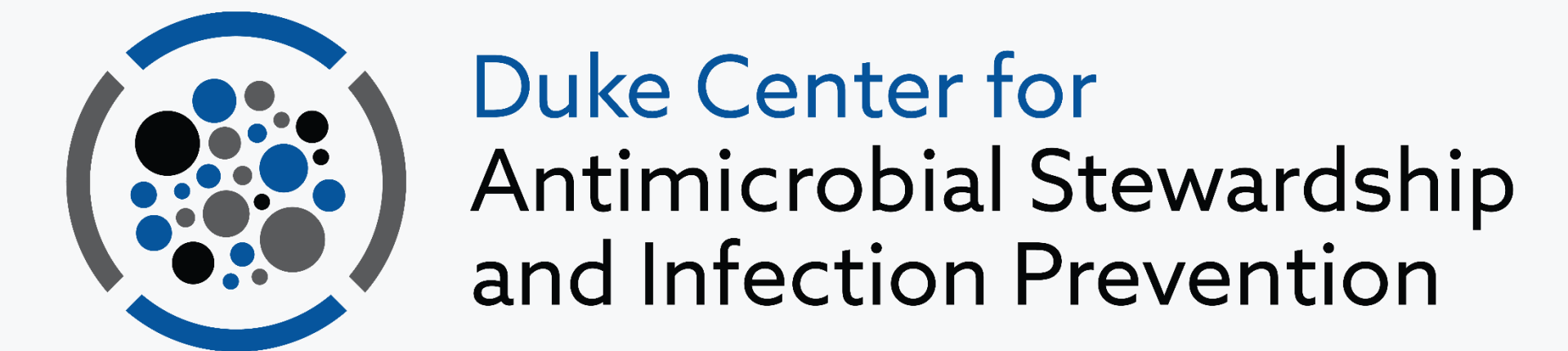


# Utility of a Risk Assessment Model in Predicting 30-day Unplanned Hospital Readmission in Adult Patients Receiving Outpatient Parenteral Antibiotic Therapy



Brenneman EK<sup>1</sup>, Funaro JR<sup>1</sup>, Dicks K<sup>1</sup>, Yarrington M<sup>1</sup>, Spivey J<sup>1</sup>, Lee H-J<sup>1</sup>, Erkanli A<sup>1</sup>, Hung F<sup>1</sup>, Drew R<sup>1,2</sup>  
<sup>1</sup>Duke University Hospital, Durham, NC; <sup>2</sup>Campbell University College of Pharmacy & Health Sciences, Buies Creek, NC



## Background

- Published 30-day all-cause readmission rates in patients receiving outpatient parenteral antibiotic therapy (OPAT) range from 6-26%.<sup>1,2,3</sup>
- A 30-day unplanned readmission risk prediction model for OPAT patients in the United Kingdom (UK) was developed and validated with external cohorts totaling 2,500 patients.<sup>2</sup>
- Given the inherent differences in patient mix, acuity, and admission criteria in the United States (US) compared to the UK, there is a need for validity testing in local cohorts of patients in order to utilize this prediction model.

## Methods

- Design:** retrospective observational cohort study
- Study population:** adult patients enrolled in the Duke University Health System (DUHS) OPAT program from 7/1/2019 – 2/1/2020
- Key Exclusion Criteria:** Patients on dialysis and solid organ or hematopoietic stem cell transplant recipients
- Primary endpoint:** 30-day unplanned readmission from index discharge
- Data Collection:** parameters for the UK prediction model<sup>1</sup>: age, number of hospitalizations in the prior 12 months, Charlson comorbidity score, mode of OPAT administration, source of infection and IV combination therapy
- Additional values** tested included vancomycin use, OPAT delivered via skilled nursing facility, and history of IV drug abuse.
- Data analysis:** discriminative ability of the model to predict 30-day unplanned readmission was validated and assessed using a scaled Brier score, C-index, calibration plot, and Hosmer-Lemeshow goodness of fit test<sup>4</sup>. Logistic regression was used to update the UK model.

