



# Generative AI for Pharma Companies

———— MARKET INSIGHTS SERIES ————

## What practical applications?

June 2023

The objective of this paper is to evaluate the current and future value of **Generative AI**, of which **ChatGPT** is currently the most well-known, for the pharmaceutical industry activity

## Introduction

### **OBJECTIVE**

- Evaluate what is the current and future value that can be expected from Generative AI and what are the implications for pharma companies' R&D, medico-marketing and sales functions

### **DEFINITIONS**

#### **Generative AI**

(Generative Artificial Intelligence)

- Generative AI is a type of AI that can **create a wide variety of data** (e.g., images, text, videos) and **produce new content** by learning patterns from existing data (it is a **subset of machine learning**)
- This technology can **produce complex and valuable content** for many industries such as healthcare

#### **GPT**

(Generative Pretrained Transformer)

- **Language generation model based on the Transformer architecture** using **deep learning** to generate **human-like text** by leveraging large amount of existing data
- It has been **launched by Open AI<sup>1</sup>** in November 2022 and is widely used for **translation** and **question answering**

#### **Transformer**

- Transformer is a **neural network architecture** used in natural language processing that employs mechanisms **to understand the relationships between words** in a **text sequence**
- Transformers have been successful due to their **ability to capture contextual relationships** and generate **high-quality outputs**

## Generative AI players, who are mainly tech specialists, develop solutions that benefit different healthcare stakeholders, such as pharma companies, HCPs and patients

### Generative AI ecosystem



#### Generative AI players

- Generative AI developers are mainly purely tech players, whether they are large companies' or specialized start-ups (e.g., Google/Alphabet, OpenAI, DeepBrain)
- **Some** players are, in addition to being experts in Generative AI, totally **dedicated** to the **health domain** (e.g., Insilico Medicine, BenevolentAI)



#### Pharma players

- Some pharma companies have established **partnerships** with Generative AI players...
- ... to strengthen their business **from R&D to marketing** (e.g., Pfizer with Insilico Medicine)



#### HCPs

- HCPs can benefit from Generative AI to **optimize** their **practice**
- These tools can be used to assist in **diagnosis** (e.g., medical imaging), **personalize treatments**, provide an easy **access to** structured and relevant **medical information**, etc.



#### Patients

- Patients can use Generative AI tools to **get quick access to medical advice** (e.g., medical chatbots), **enhance their role in** the management of **their care** (e.g., medical information, treatment management)

## The utility of Generative AI lies in its ability to generate new creative content, automate tasks, and provide innovative solutions

### Key attributes of Generative AI technologies

#### Text generation



- Text generation involves using machine learning models to generate new text based on existing data
- It has numerous applications such as **chatbot** or **textual content creation** (e.g., ChatGPT)

#### Image generation



- Image generation is a process of using deep learning algorithms to **create new images** that are visually **similar to real-world images**
- It can be used to **create art** or **generate product images** (e.g., MidJourney and DALL-E)

#### Video generation



- Video generation involves deep learning methods to generate **new videos** by predicting frames **based on previous frames** and possibly to **generate also a speech** in parallel
- Video / speech generation **can be used** as **virtual assistants** or **tutorials** (e.g., DeepBrain)







#### Data generation



- Beyond the previous applications, Generative AI can be used to **predict** and **generate** new **complex results based** on the analysis and processing of **existing knowledge** (e.g., code)
- For example, in healthcare, it can be used for **new drug candidate development**, **clinical trial design** or **synthetic medical data production** to train machine learning models

**Generative AI companies — both existing enterprises that are adding generative AI to their solution stacks and new generative AI startups — are growing very quickly and strongly**

