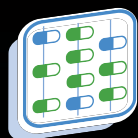


# JPMSA

JOURNAL OF THE PHARMACEUTICAL  
MANAGEMENT SCIENCE ASSOCIATION

SPRING 2015



**pmsa**

PHARMACEUTICAL MANAGEMENT  
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## PMSA Journal: Spotlighting Analytics Research

Welcome to the third edition of the *Pharmaceutical Management Science Association (PMSA) Journal*, the official research publication of PMSA.

The purpose of the Journal is to promote and embody the mission of the association, by:

- Raising awareness and promoting the use of Management Science in the pharmaceutical industry
- Fostering the sharing of ideas, challenges, and learning to increase the overall level of knowledge and skill in this area.

The Journal publishes manuscripts that advance knowledge across a wide range of practical issues in the application of analytic techniques to solve Pharmaceutical Management Science problems, and that support the professional growth of PMSA members. Articles cover a wide range of peer-reviewed practice papers, research articles and professional briefings written by industry experts and academics. Articles focus on issues of key importance to pharmaceutical management science practitioners.

If you are interested in submitting content for future issues of the Journal, please send your submissions to *PMSA Journal* editor **Devesh Verma** at [dverma@pmsa.net](mailto:dverma@pmsa.net).

### Guidelines for Authors

**Summary of manuscript structure:** An abstract should be included, comprising approximately 150 words. Six key words are also required.

All articles and papers should be accompanied by a short (about 100 words) description of the author(s).

**Industry submissions:** For practitioners working in the pharmaceutical industry, and the consultants and other supporting professionals working with them, the Journal offers the opportunity to publish leading-edge thinking to a targeted and relevant audience.

Industry submissions should represent the work of the practical application of management science methods or techniques to solving a specific pharmaceutical marketing analytic problem. Preference will be given to papers presenting original data (qualitative or quantitative), case studies and examples. Submissions that are overtly promotional are discouraged and will not be accepted.

Industry submissions should aim for a length of 3000-5000 words and should be written in a 3rd person, objective style. They should be referenced to reflect the prior work on which the paper is based. References should be presented in Vancouver format.

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Industry, academic and expert opinion authors are invited to contact the editor directly if they wish to clarify the relevance of their submission to the Journal or seek guidance regarding content before submission. In addition, academic or industry authors who wish to cooperate with other authors are welcome to contact the editor who may be able to facilitate useful introductions.

Thank you to the following reviewers for their assistance with this issue of the *PMSA Journal*:

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# The Evolving Art of Customer Valuation

*Juhi Parikh, Associate, Axtria Inc. and Kedar Naphade, Ph.D., Senior Principal, Axtria Inc.*

## Introduction

Customer valuation is critical to pharmaceutical brand strategy as it informs several key decisions such as messaging, resource allocation, services offering allocation, etc.

In simple / well established therapeutic areas, customers can be valued based on prescription volumes. However, often the competitive space presents complexities such as multiple classes of medication, combination therapies and an evolving product landscape. The disease state can present complexities such as comorbidities, multiple closely related diagnoses, potential off-label prescribing etc. There can be complexities that arise out of data availability, or lack thereof: for instance, launching into a market where competitors are distributing through Specialty Pharmacy. Further, depending on the therapeutic area, customers may be physicians, group practice accounts, hospitals or even Integrated Health Systems. In such cases, simple techniques may not be adequate.

This paper discusses the use of more complex techniques for customer valuation. Some of these methods have been used in recent years, while others are new ways of using the same data sources.

These techniques include:

- Patient segmentation & physician segmentation based on claims and Rx data
- Predictive analytics based on claims and Rx data to perform valuation

- Integration of epidemiological data into claims-based valuation
- Novel primary research techniques, integration of predictive analytics based on primary research
- Nuanced valuation of hospitals, group practices, and health systems

We also describe case studies where some of these techniques were successfully applied, resulting in key insights which in some cases were unanticipated and counterintuitive.

## Business Need for Customer Valuation

Customer Valuation is a primary tool in pharmaceutical companies in order to understand “who” the customer is and align resources. Customer valuation has a number of applications:

- Targeting decisions: which customers to target and to what extent
- Designing appropriate marketing messages for different customer profiles
- Marketing resource allocation: intelligent allocation based on knowledge of customers
- Service platform allocation: services best suited to the target profile
- Sales Force Role and Size, Alignment & Call planning

Traditionally, the word “customer” referred to a physician, although in some therapeutic areas “customer” refers to an “account” or a hospital;



further, in the present day context, this definition has expanded to include organizations or groups like Health Systems (HS), Accountable Care Organizations (ACOs), and physician buying groups or group practices.

## **Complexities Involved in Performing Customer Valuation**

While valuing customers based on past prescribing behavior several complexities can arise:

- A. Complexities due to the type of therapy or disease state, like
- Multiple closely related diagnoses, sometimes treated by the same therapy classes
  - Comorbidities
  - Multiple classes of medication for closely related disease states
  - Combination therapies
  - Evolving product landscape

The above complexities make it challenging to understand the competitors of a given product, i.e. what part of which product's business it is competing with.

- B. Complexities due to the type of customer
- For certain therapeutic areas, treatments are administered in a hospital setting. Treatments are associated with the hospital, making it impossible to use traditional techniques like prescription/treatment volume to value the influence of individual physicians. Valuation would therefore be restricted to the hospital or "account" level.
  - When the customer is a Group Practice or a Physician Buying Group, it is difficult to know which physician

within the group is responsible for the treatment, prescription or sale.

- Added to the above lack of transparency within a group or organization, in the case of physicians or hospitals that are part of a HS or an ACO, physician's writing behavior may not be autonomous, but may be influenced to varying degrees by the policies of the parent organization.

- C. Complexities due to the available source of data and its peculiarities

- The granularity of the data available or rather the lack of it (as in account level versus physician level data) can be an additional complicating factor in customer valuation. In categories where treatment takes place at hospitals, non-retail sales data is aggregated at the hospital or account level, making it possible to value the hospital in terms of prescription volumes but giving no insight into the prescribing physicians. The extent of coverage provided by the available source of data is an additional factor to consider as limited coverage can make it a source of complication.
- Specialty pharmaceuticals are a growing channel (Express Scripts has estimated that by 2014, specialty products will account for 40 percent of total drug spending in the United States - source: Nease 2011) for whom data access was fairly limited in the past, partly because the number of products was also smaller. The situation has now changed, with more crowded specialty markets, payers demanding contracting in these markets, a proliferation of complex provider account structures, and a shift towards the patient as customer. Access to data for specialty products

has also improved, however this has only further complicated the challenge of a data services model. Specialty product data comes from a wide variety of fragmented sources, each of varying quality and completeness. The data being less complete and of lower quality relative to primary care data, it is difficult to get a complete view of the market at physician level, making valuation challenging in this space.

## Evolution of Customer Valuation

Classic or traditional approaches to Customer Valuation, based on traditional prescription data

- Ranking or assigning a decile to a physician based on past prescription volumes
- For a new category, the traditional approach is to analyze the volume of the physician's past prescriptions in an analogous market
- Behavioral segmentation based on dominant prescribing behavior. Physicians are classified into segments like brand loyalists, competitor loyalists, splitters, and spreaders
- Historical targets or physicians of particular specialties may be prioritized as targets

With the improving coverage and quality of Anonymized Patient Level Data (APLD), richer patient data has opened up a new way to value physicians, providing the ability to examine aspects like adherence, stickiness, loyalty and to assign a value to each physician in a strategic way. It offers an opportunity to examine the writing behavior of individual physicians, linking the specific diagnoses with procedures and treatments, likelihood to prescribe

competitive products, etc. The availability of Healthcare organizational data has made the relationships between physicians and organizations transparent, allowing for better profiling of the latter.

Given the complexities described earlier, here are some techniques that allow for their resolution:

### 1. Valuation of Physicians based on APLD Claims data using predictive analytics:

Based on the APLD, it is possible to obtain the diagnoses as well as the products prescribed for a given patient-physician combination. Aggregating to the physician level, and using intelligent assumptions based on category understanding, one can deduce the % split of different products prescribed or procedures ordered by a given physician for the relevant diagnosis. By comparing the total scripts for each physician versus traditional prescription data, a sample of physicians can be identified having robust coverage in the APLD. In categories where such a sample is available and is sizeable enough to be statistically generalized to a larger population, predictive modeling based on a combination of APLD and past prescription data can be used to deduce the % split of products prescribed or procedures ordered by each physician for the entire target population of physicians. Physicians can thus be valued based on the percent of relevant diagnoses or procedures associated with patients undergoing treatment with products of interest. This technique can help resolve complexities due to the type of disease state or treatment i.e. multiple closely related diagnoses, sometimes treated by the same therapy classes, comorbidities, multiple classes of medication for closely related disease

states, combination therapies, or evolving product landscape, helping understand through physician valuation what the competitors of a given product are in the treatment of specific disease states.

## **2. Integration of Epidemiological Data into APLD-based physician valuation:**

**Epidemiological data** provides the incidence of disease states in the US population. APLD findings on the overall % of patients treated with a particular product, and diagnosed with a particular disease state can be triangulated to the entire population and compared with epidemiological data to help verify the overall accuracy, helping to validate findings at an individual physician level.