## Results

**Table 1. Cohort Demographics**

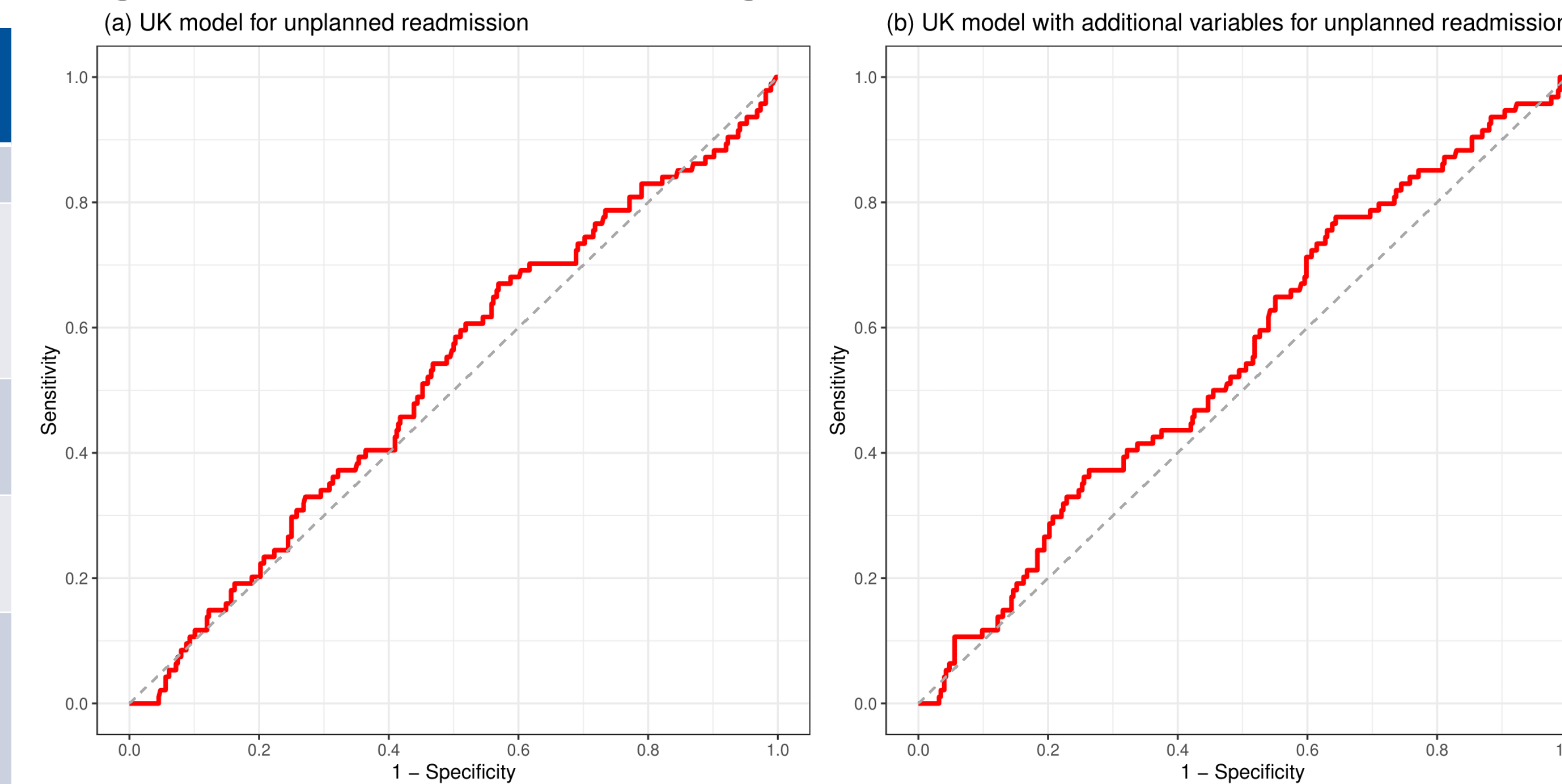
Variable	UK Cohort n = 1073	Duke Cohort n = 470
Age, mean (SD)	56 (17.5)	60.4 (16.1)
Gender		
Male	611 (56.9%)	282 (60%)
Female	462 (43.1%)	188 (40%)
Charlson comorbidity score, median (IQR)	1 (0, 2)	3 (1, 5)
Hospitalizations in prior 12 months, median (IQR)	0 (0, 1)	0 (0, 1)
Indication for OPAT		
Skin/soft tissue	616 (57.4%)	33 (7%)
Bone and joint	137 (12.8%)	276 (58.7%)
Urogenital	70 (6.5%)	23 (4.9%)
Respiratory	45 (4.2%)	15 (3.2%)
Endovascular	45 (4.2%)	64 (13.6%)
Other	160 (14.9%)	59 (12.6%)
Mode of OPAT		
Home (self/caregiver)	105 (9.8%)	335 (71.3%)
Infusion center	767 (71.5%)	0 (0%)
Community nurse	201 (18.7%)	0 (0%)
Skilled nursing facility	0 (0%)	135 (28.7%)
Concurrent IV OPAT	81 (7.5%)	88 (18.7%)
Vancomycin use	98 (9.1%)	170 (36.2%)
Duration of OPAT, median (IQR)	7 (4, 14)	33 (19, 38)

