

## **COMBINATION OF ARTIFICIAL INTELLIGENCE IN DIGITAL MARKETING AND SOCIAL MEDIA**

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**1) ABSTRACT:** The integration of Artificial Intelligence (AI) in digital marketing and social media has revolutionized various industries, including the pharmaceutical sector. This review explores the synergistic combination of Artificial Intelligence technologies with digital marketing strategies to enhance brand presence, customer engagement, and sales in the pharmaceutical industry. Artificial Intelligence-driven tools such as machine learning algorithms, natural language processing, and predictive analytics are increasingly being utilized to analyze consumer behavior, personalize marketing content, and optimize advertising campaigns on social media platforms. Moreover, Artificial Intelligence facilitates more effective and compliant communication strategies, ensuring that promotional activities adhere to regulatory standards while reaching target audiences more efficiently.

This article provides an overview of current Artificial Intelligence applications in digital marketing and social media within the pharmaceutical industry, highlighting case studies that demonstrate successful implementations. It also discusses the challenges and ethical considerations of employing Artificial Intelligence, including data privacy, misinformation, and the need for transparency in automated decision-making processes. The review concludes with insights into future trends and potential advancements in Artificial Intelligence technologies that could further transform digital marketing strategies in the pharmaceutical domain.

**2) KEY WORDS:** Artificial Intelligence (AI), Pharmaceutical Marketing, Digital Marketing, Social Media Strategy, Personalized Marketing, Pharma Social Media, Targeted Advertising, Patient Engagement, Drug Promotion, Regulatory Compliance, Chatbots in Healthcare, Pharma Branding

### **3) INTRODUCTION:**

#### **3.1) ARTIFICIAL INTELLIGENCE:**

Since the 1950s, Artificial Intelligence (AI) has been applied in various sectors, including banking and financial services. Over the last decade, it has driven significant advancements across domains such as pharmaceuticals, healthcare, and insurance industries. <sup>[1,2]</sup> In the pharmaceutical sector, key challenges persist, including the prolonged timeline of over 10 years required for most drugs to reach the market and the billions spent on clinical trials, which often fail in late-stage testing. Additionally, pharmacovigilance faces high costs related to case processing, hindering efficient adverse event reporting. Developing countries with high disease burdens, inadequate infrastructure, and limited skilled healthcare professionals encounter further obstacles in

pharmacovigilance. Artificial Intelligence plays a crucial role in these settings by enhancing drug development efficiency, expediting processes, and introducing advanced technologies to improve patient safety and outcomes. <sup>[1,3,4]</sup> The future of healthcare is envisioned to be more digitalized and regionally connected, improving accessibility, convenience, and efficiency for medical consultations. <sup>[5]</sup>

The recognition of innovative technologies that automate time-intensive tasks is essential for transforming the pharmaceutical sector. Artificial Intelligence, a subfield of computer science, involves simulating intelligent behavior in machines and enabling them to replicate human cognitive abilities. This allows Artificial Intelligence systems to solve problems and learn in ways similar to human intelligence. <sup>[6]</sup> Artificial Intelligence encompasses technologies such as Machine Learning (ML), Natural Language Processing (NLP), and Cognitive Services (CI). Machine Learning, for instance, is capable of identifying patterns, adapting behavior, and learning autonomously without explicit programming. <sup>[7]</sup> This field is instrumental in analyzing patient data—both imaging and non-imaging—to assess medical conditions and support clinicians in making informed decisions. <sup>[8]</sup>

Natural Language Processing enables machines to understand, interpret, and generate human language effectively, while Cognitive Services integrate Machine Learning and Natural Language Processing to tackle tasks traditionally requiring human intervention. Developing Cognitive Services involves preparing and curating data to train these systems effectively. In pharmacovigilance, Cognitive Services are developed and implemented at various decision points to assist users in improving workflow efficiency. <sup>[7]</sup>

### **3.2) SOCIAL MEDIA**

In 2011, approximately 2.4 billion individuals worldwide were estimated to use the Internet. <sup>[9,10]</sup> The increase in Internet accessibility, along with technological advancements, has fueled the widespread popularity of social media platforms such as Facebook, Twitter, MySpace, and Google+. Collectively referred to as Web 2.0, these interactive systems have become integral to modern communication and marketing strategies. Globally, the impact of this phenomenon is evident, with nearly 80% of active Internet users regularly engaging with social media platforms. These platforms also rank among the most visited online destinations across ten key and emerging markets, including Brazil, Mexico, India, and China. <sup>[9,11,12]</sup>

The growing dependence on the Internet and social media has also contributed to the rise of Direct-to-Consumer Advertising (DTCA) for health-related products. <sup>[13,14]</sup> In the United States, pharmaceutical expenditures on Direct-to-Consumer Advertising increased by an estimated 330% between 1996 and 2005, reaching a total of \$4 billion by 2009. <sup>[15,16]</sup>

Social media has transformed advertising strategies, with online marketers leveraging platforms such as Facebook to establish meaningful connections between businesses and consumers. These platforms create innovative opportunities to promote brands and products. By personalizing advertisements, marketers make them more appealing to specific audiences, which is why social media has emerged as a preferred advertising medium over traditional, non-digital channels. <sup>[17]</sup>

The integration of Artificial Intelligence represents a transformative development in the digital landscape, significantly influencing industries like healthcare, retail, finance, and pharmaceuticals. Within the pharmaceutical sector, the convergence of Artificial Intelligence with digital marketing and social media has led to increased brand engagement, enhanced customer experiences, and more efficient marketing strategies. The regulated nature of the pharmaceutical industry introduces unique challenges; however, Artificial Intelligence enables effective connections with target audiences while ensuring compliance with regulatory standards.

