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Predicting rescue failures in adult hospitalization units using artificial intelligence techniques

Submission date
03/10/2025

Recruitment status
No longer recruiting

Registration date
04/10/2025

Overall study status
Ongoing

Last Edited
05/08/2026

Condition category
Other

[_] Prospectively registered
[_] Protocol
[_] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
This study focuses on a problem known as Failure to Rescue (FTR). FTR occurs when a hospitalised patient experiences complications that are not recognised or treated in time. This can lead to serious consequences, including death. The aim of the study is to identify factors that contribute to FTR and to design tools that can help healthcare professionals detect these situations earlier and provide safer care.

Who can participate?
We will analyse the electronic health records of all adult patients admitted to the medical–surgical wards at Hospital Universitario de La Plana in Castellón, Spain, between March 2023 and February 2024.

What does the study involve?
We will analyse electronic health records that are routinely collected during hospital care, including information about functional assessments, vital signs, laboratory test results and care processes. Advanced data analysis techniques, such as process mining and machine learning, will be used to identify patterns and develop predictive tools that can be integrated into clinical practice.

What are the possible benefits and risks of participating?
As this study uses existing health records, patients will not need to undergo any additional procedures. There are no direct risks for patients. The benefit is that the findings may help improve early detection of complications and the safety of hospital care in the future.

Where is the study run from?
Universitat Jaume I (Spain)

When is the study starting and how long is it expected to run for?
The project will run from 1 September 2025 until 31 August 2027. However, the study will use retrospective data from adult patients admitted between March 2023 and February 2024.

Who is funding the study?
The study is funded by the Generalitat Valenciana, Conselleria d'Educació, Cultura, Universitats i Ocupació, under grant number CIGE/2024/10

Who is the main contact?
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Additional identifiers

Protocol serial number
CIGE/2024/10

Study information

Scientific Title
Predicting rescue failures in adult hospitalization units using artificial intelligence techniques

Acronym
VALENF-FTR

Study objectives
Current study objectives as of 05/08/2026:

The aim of this study is to design and validate predictive models based on machine learning and process mining to detect Failure to Rescue (FTR) in hospitalised adult patients.
Specific objectives:
1. To identify sociodemographic, process-of-care, nursing assessment, and clinical variables that act as risk or protective factors in the development of failure to rescue
2. To analyse changes in functional capacity and selected physiological parameters (heart rate, blood pressure, oxygen saturation, capillary blood glucose, body temperature, and 24-hour urine output) in different Failure to Rescue scenarios
3. To analyse the temporal trends of selected laboratory parameters within the first 48–72 hours of hospital admission or following surgical intervention
4. To examine whether differences exist in predictor variables across scenarios at risk of Failure to Rescue and according to process-of-care characteristics
5. To compare the sequences and frequencies of activities related to selected interventions, such as vital signs monitoring, referrals/consultations, or laboratory sample collection, between patients who experience Failure to Rescue and those who do not, as well as according to process-of-care characteristics
6. To compare clinical risk profiles according to the occurrence and type of situations susceptible to Failure to Rescue, considering sociodemographic, functional, physiological, laboratory, and care process-related variables
7. To assess the reliability and accuracy of machine learning and process mining models in detecting Failure to Rescue in patients

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Previous study objectives:

The aim of this study is to design and validate predictive models based on machine learning and process mining to detect Failure to Rescue (FTR) in hospitalised adult patients.
Specific objectives:
1. To identify sociodemographic, process-of-care, nursing assessment, and clinical variables that act as risk or protective factors in the development of failure to rescue.
2. To analyse changes in functional capacity and selected physiological parameters (heart rate, blood pressure, oxygen saturation, capillary blood glucose, body temperature, and 24-hour urine output) in different Failure to Rescue scenarios.
3. To analyse the temporal trends of selected laboratory parameters within the first 48–72 hours of hospital admission or following surgical intervention.
4. To examine whether differences exist in predictor variables across scenarios at risk of Failure to Rescue and according to process-of-care characteristics.
5. To compare the sequences and frequencies of activities related to selected interventions, such as vital signs monitoring, referrals/consultations, or laboratory sample collection, between patients who experience Failure to Rescue and those who do not, as well as according to process-of-care characteristics.

6. To assess the reliability and accuracy of machine learning and process mining models in detecting Failure to Rescue in patients.

Ethics approval required
Ethics approval required

Ethics approval(s)
1. Approved 27/06/2024, Research Ethics Committee of Hospital Universitario de La Plana (Road from Vila-real to Burriana, Km 0.5, Castellón de la Plana, 12540, Spain; +34 964 39 97 75; laplana@gva.es), ref: CEIC-PLANA-13/2024-01

2. Approved 22/01/2025, Human Research Ethics Committee of Universitat Jaume I (Vicent Sos Baynat Avenue, s/n, Castellón de la Plana, 12071, Spain; +34 964 72 80 00; vi@uji.es), ref: CEISH /01/2025

Primary study design
Observational

Study design
Retrospective observational single-centre study using electronic health records

Study type(s)
Other, Prevention, Screening

Health condition(s) or problem(s) studied
Failure to Rescue (FTR) in hospitalised adult patients, understood as preventable clinical deterioration that may lead to in-hospital mortality or serious adverse events (functional decline, sepsis, cardiac arrest, unplanned transfer to the ICU, or other complications). The study examines the clinical, functional, and organisational determinants of this phenomenon as a key indicator of patient safety and quality of care.

