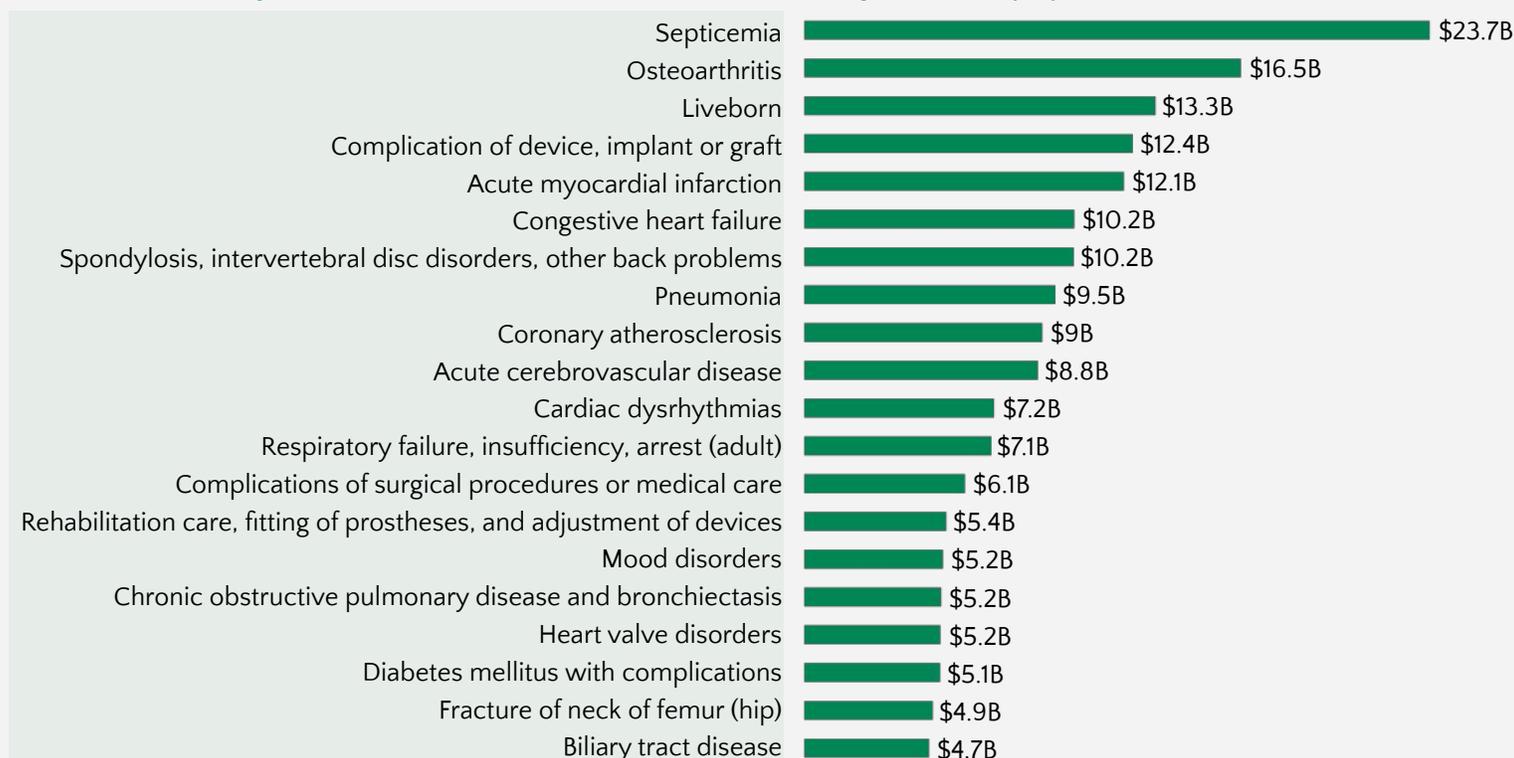


### Using Data & Analytics to Optimize Disease Diagnosis & Management

The Healthcare industry is only beginning to realize the power of its data to address the costliest conditions and complications more effectively. Leading cost drivers that are amenable to algorithmic optimization include Septicemia, Osteoarthritis, complications of device/implant/graft, Acute Myocardial Infarction, Congestive Heart Failure, Spondylosis and other back problems, Pneumonia, Coronary Atherosclerosis and Acute Cerebrovascular Disease to name a few. This new data-driven approach uses machine learning and other advanced analytics to enable winning providers to better predict patient risk of developing a disease or a complication, enact appropriate actions to diagnose earlier and limit complications, rightsize care provision, improve operational and financial performance and ultimately, competitiveness.

