

ARTIFICIAL INTELLIGENCE:

NEXT FRONTIER FOR CONNECTED PHARMA

A SCALABLE HEALTH WHITEPAPER



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EXECUTIVE SUMMARY

Big Data has improved customer-facing functions across industries, and its potential, combined with AI, can address healthcare-specific challenges. Pharma, burdened by siloed data from legacy systems, can leverage these advances for actionable insights to reduce drug discovery costs and meet value-based care demands. A connected approach is now essential.

The current pharma environment is plagued with expensive and lengthy drug discovery cycles coupled with pricing pressures by both payers and consumers. The average cost to research and develop each successful drug is estimated to be \$2.6 billion. This number incorporates the cost of failures – of the thousands and sometimes

millions of compounds that may be screened and assessed early in the R&D process, only a few of which will ultimately receive approval. The overall probability of clinical success (the likelihood that a drug entering clinical testing will eventually be approved) is estimated to be less than 12%.

The McKinsey Global Institute estimates that applying big-data strategies to better inform decision making could generate up to

\$100 billion in value annually across the US healthcare system, by optimizing innovation, improving the efficiency of research and clinical trials, and building new tools for physicians, consumers, insurers, and regulators to meet the promise of more individualized approaches.

Beyond R&D, the pharmaceutical industry faces pricing pressures, shrinking pipelines, rising costs, strict regulations, and demanding stakeholders. These challenges compel drug companies to seek greater efficiencies. For competitive advantage, pharma must learn from drug discovery data analysis. AI-driven insights, such as optimized clinical trials, real-time patient feedback, and integrated data exchange, improve drug discovery outcomes and patient care while increasing operational efficiency.

Timely access to complete drug information empowers healthcare providers to prescribe the right medication for optimal patient outcomes. Targeted marketing ensures patients also have access to accurate information, facilitating informed discussions with their providers.

It is time for Connected Pharma!

INTRODUCTION

Recent scientific and technological advances coupled with an aging population, expansion in emerging markets, and an exponential increase in mainstream adoption of digital technologies have set the ball rolling for the pharma industry, providing it with a renewed platform to revive its pipeline. With an explosion of digital data - electronic health

records, social media, genomics, clinical, wearables - today's patients are more digitally engaged. The more drug companies know about their patients, the greater the targeting opportunities for precision healthcare including personalized medicines. As a result, the pharma industry is well-positioned to derive great benefits from an integrated drug development and manufacturing approach supported by AI.

