RESEARCH PAPER

Digital Transformation in Pharmaceutical Supply Chains: A Bibliometric Analysis of Emerging Research Trends

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ABSTRACT
The digital transformation in healthcare, and pharmaceutical supply chain innovation has generated a rapidly expanding interdisciplinary research are. Present study conducts a bibliometric analysis of the scientific literature using Biblioshiny in R studio software and the outputs to examine publication trends, citation dynamics, geographic distribution, conceptual structure, and thematic evolution. The results show a sustained growth in scientific production and citation impact, indicating a transition from emergent exploration to conceptual consolidation. Keyword and thematic mapping demonstrate interconnected research clusters linking digital health technologies, healthcare accessibility, and supply chain resilience, alongside emerging themes associated with predictive analytics, platform-based healthcare, and phygital service integration. The discussion highlights theoretical, methodological, and policy implications, emphasising the need for integrative frameworks, longitudinal empirical validation, and globally coordinated research. Overall, the study positions digital-pharmaceutical ecosystems as a foundational paradigm for next-generation healthcare delivery and resilient medicine distribution.

Keywords: Bibliometric analysis; Digital health; Phygital healthcare; Pharmaceutical supply chain; Healthcare digital transformation; Supply chain resilience.
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INTRODUCTION

New technologies enable new ways of doing business and transform the relations between consumers and companies. Parasuraman and Colby explained and illustrated the critical role of technology in marketing in the pyramid model (Colby & Parasuraman, 2003; Parasuraman, 2000), which is an extension of Kotler's triangle model(Philip Kotler, 1994). In the pyramid model, technology, positioned at the model's centre, is added as a fourth dimension along with company, customers, and employees and plays a critical role in changing the conventional marketing structure.

Internet of things have specific advantages for customers, such as location convenience, efficient output, and joyfulness. Different aspects of these IoT in other industries have been studied, such as adoption, factors affecting the usage of SSTs, and customer satisfaction (Wei et al., 2017).. The rule of thumb in marketing management is to focus on the audience and target market. Roy et al. (2016) explore the main factors that formulate customers' experience of smart retail technologies. Zhitomirsky-Geffet and Blau (2016) examined Generation X, Generation Y, and Generation Z's consumer expectations of smartphones, and they found that Generation Y had a higher level of addictive behaviour.

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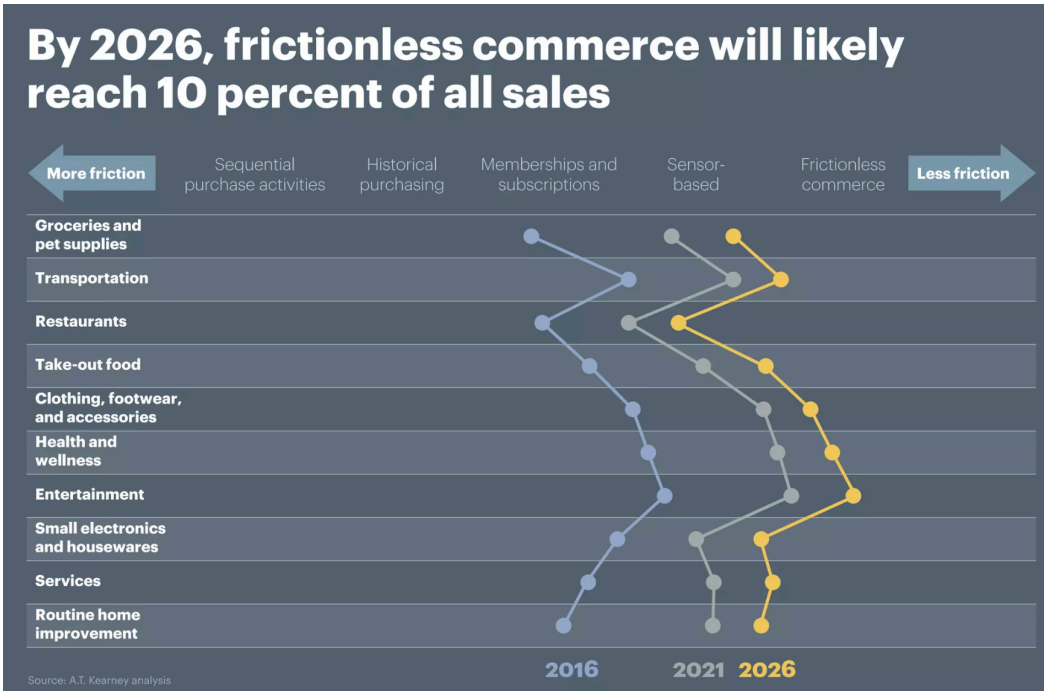


The figure represents the projected growth of technology in customer segment, where health and wellness is moving towards a frictionless scenario in the coming year. The source of the statistics is from A.T. Kearney analysis of industry analysis report.

