

Pharmacists' Knowledge and Attitudes Regarding Biologics and Biosimilars: A Literature Review

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Abstract

Advancements in biologic therapies have become crucial for managing both acute and chronic illnesses. In addition, the growing presence of biosimilar medications presents significant opportunities for reducing healthcare costs and expanding patient access to essential biologic treatments. Pharmacists, as part of the healthcare system, play an important role in the use of this group of medications. The purpose of this literature review is to examine existing research on pharmacists' knowledge and attitudes toward originator biologics and biosimilars, as well as assessing the need for further educational initiatives in this area.

A digital search of literature was carried out through journal databases, such as PubMed, and Scopus, using selected search terms, and applying the inclusion criteria that match the aim of the research. The majority of studies that are subject to evaluation have been conducted, in the form of short surveys, revealing that most of the pharmacists are familiar with the biologic and biosimilar medicines, however their measured knowledge was less extensive than their self-assessed knowledge. Pharmacists' knowledge and attitudes towards biologics exhibit a wide variation.

Insufficient clinical experience and need for additional education were identified as prerequisites for greater inclusion of biologic originator and biosimilar medicines in clinical practice.

Key words: biologics, biosimilars, pharmacists, knowledge, attitudes

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Introduction

Biologic originator medicines and their biosimilars play an increasingly important role in the management of chronic, severe, and rare diseases, particularly in high-income healthcare systems (1–3). Their use has expanded substantially over the past two decades due to their therapeutic effectiveness in conditions such as autoimmune diseases, oncology, hematological disorders, and inflammatory bowel disease, and they have significantly improved clinical outcomes and quality of life for many patients (2, 4). A biological drug is defined as a medicinal product that contains one or more active substances, derived from a biological source or produced using biological systems, including recombinant DNA technology, cell culture techniques, and other biotechnology-based manufacturing processes (2, 3, 5). Biologics include drugs made by biologic or biotechnological procedures, from cell cultures and by recombinant DNA technology, plasma and blood and blood derivatives, and immunological drugs. Compared with chemically synthesized medicines, biologics are typically large, structurally complex molecules with inherent heterogeneity. Their stability and functionality may depend on post-translational modifications such as glycosylation, as well as formulation components including stabilizers and preservatives. Variations in these characteristics may influence pharmacokinetic and pharmacodynamic properties and may also affect immunogenicity (6, 7). Evidence from clinical practice suggests that healthcare professionals' understanding of biologic medicines varies across professional groups. Physicians, who are the primary prescribers of biologics, generally demonstrate moderate awareness of biosimilars; however, uncertainties remain regarding issues such as extrapolation of indications, immunogenicity, and switching between originator and biosimilar products, which may influence prescribing behavior and contribute to variability in biosimilar uptake in clinical practice. Therefore, strict regulatory guidelines are in place to ensure the quality, safety and efficacy of biological medicines, particularly regarding the potential for immune-mediated reactions (7). In most cases, the immune response to a biologic will be clinically insignificant, such as the temporary presence of antibodies, and will not affect the overall risk-benefit profile of the product (8). However, immunogenicity may occasionally impact safety or therapeutic effectiveness, making ongoing monitoring essential (7, 9). Previous systematic and narrative reviews have examined healthcare professionals' perceptions of biosimilars, primarily focusing on physicians or mixed healthcare professional populations. These studies consistently report that although awareness of biosimilars is increasing, knowledge gaps and concerns about regulatory approval pathways and clinical equivalence continue to influence confidence and acceptance. The heterogeneity, batch-to-batch variability, high molecular weight, and structural complexity of biological substances preclude the possibility of producing identical copies by alternative manufacturers. Consequently, the development of generic equivalents for biologic medicines is not possible. Instead, similarity between originator biologic medicine (referent medicine) and biosimilar must be demonstrated based on comparative studies. Biosimilars must undergo comparative preclinical and

clinical testing due to challenges in fully characterizing them and concerns about how variations in their physical and chemical properties might affect clinical outcomes (8, 10).

Due to the fundamental distinctions between biological and chemically synthesized compounds, the streamlined regulatory framework applied to generic drugs is not applicable to biologics produced by different manufacturers. Approval of biosimilars requires a comprehensive comparability exercise, including analytical characterization, non-clinical studies, and clinical evaluation, designed to demonstrate similarity to the reference product. This regulatory pathway differs fundamentally from the generic approval process used for small-molecule medicines, as biosimilars cannot be fully characterized by chemical methods alone (8, 9, 11).

