FUZZY LOGIX™

Case Studies:
Healthcare Analytic Solutions
for Payers, Providers and
Pharmaceutical Companies

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Analytic Solutions for Payers, Providers and Pharmaceutical Companies

Payers, providers and pharmaceutical companies need to provide quality healthcare solutions efficiently while accommodating rapidly changing market conditions, a dynamic regulatory environment and rising costs.

One of the keys to success in this chaotic environment is the use of analytics. The insight hidden in the rapidly growing ocean of healthcare data will be used to redefine the future of healthcare and positively affect quality of life.

The use of analytics and "big data" is transforming the healthcare industry.

THERE ARE FOUR EMERGING TRENDS:

1. **The market for healthcare analytics is rapidly expanding.**
   "The global healthcare analytics market is growing at a compound annual growth rate of 23.7 percent from 2012 to 2017. That puts just the analytics segment of the healthcare market at $10.8 billion within four years."[1]

2. **Healthcare companies are investing in analytics.**
   "In IDC's survey of 40 hospitals and 30 insurers, 50% of respondents said their highest investment priority was advanced analytics. Forty-six percent were placing their chips on data warehousing, which is closely associated with the use of analytics".[2]

3. **The amount of healthcare data is growing at a stunning pace.**
   "Forty-one percent of respondents anticipate annual data volume increases of 25 percent, while another 18.1 percent said their data volumes would increase between 25 percent and 50 percent per year".[3]

4. **Leveraging analytics can create tremendous benefits.**
   The application of analytics has the potential to dramatically reduce the death rate from predictable and, in many cases, preventable NCDs (non-communicable diseases). "A total of 57 million deaths occurred in the world during 2008; 36 million (63%) were due to NCDs, principally cardiovascular diseases, diabetes, cancer and chronic respiratory diseases. NCD deaths are projected to increase by 15% globally between 2010 and 2020 (to 44 million deaths)."[4]

Regarding the potential value from mining Big Data in the US, "...there is an opportunity to capture more than $300 billion annually in new value, with two-thirds of that in the form of reductions to national health care expenditure—about 8 percent of estimated health care spending at 2010 levels.[5]

The opportunity to create profound business and economic impacts, and more importantly, patient health benefits by using analytics is unprecedented.

In our research and work with clients, we've seen analytics successfully leveraged by payers, providers and pharmaceutical companies. Historically, the solutions provided to each party were designed with different goals, however changes in the way healthcare will be provided and paid are driving payers, providers and pharmaceutical companies to work together to create mutually beneficial solutions.

In this paper, the following customer case studies are briefly presented.

- **Chronic Illness Prediction and Prevention**
- **Scoring the Quality and Efficiency of Care**
- **On-Demand Peer Costs Comparison**
- **Preventing Adverse Drug Reactions**
- **Understanding the Prescribing Habits of Physicians**
- **Drug Trial Simulation**

Following the case studies is a list of analytic solutions that payers, providers and pharmaceutical companies should leverage as well as a description of the enabling technology.

Proven Results

CASE STUDY - **Chronic Illness Prediction and Prevention**

OptumInsight (a division of Optum and UnitedHealth Group) works with over 6,000 hospitals, 250,000 physicians, and 350 state and federal agencies to improve the performance of health systems by providing analytics, technology and consulting services that enable better decisions and results.

One of the ways they provide insight is by building analytic models to identify individuals at risk of acquiring chronic diseases. They use the insight gained to work with partners on early intervention which can delay or prevent the onset of the diseases. Their data includes the medical history of more than 90 million patients covering more than 17 years. The data has more than 7 billion rows.

One of their first projects was to develop predictive models for type 2 diabetes mellitus. OptumInsight, had tried to perform this analysis in the past, but was constrained by the limitations of traditional analytics products. Working with Fuzzy Logix, they developed an end-to-end process that includes population identification and cohort matching, claims extraction, merging, filtering, model matrix building and solving, and also the calculation of model diagnostics (correlations) and blind data error statistics (data not used in training).

The results are that OptumInsight can now run these types of models in less than 30 minutes. This produced many benefits.

- Users can run multiple scenarios to understand which conditions need to be included to produce the optimum results. For example, does age matter? How many claims are needed? What disease codes should be included?
- Custom models can quickly be built for OptumInsight Customers (providers). For example, models can be built for different chronic diseases based on available data.
- OptumInsight can analyze 500 to 3,000 variables and predict the onset of diabetes 5 years in advance with very high accuracy.

For diabetes alone the potential for life changing impacts are clear. The size of the problem is huge:

- 25.8 million children and adults in the United States—8.3% of the population—have diabetes
- Diagnosed: 18.8 million people
- Undiagnosed: 7.0 million people
- Prediabetes: 79 million people

The related impacts on the costs of medical care for diabetes patients are also enormous. "After adjusting for population age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes."

