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EMERGING THEMES IN MEDICATION SAFETY: A BIBLIOMETRIC ANALYSIS OF PHARMACY PRACTICE LITERATURE

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Abstract:

Introduction: Medication safety is a critical focus in healthcare, aiming to reduce adverse drug events and ensure optimal patient outcomes. Despite advancements in pharmacy practice, medication errors persist as a significant global challenge, necessitating a structured understanding of the evolving trends in this field. **Methodology**: This study explores emerging trends in medication safety through a bibliometric analysis of pharmacy practice literature. Utilizing Scopus Analyzer and VOSviewer software, a dataset of 1,152 publications was analyzed to identify prominent themes, influential authors, leading institutions, and key collaborative networks. Using Scopus Analyzer and VOSviewer software, this study analyzed 1152 articles, identifying key research areas and exploring the relationship between countries, institutions, and influential authors. **Results**: The results highlight a strong focus on critical themes such as medication safety, medication errors, patient safety, and integrating technology in pharmacy practice. High-frequency keywords such as "medication safety" and "patient safety" were central to the literature, reflecting the continuous efforts to improve healthcare practices and minimize medication-related risks. Geographically, the United

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States, the United Kingdom, and Australia were found to be the leading contributors to this field, with growing involvement from emerging regions such as China and Saudi Arabia. The analysis reveals the increasing role of digital tools, including electronic health records and clinical decision support systems, in enhancing medication safety. **Conclusion:** This bibliometric analysis underscores the evolving landscape of medication safety research, emphasizing the role of pharmacists and technology in reducing medication errors. Our findings highlight the growing global recognition of the importance of medication safety and the need for further collaboration, particularly in less-represented regions. By providing insights into the shifting landscape of pharmacy practice literature and highlighting the need for continued research and international cooperation, this study informs evidence-based policies. It supports the advancement of medication safety practices globally to address medication safety challenges effectively.

Keywords:

Medication Safety, Pharmacy Practice, Medication Errors, Patient Safety, Bibliometric Analysis

Introduction

Medication safety is a critical component of healthcare, essential for minimizing adverse drug events (ADEs) and ensuring optimal patient outcomes. Despite advances in healthcare and pharmacy practices, medication errors remain a significant global concern, contributing to morbidity and mortality. Pharmacists have transitioned from traditional dispensing roles to active involvement in clinical decision-making, medication therapy management, and patient education, significantly reducing errors in areas like medication reconciliation and transitions of care (Cox, Wilkins, and Routledge, 2020; Lat *et al.*, 2020; Venkatesan, 2022). However, the growing complexity of pharmacotherapeutics and healthcare systems necessitates an ongoing focus on understanding emerging trends in medication safety (Venkatesan, 2022).

Bibliometric analysis offers a systematic approach to explore research trends, identify gaps, and guide future initiatives in medication safety. By analyzing patterns in scientific publications and citation networks, it provides insights into the evolution and impact of research in this field (Wang *et al.*, 2022). This study aims to conduct a bibliometric analysis of pharmacy practice literature, examining key themes and trends to identify areas requiring further investigation. The findings will support evidence-based practices, inform policy-making, and enhance pharmacists' contributions to advancing medication safety.

Literature Review

Medication safety remains a central focus in pharmacy practice, with continuous advancements in research and application. Several studies highlight the role of pharmacists in promoting safe medication use through innovative programs. For example, (Carr-Lopez *et al.*, 2020) introduced a remote-based module using veterans' electronic health records (EHRs) for medication safety monitoring. (Scott *et al.*, 2019) examined the implementation of entrustable professional activities (EPAs) in North Dakota, evaluating pharmacists' involvement in medication safety. (Warholak *et al.*, 2015) highlighted a drug utilization review (DUR) checklist to improve safety in community pharmacies. These studies emphasize the growing integration of technology and structured training to enhance medication safety. Community

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pharmacists are increasingly identified as key players in addressing medication safety challenges. (Al Juffali *et al.,* 2019) explored issues within Saudi Arabian community pharmacies, including commercial pressures and communication failures, aligning with (Hertig *et al.,* 2017), who showed the positive impact of pharmacy students in the transition of care programs. (Chamoun *et al.,* 2020) observed better medication safety practices in teaching hospitals in Lebanon than in non-teaching ones. These findings underline the crucial role of pharmacists in both community and hospital settings in improving safety.

Despite advancements, gaps remain, particularly in integrating mobile health technologies into medication safety programs. (Taber *et al.,* 2019) discussed the potential of mobile health tools in kidney transplant patients but noted limited application in broader pharmacy practice. Additionally, (Al Juffali *et al.,* 2019) highlighted the need for improved communication between pharmacists, patients, and healthcare teams, which warrants further research. Another trend is the integration of medication safety initiatives within clinical pharmacy, particularly through structured management systems like the Closed Loop Medication Management (CLMM). (Berger *et al.,* 2022) demonstrated that clinical pharmacists within the CLMM framework reduced medication errors (MEs), while (Alkatheri *et al.,* 2017) emphasized the importance of medication safety training in the PharmD curriculum. (Murphy *et al.,* 2022) found that opioid stewardship in rehabilitation settings reduced opioid use, showcasing the potential of structured systems to enhance safety.

The role of pharmacists in managing high-risk medications, such as lithium and warfarin, is also significant. (McKee and Cleary 2007) and (Li *et al.,* 2020) demonstrated how pharmacist-led interventions in psychiatric and ICU settings can reduce adverse drug reactions (ADRs) and improve patient safety. However, further research is needed to assess the cost-effectiveness and long-term impact of these interventions in outpatient and community pharmacy settings. Research gaps persist in standardizing medication safety training across pharmacy schools and evaluating the scalability of technological tools like electronic prescribing systems. The integration of these technologies in diverse healthcare settings, particularly in low-resource environments, remains an area for further investigation.