### Key Generative AI players

Company	Key products	Areas covered			
		Text	Image	Video	Data
 OpenAI	▪ GPT (-3, -4, Plus) / DALL-E / Whisper / InstructGPT	✓	✓		
 Alphabet Google	▪ Generative AI App builder / Bard / DeepMind	✓	✓		✓
 Microsoft	▪ GitHub Copilot / AI Enhanced Bing and Edge / Microsoft Copilot	✓	✓	✓	✓
 cohere	▪ Generate / Summarize / Classify / Embed	✓			✓
 Hugging Face	▪ BLOOM / AutoTrain / Inference endpoints	✓			✓
 Jasper	▪ Jasper Art / Jasper Chat	✓	✓		

- **Most of the main Generative AI players are pure tech players**
- Microsoft has invested € 10 billion in Open AI which is currently the figurehead of Generative AI
- **Data area mainly corresponds to code generation and algorithms**

Sources: eWeek: Generative AI companies: Top 12 leaders (April 2023) – Companies websites (as of May 2023)  
– Smart Pharma Consulting

## Most Generative AI companies in healthcare focus on R&D, and mainly operate through partnerships with pharmaceutical companies

### Key Generative AI healthcare & life sciences players

<p><b>R&amp;D</b></p> 		<p> Exscientia</p> <p> OWKIN</p> <p> Peptilogics</p>	<p> evozyne</p> <p> Insilico Medicine</p> <p> evoGene <small>DECODING BIOLOGY</small></p>	<p> Standigm</p> <p> VARIATIONAL AI</p>	<p> Benevolent<sup>AI</sup></p> <p> biomatter</p> <p> Generate:Biomedicines</p>
<p><b>Medical information</b></p> 		<p> BioGPT</p> <p> MEDPALM</p>	<p> glass.ai</p>	<p> buoy</p> <p> GYANT</p>	
<p><b>Medical imaging</b></p> 		<p> DARWIN AI</p> <p> Paige</p>	<p> NVIDIA</p>	<p> ACTIV SURGICAL</p> <p> SUBTLE MEDICAL</p>	

- Most Generative AI companies specializing in healthcare primarily **focus on R&D**, particularly in **drug discovery**...
- ...while use is **less common** in other functions (e.g., **Marketing & Sales**)
- Generative AI tools include **chatbots for patients, HCPs, and pharma companies' teams** to gather, synthesize, and analyze medical information
- Most of these companies also form **partnerships with pharma companies** (e.g., AstraZeneca and BenevolentAI)

## Generative AI excels in its ability to generate creative content efficiently, but it faces challenges in potential bias of data quality, ethics, transparency and resource requirements

### Assessment of Generative AI

#### ***STRENGTHS***

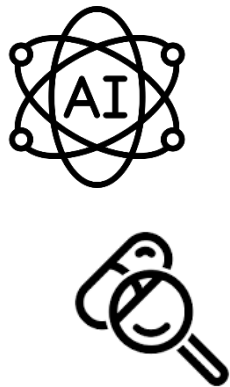
- 1. Creativity and Novelty:** Help businesses be more creative and generate new ideas and concepts
- 2. Efficiency and Speed:** Can be used to automate repetitive tasks and processes, and is able to quickly generate content and solutions
- 3. Adaptability and Flexibility:** Possibility to train the tool on large and varied databases
- 4. Improved decision-making:** Generated data allows to make decisions based on more robust rationales

#### ***WEAKNESSES***

- 1. Ethical concerns:** Ensuring transparent and ethical use of Generative AI is a challenge
- 2. Bias of data:** Models can inherit biases present in the training data which may lead to unfair outputs
- 3. Quality of data:** Lack of contextual and nuances understanding which can generate incorrect or nonsensical content
- 4. Resource intensive:** Generative AI requires specialized hardware and software, as well as trained and skilled teams

**As Generative AI technology continues to develop, drug R&D efficiency should raise due to discovery of better drugs at a much lower cost as manual curation of data will be replaced by NLP<sup>1</sup>**