Complications from diabetes include heart disease and stroke, high blood pressure, blindness, kidney disease and amputation and the costs are staggering:

- $245 billion: total costs of diagnosed diabetes in the United States in 2012
- $176 billion for direct medical costs
- $69 billion in reduced productivity[6]

We could not do this work without Fuzzy Logix in-database analytics - OptumInisight

Working with partners including providers and third parties, such as the YMCA, OptumInsight is using the results of their analysis to help patients prevent and manage their diabetes. With the staggering number of cases, even a relatively small reduction will yield powerful financial and quality of life benefits.

OptumInsight is now expanding their research to include other chronic conditions with similar results.

CASE STUDY - Scoring the Quality and Efficiency of Care

One of the largest Medicare providers and healthcare payers in the US has radically changed the way they score the quality and efficiency of care within their provider network. Historically, due to the time and effort required to run their models, they were only able to re-score providers twice a year. The effort took 6 weeks and required 26 different processing jobs. This meant that as new providers were added, and market conditions changed, the payer had no way to identify emerging issues quickly. For example, if the quality or efficiency of care was changing in ways that created costs and risks, it may have taken months to discover the issues.

In addition to improving their ability to manage costs and risks, with new policies such as the HITECH Act, the Health Data Initiative (HDI) and the Affordable Care Act (ACA) and the shift to outcomes-based (pay-for-performance) and evidence based medicine, the payer also has a flexible solution that could quickly be modified to adopt new requirements and find best practices.

One of the key challenges was that the data has more than 700 million rows and it is analyzed at ICD code level using 3 different methods so the payer needed to analyze the equivalent of 2.1 billion rows of claims data. With their new solution, the process takes less than 7 minutes.

The combination of a leading data warehouse platform and in-database analytics from Fuzzy Logix allowed the payer to move from bi-annual to weekly and on-demand scoring.

The scoring process:
- Leverages Episode Treatment Groups (ETGs) to evaluate healthcare episodes in their entirety
- Utilizes Cave Consulting Group (CCG) scores to perform physician market basket analysis, hypothesis testing and payer specific ranking
- Includes analytics to assess the reliability of the ETG and CCG scores using quantitative models and guidelines from the National Committee for Quality Assurance (NCQA) to ensure that action is taken with confidence.

The benefits are that the provider was able to:
- Improve the quality of care by quickly identifying and correcting below par performance.
- Increase profitability by increasing network efficiency.
- Compute scores at multiple levels including physician, condition, specialty and provider.
- Re-score on demand based upon parametric inputs.

An additional benefit is that payers can correct inaccurate data immediately; a process that previously could only be managed twice a year. This reduced administrative time and created cost savings for both the payer and their providers.

CASE STUDY - On-Demand Peer Costs Comparison

The Premier healthcare alliance includes 2,800 member hospitals and health systems as well as more than 93,000 other healthcare sites. Their mission is to improve the healthcare of communities. Using data and analytics, Premier has saved over 25,000 lives and $5 billion.

The amount of data involved is tremendous. For example, Premier collects data related to 2.5 million clinical transactions daily. They also have data for nearly $43 billion in purchases by healthcare companies. To analyze that much data high performing and scalable models are needed.

One of the key features of the Premier system is that healthcare providers can see how their costs compare with their peers. The challenge is identifying a true peer. For example, hospitals of similar size with similar treatment specialties may treat vastly different groups of people who have medical, diet and environmental and other differences. The patients in a 400 bed hospital in New York City may be very different than the patients in a 400 bed hospital in Mississippi.

Recently the US Government released a database of the average covered charges for the top 100 Diagnosis Related Groups (DRG) across the US. The data showed huge variation. Treating a pulmonary embolism without major complication or comorbidity cost $6,107 in Canton, OH and $129,078 in Fairfield, CA. Within OH, the costs also vary with the treatment in Dayton, OH

costing $40,706.7   Even within cities the cost of care can vary. An Echocardiogram with Doppler could cost $250 or $2,068 depending on which provider you choose in New York City.[8]

Are these costs comparisons fair? Only if it can be proven that the hospitals are treating the same types of patients.

> Using statistical modeling, Premier is able to identify true peers so that administrators can accurately compare the cost of treatment. Given the amount of data, the comparison process took 10 minutes to run each time a user wanted to evaluate their performance. By using in-database analytics to accelerate MicroStrategy, the process now takes under 1 minute. Given that over 6,000 people access more than 8 billion records covering over 150 million patients, a 10X gain in performance has improved customer satisfaction and freed up time for additional analysis.

