiological and lifestyle factors

What?

- Non-linear large data model
- Outputs a z-score, benchmarking individual against same age and sex reference group
- SHAP value analysis highlights relative contribution of each variable to overall risk score

The Special Relationship

UK and US parallels

UK data (biobank) → US analysis (NHANES) – WTW work → Can it apply to UK protection?

US v UK protection differences

Why all the air miles?

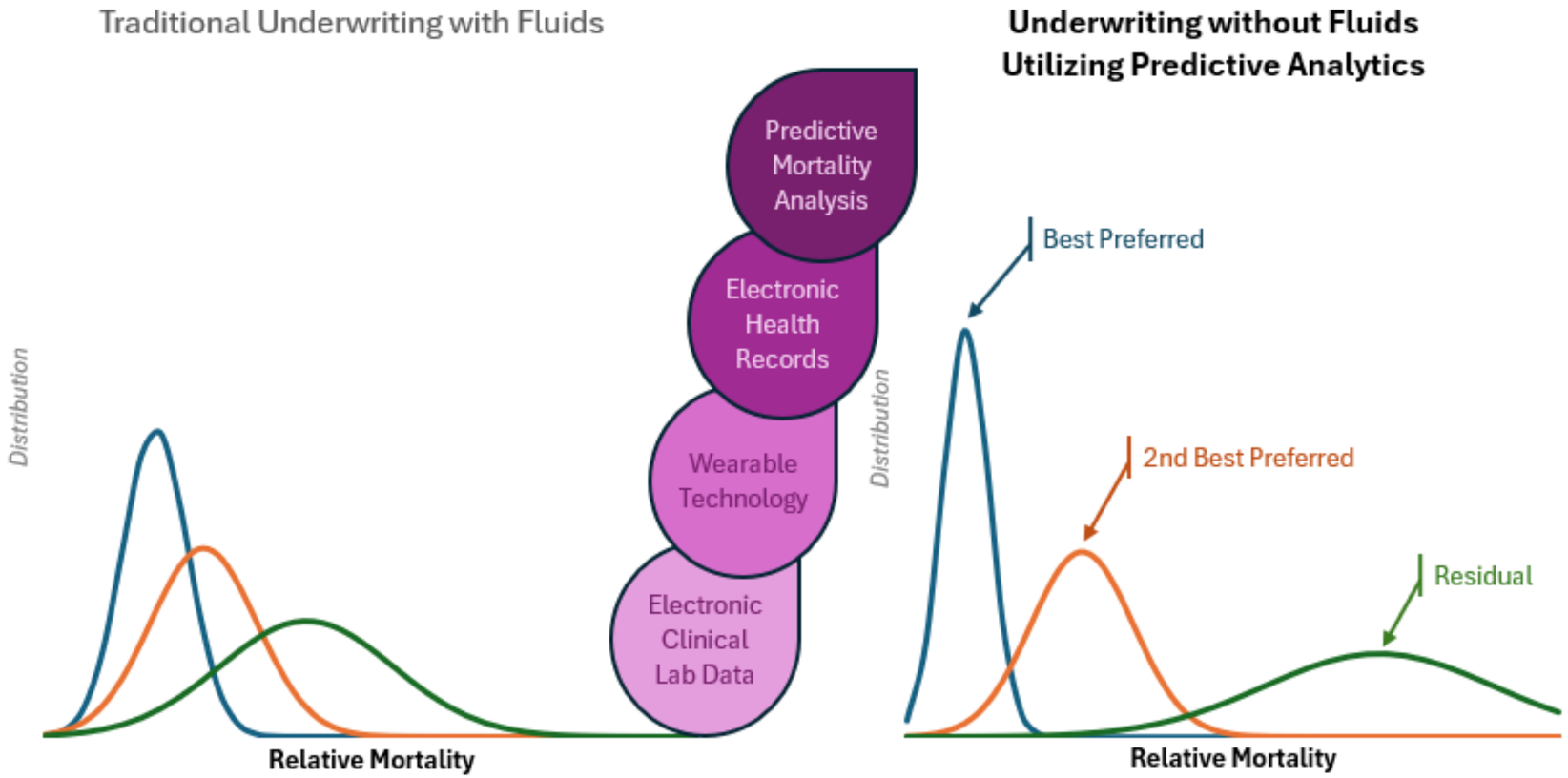
US insurers gets more evidence at underwriting stage

More extensive “fluid” collection enables more differentiated underwriting

US enthusiasm to reduce evidence collection to bring efficiency whilst not loosening risk classification means lower bar for business case

In essence in US this approach can lead to medical spend reduction whereas in the UK significant potential advantage case is around improving risk selection