The introduction of biosimilars has contributed to reducing treatment costs and improving patient access to high-cost biologic therapies, supporting healthcare system sustainability (1, 4). Despite their central role in medicines management and patient counseling, pharmacists may have variable access to independent and structured education on biosimilars, which may result in differences in knowledge and confidence compared to physicians and other healthcare professionals. Due to their streamlined regulatory approval pathways, biosimilars are more readily available and offer cost-effective alternatives to originator biologics. Their integration into clinical practice holds promise for substantial healthcare savings and broader accessibility to essential treatments (12). Although the clinical efficacy and safety of biosimilars have been supported by extensive comparability evidence and post-marketing experience, concerns and hesitancy among healthcare professionals have been reported in several settings (13–15). These concerns may relate to immunogenicity, extrapolation of indications, switching practices, and interchangeability policies, and may influence prescribing decisions and substitution practices. As a result, the uptake of biosimilars remains inconsistent across countries and clinical areas, despite regulatory support and economic incentives (1, 13, 15).

Multiple stakeholders, including regulatory agencies, healthcare institutions, payers, and professional organizations, aim to increase biosimilar adoption to improve affordability and access (1, 4). Nevertheless, barriers persist, including limited knowledge, insufficient confidence in regulatory evaluation processes, variable institutional guidance, and misinformation from non-independent sources (15, 16). Although several reviews have explored healthcare professionals' knowledge and attitudes toward biosimilars, no comprehensive review has specifically synthesized findings focusing exclusively on pharmacists in the context of recent regulatory and clinical developments. In addition, the biosimilar landscape has evolved substantially over the past decade, with increasing regulatory experience, market availability, and clinical exposure, which justifies the focus on studies conducted within the last ten years to ensure relevance to current practice. Pharmacists represent a key professional group in this context due to their role in medication procurement, substitution practices, patient counseling, pharmacovigilance, and in some settings, participation in switching decisions. However, pharmacists may have unequal access to independent education on

biosimilars, which may influence perceptions and confidence (13, 15, 17). Similar challenges have also been described among physicians, particularly specialists who prescribe biologics and who may also receive product-related information from pharmaceutical representatives alongside scientific and professional sources (14, 18, 19).

Knowledge remains fundamental for safe and effective medicine use. For biological medicines, healthcare professionals require an understanding not only of clinical indications and adverse effects, but also of key principles such as biosimilar development, comparability assessment, regulatory approval pathways, interchangeability policies, and post-marketing safety monitoring (11, 15). Since pharmacists play an important role in the safe implementation of biosimilars in clinical practice, understanding their knowledge and perceptions is essential for identifying educational needs and improving biosimilar integration into healthcare systems (13, 15, 17). Therefore, the primary objective of this literature review was to summarize published evidence from the past ten years regarding pharmacists' knowledge, attitudes, and perceptions toward originator biologics and biosimilars, and to identify factors associated with acceptance and use of biosimilars in pharmacy practice.

Materials and Methods

Search strategy

A comprehensive literature search was conducted in the electronic databases PubMed and ScienceDirect to identify relevant studies assessing pharmacists' knowledge, attitudes, or perceptions regarding originator biologics and biosimilars. The search was limited to studies published during the last ten years (January 2014 to December 2024). The following keywords and combinations were used: biological, biologic, biosimilar, pharmacist, survey, questionnaire, knowledge, attitude, and education. Boolean operators (AND/OR) were applied to optimize the search strategy. Reference lists of included articles were also screened to identify additional eligible studies.

Eligibility criteria

Studies were included if they met the following criteria: original primary research articles; studies based on survey/questionnaire methodology; studies assessing pharmacists' knowledge, perceptions, attitudes, or educational needs regarding biosimilars and/or originator biologics; studies published in peer-reviewed journals; studies available as full-text articles; studies published in the English language.

Studies that were excluded were review articles, editorials, commentaries, letters or case reports focusing exclusively on patients, pharmaceutical companies, or other stakeholders without reporting pharmacist-specific outcomes, or assessing only physicians or nurses without presenting separate pharmacist results, not including relevant outcomes related to knowledge, attitudes, or perceptions toward biosimilars. Studies including multiple healthcare professional groups (e.g., physicians, nurses, pharmacists) were also included, but only if pharmacist-specific results were clearly reported.

Study selection process

The database search resulted in 74 records from PubMed and 27 records from ScienceDirect. All retrieved citations were exported and duplicates were removed. The remaining records were screened by title and abstract for relevance. Full-text articles were then assessed for eligibility.

