

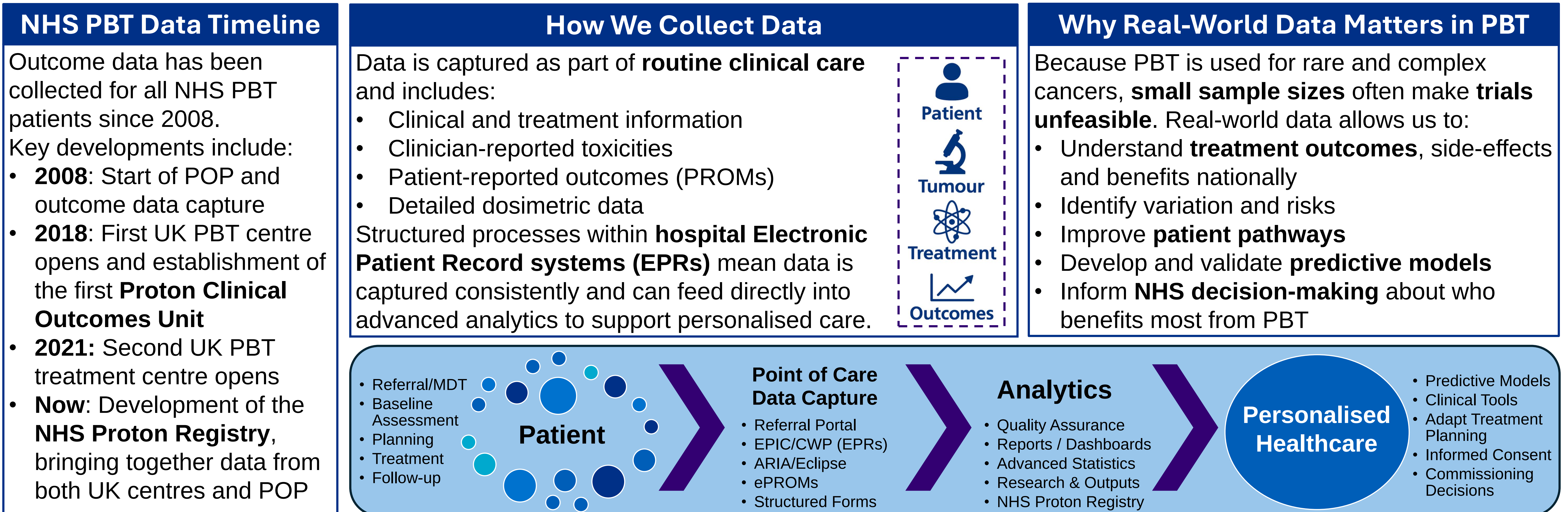
The NHS Proton Real-World Data Strategy: Personalising Proton Beam Therapy

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BACKGROUND & METHODOLOGY

Proton Beam Therapy (PBT) is a highly targeted type of radiotherapy used for **rare and complex cancers**, including many **childhood cancers**. Before 2018, NHS patients needing PBT were treated abroad through the **Proton Overseas Programme (POP)**. There are now two NHS centres delivering PBT in the UK: **The Christie NHS Foundation Trust, Manchester (2018)** and **University College London Hospitals (2021)**.



PERSONALISED CARE: PREDICTIVE MODELLING

EXAMPLE 1: Feeding Tube Risk in Head and Neck Cancers

We developed a **predictive model** that estimates whether a patient will need a **feeding tube** during treatment.

Key predictors include:

- Treatment Site**
- Tumour Stage**
- Chemotherapy Type**
- Contralateral Parotid Dose**

The model categorises patients into **low, medium, or high risk**, supporting clinical decisions about whether to fit a feeding tube before treatment or monitor and act if needed.

This helps **avoid unnecessary procedures** and improves patient quality of life. We balanced **statistical significance** against **predictive ability** to select predictors for inclusion in our final model.

