



AI Innovation in the Pharmaceutical Sector - Accelerating Research

by Daniel Faggella
CEO, Emerj Artificial Intelligence Research

Overview

- State of AI in Pharma
- AI in Pharma - Why Now?
- 3 AI in Pharma Use Cases
- Barriers to AI Adoption
- Future Potential and Trends

Key Takeaways

1. How AI is being applied in pharma R&D today
2. Which application types have traction

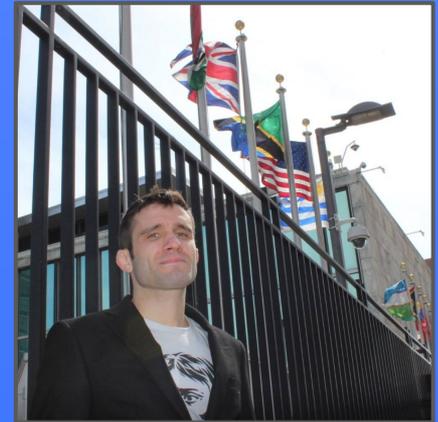
Emerj Artificial Intelligence Research



At Emerj, we have a singular focus:

Mapping the applications of AI to help leaders execute on winning AI strategies.

Global organizations trust us to support their AI goals and strategies with critical data and insight (World Bank, global healthcare firms, etc).



Presenting our AI Research at United Nations HQ, NYC



WORLD BANK



**Business Executives
for National Security**



INTERPOL

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Comparison by Function:



Expertise and Funding Score Average, Evidence of Adoption Score Average, Evidence of Returns Score Average, and Ease of Deployment Score Average

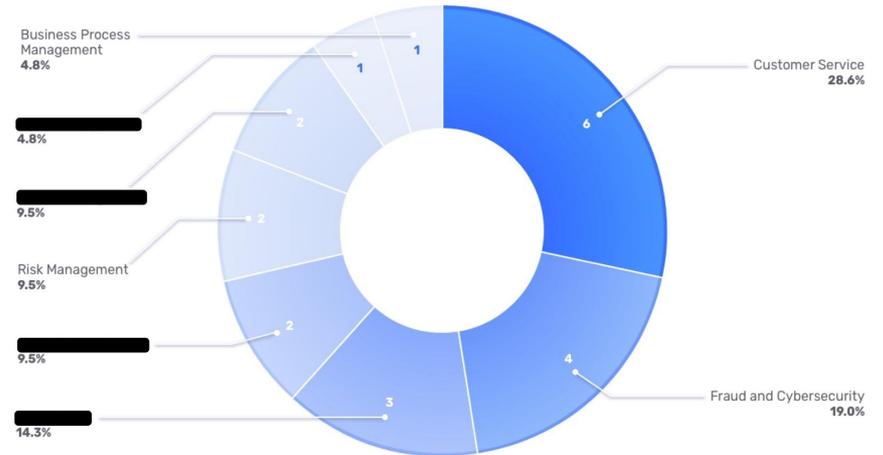


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Number and Percent of AI Vendor Product Offering Functions in [REDACTED]



(Counting only AI Vendors That Claimed to Have Worked With [REDACTED] in Case Studies and Press Releases)

