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ARTIFICIAL INTELLIGENCE IN PHARMA INDUSTRY- A REVIEW

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Abstract: Artificial intelligence use in pharmaceutical technology has increased over the years, and the use of technology can save time and money while providing a better understanding of the relationships between different formulations and processes parameters. Artificial intelligence is a branch of the computer science that deals with the problem-solving by the aid of symbolized programming. It has greatly evolved in to a science of problems - solving with the hug applications in business, health care, and engineering. The article is describes the drugs discovery ,tools of AI, manufacturing execution systems automated control processes systems ,AI to predict new treatment ,development of novel peptides from natural foods, treatment and management of rare diseases, drug adherence and dosage ,challenges to adoption of AI in pharma.

Keywords: Drug **Discovery, tools of AI, MES, ACPS, treatment and management of rare diseases, drug adherence and dosage, challenges to adoption of AI in pharma**

I.INTRODUCTION

Artificial Intelligence (AI) is a branch of computer science focused on problem-solving through symbolic programming and the design of algorithms for data analysis, learning, and interpretation. It combines fields like statistical and machine learning, pattern recognition, and clustering. AI has applications across business, healthcare, and engineering. In the pharmaceutical industry, AI has recently transformed drug development, disease management, and other critical tasks by automating processes traditionally requiring human intelligence. Over the past five years, AI has played a pivotal role in redefining how the pharma and biotech sectors address significant challenge.

HISTORY:

The history of artificial intelligence (AI) dates back to the 1950s, marked by the development of the Logic Theorist by Allen Newell and Herbert Simon in 1956, coinciding with the famous Dartmouth Conference. AI has had a challenging trajectory, initially viewed as overly ambitious, but significant milestones shifted perceptions. For instance:

- 1997: IBM's Deep Blue defeated chess champion Garry Kasparov.
- 2011: IBM's Watson won the $1 million prize in the game show Jeopardy and later expanded into healthcare and drug discovery, partnering with Pfizer in 2016 for immuno-oncology research.
- AI markets have grown rapidly. The natural language processing sector, integral for applications like text prediction and voice recognition, achieved 28.5% growth in 2017. Big data and business analytics generated $122 billion in revenue in 2015, with projections exceeding $200 billion by 2020.
- IBM's innovations extended to robotic technologies, enabling the preparation of toxic drugs like chemotherapy. This has allowed healthcare professionals at UCSF to focus more on direct patient care and collaboration with physician.

MEDI ROBOT:

The MEDi robot, short for Medicine and Engineering Designing Intelligence, is a pain management robot designed to assist children during medical procedures. Developed under a project led by Tanya Beran, a professor at the University of Calgary, its primary purpose is to ease the stress and discomfort children experience during such procedures. MEDi engages with children by building rapport and explaining what to expect, creating a supportive environment. While it lacks true AI capabilities like thinking, planning, or reasoning, MEDi is programmed to simulate intelligent interactions effective

Fig. 2: Robot pharma

ERICA ROBOT:

Erica is a care robot developed in Japan by Professor Hiroshi Ishiguro of Osaka University in collaboration with the Japan Science and Technology Agency, Kyoto University, and the Advanced Telecommunications Research Institute International (ATR). Designed with a blend of European and Asian facial features, Erica speaks Japanese and exhibits human-like traits, including an interest in animated films, a desire to visit Southeast Asia, and aspirations for a life partner who can engage in conversations with it.

TUG ROBOT:

TUG robots are autonomous hospital robots designed to deliver medications, meals, specimens, and materials. They handle heavy loads, such as linens and ash, and come in two configurations. Fixed and Secured Carts for transporting sensitive materials like medications and lab specimens.

Exchange Platform:

Used to carry racks, bins, and carts for versatile material transport. TUG robots' flexibility in handling various carts makes them highly efficient and adaptable.

Automated Control Process System (ACPS):

This system automates processes by managing and adjusting variables to achieve desired outcomes efficiently.

ACPS involves several key elements:

1. Sensing and measuring process variables.
2. Transmitting and comparing signals.
3. Setting desired values.
4. Controlling manipulated variables

Berg:

Berg is a Boston-based biotech company leveraging AI for drug discovery. It utilizes a patient database to identify and validate biomarkers causing diseases, enabling data-driven therapy development. Berg's AI platform speeds up drug discovery and reduces costs by eliminating guesswork.