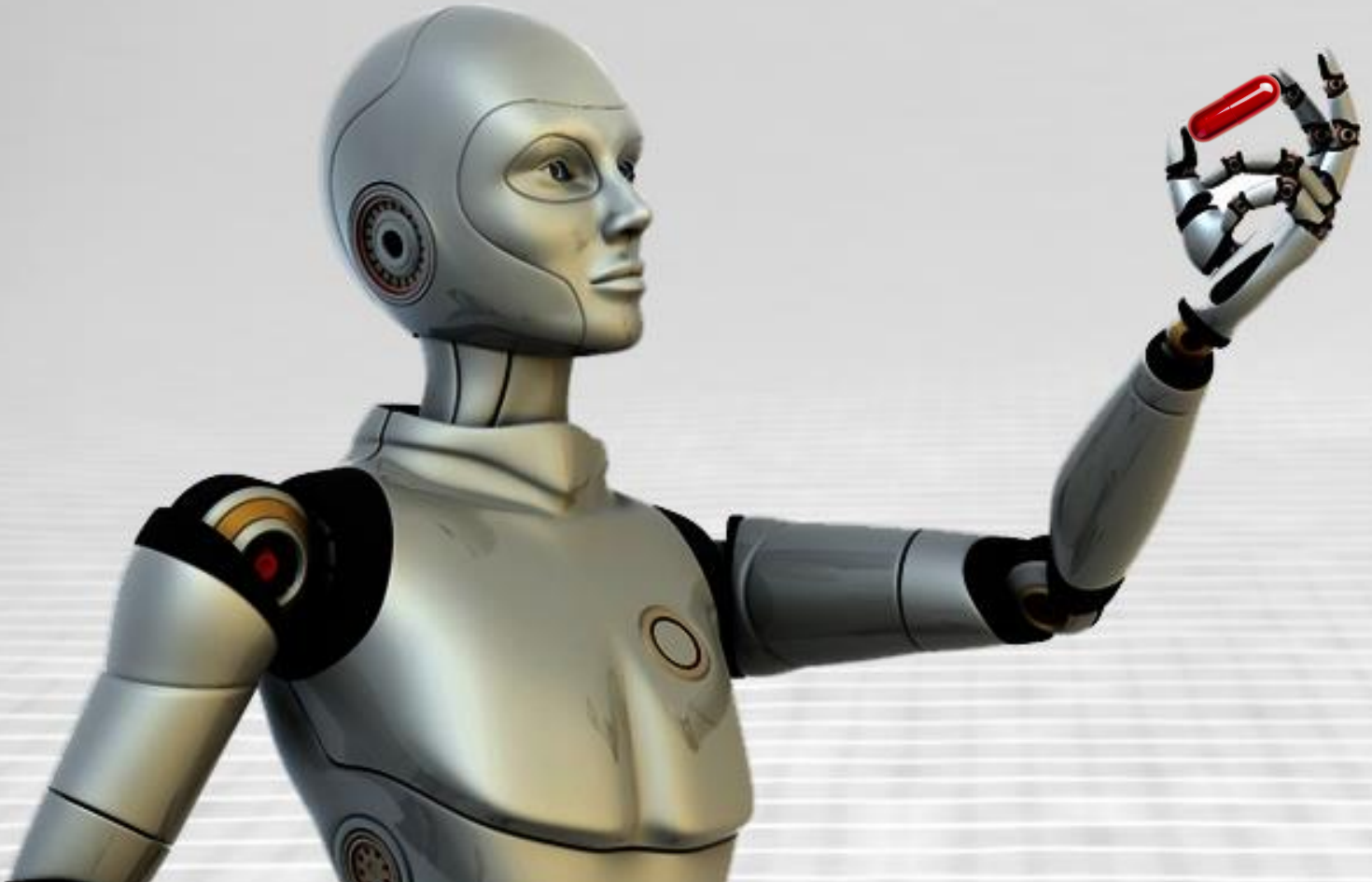
This approach not only provides the best care for patients but also generates greater efficiencies along with significant revenue opportunities for drug companies. Furthermore, there is a significant shift in focus to value-based care from the healthcare industry. Healthcare providers are incentivized to engage in wellness programs which include preventative drug regimens for cardiovascular disease, high blood pressure, and

diabetes. This shift of value-based care approach to personalized healthcare, however, requires a complete refocus on how the industry evaluates the market (shifting to individual needs instead of a population-wide solution), analyzes higher volumes of data, and puts in place newer processes and methods to complete clinical studies.

Artificial Intelligence plays a crucial role in enabling the industry to achieve these objectives, be it analytics in personalized medicine, cloud computing in collaboration, or wearable devices in remote and self-health monitoring. As the pharmaceutical industry becomes increasingly more connected, information and communication technologies will fundamentally reshape both the consumption and delivery of medications. The industry must prepare for the future by embracing next-generation technologies and systems throughout the life sciences value chain.

Pharmaceutical companies must adopt a proactive strategy, one that allows them to maximize value from prior investments by renewing existing solutions and processes and generate new value by embracing new technologies, systems, and best practices.

Artificial Intelligence will be a game changer for precision medicine and drug creation...



CHALLENGES FACED BY THE PHARMA INDUSTRY

For Big Data transformation in the pharmaceutical industry to succeed, organizations must transform to overcome the challenges they face in an ever-changing technological environment.

Healthcare's biggest data challenge is its historical siloed structure resulting from decade-old legacy systems. These disparate data silos prevent the access to complete patient profiles in real-time. It is essential going forward that organizations develop a data-centric approach allowing for the complete sharing of data across all channels – the right information at the right time in the right place.

Pharmaceutical companies are further challenged with developing new drugs with greater efficacy and minimal adverse effects. And to do so in an environment that results in greater development success rates, lower discovery costs and more direct access to patients in need.