Emerging trends also highlight the role of student pharmacists and productivity tracking in medication safety. (Fit 2008), and (Shogbon and Lundquist 2014) demonstrated the positive impact of student pharmacist interventions on patient care, while (Forehand *et al.,* 2022) emphasized the need for standardized tracking methods to assess pharmacist contributions to safety. (Strand *et al.,* 2022) and (McCarthy *et al.,* 2021) focused on pharmacists' role in managing high-risk medications like opioids, underlining the importance of risk management strategies. Despite these advancements, gaps remain, particularly in the impact of technological innovations such as automated verification systems. (Bienvenida *et al.,* 2022) found that auto verification could reduce workloads in emergency departments without compromising safety, highlighting the need for further research on integrating such technologies across various pharmacy settings.

Current research in medication safety emphasizes technology integration, structured training, and interprofessional collaboration. However, challenges like inconsistent safety standards and underuse of mobile health tools persist. Future research should address these gaps by exploring new technologies, enhancing collaboration, and standardizing practices to improve medication safety and advance pharmacists' roles. Emerging trends focus on pharmacist-led interventions,

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medication safety education, and technology to enhance safety. However, gaps remain in standardizing education, assessing intervention cost-effectiveness, and scaling technologies. Future research should address these to strengthen pharmacy practice and prevent adverse drug events. Despite progress in areas like student involvement, productivity tracking, opioid risk management, and technological innovations, gaps remain. Further studies are needed to standardize productivity tracking, assess auto-verification technologies, and fully integrate pharmacists into patient care, particularly in primary and community settings. These efforts will enhance medication safety practices. This review leads us to formulate five research questions as follows:

Research Questions (RQ)

RQ 1: What are the search trends in medication safety studies according to the year of publication?
RQ 2: Who and how much has been published in the area with regard to the authors?
RQ 3: Who are the top 10 authors based on citation by research?
RQ 4: What are the popular keywords related to the study?
RQ 5: What are co-authorship countries' collaboration?

Methodology

Bibliometrics involves collecting, managing, and analyzing data from scientific publications (Alves, Borges, and De Nadae 2021; Assyakur and Rosa 2022; Verbeek et al. 2002). It includes basic statistics, such as the journals where articles are published, publication year, and main author classification (Wu and Wu, 2017), as well as more complex techniques like document co-citation analysis. Conducting a successful literature review is an iterative process that requires identifying the right keywords, searching the literature, and analyzing findings thoroughly to create a well-rounded bibliography and obtain reliable results (Fahimnia, Sarkis, and Davarzani 2015). With this in mind, the study focused on top-tier publications, which provide valuable insights into the theories shaping this research area. Data collection was done using the SCOPUS database to ensure reliability (Al-Khoury *et al.*, 2022; Khiste and Paithankar, 2017; di Stefano, Peteraf, and Veronay, 2010). To maintain a high-quality standard, only articles published in peer-reviewed academic journals were included, while books and lecture notes were excluded (Gu *et al.*, 2019). The Scopus database, known for its broad scope, enabled the collection of publications from 2004 to December 2024 for analysis.

Data Search Strategy

Advanced searching on the Scopus database is a feature that allows researchers to perform highly specific and refined searches to retrieve the most relevant documents for their research needs. Unlike basic keyword searches, advanced searching enables users to apply various techniques and tools, such as Boolean operators, field codes, filters, and other criteria, to customize and narrow down results. Overall, advanced searching in Scopus is a powerful tool for researchers looking to gather specific and high-quality results. By tailoring the search with various operators and filters, users can locate publications that are most relevant to their research questions, leading to more accurate and efficient literature reviews or bibliometric analyses. Table 1 outlines the search criteria and filters applied during an advanced search in the Scopus database. The specific search query used is `TITLE-ABS-KEY(("Medication Safety") AND ("pharmacy practice" OR pharmacy)) AND PUBYEAR > 2003 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE, "English"))`, which specifies that the search is limited to documents containing the keywords "medication

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safety" and either "pharmacy practice" or "pharmacy" in the title, abstract, or keywords. Additionally, the search is confined to a publication timeline from 2004 to 2024 and is limited to English-language documents.

Table 1: The Search String.

Scopus	TITLE-ABS-KEY (("Medication Safety") AND ("pharmacy practice" OR pharmacy)) AND PUBYEAR > 2003 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE, "English")).

Table 2 lists the selection criterion in the search strategy. The selection criteria outlined in the table specify both inclusion and exclusion parameters for the search. This advanced search strategy helps to refine the dataset, ensuring that only relevant, high-quality, and accessible documents are included for analysis in the study.

Table 2: The Selection Criterion In The Search Strategy.

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2004–2024	> 2024

Data Analysis

VOSviewer is an accessible bibliometric software created by Nees Jan van Eck and Ludo Waltman at Leiden University in the Netherlands (van Eck and Waltman 2010, 2017). This tool is widely used for visualizing and analyzing scientific literature, focusing on producing intuitive network visualizations, clustering similar items, and generating density maps. Its flexibility supports the exploration of co-authorship, co-citation, and keyword co-occurrence networks, allowing researchers to gain a detailed understanding of research landscapes. The software's interactive interface and continuous updates enable efficient and dynamic exploration of large datasets. VOSviewer's capabilities in metrics computation, customizable visualizations, and compatibility with various bibliometric data sources make it a valuable asset for scholars analyzing complex research domains.

One of VOSviewer's key strengths is its ability to transform complex bibliometric data into visually accessible maps and charts. Designed for network visualization, the software is particularly effective at clustering related items, analyzing keyword co-occurrence patterns, and generating density maps. Its user-friendly interface benefits both novice and experienced researchers, enabling them to efficiently navigate and interpret research landscapes. VOSviewer's ongoing development keeps it at the cutting edge of bibliometric analysis, providing valuable insights through metrics computation and customizable visualizations. Its flexibility with different types of bibliometric data, such as co-authorship and citation networks, makes VOSviewer a versatile and essential tool for scholars seeking deeper insights within their fields.