## **3. Integration of Primary Research into APLD-based physician valuation:**

The combination of primary research and claims data can be a powerful tool in the valuation of physicians, each complementing the other. Insights from APLD data can be used to better understand the therapy combinations currently in practice, and can give rise to a novel approach to primary research design that targets physicians by the types of patients treated and can uncover insights regarding current and future treatments as well as likely changes and trends in treatment. This approach allows for granular insights relevant to the treatment of interest and its competitors. The research can be used to uncover physician attitudes towards existing and new products, current and future prescribing behaviors, adoption speed and more. Predictive analytics can be used to generalize these insights to each physician under consideration, adding more nuances to the APLD based valuation described above.

## **4. Customer Valuation where the customer is a Hospital, Group Practice, Physician Buying Group or Health System:**

The availability of Health care organizational data has created the opportunity to strategize for every physician within an account, rather than treat it as a single entity. This takes away the opacity of the account and allows for more nuanced valuation. New tactics in customer valuation take advantage of the insight into the diagnoses, procedures and prescribed treatments associated with each physician in the APLD to gain an understanding of the treatment combinations used by individual physicians within a hospital, group practice or health system. These tactics involve specific physicians who treat the diseases of interest being identified through diagnosis or procedure codes in the APLD. Affiliation data is used to associate an APLD physician with a given account (this could come from a number of sources like Cegedim group practice data, sales force intelligence, etc.). This technique helps identify the key influencing physicians within health systems for better targeting. A potential challenge with this technique is the limited coverage of account sales in some categories.

## **5. Customer Valuation in categories that sell through Specialty Pharmacies:**

In general, data availability, data management and data quality assurance are the key challenges surrounding products that sell through specialty pharmacies. For the product in question, it is possible to get data at the account level and even at the physician level by setting up data agreements with the specialty pharmacy in question; however, data about competing products is often unavailable. Having a

complete view of the market and hence, valuation of customers, is therefore a challenge. Further, the available data from specialty pharmacies are in different formats and need to be integrated through appropriate processes and with reliable quality assurance techniques, such as:

- *Field Based Profiling:* Sales representatives who are experienced in the relevant or allied categories may be able to leverage their experience, knowledge and relationships to identify target customers with the most potential.
- *Demographic Profiling:* Data about the demographics of the surrounding geographies, obtained from the census and similar sources can be used to identify customer potential.
- *Primary Market Research:* It is challenging to obtain data about other specialty products in the market. Through primary research, it is possible to identify markers i.e. surrogate disease states and prescription patterns that are identifiable through the available data sources, and have a correlation with the specialty product of interest. Customers can then be identified as possible targets through the presence of these markers.

## Summary

With the improving coverage and quality of Anonymized Patient Level Data (APLD), the availability of Healthcare organizational data, and the rise of distribution formats like specialty pharmacies, customer valuation techniques have evolved beyond those based mainly on traditional prescription data.

By utilizing AP LD Claims data along with predictive analytics, physicians can be valued

based on their mix of relevant diagnoses and treatments, particularly useful for complex, overlapping disease states or treatments where the market and/or competitors are hard to define. Epidemiological data can help validate the accuracy of such an approach. AP LD can also help drive primary research designs that uncover granular, physician-level insights. Further, in cases where the customer is a Hospital, Group Practice, Physician Buying Group or Health System, the availability of Health care organizational data has created the opportunity to strategize for every physician within an account, and new tactics combine it with physician level insights derived from AP LD.

For categories sold through specialty pharmacies, a complete market view (and hence valuation) poses a challenge. Here, tactics like field-based physician profiling, demographic profiling of geographies, and understanding of disease and prescription patterns through primary market research, can come to the rescue.

## Case Studies

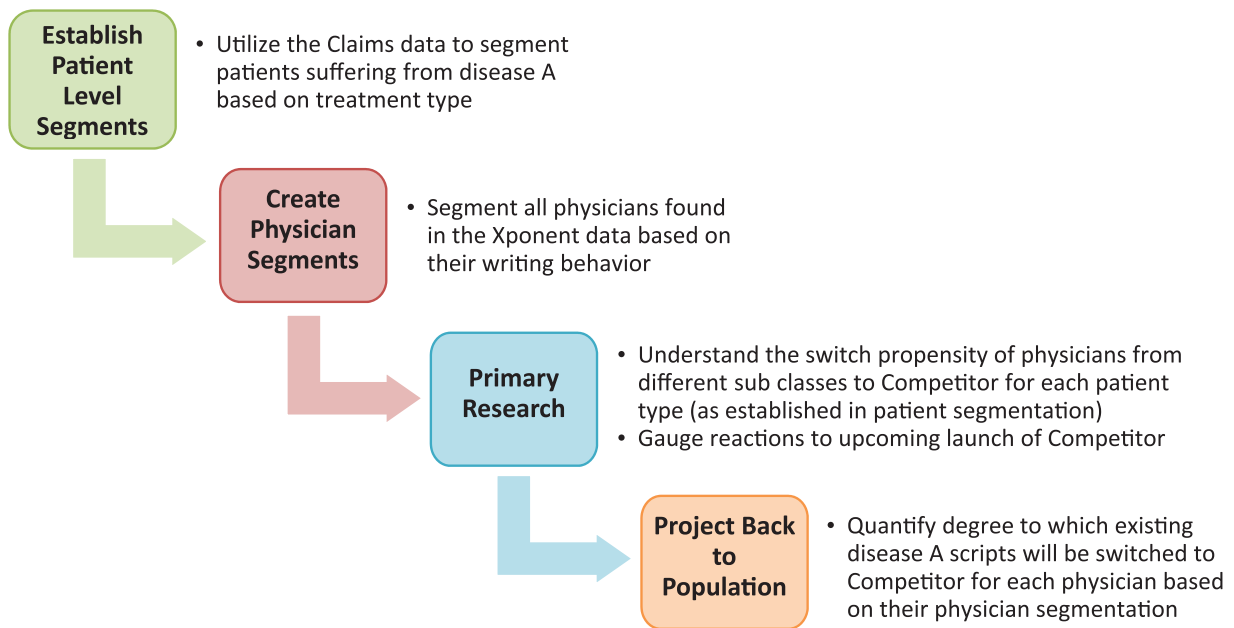
### ***Case Study 1: Assessing the impact of an upcoming competitive launch on physician-level brand sales through a valuation exercise***

#### **Background**

Consider a category with multiple closely related diagnoses treated by the same therapy classes, multiple classes of medication for closely related disease states, and combination therapies, as well as an evolving product landscape with an imminent competitive launch.

An existing drug is indicated to treat a chronic progressive disease, as well as another disease. A new competitor is slated to launch,

**Figure 1**



indicated for the chronic progressive disease only. In this case study, the competitor’s impact on the existing drug is assumed to be restricted to the fraction that will be prescribed for the chronic progressive disease only.

Broadly three main drug classes treat this disease, with single-class drugs as well as some combination-class drugs available in the market. Depending on disease progression and severity, patients can be on mono therapy, dual therapy, or triple therapy.

The existing drug belongs to the currently preferred format of dual therapy treatment and also forms part of the currently preferred form of triple therapy treatment.

**Reason/need for customer valuation**

The competitor plans to launch a combination class therapy drug, based on a combination class that does not currently exist in the market. This poses questions as to whether it will become the preferred class of dual-therapy

treatment, and whether it will form a new preferred triple therapy combination.

Further, the analysis has to answer questions as to whether the main source of risk to business due to this launch is the erosion of current business or lost opportunity for new business. The analysis also examines competitive impact by segment/specialty, and the speed of impact.

**Techniques used**

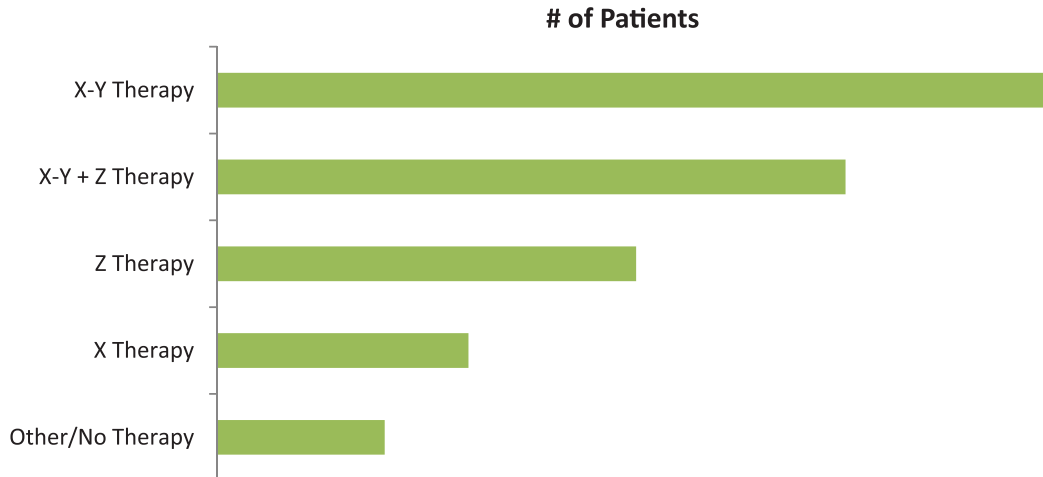
Figure 1 shows the overall analytical framework used, which utilized a blend of secondary data (physician level prescribing data, prescriber dynamics data and APLD claims data) along with primary research findings.

