

Evaluating the NEWS2 early warning score for COVID-19

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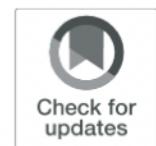
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RESEARCH ARTICLE

Open Access



Evaluation and improvement of the National Early Warning Score (NEWS2) for COVID-19: a multi-hospital study

Ewan Carr^{1*†} , Rebecca Bendayan^{1,2†}, Daniel Bean^{1,3}, Matt Stammers^{4,5,6}, Wenjuan Wang⁷, Huayu Zhang⁸, Thomas Searle^{1,2}, Zeljko Kraljevic¹, Anthony Shek⁹, Hang T. T. Phan^{4,5}, Walter Muruet⁷, Rishi K. Gupta¹⁰, Anthony J. Shinton⁶, Mike Wyatt¹¹, Ting Shi⁸, Xin Zhang¹², Andrew Pickles^{1,2}, Daniel Stahl¹, Rosita Zakeri^{13,14}, Mahdad Noursadeghi¹⁵, Kevin O'Gallagher^{13,14}, Matt Rogers¹¹, Amos Folarin^{1,3,16,17}, Andreas Karwath^{18,19,20}, Kristin E. Wickstrøm²¹, Alvaro Köhn-Luque²², Luke Slater^{18,19,20}, Victor Roth Cardoso^{18,19,20}, Christopher Bourdeaux¹¹, Aleksander Rygh Holten²³, Simon Ball^{20,24}, Chris McWilliams²⁵, Lukasz Roguski^{3,16,19}, Florina Borca^{4,5,6}, James Batchelor⁴, Erik Koldberg Amundsen²¹, Xiaodong Wu^{26,27}, Georgios V. Gkoutos^{18,19,20,24}, Jiaxing Sun²⁶, Ashwin Pinto⁶, Bruce Guthrie⁸, Cormac Breen⁷, Abdel Douiri⁷, Honghan Wu^{3,16}, Vasa Curnic⁷, James T. Teo^{9,13†}, Ajay M. Shah^{13,14†} and Richard J. B. Dobson^{1,2,3,16,17†}

Abstract

Background: The National Early Warning Score (NEWS2) is currently recommended in the UK for the risk stratification of COVID-19 patients, but little is known about its ability to detect severe cases. We aimed to evaluate NEWS2 for the prediction of severe COVID-19 outcome and identify and validate a set of blood and physiological parameters routinely collected at hospital admission to improve upon the use of NEWS2 alone for medium-term risk stratification.

Methods: Training cohorts comprised 1276 patients admitted to King's College Hospital National Health Service (NHS) Foundation Trust with COVID-19 disease from 1 March to 30 April 2020. External validation cohorts included 6237 patients from five UK NHS Trusts (Guy's and St Thomas' Hospitals, University Hospitals Southampton, University Hospitals Bristol and Weston NHS Foundation Trust, University College London Hospitals, University Hospitals Birmingham), one hospital in Norway (Oslo University Hospital), and two hospitals in Wuhan, China (Wuhan Sixth Hospital and Taikang Tongji Hospital). The outcome was severe COVID-19 disease (transfer to intensive care unit (ICU) or death) at 14 days after hospital admission. Age, physiological measures, blood biomarkers, sex, ethnicity, and comorbidities (hypertension, diabetes, cardiovascular, respiratory and kidney diseases) measured at hospital admission were considered in the models.

(Continued on next page)

Started: April

Submitted: September

Published: January

National Early Warning Score (NEWS) 2

1. Respiration rate

2. Oxygen saturation

3. Systolic blood pressure

4. Pulse rate

5. Level of consciousness

6. Temperature

“NHS England’s aim is for **all acute hospital trusts and ambulance trusts** to fully adopt NEWS2 for adult patients by 31 March 2019”.



“NEWS2 should be used when **managing patients** with COVID-19”.

“NEWS2 **should supplement clinical judgement** in assessing the patient’s condition”.



Royal College
of Physicians

Model development (n=1276)



CogStack

Model development (n=1276)

Cohort: All adult inpatients testing positive for SARS-CoV2 between **1st March and 31st April 2020** at King's College Hospital and Princess Royal University Hospital.

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Outcome: **Transfer to ICU or death within 14 days of hospital admission.**

Features: All measured within 48 hours of admission.

Albumin	Neutrophil-to-lymphocyte ratio	Supplemental oxygen flow rate
C-reactive protein	Lymphocyte-to-CRP ratio	Diastolic blood pressure
Estimated glomerular filtration rate	Urea	Systolic blood pressure
Haemoglobin	NEWS2 total score	Heart rate
Lymphocyte count	Respiratory rate	Temperature
Neutrophil count	Oxygen saturation	

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Method:	Lasso logistic regression.		

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Method: Lasso logistic regression.

Evaluation: Internally validated with nested cross-validation.

Discrimination (AUC, sensitivity, specificity, Brier score), calibration, clinical utility (decision curve analysis, number needed to evaluate).