### The 20 most expensive conditions treated in U.S. hospitals (all payers, 2013)



Source: HCUPS: <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb204-Most-Expensive-Hospital-Conditions.jsp>

### The Case of Infant Sepsis

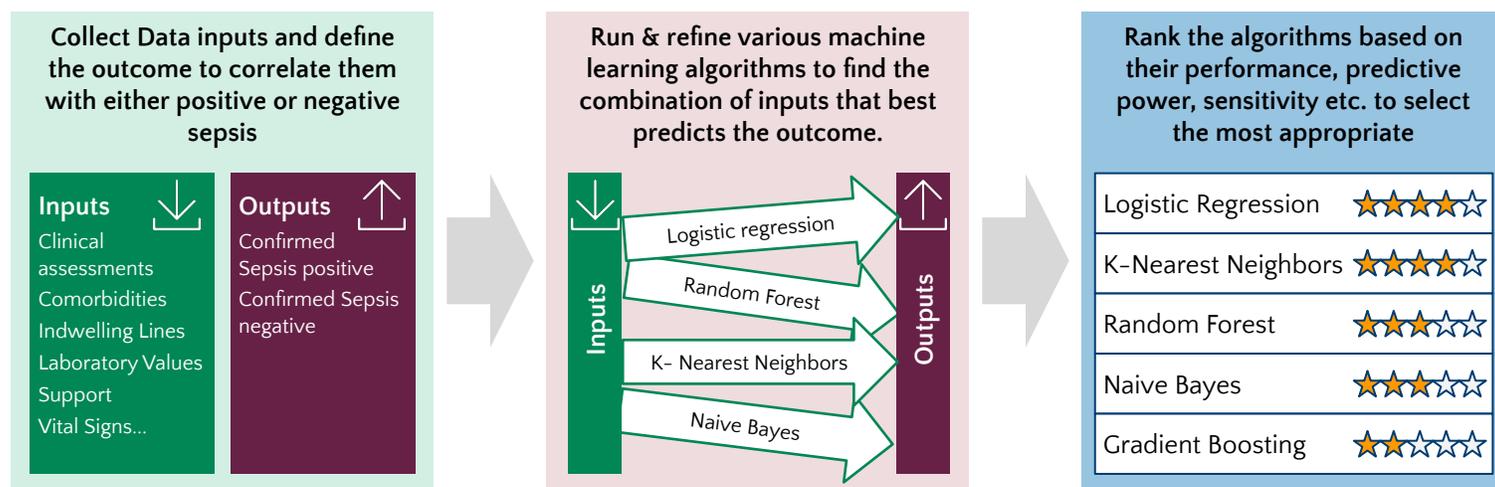
To illustrate how predictive analytics can improve care outcomes, we will discuss here a subset of health conditions amenable to algorithmic optimization: infant sepsis.

Infant sepsis is the most common cause of admission to intensive care nurseries. Each year, more than 75,000 infants and children develop severe sepsis and almost 7,000 of them die—more than children who die from cancer. Among survivors, 30–50% sustain severe long-term outcomes including prolonged hospitalization, chronic lung disease and neurodevelopmental disabilities. No specific anti-sepsis treatments exist; as such, management of patients relies mainly on early recognition allowing correct therapeutic approaches

to be started rapidly, including IV antibiotics and resuscitation with intravenous fluids and vasoactive drugs when needed. In addition to poor outcomes, late detection of infant sepsis comes with a significant price tag: Neonatal Intensive Care Units (NICU) cost US hospitals an average of \$3,500 per day. Given that infant sepsis has an average length of stay of 4.4 days, the cost of stay amounts to \$15,000 per infant, totalling \$1.1B Nationwide. This does not include cost of workup to confirm/infirm sepsis. Therefore, detecting sepsis early and starting immediate treatment is often the difference between life and death, leading to better long-term outcomes and more rational operational management.

## Infant Sepsis Early Detection Approach

By using a machine learning approach, we can train algorithms on retrospective data of infants who were suspected of sepsis and who, through blood culture, were found to be sepsis-positive or sepsis-negative. Based on this outcome, the algorithms are trained on multiple inputs from sepsis registry and EHR that are suspected to be predictive of sepsis, including clinical assessments (apnea, lethargy, etc.), comorbidities (chronic lung disease, necrotizing enterocolitis, etc.), presence of indwelling lines, lab values, and hourly vital signs. The accuracy of those algorithms is then evaluated vis-a-vis their ability to correctly predict sepsis before clinical suspicion and several of those algorithms, such as logistic regression, have been shown to predict sepsis in infants hospitalized in the NICU at least 4 hours prior to clinical suspicion, with an accuracy of ~80%