From blurred lines to clear risk classification

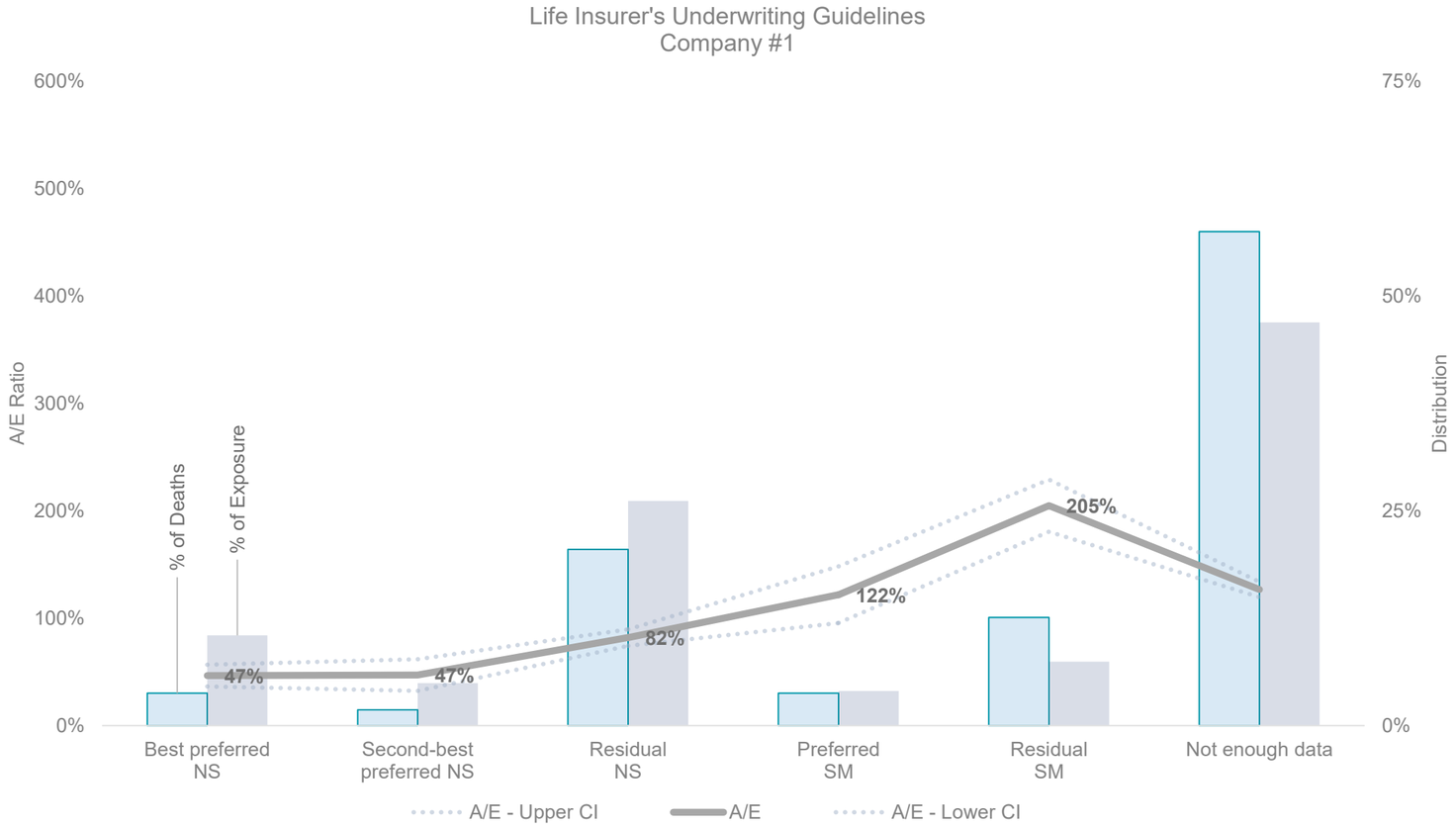


Enhanced Risk Stratification with New Data
New digital data sources provide clearer differentiation of risk classes, enabling faster, less invasive and more accurate risk classification

Enhanced Risk Stratification with New Data
In certain cases, wearables provide an alternative to fluids

Traditional US Underwriting: Current Risk Stratification

Mortality experience against current underwriting approaches*



Overlapping mortality outcomes

Traditional preferred risk classes show potentially overlapping mortality outcomes – e.g. “Best Preferred” and “Second Best” nonsmoker classes can have very similar A/E** ratios.