External validation

 [ewancarr / NEWS2-COVID-19](https://github.com/ewancarr/NEWS2-COVID-19) Public

Unpin Unwatch 4 Fork 4 Star 5

< Code Issues Pull requests Actions Security Insights Settings

master ▾ 2 branches 3 tags Go to file Add file ▾ Code ▾

 **ewancarr** Update DOI fd792f6 37 minutes ago 56 commits

File	Description	Time
images	Update README to reflect improved models	2 years ago
.gitignore	Minor changes	2 years ago
LICENSE	Add MIT license	15 months ago
README.md	Update DOI	37 minutes ago
cleaning.py	Add updated data cleaning script	2 years ago
functions.py	Improve scorers	2 years ago
pretrained.joblib	Add revised models; tidy replication script.	2 years ago
replicate.py	Save event rate in output	2 years ago
requirements.txt	Bump numpy from 1.18.1 to 1.22.0	3 months ago

README.md

Evaluation and Improvement of the National Early Warning Score (NEWS2) for COVID-19: a multi-hospital study

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About

Validating prediction models supplementing NEWS2 with blood parameters to predict 14-day ICU/death among COVID patients

prediction-model **news2** **covid19**
medrxiv

Readme
MIT license
5 stars
4 watching
4 forks

Releases 2

 Re-trained models, multiple ... Latest on 14 Jul 2020 + 1 release

Contributors 3

 **ewancarr** Ewan Carr
 **yochannah** Yo Yehudi

<https://github.com/ewancarr/NEWS2-COVID-19>

External validation in 8 sites (n=6237)