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Datasets containing information on publication year, title, author name, journal, citations, and keywords in PlainText format were collected from the Scopus database, covering the period from 2004 to December 2024. These datasets were then analyzed with VOSviewer version 1.6.20, using VOS clustering and mapping techniques to create visual maps. Unlike the Multidimensional Scaling (MDS) approach, VOSviewer places items in low-dimensional spaces, where the distance between any two items accurately reflects their relatedness (van Eck and Waltman 2010). This approach shares some principles with MDS (Appio, Cesaroni, and Di Minin 2014) but differs in its normalization of co-occurrence frequencies, employing a more suitable method, such as association strength (ASij), which is calculated (Van Eck and Waltman 2007):

$$AS_{ij} = \frac{C_{ij}}{W_i W_j}$$

which is "proportional to the ratio between on the one hand the observed number of co-occurrences of i and j and on the other hand the expected number of co-occurrences of i and j under the assumption that co-occurrences of i and j are statistically independent" (van Eck and Waltman 2010).

Result And Finding

RQ 1: What Are The Search Trends In Medication Safety Studies According To The Year Of Publication?

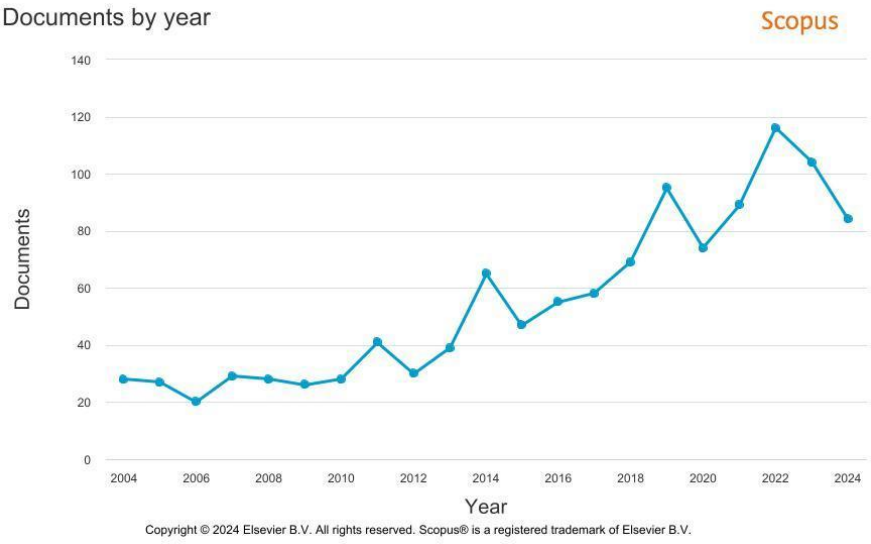

Figure 1: Plotting Document Publication By Years.

Figure 1 illustrates the trend in publications related to medication safety in pharmacy practice literature from 2004 to 2024. Over these 20 years, there has been a general upward trend in the number of publications, indicating growing interest and research activity in the field. Between 2004 and 2015, publication numbers remained relatively low and stable, with annual output

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fluctuating between 20 and 40 documents. This phase likely reflects the early stages of awareness and research in medication safety within pharmacy practice, as researchers and practitioners began to recognize its importance but had yet to see a substantial increase in dedicated publications.

A significant increase in publication volume is evident from around 2016, with peaks in subsequent years. The upward trajectory is particularly steep between 2018 and 2022 when the number of publications exceeds 100 in some years. This surge may reflect the growing emphasis on medication safety due to heightened regulatory scrutiny, advancements in healthcare technologies, and a global push for improving patient safety in clinical practices. Notably, a slight decline is observed in 2023 and 2024, possibly due to changes in research funding priorities, publication cycles, or data collection lags. Overall, the increasing trend highlights the sustained relevance and evolution of medication safety as a critical theme in pharmacy practice research, suggesting an ongoing commitment to addressing safety issues within the healthcare field.

RQ* 2: *Who And How Much Has Been Published In The Area With Regard To The Authors?

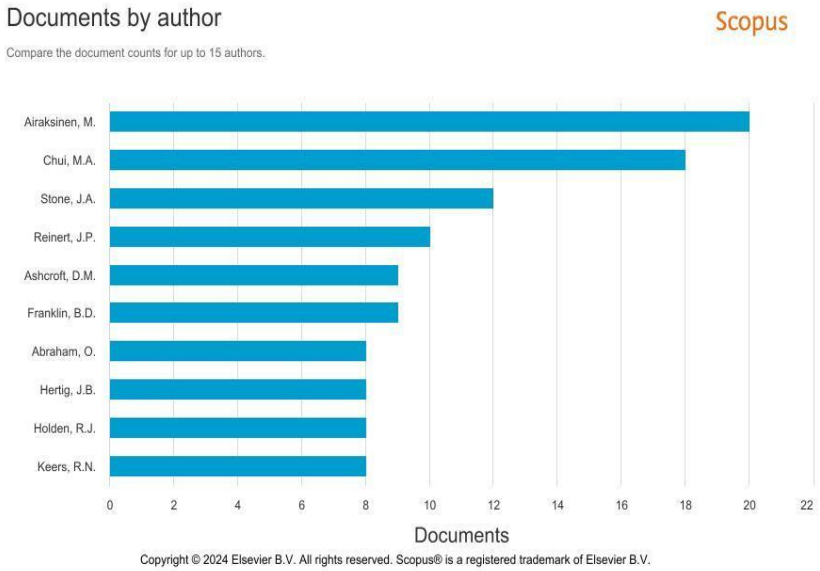

Figure 2: Plotting Document By Author.

Table 3: Percentage Of Document Number By Author.

AUTHOR NAME	Number of Document	Percentages (%)
Airaksinen, M.	20	1.74
Chui, M.A.	18	1.56
Stone, J.A.	12	1.04
Reinert, J.P.	10	0.87
Ashcroft, D.M.	9	0.78
Franklin, B.D.	9	0.78
Abraham, O.	8	0.69
Hertig, J.B.	8	0.69

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AUTHOR NAME	Number of Document	Percentages (%)
Holden, R.J.	8	0.69
Keers, R.N.	8	0.69

Figure 2 highlights the top contributing authors in the field of medication safety within pharmacy practice literature, with a comparison of document counts for up to 10 authors. M. Airaksinen and M.A. Chui lead the list with the highest document counts, each contributing nearly 20 publications. Their prolific output reflects their sustained engagement and expertise in medication safety, likely establishing them as influential figures in the field. The significant contributions of these authors underscore the importance of their research in shaping and advancing knowledge on medication safety practices and guidelines.