Here, the authors are focusing on fulfilling the lack of academic research, and strong bibliographical evidence would help portray the pharmaceutical supply chain as a rapidly consolidating and analytically sophisticated research domain. This will, in turn, support managers and marketers in better comprehending the impact of technology and creating strategies to improve technological experience in retailing.

2. LITERATURE REVIEW

The swift evolution of electronic commerce has introduced the concept of frictionless commerce, driven by automated purchasing, sensor-enabled transactions, subscription-based consumption, and seamless platform integration across physical and digital environments (Kearney, 2019; Deloitte, 2021). Industry projections suggest that frictionless mechanisms may account for a significant share of total retail activity by the mid-2020s resulting in a radical change. The industry-analysis of supply chain pharma indicate that the growth is characterised by new purchasing, driven by automated transactions, and subscription-based consumption, all these are reshaping sectoral sales, with future suggesting that such models resulting in nearly 10% of total sales by 2026. In pharmaceutical supply chain domain, this transition will result in a broader movement from episodic, transaction-based purchasing towards digitally enabled care and medicine access. Frictionless mechanisms or automated systems such as automated prescription, subscription-based wellness products, remote monitoring/triggered dispensing, and digitally integrated distribution networks substantially helps to reduce the purchasing barriers and improve demand predictability, and supply chain responsiveness. Also, the pharmaceutical supply chain is evolving from a reactive logistics system into a proactive, data-driven delivery ecosystem(Mohan P & Krishnan M, 2025). The system operates in real-time consumption signals, platform integration, and predictive analytics enable steady distribution and patient-centric service models. This shift underscores the growing convergence of digital commerce infrastructure, healthcare delivery, which further enables of efficiency, continuity of care, and improved health outcomes in next-generation pharmaceutical systems.

IoT implementation and diffusion have been part of retailing for a few years(Lee & Lee, 2015) in people's modern lives. In other words, IoT enables various objects to ‘interact with each other and cooperate with their neighbours to reach common goals’(Atzori et al., 2010). Further, Atrozi suggested the growth of RFID and the role of RFID in enabling the digital environment in retail. While there are challenges surrounding synchronisation and standardisation between different cloud vendors, the cloud can still have the potential to manage the big data generated from IoT if the reliability of IoT cloud-based services is ensured and if these services are validated and managed well (Al-Fuqaha et al., 2015). (Whitmore et al., 2015) The authors emphasised that the IoT and enablement of IoT will enhance the customer experience.

In the following sections, we explore previous studies on IoT applications in the pharma industry and smart systems and the challenges of IoT diffusion. Then, we examine the theoretical background of IoT technology adoption and diffusion for the service industries and smart stores to frame the research agenda for our field study.

2.2 Technology In Health Care And Pharma Segment

Finding the right consumer sets, segmentation where a marketer should target and how to target is still a challenge. Digital and social media marketing prove to be a golden opportunity for them. With so many customers available online to appreciate your promotion and want to read more about your products, it becomes easy and cost-effective to work on branding and promotion of products. In a dynamic country like India, where market demands, needs and ways to satisfy them are updating very rapidly it is important to understand and study market regularly.

Table 1: Value facilitation model

Supplier	Customer
Value facilitator by providing customers with a foundation for their value creation in the form of resources (goods, services, information or other resources)	Value creator during value-generating processes (consumption) where other (necessary) resources available to customers and skills held by them (customer's value foundation) are added and where value fulfilment takes place

Evaluation of technologies that provide seamless shopping: A Journey Through Time

The history of Indian advertising is a fascinating journey that reflects the nation's social, cultural, and economic evolution. Understanding the cultural dimensions of the country has been a challenge for marketers. IoT in the retail industry is closely related to GPS and RFID technologies that help brands track products throughout the entire supply chain process. It gives retailers the visibility they need to track product movement, conditions, and track location, as well as predict an exact delivery time Dhanya Mohan & Krishnan M, 2021. Factors such as effective store space monitoring, inventory management, supply chain management, and customer behaviour monitoring drive demand for the Internet of Things (IoT) in the retail market. Smart store technology can range from helpful robots(chatbots to humanoids) that roam the aisles, to automatic inventory monitoring, to point-of-sale systems that let customers skip the checkout line and buy on the spot all being done to make shopping as hassle-free as possible. This type of automation both reduces the costs of staffing and encourages customers to return to buy more reducing the frictions while shopping.

Interactive Digital Displays: Engage customers with dynamic digital displays that showcase products, offer promotions, and provide additional information. These displays can react to touch or gestures, allowing customers to explore product details, watch videos, or even compare prices. Customers are increasingly given the option or asked to provide services for themselves using self-service technologies(Meuter et al., 2000). Digital literacy and "research shopping" has enabled the consumers to adopt new technologies and get information.