University Hospitals Bristol and Weston NHS Foundation Trust

n=190; March to June

University Hospitals Southampton NHS Foundation Trust

n=633; March to June

University College Hospital London

n=411; February to April

Guy's and St Thomas' Hospital NHS Foundation Trust

n=988; March to August

University Hospitals Birmingham

n=1037; March to June

Oslo University Hospital

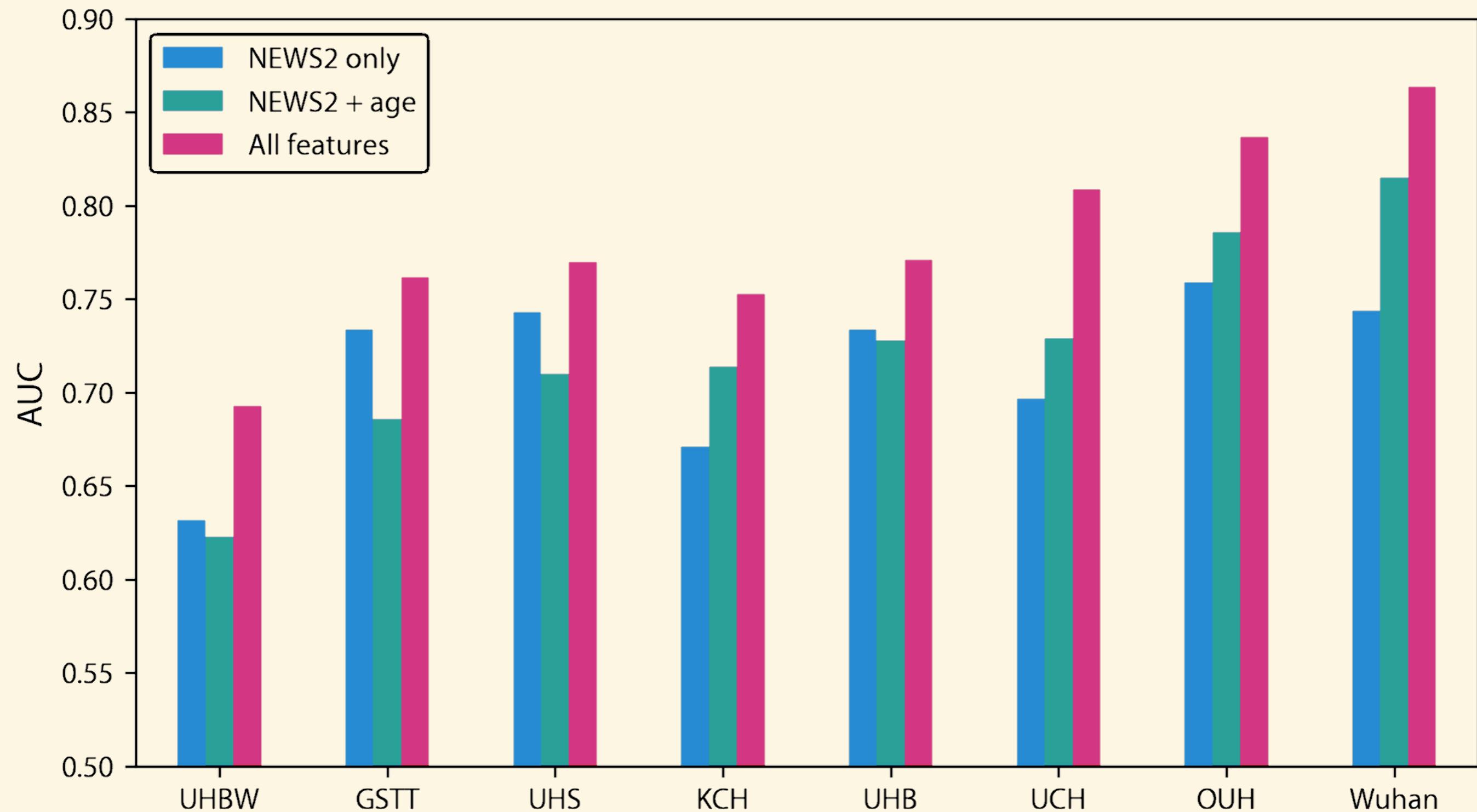