**Separate and relevant approaches were employed for patient and physician segmentation**

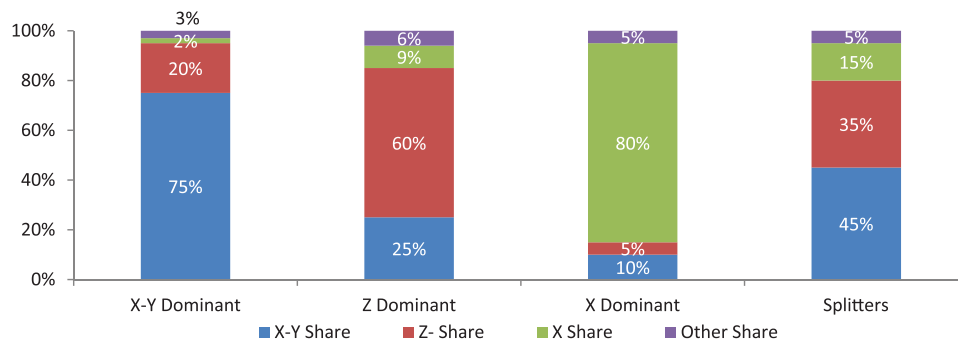
*Segmenting Patients Using Claims Data*

Claims data coupled with intelligent assumptions provided insight into the major

**Figure 2**



**Figure 3**



therapy combinations being utilized by physicians to treat patients, creating a rich patient segmentation that informed the primary research design (Figure 2).

### *Segmenting physicians via a clustering algorithm*

A clustering algorithm was used to create physician segments based on dominant prescribing behavior i.e. drug class to which the majority of a physician's scripts belonged (Figure 3).

**A multivariate logistic regression model was used to apply findings derived from**

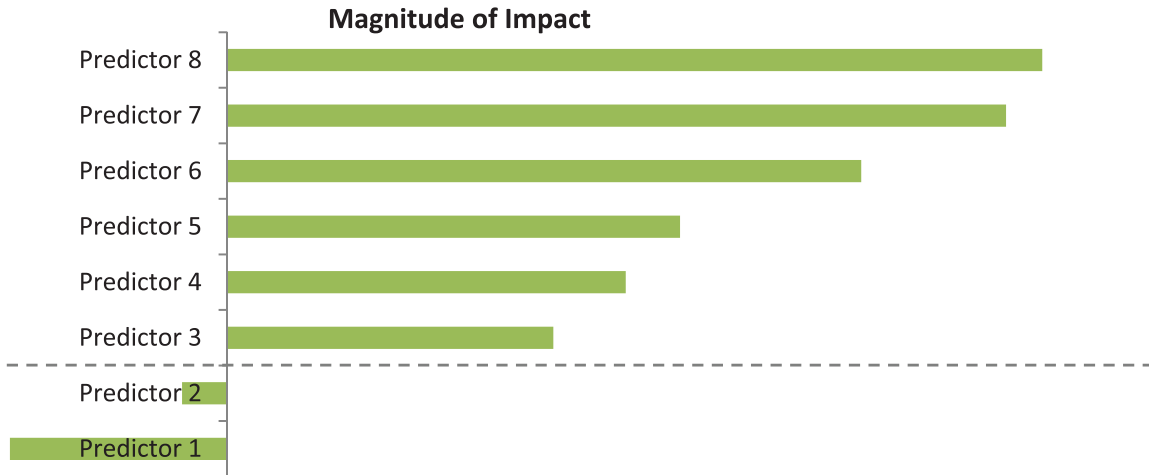
**claims data to the physician universe. Epidemiological data was integrated to ensure the robustness of findings.**

### *Predictive Analytics based on claims data*

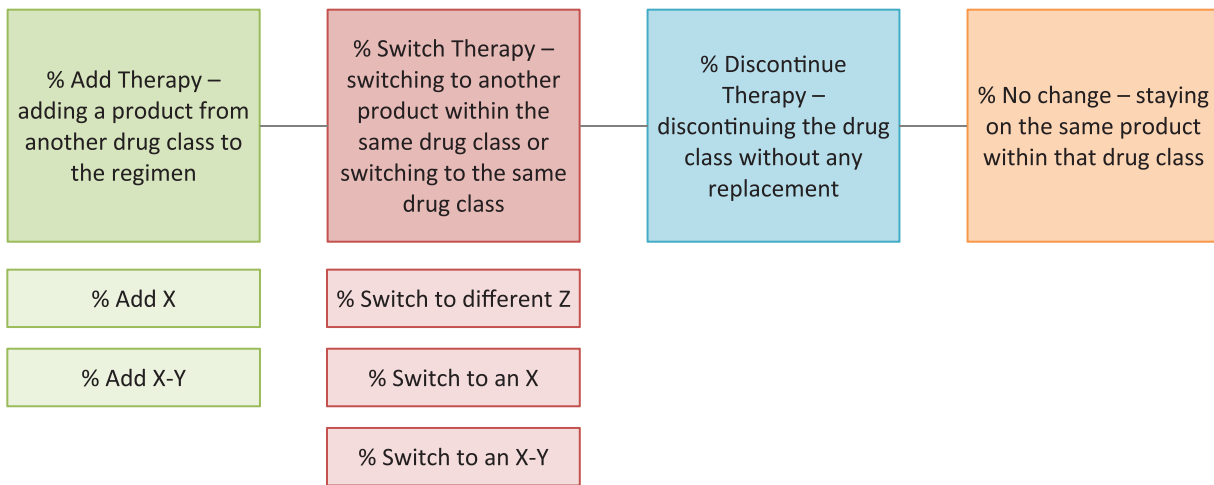
The fraction of scripts from the current product class prescribed specifically for the chronic progressive disease was estimated for each physician in the universe. A sample of physicians was first identified for whom the claims data provided the fraction of relevant scripts being prescribed for different diseases. A multivariate logistic regression model used physician level prescribing data and other predictors to project this prescribing behavior to the entire physician universe (Figure 4).



**Figure 4**



**Figure 5**



***Integration of epidemiological data***

Epidemiological data provided the incidences of different diseases in the drug-treated US population, and was integrated to provide sensitivity analysis of assumptions and ensure robustness of findings.

**An innovative approach to primary research provided the requisite granularity to uncover several important and some counter-intuitive insights related to extent and timing of risk.**

*Departure from traditional pre vs post allocation in primary research*

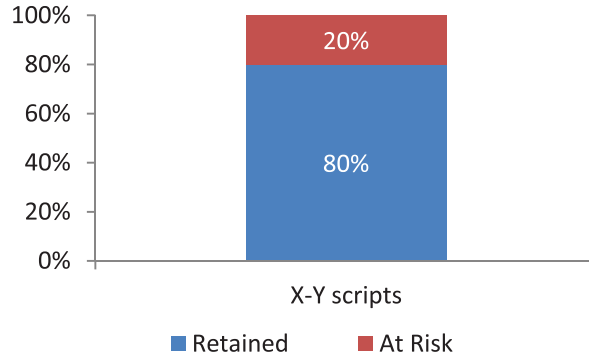
Physicians predicted their future use of different drug classes for 5 patient types suffering from disease A, with and without the new competitive launch (Figure 5 is an example of the structures used in primary research).

***Predictive Modeling to project adoption speed***

A multivariate logistic regression model was used to determine the likelihood of early adoption of the competitive launch for each physician. Physicians were classified as early or late adopters of the competitive launch based on thresholds determined from primary research.



**Figure 6**



***Predictive Analytics based on primary research to project impact***

Physician-level risk was calculated based on primary research responses and projected from the primary research sample to the population using a multivariate logistic regression model (Figure 6).

***Case Study 2: Identifying new target physicians for a rare disease medication, through a valuation exercise***

**Background**

Consider the first and only medication approved by the U.S. Food and Drug Administration to treat a certain rare disease, which has a very low incidence. Tracking down physicians treating patients for this disease is difficult, and hence even a physician having a single patient suffering from the disease is a valuable target.

**Reason/need for customer valuation**

Considerable work has already been done in targeting physicians belonging to the core specialty that treats this disease. There is a potential opportunity to expand product use by identifying incremental targets among the core specialty as well as targeting select physicians from another specialty. This raises the question as to how claims data can be leveraged to

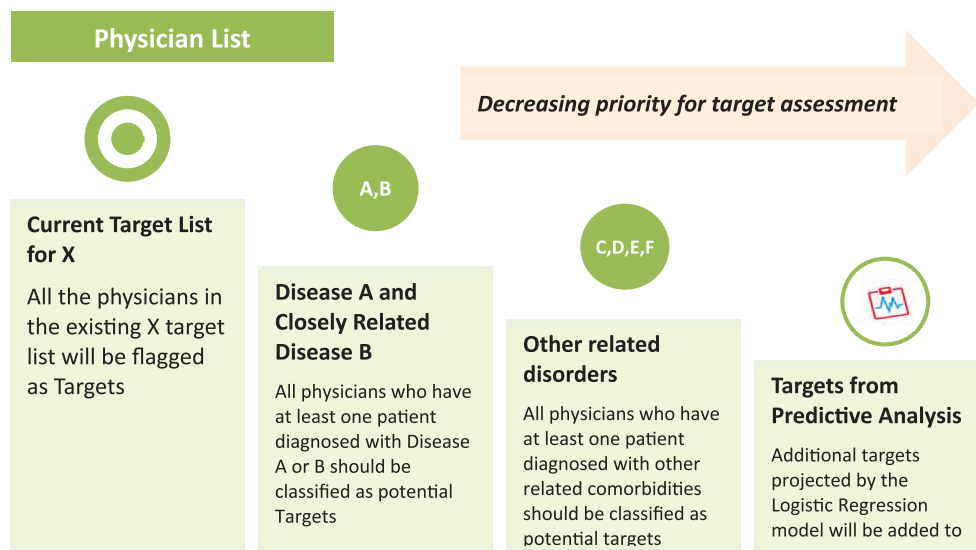
identify physicians who are valuable, and how to link primary research findings to identify the best combination of products and diagnosis codes that indicates a physician who has a patient suffering from this rare disease. For this purpose, a valuation exercise was conducted, with the desired output being an incremental list of target physicians, and their associated priority or “value”.