The screening and selection process was performed independently by three reviewers. Convenience sampling, low response rates, self-reported outcomes, and lack of validated instruments were the most frequently observed limitations in the studies. The final decision regarding study inclusion was agreed upon by all three reviewers. The study selection process, including reasons for exclusion at the full-text stage, is summarized in a PRISMA flow diagram presented below (Figure 1).

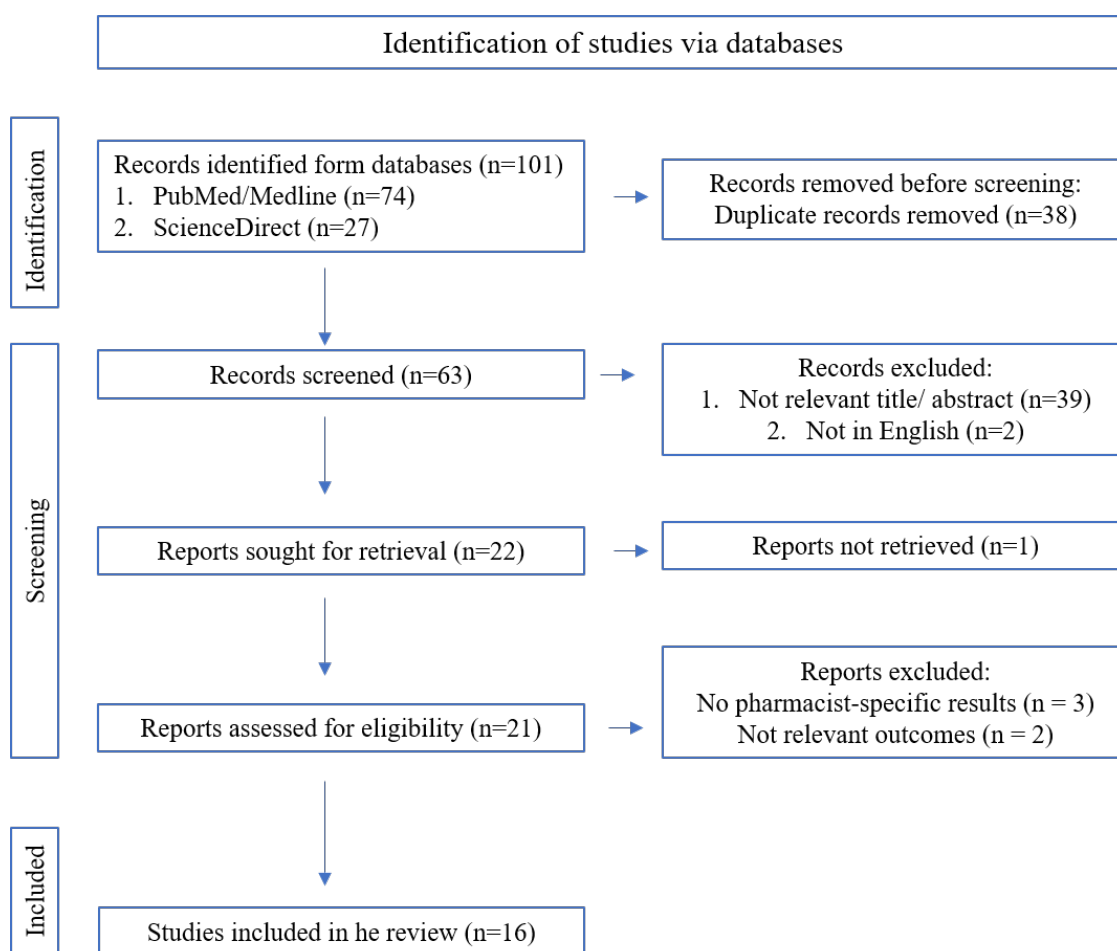


Figure 1. PRISMA flow diagram showing the study selection process for the systematic review, including identification, screening, eligibility assessment, and final inclusion of studies

Slika 1. PRISMA dijagram toka koji prikazuje proces selekcije studija za sistematski pregled, uključujući identifikaciju, skrining, procenu podobnosti i konačno uključivanje studija.

Data Extraction and Analysis

Relevant data were extracted from the included studies, including study location, sample size, participant characteristics, survey design, main outcomes regarding knowledge and attitudes, and key conclusions. Only the results related to pharmacists were included in the analysis.

