TRINITY

WHITE PAPER

Predicting Winners: AI-Powered Portfolio Management

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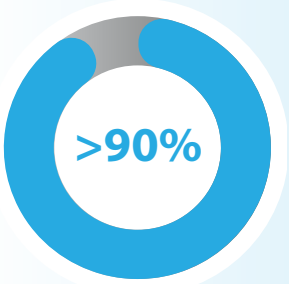
INDUSTRY

IMPACT

SERIES

In the latest entry of Trinity Life Sciences' Industry Impact Series (Picking Winners), we discussed the organizational challenges that obstruct life sciences companies from delivering innovation and value to patients. As we have observed how artificial intelligence and machine learning (AIML) have increasingly become engrained in the industry's public discourse since then, we wanted to ask the question of how AIML could be used to support portfolio decision-making across the life sciences industry. If organizational hurdles stand in the way of picking winners, can we use data and AI to predict winners?



In this installment of our Industry Impact Series, we find that not only can the latest AIML techniques identify the drivers of success and failure in commercialization, but **Trinity's AI algorithm accurately predicts outcomes for >90% of U.S. drug launches, far exceeding the accuracy of analyst consensus at time of launch (<60%).**

Trinity's AI algorithm incorporates both publicly available and Trinity-proprietary data on more than 250 U.S. drug launches since 2014 to improve portfolio decision-making, ushering in a new era of portfolio management in which data and AI help life sciences organizations to overcome the institutional hurdles and biases observed today.

Methodology

Data on more than 250 U.S. drug launches since 2014 was compiled to create a dataset enriched with 20+ variables related to product information, indication characteristics, competitive dynamics and manufacturer information. Objective insights were consolidated from publicly available sources (e.g., secondary literature, company websites, competitive intelligence databases). Trinity's Annual Drug Index, which has been consolidating expert perspectives on drug launches and performance for more than ten years, supplemented publicly available information with additional insights into product differentiation and innovation, which are critical in informing product performance.

Product Characteristics

Product Performance Relative to Standard of Care (Efficacy, Safety, Convenience, Innovation), **Acute vs. Chronic Dosing, Annual U.S. Price at Launch, Route of Administration** (Oral, IV, SC, etc.), **Technology Type** (Small Molecule, Monoclonal Antibody, etc.)

Indication Characteristics

Specialty (e.g., Neurology, Cardiology, etc.), **U.S. Addressable Patient Prevalence/ Incidence,** Relative Unmet Need, Orphan Designation

Competitive Characteristics

Competitive Volume at Launch (Within Market and Class), **Competitive Volume at Five Years on Market** (Within Market and Class), U.S. Market Value at Launch

Company Characteristics

Commercialization Experience of Company (Based on Number of Products on Market), **Specialty Experience of Company within Therapeutic Area** (e.g., Cardiology)

For this seminal analysis, Trinity sought to understand which combination of variables is most predictive of commercial success, defined by cumulative U.S. revenues through the first five years of launch. Trinity applied machine learning techniques (i.e., Random Forest) to identify clusters of variables which, together, were most predictive of 5-year revenues, and developed an algorithm leveraging twelve variables to predict into which revenue category each drug would fall:

Predicted revenue categories for each drug launch derived from the algorithm were then compared to company-reported revenues and used to derive an overall positive prediction rate for all drug launches included within the analysis.