MANUFACTURING EXECUTION SYSTEM (MES)

The benefits of using MES include compliance with guaranteed legal regulations, minimized risks, increased transparency, shortened production cycles, optimized resource utilization controlled, and monitored production steps, and optimized up to batch release [15]

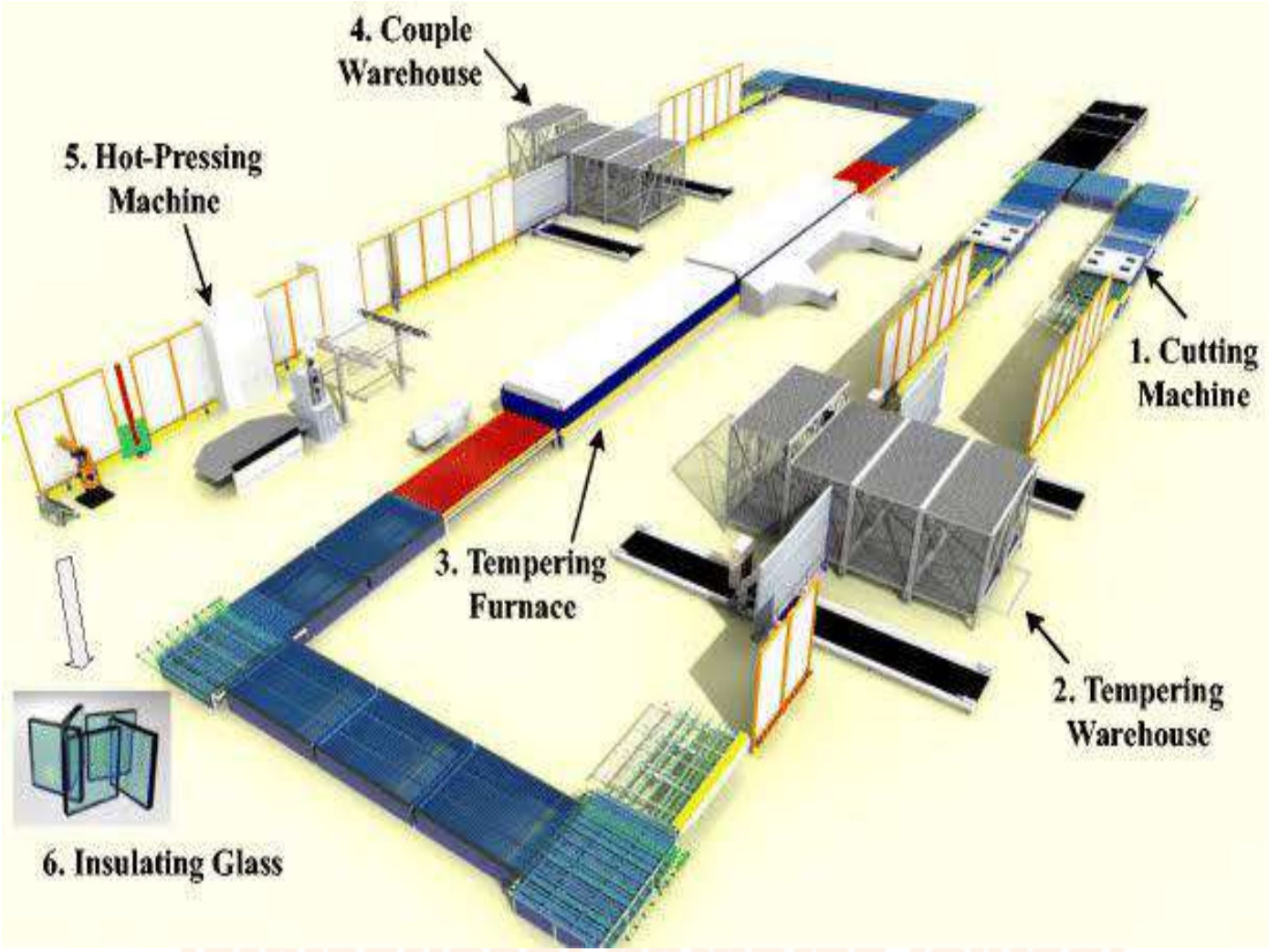

Fig.3: Manufacturing execution systems

AI TO PREDICT NEW TREATMENTS:

1. AI for Brain Disease Treatments (Verge):

Verge uses AI to analyze gene data, mapping the roles of genes in brain diseases like Alzheimer's, Parkinson's, and ALS. This approach helps improve drug discovery, particularly in preclinical trials, by monitoring the effects of treatments on the human brain early on, enabling more effective drug development.

