E HEALTH ANALYTICS
Actionable Elder Care Insights

HEALTHCARE AND DECISION INTELLIGENCE

By Lorien Pratt, Ph.D

Everyone's health status results from a complex constellation of causal events, and these individual differences impact the effectiveness of various treatments. To address the growing imperative towards patient-centered care, comprehensive information is needed based on individual patient preferences and characteristics that can guide individual treatment decisions. Machine Learning and Decision Intelligence solutions work in tandem to provide comprehensive solutions to support and enhance health practitioner capabilities using the most advanced computer technology available today. This gives us the best of both worlds: expert professional judgement combined with computer support to provide the highest quality in patient-centered care.

About the Author

Dr. Pratt is a Machine Learning pioneer and inventor of the fields of Machine Learning Inductive Transfer and Decision Intelligence. A former college professor, software developer, and technology analyst, she has given multiple TED talks and authored dozens of academic papers. She currently serves as Chief Data Scientist for E Health Analytics and Chief Scientist at Quantellia.

The gold standard for medical treatment evaluation is the randomized control trial (RCT). Used for FDA approval and other purposes, the RCT tests the effectiveness of some intervention – such as a new medicine – on a group of experimental participants. The core principal of the RCT is that participants are chosen by chance alone to belong to a control group, or to receive one or more treatments.

The result of an RCT is an assessment of the treatment's likely effect for a population similar to those who participated in the randomized trial. It does not provide results for either (a) people unlike the study participants, or (b) people with particular characteristics that may impact their response to treatment. For instance, a woman with diabetes, osteoarthritis, and a history of ovarian cancer over age ninety-two may have different responses to a treatment than the study population as a whole. Indeed, it is possible that her treatment should be different than the study indicates.

This is the realm of personalized medicine. Until recently, it has not been possible to use historical data to determine the right treatment for such a particular patient, unless and RCT was conducted for people like her. Doctors must exercise their best clinical judgment based on their professional experience, but typically without the aid of personalized historical statistics to inform their treatment decision.

There has been an explosion of data produced in recent years that can provide substantial assistance to clinicians in this regard. Data comes from Electronic Health Records (EHRs), and is generated by telehealth monitoring devices, personal fitness devices and more. This data has tremendous potential.

In addition, recent years have also seen the emergence of new techniques for analyzing that data, and which are well-suited to personalized medicine. Machine Learning (including the subfield of deep learning, which is our focus), have been proven to have a very high accuracy when analyzing data in many domains. Machine Learning is an important technology in cancer imaging[1] and is the core technology behind Google advertising. Amazon book recommendations, many financial prediction systems, and self-driving cars.

Indeed, machine learning is the most important technology in Silicon Valley today. Says Bill Gates, "A breakthrough in machine learning would be worth ten Microsofts." Peter Levine from Venture Capital firm Andreessen Horowitz reflects a general sentiment, "Machine Learning is to Big Data as human learning is to life experience…[and] every application will be re-constituted to take advantage of this trend".[2]

This combination of widely available data, deep learning, and the desire for personalized medicine is at the core of a number of emerging companies, that are providing solutions for both clinical and hospital operational use cases.

Machine Learning is typically applied to large retrospective data sets. There are usually many fields from multiple sources. Categories of data include patient demographics (age, gender), treatment history, and medication history. In addition to many columns, there are typically many rows of data in Machine Learning data sets – millions of samples are not unusual.

The results of machine learning are a predictive model as well as statistics as to the effectiveness of that model, as measured on data that was not used during model construction. A typical predictive model might take in new patient information as input and produce a likely effectiveness of treatment as a prediction.

A Machine Learning model sits within a larger context of medical decisions, and must be tuned to fit that environment. For instance, a typical model might be tuned to have a low false negative rate, e.g. the system says not to prescribe a medication, and that is wrong, at the cost of higher false positives, e.g. the system says to prescribe a medication, and this is a mistake. The right tuning depends on the cost of a false positive versus a false negative in a particular context.

The best medical decision also depends on the desired patient outcome. For example, one patient may prefer to avoid surgery at all costs, while another wishes to utilize all available surgical interventions in order to remain ambulatory.

Our Decision Intelligence software provides computer support for these decision, allowing practitioners to visualize the impact of these kinds of trade-offs and impacts on multiple patient outcomes instead of doing the calculation "in their heads." A Decision Intelligence model typically incorporates one or more Machine Learning models and then adds a decision-making infrastructure based on these models. The Machine Learning system is limited to making a prediction. The Decision Model helps to understand the effectiveness of a decision given the results of the prediction.

There are no other companies offering Decision Intelligence solutions in healthcare. For more information about E Health Analytics and our application of Machine Learning and Decision Intelligence tools, please visit our web site at http://www.ehealthanalytics.net.

---

1. See http://bit.ly/2dbId9e
2. https://www.datanami/2015/01/26/machine-learning-priority-andreessen-horowitz-2015/

E HEALTH ANALYTICS

100 Van Ness Avenue
San Francisco, CA 94102
917.892.4772
917.892.4775
info@ehealthanalytics.net
Find us on the Web:
http://www.ehealthanalytics.net