UK approach doesn’t try to differentiate

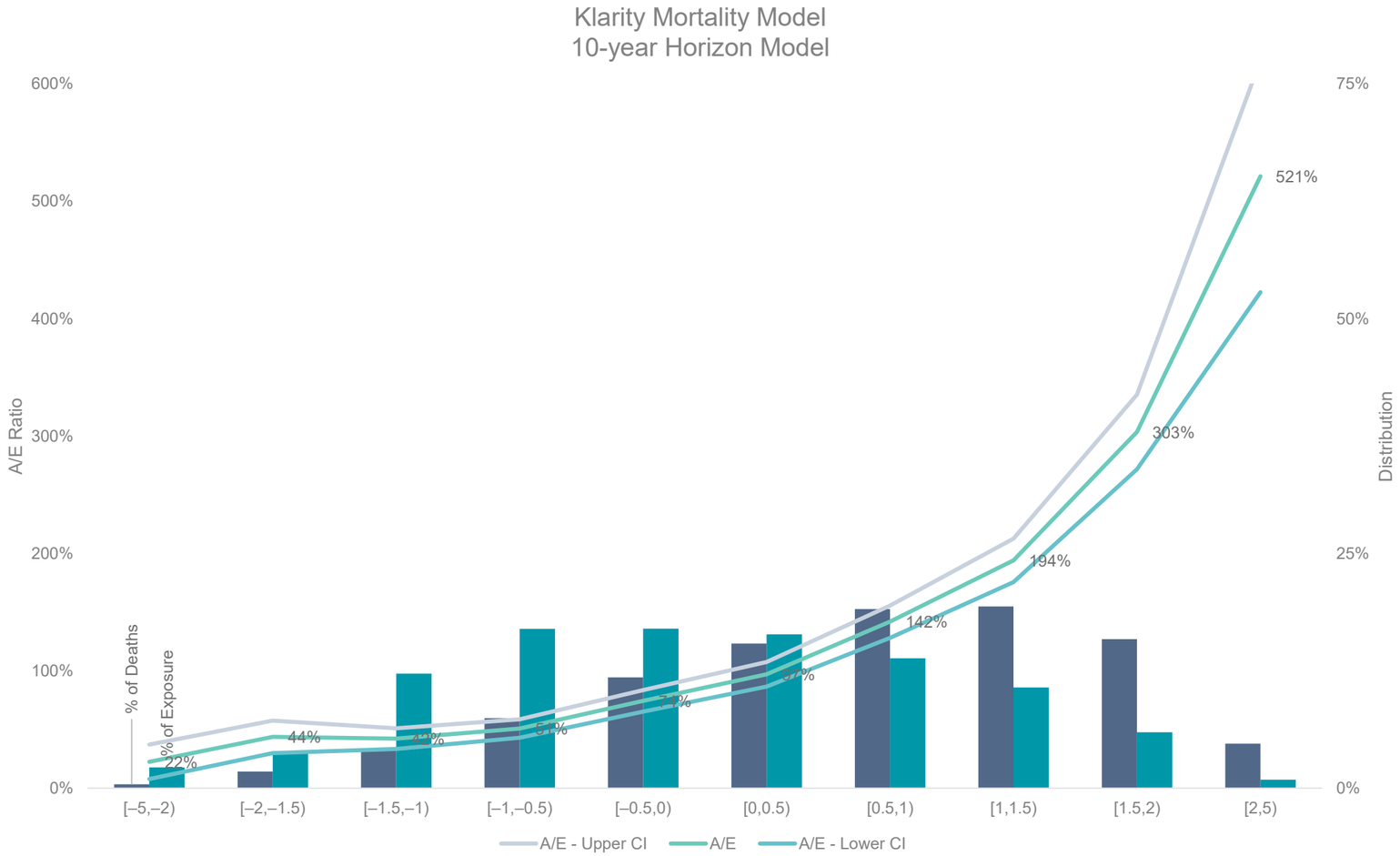
Across market c.75% of applicants receive best rate for age and gender (“standard rates”)

* *Class assignment estimated based on representative preferred guidelines; in some cases, certain information to assess criterion was missing and estimates for assignment as overall standard risk were made.*

** *Expected basis or “E” is the 2019 US Population Table, released by the Social Security Administration. 2019 was used rather than the more recent 2021 report to remove the impacts from COVID-19.*

Improving curve risk separation

Mortality experience against current underwriting approaches*



The Klarity model:

- produces scores that better align with mortality results – as risk scores increase, mortality A/E generally increases