## Application of Generative AI to R&D



- Along with predictive AI, Generative AI is a promising tool in R&D
- Thus, Generative AI can be used to:
  - **Create compounds or protein-based therapeutics, *de novo***, with **higher efficacy** and **better safety** (e.g., In 2020, researchers from the UCSF<sup>2</sup> used generative AI to create a new drug that is effective against a type of cancer that is resistant to traditional treatments)
  - Design **new drug delivery systems, enhancing the clinical outcomes** (e.g., In 2021, a team of researchers from the MIT used Generative AI to design a new drug delivery system that can improve the efficacy and safety of cancer drugs)
  - **Personalize treatments** for patients (e.g., In 2022, researchers from Oxford University used Generative AI to create a personalized treatment plan for a patient with cystic fibrosis)



- Huma.AI launched in March 2023 is an AI **platform** to **accelerate** the **development** of life-saving drugs through **better usage** of their **data**
- Its **natural language processing** platform **connects** and **searches** multiple, disparate, unstructured **data**, returning **answers** to questions **in seconds**
- It analyzes **private enterprise data** from **multiple sources** and its “expert-in-the-loop” approach leads to the **high accuracy**

*Note: Nvidia has recently introduced the BioNeMo Cloud Service<sup>3</sup> which offers pre-trained AI models to drug researchers. This service aims to streamline the drug discovery cycle and enhance its efficacy*

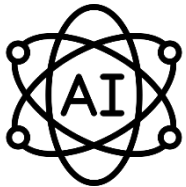
Sources: PharmExec: Huma.AI launches industry’s first generative AI platform for life sciences (2023) – “Future of generative AI in pharma and it’s breakthrough potential” Arivukkarasan Raja (May 2023) – Smart Pharma Consulting

<sup>1</sup> Natural Language Processing – <sup>2</sup> University of California, San Francisco – <sup>3</sup> Currently used by Amgen and other pharma companies



# Generative AI can improve medical affairs activities, from collection and analysis of medical insights to their delivery to various stakeholders

## Application of Generative AI to Medical Affairs



- **Medical content generation:** Generative AI can assist in generating medical content, such as scientific articles, conference abstracts and sump up existing research and clinical data to provide, and help streamlining the creation of evidence-based content
- **Medical data analysis:** Medical data, such as RWE or PROMs<sup>1</sup>, can be analyzed through Generative AI to identify correlations and patient pathway insights
- **Medical information/education chatbots:** AI-powered chatbots provide quick and accurate information to HCPs, and are also used for enhancing internal medical education and training
- **KOL identification:** Generative AI models can analyze vast amounts of data (e.g., publications, clinical trial participations) to identify and rank Key Opinion Leaders for potential collaborations
- **Medical event planning:** Generative AI analyzes historical data from medical events, such as conferences and symposiums, to generate insights on attendee preferences, topics of interest, and session formats

Sources: PharmExec: Huma.AI launches industry's first generative AI platform for life sciences (2023) – ACMA: 5 ways Artificial Intelligence will change Medical Affairs (2021) – Healthark: Generative AI (2023) – Smart Pharma Consulting

<sup>1</sup> Patient-Reported Outcome Measures

## Medical affairs can leverage generative AI to enhance medical data research and analysis efficiency, and to optimize clinical trials design and implementation

### Application of Generative AI to Medical Affairs: case studies



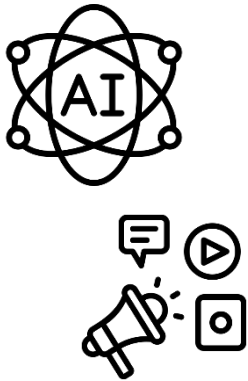
- Generative AI could **provide MSLs with advanced search and data analysis** capabilities
- This translates into:
  - **Rapid synthesis** of vast amounts of scientific and medical data **to stay updated**
  - **Accurate interpretation** to identify key **insights and trends**, and **deliver** the most valuable **information**
  - **Better time management** to focus on higher value tasks