Social media platforms play a pivotal role in the digital marketing strategies of pharmaceutical companies. These platforms enable direct engagement with healthcare professionals and patients, facilitating the sharing of educational content, promoting products, and gathering real-time feedback. The integration of Artificial Intelligence enhances these interactions by automating content creation, optimizing advertisement placements, and analyzing public sentiment to dynamically adjust strategies.

This review explores the current applications and future potential of Artificial Intelligence in digital marketing and social media within the pharmaceutical industry. By examining case studies, industry advancements, and emerging technologies, it provides a comprehensive understanding of the transformative impact of Artificial Intelligence on pharmaceutical marketing. Furthermore, it addresses critical ethical considerations, challenges, and future directions, emphasizing the importance of transparency, data privacy, and regulatory compliance in this rapidly evolving domain.

#### **4) USE AI IN PHARMACOVIGILANCE:**

The World Health Organization defines pharmacovigilance as the scientific discipline and associated activities aimed at detecting, assessing, understanding, and preventing adverse effects or other drug-related problems. Ensuring drug safety becomes a priority when a new drug enters the market. <sup>[18]</sup> Unanticipated toxicities, which may result in illness or death even at standard doses, are a significant factor contributing to failures observed during clinical trials or post-marketing surveillance. Between 2008 and 2017, the Food and Drug Administration approved 321 new drugs. During this period, the Food and Drug Administration's adverse event reporting system received over 10 million adverse event reports, with 5.8 million classified as serious and 1.1 million resulting in fatalities.

Pharmaceutical companies, as the license holders, are responsible for collecting adverse drug reaction data and submitting it to local drug regulatory bodies. A critical component of pharmacovigilance involves identifying and reporting adverse drug reactions, including the technical coding of adverse events, preparing individual case safety reports, and evaluating both the seriousness and the suspected drug's involvement. These largely manual processes are time-consuming, highlighting the necessity for innovative technologies to enhance the detection and analysis of adverse drug reactions. <sup>[19]</sup>

Despite the growing number of reported cases, significant underreporting of spontaneous adverse events continues. A potential solution is leveraging social media and health-related networks as alternative data sources. Many adults share their health experiences on these platforms, discussing prescription drug use, side effects, and treatments, thereby creating a novel reservoir of patient health data. However, some studies suggest that insights from social media may not significantly differ from existing knowledge derived from spontaneous reports and clinical trial findings. <sup>[20]</sup>

As the volume of individual case safety reports continues to rise, internal pharmacovigilance resources are increasingly strained by case processing demands. <sup>[21]</sup> This trend has led to higher costs, often encouraging companies to consider outsourcing, though case processing remains one of the largest expenses in pharmacovigilance budgets. <sup>[22]</sup> Automating adverse event case processing using artificial intelligence offers a practical solution to this cost burden. With the growing volume of individual case safety reports, assistive technologies such as artificial intelligence are becoming indispensable for managing the workload and complexity of pharmacovigilance. Artificial intelligence has the potential to simplify complex decision-making processes for pharmacovigilance professionals, enhancing their efficiency and capabilities.

However, to maximize collaboration with artificial intelligence, drug safety professionals may need to develop new skills and competencies. [23]

Electronic health records represent a valuable external data source, offering detailed information about patient health, including clinical narratives that cover symptoms, disease status, severity, and confounding factors. Although electronic health records are recognized as a rich source of health data, estimates suggest that only 1% of adverse events documented in electronic health records are reported to federal databases. [24] This underutilized knowledge reservoir could reveal significant adverse events. The surge in electronically available health information, combined with the capacity to process vast datasets through natural language processing and machine learning algorithms, has created new opportunities for advancing pharmacovigilance. [25]

Artificial intelligence holds significant potential for pharmacovigilance by enabling the precise extraction of safety data. Artificial intelligence tools can streamline or enhance nearly all aspects of pharmacovigilance, from case processing to risk assessment, leading to reduced processing times and costs. Various database tools, such as VigiFlow, VigiBase, VigiAccess, and VigiLyze, alongside analytical methods like VigiGrade, VigiMatch, and VigiRank, are used for analyzing case reports. [26]

Advances in artificial intelligence techniques are expected to lead to increasingly sophisticated approaches to drug safety. However, additional research is necessary to expand artificial intelligence applications in pharmacovigilance. While existing databases and tools are in the early stages of development, they hold significant potential for shaping the future of pharmacovigilance.

##### **5) USE AI IN DRUG DESIGN AND CLINICAL RESEARCH:**

The role of artificial intelligence technology is expanding significantly across multiple stages of drug development, including novel drug design, enhancing research and development efficiency, and improving patient enrollment decision-making processes during clinical trials. [27] Artificial intelligence not only reduces the human workload but also enables the accomplishment of complex goals within shorter time frames. Its integration into pharmaceutical product development—from laboratory research to clinical application is anticipated to grow steadily. Artificial intelligence facilitates rational drug design, supports informed decision-making, identifies suitable treatments for patients (including personalized medicine), manages clinical data, and applies insights to future drug development. This integration ultimately enhances the entire lifecycle of pharmaceutical products. [28,29]

Clinical trials are essential for evaluating the safety and efficacy of drug products in humans for specific indications. However, these trials typically last 6 to 7 years and require significant financial investments. Despite this effort, only one in ten drug candidates successfully navigate clinical trials, resulting in substantial financial losses for the pharmaceutical industry. [30] Key reasons for these failures include inappropriate patient selection, unmet technical requirements, and insufficient infrastructure. The availability of extensive digital medical data presents an opportunity to address these challenges through artificial intelligence applications.

Patient enrollment, a critical component that accounts for about one-third of the clinical trial timeline, plays a vital role in the success of clinical studies. Inadequate patient selection is a contributing factor in approximately 86% of clinical trial failures. [31] Artificial intelligence technology offers a solution by enabling the selection of specific diseased populations for enrollment in phases II and III of clinical trials. This is achieved through patient-specific genome-exposome profile analysis, allowing for the early identification of viable drug targets.