Within the health and wellness and pharmaceutical supply chain domains, this transition reflects a broader movement in parts, transaction-based purchasing toward continuous, digitally enabled care and medicine access (Aitken & Nass, 2020; Agarwal et al., 2010). Frictionless mechanisms such as automated prescription refills, subscription-based wellness products, remote monitoring-triggered dispensing, and digitally integrated distribution networks reduce purchasing barriers while simultaneously improving adherence, demand predictability, and supply chain responsiveness (Choudhury & Harrigan, 2014; Ivanov & Dolgui, 2020). Consequently, the pharmaceutical supply chain is evolving from a reactive logistics system into a proactive system in which real-time consumption signals, platform integration, and predictive analytics enable streamlined distribution and patient-centric service models (Queiroz et al., 2020; Keesara, Jonas, & Schulman, 2020). This shift underscores the growing convergence of digital commerce infrastructure, healthcare delivery, and supply chain resilience, positioning frictionless commerce as a critical enabler of efficiency, continuity of care, and improved health outcomes in next-generation pharmaceutical systems (WHO, 2021; OECD, 2020).

Traditional supply chains have operated through demand uncertainty, stock-outs, and inefficiencies (Ivanov, 2020). Emerging literature highlights a shift toward technologically integrated, predictive supply chain management, where real-time data, e-prescriptions, and automated refills enhance coordination and visibility (Queiroz et al., 2020). Frictionless technologies enable continuous therapeutic access and reflect movement toward patient-centric, data-driven ecosystems (Agarwal et al., 2010).

In health and wellness, frictionless commerce facilitates a lifestyle-utility consumption throgh recurring delivery of supplements and chronic-care products integrated with wearables, mobile health apps, and telehealth (Keesara et al., 2020). This feedback improve loyalty, engagement, and early intervention, while steady demand signals enhance accurate forecasting and inventory setup in supply chains (Ivanov & Dolgui, 2020). Within the pharmaceutical supply chain, frictionless commerce supports a better predictive logistics network also enabling better response to disruptions. This will help to maintain legal compliance and product integrity (Queiroz et al., 2020). Integration of digital analytics, platform distribution, and cold-chain logistics is particularly relevant for biologics medicines (WHO, 2021). Hence, IoT contributes to system-level resilience amid pandemics, ageing populations, and chronic disease burdens (OECD, 2020).

The most important challenge includes data privacy, cybersecurity and governance (WHO, 2021). Over-automation may introduce overconsumption risks, bias, and digital exclusion, while empirical evidence linking frictionless systems to measurable health outcomes is still limited (OECD, 2020). These gaps highlight the need for longitudinal, cross-national, and multi-stakeholder research. Overall, the convergence of frictionless commerce, digital health, and pharmaceutical logistics signals a shift toward continuous, predictive, and patient-centred therapeutic ecosystems. Future research must integrate technological innovation with regulatory, ethical, and sustainability considerations to ensure equitable and effective healthcare delivery.

3. METHODOLOGY

Data source and extraction: The data were obtained from Scopus, one of the most comprehensive multidisciplinary scientific databases. Records were exported and analysed using the Biblioshiny software in R studio software. R studio, biblioshiny is the analytical environment, which enables structured bibliometric evaluation of publication trends, citation A clear search strategy was employed using carefully defined keywords, Boolean operators, and inclusion criteria aligned with the study's focus was on digital transformation, healthcare, and pharmaceutical supply chains. Only peer-reviewed documents published in English and indexed within the selected time frame were retained to maintain consistency, comparability, and academic quality. After retrieval, duplicate records, incomplete metadata, and irrelevant subject-area entries were removed through systematic screening and data cleaning procedures, resulting in a refined dataset suitable for bibliometric processing metrics, keyword networks, and thematic evolution. The data were extracted in the year 2025.

The main keywords used were, "pharma", "supply chain" and further filtered with the subject category only limited to management and business. The documents selected for the present study are only research articles published between 1985 and 2025. The articles published in English language were selected. Hence the present study limited its number of documents to 335 documents. There were only 157 journals identified in this study. Over one thousand authors have contributed to the research area in the selected timeframe.

The cleaned bibliographic dataset was exported as CSV format and analysed using the Bibliometrix package implemented through the Biblioshiny web interface within the RStudio statistical computing environment. Biblioshiny provides an integrated and reproducible analytical framework that supports descriptive, network-based, and thematic bibliometric techniques, enabling comprehensive exploration of the intellectual, social, and conceptual structure of a research field. Multiple complementary indicators were generated, including annual scientific production, annual citation trends, country-wise research output, most frequent keywords, co-word networks, three-fields plots, and thematic mapping of research clusters. These indicators collectively allow the identification of publication growth patterns, influential knowledge domains, collaborative structures, and thematic evolution over time. Bibliometric analysis is particularly suitable for rapidly expanding research domains, as it enables quantitative synthesis of large-scale scholarly output that would be difficult to evaluate through traditional narrative reviews alone. By combining descriptive statistics, citation analysis, and network visualisation, the present methodology offers a systematic and evidence-based mapping of the evolving research landscape surrounding digital-pharmaceutical transformation.