**Table 2. Cohort Outcomes**

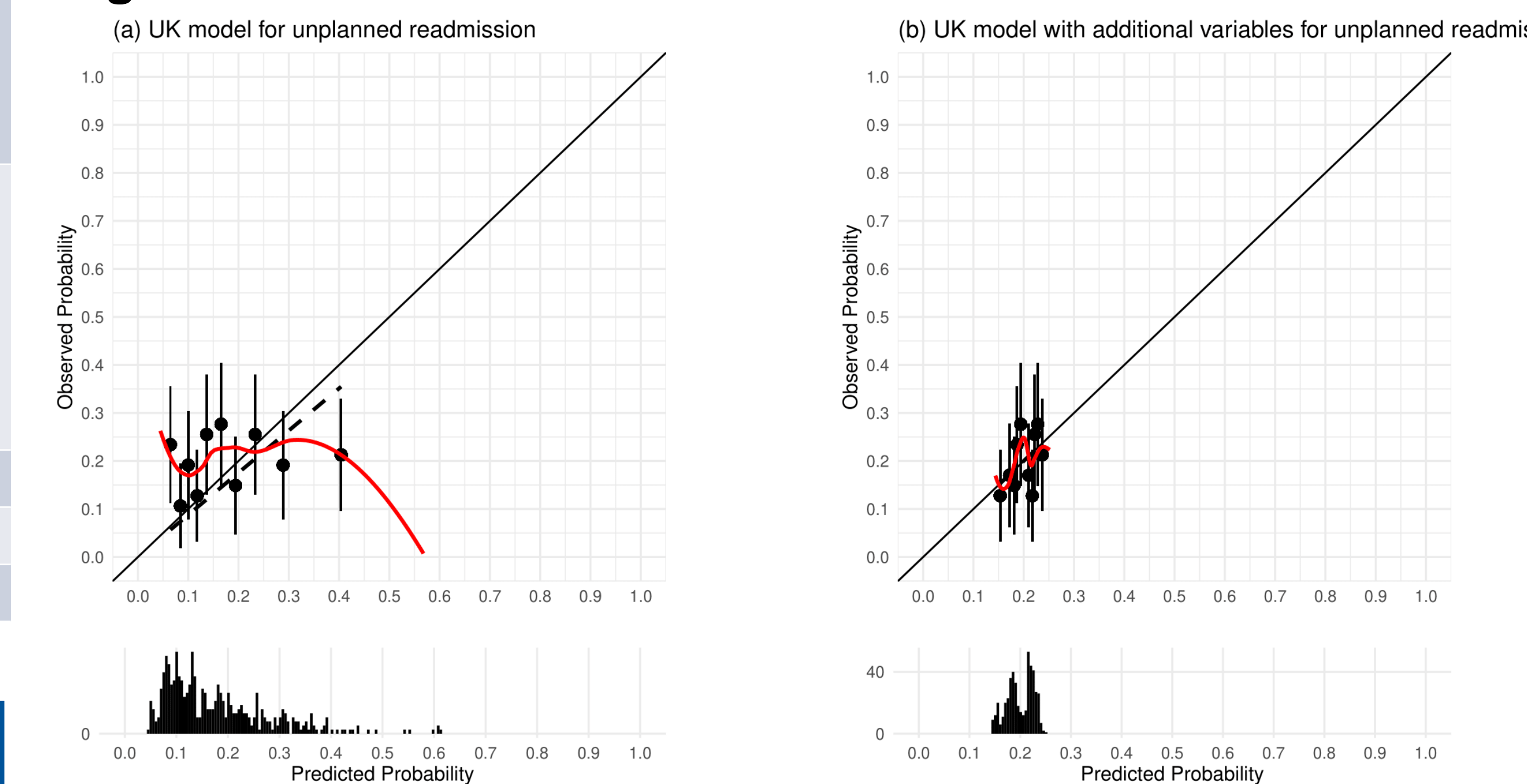
Outcomes	UK Cohort n = 1073	Duke Cohort n = 470
Readmissions within 30-day post-index discharge		
Any readmission	145 (13.5%)	105 (22.3%)
Planned readmission	22 (2.1%)	13 (2.8%)
Unplanned readmission	<b>123 (11.5%)</b>	<b>94 (20.0%)</b>
Unplanned OPAT-related readmission	73 (6.8%)	56 (11.9%)
30-day unplanned OPAT-related readmission		
Infection-related adverse effect	60 (83.3%)	30 (53.5%)
Antibiotic-related adverse effect	7 (9.7%)	17 (30.3%)
IV access	3 (2.4%)	2 (3.5%)
Other	3 (2.4%)	7 (12.5%)

