

June 2019

KelaHealth

Cardiac Case Study

Prediction of Hospital Length of Stay
and Risk-Based Recommendation of
Postoperative Care Setting for
Patients Receiving an Aortic Valve Replacement

With support from:
Cedars-Sinai Medical Center

Summary

Transcatheter aortic valve replacement (TAVR) provides a catheter-based procedure for patients that are too risky for open-heart surgery. The procedure generally reduces recovery time from up to 6-weeks to several days. American College of Cardiology projected 50,000 TAVRs in 2018 with that number expected to double in 2020. For patients who undergo a TAVR procedure in the U.S., it is common practice to recover postoperatively in the cardiac Intensive Care Unit (ICU). Recent medical literature has shown that patients at a lower risk for complications can safely recover in a routine surgical ward instead of the ICU. By targeting this “fast track protocol” based on individual risk levels, patients and hospitals alike can benefit from shorter hospital stays, improved recovery outcomes, better allocation of limited ICU beds, and overall cost savings¹.

Open to realigning its historic TAVR-recovery protocols to the clinically-accepted “fast track protocol”, the Smidt Heart Institute at the Cedars-Sinai Medical Center (CSMC) partnered with KelaHealth to investigate how effectively assigning patients to the ICU or routine surgical ward post-TAVR could impact patient care and associated costs. With an average ICU stay in the U.S. costing **twice** as much as routine surgical ward care, CSMC recognized the potential for significant cost reduction with a more targeted approach to assigning post-surgical care interventions for their TAVR patient population.

The hospital identified potential cost savings from implementing KelaHealth’s optimized patient recovery designation of care of \$12 million over 4 years for this single procedure, with savings of at least \$3m per year.

Hypothesis

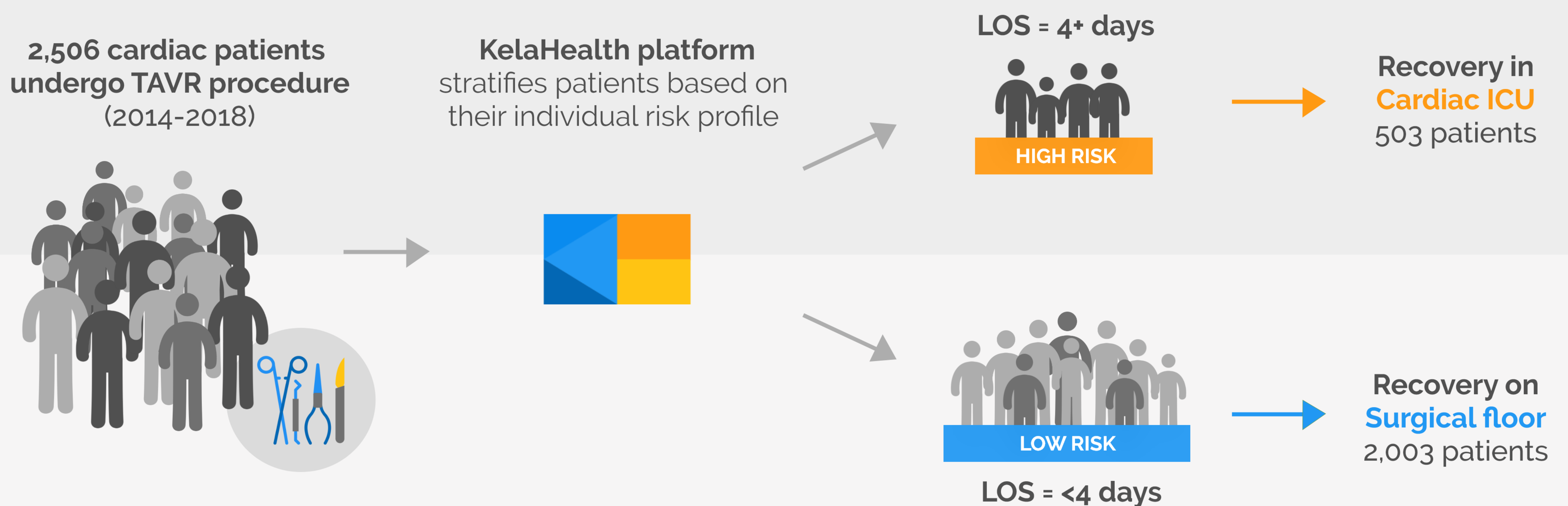
By leveraging the KelaHealth platform, Cedars-Sinai would more accurately assign patients undergoing the TAVR procedure to either floor care or ICU post-surgery. The platform would risk-stratify patients based on their predicted length of stay (LOS), a proxy for risk level, resulting in (1) more effective utilization of the limited intensive care unit beds, and (2) decreased overall length of stay for healthy patients with faster recovery. A successful implementation would validate the healthcare cost optimization associated with this targeted intervention approach.

¹ Marcantuono R, Gutsche J, Burke-julien M, et al. Rationale, development, implementation, and initial results of a fast track protocol for transfemoral transcatheter aortic valve replacement (TAVR). Catheter Cardiovasc Interv. 2015;85(4):648-54.

Study Design

As part of this retrospective study, KēlaHealth and Cedars-Sinai identified a cohort of 2506 patients who underwent TAVR surgery at the Cedars-Sinai Smidt Heart Institute between 2014-2018. Using patients' clinical information in the EHR, KēlaHealth risk stratified patients based on predicted LOS, and accordingly assigned postoperative care in the ICU or routine surgical ward.