2. Development of Novel Peptides (Nuritas and BASF):

The Irish startup Nuritas, in partnership with BASF, uses AI and DNA analysis to predict and validate functional peptides derived from natural foods. These peptide-based therapies aim to address health issues such as diabetes and promote robust functional food ingredients.

3. Rare Disease Treatments (Heal and Thera Chon):

AI is driving renewed focus on treatments for rare diseases, affecting over 350 million people globally. UK-based Heal secured $10 million in funding to develop drugs for rare conditions, while Swiss biotech Thera chon raised $60 million to use AI for drugs

targeting rare genetic diseases. In other words, they are taking an algorithmic approach to map out hundreds of genes that play complex roles in brain diseases like Alzheimer's, Parkinson's or ALS. Verge's hypothesis is that gathering & analyzing gene data will positively impact the drug discovery phase starting with the preclinical trials. The idea is that Verge can use AI to monitor the impact that specific drug treatments have on the human brain starting with the preclinical phase. As a result, drug manufacturers can get a better picture early on about the effectiveness of a drug on human cells. More specifically, Verge uses artificial intelligence to keep track of the impact certain therapies on the human brain with a particular focus on the preclinical phase [3].

4. Development of Novel Peptides from Natural food:

The Irish start up Nerites leverages AI and other novel technologies facilitate the discovery of new and more robust food and healthy ingredients. BASF (Baden Aniline and Soda Factory") will take advantage of this partnership to develop novel functional peptides derived from natural foods. In practice, BASF uses Nuritas AI and DNA analysis capabilities to predict, analyze, and validate peptides from natural sources. The main goal of BASF is to discover and deliver to the market peptide-based therapies that'll help treat conditions like diabetes.

TREATMENT AND MANAGEMENT OF RARE DISEASES:

Advances in AI, renewed interest in rare disease treatments. Currently, there are over 350 million people with over 7,000 rare diseases around the world. However, it's not all gloom and doom for patients with rare diseases as Heal, a UK-based biotech firm, has secured $10 million in Series

A funding to use AI to develop innovative drugs for rare conditions. Thera chon, another Swiss biotech company that leverage AI to develop drugs for the treatment of rare genetic diseases, a received $60 million in funding.

Fig4: Treatment and management of rare diseas

DRUG-ADHERENCE & DOSAGE:

Abbvie & AiCure:

Abbvie partnered with Acura to use AiCure's AI-powered platform to improve drug adherence. Patients record themselves taking medication, and AI verifies adherence, achieving up to 90% adherence improvement.

Bayer & Genpact:

Bayer utilizes Genpact's AI solution to monitor drug adherence, adjust dosages for optimal results, and detect side effects earlier using Pharmacovigilance AI (PVAI). Using AI for Clinical Data & Better Analytics

Apple's ResearchKit:

This platform enables easy enrollment in clinical trials via iPhone and Apple Watch, simplifying data collection and analysis. For example, Duke University uses it to diagnose autism in children through AI-driven facial recognition.

Recruiting Reliable Patients for Clinical Trials:

Patient recruitment is a significant bottleneck in clinical trials, contributing to delays and costs of up to $2 billion per drug. AI and machine learning help extract valuable patient data, reducing trial timelines and improving efficiency in the $65 billion clinical trial market.