In Pharma 2020, PwC identified three major challenges pharmaceutical companies are faced with –

Rising customer expectations: The commercial environment is getting harsher, as healthcare payers impose new cost constraints on healthcare providers and scrutinize the value medicines offer much more carefully. They want new therapies that are clinically and economically better than the existing alternatives, together with hard, real-world outcomes data to back any claims about a medicine's superiority.

Poor scientific productivity: Pharma's output has remained stable for the past decade. There's little reason to think its productivity will suddenly soar using the same discovering and developing processes.

Cultural sclerosis: The prevailing management culture, mental models, and strategies on which the industry relies are the same ones it's traditionally relied on, even though they've been eclipsed by new ways of doing business.

These challenges are offset by promising advances in the collection and analysis of healthcare data coupled with Machine Learning capabilities. In the healthcare and pharmaceutical industry, data continues to grow exponentially as a result of the R&D process itself, patients' EHRs, and feedback provided by caregivers. Effectively utilizing these data points will help pharmaceutical companies better identify new potential drug candidates, develop them effectively, and ultimately get new medications approved and reimbursed more quickly.

Furthermore, AI will offer new insights when pharmaceutical companies are reviewing their portfolios supporting drug repurposing, rescue, and repositioning.

APPLYING AI WITH CONNECTED PHARMA

Artificial Intelligence presents the pharmaceutical industry with the opportunity to solve problems previously unsolvable with simple data analysis. Through integrated intelligence, AI can perform specific analysis faster and more accurately thereby reducing costs while increasing productivity. AI will increase the impact of Connected Pharma contributing to the economic growth of the industry while augmenting the workplace for greater efficacy.

Many processes along the pharma lifecycle are still dominated by manual reviews. The problem with manual reviews is they are time-consuming, prone to user error, and are not future-proofed. Manual reviews are based on a static point in time and do not consider new data or information. New information requires a new review. AI operates in real-time constantly incorporating new inputs and offering complete, up-to-date information to healthcare providers.

Research & Development



Not only are automated processes more efficient but they tend to be more accurate, saving pharmaceutical companies both time and money. Beyond these basic benefits, AI is capable of seeing patterns that even trained professionals might miss. Further, it supplies real-time actionable insights filling the potential knowledge gap of care providers.

Let's consider three specific areas within the pharmaceutical industry that will greatly benefit from AI - R&D, Marketing, and Safety.

Research & Development offering precision medicine through Artificial Intelligence.

Treating patients precisely involves getting the right treatment plan to the right patient at the right time. There needs to be significant information available about the patient and the medication to assist in finding precise treatment plans. Artificial Intelligence offers valuable insights that will dramatically improve the outcomes of clinical trials.

AI and Big Data can better target potential candidates for clinical studies through a complete analysis of patient data and drug information to help care providers identify candidates best suited for the trials.

Identifying patients that would be best helped by new medications would improve the efficacy of the drug trials. Further, through research, new applications are often discovered for existing drugs already in the

portfolio. AI offers greater potential for drug repurposing through model development and pattern recognition.

Pharmacovigilance - Pharmaceutical companies rely on many data points to ensure the safety of their products. Clinical trials track the effectiveness of a particular medication. In addition, they track any adverse effects experienced by participants.

Further, healthcare providers must track interactions and complications when multiple medications are prescribed for treatment. This may change over time, as patients may develop resistance to certain medications.

Or as more medications are introduced to combat side effects experienced from certain treatment options.

Further complicating the process, certain patients may develop dependencies on medications like painkillers or not reveal all of the medications being consumed. Patients who seek to abuse certain medications may seek to source them from different providers.

Connected Pharma will be able to access real-time prescription data to flag abuses and possible dangerous interactions.