Following the leading authors, there is a group of contributors, including J.A. Stone, J.P. Reinert, and D.M. Ashcroft, each with around 10 to 15 publications. This group represents a core of active researchers who consistently contribute to the literature, indicating a well-established network of scholars working on medication safety—the presence of other authors, such as B.D. With multiple publications, Franklin, O. Abraham, and J.B. Hertig suggest a collaborative and multidisciplinary approach in the field. The diversity in authorship reflects the broad interest and collaborative efforts in addressing medication safety issues, highlighting a strong research community dedicated to improving pharmacy practices and patient safety.

RQ 3: What Are The Top 10 Authors Based On Citation By Research?

Table 4: Top 10 Authors' Primary Data Based On Citation By Research.

Authors	Title	Year	Source Title	Cited by
Aruru M.; Truong H.-A.; Clark S. (Aruru, Truong, and Clark 2021)	Pharmacy Emergency Preparedness and Response (PEPR): a proposed framework for expanding pharmacy professionals' roles and contributions to emergency preparedness and response during the COVID-19 pandemic and beyond	2021	Research in Social and Administrative Pharmacy	133
Zhang N.J.; Terry A.; McHorney C.A. (Zhang, Terry, and McHorney 2014)	Impact of Health Literacy on Medication Adherence: A Systematic Review and Meta-analysis	2014	Annals of Pharmacotherapy	243
Zheng S.-Q.; Yang L.; Zhou P.-X. *et al.* (Zheng *et al.*, 2021)	Recommendations and guidance for providing pharmaceutical care services during COVID-19 pandemic: A China perspective	2021	Research in Social and Administrative Pharmacy	173
Bates D.W. (Bates 2007)	Preventing medication errors: A summary	2007	American Journal of	134

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Authors	Title	Year	Source Title	Cited by
			Health-System Pharmacy	
Allemann S.S.; Van Mil J.W.F.; Botermann L. *et al.* (Allemann *et al.*, 2014)	Pharmaceutical care: The PCNE definition 2013	2014	International Journal of Clinical Pharmacy	153
Mekonnen A.B.; McLachlan A.J.; Brien J.-A.E. (Mekonnen, McLachlan, and Brien 2016)	Effectiveness of pharmacist-led medication reconciliation programs on clinical outcomes at hospital transitions: A systematic review and meta-analysis	2016	BMJ Open	332
Paoletti R.D.; Suess T.M.; Lesko M.G. *et al.* (Paoletti *et al.*, 2007)	Using bar-code technology and medication observation methodology for safer medication administration	2007	American Journal of Health-System Pharmacy	140
Wang J.K.; Herzog N.S.; Kaushal R. *et al.* (Wang *et al.*, 2007)	Prevention of pediatric medication errors by hospital pharmacists and the potential benefit of computerized physician order entry	2007	Pediatrics	115
Bobb A.; Gleason K.; Husch M. *et al.* (Bobb *et al.*, 2004)	The Epidemiology of Prescribing Errors: The Potential Impact of Computerized Prescriber Order Entry	2004	Archives of Internal Medicine	316
Smith D.H.; Perrin N.; Feldstein A. *et al.* (Smith *et al.*, 2006)	The impact of prescribing safety alerts for elderly persons in an electronic medical record: An interrupted time series evaluation	2006	Archives of Internal Medicine	122

Table 4 presents the top 10 most-cited articles in the field of medication safety within pharmacy practice, reflecting the high-impact research that has shaped this area. Zhang *et al.*'s 2014 article on health literacy's impact on medication adherence is among the most cited, with 243 citations. This article highlights the critical link between patients' understanding of health information and their ability to adhere to medication regimens, underscoring the role of health literacy in improving medication safety. The high citation count suggests that this topic resonates broadly within the healthcare community, indicating the ongoing need for strategies to enhance patient education as a means of preventing medication errors.

Several other highly cited articles focus on pharmacy's evolving role in response to public health crises, particularly during the COVID-19 pandemic. For instance, Aruru *et al.* (2021) propose an expanded framework for pharmacy professionals' involvement in emergency

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preparedness, with 133 citations. Similarly, Zheng *et al.* (2021) offer guidance on providing pharmaceutical care during the COVID-19 pandemic from a Chinese perspective, garnering 173 citations. These articles reflect a growing recognition of pharmacists as vital contributors in emergency and pandemic situations, emphasizing the need for adaptable pharmaceutical practices to ensure patient safety under challenging conditions. The significant citation counts indicate that COVID-19 has spurred new research avenues within medication safety, especially regarding crisis management and response.

The table also includes foundational studies on preventing medication errors through technological interventions. For example, Paoletti *et al.* (2007) explore bar-code technology for safer medication administration, while Bobb *et al.* (2004) discuss the potential of computerized prescriber order entry (CPOE) systems to reduce prescribing errors, with both studies receiving high citation counts (140 and 316, respectively). These articles underscore the impact of technological solutions on medication safety, particularly in hospital settings where accurate medication administration and error prevention are paramount. The substantial citations these studies have received reflect the healthcare field's commitment to leveraging technology to improve patient safety, marking technology as a key theme in medication safety research.

RQ 4: What Are The Popular Keywords Related To The Study?