Results

The database search performed for the last ten years identified 74 records in ScienceDirect and 27 records in PubMed. After the removal of duplicates and screening based on title, abstract, and full-text eligibility criteria, 16 studies were included in the final analysis. The included studies were conducted across several regions, including Europe ($n = 7$), North America ($n = 5$), Asia ($n = 3$), and the Middle East ($n = 1$), reflecting a broad international interest in pharmacists' knowledge and perceptions of biologic medicines and biosimilars. Data extracted from each study included publication details (authors, year, and country), study design and sample characteristics, and key findings related to pharmacists' knowledge, perceptions, and educational needs. Each of the 16 selected studies was thoroughly reviewed, and the following information was extracted: general information (authors, year, and country of publication), study objective and included sample, methods and results regarding the assessed knowledge and opinion on biologic originator and biosimilar drugs. The findings are summarized in Table I.

Table I Outline of the selected studies that were reviewed

Tabela I Pregled odabranih studija koje su bile uključene u pregled

No.	Study objective and sample	Methods of evaluated knowledge		Assessed knowledge	Assessed opinion	Citation
1.	to evaluate knowledge about the regulation of biosimilars sample size: $n = 36$ (physicians and community pharmacists) pharmacist subgroup not reported separately	evaluated self-assessed knowledge through online survey among physicians and community pharmacists	self-assessed knowledge	- 61% from the participant in the survey had a good knowledge of the regulation of biosimilars	- 53% emphasized the lack of high-level safety evidence for biosimilars - The primary concerns regarding the biosimilars are related to their pharmaceutical quality, safety, particularly the risk of immunogenicity. - efficacy, especially in cases involving extrapolated indications, and their interchangeability with the originator product	(18) Sidikou et al, 2016

2.	<p>to assess hospital specialists' attitudes toward prescribing biosimilars and to collect hospital specialists' opinions about the quality, safety, and efficacy of biosimilars</p> <p>sample size: <i>n</i> = 579 (<i>n</i> = 214 hospital specialists physicians; <i>n</i> = 36 hospital pharmacists)</p>	self-assessed through online survey among hospital physicians and hospital pharmacists	self-assessed knowledge	- 23% of survey respondents expressed complete or good knowledge about the scientific principles of biosimilars	- 51% of clinicians prescribed biosimilars to biologic-naive patients only, while 25% also prescribed biosimilars to patients with previous biologic exposure - more clinicians expressed doubts about the scientific validity and lack of clinical trial data for biosimilar indication extrapolation than pharmacists (41% vs. 8%)	(20) Pasina et al, 2016
3.	<p>to evaluate pharmacists' knowledge and attitudes of biosimilars</p> <p>sample size: <i>n</i> = 229</p>	self-assessed knowledge through survey among pharmacists	self-assessed knowledge	- pharmacists are familiar with differences between biosimilars and generic drugs - 26% of respondents did not receive specific biosimilar training	- the nomenclature of biosimilars plays a critical role in avoiding confusions with their reference drug - the creation of a comprehensive list of biosimilar and interchangeable biologic drugs is indeed essential - sharing responsibilities for immunogenicity risk management between pharmacists and physicians is essential for ensuring patient safety and effective treatment outcomes; - the viewpoints on patient informed consent for biologic drug substitution indeed vary widely	(21) Adé et al, 2017
4.	<p>to evaluate awareness and perceptions to biosimilars</p> <p>sample size: <i>n</i> = 520 (143 pharmacists, 377 physicians)</p>	self-assessed and measured knowledge through online survey among specialist	self-assessed and objectively measured knowledge	- pharmacists (75.2%) and specialist physicians (85.3%) were more familiar with biosimilars than general	- the majority of specialist physicians expressed opposition to pharmacist-led substitution of biological medicines - among the surveyed medical specialists prescribing biosimilars (<i>n</i> = 43),	(22) O'Callaghan et al, 2017