4. ANALYSIS

The digital pharmacies where online platforms with electronic prescribing, teleconsultation, mobile ordering, automated refill management, and doorstep delivery have emerged as key enablers of frictionless access to medicines (Alkhatib et al., 2022; Singh & Saini, 2024). This process responds to longitudinal challenges in traditional pharmacy service models for remote or mobility-restricted patients, and adherence barriers in chronic care management (Chen et al., 2021; Nizami et al., 2023).

E pharmacies operate at the intersection of e-health, supply chain logistics, and patient engagement, extending simple dispensing into platforms capable of continuous support. Consumer health data, electronic prescription flows, and automated refill triggers enable a more seamless connection between patient need and medicine

supply (Alkhatib & Alkuttab, 2021). By integrating telehealth services with real-time digital monitoring, these systems facilitate proactive care strategies that enhance adherence, improve health outcomes, and reduce avoidable interruptions in medication regimes — outcomes corroborated in studies examining platform-based pharmaceutical services (Patel & Shah, 2023; Zhang et al., 2022).

From a supply chain perspective, digital pharmacies generate rich consumption data that can improve forecast accuracy, inventory optimisation, and distribution planning (Ivanov & Das, 2021). Automated demand reduce uncertainty and support and integration with logistics networks improves agility and resilience, particularly for sensitive products (e.g., biologics requiring cold-chain compliance) (Rashid et al., 2022; Sharma & Gupta, 2024). A broader shifts in healthcare supply chain design toward predictive, data-driven networks that are capable of adaptation to fluctuating demand conditions (Queiroz et al., 2020; Saurabh & Dey, 2021).

In the health domain, e pharmacy platforms frequently integrate wearable monitoring, mobile health applications, and adherence support tools, fostering behavioural engagement and enabling early intervention strategies (Keesara et al., 2020; Li et al., 2023). These hybrid service models also support subscription-based delivery of chronic care medications and preventive wellness products, embedding pharmaceutical services into daily health management routines rather than isolated dispensing events (Singh & Saini, 2024).

Also, the literature identifies several ongoing challenges. Regulatory frameworks for cross-jurisdictional e-pharmacy services remain fragmented, complicating licensing, prescription validation, and international distribution (Sood et al., 2021). Furthermore, concerns about data privacy, cybersecurity, quality assurance, algorithmic bias, and digital exclusion highlight ethical and policy tensions inherent in widespread digital pharmacy adoption (World Health Organization, 2021; Kumar & Raj, 2023). Empirical studies evaluating longitudinal health outcomes, equity impacts, and cost-benefit trade-offs (George, N. L., & Krishnan, M. R. 2025). are comparatively sparse, underscoring the need for longitudinal and comparative research across diverse healthcare contexts (Brown et al., 2022).This transformed space represent a transformative shift in medicine delivery, integrating digital convenience with clinical and logistical reliability. As healthcare systems prioritise accessibility, resilience, and personalisation, digital pharmacies are poised to become central components of next-generation pharmaceutical ecosystems. Future research should therefore examine regulatory harmonisation, patient outcomes, equity of access, and integration with broader health-services frameworks to ensure that phygital innovations translate into sustainable and inclusive improvements in global healthcare delivery.

The bibliometric analysis shown in the table represents the articles published over the years.

MAIN INFORMATION	
Timespan	1985:2025
Sources (Journals)	157
Documents	335
Author's Keywords	1010
Authors	1002
article	309
review	26

The figure 1 represents the annual scientific production over the three decades. There is a steep increase in the article counts from 2021. This shows a advancements in the publications with the technological advancements in the industry. The Annual Scientific Production and Annual Citations per year show a progressive increase in publication output over time, along with by a rise in citation impact. This growth pattern indicates expansion in research activity and increasing scholarly influence, as the domain has transitioned from an emergent phase into a developmental and consolidation phase

