Do you Trust me? : Development, Implementation and Acceptance of a Machine Learning Model - Opportunities, Challenges and Future Direction

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Background

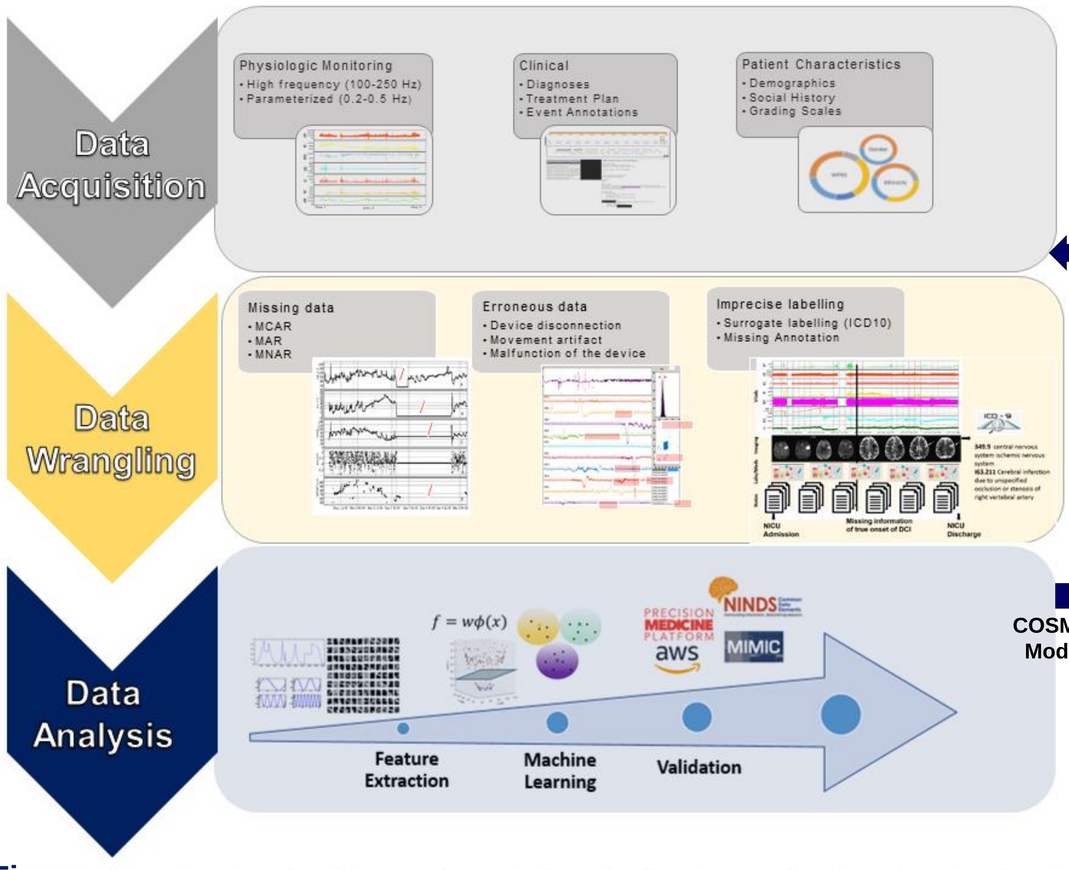
- Among machine learning models that are put into practice, half fail for one in four companies.
- Interest in developing and deploying purpose-built real-time machine learning models across centers
- Challenges in converting a model created from academia to a trustworthy implementation
  - Intrinsic to the mathematical model itself - Model evaluation and generalization
  - Logistics - automation and maintenance and integration of model into electronic health record [EHR]
  - Integration into clinician workflow
  - Barriers to adoption - privacy, security, risk assessment, identify unintended consequences on clinician workflow.