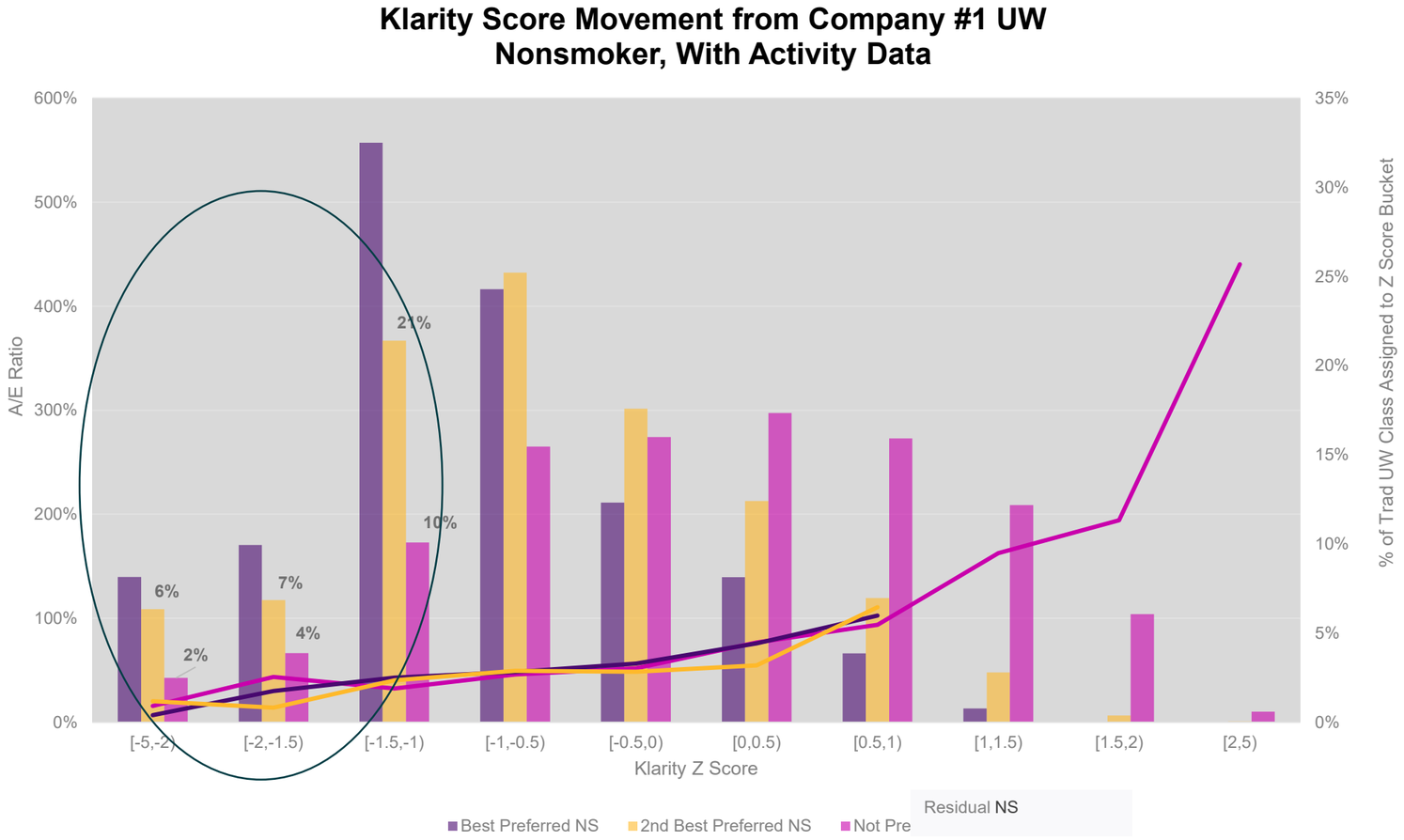
- identifies a clear gradation of risk, including flagging a small subset with very high A/E (worst risks)

- classifies individual risk using a Z-score, which reflects how much a person's predicted risk deviates from the average for their age and gender group

- 1 point on the z score indicates a movement of 1 standard deviation away from average outcome for age and gender.