		physicians, general practitioners, and community pharmacists		practitioners (40.3%) - most medical specialists (85%) and pharmacists (77%) reported being either very familiar or familiar with the term “biosimilar” - many GPs (60%) were not prepared to define the term or had never heard - around 21% of healthcare professionals identified biosimilars as the same as generic medicines	67% preferred to initiate treatment with biosimilars rather than switching patients from an originator medicine to a biosimilar, which only 28% supported	
5.	to evaluate knowledge and opinions regarding biosimilars sample size: <i>n</i> = 802 (community pharmacist and hospital pharmacists)	measured knowledge through web-based survey to community pharmacists and hospital pharmacists	objectively measured knowledge	- 66.8% of the participants reported that they were not familiar with biosimilars - half of the pharmacists from community answered that they were not all informed regarding the biosimilars, compared with 15.7% of the hospital pharmacists	Pharmacists generally held positive attitudes toward biosimilar medications, with approximately 90% identifying healthcare cost savings as a key motivation for prescribing them.	(23) Beck et al, 2017
6.	to assess clinician understanding, prescription preferences, and patient	self-assessed and measured knowledge through	self-assessed and objectively measured knowledge	- 74% of the overall participants could not give a	- the most essential factor in biosimilar prescription was safety and efficacy	(24) Cook et al, 2019

	involvement regarding biosimilars sample size: <i>n</i> = 77 (52 oncology physicians, 16 oncology pharmacists, and 9 advanced practice providers)	online questionnaire among oncology clinicians		satisfactory definition of biosimilar - 40.3% considered that a biosimilar is the same as a generic drug	- clinicians were also split concerning the role that pharmacists should play in the decision to prescribe or substitute biosimilars	
7.	to evaluate opinions of hospital pharmacists regarding the use of biosimilars in Poland sample size: <i>n</i> = 61	evaluation of knowledge and opinions through paper-based questionnaire among hospital pharmacists	self-assessed knowledge	- 65.6% of the pharmacists were very well acquainted with biosimilars	- 41.68% of the pharmacists believed that biosimilars should be used at the initiation of therapy - 86.67% believed that the greatest advantage of biosimilars is their lower price - 75% thought that pharmacists could interchange biologic to biosimilar drugs without consulting a doctor	(25) Pawlowska et al, 2019
8.	to evaluate knowledge and opinions regarding the biosimilars sample size: 305 (community and clinical pharmacists)	measured knowledge of community and clinical pharmacists	objectively measured knowledge	- 83.6% of the participants had good knowledge of the definition and characteristics of biosimilar medicines - 48.9% were confident in using biosimilars in clinical practice	- 75.08% of pharmacists thought that a substitution of interchangeable product for the reference product could be done without referring to the prescriber	(26) Shakeel et al, 2020
9.	to assess knowledge regarding biosimilars, substitution and interchangeability	measured knowledge through online survey among	objectively measured knowledge	- 56.1% of all respondents gave a correct answer about the definition	- participants generally did not feel adequately informed about biosimilars	(27) Arnet et al, 2021

	sample size: <i>n</i> = 466 (community pharmacists)	community pharmacists		of a biosimilar - 36.7% respondents gave correct answer regarding the substitution of biological medicines		
10.	to assess knowledge and attitudes regarding biosimilars sample size: <i>n</i> = 395 (pharmacists 164, oncologists 123, rheumatologists 108)	measured knowledge through questionnaire	objectively measured knowledge	86% of the participants gave a correct answer regarding the definition of a biosimilar only 26.6% knew the necessary regulation for approval of biosimilars - only 14.2% answered all questions correctly	62.8% of the participants had a good understanding of biosimilars, especially rheumatologists (75%) half of the participants felt comfortable to use biosimilars - 45.8% of the participants accepted switching patients receiving the original drug to a biosimilar	(28) Poon et al, 2021
11.	to investigate the knowledge, attitudes and practices of multiple stakeholders toward biosimilars, including HCP in China sample size: <i>n</i> = 412 (132 physicians, 157 clinical pharmacists, 123 nurses)	measured knowledge through online questionnaire	objectively measured knowledge	81.82% of the physicians and 82.17% of the clinical pharmacists showed a good understanding of biosimilars 55.30% and 59.24% of the physicians and clinical pharmacists, respectively, were aware of the regulation on the automatic approval of biosimilars	50.73% of the HCPs had positive attitude towards interchangeability of biosimilars, and were willing to recommend them to patients 46.12% believed that biosimilars could reduce medical costs 54.37% believed that biosimilars could improve the access to medication - 52.91% of HCPs presented insecurity regarding efficacy, 60.68% regarding safety and 62.87% regarding immunogenicity	(29) Hu et al, 2022

