Big Data & Predictive Analytics

Case Studies: Applying data science to human data

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Big-Data.AI Summit

Dr. Arnim Jost, Commercial Director Technology
Pharma’s profitability under pressure: R&D costs grow faster than the market and individual launch return

- **2.2x**
  
  Global pharmaceutical market size grew 2.2 times*

- **1.3x**
  
  Cumulative revenues of Excellent Launches grew 1.3 times**

- **3.2x**
  
  R&D costs to bring an NCE to market grew 3.2 times***

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* Source: Quintiles IMS: Audit market size 2003 $468bn, Audit market size 2016 $1,010bn. ** Sources: European Thought Leadership Launch Excellence I and V mode, cumulative revenues at 24 months; Consumer Price Index, US Bureau of Labor Statistics. Harvoni and Sovaldi are excluded from this analysis, as are rebates and discounts, which are growing. *** Source: Tufts University, 2003 study (cost to bring drug to market $802m) and 2014 study (same, $2,558m).
The pressure increases as the market demands More

Improve clinical trial design and execution

Demonstrate value of medicine and measure outcomes

Deliver higher commercial results more efficiently

Big Data and Advanced Analytics can help to balance necessary investments and available budgets
Multiple data sources and technologies offer various data for pharma players
Real World Data is in focus since it enables a better understanding of the healthcare of patients.
The demand of Real World Data is increasing

- **PRE COMMERCIAL**
  - Risk planning and label negotiation
  - Evidence for launch
  - Understanding of disease and burden

- **COMMERCIAL**
  - Follow-up safety and effectiveness in real life
  - Evidence to support value dossier during payer negotiations
  - Follow-up real life outcomes, value of drug
  - Reinforce positioning, broaden use

Evidence required:
- Launch
- Conditional pricing review
- New competition
- New formulation/indication
- Competitor goes Generic
Predictive Analytics on healthcare data allows to gain insights and build effective business strategies

**Sophistication of solution**

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Descriptive Analytics/Reporting</td>
</tr>
<tr>
<td></td>
<td>• What is happening?</td>
</tr>
<tr>
<td></td>
<td>• How many, how often, where?</td>
</tr>
<tr>
<td>High</td>
<td>Diagnostic Analytics</td>
</tr>
<tr>
<td></td>
<td>• What are root causes?</td>
</tr>
<tr>
<td></td>
<td>• Why did it happen?</td>
</tr>
<tr>
<td></td>
<td>Predictive Analytics</td>
</tr>
<tr>
<td></td>
<td>• What are predictors of outcome?</td>
</tr>
<tr>
<td></td>
<td>• What is likely outcome?</td>
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</table>

**Collect data**

**Structure data**

**Identify patterns**

**Make predictions**
## What sorts of techniques does Predictive Analytics use?

<table>
<thead>
<tr>
<th>Technique</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>DECISION THEORY:</strong></td>
<td>Decision-trees are created to find the optimal boundary between uncertain outcomes</td>
</tr>
<tr>
<td><strong>SIGNAL PROCESSING:</strong></td>
<td>Hidden associations are detected as ‘signals’ in noisy data</td>
</tr>
<tr>
<td><strong>ARTIFICIAL NEURAL NETWORKS:</strong></td>
<td>Associations in the data are simulated as biological processes</td>
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</table>

These advanced methods are highly flexible, able to capture complex patterns in large data and complement traditional statistical approaches.

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Source: IQVIA
Predictive Analytics already entered healthcare

US hospitals use predictive analytics infrastructure to stay one step ahead of preventable hospital readmissions, hospital-acquired conditions, and patient downturns

Data-driven decision to push content
→ 36% increase in weekly sales

In 2012 Google announced its ability to predict a flu outbreak in the U.S. five days before it would happen based on big data and search patterns.

In 2015 the center for disease control revealed that Google’s prediction was twice the size of the correct number.
How does Predictive Analytics provide value for pharma manufacturers?

**PRE-COMMERCIAL**
- Finding new indications for existing drugs
- Detecting Adverse Events
- Predicting the outcome of clinical trials
- Accelerating clinical trials

**COMMERCIAL**
- Early detection of adverse events
- Early detection of rare diseases/patient identification
- Supporting therapy decisions, e.g. Oncology
- Improved adherence and persistence
- Multi-channel promotional mix optimization
- Other commercial optimization: e.g. optimizing pricing and rebates etc.

R&D

LAUNCH

MATURITY

DECLINE

Product extension
Substantial cost savings can be realized while driving better R&D and commercial made possible by Big Data & Predictive Analytics

IQVIA Case Studies:

+ 1. Optimization of site selection
+ 2. Identifying undiagnosed patients
+ 3. Predicting treatment response
Complexity of pre-commercial development has increased

Clinical Trial Process

- Design
- Site Start Up
- Screen & Enroll Patients
- Data Collection, Analysis, Submission

60% of trials have protocol amendments

~$7.7Mn per day
Average potential sales loss

80% of trials delayed, mainly due to enrollment


There are savings to be made in R&D

Development Challenges
- Protocol amendments
- Site selection
- Delays

Pharma’s need
- Improve Design
- Improve Site ID
- Improve Recruitment

Goal
- Maximize eNPV of assets
- Identify high enrollers / eliminate low ones
- Hit targets