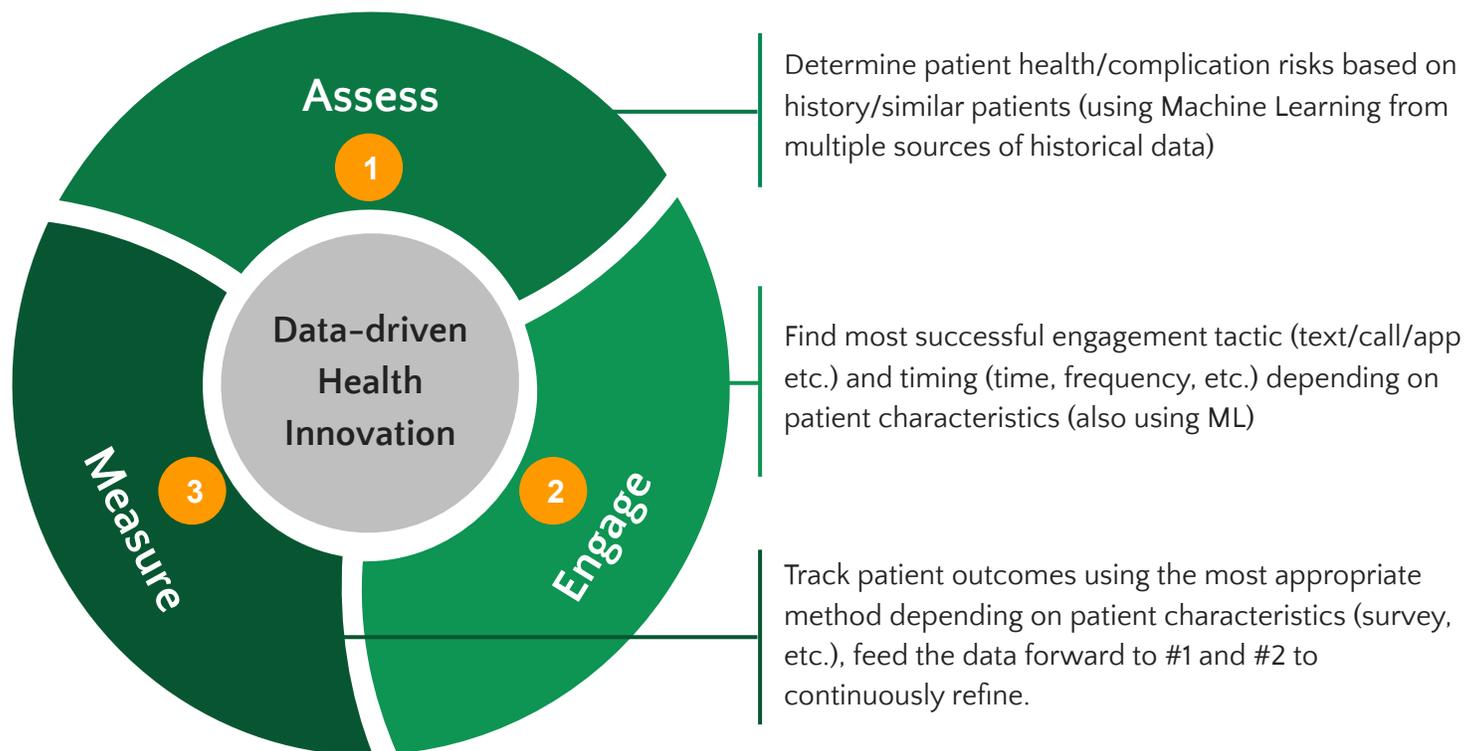


Although such advanced analytics approaches do not provide an actual diagnosis, they can be effectively incorporated into care management workflows and serve as an early alert system to the care management team to enable them to take early action, thereby saving lives and improving survivors' long-term outcomes. Also, early intervention is likely to reduce complications, length of stay and readmissions, which, in turn, improves both quality metrics and care costs.

## Beyond Infant Sepsis

Infant sepsis early detection using machine learning is one of many potential use cases where providers can leverage new advanced analytics techniques after integrating multiple streams of data, including clinical data, financial data, operational data among others. These data "silos" contain information that, if used right, can allow healthcare professionals to **Assess** (predict patient risk for disease/deterioration), **Engage** (through

data-driven personalized clinical care, medical error reduction,...) and **Measure** each initiative's impact on cost, outcomes and experience. However, this data-driven health innovation poses two main challenges: First, this data is not readily accessible in one spot where it can be easily mined. Second, data science knowledge to apply advanced machine learning techniques to get from data to insight to action is not common in healthcare organizations.



## How Clarity can help

At clarity we have developed capabilities and expertise to solve both challenges and enable you to differentiate your organization in the increasingly competitive healthcare marketplace. We help you develop both the strategy and the implementation roadmap that turn your data assets into a true competitive advantage. We help you define and prioritize use cases, pilot projects to address them and then incorporate them into your workflows. Clarity's strategy and analytical expertise helps you build the capabilities that you need. We quickly deploy advanced analytics for decision support to improve both your clinical and operational effectiveness.

Our mission is to "Disrupt the healthcare market with solutions that optimize and innovate the use of data to advance how our partners do business," That only comes with a shared investment of time upfront and a customized and specialized approach. We don't solve every problem, just those that have the biggest impact on your organization, your patients, and in turn, your bottom line. This may require more than a single solution to solve.

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Customer Analytics Service Providers, Q2 2019

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—Market Guide to Data and Analytics Service Providers, 2019

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