**Techniques used**

The disease being rare, it is challenging to find additional physicians who treat it besides those already identified as prescribers of this product. Further, patients suffering from this disease are often not diagnosed correctly. Primary research was therefore conducted among eligible physicians to specifically identify the comorbid conditions most narrowly associated with the disease. The research also threw light on the combinations of drugs used to treat the disease.

The following approach was then used to identify and prioritize physicians. Presence of the disease itself, another closely related disease, or other specific comorbid conditions (which were identified through primary research) were used to identify disease sufferers in the APLD. These patients/diagnoses were then linked to their treating physicians who were flagged as targets. Predictive analytics

**Figure 7**



based on physician prescribing patterns were used to identify other target physicians, not in the APLD. Physicians identified through this exercise were valued as below, in descending order of priority (Figure 7):

- Past Prescribers/already known to be treating this disease
- Association with patients suffering from this disease or another closely related disease in the APLD
- Association with patients suffering from known comorbid conditions in the APLD
- Not in the APLD, identified through predictive analytics based on prescribing behavior

In a category like this, identifying additional target physicians is like trying to find the proverbial needle in a haystack. Yet the above techniques allowed for the identification of a significant number (3000-4000) of incremental target physicians, with an effective “value” or priority assigned to each.

### ***Case Study 3: Valuation of accounts via physician affiliation data***

#### **Background**

Consider a treatment in a category where, for a variety of reasons (multiple treatment formats, prevalence of off-label usage, changing treatments for a given patient, difficulty in identifying true competitors), it is difficult to define a market. There is one other known competing and similar treatment, but the data for it is unavailable. Available data for the treatment of consideration includes prescriber-level as well as affiliation data linking physicians with accounts or hospitals.

#### **Reason/Need for customer valuation**

A valuation exercise was conducted in order to identify the relevant customers in order to assess promotional impact in various channels including overall response of the customers to promotion, and the effectiveness of various channels in influencing sales. Modeling could have been either the physician level or the account level. As the most important promotional activity, sales rep detailing, was

recorded at the account level, an account level model was selected.

### **Techniques used**

Valuation was conducted based on a metric called account potential, calculated based on the weighted presence of the specialties of physicians affiliated with the accounts. Weights were determined based on the nation-wide writing behavior of the particular specialty. Accounts were then deciled based on their potential and assigned to segments. Specialty composition helps determine the extent of decision making authority of a particular account, as it is likely that certain specialties make the decision to prescribe a treatment and other specialties may ensure its continuation through refill or repeat prescriptions and/or act as influencers. Specialty composition is also important in understanding the profile of the customer for better resourcing.

### ***Case Study 4: Valuation of Accounts via physician affiliation, claims data***

#### **Background**

Consider a hospital-administered treatment for a specific disease class. Instead of physician-level retail prescriptions, the available sales data consists of aggregate, account level non-retail sales. The sales force is structured to holistically target accounts or hospitals, and the existing valuation is based on aggregate account level sales volumes.

#### **Reason/Need for customer valuation**

The availability of APLD claims data as well as data on the affiliation of physicians with specific accounts calls for an approach to valuation that provides more patient and physician level insights, profiling the targets such that the sales force can sell in a more focused and targeted manner. The results of

this valuation exercise would be the account potential, i.e. the relevant patients present in a given account and the penetration of the treatment as well as its competitors.

### **Techniques used**

#### *Identifying physician affiliations*

Based on data collected by the sales force, it was possible to identify the physicians affiliated to each account. In the case of physicians with multiple affiliations, mutually agreed upon business rules were used to determine the physician's primary affiliation.

#### *Using a combination of claims and affiliation data to calculate brand penetration and the importance of the account based on APLD*

Based on a combination of physician affiliation data and APLD, it was possible to determine the importance or market potential of an account (i.e. the number of patients within the account with relevant diagnoses), the penetration of the product within the account (i.e. the number of patients being treated with a product as a percent of the number of diagnosed patients within the account), and to gain insight on the percent breakup of the different indications being treated with the product.

#### *Triangulation methodology to scale APLD findings to the total account sales*

The non-retail sales data was a reliable source of the total sales volumes at the account level. As the APLD covered only 30-40% of the total non-retail sales, it was difficult to predict true opportunity as the insights were limited to a fraction of the total account sales. Based on these two data sources, a triangulation exercise was carried out in order to scale the APLD data over the total physicians affiliated with the account and to derive insights at an account level.

## **About the Authors**

***Juhi Parikh** is an Associate with Axtria, with experience in market research, marketing analytics and consulting for Pharmaceutical and CPG clients. Prior to Axtria, Juhi worked with Nielsen (BASES), conducting marketing and forecast analytics with leading global brands.*

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# National Lab Test Database Provides Valuable Marketing Insights From All Stages of the Patient Journey

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## Abstract

Lab test results are generated at all key decision points in the patient journey, from initial presentation at first physician visit pre-diagnosis, to tests conducted at diagnosis, to the post-diagnosis monitoring stage. For a pharmaceutical brand team, access to the insights available through analysis of lab data available at all steps in the patient journey helps to identify targeted patients and their physicians earlier in the patient journey than traditional data sources, including in the pre-diagnosis stage. Use of a lab test database also facilitates identification of patients at all stages of a disease, and allows detailed patient profiling, longitudinal tracking of patient progress via weekly or monthly reports, monitoring of physician behaviors, and targeting of prescribers at critical decision points. These tactics lead to a more effective utilization of marketing resources and a positive impact on overall marketplace performance. This paper examines case studies of the impactful applications of lab test datamining and analysis using a nationwide lab test database.

*Key words:* Marketing strategy, informatics, lab test database, patient journey, patient data, patient profiling

## Introduction

This abundance of “big data” is bringing revolutionary improvements across the healthcare spectrum, playing a key role in medical breakthroughs, patient safety efforts and public health accountability.<sup>1</sup>

According to a recent Thomson Reuters survey, pharmaceutical information technology experts believe that “big data” represents a growing opportunity for the industry.<sup>2</sup> The survey found that 41.2% of the respondents

believe “big data” is particularly helpful in drug discovery and development, and 26.5% of respondents said this data helps them better understand the market.<sup>2</sup> A separate projection from McKinsey finds that effective use of “big data” could result in \$300 billion in benefits to U.S. healthcare through driving better quality and improved efficiency.<sup>3</sup>

Pharmaceutical marketing and analytics teams are digging deeper into aggregated databases, looking for new ways to more effectively reach physicians and patients, to

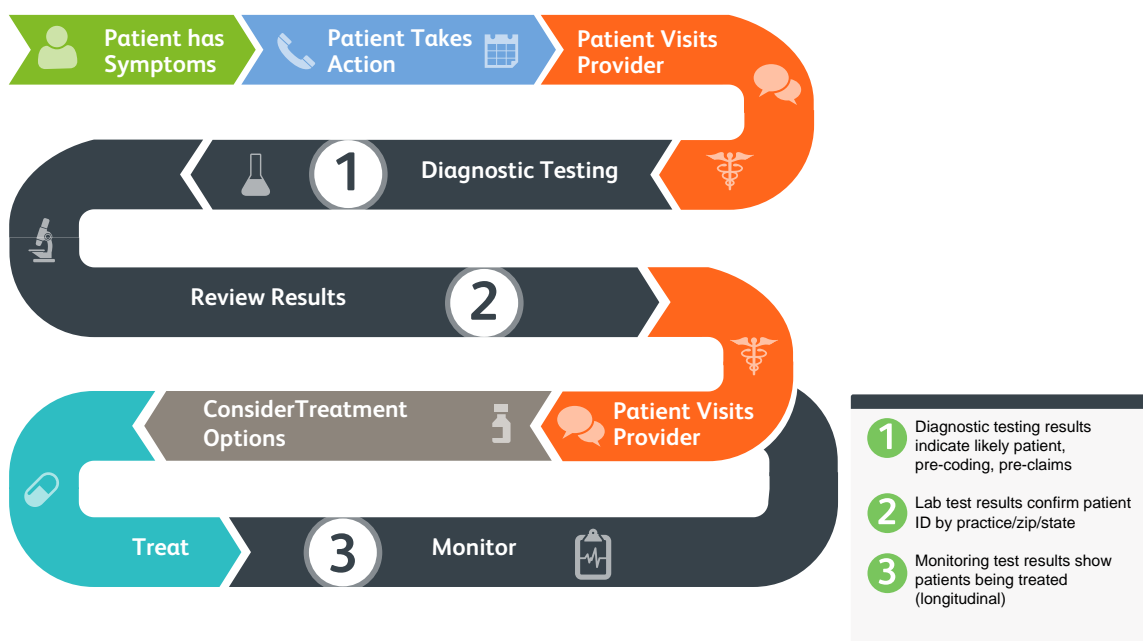
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<sup>1</sup> Jee K, Kim GH. Potentiality of big data in the medical sector: Focus on how to reshape the healthcare system. *Healthc Inform Res.* 2013 June; 19(2):79-85.