Patient dropout, which leads to the failure of about 30% of clinical trials, further exacerbates challenges, requiring additional enrollments and wasting time and resources. Artificial intelligence can mitigate this issue by monitoring patients and ensuring adherence to clinical trial protocols. For example, AiCure developed mobile software that tracked medication intake among schizophrenia patients during a phase II trial. This innovation resulted in a 25% improvement in adherence rates, contributing to the trial's successful completion. [28]

Artificial intelligence is transforming drug design and clinical research, delivering significant advantages to the pharmaceutical industry and redefining the potential of modern medicine.

highlighted for marketing purposes:

- 1 **Enhanced Drug Discovery:** Artificial intelligence accelerates the drug discovery process by analyzing extensive datasets to identify potential drug candidates more efficiently. Machine learning algorithms predict interactions between various compounds and biological targets, leading to quicker identification of promising drug candidates.
- 2 **Precision Medicine:** Artificial intelligence facilitates the development of personalized medicine by analyzing individual patient data, including genetic, environmental, and lifestyle factors. This capability allows the design of drugs tailored to specific patient populations, improving treatment efficacy and reducing the likelihood of adverse effects.

- 3 **Optimized Clinical Trials:** Artificial intelligence enhances the clinical trial process by refining patient selection and enrollment. By leveraging detailed patient-specific data, artificial intelligence can identify ideal trial candidates, predict responses to treatment, and monitor adherence to protocols. This leads to higher success rates for trials and a reduction in patient dropout rates.
- 4 **Predictive Analytics:** Artificial intelligence employs predictive models to anticipate potential challenges in drug development and clinical trials. These insights enable proactive adjustments, minimizing risks, and optimizing resource allocation, thereby improving the overall efficiency of the development process.
- 5 **Real-Time Monitoring:** Artificial intelligence-powered tools enable real-time monitoring of clinical trial participants. These tools ensure adherence to trial protocols, identify issues promptly, and enhance the reliability and efficiency of clinical trial outcomes.
- 6 **Data Integration and Analysis:** Artificial intelligence integrates and analyzes data from diverse sources, such as electronic health records, clinical trial datasets, and genomic information. This capability provides comprehensive insights that inform decision-making, improve strategies, and enhance drug development processes.
- 7 **Cost Reduction:** By streamlining the drug development pipeline, improving trial success rates, and reducing redundancies, artificial intelligence significantly reduces the overall costs associated with drug development. This makes it a valuable asset for pharmaceutical companies seeking cost-effective solutions.

## 6) AI USE IN MEDICAL AFFAIRS AND MARKETING OF PHARMACEUTICAL INDUSTRY:

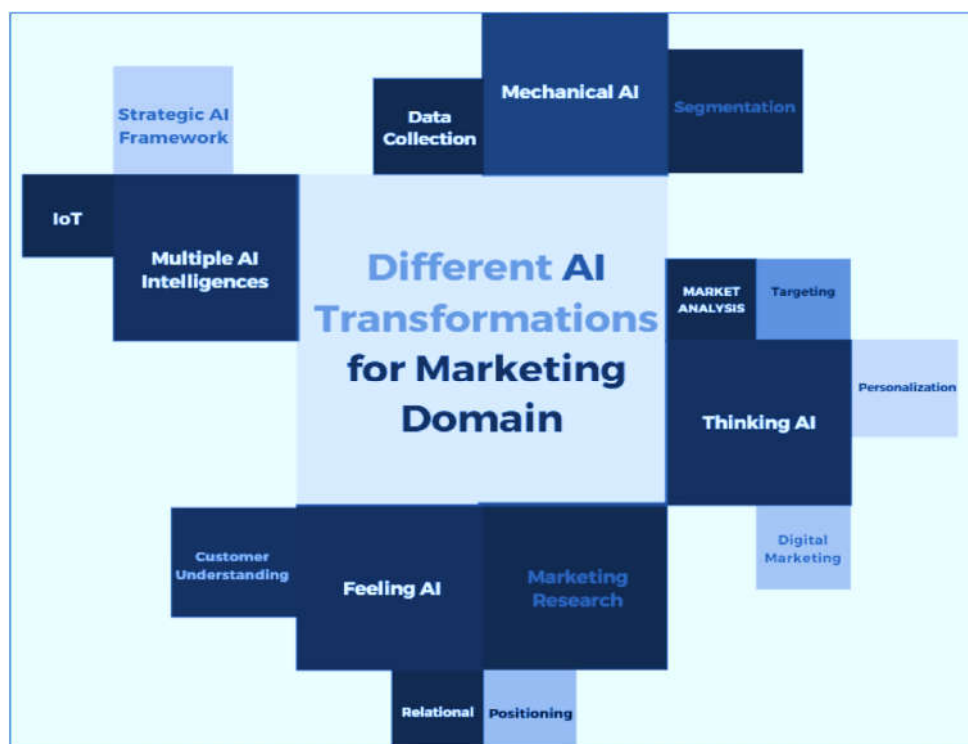
Scientific exchange serves as a cornerstone of medical affairs, establishing it as a crucial interface between healthcare professionals and other stakeholders. With the growing complexity of scientific knowledge, healthcare professionals increasingly depend on the pharmaceutical industry to provide detailed, non-promotional scientific information and foster meaningful engagement. They demand timely access to pertinent scientific content and mechanisms to retrieve this information efficiently when needed.