Reclassification of lives under model

Analysis shows better segmentation of low mortality risks is possible



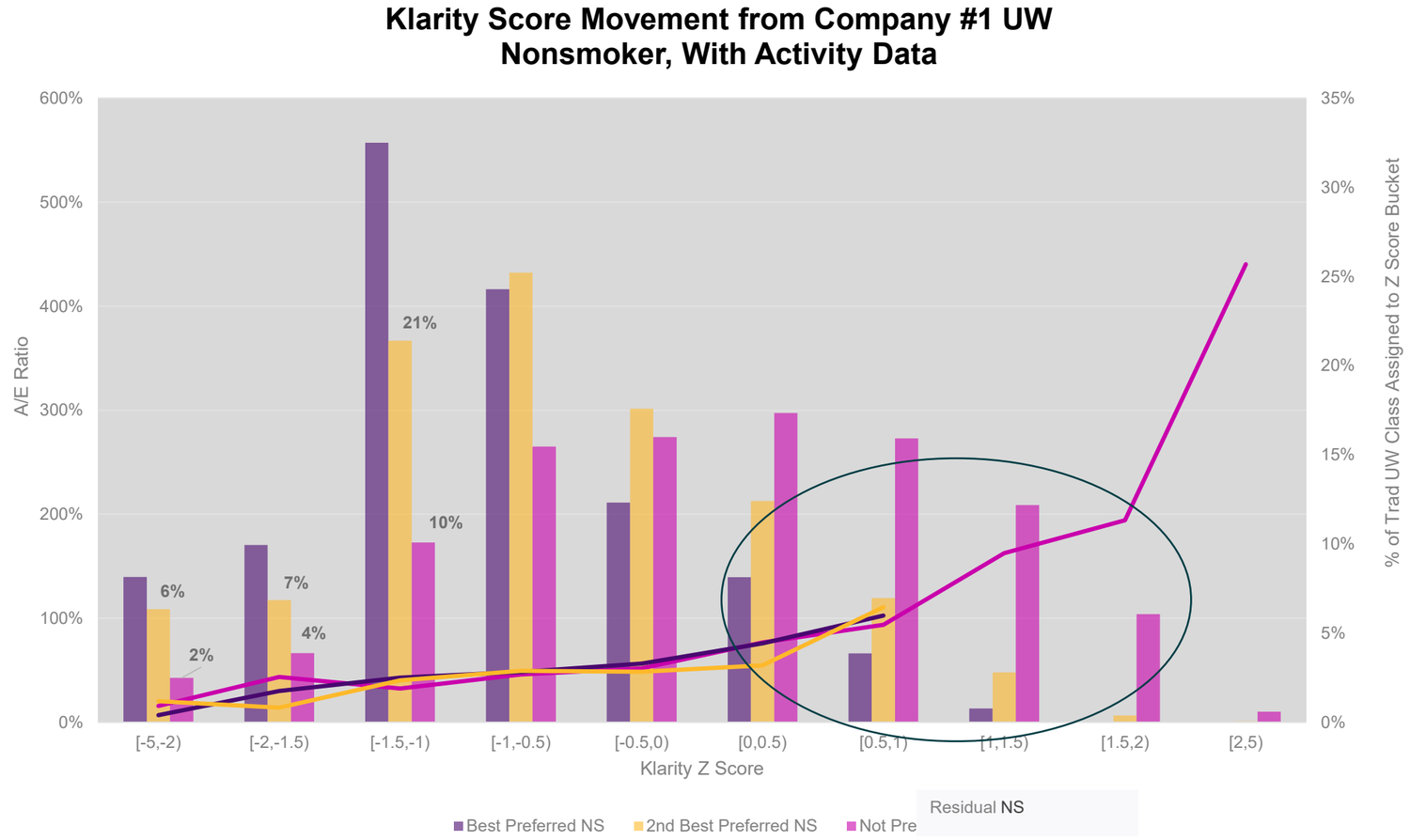
Upward reclassification: 34% of Second-Best Preferred nonsmokers and 16% of Residual (not preferred) nonsmokers actually have mortality as good as Best Preferred*

Downward Pricing Considerations

There is the potential to reduce the price being paid for risks with lower Z scores or to more actively pursue these lives who currently offer more margin between risk and price paid