With knowledge that 80% of the TAVR patients at Cedars-Sinai had a post-surgical LOS of 1-4 days within the hospital, while the remaining 20% of patients had a LOS greater than 4 days, KēlaHealth classified patients as high risk and low risk based on the LOS predictive model at a 4 day LOS threshold. A retrospective financial analysis was conducted comparing the current paradigm of cost for (1) all 2506 patients receiving care primarily in the ICU, and (2) KēlaHealth's risk-based, postoperative recovery designation of care.



INTERVENTION USING KELAHEALTH

Methods

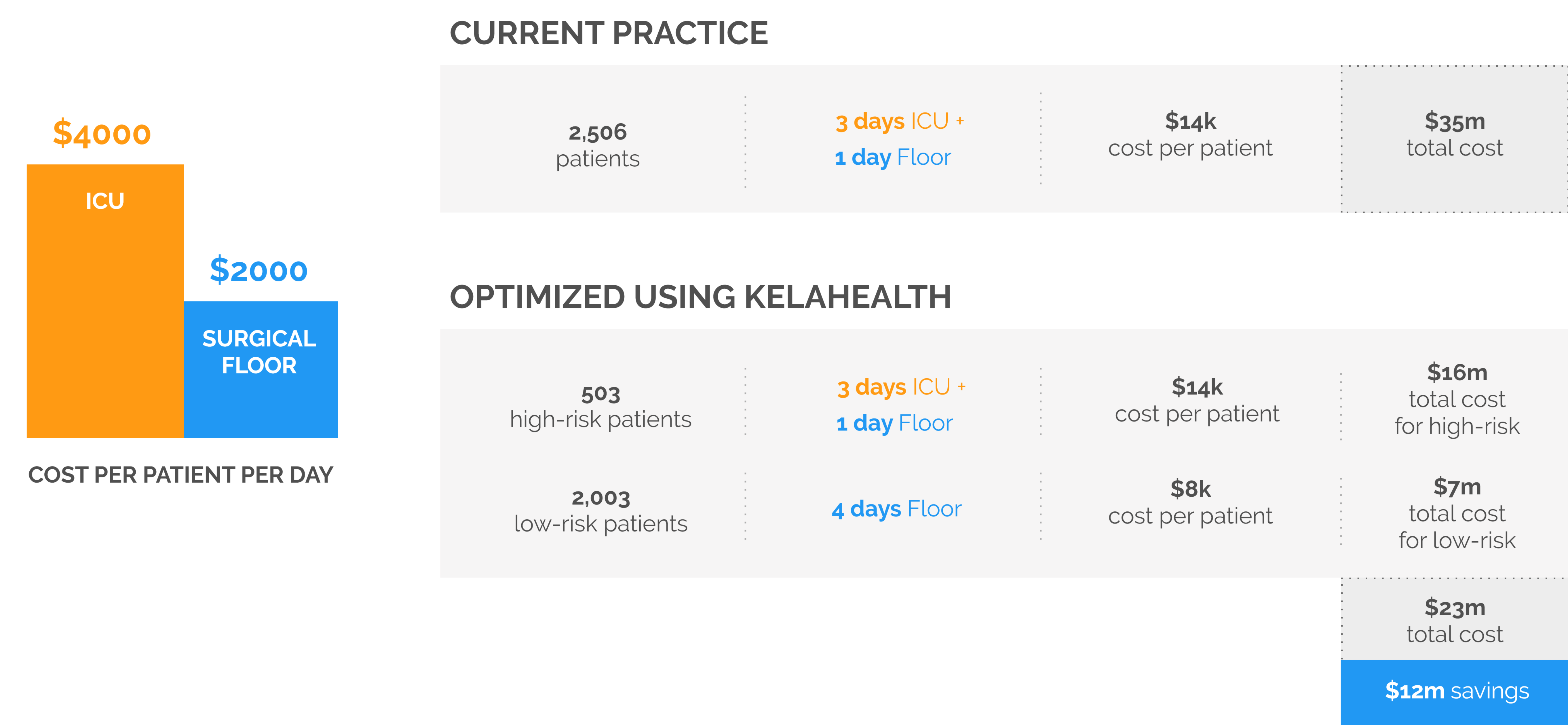
We trained and validated a tailored version of this model for this specific hospital and patient population using machine learning methodologies and other predictive statistical techniques. The model was engineered to predict the appropriate LOS based on a variety of patient parameters available in the CSMC patient datasets, including patient demographics, surgical history, medical history, and service provider notes.

The KēlaHealth platform generated a binary LOS prediction (i.e. “LOS < 4 days” or “LOS > 4 days”), which yielded the most accurate model in this population. The industry standard for measuring the performance of machine learning models is the area Under the Receiver Operator Curve (AUROC), which ranges from a scale of 0.5 (likelihood of a 50-50 chance of correctly predicting each single event, or 50% prediction accuracy) to 1.0 (likelihood of obtaining the correct answer every time).

To provide the CSMC cardiac surgical team with deeper clinical insight, the model was designed to identify and **rank** the patient parameters the platform determined to be most statistically-significant in predicting patient risk for complications, post-TAVR procedure.

Results

EHR data across 2506 CSMC patients who underwent a TAVR procedure between 2014 and 2018 was analyzed in this study. The model with the highest predictive value was determined to be at the 4-day mark with an AUC of 0.75. The financial impact to the hospital of 2506 TAVR patients is shown below. Total cost savings were \$12 million over 4 years. Per year, the savings was about \$3 million in this one procedure.



About KelaHealth

KelaHealth is a mission-driven, venture-backed team of clinicians, engineers, and business leaders who are focused on delivering higher quality care in surgery. Using machine learning, we predict patients' risk for specific surgical complications and help surgeons proactively intervene to mitigate these risks before and after surgery. The aim is to reduce complications, readmissions and ultimately, guide patients safely through the surgical journey by bringing insights from millions of patients to every patient. For more information, visit www.kelahealth.com.