To fulfill these expectations and enhance the overall customer experience, medical affairs departments have adopted digital solutions. The COVID-19 pandemic underscored the essential



role of medical information within the pharmaceutical sector, particularly during periods of critical healthcare challenges. [32]

A progressive and streamlined approach to assessing the healthcare professional experience involves determining whether interactions effectively assist healthcare professionals in achieving their goals. This evaluation goes beyond simply measuring the quality of interactions; it emphasizes using the collected data to implement impactful improvements across the pharmaceutical industry. [33]



Consumers often rely on platforms like Google for medical information, which is frequently inaccurate and potentially harmful. To address this challenge, it is crucial to position pharmaceutical companies as the primary and trustworthy sources of medical information. This objective requires advocating for more adaptable regulations that govern the digital exchange of medical content. Additionally, bridging the gap between medical and commercial teams within the pharmaceutical industry is essential to create a cohesive system that prioritizes the needs of consumers. External stakeholders, including key opinion leaders, healthcare professionals, and

consumers, expect timely and accurate responses when seeking information from pharmaceutical companies. [34]

Market positioning plays a pivotal role in defining a product's unique identity to attract consumers, forming an integral part of pharmaceutical business strategies. For example, Viagra was marketed not just as a treatment for erectile dysfunction but also as a product that improves the overall quality of life, highlighting its unique market position. [35] The integration of advanced technology and e-commerce has simplified the process for pharmaceutical companies to establish brand recognition. Leveraging search engines as innovative platforms, these companies aim to achieve prominent online visibility to reinforce their market position. As reported by the Internet Advertising Bureau, businesses focus on improving website rankings to gain a competitive edge and accelerate brand recognition. [36]

The growth and success of pharmaceutical companies hinge on continuous innovation and business expansion. However, despite substantial financial resources, the industry's research and development output has been declining, primarily due to a slow adoption of emerging marketing technologies. The rapid evolution of digital technologies, often referred to as the "fourth industrial revolution," is driving innovation in digital marketing through a multicriteria decision-making approach. This approach combines statistical and mathematical data analysis with human expertise to develop artificial intelligence-driven models that identify novel marketing strategies. [37]

Accurate market forecasting is critical in the pharmaceutical distribution sector. Artificial intelligence-powered tools, such as "business intelligence smart sales prediction analysis," are increasingly being adopted. These technologies integrate time series forecasting with real-time data to enhance the accuracy of product sales predictions. By utilizing these insights, pharmaceutical companies can reduce costs associated with overstocking and mitigate the risk of losing customers due to inventory shortages. [38]

## **7) THE IMPERATIVE OF DIGITAL TRANSFORMATION: (SOCIAL MEDIA):**

The pharmaceutical industry, like many others, is undergoing a significant transformation driven by digital media. To remain competitive in this evolving landscape, pharmaceutical companies must establish a strong online presence. Patients, physicians, and other stakeholders increasingly turn to digital platforms to seek information, making it essential for companies to complement their physical credibility with an impactful digital presence. Platforms such as Facebook, Twitter, LinkedIn, and Google provide pharmaceutical companies with opportunities to enhance their

digital marketing strategies by distributing information, engaging audiences, and fostering brand loyalty. Each social media platform plays a unique role in advancing pharmaceutical marketing, as detailed below. <sup>[39]</sup>

**a) Facebook:**

- **Audience Reach:** With over 2.8 billion monthly active users as of 2021, Facebook offers an expansive platform to reach a wide audience of potential consumers.
- **Targeted Advertising:** Facebook's advertising tools enable precise audience targeting based on demographics, location, interests, and behaviors.
- **Community Building:** Facebook pages and groups are excellent tools for building communities focused on specific health conditions, treatments, or patient experiences.

**b) Instagram:**

- **Visual Engagement:** Instagram's visually driven platform is ideal for sharing images and videos that showcase the company, highlight patient stories, or provide educational content.
- **Stories & IGTV:** Features like Stories and IGTV allow companies to share temporary content or longer videos, making them suitable for announcements, behind-the-scenes insights, or detailed discussions.

**c) Twitter:**

- **Real-time Updates:** Twitter provides a platform for sharing immediate updates on medications, medical events, or innovations.
- **Engage with Professionals:** It facilitates direct interactions with healthcare professionals and organizations, promoting dialogue and collaboration.
- **Twitter Chats:** Hosting or participating in scheduled Twitter chats on specific topics can help position the company as a thought leader.

**d) LinkedIn:**

- **B2B Engagement:** LinkedIn is particularly effective for networking with other businesses, healthcare professionals, and industry leaders.
- **Thought Leadership:** The platform enables companies to share articles, updates, and industry insights, reinforcing their position as leaders in the field.
- **Hiring:** Pharmaceutical companies can use LinkedIn to post job openings and attract top talent across pharmaceutical and marketing sectors.

**e) YouTube:**

- **Educational Content:** YouTube offers an excellent medium for creating and sharing educational videos that explain medical conditions, treatment options, drug mechanisms, or patient experiences.
- **Webinars & Interviews:** Companies can host webinars or interviews with healthcare professionals to discuss significant medical topics or conduct Q&A sessions.
- **Advertising:** YouTube's advertising platform expands reach and helps promote content to broader audiences.

Danielle Salowski, Facebook's Health Industry Manager, highlights the importance of platforms like Facebook and Instagram for healthcare marketers. Facebook reaches 1.7 billion people globally each month, with over a billion accessing the platform daily via mobile devices. Similarly, Instagram boasts 300 million daily and 500 million monthly users, underscoring its value in engaging diverse audiences.<sup>[40]</sup>

**8) INTEGRATION OF FACEBOOK AI IN PHARMACEUTICAL AUTOMATION:**

Over the past five years, the use of artificial intelligence (AI) in pharmaceutical marketing and sales has seen substantial growth, becoming a crucial tool for improving the precision and effectiveness of marketing strategies. AI plays an instrumental role in analyzing large datasets, predicting customer behavior, and personalizing interactions, which significantly enhances the value of marketing campaigns. At Eularis, we continuously explore innovative ways to integrate AI into projects to improve client outcomes. A key strength of AI is its ability to automate repetitive tasks that require extensive data analysis, such as identifying and mapping key opinion leaders (KOLs). AI can dynamically manage KOL identification by considering factors like ongoing clinical trials, numerous journal publications, and the influence of new updates on KOL databases.<sup>[41]</sup>