CHALLENGES IN AI ADOPTION IN PHARMA:

1. Unfamiliarity: AI is often perceived as a "black box" due to its complexity.

2. IT Infrastructure: Existing systems are not designed for AI, requiring costly upgrades.

3. Data Formatting: Much data exists in free text, necessitating preprocessing for AI analysis. Despite these challenges, AI is transforming pharma, and within seven years, it will become a standard technology in the industry

Fig. 5: Challenges to adoption of AI in pharma

ARTIFICIAL INTELLIGENCE IN PHARMA IS A GOOD IDEA:

Artificial intelligence (AI) has the potential to revolutionize the pharmaceutical industry by accelerating innovation and improving efficiency. AI enables tasks requiring human intelligence, such as decision-making, data analysis, and prediction, which are crucial for the healthcare sector. With vast amounts of medical data available, AI can help analyze it quickly, saving time, money, and resources while improving decision-making and patient care.

Applications of AI in Pharma:

1. Epidemic Prediction: Analyzing historical and social media data to predict outbreaks with accuracy.

2. Personalized Treatments: Tailoring care based on individual patient needs.

3. Clinical Trials: Identifying suitable candidates using predictive analytics.

4. Enhanced Tools: Building tools for patients and healthcare providers to improve treatment outcomes.

Benefits:

- Effective use of incomplete data.
- Faster data analysis and reduced time to market.
- Improved product quality at lower costs.
- Enhanced precision, accuracy, and performance.
- Rational decision-making without emotional bias.
- AI-powered surgeries and medical assessments with superior precision.
- Automation of repetitive and labor-intensive tasks.
- Fraud detection and record management.

Challenges:

1. Data Management: Medical records are often unorganized and require cleaning.

2. Transparency: Ensuring patient trust and clarity in AI-driven processes.

3. Data Governance: Legal restrictions and privacy concerns regarding medical data.

4. Resistance to Change: Pharma companies are traditionally slow to adopt new technologies.

Limitatons:

- High costs and time involved in developing and maintaining AI systems.
- Limited creativity compared to humans.
- Potential storage and retrieval challenges with complex datasets.
- In conclusion, while AI in pharma presents groundbreaking opportunities for innovation, it also requires addressing data governance, transparency, and organizational resistance to realize its full potential

APPLICATION:

1. Drug Discovery and Development:

- ✓ **Target Identification and Validation:** AI algorithms analyze biological data to identify potential drug targets and predict their efficacy.
- ✓ **Drug Screening:** AI accelerates the screening of chemical compounds, predicting their interactions and reducing the need for extensive lab experiments.
- ✓ **De Novo Drug Design:** AI designs novel molecules with desired properties using generative models.
- ✓ **Clinical Trial Optimization:** AI helps in patient recruitment, site selection, and monitoring, reducing trial timelines and costs.
- ✓

2. Precision Medicine:

- ✓ AI analyzes patient data (genomics, proteomics, and medical history) to create personalized treatment plans.
- ✓ Predicts patient responses to treatments, minimizing adverse effects.

3. Drug Manufacturing:

- ✓ **Process Optimization:** AI optimizes manufacturing processes, ensuring consistency and efficiency.
- ✓ **Quality Control:** AI-powered systems detect anomalies in production, ensuring high-quality products.
- ✓ **Predictive Maintenance:** AI predicts equipment failures, reducing downtime.

4. Supply Chain and Logistics:

- ✓ AI streamlines supply chain management by predicting demand, optimizing inventory, and ensuring timely delivery.
- ✓ Monitors environmental conditions (temperature, humidity) during drug transportation.

5. Pharmacovigilance:

- ✓ AI analyzes real-world data (social media, electronic health records) to detect adverse drug reactions.
- ✓ Speeds up reporting and regulatory compliance.

6. Marketing and Sales:

- ✓ AI identifies target audiences and predicts market trends.
- ✓ Personalizes marketing strategies based on customer preferences and behavior.

7. Healthcare Support:

- ✓ AI-powered chatbots assist in medication adherence and provide patient education.
- ✓ Enhances telemedicine by integrating pharmaceutical recommendations.

8. Regulatory Compliance:

- ✓ AI ensures compliance by monitoring data and generating reports for regulatory authorities.

CONCLUSION:

Human being is the most sophisticated machine that can ever be created. The human brain, which is working hard to create something that is much more efficient than a human being in doing any given task and it has great success to extent in doing so. The AI tools like Watson for oncology, tug robot and robotic pharmacy has change the profession considerably. The bigger the healthcare sector gets more sophisticated and more technologically advanced infrastructure it will need.

Artificial intelligence is the design and application of algorithms for analysis of learning and interpretation of data.

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