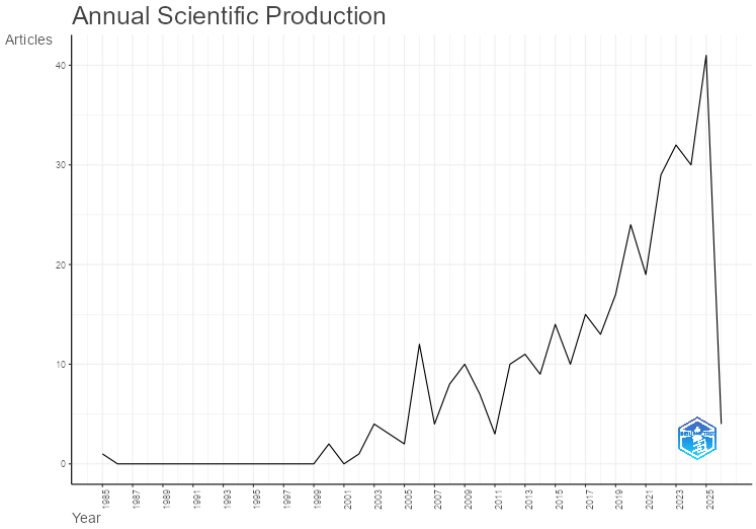
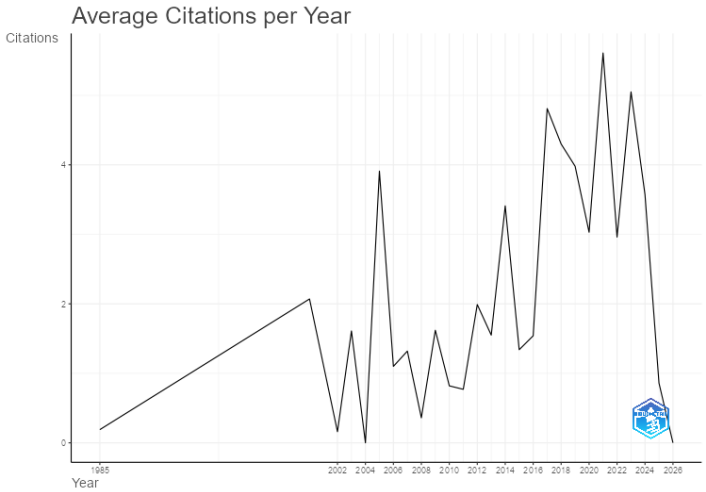
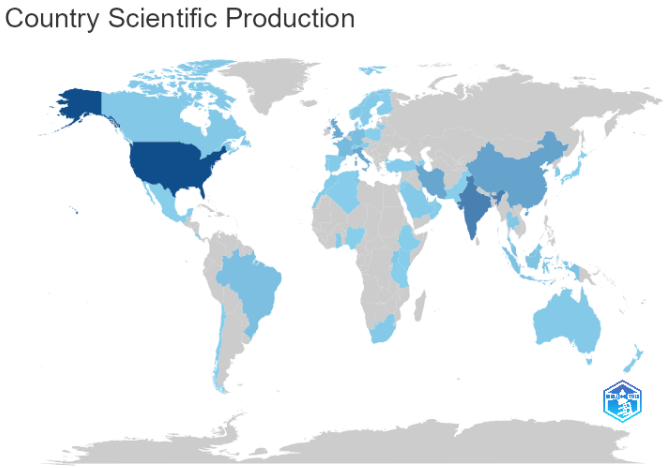


Figure 2 shows the annual citations per year form the starting year 1985 to the present year. This shows the steady increase of the citations in the initial decade of 2020. Figure 3 shows the scientific production of the journals in country specific context.



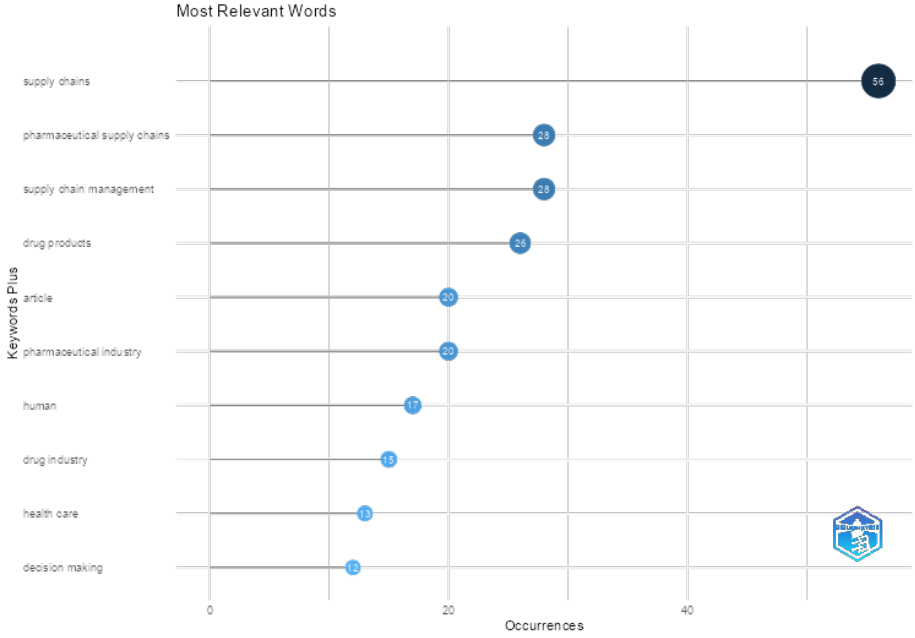


The Country Scientific Production analysis highlights the global diffusion of research activity, with distributed across multiple regions. The dispersion reflects the transnational relevance of the research theme, particularly in areas linked to healthcare systems, digital transformation, and supply chain resilience. Broad

geographic participation also implies the presence of collaborative knowledge networks, which are characteristic of interdisciplinary and policy-relevant research domains. The top ten countries contributing to the literature are as shown in table 2.