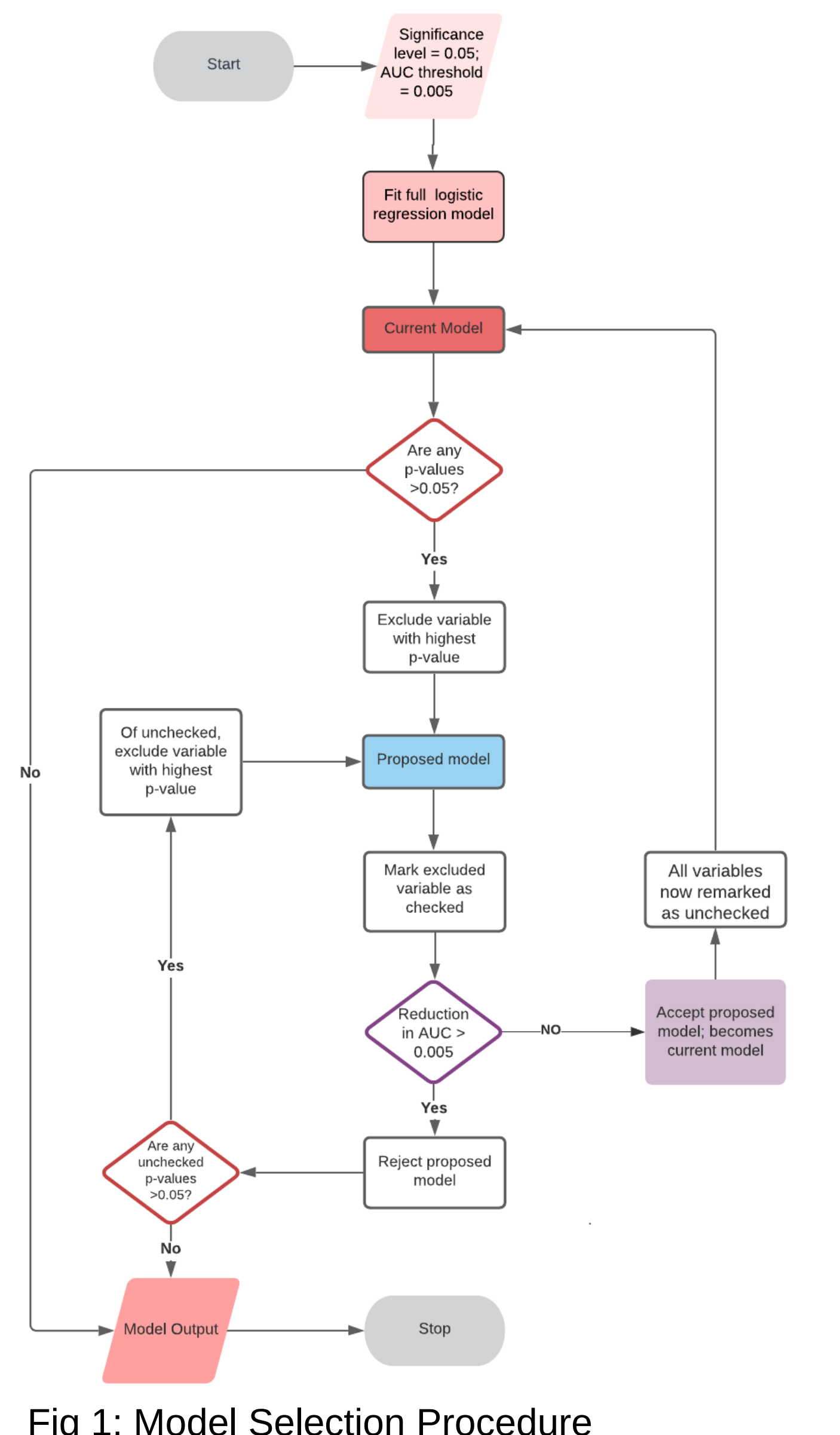


Fig 1: Model Selection Procedure

Example Patient: T-stage 3, Larynx Tumour

Contralateral Parotid Dose = 28.0 & Chemo = None	LOW
Contralateral Parotid Dose = 28.0 & Chemo = Carboplatin	MEDIUM
Contralateral Parotid Dose = 40.0 & Chemo = None	MEDIUM
Contralateral Parotid Dose = 40.0 & Chemo = Carboplatin	HIGH

EXAMPLE 2: Predicting Radiotherapy-Induced Hair Loss

A second study looked at hair loss (alopecia) in brain tumour patients treated with PBT and tested existing published normal tissue complication probability (NTCP) models.