<sup>2</sup> Thomson Reuters. Big data and the needs of the pharmaceutical industry. White paper. Thomson Reuters, Inc., 2013.

<sup>3</sup> McKinsey Global Institute. Big data: the next frontier for innovation, competition and productivity. McKinsey and Company, 2011.

**Figure 1: Lab Test Touchpoints in the Patient Journey**



plan brand strategy, to educate stakeholders, and to improve health outcomes. With multiple sources of healthcare data available to marketing and analytics groups within the pharmaceutical industry, a new challenge has arisen: how to identify and utilize the data sources that most effectively inform and support a brand’s strategic plan.

Patient claims data is a traditional source of information on patient care, and data from patient records is also available—but both of these sources deliver a retrospective look at how diagnoses and treatment decisions were made. The development of a nationwide, lab test database gives brand managers, marketers and data analysts a new source of actionable data from earlier in the patient journey, pre-diagnosis and pre-treatment, which allows for patient identification earlier and can result in improved sales force efficacy compared with traditional data sources. In addition, tracking patients via lab test results allows for longitudinal views of patient data that reflect real outcomes.

This paper will review several examples of how brand teams and market researchers can use lab data analytics to develop more effective marketing plans. It also examines the implications of advanced patient analytics based on lab data, and its role in the development of pharmaceutical marketing programs designed to accurately identify patients and prescribers, and also reveal actual physician behaviors. Finally, the paper describes how the application of analytics to clinical algorithms based on patient-level lab data can be used to learn more about the health care professional providing treatment by specific condition, leading to more effective promotional activities.

### The Patient Journey and Big Data

Along the patient journey, patients are questioned, examined, tested, treated and then monitored to achieve the best care (Figure 1). Data is captured at every step taken by patients, which contributes to the vast amount of “big data” that technicians are tasked with

**Table 1: Comparison of Data Sources**

<b>Data Source</b>	<b>Patient Journey Stage</b>	<b>Patient Longitudinal View</b>	<b>Timeliness (speed of reporting)</b>	<b>Test result available</b>
Lab Data	Before Tx choice	Yes	Within 10 days of physician receiving result	Yes
Claims Data	Before Tx choice	Yes	10 - 20 days of physician receiving result	No
Rx Data	After Tx choice	Yes	NA	No

*Tx = treatment; Rx = Therapy; NA = not applicable.*

analyzing and mining for insights. When this mass of patient data is appropriately analyzed, then the patient journey can be translated into a regular source of critical insights and advantages that are vitally important to the brand teams navigating the highly competitive pharmaceutical market, helping them to better deploy their marketing budgets and sales teams, and better predict emerging market trends.

One of the most valuable touch points for pharmaceutical and biotech marketers from late in the patient journey is tracking clinician behaviors at the prescription step – the “who, what, when, where and why” of the prescription pad. But this step occurs after other critically important benchmarks in the patient journey have passed, such as when patients are first diagnosed, when their test results first become available, before physician-patient consultations occur, and before treatment decisions are made. For the marketer, being

able to identify and track physicians and patients at these earlier key decision points, through timely data reports and expert analysis, offers new business insights that are not available from traditional data sources, and can lead to a competitive edge in branding success and overall marketplace performance (see Table 1).

Lab data represents a key component in physician diagnosis and treatment of patients in each patient’s journey. About 7 billion lab tests are performed each year in the United States, and the results support as many as 70% of the clinical decisions that healthcare professionals make.<sup>4</sup> In addition, as many as 94% of physician views of patient electronic medical records include reviews of laboratory data.<sup>5</sup> The anticipated growth of molecular and genetic testing will further increase both the importance of labs and the richness of the data waiting to be mined. Indeed, The Global Genetic Testing Market Forecast predicts a 9%

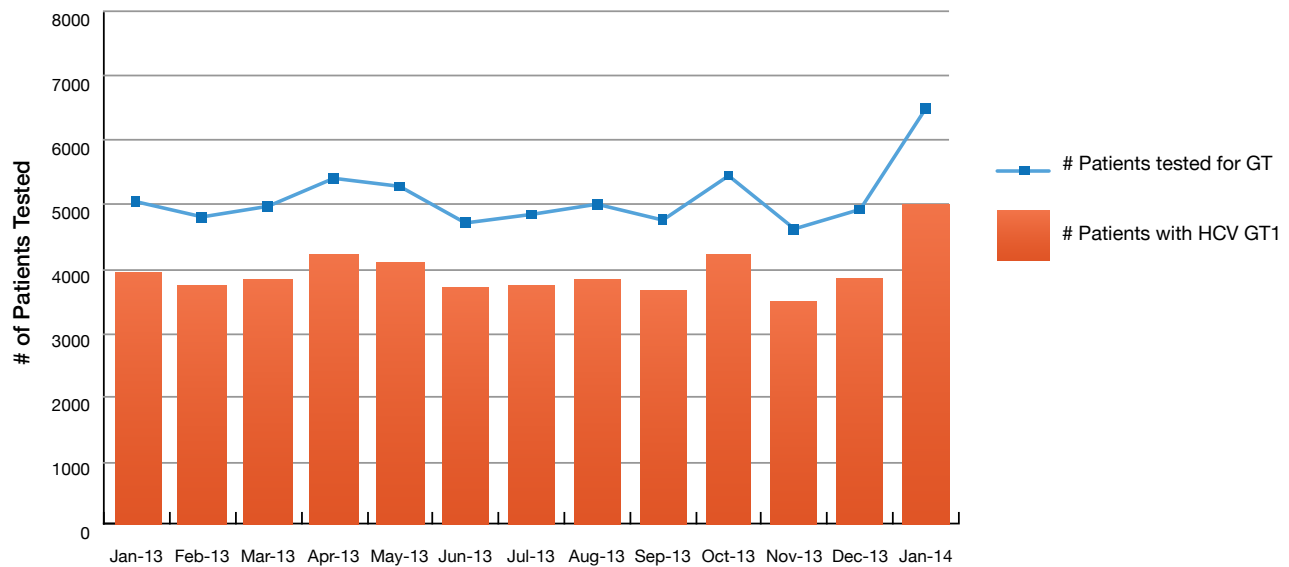
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<sup>4</sup> Lewin Group. Laboratory Medicine: A National Status Report. 2008.

<sup>5</sup> Warren JS. Laboratory Test Utilization Program. Structure and impact in a large academic medical center. Am J Clin Pathol 2013;139:289-297.



**Figure 2: Patients with HCV in the Medivo LVX Tested for Genotype, Jan 2013 – Jan 2014**



GT = genotype

compound annual growth rate in genetic testing alone through 2017.<sup>6</sup>

Greater access and understanding of lab data results open up new opportunities for improving sales force planning and optimizing the sales representative-physician interaction. An analysis of lab test data can validate current physician targets, as well as identify new accounts with specific patient groups for whom the physician is considering treatment options.

### Case Study 1: Physician Profiling Assists Launch of an HCV Drug

For brand teams, it is critically important to have a deep understanding of physician behavior regarding therapy selection for newly diagnosed patients, particularly when a new therapy is being launched. This was evident

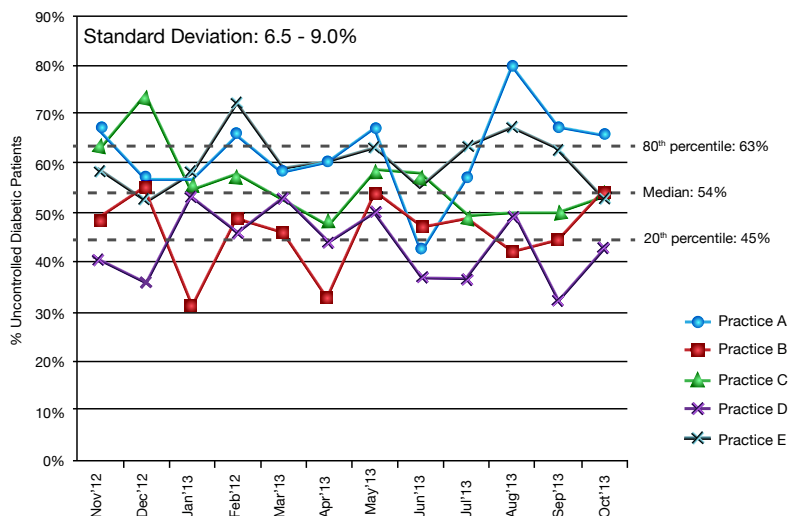
in the high value, highly dynamic market for hepatitis C virus (HCV) agents in 2013, when a brand team at a pharmaceutical company needed to evaluate physician awareness of various agents and to better understand the impact of new therapies on physician behavior. The company’s marketing team made it a top priority to find new ways to study the HCV marketplace at the practice level.

