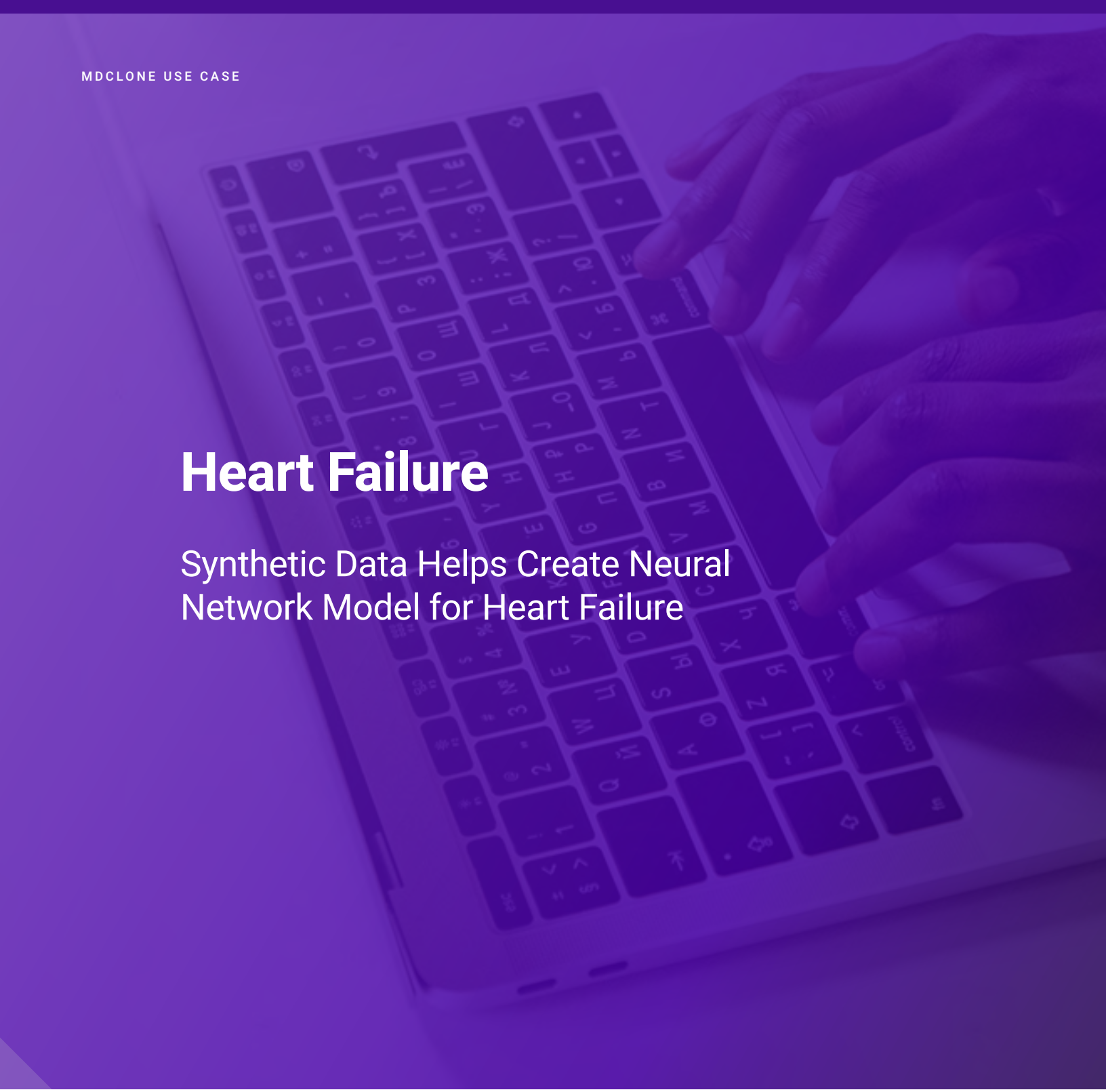
MDCLONE USE CASE



Heart Failure

Synthetic Data Helps Create Neural Network Model for Heart Failure

MDCLONE

VHA INNOVATION Ecosystem

MDCLONE USE CASE

Heart Failure

The VHA needed a robust synthetic version of a patient cohort that they could use to build a neural network model to better understand their data and predict which heart failure patients were at risk of readmission after an initial event.

Overview

Chronic heart failure poses a major public health problem in developed countries, including in the United States. The use of new treatments and medications has vastly improved the outcomes of patients with heart failure in recent decades, but mortality in this population still remains high.

Among patients in the Veterans Health Administration (VHA) in particular, heart failure is the leading cause of admissions among ambulatory care-sensitive conditions, responsible for twice as many hospitalizations as the second-leading cause, chronic obstructive pulmonary disease. In addition, researchers have found that there is an association with post-traumatic stress disorder (PTSD) and heart failure, a devastating correlation for the US Veteran population.

Chronic heart failure is one of the most high-cost cardiovascular conditions in the VHA, resulting in high readmission rates, lowered quality of life, and greater risk for mortality. Patients with heart failure have less adherence to medications and dietary recommendations, which plays a role in patient outcomes. Roughly 22% of Veterans with heart failure are readmitted within 30 days, and 25% of them die within one year of discharge. Finally, gender disparities exist in the cardiovascular disease population of Veterans, further complicating treatment and outcomes.