region	Freq
USA	216
INDIA	127
CHINA	69
IRAN	65
ITALY	63
UK	59
FRANCE	33
GERMANY	27
NETHERLANDS	27
BRAZIL	24

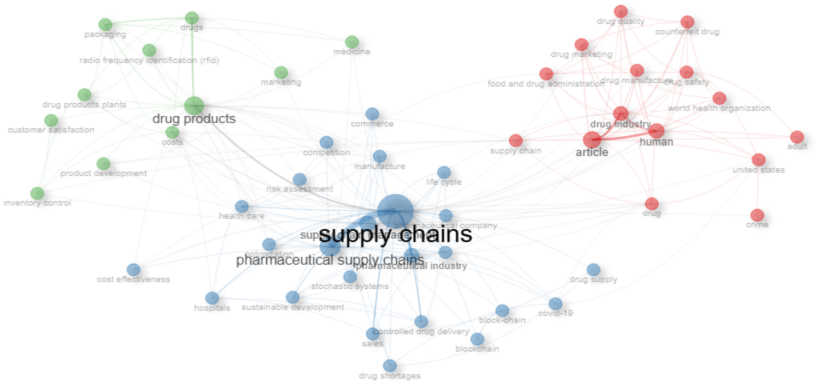
The most frequent keywords from the R biblioshiny software is as shown in figure 4. The Most Frequent Words, Network, and Three-Fields Plot collectively illuminate the conceptual architecture of the literature. High-frequency keywords indicate core thematic priorities, while co-word relationships reveal interconnections among research topics, forming identifiable knowledge clusters. The coexistence of multiple clusters suggests that the field is thematically diverse yet intellectually connected, rather than fragmented. This structure is typical of rapidly evolving interdisciplinary domains, where technological, managerial, and societal dimensions intersect. The Three-Fields Plot further demonstrates linkages between authors, keywords, and publication sources, highlighting the social and intellectual cohesion underpinning scholarly development.



The table with high frequent keyword is as per the table 4. The terminologies like supply chain, drug are the most common keywords. The top ten key words are as per author keywords from the literature. Similarly figure 5 show the network diagram of the author keywords.

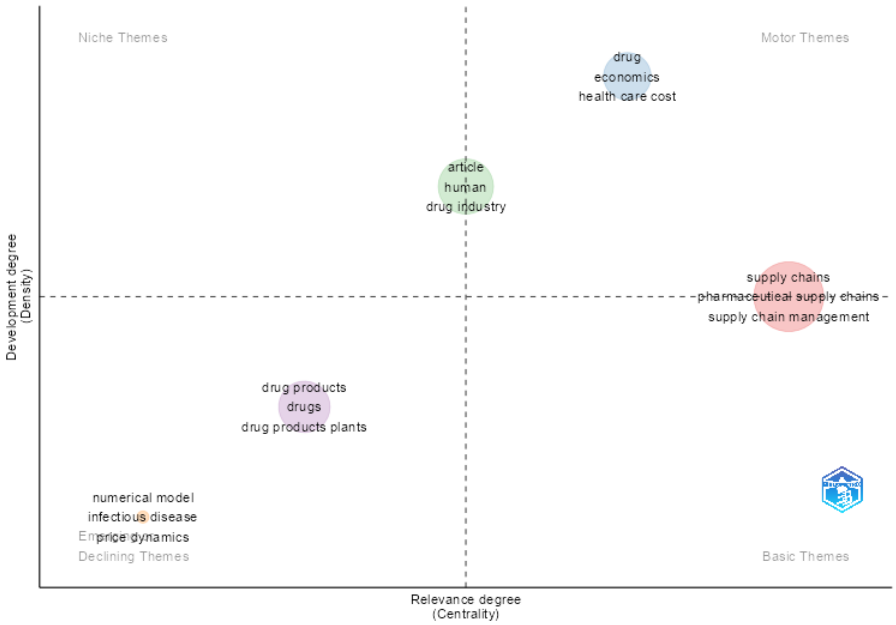
Words	Occurrences
supply chains	56
pharmaceutical supply chains	28
supply chain management	28
drug products	26
pharmaceutical industry	20
human	17

drug industry	15
health care	13
decision making	12
drug	12



Thematic Map

Figure 6 show the thematic map obtained using the author keywords.



