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Building a Bridge Between Research and Practice: Transforming the Pharmaceutical Industry in the digital Era

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ABSTRACT

This study aims to describe the role of digital transformation in bridging research and practice in the pharmaceutical industry, while identifying emerging barriers and opportunities. The method used is qualitative research with a descriptive approach, through in-depth interviews, observations, and documentation studies of pharmaceutical industry stakeholders. The results show that digitalization through the use of artificial intelligence, big data analytics, blockchain, and telepharmacy can accelerate the translation of research findings into industrial practice. However, this transformation still faces obstacles such as limited human resources, high investment costs, and regulations that are not yet fully adaptive. This study emphasizes that collaboration between academia, industry, and regulators, supported by digital technology, is key to building a more efficient, innovative, and evidence-based pharmaceutical industry model in the digital era.

INTRODUCTION

The pharmaceutical industry is currently undergoing a major transformation triggered by the increasingly rapid development of digital technology (Subha et al., 2024). Utilizing big data enables large-scale analysis of health data and drug research, while artificial intelligence (AI) is used to accelerate drug discovery, personalize therapies, and improve healthcare efficiency. Blockchain technology is here to ensure the security, transparency, and authenticity of the drug supply chain, thereby reducing the risk of counterfeiting pharmaceutical products (Kumar et al., 2024).

On the other hand, telemedicine opens up new opportunities in digital pharmacy services by offering remote consultations, real-time patient monitoring, and faster and more targeted drug distribution. All of these developments are driving the global pharmaceutical industry to adapt to a new paradigm based on digital innovation to improve the quality of healthcare services, expand access, and accelerate research and development in the pharmaceutical sector (Santoso et al., 2025).

This transformation has had a significant impact on various aspects of the pharmaceutical industry, from drug research to patient care. At the research stage, digital technology enables faster and more accurate analysis of genomic and clinical data, accelerating the discovery of new drug molecules and the development of more targeted therapies (Farmiati, 2022)

In distribution, digital systems and blockchain help monitor the drug supply chain in real-time, improve security, and ensure the quality and authenticity of products all the way to consumers (Susanto et al., 2025). From a marketing perspective, digital platforms and big data analytics are being leveraged to understand consumer needs, develop more personalized promotional strategies, and reach patients through various online channels. Meanwhile, in patient care, telemedicine and digital pharmacy applications offer online consultations, e-prescriptions, and ongoing health monitoring services, improving the accessibility, convenience, and overall quality of healthcare services.

The main challenge in transforming the pharmaceutical industry lies in the significant gap between scientific research findings and industry practices. Pharmaceutical research often yields significant innovations, including drug development, digital technology utilization, and data-driven healthcare models. However, these innovations often remain confined to the academic realm and are not readily implemented broadly in the industry (Zhong & Ouyang, 2020). This creates a mismatch between the enormous potential offered by research and the actual needs in the field, so that the benefits of research results cannot be fully felt by the community or the business world.

One of the main reasons for the slow adoption of pharmaceutical innovation is regulatory barriers, high costs, and resistance to digital change. While strict regulations are necessary to ensure the safety and effectiveness of pharmaceutical products, they can also slow the adoption of new technologies (Augestri et al., 2025). Furthermore, the high cost of integrating digital technologies such as big data, AI, and blockchain presents a challenge for many companies, especially small and medium-sized enterprises. Equally important, resistance to change from the workforce and management also hinders the digital transformation process. As a result, the translation process from research to industry practice takes a long time, preventing innovation from immediately having an optimal impact on the advancement of the pharmaceutical industry and improving the quality of healthcare services.

The urgency of digitalization in the pharmaceutical industry lies in its ability to accelerate the translation of research into real practice, so that the benefits of research results can be felt more quickly by the public (Finelli & Narasimhan, 2020). The digital era has enabled various innovations, such as digital clinical trials, which utilize online patient data to accelerate clinical trials; the use of real-world evidence to assess drug effectiveness outside of conventional clinical trials; and the automation of manufacturing processes that improve production efficiency, quality, and precision. These technologies can reduce time and cost constraints in drug development, while knowledge distribution and innovation implementation can occur more quickly and equitably.

