Eastern England SECURE DATA ENVIRONMENT

Part of the NHS Research Secure Data Environment Network

NHS

From Algorithm to Impact:

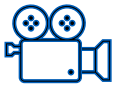
Can AI help predict pressure ulcers before they happen?

Monday 19 October, 11:00-11:45am

Health Innovation East Midlands

Local change, national impact

Housekeeping



This session is being recorded and will be shared on our websites.



Please keep microphones muted during presentations.



Cameras are optional but welcome during the Q&A.



We'll have **time for questions at the end,** please do **pop questions into the chat whilst each of speakers are presenting.**

If we run out of time to answer all questions we will follow up after today's session.

Introducing the Eastern England Secure Data Environment (SDE)

The EE SDE comprises a research governance framework and technical platform that work together to make de-identified NHS patient data securely accessible for approved research in the public interest.

The **East Midlands SDE** joined **East of England SDE**, under a common operating and governance arrangements from 1 February 2026. The combined population is ~12 million.

The combined SDE is hosted by **Cambridge University Hospitals NHS Foundation Trust.**



SDE fit with the health data ecosystem

	Shared Care Records	Strategic data platforms	Federated Data Platform	Eastern England SECURE DATA ENVIRONMENT	OpenSAFELY
What is it?	Set of standards and data sharing technologies between clinical / care systems	Platform to hold linked system data warehouse and analytics tools	Series of platforms to link and analyse data using common standards	Platform to temporarily hold and analyse linked datasets for specific approved studies	Analytics process to apply to Primary Care data – querying, without viewing underlying data. Originally Covid19 research – now expanded to other disease areas
Why is it used?	Direct care	Proactive care Planning	Direct care Proactive care Operational	Research	Research
What data does it hold?	Key information from health and social care records *Identifiable*	Commissioning datasets and primary care records, plus other health and social care records (vary by area) *Pseudonymised* *Re-identifiable (direct care only)*	Health and social care records and operational data *Identifiable (direct care only)* *Pseudonymised (otherwise)*	Sub-sets of any health and care data records (vary by study needs) *Linked + De-identified* *Linkable to other data sources*	Sub-sets of primary care records only (vary by study needs) *'Eyes off' Analysis of primary care data only – not linkable*
Who can use it?	Care professionals	Approved clinical, operational & BI NHS staff	NHS staff with existing data access	Approved researchers	Approved researchers

Using the Secure Data Environment for research

Choose the route that best fits your data, approvals and research needs

1 SDE sourced data + infrastructure

Access research-ready, de-identified NHS data within the SDE's secure research environment

For when the data you need is available through the SDE

- Expert support for your study – from feasibility to navigating data access committee application and approvals
- Projects operate under Confidentiality Advisory Group (CAG) and NHS Research Ethnics approvals of the SDE as a recognised research database
- One single route for data from multiple providers partnered with the SDE
- One Data Access Request ➡ one Data Access Agreement

2 Bring your own data

Use the secure SDE platform to analyse data you already hold under your own ethics and regulatory approvals.

For when you want a secure platform to analyse your own data

- Collaborate securely with project partners using a managed NHS research environment
- Suitable for data held under existing ethics and regulatory approvals
- Access to the SDE and analytical tooling – a safe alternative to data sharing for collaborative research

3 Combined data project

Securely combine researcher-provided data with approved SDE accessed data for a single research project.

Enables richer analysis where linkage adds value.

- Combine researcher provided data with approved SDE-accessed NHS data
- Enables approved linkage between researcher-provided **structured** datasets and SDE-sourced NHS data where there is a clear research justification and appropriate governance approval
- Researcher must hold appropriate approvals for their own dataset
- Linkage subject to SDE governance review and approval

Dedicated service desk supporting researchers on the platform when your project is live

What can a researcher access?