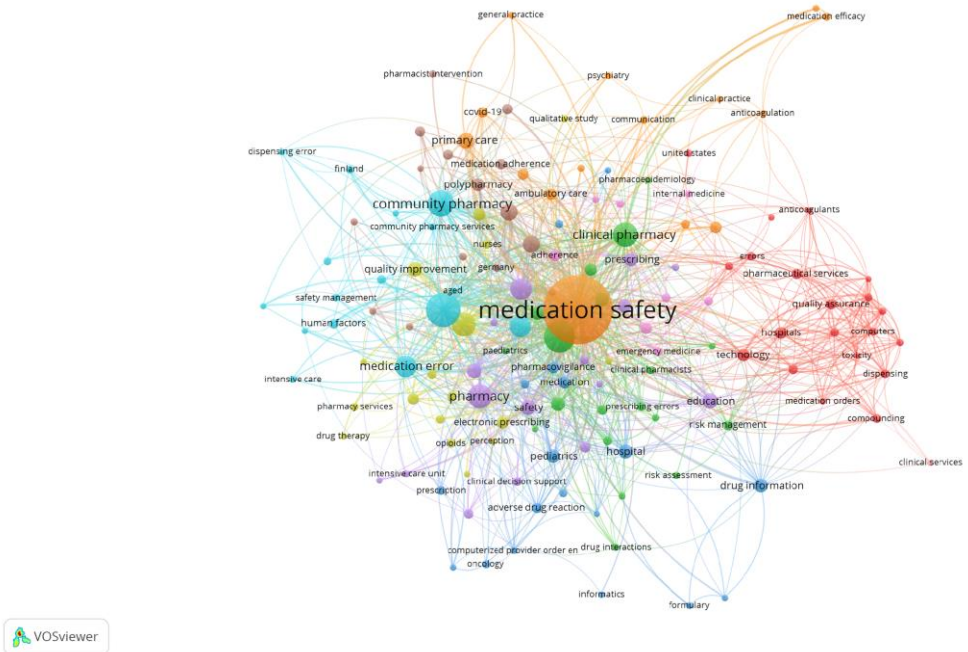

Figure 3: Network Visualization Map Of Keywords' Co-Occurrence.

The data reveals distinct trends within the field of medication safety in pharmacy practice, as indicated by high-frequency keywords such as "medication safety" (502 occurrences, link strength 976), "medication errors" (99 occurrences, link strength 226), and "patient safety" (123 occurrences, link strength 286). These keywords highlight a critical emphasis on ensuring safe

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medication practices and minimizing medication-related incidents within healthcare settings. The strong link strengths of these terms suggest that these topics are central to pharmacy practice literature, often appearing in conjunction with other safety-focused concepts like "adverse drug events," "clinical pharmacy," and "pharmaceutical care." This interconnectedness indicates a focus on safeguarding patients by reducing medication risks, a recurring theme in the study of pharmacy practices.

Moreover, terms such as "community pharmacy" (73 occurrences, link strength 172) and "hospital pharmacy" (15 occurrences, link strength 41) emphasize the settings in which medication safety practices are implemented. "Community pharmacy" appears especially prominent, which could reflect the increased role of pharmacists in primary care and outpatient settings. In parallel, keywords related to "medication reconciliation" (61 occurrences, link strength 157) and "medication review" (30 occurrences, link strength 88) indicate a focus on processes that ensure the correct administration of medications and enhance patient outcomes. This focus suggests a proactive approach in which pharmacy professionals are actively involved in verifying medication histories, monitoring therapeutic efficacy, and managing potential drug-related problems.

Additionally, the dataset highlights emerging themes related to technology and its impact on medication safety, such as "electronic health records" (10 occurrences, link strength 25) and "clinical decision support systems" (8 occurrences, link strength 19). The inclusion of these terms indicates an ongoing shift toward integrating technology in pharmacy settings to support safer and more efficient medication management practices. Similarly, the appearance of "automation" (10 occurrences, link strength 26) and "health information technology" (6 occurrences, link strength 20) further underscores this trend. These emerging themes in technology-driven solutions demonstrate a growing recognition of the value of digital tools in enhancing patient safety and optimizing medication administration processes in diverse healthcare environments.

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RQ 5: What Are Co-Authorship Countries' Collaboration?

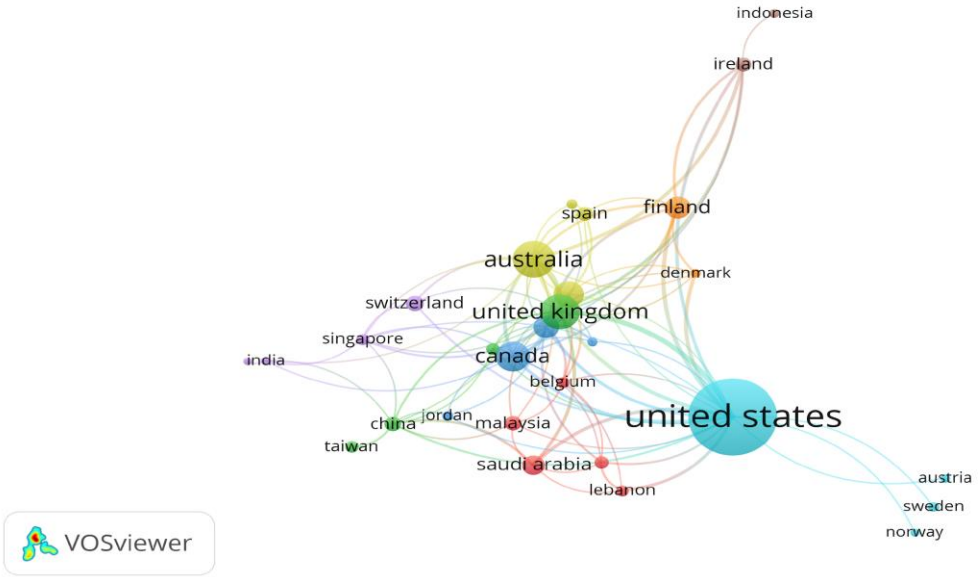

Figure 4: The Proportion Of Authorship By Countries.

The analysis of emerging themes in medication safety across pharmacy practice literature reveals notable geographical variations in research output, citations, and collaboration patterns. The United States leads with a substantial number of documents (504), citations (8034), and total link strength (65), signifying its central role in the field and its wide-reaching influence. The United Kingdom and Australia follow, with 106 and 115 documents, respectively, reflecting strong engagement in medication safety research in these regions. Canada and the Netherlands, though producing fewer documents, maintain high citation counts (676 and 1279, respectively) and significant link strengths, indicating their research impact and collaboration networks in the field.