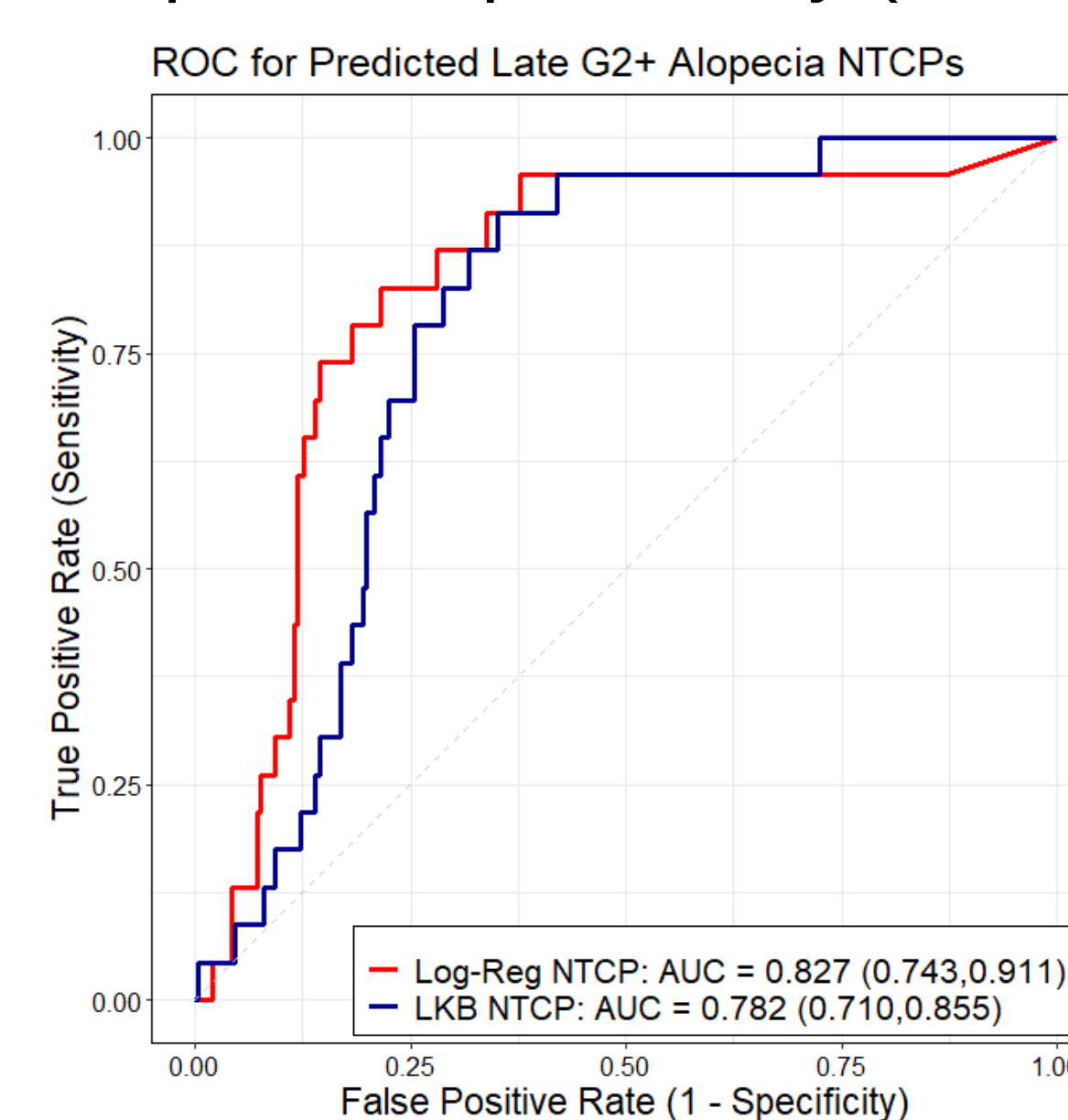


Fig 2: ROC Curves for NTCP Models

Findings showed:

- Previously published models **lacked generalisability**
- Validation is essential before using predictive models in routine care
- Consistent scoring and reporting of side effects is needed across centres

This work helps ensure predictive tools used in the NHS are safe, accurate, and clinically meaningful.

