June 2019

KelaHealth
Vascular Case Study

Prediction of Surgical Site Infection and Risk-Based Use of Negative Pressure Therapy on Closed Incisions for Vascular Surgery

With support from:
National Science Foundation
Duke Health System
Acelity/KCI

Summary

In a continual effort to improve the quality of care, Duke Health identified a need to decrease rates of surgical site infections (SSI) within its vascular surgery department. With SSI costing the hospital an additional $10,497 per occurrence[1], optimizing intervention recommendations to improve care and manage financial impact to the hospital was critical.

Historically, standard intervention for patients undergoing vascular surgery has been applying sterile dressing to the surgical site (SD), with regular dressing change when soiled. Due to concern for unacceptable SSI event rates, the vascular surgery department began adopting negative pressure therapy on a closed incision (ciNPT), a device that was shown to be highly effective in infection prevention[2 3]. An individual surgeon's assessment of patient risk and preference drove the decision to apply the ciNPT intervention (cost estimate: $495/unit) over the sterile dressings (cost estimate: negligible).

Duke Health sought an objective, risk-based stratification platform to appropriately target the use of the high-acuity versus standard interventions for vascular surgery patients in order to improve clinical outcomes and financial savings for its patients. With support from Duke University and Acelity/KCI, KelaHealth designed and conducted a retrospective study to assess the efficacy of a risk-based intervention strategy like KelaHealth as compared to the status quo, physician subjective assessment only.

The primary outcomes of interest were the rate of surgical site infections and estimated costs. This study showed that Kelahealth can produce an estimated 41.3% reduction of SSI events and a 26.0% reduction in cost.

Hypothesis

By leveraging the KelaHealth platform, Duke Health could more accurately identify vascular patients at high risk for surgical site infection and appropriately target the use of a standard intervention, sterile wound dressing (SD) versus a high-acuity intervention (ciNPT)[1], resulting in improved patient outcomes, the reduction of SSI, and increased cost savings for the hospital.

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1 Boltz MM, Hollenbeak CS, Julian KG, Ortenzi G, Dillon PW. Hospital costs associated with surgical site infections in general and vascular surgery patients. Surgery. 2011;150(5):934-42.

2 Kwon J, Staley C, McCullough M et al. A Randomized Clinical Trial Evaluating Negative Pressure Therapy to Decrease Vascular Groin Incision Complications. Journal of Vascular Surgery. 2018; 68(6):1744-1752.

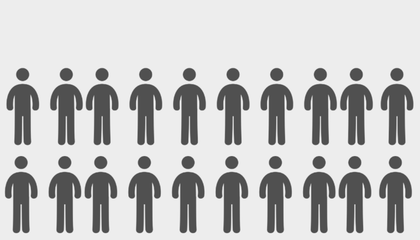
3 Gombert A, Babilon M, Barbati M et al. Closed-incision negative-pressure therapy reduces surgical site infections in vascular surgery: a prospective

Study Design

As part of this retrospective study, KelaHealth identified 370 infrainguinal vascular surgery patients at Duke Health who did and did not receive the ciNPT as part of their surgical care. Roughly fifty percent of patients had received ciNPT (179) and the other fifty percent of patients had received sterile dressing only (191) based on surgeons' subjective assessments. The entire cohort of patients' data were run through the KelaHealth platform and classified into two strata based on their predicted risk level for an SSI occurrence, high risk or low risk. These groups were then segregated into a total of four groups based on their risk level (high or low) plus the surgical intervention that had been applied in each individual's case (SD or ciNPT). These four groups were defined and labeled as 'appropriate care' (high risk + ciNPT and low risk + SD) and 'inappropriate care' (high risk + SD and low risk + ciNPT). Clinical and financial comparisons were drawn between the objective, risk-based, 'appropriate care' strategy and the subjective, 'inappropriate care' strategy.

370
Vascular Patients

KelaHealth Risk Assessment



HIGH RISK

282 patients

LOW RISK

88 patients

Actual treatment of patients: **ciNPT** (intervention) or **SD** (control)

ciNPT	SD	ciNPT	SD
148 patients	134 patients	31 patients	57 patients
APPROPRIATE CARE	UNDERCAUTIOUS	OVERCAUTIOUS	APPROPRIATE CARE

Methods

KelaHealth deployed a deep learning model to identify vascular patients at high risk for surgical site infection (SSI). The algorithm was trained and validated on a national cohort of 72,435 cases defined by CPT codes specific to vascular surgeries with an infrainguinal approach. These same CPT codes also defined the test set (i.e. the Duke institutional cohort of 370 patients).

Once the platform had classified each patient to one of the 4 groups identified in the study design, the documented rate of SSI in this cohort at Duke Health was compared to KelaHealth's projected rate of SSI applied to the whole cohort. In other words, the actual patient SSI events that had occurred within a physician-assessed intervention regimen were compared to the projected SSI rates associated with a KelaHealth risk-based intervention strategy.

Results

Among a cohort of 370 patients undergoing vascular surgery, KelaHealth's SSI risk prediction platform estimated a 41.3% reduction of SSI events and approximately a 26.0% reduction in cost or $148,458, equating to $401 per patient.

By combining machine learning-based risk stratification and evidence-based interventions, the KelaHealth platform successfully developed a tailored surgical intervention recommendation for all 370 of the Duke Health cohort patients based on each patient's unique risk profile. In this retrospective study, we demonstrated how KelaHealth's objective risk-based methodology may have resulted in improved patient clinical outcomes and significant cost savings for vascular surgery patients at Duke Health.

$10,497

Increased cost, per patient, in a SSI event

$495

ciNPT cost per device, for preventing a suspected SSI

	Actual SSI (without risk-based adoption strategy)	**Intervention using KelaHealth projected SSI** (with risk-based adoption)	**Cost reduction from risk-based intervention**
Surgical site infection (SSI) events	**46 (12.4%)**	**27 (7.3%)**	↓ **41.3%** fewer infection events
Total cost of SSI events + ciNPT used or recommended	**$571,467**	**$423,009**	↓ **26%** $401 per patient saved

Chair of Surgery at Duke University Health System **Dr. Allan D. Kirk MD PhD FACS** recognized the value of KelaHealth's technology.

> ***"The early success of KelaHealth has led to constructive next steps at Duke. Our system has full confidence in KelaHealth's ability to implement innovative technology to provide value to our clinicians."***

KelaHealth has engaged in follow-on work to implement KelaHealth's commercial platform within Duke Surgery.

For more information, including access to peer-reviewed publications related to this case study, please contact us at learn@kelahealth.com.

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**.