n=163; March to June

Wuhan Sixth Hospital and Taikang Tongji Hospital

n=2815 cases; February to March

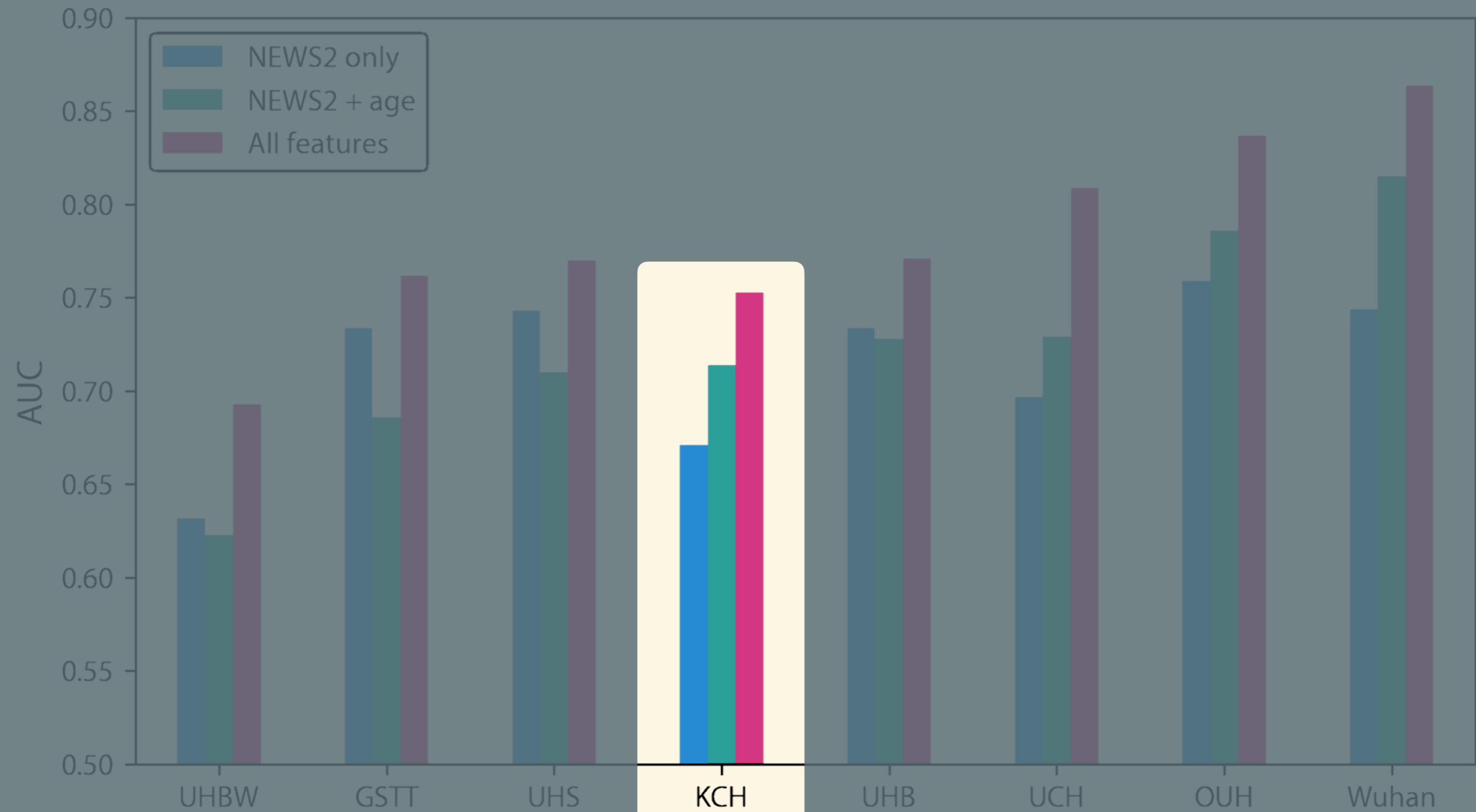
Findings

AUC ICU or death at 14 days



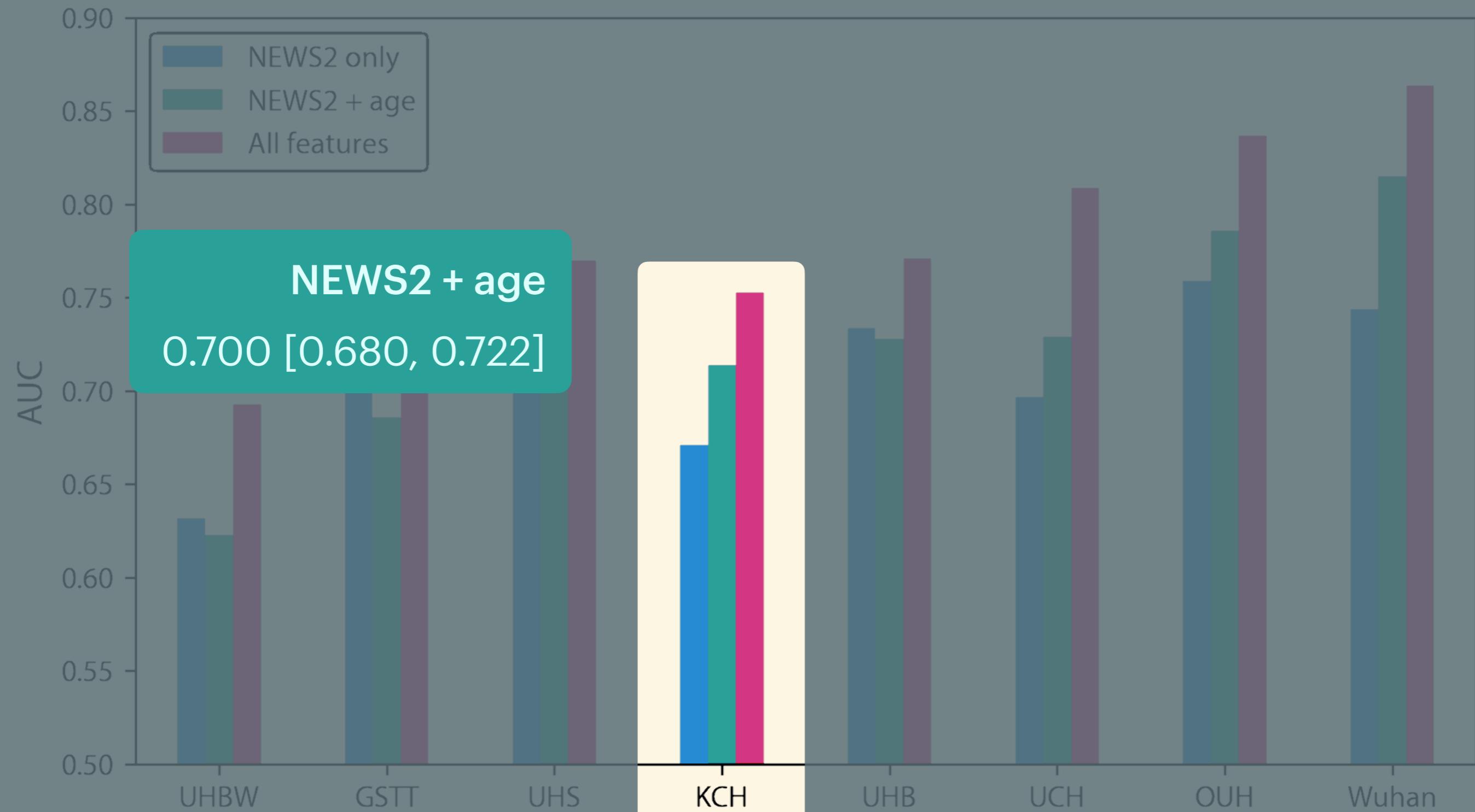
Findings

AUC ICU or death at 14 days



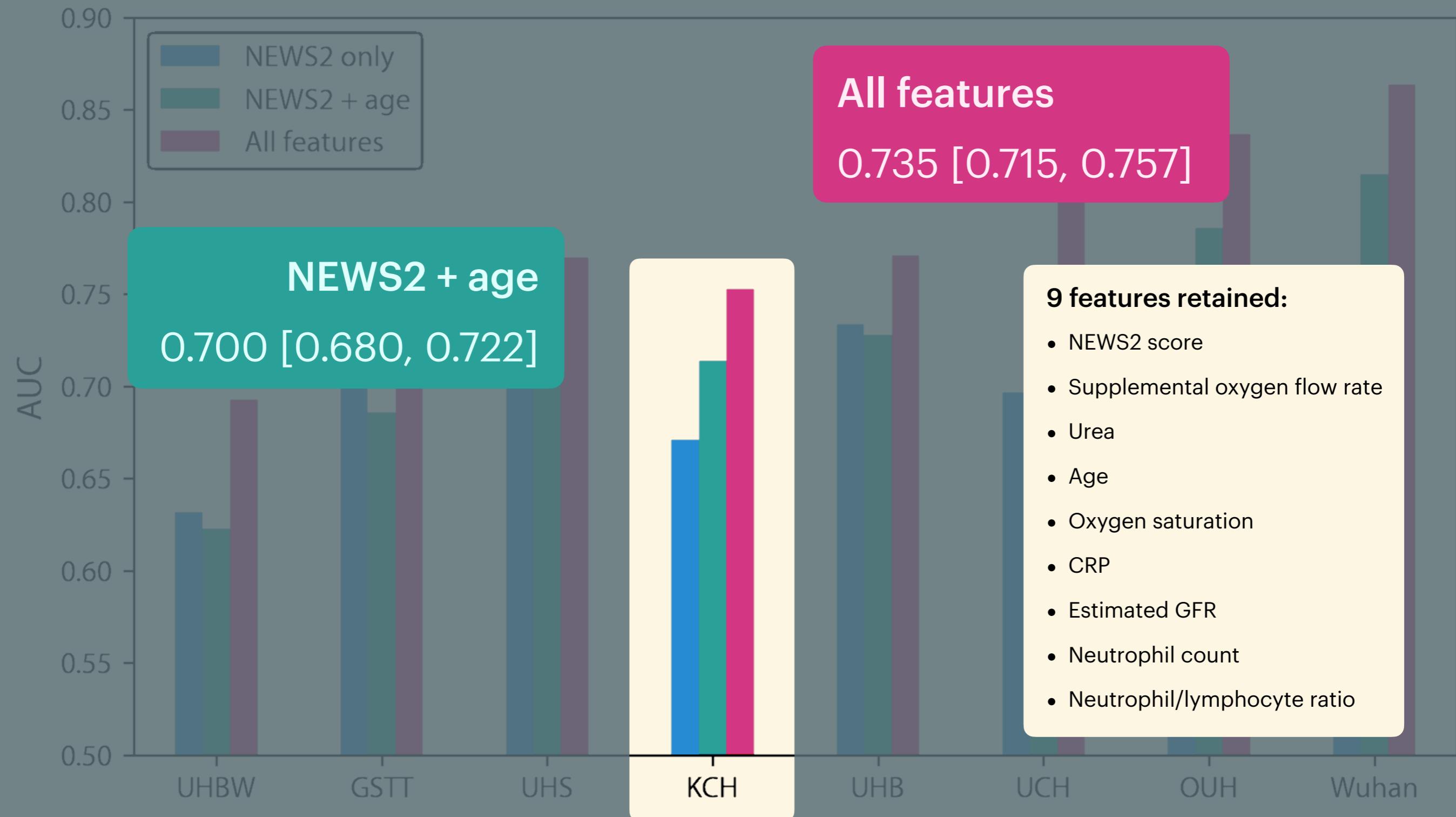
Findings

AUC ICU or death at 14 days



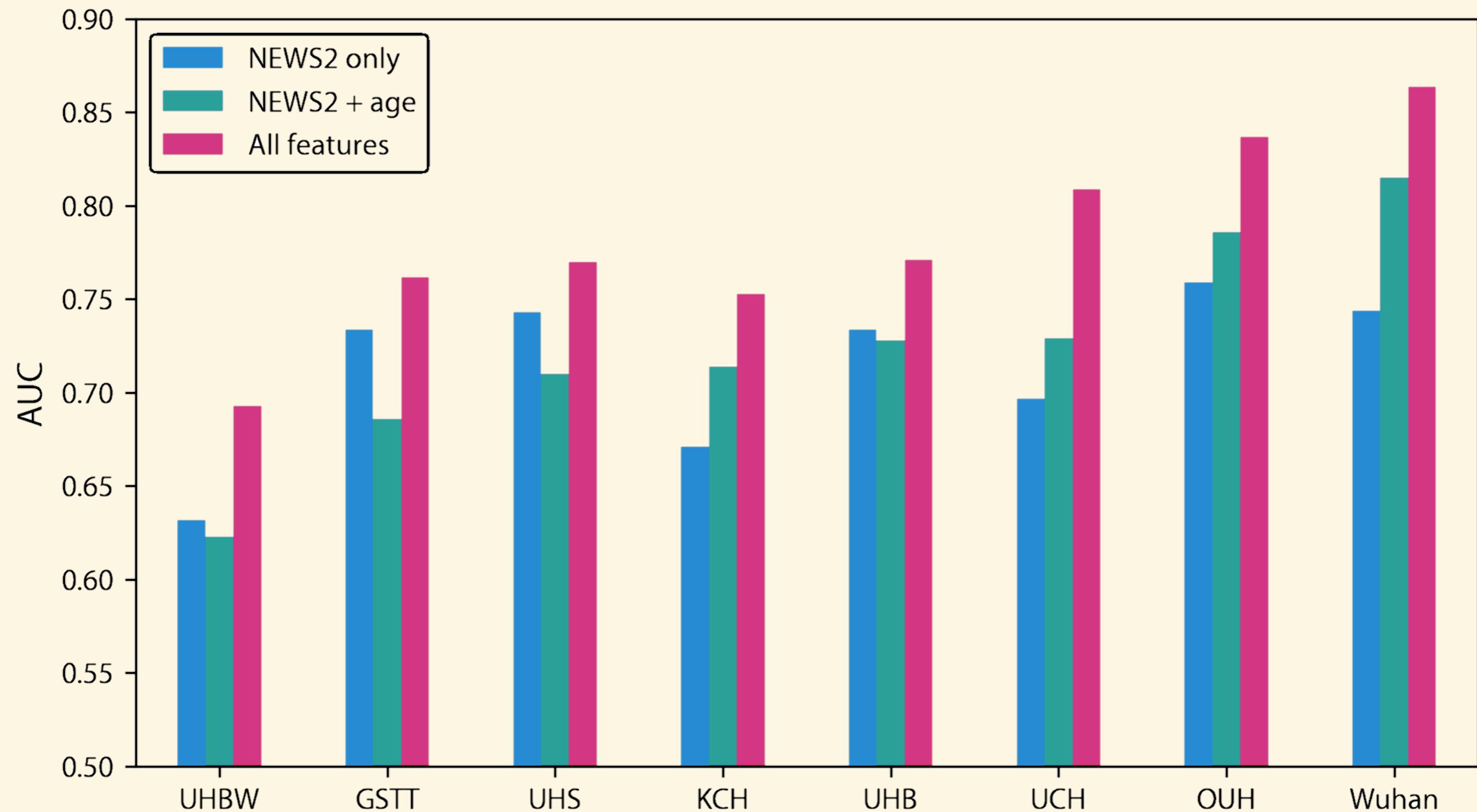
Findings