Reclassification of lives under model

Analysis shows better segmentation of high mortality risks is possible



Downward reclassification

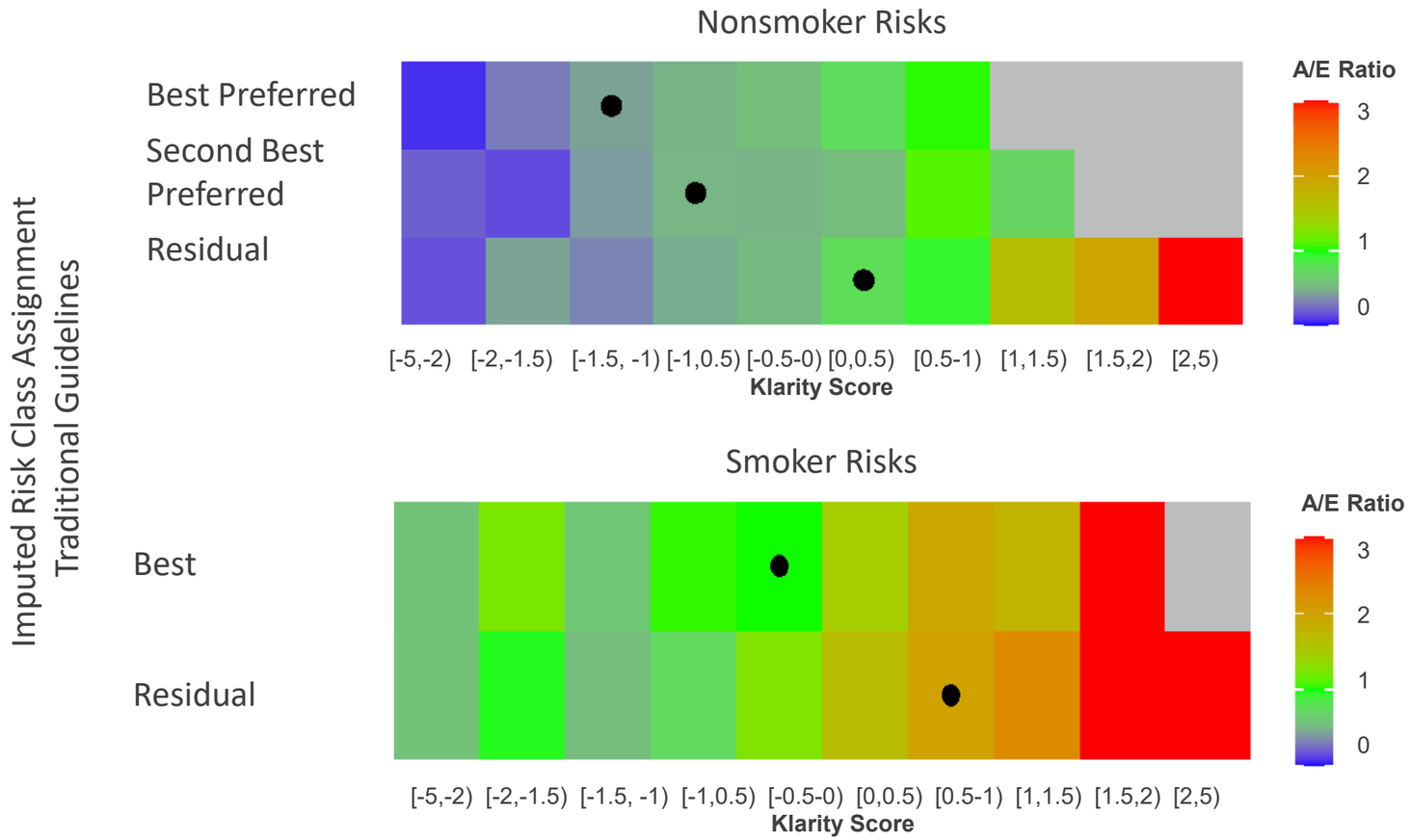
Conversely, 6% of today's Best Preferred and 13% of Second-Best have A/E >105% (worse than expected), resembling residual risks*

Upward Pricing Considerations

Use of the Z score enables identification of the more right-tailed risks that fit within a residual standard class; enabling ability to charge for these risks more appropriately or not offer terms at all

