Philips Lifeline CareSage Analytics Engine

Retrospective Evaluation on Patients of Partners Healthcare at Home

Mariana Simons and Jorn op den Buijs - Philips Research
Linda Schertzer – Philips Lifeline

Introduction

The most common cause of emergency transports/admissions in aging population is deterioration in their health status due to multiple chronic conditions. The Philips Lifeline's CareSage analytics engine utilizes a Personal Emergency Response Service (PERS) data to predict ER transport–related medical emergencies, see Figure 1. Their timely detection is critical in optimizing clinical and financial outcomes.

Study Objective

To evaluate 1) healthcare expenditure and clinically validate 2) CareSage predictive model on patients of Partners Healthcare at Home (PHH) that have been using the Philips Lifeline service. This study is unique in utilizing PERS connected technology as a source of data to identify patients at risk of ER transports or admissions that may result in high healthcare expenditure.

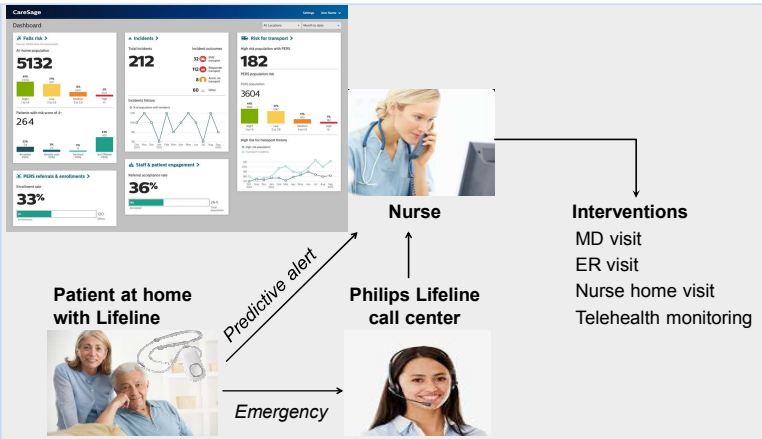


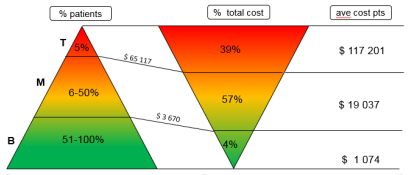
Figure 1: CareSage Settings

Methods

- We identified 3 335 patients with in-/out-patient encounters in the fiscal years FY11-FY15 in 5 Partners Healthcare-affiliated hospitals through cross-reference of Philips Lifeline and Partners Healthcare at Home (PLL/PHH) data.
- The healthcare expenditure were assessed by linear regression models.
- The CareSage logistic regression model to predict ER transport based on PERS data only was validated on PHH patients.
- An enhanced model predicting hospital admissions through ER was developed using both PERS and EHR data.
- Model performance was evaluated by the area under the receiver operator characteristic curve (AUC) and the positive predictive value (PPV).

Results

- Patients in the top, middle and bottom segments of the cost acuity pyramid account for 39%, 57% and 4% of the total cost in FY15, respectively, see Figure 2.
- Increasing trends in total cost, average cost per patient and per encounter were detected through FY11-FY15 based on linear regression analysis, see Figure 3.
- The CareSage predictive model that identifies patients at high risk of ER transport in the coming 30 days has AUC=0.74, whilst the enhanced model that identifies patient at high risk of hospital admission through ER has AUC=0.85, see Figure 4.
- The PPV in the top 5% for one year prediction window was also good: 63% and 68% for ER transport and admission, respectively. The most important variables for both models were the frequencies and recencies of past adverse events.



Segments	Total pts	Total pts (%)	Total cost	Total cost (%)	Ave cost pts
Top	110	5%	$ 12 892 142	39%	$ 117 201
Medium	993	45%	$ 18 903 619	57%	$ 19 037
Bottom	1 103	50%	$ 1 184 606	4%	$ 1 074
Total	**2 206**	**100%**	**$ 32 980 368**	**100%**	**$ 14 950**

Figure 2: Total cost acuity pyramid in fiscal year 2015

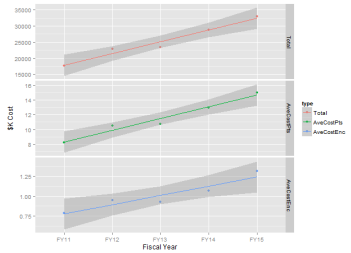


Figure 3: Trends in healthcare expenditure FY11-FY15

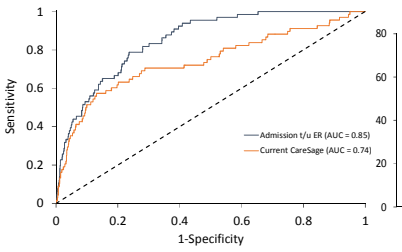


Figure 4: Predictive models ROC curves

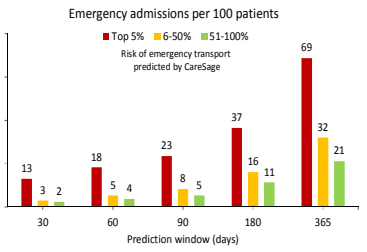


Figure 5: Admissions by predicted risk of ER transport

Conclusions

- The clinical validation of the CareSage predictive model showed very good performance.
- Predictive models based on PERS and EHR data can identify patients at risk of ER transports and admissions that contribute to high healthcare cost.
- Healthcare organizations can use the outcome of these predictive models to design relevant interventions targeting their high risk patients.

mariana.simons@philips.com, jorn.op.den.buijs@philips.com, linda.schertzer@philips.com
www.philipslifeline.com/caresage

Disclaimer: This analysis was conducted using data from Partners Healthcare at Home population. Other population results may vary.

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