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Findings

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Findings

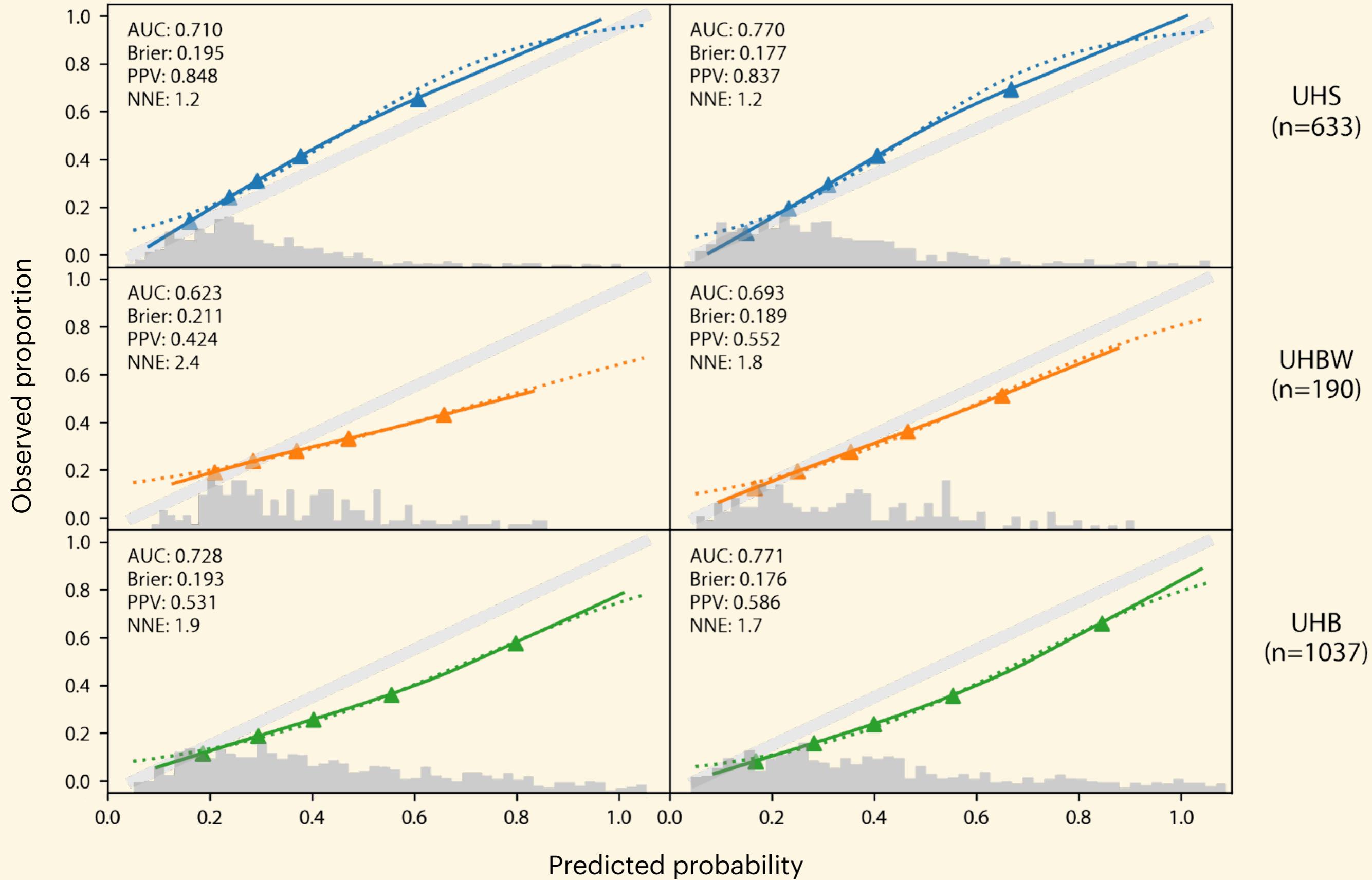
Calibration ICU or death at 14 days



**Do estimated risks correspond
to observed proportions?**

Findings

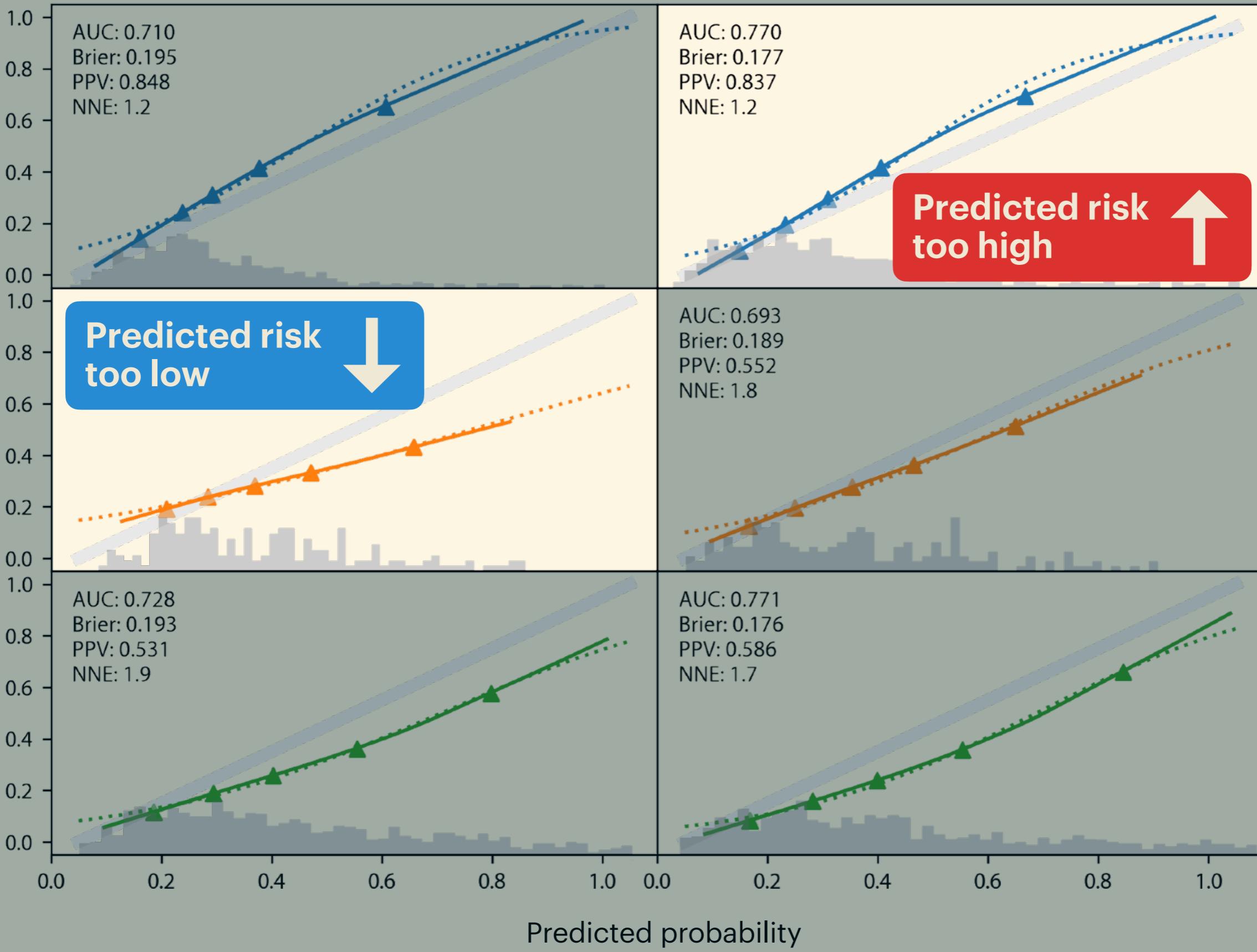
Calibration ICU or death at 14 days



Findings

Calibration ICU or death at 14 days

Observed proportion



UHS
(n=633)

UHBW
(n=190)

UHB
(n=1037)

“NEWS2 score had poor-to-moderate discrimination for medium-term COVID-19 outcome which raises questions about its use as a screening tool at hospital admission”

Prediction models for diagnosis and prognosis of COVID-19: systematic review and critical appraisal

(Wynants et al., July 2022)

 OPEN ACCESS



 FAST TRACK

RESEARCH

Prediction models for diagnosis and prognosis of covid-19: systematic review and critical appraisal

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Abstract

OBJECTIVE

To review and appraise the validity and usefulness of published and preprint reports of prediction models for prognosis of patients with covid-19, and for detecting people in the general population at increased risk of covid-19 infection or being admitted to hospital or dying with the disease.