- De-identified **routinely collected secondary care data**
- Medication and diagnostic data – **not easily available elsewhere**
- Ability to **find and link datasets** across the region to support cohort discovery and identify linked data relevant to your study
- **Dedicated service desk and ticketing system** supporting researchers on the platform
- Bring your own data and use the secure platform for analysis (own ethics/approvals required)
- Governance + Single Data Access Committee



~1.5 million



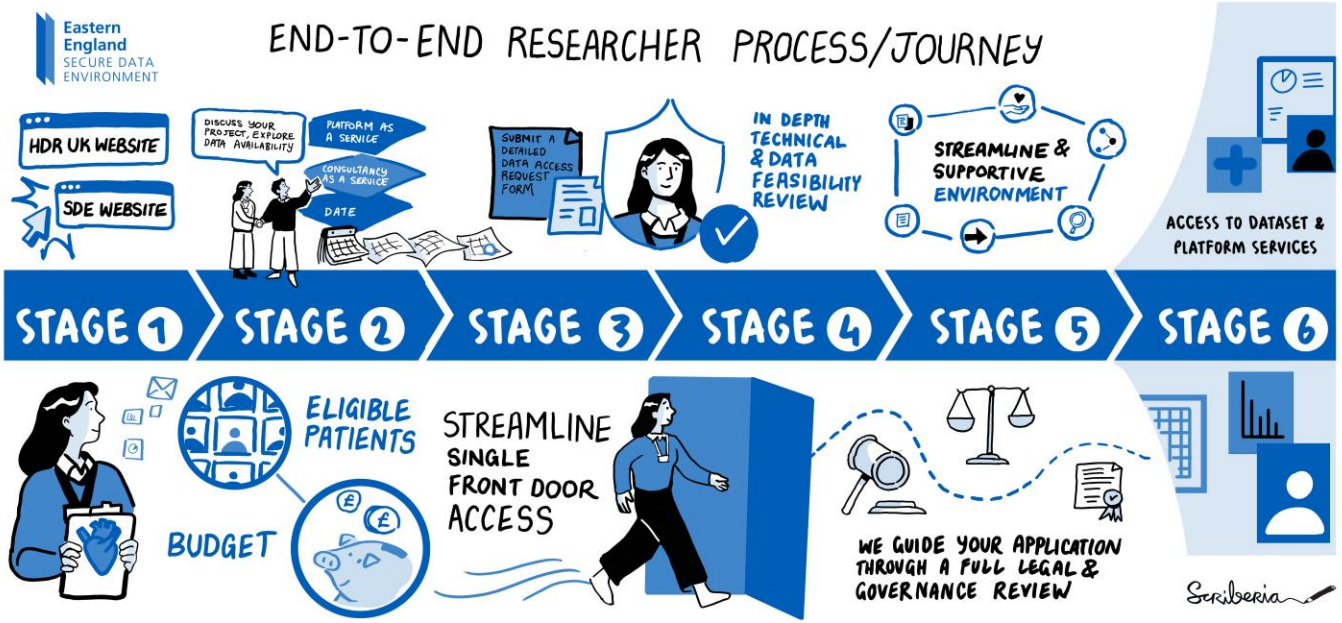
10 years +



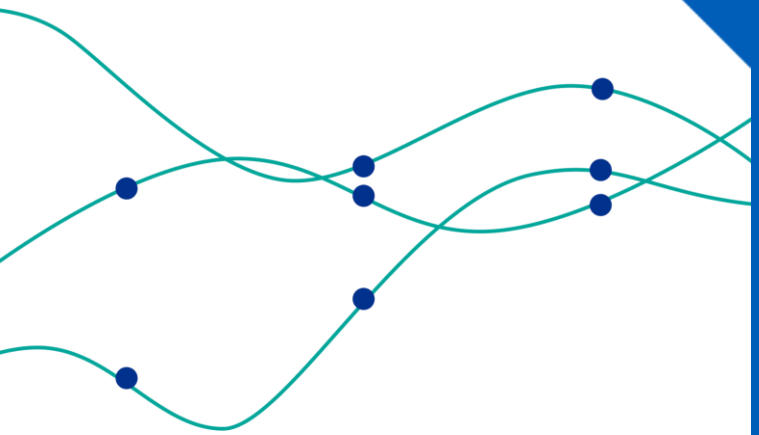
>2 Billion

	Cambridge University Hospitals NHS Foundation Trust	Milton Keynes University Hospitals NHS Foundation Trust	Norfolk and Norwich University Hospitals NHS Foundation Trust
# patients	1,067,482	419,285	31,847
# years	>10	Up to 18	>10

Researcher data journey



NHS



Eastern England
SECURE DATA ENVIRONMENT

Part of the
NHS Research Secure Data Environment Network

SDE Project

Simon Erridge

IMPERIAL

In collaboration with

Prelego

Validating PressureAI in the East of England Secure Data Environment

Learnings from evaluating a machine-learning model for hospital-acquired pressure ulcers using real-world NHS data

Dr Simon Erridge | Department of Surgery & Cancer, Imperial College London | Chief Medical Officer, Prelego