sd, standard deviation; IQR inter-quartile range

**Figure 1. Receiver Operating Curve**



**Figure 2. Calibration of Model**



**Table 3. Model Performance**

Statistical Test	Original UK model			UK model with additional variables		
	aOR	95% CI	p-value	aOR	95% CI	p-value
Discrimination, c-statistic	0.52	(0.46, 0.59)	—	0.55	(0.49, 0.62)	—
Hosmer-Lemeshow (df)	47.54 (8)	—	<0.001	7.04 (8)	—	0.53
Scaled Brier score	-0.07	—	—	0	—	—
Calibration slope	0.06	(-0.28, 0.38)	—	1	(-0.39, 2.43)	—
Calibration-in-the-large	-1.29	(-1.9, -0.72)	—	0	(-1.94, 1.97)	—

aOR, adjusted odds ratio; CI, confidence interval; df, degrees of freedom

## Discussion

- Almost half of the unplanned readmissions were not OPAT related, but in further analysis of only OPAT related unplanned readmissions, the model still had poor predictive ability.
- Decreases in the performance of a model are common in external validation studies, often caused by differences in populations.
- Patients who self-administer antibiotics at home, seen more in the DUHS cohort, do not undergo the same monitoring as patients who receive antibiotics at an infusion clinic.

## Limitations

- The retrospective nature of the study introduces the potential for reduced accuracy of recorded data.
- Patients who had readmissions outside of the electronic health record would have been missed.
- The determination of some secondary characteristics, was done via the discretion of the reviewing clinicians.

## Conclusions

- The prediction model was not able to reliably discriminate the risk of 30-day unplanned readmission in DUHS patients receiving OPAT.
- The additional variables tested did not improve the predictive ability of the model.

## References

- Durojaiye, O.C., et al. Clin Microbiol Infect, 2019. 25(7): p. 905 e1-905.
- Durojaiye, O.C., et al., J Antimicrob Chemother, 2021. 76(8): p. 2204-2212.
- Huang, V., et al., BMC Pharmacol Toxicol, 2018. 19(1): p. 50.
- Steyerberg EWN, et al. Epidemiology. 2010 Jan;21(1):128-38.

Conflict of interest: Nothing to disclose