European countries like Germany and Belgium show moderate research contributions with relatively high citation counts (647 and 260, respectively), suggesting that their studies are well-regarded. Countries like Denmark and Ireland also demonstrate strong link strengths relative to their document count, indicating influential research outputs and active international collaboration. In contrast, countries with smaller outputs, such as Jordan, Lebanon, and Malaysia, contribute modestly to the literature but still gain notable citations, which may highlight their research's specific relevance or niche focus within medication safety.

Emerging countries in Asia and the Middle East, including China, Saudi Arabia, and Taiwan, show growing engagement in medication safety research with decent citation metrics, reflecting an increasing focus on this area. Although these countries have lower total link strengths, their document outputs and citation counts suggest a developing but impactful contribution. Meanwhile, smaller contributors like Poland, Qatar, and Sri Lanka show minimal engagement, pointing to the untapped potential for these regions to expand their presence and collaborations in pharmacy practice literature concerning medication safety.

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Conclusion

The trends in medication safety research within pharmacy practice literature reveal a growing body of work, particularly from 2016 onwards. Initially, publications remained low from 2004 to 2015, reflecting the early stages of research in this area. However, starting in 2016, a sharp increase in the number of publications occurred, with a peak between 2018 and 2022. This surge is likely linked to increasing regulatory attention, the introduction of new technologies, and a global emphasis on improving patient safety. Despite a slight decrease in publications in 2023 and 2024, the overall trend signifies sustained interest in medication safety research, emphasizing its relevance and evolution as a crucial issue in healthcare.

The research landscape is marked by a few highly influential authors and collaborative networks. Leading contributors have produced a significant volume of publications, shaping the field's development. This group of researchers has provided foundational knowledge, particularly on topics such as medication errors, health literacy, and technological solutions in medication safety. Additionally, studies on pharmacy practice during public health emergencies, such as the COVID-19 pandemic, have garnered substantial attention. The broader research community also plays an essential role in advancing the field, with a collaborative and multidisciplinary approach driving progress in addressing medication safety challenges across various healthcare settings. This growing body of literature continues to inform and improve patient safety practices within pharmacy.

The analysis of medication safety research within pharmacy practice highlights several key trends in both the use of terminology and the geographical distribution of contributions. Prominent keywords such as "medication safety," "medication errors," and "patient safety" frequently appear across the literature, underscoring the ongoing focus on improving medication practices and reducing risks associated with medications in healthcare settings. This is supported by additional terms such as "community pharmacy" and "hospital pharmacy," which emphasize the various settings where these practices are applied. There is also a noticeable shift toward technology-driven solutions, with keywords related to "electronic health records," "clinical decision support systems," and "automation," indicating the increasing role of digital tools in enhancing medication safety.

Regarding the geographical aspect, the United States stands out as a major contributor to the field, followed by the United Kingdom and Australia, which also show significant engagement in medication safety research. Other countries such as Canada, the Netherlands, and Germany demonstrate strong citation counts, reflecting their influence and active participation in global research networks. Emerging nations in Asia and the Middle East, including China and Saudi Arabia, are increasingly contributing to the body of knowledge on medication safety. However, their collaboration networks are still developing. Smaller contributors such as Poland, Qatar, and Sri Lanka have room for growth in the field, suggesting opportunities for further research collaboration and development in medication safety within pharmacy practice.

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References

Al-Khoury, Abeer, Sahraa Anwer Hussein, Muthana Abdulwhab, Zainab M. Aljuboori, Hossam Haddad, Mostafa A. Ali, Ibtihal A. Abed, and Hakeem Hammood Flayyih. 2022. "Intellectual Capital History and Trends: A Bibliometric Analysis Using Scopus Database." *Sustainability (Switzerland)* 14(18). doi: 10.3390/su141811615.

Alkatheri, A. M., R. Bustami, A. M. Albekairy, H. Almodaimegh, S. Alghamdi, S. Alharbi, N. Khalidi, J. E. Murphy, and A. M. Qandil. 2017. "Pharmacy Educators' Knowledge of Medication Safety and Their Perception toward Its Integration into the Doctor of Pharmacy Curriculum in Saudi Arabia." *American Journal of Pharmaceutical Education* 81(2).

Allemann, S. S., J. W. F. Van Mil, L. Botermann, K. Berger, N. Griese, and K. E. Hersberger. 2014. "Pharmaceutical Care: The PCNE Definition 2013." *International Journal of Clinical Pharmacy* 36(3):544–55. doi: 10.1007/s11096-014-9933-x.

Alves, Josivan Leite, Igor Bernardino Borges, and Jeniffer De Nadae. 2021. "Sustainability in Complex Projects of Civil Construction: Bibliometric and Bibliographic Review." *Gestao e Producao* 28(4). doi: 10.1590/1806-9649-2020v28e5389.

Appio, Francesco Paolo, Fabrizio Cesaroni, and Alberto Di Minin. 2014. "Visualizing the Structure and Bridges of the Intellectual Property Management and Strategy Literature: A Document Co-Citation Analysis." *Scientometrics* 101(1):623–61. doi: 10.1007/s11192-014-1329-0.

Aruru, M., H. A. Truong, and S. Clark. 2021. "Pharmacy Emergency Preparedness and Response (PEPR): A Proposed Framework for Expanding Pharmacy Professionals' Roles and Contributions to Emergency Preparedness and Response during the COVID-19 Pandemic and Beyond." *Research in Social and Administrative Pharmacy* 17(1):1967–77. doi: 10.1016/j.sapharm.2020.04.002.

Assyakur, Dienda Sesioria, and Elsye Maria Rosa. 2022. "Spiritual Leadership in Healthcare: A Bibliometric Analysis." *Jurnal Aisyah : Jurnal Ilmu Kesehatan* 7(2). doi: 10.30604/jika.v7i2.914.

Bates, D. W. 2007. "Preventing Medication Errors: A Summary." Pp. S3–9 in *American Journal of Health-System Pharmacy*. Vol. 64. Division of General Internal Medicine, Brigham and Women's Hospital, United States: American Society of Health-Systems Pharmacy.