However, not all pharmaceutical companies are able to optimally adapt to the demands of digitalization, especially in developing countries. Limited technological infrastructure, high investment costs, and a lack of skilled digital talent are key obstacles. Furthermore, regulations that have not fully adapted to technological developments also slow down digital adoption (Ausat et al., 2025). This situation creates a gap between large companies that have been able to maximize digitalization and small and medium-sized enterprises that still face numerous obstacles. Therefore, accelerating the digitalization of the pharmaceutical industry needs to be prioritized so that this transformation becomes more than just talk and truly has a significant impact on research, industry, and healthcare services.

Most previous research has focused on the innovative aspects of pharmaceutical technology, such as the use of artificial intelligence (AI) in drug research or the use of blockchain for distribution. This has led to a lack of attention to the integration of academic research findings with industry practice in the context of digital transformation. Studies that comprehensively discuss how research findings can be effectively applied in industry are still limited, creating a gap between theory and implementation. Furthermore, research exploring the role of cross-sector collaboration—involving researchers, industry, regulators, and practitioners in building bridges between pharmaceutical research and practice in the digital era is also

limited, even though such collaboration is crucial for accelerating innovation adoption and delivering tangible impact on the development of the pharmaceutical and healthcare industries.

The novelty of this research lies in its qualitative approach, which highlights the symbiotic relationship between pharmaceutical research and industry practice, by providing a digital transformation perspective as a bridge that accelerates the implementation of research findings into real-world practice. This research focuses not only on technological innovation but also offers a new conceptual framework for understanding how the pharmaceutical ecosystem—involving researchers, industry, regulators, and practitioners—can adapt more integratively in the digital era.

The purpose of this study is to describe in depth how digital transformation impacts the relationship between academic research and pharmaceutical industry practice, thus understanding the dynamics between the two in the digital era. It also aims to identify various obstacles and opportunities that arise in the process of implementing research findings into industrial practice through the use of digital technology, including regulatory, cost, infrastructure, and human resource readiness.

Furthermore, this research seeks to analyze cross-sector collaboration strategies that can strengthen the relationship between researchers, industry, and regulators, thus creating a more adaptive and sustainable digital pharmaceutical ecosystem. Ultimately, this research is expected to generate conceptual recommendations that can serve as the basis for developing a pharmaceutical industry transformation model in the digital era, accelerating the adoption of innovations while improving the quality of healthcare services globally.

METHODOLOGY

This research method uses a descriptive qualitative approach to understand the phenomenon of pharmaceutical industry transformation in the digital era by emphasizing the exploration of the experiences, perceptions, and practices of industry players (Hermes et al., 2020). The research location covers the pharmaceutical industry and related institutions such as pharmaceutical companies, regulators, digital pharmacies, and research institutions, and can be conducted in several major cities that are centers for pharmaceutical and digital health development. The research subjects are key informants including pharmaceutical company managers, researchers, health regulators, pharmacists, and digital health technology experts. The inclusion criteria for informants are those who have direct experience in the development or implementation of digital technology in the pharmaceutical sector.

Data collection techniques were carried out through in-depth interviews, participatory observation, and documentation studies in the form of annual reports, policies, scientific publications, and pharmaceutical association data, with instruments in the form of semi-structured interview guidelines, observation notes, and supporting documents.(Miller et al., 2019)Data analysis used thematic analysis with stages of data reduction, data presentation, and conclusion drawing, both manually and with the help of qualitative analysis software such as NVivo or Atlas.ti. Data validity was maintained through source triangulation, member checking, and peer debriefing, while research ethics were observed by maintaining the confidentiality of informants' identities, seeking informed consent, and using the data only for academic purposes.