Health Innovation East | East of England SDE launch webinar

Hospital-acquired pressure ulcers: costly and largely preventable

Why earlier identification of risk matters

£1.4bn

estimated annual cost of pressure ulcers to the NHS

~1%

of total NHS spend

Up to 90%

preventable with appropriate care interventions

Current practice: bedside risk scales

- Manual, intermittent and adds documentation
- May miss deterioration during an admission
- Modest discrimination: median AUROC 0.61–0.77

The opportunity: routinely collected data

- Blood tests, observations and diagnoses already recorded
- Risk recalculated automatically every inpatient day
- Prevention targeted earlier to rising risk

Guest JF, et al. BMJ Open 2018;8:e021769. Wellell. The Pressure Problem, 2024. Kandula UR. BMC Nurs 2025;24:11. EPUAP/NPIAP/PPPIA Guideline 2019. AUROC, area under the ROC curve.

EHR models beat bedside scales, but few are externally validated

Systematic review and meta-analysis, 2000–2026

Pooled c-statistic

0.852

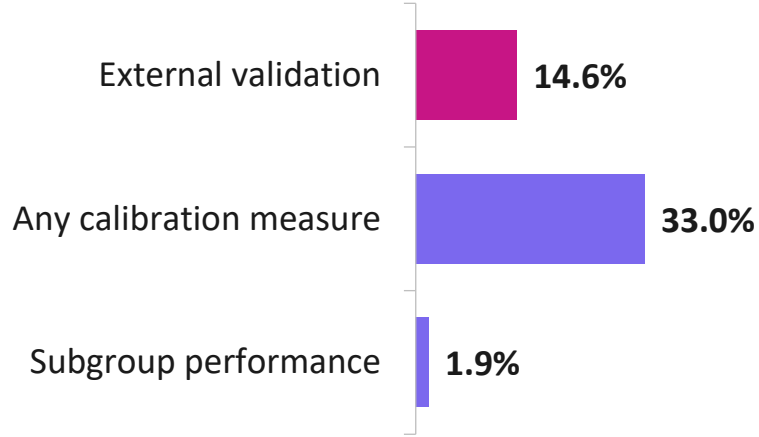
95% CI 0.831–0.871 | I^2 = 97.2%

103 studies, 3.6 million participants

Models outperformed **the Braden Scale** in within-study comparisons

All 115 model evaluations at high risk of bias (PROBAST)

Proportion of included studies reporting…



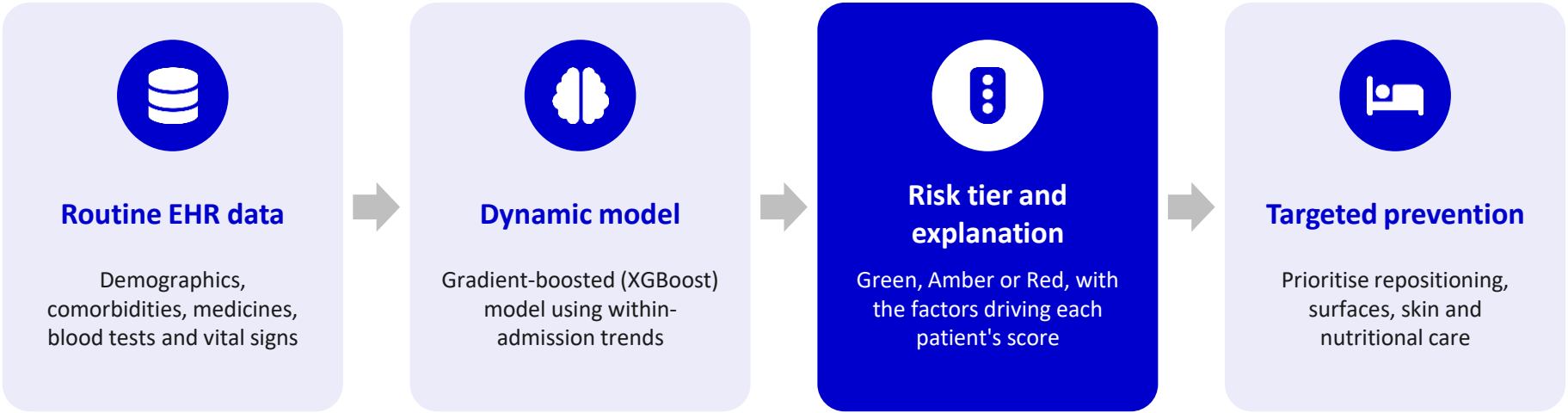
External validation 15/103 | Calibration 34/103 | Subgroup performance 2/103

Implication: the concept is supported, but adopting any individual model requires external validation, calibration and prospective evaluation

Kawka M, Erridge S, et al. Systematic review and meta-analysis (submitted). PROSPERO CRD420261446789. HAPU, hospital-acquired pressure ulcer; EHR, electronic health record.