Economic Value of model

An improved model can improve pricing accuracy and business volume

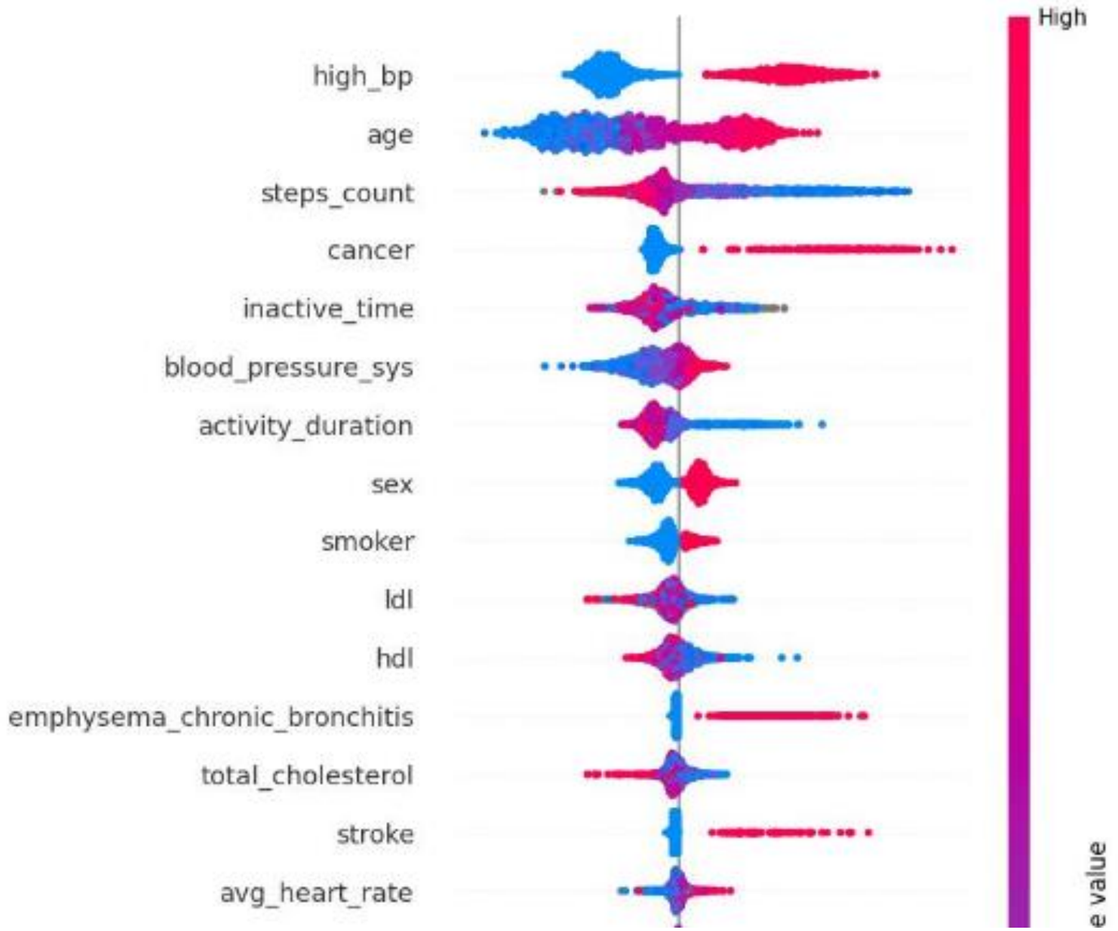


- **Misclassification reduced**
  Many “best” class lives were actually higher mortality risk and many “standard” or residual lives reflected Z scores aligned with lower risk. Using a redistribution aligned with Z scores enables a tightening of the mortality spread within each class.

- **Individualise Pricing**
  Coupling predictive analytics with health-related indicators such as activity and inactivity levels, sleep duration, and resting heart rate, enables a new paradigm for more personalized pricing and rethinking the customer experience.

Reclassification of lives under model

Analysis shows better segmentation of high mortality risks is possible



The top predictors span lifestyle and medical risk factors:

Lifestyle factors

Daily activity duration, step count and inactive time have a strong correlation to mortality risk. Not considering these risk factors results in a sub-optimal risk assessment

Health factors

Traditional markers like high blood pressure and a history of cancer are also among the most influential risk factors, confirming medical history remains important.

Personalised data insights

Mortality summary

Klarity Life Expectancy
Personalized life expectancy impact

30.9
Years Life Expectancy

Standard Life Expectancy:	31.2 years
Klarity Life Expectancy:	30.9 years
Years Impact:	-0.3 years

NEUTRAL
Based on a z-score of 0.29, life expectancy is decreased by 0.3 years compared to the standard population.