Interventions
This is a retrospective observational study based on electronic health records of adult patients admitted to University Hospital La Plana between March 2023 and February 2024.

Variables collected include:
1. Sociodemographic: age, sex assigned at birth.
2. Process of care: hospital ward (unit name), admitting and discharge service, type of process (medical/surgical), type of admission (scheduled/emergency), primary and secondary diagnoses (ICD-10), Charlson comorbidity index, length of stay, discharge reason (recovery; voluntary discharge; transfer to another hospital; transfer to another ward; death; other).
3. Functional assessment: VALENF instrument (7-item meta-instrument assessing functional capacity, risk of falls, and risk of pressure injuries), overall score and items collected at admission and during subsequent re-evaluations.
4. Physiological parameters: systolic/diastolic blood pressure, heart rate, respiratory rate, oxygen saturation, body temperature, urine output, capillary blood glucose.
5. Laboratory parameters: C-reactive protein (CRP), procalcitonin (PCT), leukocyte count, neutrophil-to-lymphocyte ratio (NLR), D-dimer, platelet count, serum albumin, creatinine, urea /blood urea nitrogen (BUN), alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin, lactate, troponin, N-terminal pro-B-type natriuretic peptide (NT-proBNP), red cell distribution width (RDW).

6. Events susceptible to Failure to Rescue: in-hospital mortality, functional decline (>20-point decrease in the VALENF instrument or <60 in patients ≥80 years), urgent referrals, unplanned ICU admission, urgent surgery, interhospital transfer, cardiac arrest, sepsis, prolonged length of stay, and readmission within 7 days after discharge.

Data collection:
Data will be obtained through the hospital information system. The Documentation Service will provide the research team with a pseudonymised database, structured in agreement with the hospital's IT department. The original database containing identifiable data will remain under the hospital's custody. Researchers will work exclusively with pseudonymised identifiers (episode number). Access to the electronic health record will be restricted to a limited group of trained investigators responsible for labelling and validating Failure to Rescue cases. In addition, temporal records (timestamps) of functional assessments, physiological and laboratory parameters, and care-related events will be extracted, enabling the application of process mining techniques.
The sample size was estimated at 11,091 participants.

Intervention Type
Other

Primary outcome(s)
Occurrence of Failure to Rescue (FTR), defined as the presence of at least one of the following events measured using patient records:
1. Functional decline defined as a >20-point decrease in the VALENF functional capacity score, or as a discharge score <60 in patients aged ≥80 years
2. In-hospital mortality, unplanned ICU admission, urgent surgery, urgent interhospital transfer, cardiac arrest, sepsis, or prolonged length of stay (measured during hospitalization).
3. Readmission within 7 days after hospital discharge.

Key secondary outcome(s)
Different dimensions of Failure to Rescue (FTR) measured using patient records:
1. Sociodemographic, functional, physiological, laboratory, and process-of-care variables associated with the occurrence of FTR, measured using clinical records and the VALENF instrument, assessed during hospital stay.
2. Temporal evolution of functional capacity, measured using the VALENF instrument during hospitalization.
3. Temporal evolution of physiological parameters, measured using standard clinical monitoring (vital signs, hemodynamics) during hospitalization.
4. Dynamics of laboratory markers related to inflammation, infection, renal, cardiac, and metabolic function, measured using routine laboratory tests within the first 48–72 hours after admission or surgery.
5. Comparison of predictor variables across different types of FTR events (mortality, unplanned ICU admission, urgent surgery, or sepsis), measured using hospital records at index hospitalization.
6. Deviations in care process sequences, measured using process mining techniques applied to electronic health records, assessed during hospital stay.
7. Predictive performance of machine learning and process mining models for detecting FTR, evaluated for reliability and accuracy using internal validation datasets.

Completion date
31/08/2027

Eligibility

Key inclusion criteria
1. Adult patients (≥18 years) admitted to the medical–surgical hospital wards of University Hospital la Plana.
2. Admission between 1 March 2023 and 29 February 2024
3. Length of hospital stay >48 hours

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
18 Years

Upper age limit
101 Years

Sex
All

Total final enrolment
9304

Key exclusion criteria
1. Patients admitted to special units (ICU, emergency department, operating theatre and recovery room, maternal and child unit, or home hospitalisation)
2. Patients with a single care episode lasting less than 48 hours

Date of first enrolment
01/03/2023

Date of final enrolment
29/02/2024

Locations

Countries of recruitment
Spain

Study participating centre
Univerity Hospital La Plana
Road from Vila-real to Burriana, Km 0.5

Castellón de la Plana
Spain
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Sponsor information

Organisation
Universitat Jaume I

ROR
https://ror.org/02ws1xc11

Funder(s)

Funder type
Government

Funder Name
Conselleria de Educación, Cultura, Universidades y Empleo – Generalitat Valenciana (Regional Ministry of Education, Culture, Universities and Employment – Valencian Regional Government) (CIGE/2024/10)

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available