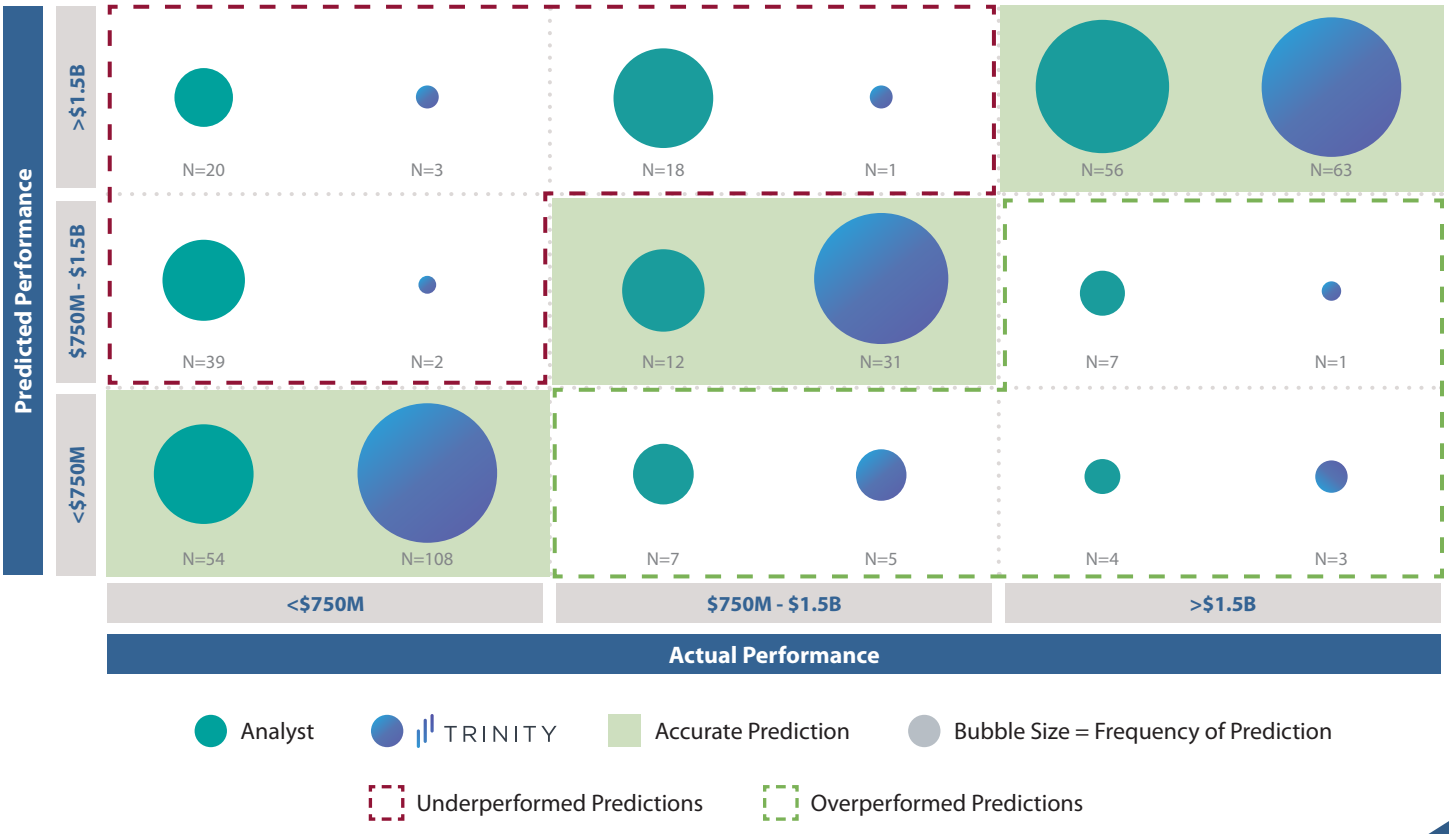
Results

Algorithm-predicted revenue categories were compared to reported cumulative 5-year U.S. revenues for each drug included within the analysis. Trinity's AI algorithm correctly predicted the commercial outcome in greater than 90% of all drug launches. Of the 67 drugs achieving >$1.5B in cumulative U.S. sales in the first five years of launch, Trinity's AI algorithm accurately predicted 63 of these outcomes. Importantly, of the 113 drugs which achieved <$750M in cumulative U.S. sales in the first five years of launch, Trinity accurately predicted 108 of these outcomes. Thus, not only does the algorithm identify the predictors of commercial success, it equally identifies those drugs likely to experience considerable difficulties in driving broad adoption.

To contextualize the accuracy of Trinity's AI algorithm, results were compared to 5-year analyst consensus U.S. forecast at time of launch (Evaluate Pharma). As expected, forecasts from buy-side analysts are typically bullish on forecast expectations and fail to fully take into account key drivers and barriers of commercial launch performance (e.g., access, competition), overestimating performance 36% of the time (vs. <5% for Trinity's AI algorithm). Underestimating commercial performance occurs less frequently, but Trinity's AI algorithm still outperforms analyst consensus (8% of analyst consensus for 5-year launch forecasts underestimate performance vs. <5% of the time leveraging Trinity's model). In aggregate, analysts were able to accurately estimate commercial performance in 56% of drug launches (vs. 90%+ leveraging Trinity's AI algorithm).

Exhibit A. Trinity's AI Algorithm Performance vs. Analyst Consensus

Trinity's AI Algorithm vs. Analyst Consensus: U.S. Revenues Through Five Years Post-Launch



Subsequently, machine-learning algorithms were applied to identify clusters of variables which, together, are most predictive of cumulative revenue outcomes for U.S. drug launches. When considering the relative importance of variables to predicting potential 5-year blockbuster status:

First Tier

Product-related attributes (e.g., efficacy, safety, convenience) are the most important driving factors – reinforcing the hypothesis that having a drug with strong clinical attributes is the clearest predictor of success.

Second Tier

In a second tier, unmet need and perceived innovation/novelty of technology are strong predictors of success, but are a step down from product performance – while entering a high need market can give you a leg up on performance, it is not a substitute for a strong clinical profile.