Partnering with Fuzzy Logix presents a great opportunity for us to improve the performance of existing applications and to leverage their skills to build custom analytical models that will drive higher value for our customers and investors – Premier

CASE STUDY - Preventing Adverse Drug Reactions

A major University based in Buffalo, NY has one of the largest databases of drug ingredients, patient data and adverse reactions ever built. It contains records that cover over 4 million adverse reactions and includes information for 4,000 different medications plus patient demographic, outcome, source and other administrative information. The university is running multiple projects to identify and predict and reduce adverse drug reactions (ADRs).

Research shows that ADRs unfortunately occur too often:
• ADRs are one of the leading causes of morbidity and mortality in health care.[9]
• Studies estimate that 6.7% of hospitalized patients have a

serious adverse drug reaction with a fatality rate of 0.32%.[9,10]
• If these estimates are correct, there are more than 2,216,000 serious ADRs in hospitalized patients, causing over 106,000 deaths annually. Making ADRs the 4th leading cause of death—ahead of pulmonary disease, diabetes, AIDS, pneumonia, accidents, and automobile deaths. [9,11]
• It is estimated that over 350,000 ADRs occur in U.S. nursing homes each year.[9,12]
• One estimate of the cost of drug-related morbidity and mortality is $136 billion annually, which is more than the total cost of cardiovascular or diabetic care in the United States. [9,13]

Analyzing the amount of data available was time consuming and therefore the types of analysis that could be run have historically been limited. Using in-database analytics from Fuzzy Logix provided a tremendous speed boost so that researchers could analyze full sets of data (not just samples) and perform complex analysis using many variables.

Like much of the data in healthcare, the adverse reaction data is sparse. For example all drugs don't have all ingredients, but there are many ingredients used in the manufacture of drugs. Not only is the data sparse, but the number of potential combinations of drug ingredients is huge. Using models designed to handle sparse data and high numbers of variables, the university was able to run correlation analysis, to determine where there is a high correlation of adverse reactions due to different combinations of ingredients.

Using in-database models allowed the university to perform analysis that wasn't previously possible.

While in-database analytics provided a 10X to 100X boost in performance, given complexity of the analysis, we've further determined that using graphics processing units (GPU's) would provide additional 10X to 100X gain. Using GPU's would allow the university to perform calculations in seconds that would take hours to run using in-database models and days to run using traditional analytics products.

CASE STUDY – **Understanding the Prescribing Habits of Physicians**

Pharmaceutical companies spend between $3.7 and $12 billion on research, development and approvals to bring a drug to market.[14] While new drugs can positively impact health, they must also pay for themselves and fund future research. The pharmaceutical industry has a responsibility to its customers, shareholders and employees to provide high quality healthcare solutions profitably.

The challenge is how to effectively sell and market pharmaceutical products in an enormous and competitive market.

• The global pharmaceuticals market is worth $300 billion a year, a figure expected to rise to $400 billion within three years.[15]

• Pharmaceutical companies commonly spend a large amount on advertising, marketing and lobbying. In the US, drug companies spend $19 billion a year on promotions.[16,17]

In addition to market dynamics, pharmaceutical companies must deal with shrinking budgets and effectively "do more with less." The average size of the annual marketing budget of global pharmaceutical industry supplier respondents stood at US$4.2 million in 2012, a figure that decreased to US$2.6 million in 2013.[18]

To better understand their opportunities, pharmaceutical companies turn to a leading healthcare analytics company that provides information services in over 100 countries around the world and processes 36 billion transactions annually. The company wanted to understand the impact of geography and demographics on the prescribing habits of physicians by analyzing a large volume of data. Fuzzy Logix models were used to analyze data for four business cases:

• The effect of benefit tier differences on brand utilization.
• Understand physician prescribing habits by region.
• Cluster analysis based on prescription volume, geography and demographic characteristics.
• Assess the effect of population socio-economic status on prescribing habits.

Key findings included:
• Understanding the influence of insurance plan tiers, patient demographics and socio-economic factors on physician prescribing habits.
• Identify clusters of doctors who exhibit similar prescribing habits and who have patients with similar demographics.
• Identifying opportunities for sales representatives to work with physicians whose prescribing habits exhibit outlier behavior.

The conclusion of the study was that there are key insights hidden in historical data that can help pharmaceutical companies ensure sales and marketing efforts are optimally targeted.

The insight derived from using analytics will allow pharmaceutical companies to improve sales force and marketing effectiveness.

CASE STUDY – **Drug Trial Simulation**

Moving a new drug through the approvals process can be time consuming and expensive. Between 1997 and 2011, the 12 leading pharmaceutical companies spent $802 billion to gain approval for 139 drugs (an average of $5.8 billion per drug).[14] The cost of clinical trials is a significant portion of the overall expenditure. For example "Phase III trials now represent about 40 percent of pharmaceutical companies' R&D expenditures."[19]

Running drug trial simulations can help reduce the costs and speed the delivery of drugs to the market. One of the largest pharmaceutical companies had a desire to leverage simulation but there were more than 10,000 datasets and millions of calculations involved in the process. The challenge was how to reduce a multiday process to less than one day.