Challenges

Heart failure can be difficult to manage because the disease is variable. A treatment regimen that one Veteran responds to may not work for another Veteran, and vice versa. When a Veteran is discharged from the hospital, their therapy must be regularly adjusted based on their dynamic physiological state. The heart failure management guidelines provided by the VHA indicate that hospitalizations due to heart failure could be largely prevented if ambulatory care were provided in a timely and effective manner. But siloed data delays the intervention.

The VHA needed a robust synthetic version of a patient cohort that they could use to build a neural network model to better understand their data and predict which heart failure patients were at risk of readmission after an initial event. They could then potentially use this model in a clinical setting to gain real-time insights to prescribe better treatments and ultimately decrease readmissions for heart failure patients.

Key Questions

The VHA sought to use a recurrent neural network (RNN) model to capture non-linear temporal trends in patients' journeys to predict readmission risk of heart failure patients.

The VHA wanted to know:

- What kind of data did it need to generate accurate predictions?
- What variables did it need to add to its patient cohort model to be able to accurately assess heart failure outcomes?
- What is the ideal length of stay that should be used to generate synthetic data?
- Could it obtain a robust enough synthetic version of its patient cohort to develop a strong predictive model that could then be shared with third parties?

The VHA aimed to develop an RNN that would enable prediction of readmissions in its heart failure patient population. After a successful RNN model is deployed, the VHA will begin working to validate the model for use in a clinical setting. This will provide it with a tool it can use to query data in real time and get deeply relevant clinical insights to minimize patient readmissions and drive better health outcomes for heart failure patients.

Results to Date

The VHA performed an initial cohort analysis in which it generated synthetic derivatives of real data using MDClone technology in the Arches platform at the VHA IE and then compared the synthetic data against the original data. The VHA iteratively added clinically relevant attributes for the cohort while preserving the fidelity of the synthetic data.

The VHA discovered that the readmission rate was higher in a cohort of patients where the length of stay was truncated to 5 or less days than for patients whose length of stay was between 5 and 14 days. The VHA then added the following variables: systolic blood pressure, NT-proBNP (min, max, median, count) during the first 14 days, anemia status (true/false), and daily diuretics administration.

After adding these variables and observing its model, the VHA IE made the decision to start with synthetic data for heart failure patients with length of stay less than or equal to 5 days. The VHA IE included daily max observations for creatinine and heart rate, daily minimum values of serum sodium and systolic blood pressure, and daily observation of whether diuretics were administered or not.

The quality of MDClone's synthetic derivative enabled the VHA to begin developing a strong predictive model that it will eventually be able to share with third parties, who can use the model and the synthetic data within for their own research studies and comparisons.

Conclusion

Without MDClone, the VHA IE would have faced significant data governance challenges and been unable to share health data for collaborations. With MDClone, the VHA is empowered

to share synthetic data freely without risking patient privacy. Additionally, using MDClone's tools, the VHA was able to generate high-quality synthetic data for use in its RNN model, enabling it to create early models, validate its results, and ultimately drive down cycle time for learning.

Finally, the VA Boston Healthcare System and Empallo are in a collaboration applying machine learning and AI techniques to existing synthetic and patient-derived clinical data to predict future clinical events as part of a quality-improvement initiative. This collaboration will inform future prospective evaluations of this AI technology, which the VHA can then use on its own synthetic data.

About the Technology

The MDClone ADAMS Platform is a self-service data environment empowering users to organize and access information quickly, sparking ideas and insights that power research, drive better patient outcomes, and create impactful healthcare innovation.

Data are everywhere. Insights are hard to find.

Navigating data in a health system can be challenging, expensive, and time consuming. Answering simple questions can take months or longer due to siloed systems, complex data models, unstructured data, privacy regulations, and limited support from IT and data teams.

With MDClone's unique underlying technology, healthcare organizations can leverage ideas from across the entire ecosystem, overcoming common obstacles that hinder research, innovation, and collaboration.

Fast Access to Dynamic Data Exploration, Analysis, and Action

The rapid cycle of idea-to-data-to-insight enables healthcare organizations to ask for information, discover insights, act on new understandings, measure performance, and share ideas around the world to improve patient health and outcomes.

- Independent self-service discovery
- Interact with all patient data from any source
- Leverage structureless data
- Collaborate freely using synthetic data

Learn more at mdclone.com

About Veterans Health Administration

The Veterans Health Administration (VHA) is America's largest integrated healthcare system. The VHA mission is to honor America's Veterans by providing exceptional healthcare that improves their health and well-being.

The VHA Innovation Ecosystem (VHA IE) is the catalyst for enabling the discovery and spread of mission-driven healthcare innovation to advance care delivery and service that exceeds expectations, restores hope, and builds trust within the Veteran community. The VHA IE was established to enable mission-driven healthcare innovation to advance care delivery for Veterans.

va.gov/innovationecosystem

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sales@mdclone.com
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