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DEVELOPMENT OF A MACHINE LEARNING MODEL TO PREDICT DELIRIUM IN CANCER PATIENTS RECEIVING PALLIATIVE CARE TREATMENT

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Background

- Among patients with advanced cancer admitted to the acute palliative care unit (APCU), delirium can affect 42-88% of individuals.
- However, few comprehensive studies have thoroughly examined its prevalence and potential risk factors.
- We aimed to present a new approach to predict to delirium admitted to the acute palliative care unit.

Methods

- **Methods:** multicenter, patient-based registry cohort collected from four hospitals in South Korea (between January 1, 2019, and December 31, 2020)
- **Delirium:** identifed by reviewing the medical records based on the criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
- Machine learning models: extreme gradient boosting, adaptive boosting, gradient boosting, light gradient boosting, logistic regression, support vector machine, and random forest
- Key inclusion criteria
- aged 20 years or older
- diagnosed with advanced solid cancer
- admitted to the APCU
- => 2328 patients who met the eligibility criteria

For k-fold cross-validation, the combination of extreme gradient boosting and random forest provided the best performance, achieving the following accuracy metrics: 68.83% sensitivity, 70.85% specificity, 69.84% balanced accuracy, and 74.55% area under the receiver operating characteristic curve.

LGB AdaE XGB Logis LGB LGB LGB-

Table1. Five-fold cross validation result comparison according to machine learning models

using feature importance analysis, sex was determined to be the top contributor in predicting delirium, followed by a history of delirium, chemotherapy, smoking status, alcohol consumption, and living with family.

Results

	Training data (n=18	351)		
del	Sensitivity, % (SD)	Specificity, % (SD)	Balanced accuracy, % (SD)	AUROC, % (SD)
	66.58 (7.96)	64.63 (2.89)	65.60 (3.97)	71.92 (5.87)
3	68.03 (9.61)	66.89 (3.54)	67.47 (3.72)	73.60 (5.44)
	74.13 (6.48)	64.68 (4.35)	69.41 (1.48)	74.06 (4.12)
Λ	62.05 (11.81)	66.02 (5.11)	64.04 (5.83)	70.42 (5.03)
Boost	58.12 (16.29)	59.39 (13.34)	58.75 (7.56)	64.01 (7.41)
Boost	67.21 (16.70)	63.52 (20.43)	65.37 (3.50)	73.81 (5.48)
istic regression	57.52 (8.28)	68.18 (1.84)	62.85 (3.71)	69.70 (3.39)
3 + RF	64.22 (10.28)	71.49 (4.32)	67.85 (4.03)	74.08 (5.13)
+ XGB	68.83 (8.36)	70.85 (4.41)	69.84 (4.46)	74.55 (4.81)
3+XGB	65.81 (8.22)	70.85 (3.96)	68.33 (4.71)	73.81 (5.13)
3+RF+XGB	69.60 (8.18)	65.15 (3.95)	67.38 (4.57)	73.64 (5.14)

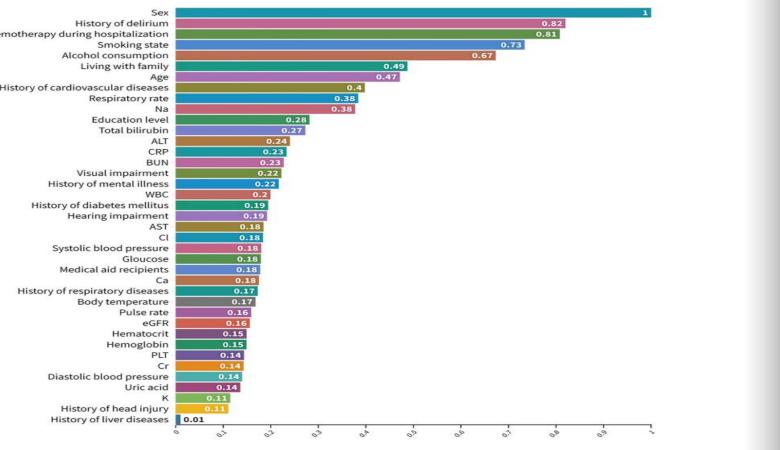


Figure 1. Ranked feature importance values for all 39 features

dicting Delirium from Pa	tients with Can	cer			
ut patient's information					
Patient Information	Input values		Patient information	Input v	alues
Sex	Male	٧	Alcohol consumption	Rarely	v
Age	53		Smoking state	Never	~
Chemotherapy during hospitalization	Yes	۷	Hemoglobin [g/dL]	8.9	
Living with family	Ne	v	Hematocrit [%]	28.5	
Medical aid recipients	Others	v	White blood cell count (WBC) [x10^3/uL]	6.41	
Education level	No education	۷	Platelets (PLT) [x10^3/uL]	142	
Visual impairment (waering glasses)	Yes	۷	Aspartate transaminase (AST) [IU/L]	17	
Hearing impairment (using hearing aids)	No	۷	Alanine transaminase (ALT)	11	
History of mental illness	No	v	[IU/L]		
History of hear injury	No	v	Total bilirubin (T.bil) [mg/dL]	0.3	
History of delirium	Yes	٧	Blood urea nitrogen (BUN)	8.5	
History of cardiovascular diseases	No	v	[mg/dL]		
History of respiratory diseases	No	¥	Cr [mg/dL]	0.75	
History of diabetes mellitus	No	•	eGFR [mL/min/1.7]	73	
	No	*	Glucose [mg/dL]	119	
History of liver diseases		*	Na [mEq/L]	138	
Systolic blood pressure [mmHg]	107		CI [mEq/L]	101	
Diastolic blood pressure [mmHg]	58		Ca (mg/dL)	9.1	
Pulse rate [Beats per minute]	55		K [mEg/L]	4.6	
Respiration rate [Breaths per minute]	20		Uric acid [mg/dL]	3	
Body temperature [Celsius]	37		CRP [mg/dL]	51.5	

Figure 2. Deployed web application predicting delirium: (a) user input, (b) prediction results with delirium probability in patients with advanced cancer (http://ai-wm.khu.ac.kr/Delirium/)

Palliative care

Funding information

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elirium Prediction Results		
rediction Delirium Results: normal.		
Patient information	Input values	Patient info
Sex	1	Alcohol con:
Age	53	Smoking sta
Chemotherapy during hospitalization	1	Hemoglobin
Living with family	0	White blood
Medical aid recipients	0	Platelets (PL
Education level	1	Aspartate tra
Visual impairment (waering glasses)	1	Alanine tran
Hearing impairment (using hearing aids)	0	Total bilirub Blood urea
History of mental illness	0	Cr
History of hear injury	0	eGFR
History of delirium	1	Glucose
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History of diabetes mellitus	0	a
History of respiratory diseases	0	Ca
History of liver diseases	0	К
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Respiratory rate	20	
Body temperature	37	

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Conclusions

Based on a large-scale, multicenter, patient-based registry cohort, a machine learning prediction model for delirium in patients with advanced cancer was developed in South Korea. We believe that this model will assist healthcare providers in treating patients with delirium and advanced cancer.

Keywords: Delirium; cancer; Feature importance; Machine learning;

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