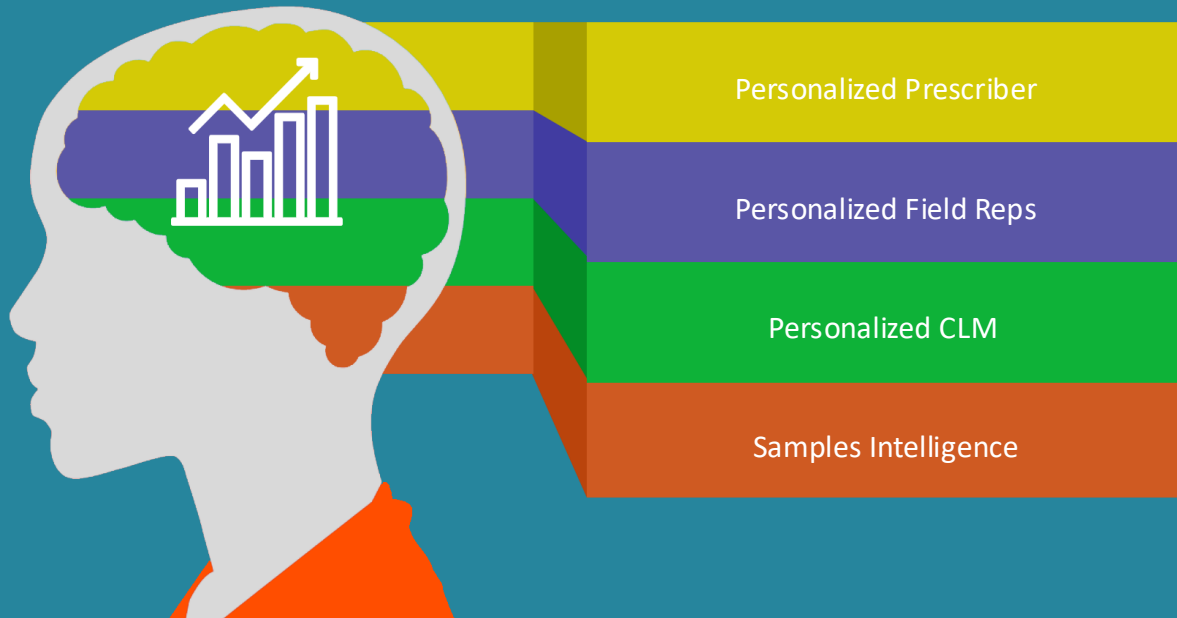
Commercial Effectiveness – Artificial Intelligence offers actionable insights generated from real-world data to provide greater predictive intelligence relating to patients and expected outcomes.

By incorporating numerous care factors including a patient's health history, genetic disposition, lifestyle indicators, and environmental

factors – pharma is getting closer and closer to finally offering personalized, precision medicines.

Through target audience marketing, pharmaceutical companies can further ensure that the right information is presented at the right time to facilitate informed patient and provider discussions.

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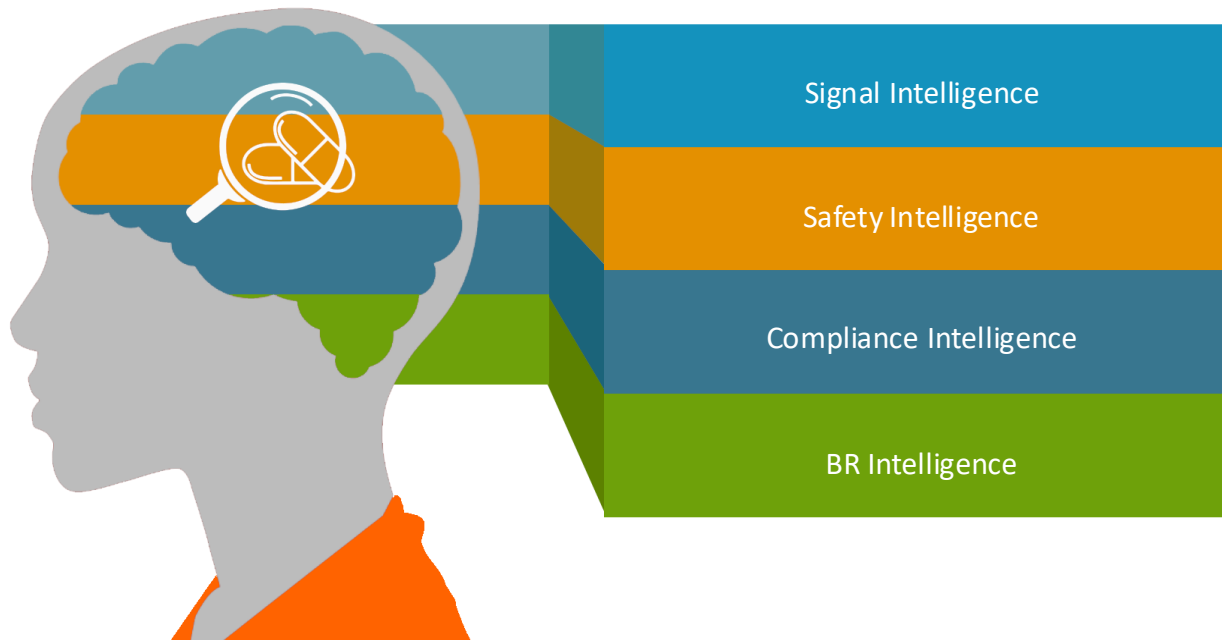
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Pharmacovigilance