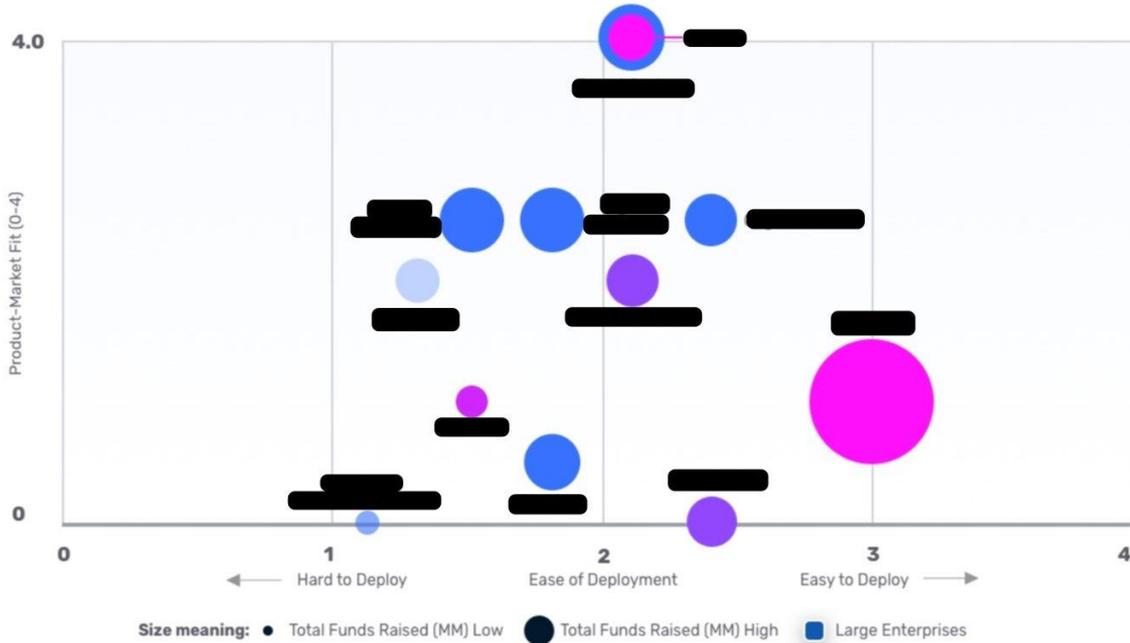


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Compliance AI Vendor Product Offerings in Banking:



Product/Market Fit Score Versus Ease of Deployment Score



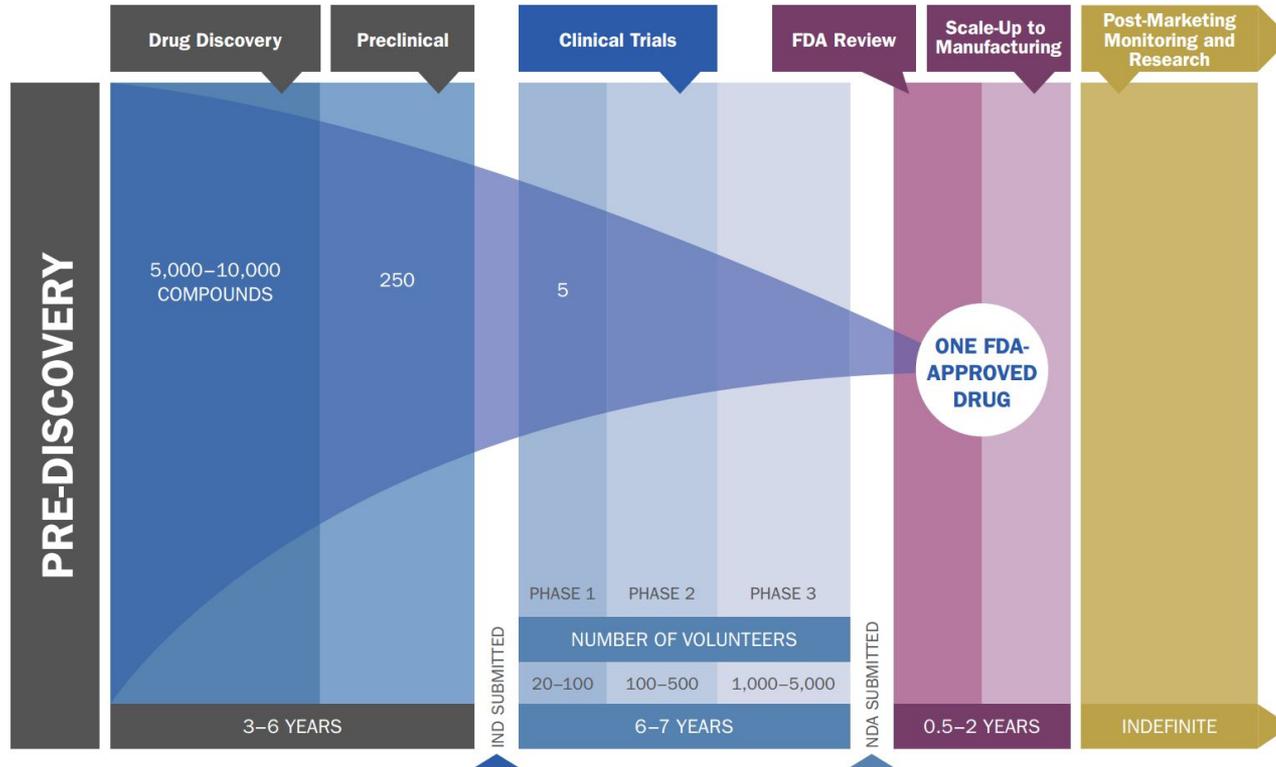
#	AI Vendor Name	Ease of Deployment Score (0-4)	Product/Market Fit Score (0-4)	Expertise and Funding Score (0-4)	Total Funds Raised (MM)
1	████████████████████	2.1	4	4	98
2	████████████████████	1.5	2.5	4	81
3	████████████████████	3	1	3	532