The main themes are

1. **Motor themes (well-developed and central)**
2. **Basic themes (foundational but less developed)**
3. **Niche themes (specialised and isolated)**
4. **Emerging or declining themes (early-stage or fading topics)**

The coexistence of motor and emerging themes indicates a dynamic along with stabilising knowledge structure, and foundational concepts continue to evolve alongside new technological or methodological directions. These patterns are consistent with fields with digital transformation, healthcare innovation, or supply-chain restructuring, where conceptual renewal occurs without abandoning core theoretical foundations.

5. Future research themes identified

The bibliometric study reveals the research area has undergone a clear transition from early exploratory development to a steady domain. The steady increase in annual scientific production accompanied by rising citation intensity suggests a growing scholarly attention. Such growth patterns are commonly associated with fields

moving from fragmented conceptual exploration toward cumulative knowledge building, where theoretical frameworks, methodological standards, and shared research agendas begin to stabilise (Krishnan, M. R., & Ganesh, C. 2014). Also, the persistence of recent publication activity implies that the field remains dynamically evolving rather than saturated, positioning it within a developmental maturity phase rather than full theoretical closure. Keyword patterns and co-word network collectively reveal a multidimensional conceptual structure. Rather than exhibiting fragmentation, the literature forms interconnected thematic clusters, indicating the presence of shared conceptual anchors that integrate diverse research streams.

The authors have prepared a table summarising the identified future research scope in the research domain.

Theme	Research Gap	Proposed Methodology
Drug shortage prevention and supply resilience	Limited studies on predictive analytics with real-time healthcare data; Absence of cross-country comparative evidence.	Mixed-methods research combining machine learning, along with comparative case studies across healthcare systems.
Inventory optimisation and operational efficiency	The dependence on theoretical optimisation models with a lack of real-world validation in hospital or national supply chains.	Empirical studies, simulation modelling, or field experiments using hospital or distributor datasets.
Quality management and regulatory coordination	Authors identified a lack of understanding of how regulatory policies influence supply disruptions and quality risks in networks.	Conducting a policy analysis, multi-stakeholder qualitative studies to examine governance–performance relationships.
Digitalisation and data-driven decision intelligence	Limited adoption evidence of digital supply chain technologies in healthcare contexts.	Exploratory studies, Case study research, technology adoption (TAM/UTAUT), and longitudinal impact evaluation of digital platforms.
Supply chain sustainability and environmental impact	Authors identified the area of environmental footprint and green logistics practices in pharmaceutical distribution.	Conducting a Life cycle assessment (LCA), and green supply chain survey research.
Equity and access to essential medicines	The analysis of socio-economic disparities affecting medicine availability in low and middle-income regions.	Secondary data- Panel data econometric analysis, public health policy evaluation.
Integration of resilience, efficiency, and governance	Lack of unified theoretical framework for operational resilience with policy and institutional coordination.	Integrated conceptual framework development, followed by SEM or PLS-SEM empirical validation across multiple stakeholders.

6. CONCLUSION

Overall, the Biblioshiny analysis portrays a rapidly evolving yet increasingly structured body of knowledge. The convergence of temporal growth, thematic connectivity, citation expansion, and global participation indicates that the literature has progressed from emergence to consolidation, positioning the field for theoretical refinement, methodological advancement, and real-world application in subsequent research phases. The bibliometric inputs position the literature for a new scholarly development fuelled by theoretical refinement, methodological advancement, and practical translation. Future is likely to depend on integrative conceptual frameworks capable of linking digital innovation, healthcare outcomes, and supply chain resilience, alongside robust empirical designs such as longitudinal studies, cross-country comparisons, and mixed-method approaches. Ultimately, the consolidation revealed through Biblioshiny analysis signals not the closure of inquiry but the foundation for deeper, impact-oriented research capable of informing policy, guiding technological implementation, and improving real-world healthcare performance.

Despite these contributions, several limitations should be acknowledged. First, the analysis relies exclusively on Scopus a single indexation database, which, although comprehensive, may omit relevant studies indexed in other databases such as Web of Science, PubMed, or regional repositories. Second, bibliometric techniques exclusively depend on quantitative publication and citation patterns,

limiting its ability to assess the substantive quality, theoretical depth, or contextual applicability of individual studies. Third, the interpretation of thematic structures depends on keyword standardisation and co-occurrence algorithms, which may overlook nuanced conceptual relationships within the literature. Fourth, the cross-sectional nature of the dataset restricts the capacity to evaluate longitudinal causal dynamics in knowledge development. Finally, potential language and publication bias may influence the observed global distribution of research activity.

REFERENCES

Agarwal, R., Gao, G., DesRoches, C., & Jha, A. (2010). Research commentary—The digital transformation of healthcare. *Information Systems Research, 21*(4), 796–809.