PressureAI: a daily risk score from data hospitals already collect

Clinical decision support software to help prioritise preventive care



Updated every inpatient day

No additional data entry
for ward staff

Adjunct to clinical judgement
does not replace skin inspection or assessment

Adult inpatients (≥18 years)
acute medical and surgical admissions

Developed and internally validated in Imperial's iCARE SDE

Imperial College Healthcare NHS Trust, 2015–2025

638,125

adult admissions

13,634

HAPU events

10 years

of routinely collected EHR data

Patient-level partition (no patient appears in more than one set)



Held-out test set

38,048 admissions | 283,364 patient-days | 799 with HAPU (2.1%)

- Outcome from incident reporting (Datix), linked to EHR records
- Reported in line with TRIPOD+AI
- Uncertainty from 1,000-resample, patient-clustered bootstrapping

HAPU, hospital-acquired pressure ulcer; TRIPOD+AI, Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis, AI extension.

Internal validation: strong discrimination and useful lead time

Held-out iCARE test set (38,048 admissions)

0.919

AUROC across the whole admission

95% CI 0.910–0.927

0.840

AUROC for each daily prediction

95% CI 0.827–0.852

74.2%

of HAPU admissions flagged Amber or Red

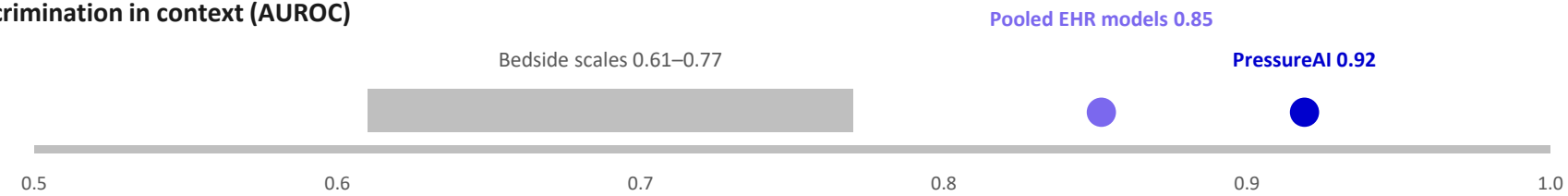
593 of 799

11 days

median lead time from first alert

71.7% flagged ≥24 h before the event

Discrimination in context (AUROC)

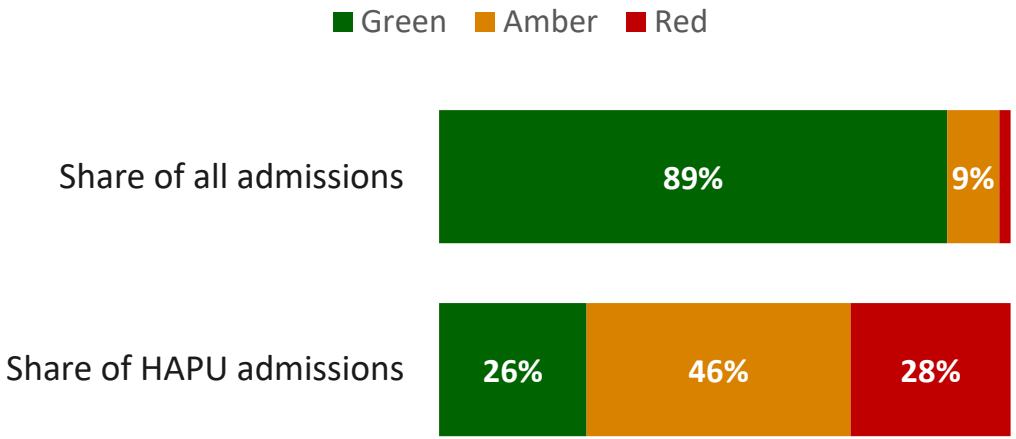


Internal validation only. Comparison with published ranges is indicative and does not replace external validation.