Klarity Age-Equivalent Analysis
How risk translates to apparent age

49.0
Age-Equivalent Years

Chronological Age:	49
Klarity Age-Equivalent:	49
Age Shift:	0.0 years

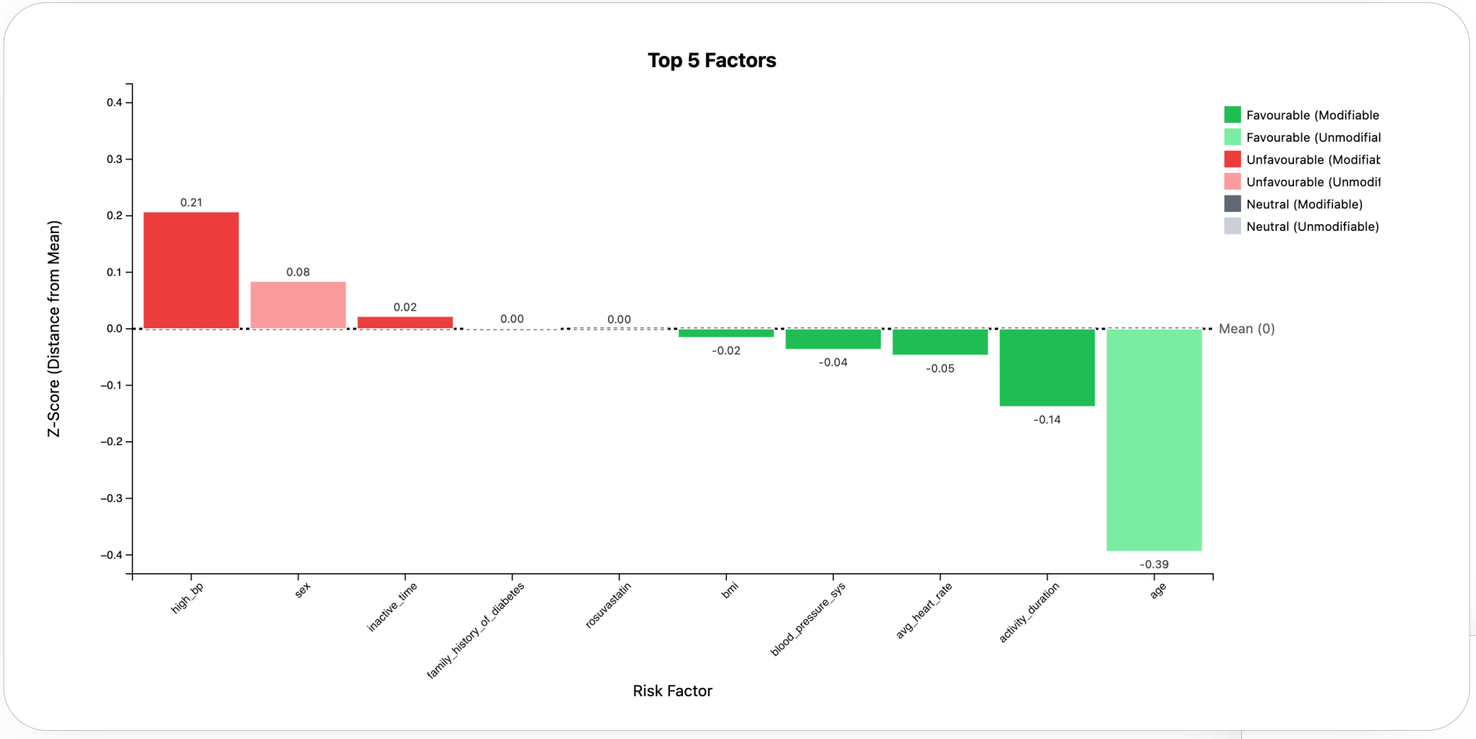
+0.0 years
This person's mortality risk is equivalent to someone who is 49.0 years old

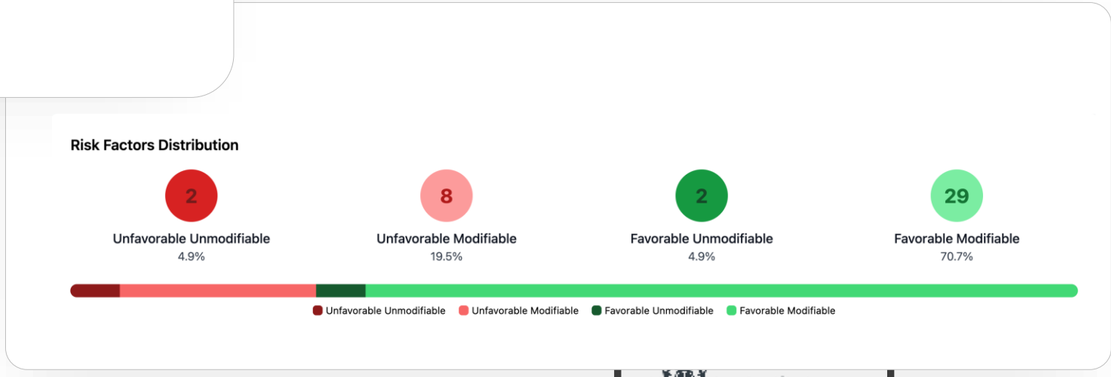
10-Year Mortality Risk

Baseline 10-Year Mortality Risk	6.66%
Klarity 10-Year Mortality Risk	6.88%

Personalised data insights

Transparent summary





Potential application in UK Protection Market

Doing more with less – using data to ask less questions with same predictive ability

Optional use through process – using data as alternative to further evidence collection

Doing more with more – using data through process to improve predictive ability

From modelling to reality

Refining underwritten premium

- Use data to enable earlier risk classification to be made and different ratings to be applied at policy outset

- Ask for access to wearable data to obtain information on representative sample of all new business

- Use data to propose amendments to underwriting decisions and/or evidence obtained

- Success criteria:

- show potential to amend underwriting decisions in c. 20% of cases
- minimise friction to application process
- understand balance between friction and improved terms

From modelling to reality

Informing and improving health

- Use data to assist measurable improvement in customer health
- Use underwriting information to flow into post-issue engagement
- Re-engage through policy duration
- Success criteria:
  - Customer engagement with significant % of portfolio
  - Mortality improvements observed in engaged users
  - Improved customer loyalty

How wearable-driven mortality modelling reshapes risk stratification in Life Insurance Underwriting

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