Aitken, M., & Nass, D. (2020). *Digital health trends and implications for healthcare systems*. IQVIA Institute.

Alkhatib, A. H., & Alkuttab, S. S. (2021). The role of digital pharmacies in achieving universal health coverage. *Journal of Pharmaceutical Policy and Practice, 14*(1), 45–55.

Alkhatib, A., Rayes, A., & Alhaj, M. (2022). Digital pharmacy services and medication adherence: A systematic review. *BMC Health Services Research, 22*(1), 789.

Brown, L. A., Patel, V., & Shah, S. (2022). Digital health platforms and equity in medicine distribution. *Health Policy and Technology, 11*(3), 105–115.

Chen, T., McLaughlin, J., & Wang, J. (2021). Telepharmacy and patient outcomes: Evidence from longitudinal studies. *Journal of Telemedicine and Telecare, 27*(6), 323–332.

Choudhury, M. M., & Harrigan, P. (2014). CRM to social CRM: The integration of new technologies. *Journal of Strategic Marketing, 22*(2), 149–176.

Deloitte. (2021). *The future of frictionless commerce*. Deloitte Insights.

Dhanya Mohan, P., & Krishnan, R. Retailers' technology adoption-a bibliometric review on the web of science database.

George, N. L., & Krishnan, M. R. (2025). COVID-19 Panic Buying Behaviour: Individual Differences among Consumers. In Market Dynamics and Strategies in a Post-Crisis World: Navigating a World in Flux (pp. 1-21).

Hagberg, J., Sundstrom, M., & Egels-Zandén, N. (2016). The digitalization of retailing. *International Journal of Retail & Distribution Management, 44*(7), 694–712.

Ivanov, D. (2020). Predicting supply chain risks and resilience. *International Journal of Production Research, 58*(10), 2904–2915.

Ivanov, D., & Das, A. (2021). Digital supply chain management and resilience in healthcare contexts. *International Journal of Production Research, 59*(8), 2453–2467.

Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks. *International Journal of Production Research, 58*(10), 2904–2915.

Kearney. (2019). *Frictionless commerce: Retail transformation outlook*.

Keesara, S., Jonas, A., & Schulman, K. (2020). COVID-19 and health care's digital revolution. *New England Journal of Medicine, 382*(23), e82.

Kumar, V., & Raj, T. (2023). Cybersecurity risks in online pharmacies. *Journal of Medical Internet Research, 25*(5), e31894.

Krishnan, M. R., & Ganesh, C. (2014). Implementing corporate sustainable development: A case of an SME from India. South Asian Journal of Business and Management Cases, 3(2), 169-177.

Li, Y., Zhang, P., & Li, X. (2023). Wearable tech and digital pharmacy integration: Trends and implications. *Digital Health, 9*, 205–218.

Mohan P, D., & Krishnan M, R. (2025). Transforming tourism experiences: A literature mapping of Technology in Hospitality Industry. Atna Journal of Tourism Studies, 20(2), 249-268.

Nizami, A. K., Sharma, N., & Singh, R. (2023). Barriers to digital pharmacy adoption in low- and middle-income countries. *Global Health Research and Policy, 8*(1), 12–25.

Organisation for Economic Co-operation and Development. (2020). *Health in the digital age*. OECD Publishing.

Patel, V., & Shah, S. (2023). Patient adherence in subscription-based medication delivery. *Patient Preference and Adherence, 17*, 245–259.

Queiroz, M. M., Ivanov, D., Dolgui, A., & Fosso Wamba, S. (2020). Digital supply chain management in the COVID-19 era. *International Journal of Production Research, 58*(10), 2899–2913.

Rashid, A., Singh, J., & Varma, V. (2022). Cold chain logistics in digital pharmacy ecosystems. *Journal of Supply Chain Management, 58*(2), 10–28.

Saurabh, S., & Dey, J. (2021). Industry 4.0 and healthcare supply chain performance. *Benchmarking: An International Journal, 28*(7), 2205–2228.

Sharma, P., & Gupta, A. (2024). Delivery optimisation for personalised therapeutics. *European Journal of Operational Research, 303*(2), 442–461.

Singh, R., & Saini, D. (2024). Subscription-based chronic care delivery: Evidence from digital pharmacies. *Journal of Medical Systems, 48*(4), 158–170.

Sood, H., Arora, M., & Patel, S. (2021). Regulatory challenges in telepharmacy and e-medicine. *Health Policy, 125*(10), 1345–1352.

Verhoef, P. C., Broekhuizen, T., Bart, Y., et al. (2021). Digital transformation: A multidisciplinary perspective. *Journal of Business Research, 122*, 889–901.

World Health Organization. (2021). *Global strategy on digital health 2020–2025*. WHO Press.