Berger, V., C. Sommer, P. Boje, J. Hollmann, J. Hummelt, C. König, S. Lezius, A. V. D. Linde, C. Marhenke, S. Melzer, N. Michalowski, M. Baehr, and C. Langebrake. 2022. "The Impact of Pharmacists' Interventions within the Closed Loop Medication Management Process on Medication Safety: An Analysis in a German University Hospital." *Frontiers in Pharmacology* 13. doi: 10.3389/fphar.2022.1030406.

Bienvenida, A., C. Kroll, D. Ruhland, A. Steffenhagen, B. W. Patterson, and J. Halfpap. 2022. "Implementation and Safety Evaluation of Autoverification for Select Low-Risk, High-Volume Medications in the Emergency Department." *American Journal of Health-System Pharmacy* 79(23):2150–58. doi: 10.1093/ajhp/zxac241.

Bobb, A., K. Gleason, M. Husch, J. Feinglass, P. R. Yarnold, and G. A. Noskin. 2004. "The Epidemiology of Prescribing Errors: The Potential Impact of Computerized Prescriber Order Entry." *Archives of Internal Medicine* 164(7):785–92. doi: 10.1001/archinte.164.7.785.

Carr-Lopez, S. M., L. Strohecker, Y. Mai, R. K. Miyahara, and A. Shek. 2020. "A Module in Medication Safety Involving Remote Access and Review of Veterans' Health

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 6 Issue 19 (December 2024) PP. 191-207
DOI 10.35631/IJIREV.619015

Records." *American Journal of Pharmaceutical Education* 84(12):1570–78. doi: 10.5688/ajpe7664.

Chamoun, N., U. Usta, L. R. Karaoui, P. Salameh, S. Hallit, P. Shuhaiber, A. M. Henaine, Y. Akiki, R. M. Zeenny, and K. Iskandar. 2020. "Current Trends in Hospital Pharmacy Practice in Lebanon." *Hospital Pharmacy* 55(2):112–18. doi: 10.1177/0018578718823733.

Cox, Anthony R., S. Wilkins, and P. Routledge. 2020. "How Do Pharmacists Contribute to Global Medication Safety?" *International Journal of Pharmacy Practice* 28. doi: 10.1111/ijpp.12676.

van Eck, Nees Jan, and Ludo Waltman. 2010. "Software Survey: VOSviewer, a Computer Program for Bibliometric Mapping." *Scientometrics* 84(2):523–38. doi: 10.1007/s11192-009-0146-3.

van Eck, Nees Jan, and Ludo Waltman. 2017. "Citation-Based Clustering of Publications Using CitNetExplorer and VOSviewer." *Scientometrics* 111(2):1053–70. doi: 10.1007/s11192-017-2300-7.

Van Eck, Nees Jan, and Ludo Waltman. 2007. "Bibliometric Mapping of the Computational Intelligence Field." Pp. 625–45 in *International Journal of Uncertainty, Fuzziness and Knowldege-Based Systems*. Vol. 15.

Fahimnia, Behnam, Joseph Sarkis, and Hoda Davarzani. 2015. "Green Supply Chain Management: A Review and Bibliometric Analysis." *International Journal of Production Economics* 162:101–14.

Fit, K. E. 2008. "Documentation of Student Pharmacists' Interventions from Medication Histories in a Primary Care Setting." *Journal of Pharmacy Technology* 24(6):330–35. doi: 10.1177/875512250802400603.

Forehand, C. C., K. Fitton, K. Keats, A. Chase, S. E. Smith, and A. Sikora Newsome. 2022. "Productivity Tracking: A Survey of Critical Care Pharmacist Practices and Satisfaction." *Hospital Pharmacy* 57(2):273–80. doi: 10.1177/00185787211024209.

Gu, Dongxiao, Tongtong Li, Xiaoyu Wang, Xuejie Yang, and Zhangrui Yu. 2019. "Visualizing the Intellectual Structure and Evolution of Electronic Health and Telemedicine Research." *International Journal of Medical Informatics* 130. doi: 10.1016/j.ijmedinf.2019.08.007.

Hertig, R., R. Ackerman, B. Zagar, and S. Tart. 2017. "Pharmacy Student Involvement in a Transition of Care Program." *Currents in Pharmacy Teaching and Learning* 9(5):841–47. doi: 10.1016/j.cptl.2017.06.004.

Al Juffali, L., S. Al-Aqeel, P. Knapp, K. Mearns, H. Family, and M. Watson. 2019. "Using the Human Factors Framework to Understand the Origins of Medication Safety Problems in Community Pharmacy: A Qualitative Study." *Research in Social and Administrative Pharmacy* 15(5):558–67. doi: 10.1016/j.sapharm.2018.07.010.

Khiste, G. P., and R. R. Paithankar. 2017. "Analysis of Bibliometric Term in Scopus." *International Research Journal* 01(32):78–83.

Lat, Ishaq, Christopher Paciullo, Mitchell J. Daley, Robert MacLaren, Scott Bolesta, Jennifer McCann, Joanna L. Stollings, Kendall Gross, Sarah A. Foos, Russel J. Roberts, Nicole M. Acquisto, Scott Taylor, Michael Bentley, Judith Jacobi, and Tricia A. Meyer. 2020. "Position Paper on Critical Care Pharmacy Services: 2020 Update." *Critical Care Medicine* 48(9):e813–34. doi: 10.1097/CCM.0000000000004437.

Li, X. X., S. Q. Zheng, J. H. Gu, T. Huang, F. Liu, Q. G. Ge, B. Liu, C. Li, M. Yi, Y. F. Qin, R. S. Zhao, and L. W. Shi. 2020. "Drug-Related Problems Identified During Pharmacy Intervention and Consultation: Implementation of an Intensive Care Unit

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 6 Issue 19 (December 2024) PP. 191-207
DOI 10.35631/IJIREV.619015

Pharmaceutical Care Model." *Frontiers in Pharmacology* 11. doi: 10.3389/fphar.2020.571906.

McCarthy, K. R., E. Christakos, A. Kurzatkowski, and S. A. Gernant. 2021. "Characterizing Perceptions of an Abbreviated ISMP Medication Safety Self Assessment for Community Pharmacies." *Journal of the American Pharmacists Association* 61(4):S105–17. doi: 10.1016/j.japh.2021.02.013.

