KelaHealth Whitepaper

Bringing Insights from Millions of Patients to Every Patient

kēlaHealth

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Introduction

With the shift from a volume to a value-based model, hospitals are seeking solutions to improve patient outcomes and manage costs. By proactively identifying clinical risks and matching patients to interventions most appropriate for these risk strata, KelaHealth is designed to support hospitals in driving dynamic, continual quality improvements in care over time.

Currently, perioperative management relies on subjective surgeon experience and current—and often incomplete—knowledge of ever-changing best-practice recommendations, resulting in significant variability in risk assessment and preventative practice. Therefore, the principal objective of this proposal is to develop and test a software platform that links accurate and objective risk stratification with evidence-based interventions targeting specific complications for surgical providers to deploy at the point-of-care.

Vision

KelaHealth provides hospitals with a decision support tool that predicts patient risk, recommends stratified interventions, and automates tracking of the patients' clinical outcomes in order to improve quality of care while reducing overall health care costs. Through the use of cutting-edge machine learning methodologies combined with clinician expertise, KelaHealth pushes the envelope to deliver powerful, 'actionable' insights and enable clinicians to appropriately and cost-effectively target preventative care case-by-case.

KelaHealth's risk-based approach to determining surgical interventions delivers the following key benefits to surgical centers' efforts to adhere to value-based care models:

Personalized Predictions | Machine learning models provide accurate, tailored predictions for each patient. Utilizing a library of trained machine learning models in the surgical space, KelaHealth predicts risk for a wide-range of surgical outcomes.

Consistent Actions | Stratified interventions are appropriately recommended on a case-by-case basis to ensure that each patient is receiving care in alignment with his or her unique risk profile.

Transparent Outcomes | Postoperative outcomes for all complication categories are tracked using Natural Language Processing (NLP) & heuristics. Patients' 30-90 day results are displayed via a user-friendly interface to surgical teams in a timely manner to improve practice.
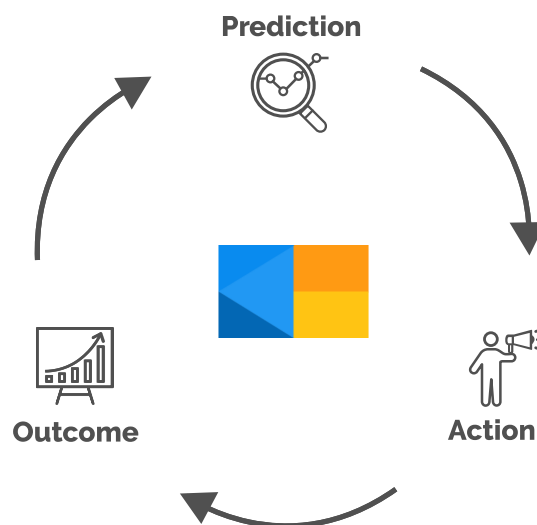
Methods

Unlike other predictive analytics tools, KelaHealth combines machine learning-based risk stratification with evidence-based interventions to empower hospitals to implement objective practice strategy. The KelaHealth methodology enables hospitals to be more efficient and consistent in recommending tactical surgical interventions to improve patient care, and objectively track patient outcomes and cost savings to demonstrate hospital success. Regardless of hospital size or data resources, each client can implement the KelaHealth platform to achieve their specific value-based care and cost-saving initiatives.

Research

With initial research stemming from a dataset of over 4 million surgical patients from 700 U.S. hospitals, KelaHealth's work originated from deeply scientific and clinically rigorous investigations around surgical quality.

Leveraging technology from this early research, KelaHealth continues to develop and maintain a comprehensive library of surgical complication prediction models.

These generalized models can analyze more than 200 clinically relevant patient parameters to determine a patient's risk level across multiple surgical outcomes. Statistical studies have validated the highly-accurate nature of these predictive models.

This database and associated library of validated predictive models serve as the building blocks of the KelaHealth platform. By adapting our surgical outcomes database and generalized models to a hospital's specific use case, KelaHealth can address the unique surgical requirements of our clients to make recommendations of greatest interest using a hospital's own EHR datasets.

Predictive performance as measured by c-statistics of KelaHealth's wide and deep learning model, validated on local data.

| Models	Wide and Deep Learning Method (c-statistic)
Wound complication	0.782
Cardiac complication	0.867
Respiratory complication	0.856
Thombotic complication	0.780
Renal complication	0.872
Neurologic complication	0.828
Urinary tract infection	0.770
Bleeding complication	0.888
Septic complication	0.822
Reoperation	0.740
Readmission	0.711
Mortality	0.924

Machine Learning & Transfer Learning

Upon engaging KelaHealth, a hospital works with our team to define its surgical quality goals and tailor our risk prediction platform to 'surface' the desired risk profiles and intervention recommendations. With the understanding of the hospital's value-based care goals, KelaHealth leverages its library of nationally-trained machine-learning prediction models and selects the most appropriate models for the hospital's use case.