@danfaggella

State of AI in Pharma

Figure 12: The Research and Development Process

Developing a new medicine takes an average of 10–15 years.



SOURCE: Pharmaceutical Research and Manufacturers of America, Drug Discovery and Development: Understanding the R&D Process, www.innovation.org.

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AI Adoption in the Pharma Pipeline

Most adoption is occurring at the earlier phases of the R&D pipeline, for a few reasons:

- There is much more data and activity there, comparatively (like why AI is used in B2C eCommerce, but less so in B2B)
- Clinical trials pose unique challenges in terms of regulation

AI Adoption in the Pharma Pipeline

Target Discovery: Find proteins that can be targeted to treat a disease. Understand the mechanisms of a disease.

Drug Discovery: Find compounds that bind to the chemical target. Includes: High throughput screening, computer-based design.

Efficacy Trials: Controlled study with an extremely limited number (20-80) of (often healthy) people to determine side effects and safety.

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Startup Ecosystem

As of July, 2019, Emerj found:

- 122 AI vendors in pharma
- Over \$3B in VC funds raised
- ~70% based in the USA

Company Name	Company URI	LinkedIn Lin	Sub-Industry	Product Narr	Year Founde	HQ Country	HQ City	Number of E	Total Funds
VeriSIM Life	https://verisimlife	https://www.linkedin	Pharma		2017	USA	San Francisco, CA	11	N/A
XtaiPi	http://www.xtalpi	https://www.linkedin	Pharma		2014	USA	Cambridge, MA	38	67.5
Biorelate	https://www.biorelate	https://www.linkedin	Pharma		2014	UK	Manchester	21	1.05
Causaly	https://www.causaly	https://www.linkedin	Pharma		2017	UK	London	8	1
Deep Intelligence Pharma	https://www.dip-g	https://www.linkedin	Pharma		2017	China	Beijing	6	21.6
AI Therapeutics	https://www.ai-th	https://www.linkedin	Pharma		2013	USA	Guilford, CT	19	N/A
AIcure	http://www.aicure	https://www.linkedin	Pharma/Healthcare		2009	USA	New York, NY	57	27.3
Aridhia Informatics	https://www.aridh	https://www.linkedin	Pharma/Healthcare		2007	UK	Glasgow	34	1.45
BioSymetrics	https://www.biosym	https://www.linkedin	Pharma/Healthcare		2015	USA	New York, NY	10	N/A
Biovista	https://www.biovista	https://www.linkedin	Pharma/Healthcare		2005	USA	Charlottesville, VA	19	N/A
BlackThorn Therapeutics	https://www.blackthorn	https://www.linkedin	Pharma/Healthcare		2016	USA	San Francisco, CA	49	54
Brite Health	https://britehealth	https://www.linkedin	Pharma/Healthcare		2015	USA	Palo Alto, CA	28	N/A
Catalia Health	http://www.catalia	https://www.linkedin	Pharma/Healthcare		2014	USA	San Francisco, CA	19	7.8