Good Discrimination
Models able to predict alopecia incidence well

Poor Calibration
Models over-predicted risk of alopecia

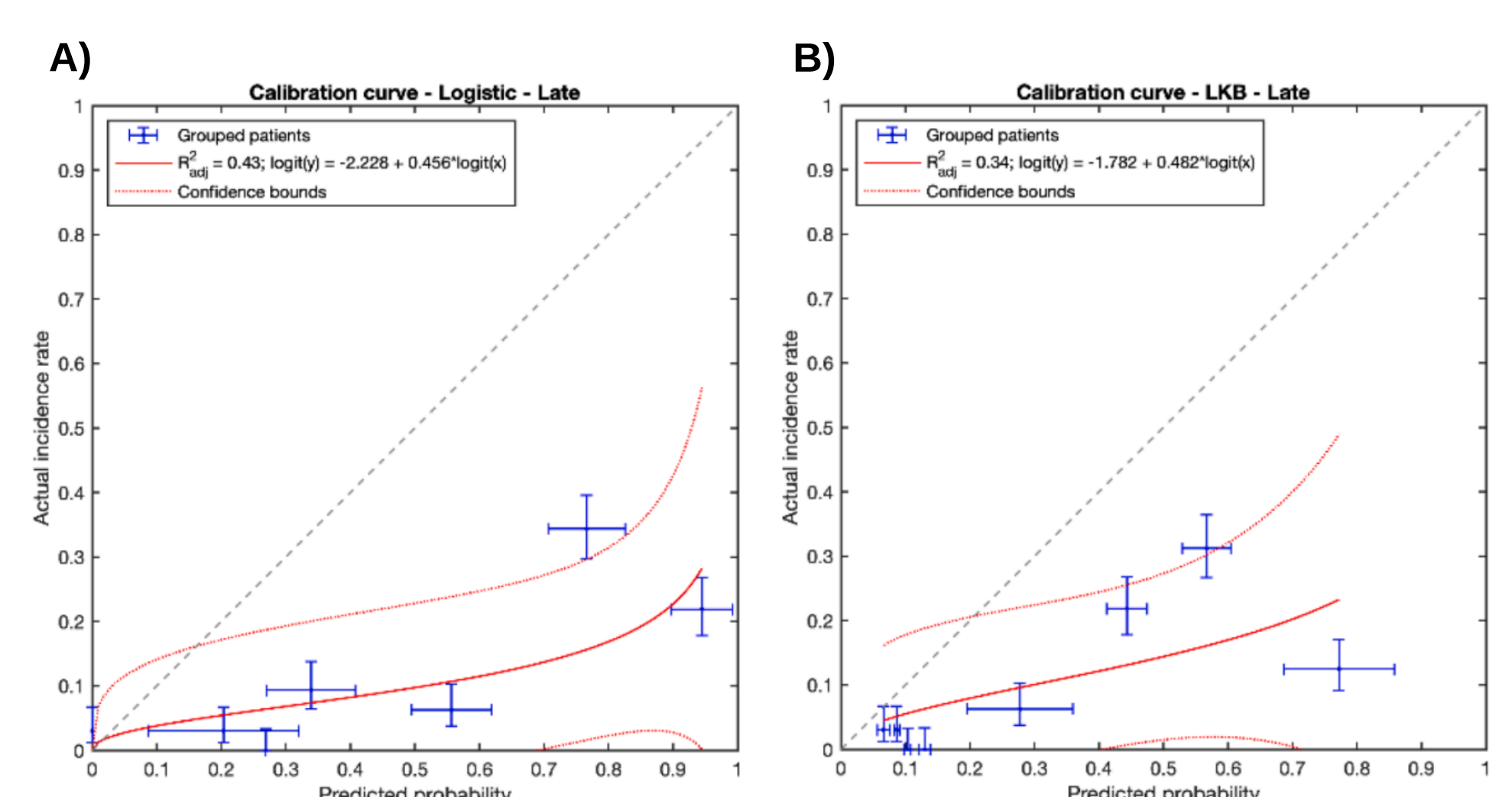


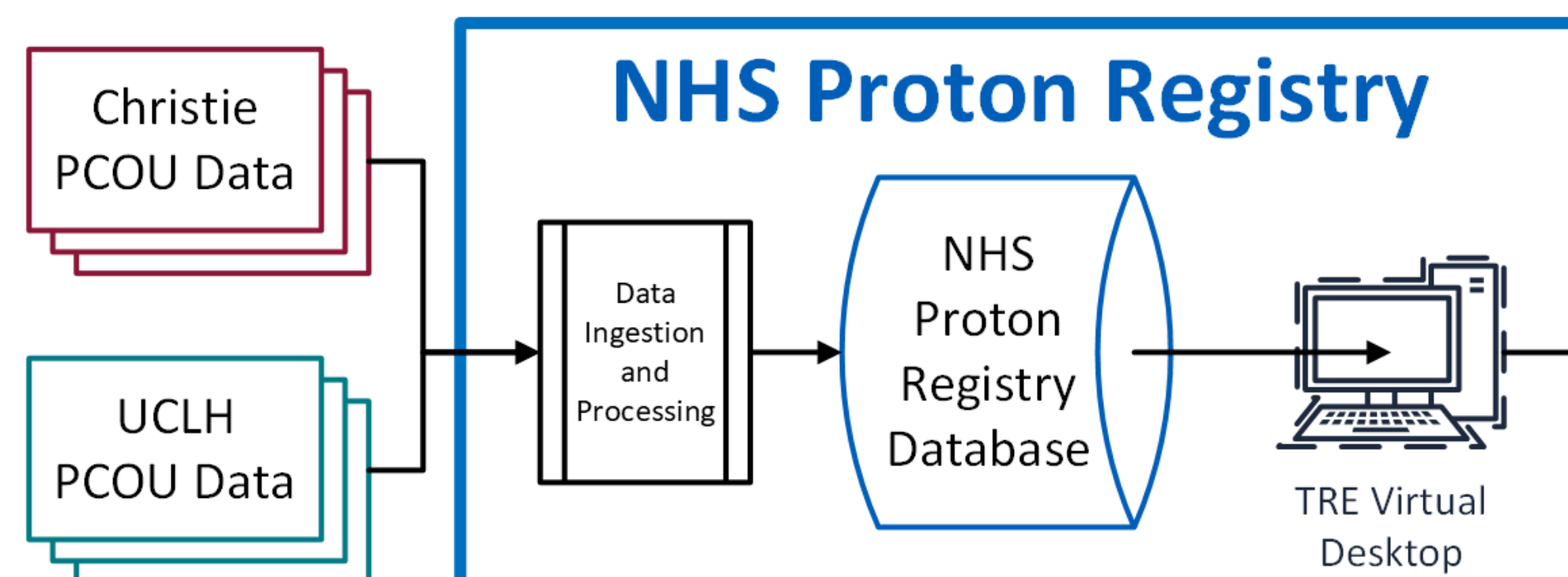
Fig 3: Calibration curves for NTCP models.

A) Logistic Regression Model B) Lyman-Kutcher Burman Model

NATIONAL AND FUTURE IMPACT

National dataset for assessment of:

- Mortality
- Tumour control
- Treatment-related side effects
- Equity of access



Evidence for Clinical Decisions

4000+ Patients >50% Paediatric 30+ Indications

- Improve **personalisation** of PBT
- Support **informed patient consent**
- Help plan treatments to **minimise side-effects**
- Guide NHS service development & prioritisation
- Identify **research opportunities** across the UK
- Guide NHS **commissioning decisions**

Conclusion: Real-world data is transforming how Proton Beam Therapy is delivered across the NHS. By combining structured data capture, national collaboration, and predictive modelling, we are **improving safety, personalisation, and outcomes** for patients with rare and complex cancers.

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