Patient Condition Modeling in RPM systems: Heart Failure Hospitalization Prediction

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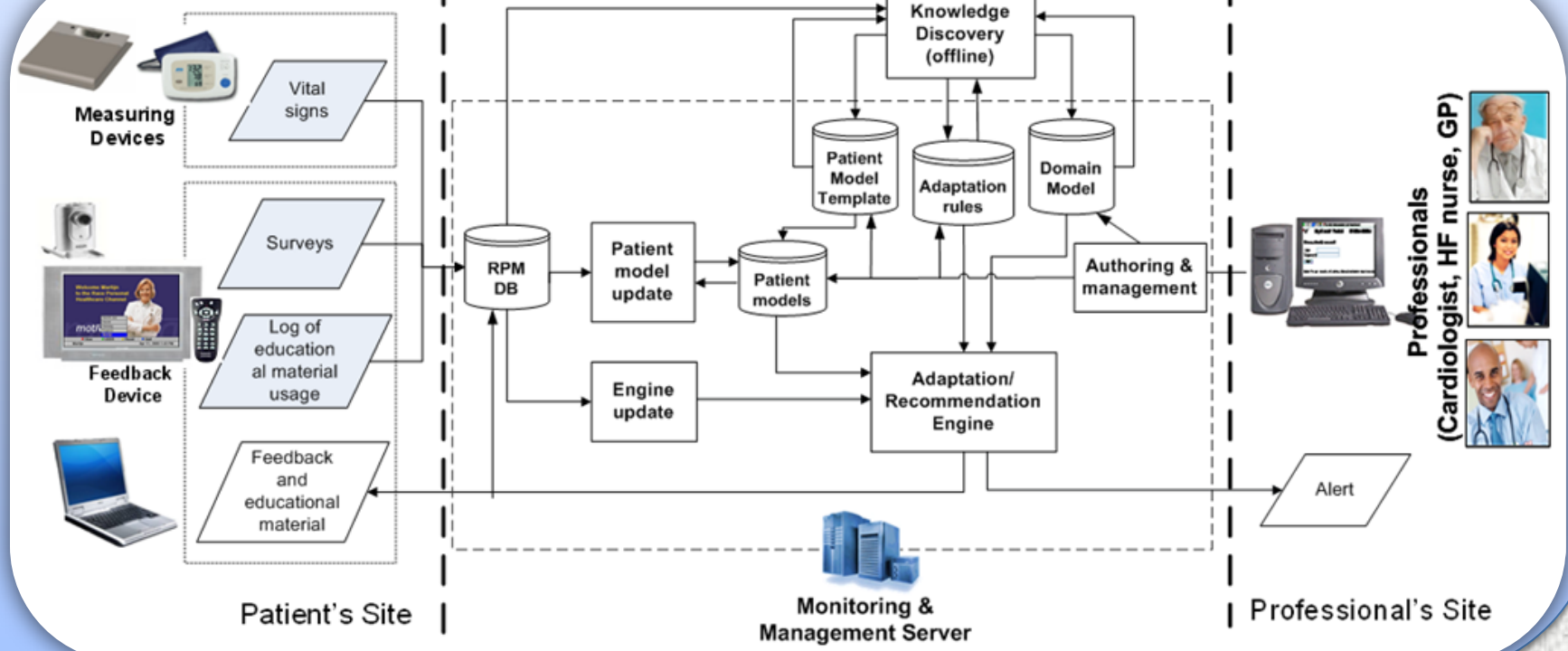
Background and preceding work

Remote patient management (RPM) systems enable

- Monitoring of vital signs of patients at home (blood pressure, weight, etc)
- Providing educational and/or motivational feedback to patients at home
- Alerts to medical professionals of patient's at risk so that they can intervene to prevent worsening of patient's condition and hospitalizations
- All with the aim of improving clinical outcomes of chronic patients, including mortality, hospitalization, and quality of life.

Our recent proposal

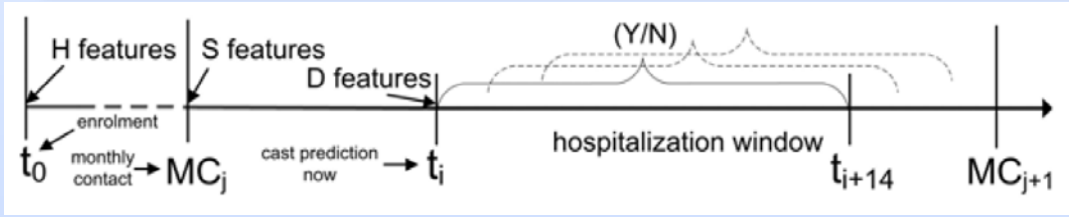
- Possible architecture of next generation personalized RPM systems heavily based on knowledge discovery from RPM data leading to identification of potentially useful features and patterns for patient modeling and adaptation rules