The team elected to study analytics based on monthly reports generated from a nationwide lab database. The reports identified physicians with newly diagnosed HCV patients in their practices, including antibody, reflex and genotype testing. Testing to identify the genotype of the virus usually occurs prior to treatment, and provides information necessary for selection of optimal therapy. (Figure 2). The reports provided the brand team a new perspective on their marketing plans, based

<sup>6</sup> Genetic testing market outlook to 2017. RNCOS Business Consulting Services. May 2013. Available at: <http://www.rncos.com/Report/IM492.htm>.

**Figure 3: Practices with Large Number of Patients with Diabetes (2012 - 13)**

- Large Practices have less variability than small practices, but manage patients less effectively.
- Median percentage of uncontrolled patients is 54% (range 45% to 63%)



on longitudinal patterns of HCV testing and genotype results. Currently available data such as claims data do not include the genotype result, which is important in determining which treatment choice is best for the patient. As a result of obtaining these reports, brand managers and their field forces knew which physician practices had newly diagnosed patients with HCV by specific genotype. Furthermore, reps are now able to target physicians with appropriate patients prior to treatment choice. This information was available to the team as they were deciding how to deploy their marketing tactics at a practice and regional level and are gaining faster product adoption than they would with traditional data sources.

### Case Study 2: Mapping Uncontrolled Diabetic Patients

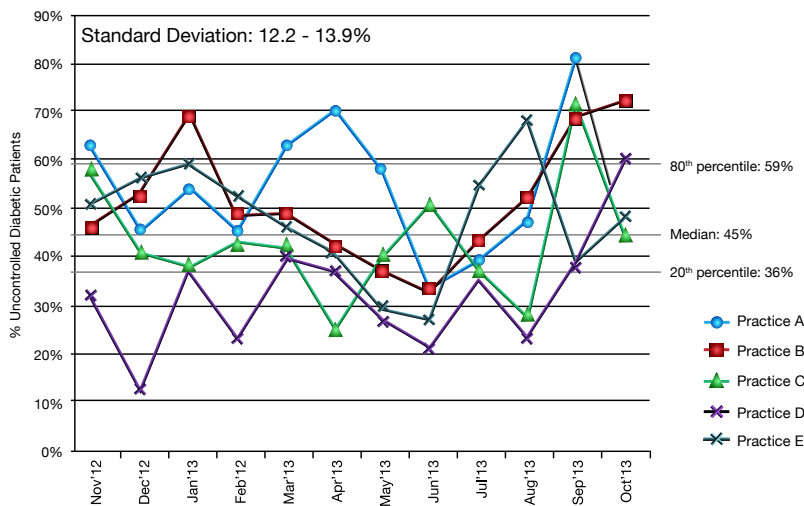
Our second case study looks at the needs of a brand team at a pharmaceutical company developing and launching a new marketing campaign to drive sales of their diabetes

drug. Among the tactics was learning more about physician management of patients with uncontrolled diabetes. The brand team also needed to profile and segment physician practices based on relevant patient populations.

Using lab results and proprietary algorithms for physician and patient profiling, it was possible to identify the physician practices with relatively high rates and variability of uncontrolled diabetic patients. Through this profiling project, which utilized longitudinal patient HbA1C results, it was determined that the median rate of uncontrolled diabetic patients was 45% for practices with lower numbers of patients with diabetes (defined as ~20 patients with diabetes) and 54% for practices with higher numbers of patients with diabetes (defined as 70 patients with diabetes or more) (Figures 3 and 4). A review of the profile reports also showed that practices with higher numbers of patients with diabetes have less variability in rates of patients with controlled diabetes than practices with lower numbers, but practices with higher numbers of patients with

**Figure 4: Practices with ~20 Patients with Diabetes**

- High variability in managing diabetic patients across practices and over time
- Median percentage of uncontrolled patients is 45% (range 36% to 59%)



diabetes also tend to manage their patients less effectively.

This case study illustrates that the insights available through data mining and analysis of lab test results can assist brand managers in identifying practices with targeted patient populations, track physician management choices for a particular disease, and show changes in these behaviors over time.

### Case Study 3: Finding Patients with Acromegaly

Acromegaly, a disorder caused by growth hormone hypersecretion from a pituitary adenoma, is a relatively rare disease. The National Institutes of Health (NIH) estimate that acromegaly has a prevalence of about

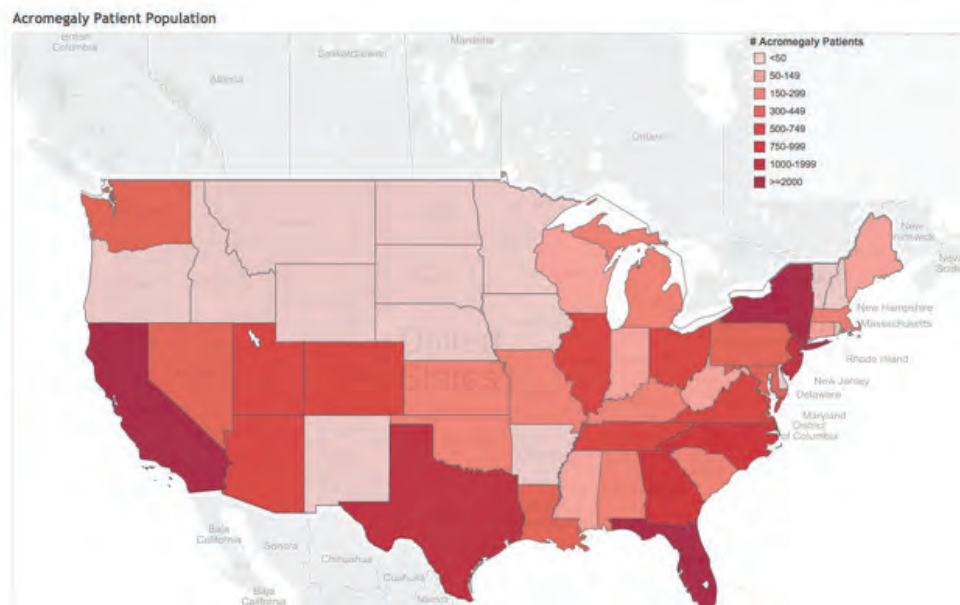
60 cases/million population; about 1,000 new cases are identified in the US annually.<sup>7</sup> However, the NIH notes that acromegaly cases may be slow to develop and are often missed by clinicians. Therefore the true incidence and prevalence is unknown, and may be higher.<sup>7</sup>

Acromegaly is typically identified through a blood test, although in some cases it may be picked up as an incidental finding on a skull radiology exam.<sup>7</sup> It is important to diagnose and treat acromegaly early, in order to prevent the development of irreversible symptoms such as enlarged organs, hands and feet, and also to reduce the risk of excess mortality (2 - 2.5 times higher) associated with the disease, which are eliminated by treatment.<sup>8</sup> However, claims data can only find patients once a diagnostic code has been assigned, which may be a considerable time after the diagnosis is indicated by lab test results.

<sup>7</sup> Acromegaly. National Endocrine and Metabolic Diseases Information Service (NEMDIS). A service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), National Institutes of Health (NIH). Available at: <http://endocrine.niddk.nih.gov/pubs/acro/acro.aspx#common> Accessed October 9, 2014.

<sup>8</sup> Katznelson L, Atkinson JL, Cook DM, Ezzat SZ, Hamrahian AH, Miller KK; American Association of Clinical Endocrinologists. American Association of Clinical Endocrinologists medical guidelines for clinical practice for the diagnosis and treatment of acromegaly - 2011 update. *Endocr Pract.* 2011;17 (suppl 4):1 - 44.

**Figure 5: Acromegaly Patients in a Large National Lab Test Database by State**



Due to the rarity of the disease, a pharmaceutical company recognized that it can be difficult to find practices where patients with acromegaly are being treated, particularly to find new patients. The company worked with our team to search a large lab test database, with a goal of finding patients with acromegaly, including newly diagnosed patients, at the physician’s practice location. The database showed the prevalence of patients with acromegaly by state (Figure 5). In addition, reports from the database showed the incidence of new cases of patients with acromegaly on a state- and practice-level. (Figure 6) Weekly reports assisted the brand manager to target efforts of their sales force, and delivery of brand messages to physicians known to be treating patients with acromegaly. As shown in Figure 6, the sales rep with physicians in zip code 33607 targeted the physician practices (practice names hidden for confidentiality reasons) with 5 newly

diagnosed acromegaly patients and delivered brand messages to those physicians prior to treatment choice.

The brand team has noted that the reports have identified physicians treating patients with acromegaly who would not have been found through traditional data sources.<sup>9</sup> This information has directly translated into re-prioritization of the field force call and messaging plans.<sup>9</sup> The team is working on designing analyses to measure the impact of the new messaging and targeting plan on sales over time.