				- 18.18% of the physicians and 18.47% of the clinical pharmacists were familiar with interchangeable biosimilar products and their registration in China		
12.	to examine and compare the knowledge, perceptions and information needs regarding original biologics and biosimilars sample size: <i>n</i> = 764 (pharmacists)	measured knowledge through online survey among pharmacists	objectively measured knowledge	- participants were familiar with the term - lack of knowledge among community pharmacists on biosimilars, especially regarding the substitution rules	- around 85% of the participants were highly interested in additional training on this topic	(26) Messner et al, 2023
13.	to assesses understanding of biosimilars, including interchangeability sample size: <i>n</i> = 507 (498 pharmacists)	self-assessed and measured knowledge through web-based survey among pharmacists	self-assessed and objectively measured knowledge	- 87% of the respondents knew that the biosimilar had equivalent efficacy and safety to its reference product	- 20% understood that a pharmacist can substitute a Food and Drug Administration-approved interchangeable without permission of the prescriber - 53% responded that it is appropriate for a pharmacist to dispense an interchangeable in place of its reference product without authorization from the prescriber if consistent with state law - more than 50% of the participants felt moderately or very comfortable addressing patients' questions about biosimilars	(30) Stevenson et al, 2023

14.	<p>to assesses knowledge and perceptions on biosimilars</p> <p>sample size: <i>n</i> = 75 (31 prescribers and 44 pharmacists)</p>	<p>self-assessed and measured knowledge through online questionnaire among autoimmune prescribers and health system specialty pharmacists</p>	<p>self-assessed and objectively measured knowledge</p>	<p>- 48.0% of the prescribers and 42.0% of the pharmacists understood the regulations of interchangeability and substitution of biosimilars</p>	<p>- 16.0% of the prescribers and 13.4% of the pharmacists reported being “very prepared” to have dialogue with patients regarding the biosimilar options</p> <p>- 43% of the prescribers indicated they would prescribe a biosimilar to biologic-naive patients</p> <p>- 13.3% of the prescribers would be willing to prescribe a biosimilar to patients successfully established on biologic therapy</p> <p>- 68.1% of the pharmacists were comfortable recommending a biosimilar substitution to a biologic-naive patient</p> <p>- 18.1% would recommend a biosimilar substitution to a patient successfully established on a biologic therapy</p>	<p>(31) Giavatto et al, 2024</p>
15.	<p>to assesses knowledge, practices and attitudes regarding biosimilars</p> <p>sample size: <i>n</i> = 504 pharmacists</p>	<p>measured knowledge through self-administered survey among pharmacists</p>	<p>objectively measured knowledge</p>	<p>- 40.47% of the pharmacists reported that insufficient knowledge was one of the barriers to accepting biosimilars</p> <p>- 40.67% reported that lack of experience was also a barrier to accepting biosimilar medicines</p>	<p>Findings from the study indicated that community pharmacists demonstrated limited understanding, negative perceptions, and inadequate application of biosimilar therapy in their practice.</p>	<p>(32) Jarab et al, 2025</p>

16.	to assess the perceptions of physicians and pharmacist regarding decision-making and familiarity with biologics sample size total: n = 249 (99 pharmacists and 150 physicians)	self-assessed knowledge through electronic survey among physicians who prescribe biologics and pharmacists	self-assessed knowledge	- a total of 65.7% of the pharmacists and 50.7% of the physicians had completed continuing education focused on biologics - pharmacists (47.5%) were more likely to strongly recommend biosimilar products for patients beginning new treatments than physicians (31.3%)	The main approach for the adoption of interchangeable biosimilars was identified as implementing research initiatives and educational efforts that evaluate the real-world outcomes of biosimilars.	(33) Ling et al, 2025
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The evaluation of the reviewed articles was set to topics that concerned pharmacists: 1) self-rated knowledge of biologics and biosimilars; 2) evaluated knowledge of biologics and biosimilars; 3) opinions regarding the advantages and disadvantages of biosimilars and 4) identified need of further education.

Evaluation of the Knowledge and Opinions on Original Biologic and Biosimilar Medicines Among Pharmacists

The earliest study regarding the researched topic was performed by Pasina et al. in 2016, in Italy. This study was aimed to assess hospital specialists' attitudes toward biosimilars. The results showed that only 23% of the survey respondents (pharmacists) expressed complete or good knowledge about scientific principles that differentiate originators to biosimilars. In addition, 41% of the hospital specialists expressed doubts about the scientific validity and concern about the lack of clinical trial data for biosimilar indication extrapolation, with only 8% of the pharmacists expressing concern (20).