- Medical Affairs teams can leverage Generative AI to **enhance design of clinical trials**
- Protocol can be designed by **analyzing historical ones** and identify **potential bottlenecks** and **refine end points** to optimize them
- Generative AI can **help** Medical Affairs teams to **predict patient outcomes** based on different factors (e.g., treatment regimen, genetic profile)
- This use allows the **optimization of clinical trials and their results**

## Generative AI can be used to enhance the efficiency of the marketing department by refining the knowledge of the environment and the personalization of the communication

### Application of Generative AI to Marketing



- **Customer experience journey:** Generative AI can **analyze customer engagement** data and **generate customer journey maps** to better **understand how** customers **interact** with the brand and identify **opportunities for improvement**
- **Branding and messaging:** Impactful branding and messaging based on **customer data** and **insights** can be generated by AI to **provide content** and **solutions** across the **omnichannel approach**
- **Market research:** Generative AI models can **identify trends, patterns** and **insights** from **literature** or **social media** conversations, and allow a **deeper understanding** of patients and HCPs **preferences**
- **Material and chatbots:** AI tools can generate **hyper-personalized content** and **creative formats** for promotional materials, with the **most optimized support** and within the **regulatory constraints**
- **Digital marketing optimization:** The model can be used on internal information to analyze customer data and generate optimization algorithms, to improve promotional campaigns, social media advertising<sup>1</sup>

Sources: Pharma Marketing: Leveraging Generative AI to support Commercialization activities of Pharmaceutical products (2023)– “Future of generative AI in pharma and it’s breakthrough potential” Arivukkarasan Raja (May 2023)– Smart Pharma Consulting

<sup>1</sup> In countries and for products it is allowed

## Novartis and Merck & Co have used Generative AI to improve their marketing activities, both during launch and after commercialization

### Application of Generative AI to Marketing: case studies



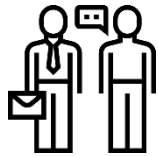
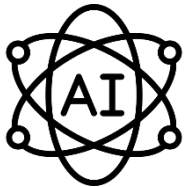
- Novartis has used Generative AI to **identify brand names** for its drugs
- The company used an algorithm that analyzed thousands of potential names and selected the most relevant options based on:
  - Brand availability
  - Customer preferences
- Accenture estimated that the use of **Generative AI in drug branding and launch** can result in **cost savings** of up to **25%** and **improve market access**



- Merck & Co implemented “Carla<sup>1</sup>”, a **chatbot** designed to **improve customer service** for fertility drugs<sup>2</sup>
- Carla uses Generative AI to **answer** customer **inquiries** and provide **personalized recommendations** based on customer’s **individual needs and preferences**
- Since implementing Carla, significant **improvements** in customer **satisfaction** have been achieved...
- ...and a **reduction in response times**

**Generative AI tools can assist pharma sales reps to gain a deeper understanding of customer needs and preferences, improve sales strategies and positively differentiate from competitors**

### Application of Generative AI to Sales



- **Sales content generation:** Generative AI can be used to **generate persuasive and engaging sales content** such as sales speech or e-mails and provide **personalized messaging** tailored to different customers according to their profile
- **Next-best action and call plans:** The model can **help sales reps** by generating **customized actions** for each customer **depending on the customer journey** and **proposing** the most **appropriate and engaging actions**
- **Customer segmentation and targeting:** By analyzing customer data, generative AI can **identify patterns** and **segment customers** based on their **behaviors and practice**, and can also **generate** a list of relevant **prescribers that were out of target**
- **Sales training and simulations:** Generative AI tools can **create sales scenarios or virtual training environments** for sales teams which improves their sales techniques, objection handling skills, and product knowledge through **interactive simulations**
- **Sales performance:** Generative AI models **can help analyzing sales data** and **provide insights** on performance (e.g., script rates, script drivers, physician conversion rates) and **make recommendations** for performance improvement

