IPM.ai
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CASE STUDY: IMPROVING OUTCOMES AT SCALE

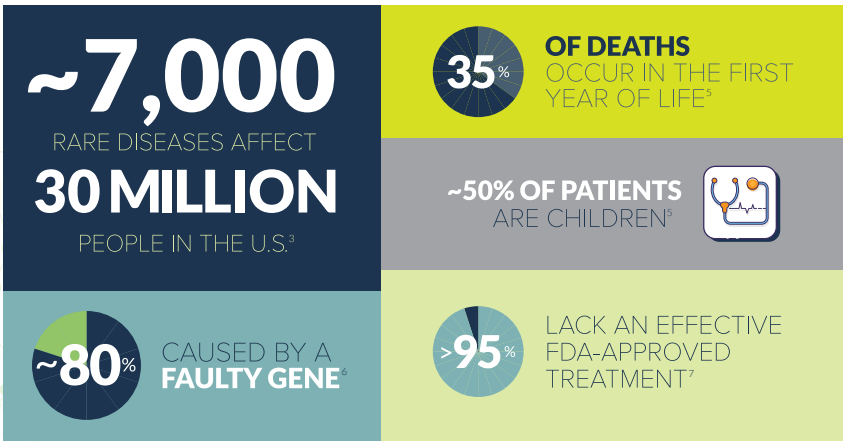
Shortening the Rare Disease Diagnostic Odyssey

Burden of rare disease

While there is no universal definition of a rare disease, a disease is defined as rare in the United States if it affects less than 200,000 people (620 patients per million).[1,2] Today, there are nearly 7,000 known rare diseases affecting 30 million people in the U.S.[3] While each disease affects a small patient population, as a category, rare diseases have a significant impact on patients, their families, and the healthcare system.

Rare diseases are devastating to children and families. 95% of rare diseases have no pharmacological treatment options, exacerbating the mis-diagnosis trajectory, and resulting in significant healthcare spend that does not improve patient outcomes.[4] Many of these diseases are chronic, debilitating, or fatal. In the small number of cases where treatments exist, they are often complex, costly, and patients may wait years for a correct diagnosis.

Rare diseases are challenging to diagnose because patients, families, and physicians have little awareness of the disease and its often complex symptomatology. As the U.S. medical system is organized



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around specialists who treat 'the organ,' most physicians, even specialists, will never encounter a rare disease in the ordinary course of care and symptoms may be misdiagnosed as common illnesses (albeit with the best of intentions). Consequently, patients face difficulties accessing high-quality care and support. In most cases, the path to accurate diagnosis is fraught with delays and misdiagnoses. Patients often embark on a diagnostic odyssey, going from doctor to doctor until they are finally (hopefully!) referred to a specialist familiar with the disease. Ironically, even the right specialist will have significant difficulty putting all the pieces together, as they do not have access to a longitudinal patient record. During this time, a patient's condition can deteriorate dramatically, resulting in low quality of life, disability or even premature death.

Complicating this already dire situation, most rare diseases lack the codes needed for diagnosis, treatment, billing, reimbursement, and research. Of the ~7,000 rare diseases known to exist, only about 500 have a diagnostic code in the International Classification of Diseases (ICD), 10th revision.[9] ICD codes are used by healthcare providers to classify diagnoses, symptoms, findings and procedures as well as guide treatment decisions. These codes are also critical for processing health insurance claims, for research, and for the building of physician awareness of the conditions themselves.

> "Without an ICD code, a rare disease cannot be easily recognized within a healthcare system, fragmenting care."

Without an ICD code, a physician is left describing the signs and symptoms of a rare disease rather than establishing a diagnosis for the disease itself. As a result, the rare disease cannot be easily recognized within a healthcare system, further fragmenting care. Overcoming these barriers requires persistence from patients and their families, and demands innovation from the healthcare ecosystem.

The Challenge

A pharmaceutical company developed an FDA-approved therapy for an ultra-rare life-threatening disease (less than 20 patients per million; or less than 6,500 patients in the U.S.)[2] that progresses rapidly. The disease is hereditary and has a range of debilitating symptoms. Since it is ultra-rare, even specialists are unfamiliar with the disease and how to test for it. As a result, most patients are either not diagnosed or are diagnosed late, after the disease has progressed to a critical stage and taken a major toll on their quality of life.

The company wanted to reduce the time to correctly diagnose patients and identify those who are appropriate candidates for therapy. Since traditional diagnostic codes do not suffice, the company needed to build:

1. A **model** to profile these ultra-rare disease patients and the specialists likely to see them.
2. A **diagnostic support tool** to help specialists correctly diagnose patients with the ultra-rare disease.

Both the model and the diagnostic support tool required different data types and sources to provide a complete, longitudinal view of the patient. The relevant data – genomic, clinical, claims and other data - was fragmented across different institutions and

systems. Further, there was no easy way to aggregate and link these disparate data sources.

The Solution

Step 1: Building a holistic view of the patient

The company's first challenge was to source the necessary data. Working with IPM.ai and Datavant, the pharmaceutical company identified several different sources that offered genomic, clinical or claims data. Each source had only one data type, and no one source was comprehensive for a given data type. The pharmaceutical company, IPM.ai and Datavant evaluated the different sources to determine the combination that offered the most comprehensive coverage for the population of interest.