ARTIFICIAL INTELLIGENCE IS PHARMA'S NEXT FRONTIER IN LIFE SCIENCES

The majority of drugs take about 10 years or more to come to market, cost billions, and have the potential to financially ruin an organization should they fail in late-stage trials. There is a tremendous risk in drug discovery and considerable financial costs associated with such speculation.

Pharmaceutical companies need to develop portfolios and in doing so must mitigate the risks by ensuring the appropriate allocation of scarce R&D funds to enable expedited decision-making for portfolio and pipeline progression. Artificial Intelligence (AI) provides the essential tools to address these challenges increasing the likelihood of successful drug discoveries. Furthermore, with an explosion of digital data availability, the stage is set to drive benefits from an integrated drug R&D, manufacturing, supply chain, sales, and marketing environment. The use of Artificial Intelligence in the pharmaceutical industry can not only provide the best care to patients but also generate significant revenue growth with greater speed and accuracy, and using fewer resources. Following are a few Artificial Intelligence use cases for reference:

Accelerating Drug Discovery with Artificial Intelligence

Today, pharmaceutical companies must screen large numbers of molecules for drug candidates, then painstakingly test each in the hope of finding a winner. This expensive process takes an enormous amount of time.

It's estimated that, on average, a new drug introduced to the market can take up to 1,000 people, 12-15 years, and up to \$2.5 billion to develop.

AI is reinventing drug discovery by using deep learning and natural language processing to understand and analyze vast quantities of bioscience information — patients, genomic data, and the more than 10,000 publications uploaded daily across all biomedical journals and databases, which involves analyzing how different molecules interact with one another. Deep Learning predicts how molecules will behave and how likely they are to bind together. The technology teaches itself about molecular interaction by identifying patterns, similar to how Artificial Intelligence learns to recognize images.

“Fast may even be an understatement; Drug Discovery with Artificial Intelligence can reportedly screen one million compounds in a day, a volume that would take months via traditional methods. Though it can't invent a new drug, or even say for sure whether a combination of two molecules will yield an effective drug. What it can do is predict how likely a compound is to work against a certain illness.

Researchers then use those predictions to narrow thousands of options down to dozens (or less), focusing their testing where there's more likely to be positive results.”

Clinical Trial Research with Artificial Intelligence

Clinical trials serve as the engine for bringing new treatments and therapies to market. Pharmaceutical companies need to test discoveries for efficacy and safety on a select group of patients in a controlled setting before they are approved to be marketed to the general population. Artificial Intelligence has the potential to transform clinical trials and thereby improve the quality and safety of these life-enhancing therapies and accelerate the pace with which they are brought to market.

Automated experimentation systems will play a bigger role in the trial structure. AI will increasingly be utilized to predict how drugs will interact with targets, allowing clinical trial experimentation to be reduced by up to 70 percent. Artificial Intelligence can reportedly predict drug activity and toxicity with much higher precision than other computational methods, partly because its prediction power improves as it inputs experiment results. Machine Learning can reduce uncertainty by applying algorithms that repeatedly choose meaningful experiments based on emerging patterns.

The authors point to a recent case in which an algorithm developed a model that was accurate 92 percent of the time, though it only physically conducted 29 percent of the experiments needed for the study.

Drug Repurposing Processes with Artificial Intelligence

In drug discovery, drug repurposing has gained an increasingly important role, because it helps to circumvent preclinical development and optimization issues, hence reducing time effort, expenses, and failures typically associated with the drug discovery process.