A study performed by Adé et al. in 2017, evaluated self-assessed knowledge through survey among pharmacists and concluded that they were familiar with the main differences between originator and biosimilar biologics. Moreover, this study revealed that the knowledge and awareness of pharmacists regarding biosimilars in Quebec, Canada and France were alike. These results are in line with the need for pharmacists to be familiar with particularities and key issues of these medicines, as they play a key role for their introduction in clinical practice. This also adds to their awareness of the evolution of the legal framework, in order to ensure their safe and optimal use (21). Another study, published in 2017, was performed in Ireland by O'Callaghan et al. They revealed that the

pharmacists (75%) were more familiar with biosimilars than the general practitioners (40%). The majority of the specialist physicians expressed opposition to pharmacist-led substitution of biological medicines, although some thought it could be acceptable, if agreed with the clinician in advance (22).

Cook et al. conducted a survey in USA in 2019 related to clinician understanding and prescription of biosimilars. 74% of the respondents could not give an appropriate definition of a biosimilar, and 40.3% considered a biosimilar the same as a generic drug. This study also surveyed the opinion of medical specialists regarding the involvement of pharmacists, especially in the decision regarding the substitution of originator to biosimilar and received split opinions of clinicians. Only 13% of the participants considered that pharmacists should be involved in the therapy decision-making regarding biologics. However, they thought that the decision could not be made by pharmacists alone (24).

When it comes to the investigation of the same topic in Asian countries, a recent survey report by Poon et al., which included hospital pharmacists in Taiwan, revealed that 86% of the participants gave (recognized) the correct definition of a biosimilar, and only 26.6% of the respondents knew the exact difference between biosimilars and originators (22).

A more recent and nationwide study conducted by Arnet et al. in 2021 included EU countries Belgium, Finland, Germany and non-EU regions like Switzerland and Thailand to elucidate the knowledge regarding the definition of biosimilar medicines. A total of 56.1% of all respondents (community pharmacists) gave a correct answer. However, the respondents generally identified their insufficiency of knowledge and did not feel well informed about biosimilars, with only 36.7% responding with a correct answer to the question related to the substitution of biological medicines (27).

Two studies conducted among pharmacists in the United States indicate similar results: the study conducted by Messner et al. in 2023 measured knowledge among pharmacists through an online survey and presented lack of knowledge among community pharmacists on originators and biosimilars, especially regarding the interchangeability and substitution (26). In a recent study performed by Giavatto et al., 48.0% of the prescribers and 42.0% of the pharmacists understood the regulations of interchangeability and substitution of biosimilars, while in the study conducted in Poland in 2019, most of the hospital pharmacists that were surveyed generally felt uncomfortable to recommend biosimilar substitution without a physician's approval (25, 31).

In general, pharmacists were familiar with interchangeability and their registration, and held positive attitudes toward biosimilars (23, 29). A study conducted in China by Hu et al. in 2022 showed that 82.17% of the clinical pharmacists had a good understanding of biosimilars. Regarding the increase of the usage of biosimilars, a vast number of the community and clinical pharmacists that were surveyed in Pakistan believed that pharmacists could contribute in increasing the uptake of biosimilars (34).

A study by Stevenson et al. in 2023 gave similar results – 87% of the respondents (pharmacists) involved in study knew that a biosimilar had equivalent efficacy and safety to its reference product (30).

Another study conducted in 2025 among pharmacists from different regions in the UAE was analyzed and showed similar results. The need for educational programs and the necessity to increase and improve knowledge were confirmed as prerequisites for a greater inclusion of these medicines in clinical use (32).

A study conducted in United States by Ling et al. in 2025 showed that the majority of the respondents indicated the need for educational programs for the adoption and use of biosimilar medicines. A greater percentage of pharmacists (47.5%) than physicians (31.3%) were “extremely likely” to recommend biosimilar products to patients initiating treatment for the first time (33).

In the included studies, the pharmacists generally demonstrated moderate to high familiarity with the term “biosimilar”; however, important knowledge gaps were frequently identified, particularly regarding regulatory approval processes, interchangeability, and substitution policies. Several studies reported misconceptions, including confusion between biosimilars and generic medicines. The pharmacists’ attitudes toward biosimilars were predominantly positive, particularly regarding their potential to reduce healthcare costs and improve patient access. Nevertheless, concerns regarding safety, immunogenicity, switching, and extrapolation of indications were repeatedly reported. Most studies highlighted the need for further professional education and training to improve pharmacists’ confidence in counseling patients and supporting biosimilar adoption in clinical practice.