AUROC, area under the receiver operating characteristic curve; HAPU, hospital-acquired pressure ulcer. Bedside scale range: EPUAP/NPIAP/PPPIA 2019. Pooled EHR models: Kawka et al. (submitted).

Risk tiers focus prevention on a small, high-yield group

Admission-level performance at the locked operating point



29.7% developed a HAPU (224/754)

2.0% of admissions | 14-fold enrichment over baseline

10.7% developed a HAPU (369/3,448)

9.1% of admissions

0.6% developed a HAPU (206/33,846)

89.0% of admissions | negative predictive value 99.4%

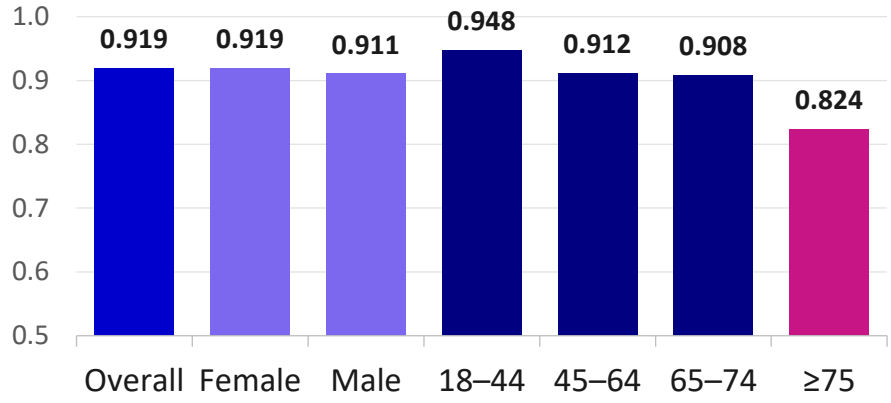
Amber + Red: 11% of admissions, capturing 74% of patients who developed a HAPU. A basis for directing specialist surfaces and tissue viability time where they are most likely to help.

Observed HAPU incidence by tier on the held-out iCARE test set (n = 38,048 admissions; prevalence 2.1%). HAPU, hospital-acquired pressure ulcer.

Consistent across patient groups and explainable at the bedside

Subgroup fairness and SHAP (SHapley Additive exPlanations) analysis

AUROC by sex and age band (years)



Ethnicity: 0.900–0.943 across groups with adequate events

Age ≥75: lower AUROC and more false positives, but the highest recall (0.782). Disclosed and monitored post-market

Top drivers of predicted risk (global SHAP)

1. **Serum albumin** Nutrition
2. **Age at admission** Frailty
3. **Urea:creatinine ratio** Hydration and renal function
4. **C-reactive protein** Inflammation
5. **Conscious level (GCS)** Mobility and neurological status

Each patient's score can be decomposed to show clinicians why they have been flagged.

AUROC, area under the receiver operating characteristic curve; GCS, Glasgow Coma Scale. Subgroups with <30 patients or <5 events omitted.

Coming soon: external validation on a population like yours

Retrospective validation of PressureAI in the East of England SDE

If your trust contributes data to the East of England SDE, PressureAI will have been tested on your own patient population before it ever reaches your wards.

Who is included

- Adults aged 18 years and over
- Inpatient admissions of 24 hours or longer
- Hospitals contributing to the East of England SDE

What it will report

- Discrimination and early-warning performance
- Calibration at the local HAPU rate
- Fairness by age, sex and ethnicity

What it means locally

- Evidence from a population like your own
- A basis for local risk-tier thresholds
- Local data to inform go-live

Part of the post-market clinical follow-up plan, alongside the prospective validation underway at Imperial.

HAPU, hospital-acquired pressure ulcer; SDE, Secure Data Environment.

How the East of England SDE supports safe evaluation of AI

External validation without patient-level data leaving the NHS



Frozen model

Locked weights and thresholds.
No retraining inside the SDE

East of England SDE

- De-identified records from East of England hospitals
- Model applied within the secure researcher environment
- Pre-specified analysis of discrimination, calibration and fairness



Aggregate results only

Output checking and small-number suppression before release



An independent population

Geographically and organisationally distinct from the development Trust



Ongoing post-market evidence

Independent real-world performance data within post-market clinical follow-up



Readiness for local adoption

Tier thresholds re-derived to each population's HAPU rate before use

HAPU, hospital-acquired pressure ulcer; SDE, Secure Data Environment.