Clinical Use Case : ContinuOuS Monitoring tool for delayed cerebral IsChemia (COSMIC)

- Delayed cerebral ischemia (DCI) is a stroke syndrome that occurs in up to 30% of patients after ruptured brain aneurysm.
- It lacks a clearly defined time of onset, due to the insidious nature of onset.
- Using physiologic signal inputs and machine learning, we developed and externally validated a temporal classification model that provides a real-time risk score for DCI.
  - Data Acquisition
  - Data Wrangling
  - Feature Engineering
  - Model Building

Run time technical challenges

- File Corruption – in big data environment
- Data Quality - Data lags
- Software Version Incompatibility Issues
- Targeted Patient Identification



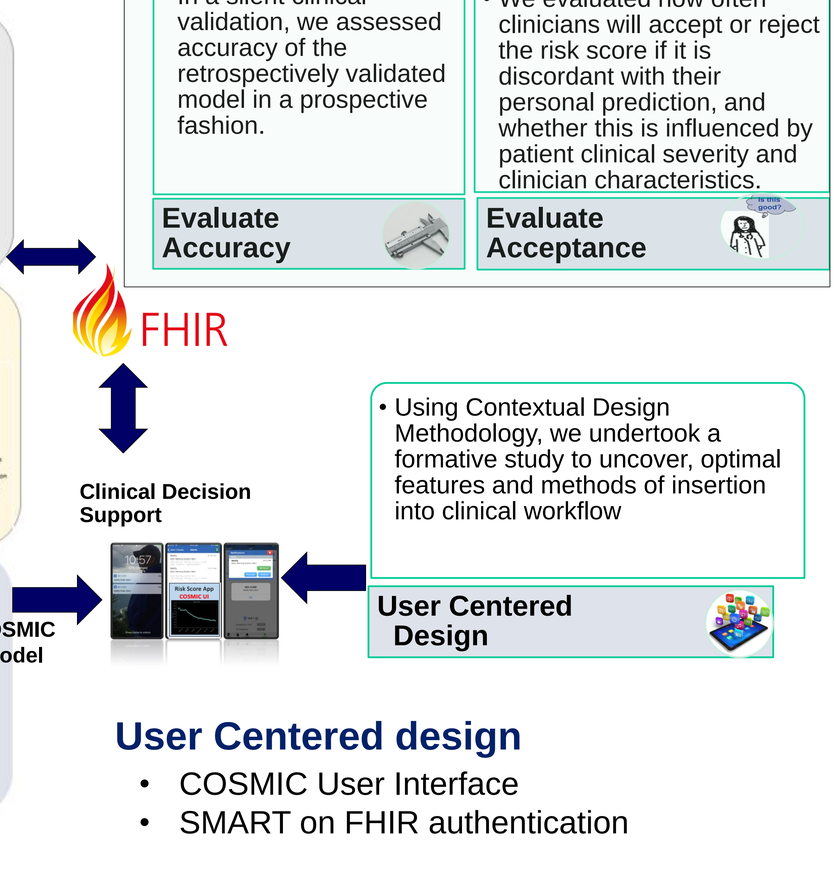


Figure Illustrating the **Algorithm Implementation Pipeline for Applications in Intensive Care (ALPACA):** i) Retrospectively develop the Machine learning Model, including: a) acquire physiological data, b) Data Wrangling: deal with missing data and incorrect labelling of the data, c) Data analysis: design the features, build and evaluate machine learning model; ii) Real-time deployment of the Clinical Decision Support Service (CDSS) accepts data from data stores, runs the machine learning model, and provides model output for a user interface; iii) Evaluate accuracy within a silent clinical validation; iv) Evaluate acceptance of the risk score by trained clinicians in a simulation study.. Fast Healthcare Interoperability Resources (FHIR): standard describing data formats and elements and an API for exchanging health information on EHR.

User Centered design

- COSMIC User Interface
- SMART on FHIR authentication

Risk Assessment and Model Acceptance

- Evaluation in a realistic clinical setting after deploying at bedside

Table 1. Observational Pilot Study Patients (Silent Score)

Age	Sex	HH	MFS	DCI	COSMIC Score	Precision Recall	EVD
44	F	5	4	Yes	DCI	TP	Yes
50	F	4	3	Yes	DCI	TP	Yes
58	M	1	4	Yes	No DCI	FN	Yes
64	M	1	1	Yes	No DCI	FN	
34	F	2	3	No	No DCI	TN	Yes
61	F	2	4	No	No DCI	TN	Yes
88	F	2	3	No	No DCI	TN	Yes
38	F	2	3	No	No DCI	TN	Yes
68	M	1	1	No	No DCI	TN	
53	M	2	3	No	No DCI	TN	
31	F	2	3	No	No DCI	TN	

HH=Hunt Hess, MFS=modified Fisher Score, TP=true positive, TN=true negative, FN=false negative, EVD=external ventricular drain

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