Deep6 AI	https://deep6.ai	https://www.linkedin	Pharma/Healthcare		2015	USA	Pasadena, CA	32	N/A
EvidScience	https://evidscience	https://www.linkedin	Pharma/Healthcare		2017	USA	El Segundo, CA	9	0.5
Gritstone Oncology	https://gritstoneoi	https://www.linkedin	Pharma/Healthcare		2015	USA	Emeryville, CA	123	216
Inference	http://inference.ai	https://www.linkedin	Pharma/Healthcare		2015	USA	Cambridge, MA	65	14
Path AI	https://www.pathai	https://www.linkedin	Pharma/Healthcare		2016	USA	Boston, MA	69	75.2
Sensyne Health	https://www.sensyne	https://www.linkedin	Pharma/Healthcare		2018	UK	Oxford	72	76.5
Verantos	https://verantos.c	https://www.linkedin	Pharma/Healthcare		2013	USA	Menlo Park, CA	5	N/A
VYASA Analytics	https://vyasa.com	https://www.linkedin	Pharma/Healthcare		2016	USA	Newburyport, MA	11	1.8
DeepMind (Google)	https://deepmind	https://www.linkedin	Pharma/Healthcare		2010	UK	London	725	N/A
Innoplexus	http://www.innoplex	https://www.linkedin	Pharma/Life Science		2015	Germany	Frankfurt	258	N/A
Iris AI	https://iris.ai	https://www.linkedin	Pharma/Life Science		2015	Norway	Oslo	16	2.4
Arcoris	http://arcoris.com	https://www.linkedin	Pharma/Life Sciences		2016	UK	Oxford	5	N/A
Berg Health	https://www.berg	https://www.linkedin	Pharma/Life Sciences		2006	USA	Framingham, MA	81	N/A
Berkeley Lights	https://www.berkeley	https://www.linkedin	Pharma/Life Sciences		2011	USA	Emeryville, CA	139	225.3
BIOAGE Labs	http://bioagelabs	https://www.linkedin	Pharma/Life Sciences		2015	USA	Richmond, CA	20	33.9
BioXplor	https://bioexplor.co	https://www.linkedin	Pharma/Life Sciences		2017	USA	Berkeley, CA	10	0.1
CytoReason	https://www.cytoreason	https://www.linkedin	Pharma/Life Sciences		2016	Israel	Tel Aviv	24	N/A
e-therapeutics	https://www.etherapeutics	https://www.linkedin	Pharma/Life Sciences		2001	UK	Oxford	24	66.8
Envisagenics	https://www.envisagenics	https://www.linkedin	Pharma/Life Sciences		2014	USA	New York, NY	16	4.6
Euretos	http://euretos.com	https://www.linkedin	Pharma/Life Sciences		2012	Netherlands	Utrecht	13	N/A
FDNA	http://fdna.com	https://www.linkedin	Pharma/Life Sciences		2011	USA	Boston, MA	51	N/A
LabGenius	https://www.labgenius	https://www.linkedin	Pharma/Life Sciences		2012	UK	London	25	3.7

AI in Pharma - Why Now?

Factors Encouraging Adoption

A Push for Personalized Medicine: This trend requires matching genetic data with drugs - in other words: Finding new patterns across more data.

Data Overload and Pattern Recognition: Finding patterns in terabytes of data is a natural fit for ML.

Ability to Decide and Adopt: Unlike a hospital setting (where doctors, patients, and executives all need to be considered), pharma firms have relatively clear stakeholders (i.e. who pays, who benefits).