RESULTS AND DISCUSSION

Research shows that digitalization plays a crucial role in driving the transformation of pharmaceutical industry research and practice. In research, artificial intelligence (AI) and machine learning have been shown to accelerate the discovery of new drugs, while big data analytics facilitate the integration of clinical research data and

public health data. In industry, the implementation of a digital supply chain improves the efficiency of drug distribution, blockchain is being utilized to ensure supply chain transparency and security, and telepharmacy services are emerging as a form of digital-based patient care (Apriani et al., 2023).

However, digital transformation still faces several obstacles, including limited human resources competent in digital technology, high infrastructure investment costs, and regulations that are not yet fully adaptable to innovation. On the other hand, opportunities for cross-sector collaboration between academia, industry, and regulators offer significant potential to accelerate the translation of research into practical practice, supported by digital platforms that enable cross-border research integration and accelerate the clinical trial process.

Table 1. Interview Result Instrument

Research Aspects	Indicator	Interview Questions	Objective
Digital Transformation in Pharmaceutical Research	Utilization of technology (AI, big data, digital trials)	1. How does your company/institution utilize digital technology in the pharmaceutical research process? 2. What is the biggest impact of digitalization on new drug research?	Exploring the application of digital technology in pharmaceutical research.
Implementation in Industry	Application of digital supply chain, blockchain, telepharmacy	3. What digital technologies have been implemented in your pharmaceutical company's operations? 4. What are the advantages and challenges in implementing this digital system?	Knowing the digitalization practices that have been implemented in the industry.
Barriers to Digital Transformation	HR, costs, regulations, infrastructure	5. What obstacles are faced in implementing digitalization in the pharmaceutical industry?	Identifying obstacles in digital transformation.

		6. How does the company/institution's strategy address these limitations?	
Research and Industry Collaboration	Collaboration between academics, industry, and regulators	7. Does your company have collaborations with research institutions or universities? 8. To what extent does the collaboration help accelerate the application of research to industrial practice?	Understanding the collaboration patterns between research and practice.
Strategy and Recommendations	The ideal model of research–practice integration	9. In your opinion, what strategies are effective for bridging academic research and pharmaceutical industry practice? 10. What are your recommendations for strengthening digital transformation in the pharmaceutical sector?	Formulate recommendations for an integration model of research and practice.

Source: 2025 Data Processing Results

The interview instrument in this study was designed to deeply explore the informants' views and experiences regarding digital transformation in the pharmaceutical industry. The questions were semi-structured to provide a framework for the main topics, while still allowing the informants flexibility to elaborate. The aspects examined included the use of digital technology in pharmaceutical research, its implementation in the industry, the obstacles encountered, collaboration patterns between research and practice, and strategies and recommendations for the future. This instrument enabled researchers to obtain comprehensive data on how digitalization serves as a bridge between academic research and pharmaceutical industry practice in the digital era.

Research and Practice Still Have a Gap

The research results show that there is still a real gap between academic research and the practical needs of the pharmaceutical industry, especially in terms of implementing digital technology (Abrar, 2025). Many innovations emerge from

research, such as the use of artificial intelligence for drug discovery or the use of big data in clinical analysis, but not all of them are immediately adopted by industry. This gap stems from differing focuses: academics tend to emphasize the development of theories and conceptual models, while industry demands solutions that are applicable, efficient, and compliant with regulations and market conditions. As a result, the enormous potential of research findings often remains elusive, resulting in practical applications that directly impact production efficiency, distribution, and patient care.

This condition emphasizes the need for a bridge that can bring together the world of research and industry through a targeted digitalization strategy (Frank et al., 2019). Digitalization can serve as a catalyst that facilitates the integration of academic knowledge with practical needs, for example through digital collaboration platforms, technology-based clinical trials, or real-world evidence models that are more closely aligned with industry practices. With this strategy, innovative research findings can be more quickly translated into concrete solutions, while industry gains access to new findings that can enhance competitiveness and sustainability. Ultimately, the success of building this bridge depends heavily on the shared willingness of across sectors—academia, industry, and regulators—to collaborate more openly and adaptively to address the challenges of the digital era.