## Conclusion

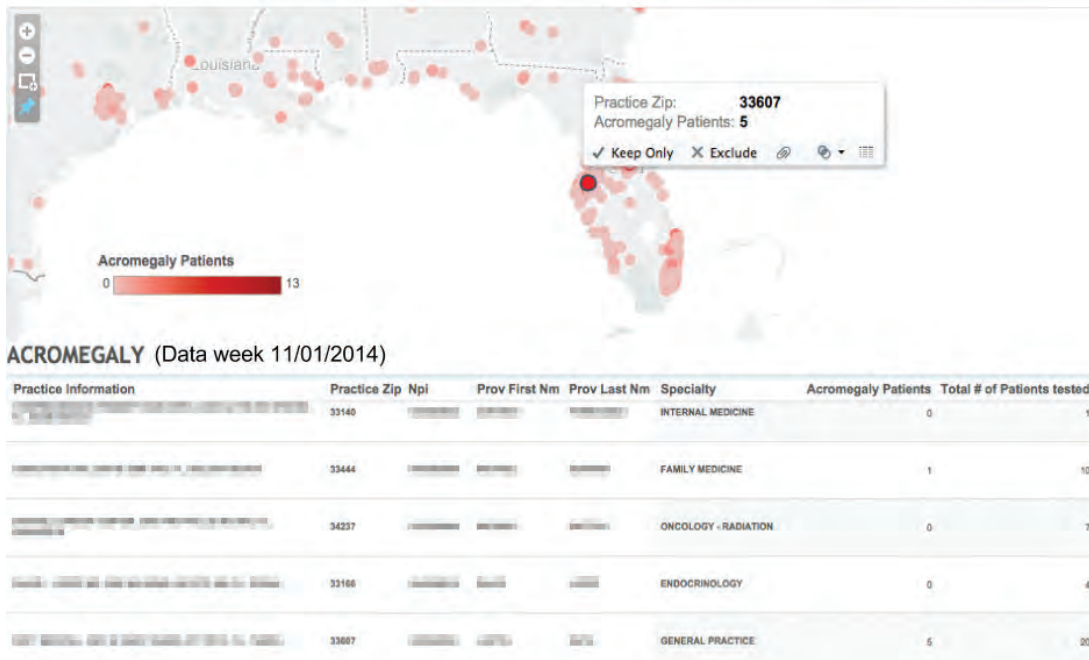
Clinical lab data from a national database offers a new way to mine valuable data, generating timely reports that inform brand managers about patients from all stages of

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<sup>9</sup> Unpublished client email to Medivo, 2014.

## Figure 6: Sample of Weekly Acromegaly Report at the Practice Level

Report delivered within 10 days after test performed, and before treatment decision



the patient journey, pre-diagnosis through to follow up; monitoring. Taking this unique view of lab data gives brand teams and market researchers a new set of insights into patient profiling, physician profiling, demographics and a longitudinal view of lab data reflecting treatment selection at all stages of the patient journey. A longitudinal view of patient's lab results made available (anonymized) to brand teams at the physician practice level prior to the physician's treatment choice offers an especially powerful new tool for increasing marketing and sales effectiveness. We are currently researching the impact of lab test reports delivered regularly to brand managers from a nationwide database on marketing and sales.

## Acknowledgments

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# A Smart Approach to Select Test Cities for a DTC Pilot

*Razek Karnoub, Ph.D., Director, Axtria Inc. and David Wood, Ph.D., Senior Principal, Axtria Inc.*

## Introduction

The decision to run a national direct to consumer advertising campaign (DTC) for a pharmaceutical treatment runs in the tens of millions of dollars, at least. Occasionally, it has well exceeded the two hundred million dollars mark; with the Lunesta butterfly being one example. The decision depends on several factors including the size of the patient population, the likelihood that the DTC motivates patients to go to doctors and ask for the drug, and the likelihood that physicians comply with the request. Given key parameters from Market Research, or maybe other instruments, models can be built to predict the Return on Investment (ROI) of these campaigns and inform go/no-go decisions. But, even with these models, there remains instances where the parameters and the uncertainty surrounding them combine to produce projections that may not indicate a clearly profitable or clearly unprofitable campaign. In these situations, the next prudent course of action is to run a pilot of the campaign in several test markets as a gauge on the likely ROI of a full campaign. With data from the pilot in hand, one builds an ROI model for the larger DTC. If the pilot yields an acceptable ROI, then the larger campaign proceeds. If not, the loss would be the investment in the pilot, rather than the much larger sum that a full DTC campaign would cost. The question then becomes: which markets to run the pilot in, how to compute the pilot ROI

and how to project that ROI to the Nation. In this article, we contend that these are tightly related questions and elaborate a common framework to answer them.

Note: **this article details a strategy for selecting cities (test markets) for a pilot study, at lowest cost and designed to produce maximum confidence in the indicative power of the pilot.** The article does not speak to the problem of how to do the measurement; in the particular case that inspired the development of this approach, a classic difference-of-differences test and control strategy was used.

## Challenges

The media market in the US is subdivided into 210 geographies “Designated Market Areas” (DMAs) that receive similar TV and Radio offerings. Each of these markets has its own mix of population and economic statistics: population size by age, gender, race, median income, etc. Each DMA has its own characteristics as far as the incidence of any particular disease and the associated treatments as well; market shares of some treatments may vary significantly from one DMA to another.

In a traditional ‘Test and Control’ approach, one would select DMAs to run the pilot campaign on (the test group) and then match the selection to other DMAs the pilot will not

affect (the control group). For each test DMA, a control DMA is selected to mirror the relevant statistics as closely as possible. Naturally, this process yields the best available control; not necessarily a “perfect” one (i.e., a perfect clone of the matched test DMA). Additionally, the test DMAs selection should be done with an eye to being able to represent the entire Nation (the USA, in this case). This usually means choosing the test sample randomly with a size sufficiently large in order to achieve an acceptable projection error. But practically, the process is affected by constraints, including budgetary or technological, that in the end produce less than a perfect representation and projection to the Nation as a whole.

## **Approach**

The methodology we propose attempts to perfectly reproduce the Nation in the test sample, without resorting to randomness or sample size as means. It attempts to perfectly reproduce each test DMA as well, in the same way. The idea behind it is to consider the Nation as a convex combination of DMAs rather than as a sample of ‘randomly’ chosen DMAs. The DMAs that combine to reproduce the Nation become the ‘test group’. Each DMA of the test group is similarly matched to another convex combination of DMAs, which now becomes the test city’s ‘control group’. The set of all DMA control groups is, in the end, the ‘control group’ we seek.

Central to both the ‘Traditional Test and Control’ and the ‘Weighted Test and Control’ approaches is the idea of DMA characteristics to match on. This likely entails a mixture of both science and the ‘Art of the Feasible’, tailored to the particular case at hand. Ideally, we would like to match on a set of characteristics (variables) that fully explain sales at the DMA

level. Examples include epidemiologic variables such as disease incidence, the promotional effort behind the product, a notion of the competitive landscape, and some representation of the managed care situation for the brand. *Ideally, we need an understanding of the media cost at the DMA level as well; not to match on, but to minimize the pilot cost.*

In practice, some of these variables may not be available for a given study, but what would be available are some of their consequences. For example, competitive promotion or competitive managed care positions may not be available. In lieu of these, one might consider competitive sales variables. Similarly, disease incidence may be hard to obtain at a DMA level, but treatments, pharmaceutical and not, may be available and could be used as proxy.

## **Case Study**

These ideas have their origin in a study of the potential profitability of a DTC campaign for a specialty pharmaceutical product. No DTC campaigns on that product have previously been attempted; so no prior experience or data on such campaigns existed to learn from. Preliminary analysis (conducted by the media organization that planned to run the campaign) showed that the campaign could be profitable but not in a clear way. The uncertainty of the parameters was such that sinking many tens of millions of dollars into the full DTC seemed too risky. Spending a couple of million on a pilot to learn from appeared to be the sensible course to follow.

**Table 1**

DMA	Expected Product X NRx per 1000 Above 40	Product X NRx per 1000 Above 40	All Treatments per 1000 Above 40	Branded NRx per 1000 Above 40	PDEs per 1000 Above 40	Average Media Costs	Selection Coefficients
<b>Nation</b>	<b>1.60</b>	<b>1.54</b>	<b>74.71</b>	<b>6.26</b>	<b>2.35</b>		
<b>Convex Combination</b>	<b>1.60</b>	<b>1.54</b>	<b>74.71</b>	<b>6.26</b>	<b>2.35</b>	<b>\$306.38</b>	
Columbus, OH	1.88	1.72	71.37	7.87	3.46	\$34.63	24.4%
Columbia, SC	1.53	2.39	143.56	9.06	4.82	\$40.38	7.6%
Lubbock, TX	1.29	6.29	222.95	19.20	5.31	\$35.50	0.3%
Tulsa, OK	3.00	1.42	64.37	5.66	3.00	\$69.00	23.5%
Evansville, IL	1.36	2.03	60.30	7.87	1.43	\$61.13	5.1%
Champaign & Springfield – Decatur, IL	0.63	1.23	70.35	4.76	0.89	\$65.75	39.1%

Table 1 above exhibits a set of matching variables used to determine the DMAs of the pilot DTC. The market for the product of interest, Product X, is mostly non-pharmaceutical, and virtually all patients are at least 40 years old. The branded pharmaceutical market is relatively small in this case. The generic market is twice as large as the branded, but we kept it out of the matching process as the characteristics we already include implicitly account for it. PDE refers to ‘Promotional Detail Equivalent’ and represents the personal (representative-physician) promotional effort behind Product X. The ‘Expected Product X NRx’ variable incorporates the notion of trend in the product’s sales. Different DMAs may be on different sales trends due to different local factors that are not readily available for consideration. This computed variable captures these dynamics, albeit indirectly.