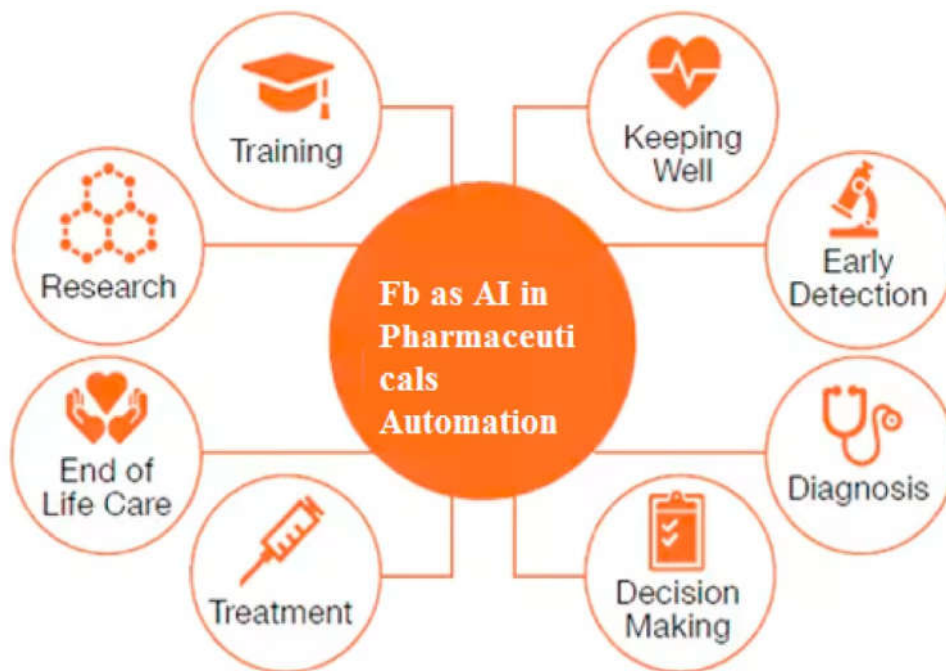
The growing efficiency of AI allows it to perform tasks traditionally handled by humans with enhanced speed, precision, and cost-effectiveness. This advancement is particularly impactful in the healthcare industry, where AI and robotics integration is rapidly gaining traction. As these technologies continue to evolve and become embedded in daily life, they are increasingly becoming essential components of the healthcare ecosystem.<sup>[42]</sup>

- **Precision Advertising:** Facebook's AI tools enable precise targeting for pharmaceutical advertising by analyzing user data to reach specific groups, such as patients with certain

health conditions or healthcare professionals. This ensures that marketing campaigns are more effective and tailored to the intended audience.

- **Enhanced Patient Interaction:** AI can be leveraged to create interactive and personalized content on Facebook, including chatbots that provide information about medical conditions, treatment options, and medication adherence. This fosters better patient engagement, contributing to improved health management and patient satisfaction.
- **Data-Driven Insights:** Facebook's AI capabilities allow the collection and analysis of data from user interactions, providing pharmaceutical companies with valuable insights into patient behaviors, preferences, and needs. These insights can inform product development, marketing strategies, and customer service enhancements, ensuring that campaigns are data-driven and aligned with patient interests.
- **Automation of Routine Processes:** AI can automate several routine tasks, such as monitoring social media for feedback on drug safety, managing customer service inquiries, or monitoring discussions around a pharmaceutical product. This automation streamlines operations, reduces human error, and ensures that responses are timely and accurate.
- **Support for Research and Development:** AI tools on Facebook can be used to analyze public sentiment and trends related to specific pharmaceutical products. This analysis can provide valuable input during the research and development stages, helping guide product development and improve the market readiness of new drugs by aligning with consumer perceptions and concerns.

Overall, the integration of Facebook's AI into the pharmaceutical industry enhances marketing effectiveness, patient engagement, and operational efficiency, contributing to more responsive and effective pharmaceutical practices.



## 9. Artificial Intelligence in Digital Marketing:

### 1. Personalization and Customer Targeting:

**Hyper-Personalization with Artificial Intelligence:** Artificial Intelligence enables brands to deliver hyper-personalized experiences by analyzing massive datasets and uncovering individual user behaviors and preferences. Artificial Intelligence tools can track online activity, purchase history, social media engagement, and even real-time interactions to create a detailed profile of each customer. This allows businesses to:

- Serve personalized content (e.g., articles, videos, emails) tailored to each user's interests.
- Adjust advertisements dynamically based on real-time user behavior, increasing engagement and conversion.

### Example:

- Netflix uses Artificial Intelligence algorithms to recommend content based on viewing history.
- Amazon recommends products based on purchase history and browsing patterns.

**Machine Learning for Real-Time Personalization:** Machine Learning models are essential for identifying patterns and trends in user data, enabling brands to predict customer behavior. Algorithms learn from user actions, such as clicks, time spent on a website, and purchase frequency, allowing marketers to create real-time personalized experiences. For instance:

- If a customer shows interest in certain types of products (e.g., luxury items), the Artificial Intelligence can recommend high-end options in future interactions.
- Real-time campaigns can adjust advertisements or email content based on the user's current activity, leading to higher engagement and sales.

#### **Case Studies:**

- **Netflix:** Uses Artificial Intelligence to recommend television shows and movies, boosting user engagement and retention by personalizing the platform.
- **Amazon:** Artificial Intelligence powers personalized product recommendations based on user data, driving a significant portion of its sales. <sup>[43]</sup>

## **2. Content Creation and Curation: Artificial Intelligence in Automating Content Generation:**

Artificial Intelligence is increasingly used to automate content creation through tools like Generative Pretrained Transformer-3 (GPT-3) and automated video editors. These technologies help marketers quickly produce a range of content types such as blog posts, product descriptions, email copy, and social media updates. Artificial Intelligence can generate high-quality, relevant text based on input data and past performance metrics, allowing for:

- Mass content production at scale.
- More efficient use of resources as marketers can focus on creative strategy instead of time-consuming content creation.