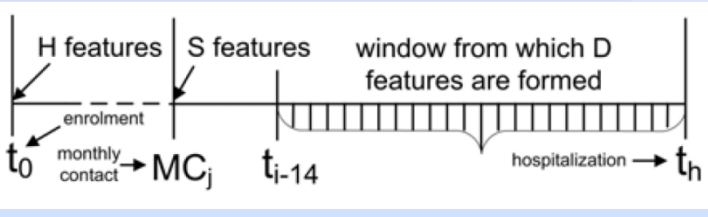
Our approach

Focus of this work is *Heart Failure Hospitalization Prediction*: On a daily basis, based on the available data about a patient at moment t_i cast a prediction whether the hospitalization for this patient is likely within next 14 days period $(t_{i+1}, t_{i+14}]$

Our contribution: We proposed an approach to learn a classifier that utilizes information spread across different data sources and is able outperform the expert-authored rules used to trigger alerts



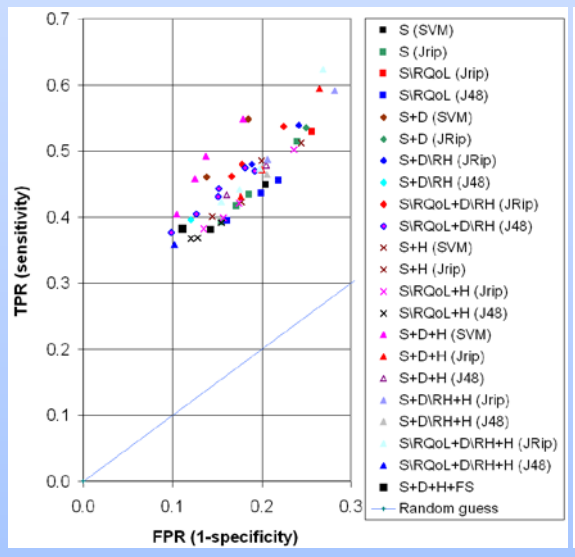
Hospitalization prediction for the following two weeks window



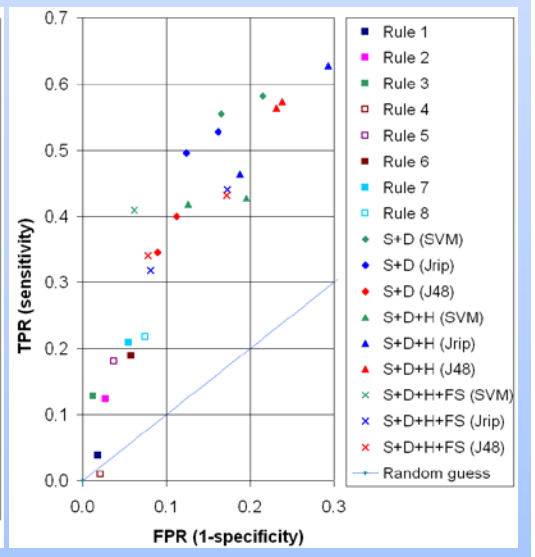
Forming of a positive (HFH took place) training instance

Experimental evaluation on TEN-HMS dataset

Hospitalization prediction accuracies for different classifiers and feature sets



10CV on training set



test set

Classification model		TPR	FPR	YIndex	HRate
Rule 1		0.038	0.019	0.019	0.316
Rule 2		0.123	0.028	0.095	0.211
Rule 3		0.128	0.012	0.115	0.211
Rule 4		0.010	0.022	-0.012	0.053
Rule 5		0.180	0.038	0.143	0.263
Rule 6		0.189	0.058	0.131	0.316
Rule 7		0.209	0.055	0.153	0.421
Rule 8		0.217	0.075	0.142	0.474
S+D (SVM)	max TPR	0.582	0.215	0.367	0.526
	min FPR	0.555	0.124	0.371	0.474
S+D (JRip)	max TPR	0.527	0.162	0.365	0.684
	min FPR	0.495	0.124	0.371	0.579
S+D (J48)	max TPR	0.400	0.112	0.288	0.526
	min FPR	0.345	0.090	0.256	0.579
S+D+H (SVM)	max TPR	0.427	0.196	0.232	0.474
	min FPR	0.418	0.126	0.292	0.727
S+D+H (JRip)	max TPR	0.627	0.293	0.334	0.737
	min FPR	0.464	0.188	0.276	0.579
S+D+H (J48)	max TPR	0.573	0.239	0.334	0.632
	min FPR	0.564	0.231	0.332	0.632
S+D+H+FS (SVM)	max TPR	0.432	0.172	0.259	0.632
	min FPR	0.409	0.062	0.348	0.579
S+D+H+FS (JRip)	max TPR	0.441	0.173	0.268	0.632
	min FPR	0.318	0.082	0.237	0.368
S+D+H+FS (J48)	max TPR	0.432	0.172	0.259	0.632
	min FPR	0.341	0.078	0.263	0.474

For further information please visit www.win.tue.nl/~mpechen/projects/rpm/ or e-mail us at m.pechenizkiy@tue.nl