Business Motives

Finding New Drugs or Treatments: Could be with new data, but often simply involves making the most of older data. (Discovery)

Determine Drugs Likely to Pass Trials: Find common factors among drugs or compounds in order to determine which are most promising and worthy of investment. (Prioritization)



Drug Development by the Numbers

Costs:

- ~\$2.5 billion in costs
- 11-14 years
- Of 10,000 hits, maybe 1 will become a drug

Upside:

- Billions per year in revenues from a blockbuster
(Abilify: \$7.8B in sales in 2013)

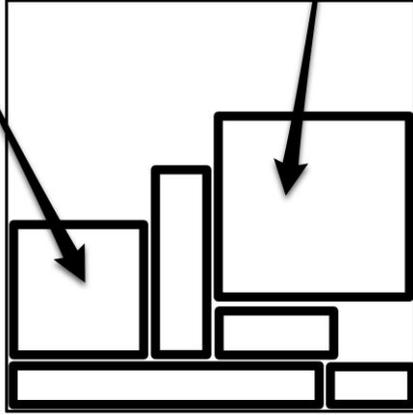


AI in Pharma - Use-Cases

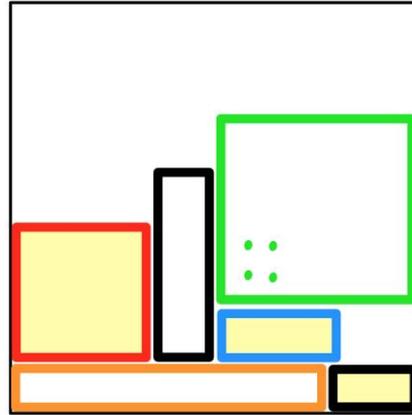
Data Collection

Data Enrichment

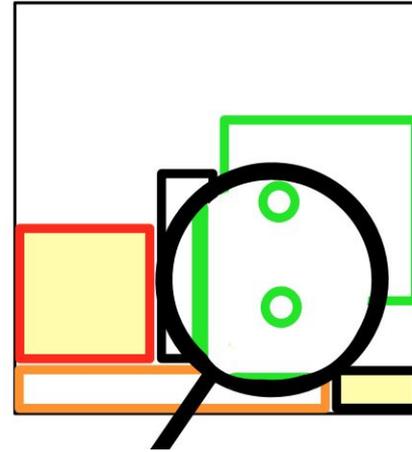
Search/Discovery



Ex: Scanning lab notebooks for digital storage (computer vision, optical character recognition)



Ex: Classifying grant documents



Ex: Finding specific genes that correlate with specific drug side effects

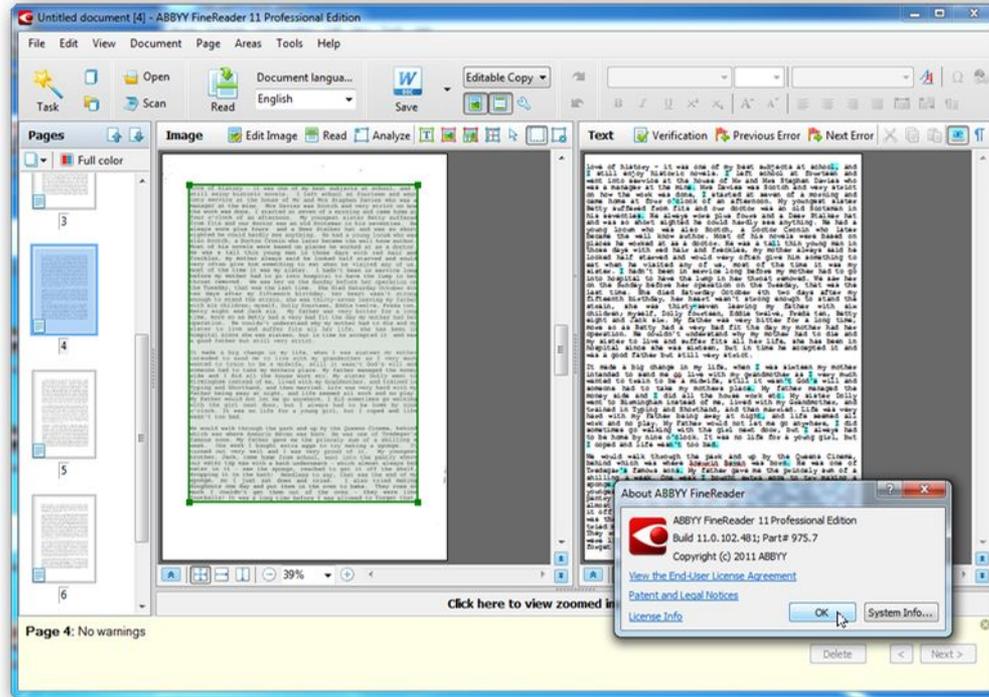
1. Data Collection (ABBYY)