Using human input, real-world data, and Machine Learning algorithms to support drug repurposing efforts. Artificial Intelligence-powered applications can shift through all of this information to try and find relationships between drug molecules and certain diseases. A successful initiative like this could install an efficient, cost-effective process that the entire pharmaceutical industry can adopt to help bring new therapies to market.

Artificial Intelligence for Commercial Effectiveness

So far, pharma marketing strategies are based more on qualitative data, some traditional quantitative data, and a huge dose of marketers 'gut feel'. It continues to happen when the world is moving towards innovative data-driven decision models.

Putting perpetual data streams and rapidly advancing tools and technology to work, life sciences companies can train Artificial Intelligence algorithms to drive business decisions. By applying constantly learning algorithms through Micro Intelligence, organizations can handily pinpoint the next steps to take with established customers, identify new customers to target, determine the preferred communication channel, and create the most effective content and talking points.

It can also add immense value right at the decision-making stages to determine the key ingredients of an effective strategic plan in several critical areas, such as:

Arriving at the optimal product portfolio mix with the right expense tag attached to each brand

- Deep Learning about market dynamics, customer behavior, and their interplay
- Matching unmet customer needs with enhanced and differentiated value offerings – both tangible and intangible
- Effective bundling of brand offerings and associated services for each patient segment

- Selecting the right mix of communication channels, including social media, to ensure maximum productivity in reaching each category of the target audience
- Detailed strategic blueprint for each type of stakeholder engagement, along with related value offerings
- Arriving at the best possible resource mix with the available budget
- Real-time monitoring of each strategic action step, consistently, making quick changes on the run, if and when required

Artificial Intelligence Powered Bots

Computer programs that talk like humans are known as bots. Bots have the potential to replace the initial human interactions between physicians and sales reps. Possibilities include marketing bots (digital brochures in bot form) as well as clinical decision support bots that are relevant to a company's leading pharmaceutical brands.

Physicians typically are tech-savvy and among the fastest adopters of mobile devices, including tablets. As such, they will likely be early adopters of bots. Pharmaceutical companies will be able to create bots for physicians in the same way that they currently create apps.

Pharmaceutical companies can also get involved in this new marketing channel by developing chatbots that are specific to the needs of their core audience.

- For example, a company can develop a particular disease state bot that answers all types of patient questions about a specific disease. Educating these patients can help them for starting with a specific treatment option that is launching soon.
- A separate chatbot can be developed around a specific treatment option. This would allow patients or physicians with the opportunity to get all relevant information about the brand that they require in order to prescribe or start treatment. This includes access to adverse events, tolerability, dose, efficacy, financial resources, etc.
- Once a treatment option is prescribed, a third kind of chatbot can help with patient adherence. This chatbot can inform patients of potential side effects and how to react, provide reminders of when the treatment should be administered, present a video on how to properly dose and administer the treatment, etc.

TOP DRIVERS OF CONNECTED PHARMA

Shift from new drug discovery to personalized treatment solutions

Connected devices support the need to improve medication adherence

Shift from drug salesperson to transparency and information to identify medications for personalized care

Marketing supports knowledge base approach to care

Greater collaboration between universities, researchers, payers, providers and patients

A growing shift to precision and personalized medicines

Empowering care providers with new tools to support medication adherence

Creating transparency and a knowledge base to support care decisions



A CONNECTED APPROACH TO PHARMA

Connected Pharma is about a digital transformation from historical data silos created by various internal departments to a collaborative data strategy allowing for the flow of real-time data between all phases of the product lifecycle. Through AI, pharmaceutical companies can embrace predictive analytics that yields better outcomes for new compound discovery, identifying alternative applications, sourcing potential trial candidates, and analyzing real-time results for efficacy, safety, and market opportunities. Pharmaceutical companies need to adopt a value-based care approach for better care outcomes while driving efficiencies to improve the bottom line.

To be successful, an end-to-end integration of all data from discovery to regulatory approval to real-world usage is necessary. This can only be achieved through a data strategy that establishes a central data resource that links all types of data sources including internal sources, partners, and retailers, along with real-time patient outcomes.

This collective data must be available in real-time throughout the organization to provide actionable insights that drive better outcomes.