Faster Timelines, Improved Predictability and Maximized Value
Improving site selection for psychiatric disorders Phase 3 study

Traditional site
- 3 eligible patients
- Mid-tier predicted performance

NextGen site
- Predictive performance and quality models alongside patient availability
- 14 eligible patients
- Top-tier predicted performance

60% Improvement in patient enrollment rate

Source: IQVIA; Note: example above for illustration purposes; results will vary
Avoiding delays by identifying patients for rare disease Phase 2 study (IPF)

Heat map of IPF patient potential
- Low
- High

Site location

20% Improvement in Site Identification

57.1%

47.6%

Traditional

NextGen

Source: IQVIA. Note: example above for illustration purposes; results will vary.
Predictive Analytics enables not only defining optimal patient cohorts but identifying undiagnosed rare disease patients too.

350 million patients suffer a rare disease worldwide.

7,3 physicians (avg.) are seen before diagnosis.

40% of patients are misdiagnosed initially.

7,000 rare disease have been identified.

4.8 years (avg.) before an accurate diagnosis.

Rare diseases are not so rare, but finding those patients is taking too long.
Raising disease awareness in a targeted way

1. Identify patients with the disease and analyze their medical history PRIOR to the 1st diagnosis of the disease

- Medical history prior to 1st diagnosis of disease
  - Tests & Diagnostic Procedures
  - Symptoms
  - Comorbidities/Misdiagnoses
  - Specialist/ER visits
  - Treatments
  - Demographics
    - Age

2. Develop an algorithm to identify unique patterns of the disease in patients’ pre-diagnosis medical history

3. Find and target patients in the wider universe who are identified by the algorithm as potentially undiagnosed

Patients identified by the algorithm

Patients not identified by the algorithm

Source: IQVIA
Predicting high-risk undiagnosed patients in collaboration with NHS

Making diagnosis possible
Diagnosis rates for high-risk patients*

<table>
<thead>
<tr>
<th>Without the model</th>
<th>With the model</th>
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<tbody>
<tr>
<td>0.01%</td>
<td>5.20%</td>
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- **National coverage** of all hospital episodes in England collected in single data source
- **Machine learning**: 100+ medical and demographic predictors of 100M patients
- **Alerts** sent from KOL at specialist clinic via mail to physicians with guidance to screen named patients for rare condition
- **Physicians carry out diagnostic test**; Newly diagnosed patients referred to specialist clinic
Predicting treatment response can improve drug development and patient care

**Key Benefits**

- Enhance treatment effectiveness and value proposition by focusing on patients likely to respond positively to treatment
- Help identify unmet need – patients who fail to respond positively to current treatments

**Chances of success**

- Good if only one product/treatment class is involved
- Challenging if objective is modeling comparative treatment response (better response to treatment A vs. B)

**Real-World Applications**

- Clinical Decision Support Tool deployed with providers at the point of care
- Medical Publication on the predictors of good treatment response
- Healthcare provider targeting
- Stakeholder education & messaging materials and publications
Predicting outcomes in a chronic degenerative condition

**Need:** Predict optimal response for high burden treatment

**Machine learning:** ~18,000 patients, multiple responses

**Goal:** Treatment optimization tool to support physician-patient engagement

shows no predicted benefit of more than 10 doses
More informed decisions across healthcare bring benefit to all stakeholders

<table>
<thead>
<tr>
<th>Life Science companies</th>
<th>Regulators</th>
<th>Providers and payers</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>• Insights in</strong> disease characteristics, patient response to therapy, patterns of product usage</td>
<td><strong>• Ability to make decisions on</strong> better built trials (e.g. patient cohorts)</td>
<td><strong>• Reduction of costs of non-adherent/responded patients or adverse reactions</strong></td>
<td><strong>• More likely to receive necessary information and</strong> best treatment <strong>for their condition</strong></td>
</tr>
<tr>
<td><strong>• Appropriate message</strong> delivered to right stakeholders</td>
<td><strong>• Quicker insight into the way in which various products are performing in the healthcare environment</strong></td>
<td><strong>• Identification of undiagnosed diseases</strong></td>
<td><strong>• Better chance of identifying health risks and early addressing</strong></td>
</tr>
<tr>
<td><strong>➢ Commercial advantage</strong> and translation of clinical benefits into real-world value</td>
<td><strong>➢ Enhanced clarity of clinical trial outcome and real-world performance</strong></td>
<td><strong>➢ Improved patient pathway that drive the stability and sustainability in healthcare systems</strong></td>
<td><strong>➢ Enhanced treatment outcome at an overall lower cost</strong></td>
</tr>
</tbody>
</table>

Source: IQVIA European Thought Leadership Team

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Domain Expertise

Institutional knowledge and domain expertise across diseases, geographies and scientific methods

Unparalleled Data

One of the world’s largest curated healthcare data sources with innovative privacy protections

Transformative Technology

Leading technologies to provide real-time access to operations-critical information

Advanced Analytics

Faster, more precise decision-making generated by advanced analytics designed for healthcare
Thank you!

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