Digital Transformation as a Connector

Digital transformation in the pharmaceutical industry has proven to act as a bridge that can reduce barriers to translating research results into real practice (Seyhan, 2019). Digital technologies such as big data analytics, artificial intelligence, blockchain, and telepharmacy not only accelerate research and distribution processes but also introduce new, more efficient, data-driven service models. The presence of these technologies makes digitalization a crucial catalyst for driving the integration of academic knowledge with industry needs, enabling innovations to be more quickly applied in drug development and patient care.

However, the effectiveness of digital transformation depends heavily on several key supporting factors. Human resource readiness is key, as specialized competencies are required to understand and operate complex digital technologies. Furthermore, adequate digital infrastructure—including internet networks, analytical software, and data security systems—must be in place for optimal digitalization. Equally important, adaptive regulations are also needed to accommodate technological developments without compromising safety and ethics in the pharmaceutical sector (Lescrauwaet et al., 2022). With a balance between technology, human resources, infrastructure, and regulations, digital transformation can function optimally as a bridge between pharmaceutical industry research and practice.

Implications for the Pharmaceutical Industry

The implications of the findings of this study emphasize that the pharmaceutical industry needs to build a collaborative ecosystem that is not solely profit-oriented, but also emphasizes the importance of knowledge sharing between stakeholders (Atkins et al., 2023). Cross-sector collaboration involving academics, industry, regulators, and practitioners will strengthen information exchange and accelerate the process of translating research into practice. In this way, innovations will not remain theoretical but can be truly implemented to meet industry needs while improving the quality of healthcare services.

In addition, digitalization has great potential to encourage more transparent, efficient, and evidence-based pharmaceutical practices (Ogundipe et al., 2025). By leveraging technologies such as big data, blockchain, and telemedicine, the pharmaceutical industry can improve supply chain accountability, optimize operational efficiency, and provide more targeted services to patients. This transformation also opens up opportunities to strengthen public trust and create new competitiveness for the pharmaceutical industry in facing global dynamics in the digital era.

Academic and Practical Contributions

Academically, this research makes a significant contribution to enriching the literature on pharmaceutical industry transformation by emphasizing the urgency of integrating academic research and industry practice through digitalization. This approach presents a new perspective on how digital technology can serve as a catalyst in accelerating innovation translation, while also offering a conceptual framework for understanding the dynamics of cross-sector collaboration in the digital era (Rey-Garcia et al., 2021). Thus, this research not only adds to the theoretical knowledge but also opens up space for further study on strategies for connecting research and practice in the pharmaceutical field.

Practically, this research provides recommendations that can serve as a reference for stakeholders in strengthening the transformation of the pharmaceutical industry. Key recommendations include the need for regulations that are more adaptive to technological developments, the development of competent human resources in the digital sector, and increased investment in digital infrastructure to support efficiency and transparency. With these steps, it is hoped that the pharmaceutical industry will be able to optimize the potential of digitalization, not only to increase competitiveness but also to provide tangible benefits to public health services (Fitriani et al., 2025).

CONCLUSION

Digital transformation has accelerated pharmaceutical research and practice through the use of technologies such as AI, big data analytics, blockchain, and telepharmacy. However, a gap remains between academic research and industry practice, particularly in the implementation of research findings in production, distribution, and healthcare systems. Obstacles include limited technologically literate human resources, high investment costs for digital infrastructure, and regulations that are not yet fully adaptive. Therefore, cross-sector collaboration between researchers, industry, and regulators is key to accelerating the translation of research into real-world practice. This study confirms that digitalization serves as a bridge connecting research with practice and serves as a foundation for developing a more innovative, efficient, and evidence-based pharmaceutical industry model.

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