Once identified, these models are tailored to the hospital's unique 'footprint' using local EHR datasets. To further tune these models, a specific machine-learning method known as "transfer learning" is applied. Transfer learning allows models to strengthen predictions of surgical risk by applying knowledge previously gained from models trained on a broader scale to the customer's local demographics and policy 'footprint'.

This tailors "general" learning to a specific and narrowed dataset, which allows for great prediction performance. In a study done with a hospital partner, we were able to increase outcome prediction accuracies up to 18% with transfer-learned models as compared to our "out of the box", national models and other clinical risk scores in use today.

Additionally, it overcomes shortcomings faced by hospitals with limited patient datasets by enhancing their EHR with information KelaHealth analyzed in previous client engagements.
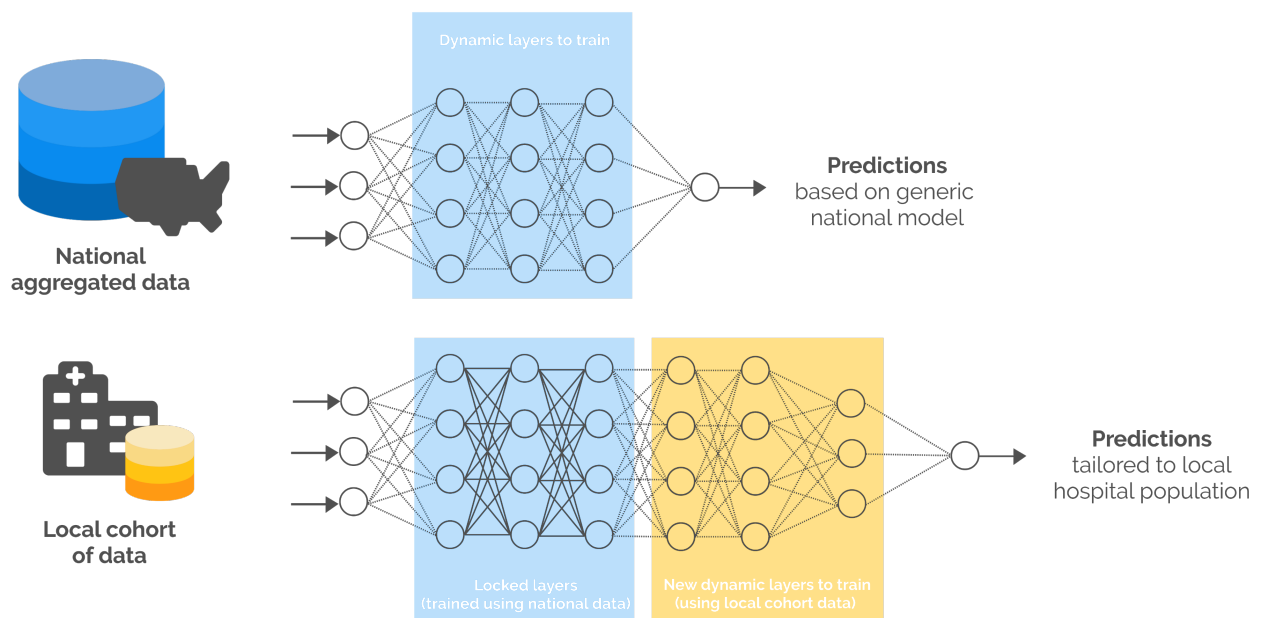
Technology

KelaHealth offers on-cloud solutions based on hospital needs using a HIPAA-compliant commercially available cloud platform such asAmazon Web Services (AWS). The KelaHealth software solution is designed to be agnostic to hosting software and hardware platforms, allowing us to operate our applications on any public or private cloud hosting settings. Additionally, KelaHealth's use of managed services and serverless technologies enables us to keep costs low for our customers.

Our scalable data pipeline application enables distributed computing on cloud for faster processing time and the ability to accommodate larger volumes of incoming data in the future. Our data processing library is designed to be fault tolerant, parallelizable, and able to deal with unexpected data formats. Through the use of modern application management tools, such as Docker Containers, our cloud-based solution can be quickly deployed in accordance with the requirements posed by both surgical and IT departments within hospitals.

The KelaHealth platform supports direct EHR integration and offers the flexibility of providing streamed or batch predictions based on customer needs. From inputting customer EHR to sending the associated risk predictions, we make the process of data analytics seamless to ensure no time is lost in the surgical workflow upon platform deployment.

System Architecture

KelaHealth's centralized machine learning platform is designed to maintain engineering efficiency in an elegant architecture. KelaHealth's models are deployed securely within our cloud-based KelaForecast platform and queried by internally- and externally-facing applications using Application Programming Interfaces (APIs). This single API infrastructure allows KelaHealth to be technically hyper-efficient and serve a broad range of customers for business growth.