McKee, J., and S. Cleary. 2007. "High-Risk, High-Alert Medication Management Practices in a Regional State Psychiatric Facility." *Hospital Pharmacy* 42(4):323–30. doi: 10.1310/hpj4204-323.

Mekonnen, A. B., A. J. McLachlan, and J. A. E. Brien. 2016. "Effectiveness of Pharmacist-Led Medication Reconciliation Programmes on Clinical Outcomes at Hospital Transitions: A Systematic Review and Meta-Analysis." *BMJ Open* 6(2). doi: 10.1136/bmjopen-2015-010003.

Murphy, L., K. Leblanc, S. Badr, E. Ching, L. Mao, N. Steenhof, B. Hamandi, B. Rubin, A. Seto, and A. D. Furlan. 2022. "Opioid Utilization and Management in the Setting of Stewardship During Inpatient Rehab Care." *Drug, Healthcare and Patient Safety* 14:161–70. doi: 10.2147/DHPS.S360832.

Paoletti, R. D., T. M. Suess, M. G. Lesko, A. A. Feroli, J. A. Kennel, J. M. Mahler, and T. Sauders. 2007. "Using Bar-Code Technology and Medication Observation Methodology for Safer Medication Administration." *American Journal of Health-System Pharmacy* 64(5):536–43. doi: 10.2146/ajhp060140.

Scott, D. M., C. A. Naughton, N. Petry, and D. L. Friesner. 2019. "Assessment of Practice Management Entrustable Professional Activities by Pharmacists in North Dakota." *American Journal of Pharmaceutical Education* 83(10):2161–75. doi: 10.5688/ajpe7486.

Shogbon, A. O., and L. M. Lundquist. 2014. "Student Pharmacists' Clinical Interventions in Advanced Pharmacy Practice Experiences at a Community Nonteaching Hospital." *American Journal of Pharmaceutical Education* 78(3). doi: 10.5688/ajpe78350.

Smith, D. H., N. Perrin, A. Feldstein, X. Yang, D. Kuang, S. R. Simon, D. F. Sittig, R. Platt, and S. B. Soumerai. 2006. "The Impact of Prescribing Safety Alerts for Elderly Persons in an Electronic Medical Record: An Interrupted Time Series Evaluation." *Archives of Internal Medicine* 166(10):1098–1104. doi: 10.1001/archinte.166.10.1098.

di Stefano, Giada, Margaret Peteraf, and Gianmario Veronay. 2010. "Dynamic Capabilities Deconstructed: A Bibliographic Investigation into the Origins, Development, and Future Directions of the Research Domain." *Industrial and Corporate Change* 19(4):1187–1204. doi: 10.1093/icc/dtq027.

Strand, M. A., H. N. Eukel, O. Frenzel, E. Skoy, J. Steig, and A. Werremeyer. 2022. "Opioid Risk Stratification in the Community Pharmacy: The Utility of the Opioid Risk Tool." *Research in Social and Administrative Pharmacy* 18(12):4065–71. doi: 10.1016/j.sapharm.2022.07.009.

Taber, D. J., N. A. Pilch, J. W. McGillicuddy, C. Mardis, F. Treiber, and J. N. Fleming. 2019. "Using Informatics and Mobile Health to Improve Medication Safety Monitoring in Kidney Transplant Recipients." *American Journal of Health-System Pharmacy* 76(15):1143–49. doi: 10.1093/ajhp/zxz115.

Venkatesan, Latha. 2022. "Patient Safety Challenge: Medication without Harm." *Nursing Journal of India* CXIII(05):232–34. doi: 10.48029/nji.2022.cxiii507.

Verbeek, Arnold, Koenraad Debackere, Marc Luwel, and Edwin Zimmermann. 2002. "Measuring Progress and Evolution in Science and Technology - I: The Multiple Uses

International Journal of Innovation and Industrial Revolution
IJIREV
EISSN: 2637-0972
Volume 6 Issue 19 (December 2024) PP. 191-207
DOI 10.35631/IJIREV.619015

of Bibliometric Indicators." *International Journal of Management Reviews* 4(2):179–211. doi: 10.1111/1468-2370.00083.

Wang, J. K., N. S. Herzog, R. Kaushal, C. Park, C. Mochizuki, and S. R. Weingarten. 2007. "Prevention of Pediatric Medication Errors by Hospital Pharmacists and the Potential Benefit of Computerized Physician Order Entry." *Pediatrics* 119(1):e77–85. doi: 10.1542/peds.2006-0034.

Wang, Yu, Yifei Rao, Yuling Yin, Yaolei Li, Zhijian Lin, and Bing Zhang. 2022. "A Bibliometric Analysis of Global Trends in the Research Field of Pharmaceutical Care over the Past 20 Years." *Frontiers in Public Health* 10. doi: 10.3389/fpubh.2022.980866.

Warholak, T. L., M. T. Rupp, A. Zale, M. Hines, and S. Park. 2015. "Check It out: A Practical Tool for Improving Medication Safety." *Journal of the American Pharmacists Association* 55(6):621–25. doi: 10.1331/JAPhA.2015.14280.

Wu, Yen Chun Jim, and Tienhua Wu. 2017. "A Decade of Entrepreneurship Education in the Asia Pacific for Future Directions in Theory and Practice." *Management Decision* 55(7):1333–50.

Zhang, N. J., A. Terry, and C. A. McHorney. 2014. "Impact of Health Literacy on Medication Adherence: A Systematic Review and Meta-Analysis." *Annals of Pharmacotherapy* 48(6):741–51. doi: 10.1177/1060028014526562.

Zheng, S. Q., L. Yang, P. X. Zhou, H. B. Li, F. Liu, and R. S. Zhao. 2021. "Recommendations and Guidance for Providing Pharmaceutical Care Services during COVID-19 Pandemic: A China Perspective." *Research in Social and Administrative Pharmacy* 17(1):1819–24. doi: 10.1016/j.sapharm.2020.03.012.