DESIGN

Living systematic review and critical appraisal by the

DATA EXTRACTION

At least two authors independently extracted data using the CHARMS (critical appraisal and data extraction for systematic reviews of prediction modelling studies) checklist; risk of bias was assessed using PROBAST (prediction model risk of bias assessment tool).

RESULTS

126 978 titles were screened, and 412 studies describing 731 new prediction models or validations were included. Of these 731, 125 were diagnostic

Prediction models for diagnosis and prognosis of COVID-19: systematic review and critical appraisal

(Wynants et al., July 2022)

Prediction models for diagnosis and prognosis of COVID-19: systematic review and critical appraisal

(Wynants et al., July 2022)

606

**prognostic models
for COVID-19**

Prediction models for diagnosis and prognosis of COVID-19: systematic review and critical appraisal

(Wynants et al., July 2022)

606

**prognostic models
for COVID-19**

95%

**had high or unclear
risk of bias**

Prediction models for diagnosis and prognosis of COVID-19: systematic review and critical appraisal

(Wynants et al., July 2022)

606

prognostic models
for COVID-19

95%

had high or unclear
risk of bias

3

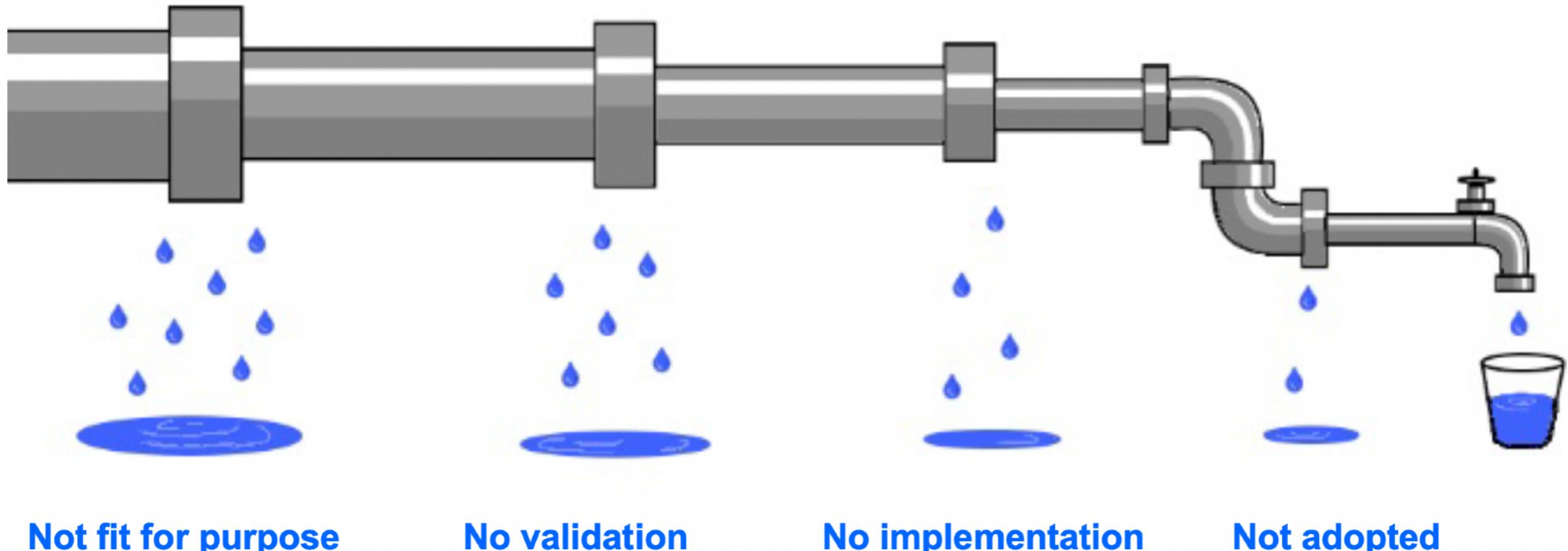
models with low risk of bias
for patients admitted to
hospital with COVID-19

1. Carr model
2. ISARIC4C
3. Xie model

Fewer models, more validation, more implementation

606...

...0?



Developing, validating, updating and judging the impact of prognostic models for respiratory diseases

Thank you for listening.



@ewancarr