KelaHealth's enterprise-level API integrates with a hospital system's EHR backend architecture and serves customer needs on demand. The technical workflow for the API is as follows:

1. Implement a data extraction pipeline from the EHR system
2. Generate predictions using nationally-trained and custom models for the given health system and use case
3. Utilize the customer-specific API to serve their predictions and other information
4. Implement customized web and mobile apps that consume APIs
5. Implement a user-friendly application that integrates into a hospital's EHR system and surgical workflow.

To accommodate a variety of customers with different computing systems, APIs will be implemented in commonplace API architectures, REST, and Fast Healthcare Interoperability Resources (FHIR) APIs.
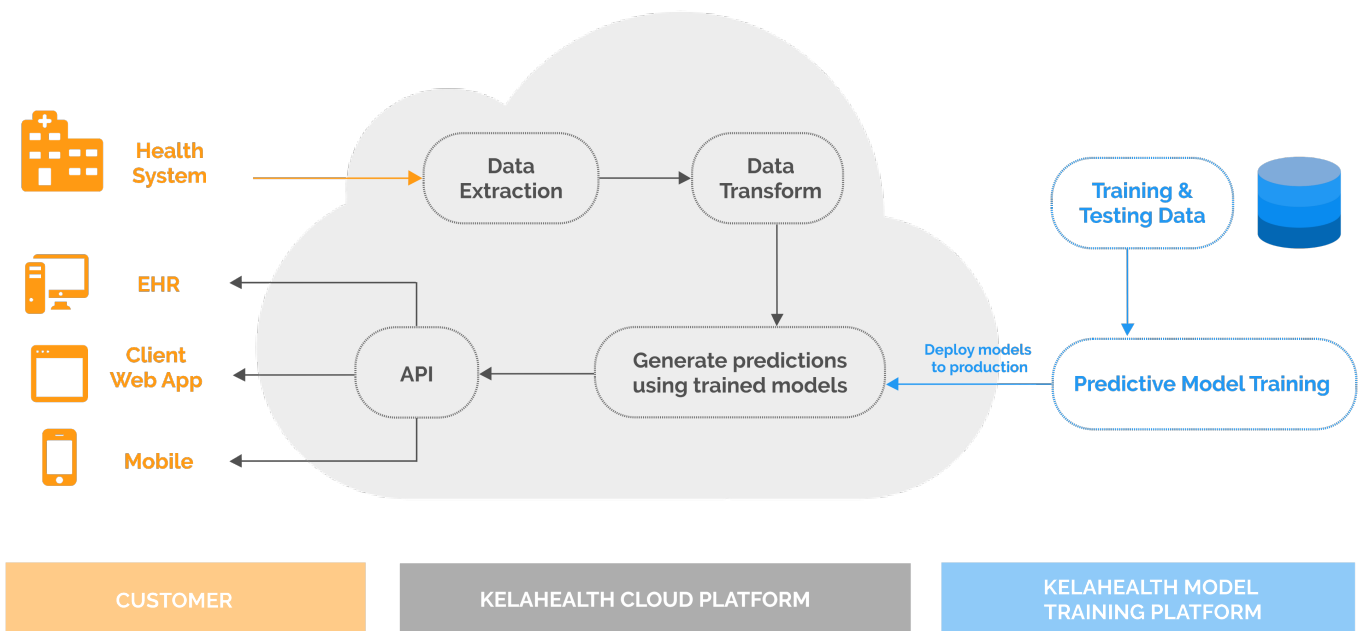
Security

The development of KelaHealth's custom models requires a combination of sensitive PHI data, surgical history notes, and user feedback. For this reason, KelaHealth develops a hospital-approved systems integration plan and a cloud server architecture plan, which enables the platform to meet the data security and patient privacy requirements of hospitals.

KelaHealth upholds a stringent privacy policy and follows modern security protocols to prevent unintended exposure of sensitive data. Any generated data will be redundantly stored in a secure, HIPAA-compliant, and professionally managed cloud storage provider. Additionally, no data will be given to third parties with or without compensation.

Conclusion

With an industry paradigm continuing to shift from volume-based to value-based care models, improving patient outcomes while managing costs is becoming increasingly critical for hospitals. Rather than relying solely on subjective surgeon experience, KelaHealth is empowering clinicians to make data-driven, consistent decisions with its perioperative care decision support tool to achieve value-based care goals and to improve the quality of care for all patients. Through the development of tailored predictive models that leverage machine learning and other statistical predictive methods, KelaHealth is able to bring insights from millions of patients to every patient.

See how KelaHealth is helping hospitals meet their value-based care initiatives. Read our hospital case studies at https://www.kelahealth.com/evidence

For more information or collaboration opportunities contact Steve Ditto, Chief Commercial Officer at steve@kelahealth.com