The set of DMAs displayed in that table represents the solution to minimizing the media cost of the selected DMAs subject to the requirement that the selected DMAs are able to be

combined into a convex combination that provides an exact (or near-exact) match to the overall National characteristics. These are the DMAs of the pilot DTC, of course. This result is achieved by solving the following mathematical model:

$$\begin{aligned}
 & \text{Min. } \sum_i c_i u_i \\
 & \text{s.t.} \\
 & \sum_j \alpha_j a_{ij} = b_j, \forall j \\
 & \sum_i \alpha_i = 1 \\
 & \alpha_i \leq u_i, \forall i \\
 & u_i = 0 \text{ or } 1, \forall i \\
 & \alpha_i \geq 0, \forall i
 \end{aligned}$$

Note that the constraint  $\sum_i \alpha_i = 1$  forces some  $\alpha_i$ ’s to be non-zero. This, in turn, forces the corresponding  $u_i$ ’s to be 1, hence forcing a contribution in the objective. In fact,  $u_i = 1$  if and only if DMA  $i$  is to be selected.

**Table 2**

DMA	Expected Product X NRx per 1000 Above 40	Product X NRx per 1000 Above 40	All Treatments per 1000 Above 40	Branded NRx per 1000 Above 40	PDEs per 1000 Above 40	Selection Coefficients
Columbus, OH	1.88	1.72	71.37	7.87	3.46	
Convex Combination	1.88	1.72	71.37	7.87	3.46	
New York, NY	3.28	2.62	83.71	13.65	4.08	34.0%
San Diego, CA	0.73	1.51	52.26	6.84	3.83	9.4%
Birmingham, AL	2.73	1.53	29.68	5.85	4.12	11.5%
Wilkes Barre - Scranton, PA	0.65	0.90	19.51	3.12	2.71	30.7%
Tucson (Sierra Vista), AZ	0.66	0.97	205.18	5.30	2.26	13.0%
Wilmington, NC	6.74	7.29	135.29	18.40	7.45	1.5%

The result of a slightly different minimization problem is displayed in Table 2. In this case, the control set for one of the selected test DMAs, Columbus, OH, is determined. Note that the characteristics of that DMA are perfectly reproduced, as well.

The mathematical model generating this solution is:

$$Min. \sum_j (d_j^+ + d_j^-)$$

s.t.

$$\left( \sum_i \alpha_i a_{ij} \right) - b_j = d_j^+ - d_j^-, \forall j$$

$$\sum_i \alpha_i = 1$$

$$\alpha_i, d_j^+, d_j^- \geq 0, \forall i, j$$

Note that in this model, we essentially minimize  $\sum_j |(\sum_i \alpha_i a_{ij}) - b_j|$ ; a distance measure between the DMA of characteristics  $b_j$  and the convex combination to represent it.

## Project Outcomes & Benefit

Ultimately, the value of doing any pilot study of this type (prior to a larger, more expensive, and more risky expenditure) hinges on two questions:

1. Can we reliably “project” from the pilot to the Nation as a whole (or, more generally, to the proposed scope of the larger study)?
2. Can we measure the ROI of the proposed pilot accurately?

The approach described in this article provides advantages to both these questions. The primary advantages of this approach is the ability to select a “representative” set of test cities or DMAs whose outcomes (in the pilot) can be exactly weighted for accurate projection to national scale. Furthermore, the selection of those cities can be made with total media cost as an objective to be minimized. (The minimum cost is obtained by selecting cities with relatively low media costs that are collectively still representative of the Nation as a whole.)

Similarly, the ability to find the convex combination weighting of the “test set” to be specifically representative the Nation may allow running the pilot in fewer DMAs overall (with the same or better predictive power) than would be required with random selection methods.

For the 2<sup>nd</sup> question, the ability to find a weighted combination of multiple control DMAs that will very nearly exactly match the relevant characteristics of each test city provides greater confidence in the accuracy of the ROI determined from the pilot. This process provides a quality of matches (across multiple dimensions) between test and control DMAs that cannot be achieved by any standard process of finding the best available matched pair.

In the particular example that inspired this work, a preliminary decision had selected six test DMAs. We were able to show that those cities were not well representative of the nation as a whole . . . they had some of the highest incidence rates, treatment rates, and most favorable managed care environments in the nation. (In effect, they appeared to have been selected as the cities where the DTC campaign was most likely to be effective . . . but there was no possible combination of those cities that could be projected to a national ROI estimate.)

The decision was made to keep the same # of test cities originally selected (6), but redirect them to lower-cost markets that were provably more representative of the nation. This directly saved \$1.5 MM in media costs for the pilot.

Somewhat unhappily, the pilot DTC campaign was judged as “not successful enough” based on the results from the pilot ... raising sales, but not by an amount sufficient to justify the expenditure. The pilot allowed the

company to save \$30 - \$50 million in expenses that would have resulted in a loss-making investment.

## **Conclusion**

To make the leap of faith that the ROI observed in a pilot DTC campaign will manifest in a larger national campaign, the cities selected for the pilot have to satisfy basic requirements:

- Cities selected as part of the test group need well-matching counterparts in the control group. Matching would be done on all factors that could affect prescribing. If possible, the only difference between test and control cities would be the DTC itself.
- Ideally, the selected cities in the test set need to be representative of the nation as a whole.

Classic methods for identifying control cities depend on finding a single ‘best match’ control city for each test unit, matching on the relevant set of variables for the particular situation (population, current market and brand volume, other promotion, etc.) Even under the best of conditions, this matching is usually only approximate.

The abovementioned framework allows finding linear combinations of multiple control cities that can almost perfectly (in their weighted combination) replicate the critical variables of each test city. The weighted combination of the controls can then deliver a more robust measurement of DTC impact. Similar analysis can help better select the original pilot test cities, trading off cost minimization for the pilot while still having a test group that can be assessed as fully representative of the nation as a whole.



The approach has been found useful in situations where companies seeking to do DTC do not have the budgets for national buys and/or where prior experience (data/results) does not exist. In addition to informing the overall investment decision, the DTC pilot results can be used to target DMAs for DTC investment/avoidance. The proliferation of cable TV distribution options has increased the ability to target markets with greater precision. While complicating the work of the agency media buyers, this pragmatic (“crawl, walk, run”) approach has worked well with pharmaceutical firms willing to pursue data-driven decisions.

## Literature

Literature on the increasing importance (and various impacts) of Direct-to-Consumer advertising in the pharmaceutical sector can be found in multiple places; below is a small sample of such material:

1. Dieringer NJ, Kukkamma L, Somes GW, and Shorr RI, Self-reported responsiveness to direct-to-consumer drug advertising and medication use: results of a national survey. <http://www.ncbi.nlm.nih.gov/pubmed/21942938>
2. Fain, Kevin M. JD, MPH; Alexander, G. Caleb MD, MS, Mind the Gap: Understanding the Effects of Pharmaceutical Direct-to-Consumer Advertising. *Medical Care* (American Public Health Association) April 2014, Volume 52, Issue 4. [http://journals.lww.com/lww-medicalcare/Citation/2014/04000/Mind\\_the\\_Gap\\_Understanding\\_the\\_Effects\\_of.2.aspx](http://journals.lww.com/lww-medicalcare/Citation/2014/04000/Mind_the_Gap_Understanding_the_Effects_of.2.aspx)
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4. Montoya ID1, Lee-Dukes G, Shah D., Direct-to-consumer advertising: its effects on stakeholders. *Journal of Allied Health* 2008 Summer 37(2) 116-20. <http://www.ncbi.nlm.nih.gov/pubmed/18630788>
5. McCullough, Jeffrey S, and Ng, Serena , The Health Consequences of Direct-to-Consumer Pharmaceutical Advertising; a presentation at ASHEcon 2014. <https://ashecon.confex.com/ashecon/2014/webprogram/Paper2591.html>

Similarly, there are multiple sources in the literature about strategies to measure the impact of promotion campaigns generally and DTC in particular. (Some of the references here discuss measurement strategies in the context of the specific study being reported):

1. O’Donoghue, Amie C., Williams, Pamela A., Sullivan, Helen W., Boudewyns, Vanessa, Squire, Claudia, Willoughby, Jessica Fitts , Effects of comparative claims in prescription drug direct-to-consumer advertising on consumer perceptions and recall. *Social Science & Medicine*, Volume 120, November 2014, Pages 1 – 11. <http://www.sciencedirect.com/science/article/pii/S0277953614005656>

2. Ronald J Vogel, PhD, Sulabha Ramachandran, MS, Woodie M Zachry III, PhD, A 3-stage model for assessing the probable economic effects of direct-to-consumer advertising of pharmaceuticals. *Clinical Therapeutics* Volume 25, Issue 1, January 2003, Pages 309–329. <http://www.sciencedirect.com/science/article/pii/S0149291803900439>
3. Rosemary J. Averya, Matthew D. Eisenberg, Kosali I. Simon, The impact of direct-to-consumer television and magazine advertising on antidepressant use. *Journal of Health Economics*, Volume 31, Issue 5, September 2012, Pages 705–718. <http://www.sciencedirect.com/science/article/pii/S0167629612000562>
4. Atherly A, Rubin PH The cost-effectiveness of direct-to-consumer advertising for prescription drugs. *Med Care Res Rev.* 2009 Dec;66(6):639-57. <http://www.ncbi.nlm.nih.gov/pubmed/19423875>

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