*Sources: Mayank Misra: Leveraging Generative AI to support sales activities of Pharmaceutical products (2023) – Pharma Marketing; Leveraging Generative AI to support Commercialization activities of Pharmaceutical products (2023) – Smart Pharma Consulting*

## Generative AI holds a huge potential in efficiently managing schedules and optimizing productivity, revolutionizing the way sales reps streamline their time and activities

### Application of Generative AI to Sales: case studies



- Generative AI tools represent a valuable **opportunity** for sales reps to **manage** their **time**
- For example, it could generate in a couple of seconds a **list of physicians** that have **not been contacted** for **90 days** to schedule meetings
- Generative AI model could also **provide** a **time management plan** according to:
  - **Internal data** (e.g., availability, objective)
  - **External data** (e.g., HCPs availability, traffic status to optimize the travel time)



- Sanofi has partnered with IBM Watson Health, now Merative<sup>1</sup>, to develop Sanofi Genie
- Sanofi Genie is an AI-powered **virtual assistant** for sales reps which **answers sales questions...**
- ...and **provides** personalized **recommendations based** on sales **data** and **activity**
- The tool **helps** sales reps to **quickly find** the **information** they need and **improve** their **impact in activity** and **performance**

Sources: Harvard Business Review: Generative AI will change your business. Here's how to adapt (2023) – AI is transforming the way business approach Sales training (2023) – Smart Pharma Consulting

<sup>1</sup> IBM sold the Watson Health entity to Francisco Partners, which made it a separate company, Merative

In a near future, the development of Generative AI will significantly enhance the robustness, effectiveness and efficiency of the various existing tools and systems

### Near future Generative AI development and impact

## ***DEVELOPMENTS***

- Research in Generative AI is focusing on more efficient and effective training methods development (e.g., self-supervised learning)



- Development of more robust and flexible generative models able to produce multi-modal contents



- Another area of research is focused on developing models that are better able to understand the input context



## ***IMPACT***

- Enhanced training of Generative AI models makes outputs more qualitative (e.g., ChatGPT-4 vs. ChatGPT-3)

- More complex and varied outputs across a wider range of tasks and domains

- Generation of more accurate content and production of more coherent responses
- This area of work is key for scientific use

*“Generative AI has started to revolutionize the way Pharma companies operate along their value chain”*

Consulting firm dedicated to the pharmaceutical sector operating in the complementary domains of strategy, management and organization

## Market Insights Series

- The Market Insights Series has in common to:
  - Be well-documented with recent facts and figures
  - Highlight key points to better understand the situations
  - Determine implications for key stakeholders
- Each issue is designed to be read in 15 to 20 minutes and not to exceed 24 pages

## Generative AI for Pharma Companies

What practical applications?

- This position paper describes and analyzes the current and potential applications and value creation of Generative AI for pharmaceutical companies
- Thus, the strengths and weaknesses of Generative AI are evaluated
- The applications of Generative AI to:
  - Drug R&D
  - Medical Affairs
  - Marketing
  - Salesare described and illustrated with practical examples

## Smart Pharma Consulting Editions



- Besides our consulting activities which take 85% of our time, we are strongly engaged in sharing our knowledge and thoughts through:
  - Our teaching activities in advanced masters (ESSEC B-school, Paris Faculty of Pharmacy)
  - Training activities for pharma executives
  - The publication of articles, booklets, books and expert reports
- Our publications can be downloaded from our website:
  - 41 articles
  - 68 position papers covering the following topics:
    1. Market Insights
    2. Strategy
    3. Market Access
    4. Medical Affairs
    5. Marketing
    6. Sales Force Effectiveness
    7. Management & Trainings
- Our research activities in pharma business management and our consulting activities have shown to be highly synergistic
- We remain at your disposal to carry out consulting projects or training seminars to help you improve your operations

Best regards

Jean-Michel Peny