**Natural Language Processing:** Natural Language Processing is a critical part of Artificial Intelligence in content marketing, allowing for the generation of human-like text, language understanding, and sentiment analysis. Artificial Intelligence-powered tools, such as chatbots, also use Natural Language Processing to engage with users in natural conversation, improving customer interactions and engagement.

#### **Benefits for Marketers:**

- **Scalability:** Artificial Intelligence allows for the mass production of content without sacrificing quality.
- **Efficiency:** Marketers can quickly generate large amounts of content, including social media posts, product descriptions, and blog articles, enabling timely campaigns. <sup>[44]</sup>

### 3. Chatbots and Virtual Assistants:

**Artificial Intelligence-Powered Customer Service:** Chatbots are revolutionizing customer service by providing real-time support and automating repetitive tasks. Artificial Intelligence chatbots use Natural Language Processing to understand user queries and provide accurate responses. They are available 24/7, improving the overall customer experience by:

- Answering routine questions instantly (e.g., order status, product details).
- Assisting with lead generation by collecting user information.
- Recommending products or services based on the user's needs.

#### Examples of Successful Chatbot Implementations:

- **Sephora:** Their chatbot offers personalized beauty product recommendations and makeup tips based on user preferences.
- **H&M:** Their virtual stylist chatbot suggests outfit ideas based on the user's style and past purchases, enhancing the shopping experience. <sup>[45]</sup>

### 4. Predictive Analytics and Data-Driven Insights:

**Artificial Intelligence's Role in Data Analysis:** Artificial Intelligence processes vast amounts of marketing data from social media interactions, website activity, and email campaigns, providing insights into customer behavior, purchasing trends, and campaign performance. Predictive analytics helps marketers anticipate future behavior, making their campaigns more effective by:

- Identifying the best time to engage customers.
- Predicting the likelihood of a customer making a purchase.
- Segmenting customers based on their buying patterns.

**A/B Testing and Campaign Optimization:** Artificial Intelligence can automate A/B testing, allowing marketers to test different versions of advertisements, landing pages, or email campaigns and analyze performance in real time. Artificial Intelligence algorithms can adjust campaigns on the fly, optimizing for better engagement or conversions.

**Sentiment Analysis:** Artificial Intelligence-powered sentiment analysis tools scan social media conversations, product reviews, and customer feedback to understand public opinion. These insights allow marketers to refine their messaging and address any negative perceptions proactively. <sup>[46]</sup>

## 10. AI IN SOCIAL MEDIA MARKETING:

### 1. Social Media Monitoring and Sentiment Analysis:



**Artificial Intelligence Tools for Brand Monitoring:** Artificial Intelligence has revolutionized how brands monitor their presence on social media platforms by providing sophisticated tools like Hootsuite, Brandwatch, and Sprinklr. These tools employ natural language processing and machine learning algorithms to track social media activity in real-time. The core benefits include:

- **Tracking Mentions:** Artificial Intelligence-powered social media monitoring tools can track mentions of a brand, its products, or services across different platforms such as Twitter, Facebook, Instagram, and Reddit. They analyze hashtags, user comments, and posts to provide a comprehensive view of public discussions.
- **Sentiment Analysis:** Artificial Intelligence's natural language processing capabilities allow it to assess the sentiment behind social media posts, categorizing them as positive, negative, or neutral. This helps brands gauge customer satisfaction and the overall mood of their audience regarding their offerings. For example, a surge in negative sentiment might indicate dissatisfaction with a recent product or campaign, prompting immediate action.
- **Brand Reputation Management:** These Artificial Intelligence tools help track key metrics around brand reputation. A sudden spike in mentions, either positive or negative, triggers alerts for marketing teams, allowing them to quickly address issues, engage with customers, or adjust their messaging.
- **Proactive Customer Engagement:** By understanding customer sentiment in real-time, brands can engage more effectively with their audience. Positive sentiment can be amplified by acknowledging positive feedback, while negative sentiment can be addressed through targeted customer support or damage control.
- **Refining Marketing Strategies:** Insights from sentiment analysis inform brands about the effectiveness of their marketing strategies. If sentiment shifts after a campaign, marketers can adjust their approach accordingly, ensuring they align with their audience's feelings.

[47]

## 2. AI-Driven Influencer Marketing

**Identifying Relevant Influencers** Artificial Intelligence-driven influencer marketing tools, such as Influencity, Upfluence, and Traackr, have revolutionized how brands choose influencers for their campaigns. Instead of relying solely on follower count, these tools delve deeper into the

audience demographics, engagement patterns, and content preferences to ensure authentic and effective collaborations.

- **Audience Demographics:** Artificial Intelligence tools analyze influencers' followers based on factors such as age, location, gender, and interests, allowing brands to identify influencers whose audiences match their target demographics.
- **Engagement Metrics:** Artificial Intelligence examines not only how many likes, shares, or comments an influencer's posts receive but also the quality of that engagement. By focusing on influencers who drive meaningful interactions (such as thoughtful comments or conversions), brands can create more effective campaigns.
- **Content Relevance:** Artificial Intelligence assesses the type of content an influencer creates and how well it aligns with the brand's messaging. For example, Artificial Intelligence might recommend a beauty influencer with a history of engaging content about skincare if the brand is launching a new skincare line.

**3. Predicting Influencer Effectiveness** Artificial Intelligence tools analyze historical data on influencer campaigns to predict the potential return on investment from a new collaboration. They consider past engagement rates, audience interactions, and the effectiveness of specific content types, such as videos or stories, to estimate campaign performance.