Under the Health Insurance Portability and Accountability Act (HIPAA), the data sources were not able to share identified data with either the pharmaceutical company or IPM.ai. To solve this problem, each source worked with Datavant to de-identify their data behind their own firewalls. As Datavant de-identified data for each source, it also applied an anonymous ID (or "token") to each record. The anonymous ID was built from the underlying identifying information contained in each record and could be used to link corresponding records across datasets. This capability is sometimes referred to as privacy-preserving record linkage (or "PPRL").

Each data source then sent its de-identified and tokenized data to IPM.ai. Using Datavant's anonymous ID, IPM.ai built an aggregated, longitudinal dataset that could power its models.

Step 2: Building the model and diagnostic support tool

The model that IPM.ai built allowed the pharmaceutical company to predict those likely suffering from the ultra-rare disease, albeit without a diagnosis. The model also helped identify likely treating physicians, as each de-identified patient record was linked to one or many national provider identifiers (NPI). The pharmaceutical company could then develop disease education programs, outreach campaigns, and training modules for those specialists.

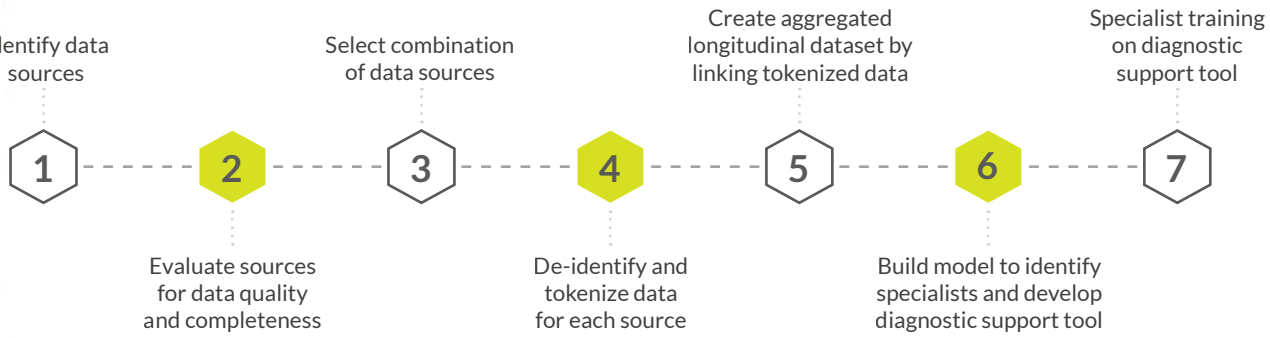
Finally, using the aggregated, de-identified dataset, the pharmaceutical company and IPM.ai built a diagnostic support tool to help specialists accurately diagnose patients with the ultra-rare disease in a timely manner.

Step 3: Implementation

With insight from the aggregated, longitudinal dataset and IPM.ai's model, the pharmaceutical company was able to send representatives to select specialists - those who are highly likely to see patients with the ultra-rare disease.

While the representatives cannot tell specialists the identity of a patient, they can let them know that they are likely seeing a patient with the ultra-rare disease. The representatives can then educate these select specialists about the ultra-rare disease and train them using the diagnostic support tool.

Improving rare disease diagnosis rates using *privacy-preserving record linkage*



Outcome

Targeted education, outreach, and training of specialists likely to see patients with the ultra-rare disease is enabled through a model built on top of an aggregated dataset composed of genomic, clinical and claims data. These efforts have resulted in a significant increase in diagnostic testing for the ultra-rare disease, as demonstrated by a 40% increase in diagnosis rate and 66 new patient start forms. Patients are now likely to be diag-nosed earlier and receive the necessary therapy before their ultra-rare disease progresses to a more critical stage, thus increasing patient outcomes, reducing the costs associated with mis-diagnosis/treatment, and improving overall quality of life.

Types of Data Used

Claims

Genomic

EHR

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[1] Richter T, Nestler-Parr S, Babela R, Khan Z.M., Tesoro T, Molsen 5, & Hughes D.A. (2015). Rare disease terminology and definitions—a systematic global review: report of the ISPOR rare disease special interest group. Value Health,18(6), 906-914.

[2] Alexion Corporate Communications. August 2018. Rare and Ultrarare Diseases.

[3] National Institutes of Health. National Center for Advancing Translational Sciences. Genetic and Rare Disease Information Center. (2017, Nov 30). FAQs about rare diseases. Retrieved from https://rarediseases.info.nih.gov/diseases/pages/31/faqs-about-rare-diseases

[4] America's Biopharmaceutical Companies. February 2018. Rare Disease by the Numbers. Retrieved from https://innovation.org/about-us/commitment/research-discovery/ rare-disease-numbers.

[5] Kvancz DA. (2016). The Impact of Rare Disease and Drug Therapy. Am J Pharm Benefits, 8(4),128-132.

[6] Shire. Feb 2016. The global challenge of rare disease diagnosis. The benefits of an improved diagnosis journey for patients.

[7] Global Genes. RARE facts. Retrieved from https://globalgenes.org/rare-facts/

[8] Shire. Jan 2015. The global challenge of rare disease diagnosis. A policy briefing.

[9] National Institutes of Health. National Center for Advancing Translational Sciences. Genetic and Rare Disease Information Center. (2016, June 24). ICD coding for rare diseases. Retrieved from https://rarediseases.info.nih.gov/guides/pages/123/icd-coding-for-rare-diseases

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