Running drug trial simulations on the legacy grid system took 210 hours. Using Fuzzy Logix GPU-based solutions the process finished in 30 minutes.

The process is for only one drug in only one phase of the trial. Multiply that by the total number of drugs in the pipeline and the additional benefits from using high speed analytics becomes that much greater.

One of the benefits includes ruling out drugs that will not make it through the process sooner so that resources can be reallocated to drugs that demonstrate higher potential. There are tremendous financial benefits.

For each of the top 50 drugs in the US, the average daily sales in 2012 were $3,116,570. Assuming that the process of bringing a new drug to market can be shortened by 20 days using simulation, the solution could bring $62,331,398 in additional revenue for each drug coming to market.

Healthcare Solutions Enabled by Analytics

PAYER ANALYTICS
- Predictive Health for Chronic Illness
- Healthcare Peer Comparison
- Predict Prescribing Habits Of Physicians
- Predictive Claims Management
- Provider Network & Performance Scoring
- Member Profiling & Segmentation
- Benefits Analysis

PROVIDER ANALYTICS
- Predictive & Preventative Health
- Health Campaign Management
- Evidence Based Health and Comparative Effectiveness

FINANCIAL ANALYTICS
- Profitability Analysis
- Claim Reserves Analysis
- Medical Cost Analysis
- Customer & Product Churn Analytics
- Budgeting & Forecasting Analysis
- Fraud, Waste And Abuse Analysis

SALES & MARKETING
- Marketing Performance Analytics
- Marketing campaign Optimization & ROI
- Customer Segmentation
- Competitor Network Analytics
- Measure Effectiveness Of Marketing Campaigns
- Optimize Online Advertisement
- Clickstream Analytics
- Call Center Analytics
- Sales Performance Analytics
- Customer Targeting For Promotions
- Churn Prediction Based On Buying History
- Demand And Sales Forecasting

PHARMACY & DRUG DISTRIBUTION
- Adverse Reactions From Medications
- Market Share Analytics
- Rx Usage Analytics By Drug & Disease
- Pharmacy Benefit Management
- Rx Adherence
- Product & Service Pricing

The Technology That Makes it Possible

The predictive health applications covered in this paper are made possible with two specific technologies; in-database analytics and graphics processing unit based analytics.

Conventional analytical approaches have a number of challenges that include managing the time and expense of data movement and duplicate data storage, the need for specialized languages and application servers that require large amounts of data center space. These legacy tools have a limited ability to analyze big data or to solve computationally intense problems.

In-database analytics is the perfect solution for the analysis of big healthcare data. Databases have become extremely powerful and have transitioned from simply storing and retrieving data to being the ideal choice to analyze huge amounts of data. Fuzzy Logix offers over 600 in-database models with DB Lytix a library of mathematical, statistical, simulation and data mining algorithms and FIN Lytix, our library of financial models. Our customers have experienced a number of benefits by adopting this proven technology including:

- **Speed**. Analyze data 10X to 100X faster due to a massive reduction in data movement and using efficient processing along with data and computational parallelism.
- **Easy Adoption**. The models take 30 minutes to install and can be run using existing reporting tools or directly from SQL.
- **Cost Savings**. Reduce the data center footprint and eliminate duplicate data storage and restrictive licensing models.
- **Scalability**. Analyze petabytes of data with an almost unlimited number of variables.
- **Timely Results**. Drastically shorter cycle times to build analytics; teams can be 10X more efficient at model building.

For analytic challenges that are computationally intense we offer analytics that leverage NVIDIA graphics processing units (GPUs). Think of GPUs as a self-managing compute grid in a box. Add hundreds hyper-efficient parallel algorithms and make them accessible so that any program can simply call the function and the result is Tanay and Tanay RX. Using these models can improve the performance of analytics that require a high number of calculations by a factor of more than 1,000X.

In summary, when the problem is data intensive, you should choose in-database analytics and if the problem is computationally intense, you should select GPU-based processing. Both solutions offer performance gains and cost savings that are impossible to achieve with legacy analytics products.

About Fuzzy Logix

Fuzzy Logix is a market leader in analytic solutions. We are revolutionizing analytics with our in-database and GPU-based analytic software solutions.

Many leading healthcare and pharmaceutical companies are leveraging our solutions to gain new insight from their massive enterprise data and to improve patient care and their business performance. More information and customer success videos can be found here.

Fuzzy Logix offers software and consulting services to help you realize powerful benefits that are only possible to achieve by leveraging analytics.

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