- **Predictive Analytics:** Artificial Intelligence helps predict which influencers are likely to generate the best results for specific campaigns by analyzing past performance. If an influencer has consistently driven high engagement and sales in similar campaigns, they become a top choice for brands.
- **Real-Time Campaign Monitoring:** Once a campaign is live, Artificial Intelligence tools track real-time performance metrics (e.g., engagement rates, clicks, conversions), allowing brands to make data-driven adjustments. For instance, if an influencer's posts aren't performing as expected, the brand can adjust content strategy or explore alternatives. <sup>[48]</sup>

**4. Social Media Advertisement Optimization Optimizing Advertisements with Artificial Intelligence** Artificial Intelligence is transforming social media advertising by making it more efficient and effective. Platforms like Facebook Ads, Instagram Ads, and Google Ads use Artificial Intelligence algorithms to automatically optimize advertisement campaigns based on audience behavior and engagement data. Key features include:

- **Automatic Audience Targeting:** Artificial Intelligence tools use data from past user interactions to identify which segments of a brand's audience are most likely to engage with an advertisement. By continuously learning from user behavior, Artificial Intelligence improves targeting accuracy over time, ensuring that advertisements reach the right audience with the highest likelihood of conversion.
- **Dynamic Advertisement Adjustments:** Artificial Intelligence algorithms can adjust advertisement placement and bidding strategies in real-time based on how an advertisement is performing. For instance, if an advertisement is performing well with a particular demographic, Artificial Intelligence will increase the advertisement's exposure to that group while reducing spending on underperforming segments.
- **Cost-Effective Bidding:** Artificial Intelligence tools can automatically manage bidding strategies, optimizing for lower cost-per-click while maximizing reach and engagement. Artificial Intelligence also identifies optimal times to display advertisements, ensuring better performance and reducing unnecessary advertisement spend.
- **Performance Insights:** Artificial Intelligence provides detailed insights into advertisement performance, showing marketers which creative assets, messages, and formats are resonating with the audience. This helps in creating more effective campaigns by identifying what works best for different audience segments.

##### 5. Benefits for Brands:

- **Higher Return on Investment:** Artificial Intelligence optimizes advertisement spend by ensuring advertisements are targeted more effectively and by adjusting bids in real-time, leading to a better return on investment.
- **Precise Targeting:** Artificial Intelligence's ability to track and analyze user behavior allows for highly specific targeting, which increases the chances of converting potential customers. <sup>[49]</sup>

**6. Artificial Intelligence-Enhanced Visual and Video Content Artificial Intelligence's Role in Visual Content Analysis** Artificial Intelligence plays a significant role in analyzing how users engage with visual and video content on social media. With the rise of platforms like Instagram, YouTube, and TikTok, visual content is essential to brand marketing. Artificial Intelligence tools can track how users interact with images, videos, and even augmented reality content to help brands understand what resonates best with their audience.

- **User Engagement Metrics:** Artificial Intelligence tools analyze engagement metrics like viewing time, shares, likes, and comments on visual content. By understanding these metrics, brands can identify which types of visuals drive the most engagement and adjust their content strategy accordingly.
- **Content Suggestions:** Artificial Intelligence-powered platforms can recommend changes to visual content to improve engagement. For example, tools like Canva or Adobe Spark may use Artificial Intelligence to suggest design improvements based on trends and user preferences.
- **Facial Recognition and Personalization:** Some Artificial Intelligence tools, like those integrated into social platforms (e.g., Snapchat filters or Instagram augmented reality effects), use facial recognition to personalize experiences. Brands can create augmented reality effects that interact with users' facial features, enhancing engagement and creating immersive brand experiences.

**7. Automation in Video Editing and Creation** Artificial Intelligence-powered tools like Magisto or Animoto allow marketers to automate video creation and editing processes. These tools can quickly produce engaging videos by analyzing user data and previous performance metrics to determine the best content style and format for a given audience.

- **Efficient Video Creation:** Artificial Intelligence-driven platforms can automatically edit videos, add music, and apply transitions, making the video production process faster and more accessible for brands that need to create content quickly and at scale.
- **Enhanced Visual Recognition:** Artificial Intelligence can analyze visual data within videos, such as identifying objects, text, or logos, helping brands ensure consistent branding and message delivery across various social media channels. <sup>[50]</sup>

## **11. CHALLENGES AND ETHICAL CONSIDERATIONS IN AI-DRIVEN SOCIAL MEDIA MARKETING**

**1. Data Privacy and Security** Artificial Intelligence tools in social media marketing heavily rely on vast amounts of user data to personalize experiences, optimize advertising, and monitor brand sentiment. However, the collection, storage, and usage of this data raise significant privacy and security concerns:

- **Data Collection:** Artificial Intelligence tools gather extensive data on users' online behavior, including browsing habits, preferences, interactions, and even personal

information. This creates concerns about how much data is being collected, whether users are aware of it, and if they've given explicit consent. With privacy regulations like the General Data Protection Regulation and the California Consumer Privacy Act, companies must ensure compliance, but not all Artificial Intelligence systems are transparent about their data practices.

- **User Consent and Transparency:** Many users are unaware of the extent to which their data is being used for marketing purposes. Ethical considerations arise regarding whether companies are sufficiently transparent in how they collect, store, and leverage personal information. Users may be uncomfortable with the idea that their behavior is being tracked and analyzed to personalize advertisements or content.
- **Security Risks:** As Artificial Intelligence systems gather and analyze sensitive data, they become attractive targets for hackers. Data breaches can expose users to identity theft, fraud, and other malicious activities. Maintaining robust cybersecurity measures is essential to protect both company assets and user privacy.