Third Tier

Interestingly, patient volume factors (e.g., addressable population, acute vs. chronic dosing) fall into a third tier of importance, significantly less important than product quality and unmet need. However, for ultra-orphan and mass markets (i.e., at either end of the epidemiology spectrum), these factors become more critical in predicting commercial success.

Fourth Tier

While still impacting the model, pricing, competitive dynamics and company experience fall into a fourth tier, indicating that these factors will primarily make a difference if all other factors are equal – in other words, they can drive success – but will not make or break an opportunity.

While the algorithm is not currently powered for sub-analyses, we directionally observe a number of differences across therapeutic areas.

- In Oncology, efficacy is increasingly important in predicting outcomes, with physicians willing to compromise on convenience and less sensitive to order of entry (OOE)
- In rare diseases, drugs launching into populations with considerable unmet need are able to find commercial success, even with a less differentiated efficacy profile
- And in an increasingly competitive space in Neurology, order of entry dynamics play an increasingly important role in predicting commercial outcomes, particularly given the maturation of several rare Neurology patient populations (e.g., myasthenia gravis, neuromyelitis optica spectrum disorder (NMOSD))

Exhibit B. Criticality Index for Predicting $1.5B+ in First Five Years of U.S. Launch

Category	Metric	Criticality Index (For Achieving $1.5B in Five Years)				
		Overall	Oncology	Non-Oncology	Rare Disease	Neurology
Product	Efficacy (1-9 Rating)	1.00 (Indexed)	↑	↑	↓	↑↑
Product	Safety (1-9 Rating)	0.99	↑	↓	↑	↑
Product	Convenience (1-9 Rating)	0.89	↓↓↓	↑↑	↑	↑↑
Indication	Technology	0.75	↑↑	↓	↓↓	↓↓
Product	Innovation (1-9 Rating)	0.71	↓	↑	↑	↑↑
Indication	Unmet Need (1-9 Rating)	0.67	↓↓	↑	↑↑	↑↑↑
Indication	U.S. Addressable Population	0.35	NA	NA	NA	NA
Product	Dosing Chronicity	0.33	↑↑↑	↓↓	↑	↓↓
Indication	Primary Treating Specialty	0.25	NA	↑	↑↑	NA
Market	Class OOE on Market	0.21	↓	↑	↑	↑↑↑
Company	Number of Products on Market at Launch	0.18	↑	↑	↑	↓
Product	Annual Price at Launch	0.13	↑↑	↓	↓	↑↑

TA-level Outputs Directional ONLY; predictive power decreases given lower sample sizes

Metric Importance in Category

↑ Slightly more important
↑↑ Somewhat more important
↑↑↑ Much more important
↓ Slightly less important
↓↓ Somewhat less important
↓↓↓ Much less important

Our Final Thoughts

Trinity is currently implementing this algorithm for a variety of use cases tailored to the life sciences industry, with an emphasis on AIML-driven applications for large pharmaceutical manufacturers with a diversified portfolio of assets across therapeutics areas and phases of development.

01

Identify 'Quick Kill' Opportunities and Potential Blockbusters Within Your Portfolio

Apply the algorithm across a manufacturer's portfolio to minimize investment in assets with minimal likelihood to achieve commercial success, identify assets for additional investment

02

Improve Clinical Stage Gates for Late-Stage Assets

Leverage the algorithm to characterize differentiation thresholds (TPP considerations, competitive positioning) that can support successful commercialization

03

Prioritize Targets for External Innovation

Enhance current substrate scanning efforts with data-driven triage of patient populations and assets with characteristics indicative of commercial success

Trinity's AI algorithm represents a dynamic tool which will continue to evolve as the model learns based on additional data sources and drug launches. As we incorporate new data, we will explore additional use cases for the algorithm, including the development of algorithms tailored to specific therapeutic areas (e.g., Oncology, Rare Diseases, etc.) as well as potential utility and accuracy in predicting annual revenue forecasts for individual assets.

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About Trinity

With almost 30 years of expertise, a best-in-the-business team and unrivaled access to data and analytics, Trinity Life Sciences is a modern partner to companies in the life sciences industry. Trinity combines strategy, insights and analytics to help life science executives with clinical and commercial decision-making. We serve over 300 pharmaceutical, biotech and medical device clients, helping them develop the right drugs and devices for today's market and optimize them once in market. We have a diverse staff of over 1200 people and 11 global offices across the U.S., Europe and Asia. Ultimately, we know that every decision our clients make impacts a life, and when we help our clients achieve their goals, the world benefits. To learn more about how Trinity is elevating the industry and driving evidence to action,visit trinitylifesciences.com.

For more information, please contact us at info@trinitylifesciences.com.