Genetic and Genomic Data



Patient Centric Data



Sensors & Smart Devices



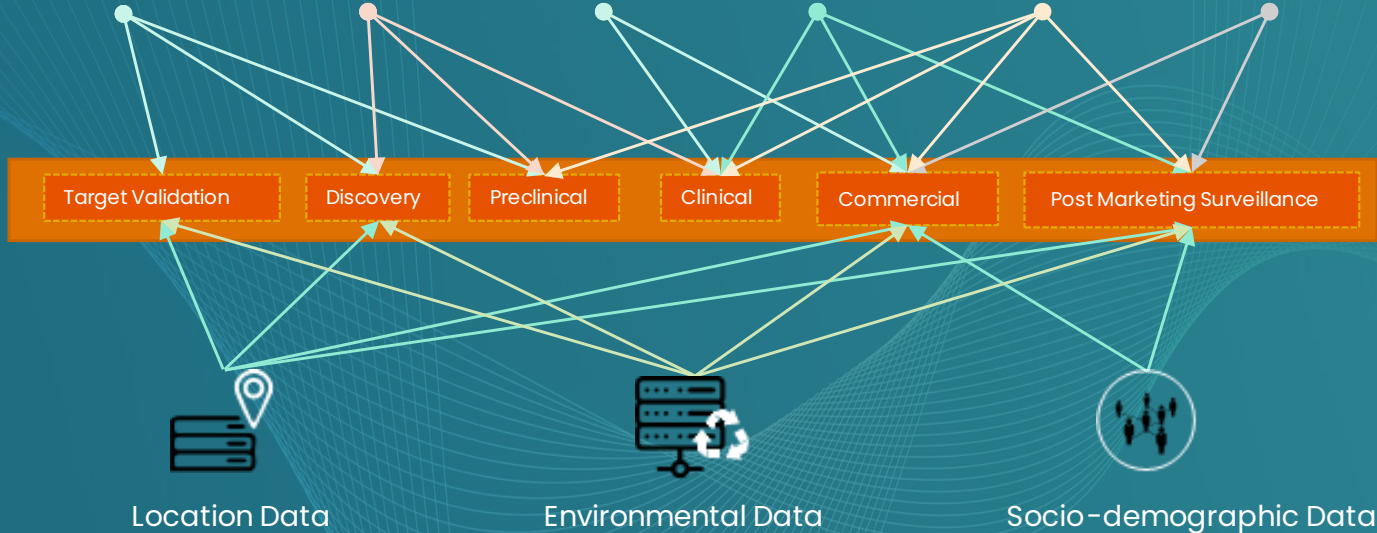
Interactive Media



Healthcare Information Network



Market Data



INTEROPERABILITY | COMMON METADATA | MACHINE LEARNING



CONNECTED PHARMA

POWERED BY AI

CONCLUSION

Artificial Intelligence offers a compelling opportunity for pharmaceutical organizations.

From drug discovery to care options to repurposing, Artificial Intelligence allows organizations to more efficiently manage and extend the product lifecycle, increase communications with providers and patients, and meet the growing demands of stakeholders. The promise of Connected Pharma is poised to revolutionize the pharmaceutical industry.

Artificial Intelligence offers insights generated from real-world data to provide more accurate information on patients and expected outcomes. By incorporating numerous care factors including a

patient's health history, genetic disposition, lifestyle indicators, and environmental factors – pharmaceutical companies are getting closer and closer to finally offering personalized, precision medicines.

As the pharmaceutical industry shifts to precision medical solutions, Artificial Intelligence will offer actionable insights to ensure doctors and patients have complete, real-time information to make informed choices for personalized care. In addition, healthcare providers will be provided tools to minimize drug interactions and patient abuse.

It is time for Connected Pharma!

About Scalable Health

Scalable Health is healthcare division of Scalable Systems focused on providing innovative products and solutions in healthcare and life sciences market.

www.scalablehealth.com

About Scalable Systems

Scalable Systems is a Data, Analytics & Digital Transformation Company focused on vertical specific innovative solutions. By providing next generation technology solutions and services, we help organizations to identify risks & opportunities, achieve sales and operational excellence to gain an innovative edge.

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