**2. Ethical Artificial Intelligence** As Artificial Intelligence systems become more advanced, ethical concerns over their capabilities and applications have become more prominent:

- **Deepfakes:** Artificial Intelligence technology can be used to create deepfakes—synthetic media where someone appears to say or do something they didn't actually do. While deepfakes are sometimes used creatively in marketing, they can also be exploited for malicious purposes, such as disinformation or manipulation. Brands must be cautious when employing Artificial Intelligence-generated content to ensure ethical use.
- **Automated Interactions:** Artificial Intelligence-powered chatbots and virtual assistants are increasingly used to interact with customers. However, ethical dilemmas arise when automated systems mimic human interactions without disclosing their non-human nature. Deceptive Artificial Intelligence interactions could undermine trust and damage a brand's reputation.
- **Bias in Artificial Intelligence Algorithms:** Artificial Intelligence systems are only as good as the data they are trained on, which can lead to bias. If Artificial Intelligence models are trained on biased data, they may reinforce existing societal biases, affecting who sees certain content or advertisements. For instance, Artificial Intelligence may

disproportionately favor certain demographic groups over others, leading to ethical concerns around fairness and inclusivity.

- **Balancing Automation with Human Oversight:** While Artificial Intelligence can automate many tasks, there is a fine line between efficiency and dehumanization. Over-reliance on Artificial Intelligence can lead to impersonal interactions and missed opportunities for genuine engagement. Ethical Artificial Intelligence use requires a balance between automation and human involvement to ensure authenticity.

## 12. FUTURE TRENDS IN AI FOR DIGITAL MARKETING AND SOCIAL MEDIA:

**1. Voice and Visual Search** Artificial Intelligence is playing a critical role in shaping the future of search functionality by enhancing voice and visual search capabilities, making it easier for consumers to find products and services through non-text-based inputs.

- **Voice Search:** With the rise of voice-activated assistants like Amazon's Alexa, Google Assistant, and Apple's Siri, voice search is becoming an integral part of how users interact with brands. Artificial Intelligence enables voice recognition and natural language processing, allowing users to search for products, services, or information in a more conversational manner. For example, a user can ask their smart assistant to “find nearby coffee shops” or “search for blue sneakers,” and Artificial Intelligence will analyze the query to deliver relevant results.
- **Visual Search:** Platforms like Pinterest and Instagram are pioneering visual search features that allow users to search for products by uploading images. Artificial Intelligence algorithms use image recognition technology to analyze visual content and suggest similar products. This trend is especially popular in fashion, home decor, and retail, as consumers can visually search for items that catch their eye without needing to describe them in words.
- **Optimizing for Voice and Visual Search:** Brands will need to optimize their content and product listings for these new forms of search. Artificial Intelligence-powered tools can help identify keywords, tags, and descriptions that align with how consumers search using voice or images. <sup>[51]</sup>

**2. Augmented Reality/Virtual Reality Integration** Augmented reality (AR) and virtual reality (VR) are increasingly becoming part of social media marketing strategies, and Artificial Intelligence is enhancing these immersive experiences to create more engaging and personalized interactions.

- **Augmented Reality:** Augmented reality enables users to interact with digital elements overlaid on the real world. Brands are using augmented reality in social media to allow users to “try on” products virtually, such as makeup, clothing, or accessories. For example, beauty brands like Sephora offer augmented reality experiences where customers can see how a shade of lipstick would look on their face before purchasing. Artificial Intelligence-driven facial recognition and computer vision technologies enable these interactive augmented reality features, making them more accurate and seamless.
- **Virtual Reality:** Virtual reality creates entirely immersive digital environments where users can explore and interact with brands. Artificial Intelligence enhances virtual reality experiences by personalizing virtual environments based on users’ preferences and behavior. For example, a brand could create a virtual reality showroom where customers can explore products in a virtual space tailored to their style and preferences.
- **Artificial Intelligence’s Role in Enhancing Augmented Reality/Virtual Reality:** Artificial Intelligence improves the quality and personalization of augmented reality/virtual reality experiences by analyzing user data to offer custom recommendations, suggest similar products, or tailor virtual environments based on individual behavior patterns. <sup>[52]</sup>

**3. Hyper-Automation** The future of digital marketing will see increasing levels of Artificial Intelligence-driven hyper-automation, where Artificial Intelligence systems not only automate tasks but also self-improve and coordinate across multiple channels, providing a seamless, omnichannel marketing experience.

- **Seamless Customer Engagement:** Hyper-automation refers to the use of advanced Artificial Intelligence and machine learning to automate entire processes end-to-end, minimizing the need for human intervention. In the context of social media marketing, hyper-automation can create a seamless flow of customer engagement across platforms. For example, if a customer interacts with a brand on Instagram, Artificial Intelligence can automatically send them a personalized follow-up via email or direct them to a product page based on their interaction history.
- **Cross-Channel Integration:** Hyper-automation will enable brands to provide consistent customer experiences across multiple platforms, from social media to websites and apps. Artificial Intelligence will be able to track user interactions across channels and adjust

marketing strategies in real-time to ensure that each touchpoint is personalized and cohesive.

- **Efficiency and Scalability:** Hyper-automation will allow brands to scale their marketing efforts without sacrificing personalization. By automating content creation, advertisement optimization, customer interactions, and analytics, Artificial Intelligence will enable marketers to reach larger audiences while maintaining high levels of engagement and relevancy. <sup>[53]</sup>

## CONCLUSION:

The integration of Artificial Intelligence (AI) in digital marketing and social media has significantly transformed the landscape of pharmaceutical marketing. AI technologies such as machine learning, natural language processing, and predictive analytics are now essential tools for optimizing marketing strategies, enhancing customer engagement, and ensuring compliance with regulatory standards. The combination of AI with social media platforms allows pharmaceutical companies to reach targeted audiences more effectively, personalize content, and gather valuable insights from consumer behavior. While these advancements offer numerous benefits, including cost reduction and improved communication, they also raise important ethical considerations, such as data privacy and the need for transparency. As AI continues to evolve, it is poised to further revolutionize digital marketing strategies in the pharmaceutical industry, driving innovation and improving patient engagement.

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