Process:

- PDFs, images, or other data formats and processed and manually labelled
- Training data: Documents of a similar format are labelled and organized by subject matter experts
- Test: Machine learning algorithm attempts to transcribe images/PDFs per its reference examples
- Feedback: Subject matter experts edit and provide feedback to the system



1. Data Collection (ABBYY)



2: Enrichment (Sinequa)

Process:

- Documents (say, lab notes) are manually tagged as containing a specific topic (ie. a specific gene) or belonging in a specific category (ie. "Oncology")
- Next, a system is trained on these classifications, and automatically labels similar documents
 - Or --
- The AI system can detect terms or phrases (such as a specific toxin or symptom), and can tag
 - In either case, humans can validate or re-label documents to provide feedback to the system

The logo for SINEQUA, featuring the word "SINEQUA" in a bold, sans-serif font. The letter "Q" is stylized with a rainbow-colored circular graphic behind it.

3: Search/Discovery (BenevolentAI)

“...we machine read all available literature and pool it together in a database of facts that can be extracted from this literature. That forms the basis of the hypothesis that we generate to find therapeutic targets for diseases.” - *Amir Saffari, SVP of AI at BenevolentAI*

Process:

- Scanning literature, press, grants for facts and connections that can be searched by category to generate new ideas and hypotheses

The BenevolentAI logo, consisting of the text "BenevolentAI" in white, sans-serif font centered within a solid blue square.

Barriers to Adoption

Barriers to Adoption

Data and Regulation: Accessing historical data is challenging (silos), and regulation makes it hard to access data related to patients.

Connecting Unstructured Data: Unstructured data is challenging to categorize to label, find, discover, and connect. What should be labelled and categorized how?

Barriers to Adoption

Talent: Hiring data science talent is hard - getting computer scientists to work with life sciences professionals presents novel challenges.

Use-Cases and Workflows: “Will this data and this algorithm help us with this result?” Only one way to find out: trial and error.

- In eCommerce there are models and methods for product recommendations, we may be years away from such robust known best-practices in pharma.

Barriers to Adoption



Most of the barriers we see across pharma are similar to barrier in other sectors (transformation, finance, natural resources, etc).

Future Potential and Trends

Future Potential - Next 5 Years

IoT and OCR: Increasing sources of data from apps, wearables, and new medical equipment.

Application Maturity: Data collection, enrichment, and discovery workflows and protocols will be more developed. A new level of “normal” will be achieved.

Venture Investment: \$200MM in 2015, \$700MM in 2018
– ??? in 2021.

Optimism for the Pharma Sector

Culture of Experimentation:

- Openness to risking massive resources for uncertain result
- Ability to carefully execute on and measure many experiments in parallel

Culture of Discovery:

- Not just searching, but aiming to find new patterns and connections

Many industries (e.g. banking, traditional retail, heavy industry) lack these strengths.

That's all, folks

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Resources

- <https://emerj.com/ai-sector-overviews/artificial-intelligence-pharma-research-development/>
- <https://www.ibm.com/us-en/marketplace/clinical-decision-support-oncology>
- <https://emerj.com/ai-sector-overviews/machine-vision-in-pharma-current-applications/>
- <https://emerj.com/ai-sector-overviews/natural-language-processing-in-pharma-current-applications/>
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