The access pathway for a machine-learning validation project

Machine-learning projects add their own requirements

1 Organisation validation

SDE Network registration; DSPT or ISO 27001 assurance

2 Researcher accreditation

Terms of Use, information governance training, vouching

3 Data access request

Lay summary, protocol, variable list and outcome definition

4 Data Access Committee

Public benefit, proportionality and data minimisation

5 Data access agreement

Contract between the SDE and the research organisation

6 ML risk assessment

Model ingress, training intent, disclosure risk and egress plan

7 Extraction specification

Cohort and variable logic mapped to the OMOP data model

8 Analysis and output checking

Results reviewed by the SDE before release

Steps specific to machine-learning and common-data-model projects

Learning 1: know each SDE's data model and access approach first

Two SDEs, two valid designs, different demands on the applicant

	iCARE (development)	East of England SDE (external validation)
Data model	Trust EHR-derived research tables	OMOP Common Data Model with standardised concepts
Access approach	Broad access within approved data domains, e.g. the full range of blood tests	Data minimisation: only pre-specified variables are extracted
Outcome ascertainment	Coded diagnoses linked to incident reports (Datix)	Coded diagnoses (ICD-10 L89, SNOMED CT) with timing rules
What it asks of you	**Features can be refined as the model develops**	**Feature set and definitions must be complete at submission**

Data minimisation protects public trust. It also means the protocol must be right first time.

Learning 2: lock the model before you write the data request

Data minimisation rewards absolute precision in the protocol

Our experience

- The data request was submitted while the model was still being finalised.
- The final model drew on blood tests, such as differential white cell counts, that were not itemised in the original extraction list.
- Under data minimisation, anything not requested is not extracted, so the specification had to be revisited.

Checklist before submitting a data request

- Freeze the model version and final feature set
- Map every variable to the SDE's data model, including units and timestamps
- Harmonise the outcome definition, including present-on-admission handling
- Request the data dictionary and feasibility counts early
- Pre-specify outputs for egress and small-number suppression
- Agree an amendment route for future model updates

From Imperial research to NHS adoption

Now developed by Prelego, an Imperial College London spin-out



Imperial research

Model developed and internally validated in iCARE

Complete

Prelego spin-out

Formed to take PressureAI through regulation and into practice

Complete

CE marking

Class IIa SaMD: notified body Stage 2 audit passed

Anticipated shortly

Validation

Prospective study underway at Imperial; retrospective in the EoE SDE and US data

In progress

NHS adoption

EHR-integrated deployment with NHS trusts

Next

What this could offer hospitals

Targeted prevention

Direct specialist surfaces and tissue viability time to the patients most likely to benefit

Automated and explainable

Daily scores from existing EHR data, with the reasons shown for each patient

Local evidence first

SDE validation and local threshold setting before go-live

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Thank you

Take-home messages

1 SDEs make rigorous, privacy-preserving external validation of AI feasible at scale

2 Understand each SDE's data model, and lock the model before applying

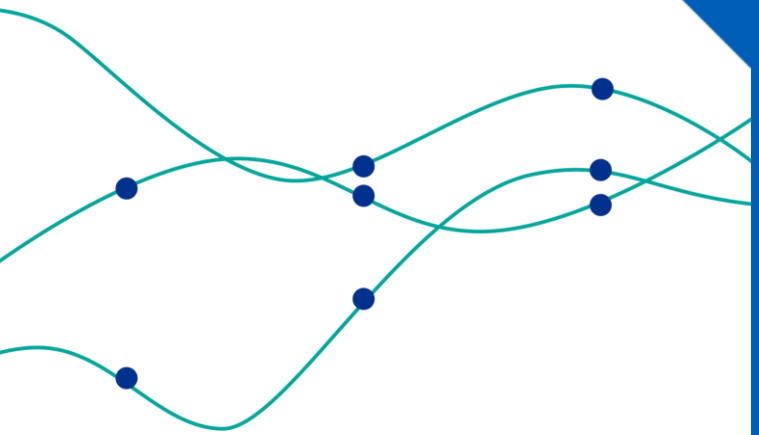
3 External validation is the bridge between promising AI and safe NHS adoption

Co-authors: M Cespa, T Jones, MC Ioannides, SA Bowyer, PAM Mediano, MH Sodergren

With thanks to the East of England SDE team, iCARE and the NIHR Imperial Biomedical Research Centre

Disclosure: SE is Chief Medical Officer of, and holds equity in, Prelego Holdings Ltd

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Questions

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