Discussion

Considering that beside medical doctors, pharmacists can also have a role in the acceptance and uptake of biologics, both originators and biosimilars, many of the performed studies involve surveying these professionals, with some studies also involving patients’ and nurses’ knowledge and opinions which were not covered by the aim of this review. Study findings indicate considerable variability in pharmacists’ understanding of originator biologics and biosimilars, regardless of whether the survey methodology distinguished between objectively measured knowledge and self-assessed competence.

In general, the studies consistently reveal a notable gap between healthcare professionals’ objectively assessed knowledge and their self-perceived understanding of biologic therapies, with this discrepancy being particularly pronounced in the context of biosimilars.

The evaluation in the selected studies was conducted through administered questionnaires that allow a detailed assessment of self-assessed and measured knowledge related to key areas such as definitions, regulatory frameworks, clinical application, and attitudes toward originator biologics and biosimilar medicines. Although the majority of

survey participants indicated that they consulted multiple sources of information regarding biologic medicines, their overall knowledge did not consistently reflect this reported engagement. A significant proportion of the respondents incorrectly identified biosimilars as equivalent to generic medicines (22). Consequently, educational initiatives led by academic institutions and professional medical societies complemented by informational resources from pharmaceutical companies are essential for enhancing healthcare professionals' understanding of biologic therapies. Strengthening this knowledge base is critical to ensuring the informed and effective integration of both originator biologics and biosimilar medicines into routine clinical practice, as noted also by Sidikou et al. (18, 24).

Furthermore, the findings of this review, especially the ones that involve both medical specialists and pharmacists, indicate that pharmacists are generally more familiar with originator biologics and biosimilars compared to medical specialists. When it comes to pharmacist-led substitution of biological medicines, the majority of the medical specialists expressed opposition. However, some suggest that such substitution may be acceptable if it is pre-approved by the prescribing clinician. These results align with the conclusions of a previous systematic review by Leonard et al., which examined healthcare providers' perceptions of biosimilars and found that attitudes had remained largely unchanged in recent years (13).

Our study aimed to synthesize findings from the existing published research. Although many of the results converged on similar conclusions, notable limitations were identified. The selected studies employed diverse methodologies, utilized varying questionnaires, and lacked unified protocol for data collection, which is directly related to the study objectives that also varied. Consequently, our analysis focused exclusively on specific topics that aligned with the predefined objectives of the study.

Conclusion

This literature review underscores that insufficient knowledge and understanding of originator biologics and biosimilars are still an important issue, despite nearly two decades since biosimilars were introduced into clinical practice. This persistent gap highlights the need for ongoing educational initiatives targeting healthcare professionals. Evidence from multiple countries further reinforces the global relevance of this issue, demonstrating that the challenge transcends regional boundaries and requires coordinated international efforts to address. Gaps remain in pharmacists' understanding and comfort with key concepts about biosimilar products, including interchangeability, suggesting the need for further education.

National recommendations and guidelines for switching and interchangeability of biologic medicines are also needed to support the healthcare professionals in the process.

Many studies evaluate pharmacists' knowledge and attitudes regarding both original biologics and biosimilars, and we believe that the need for further evaluation of the progress in this topic is especially important and will persist in the future.

Regarding the fact that biologics market is constantly growing, it is essential to provide healthcare professionals with basic knowledge, as well as to improve the knowledge of specific therapies. This educational support is critical to make complete use of the benefits of these innovative treatments in clinical practice.

Declaration of Competing Interest

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Author contributions

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Znanje i stavovi farmaceuta o biološkim i biosličnim lekovima: pregled literature

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Kratak sadržaj

Napredak u biološkim terapijama postao je ključan za lečenje i akutnih i hroničnih bolesti. Pored toga, sve veće prisustvo biosličnih lekova predstavlja značajne mogućnosti za smanjenje troškova zdravstvene zaštite i proširenje pristupa pacijenata osnovnim biološkim tretmanima. Farmaceuti, kao deo zdravstvenog sistema, igraju važnu ulogu u upotrebi ove grupe lekova. Svrha ovog pregleda literature je da se ispituju postojeća istraživanja o znanju i stavovima farmaceuta prema originalnim biološkim lekovima i biosimilarima, kao i da se proceni potreba za daljim obrazovnim inicijativama u ovoj oblasti.

Digitalna pretraga literature sprovedena je putem baza podataka časopisa, kao što su *PubMed* i *Scopus*, koristeći odabrane termine za pretragu i primenjujući kriterijume za uključivanje koji odgovaraju cilju istraživanja. Većina studija koje su predmet evaluacije sprovedene su u obliku kratkih anketa, što otkriva da je većina farmaceuta upoznata sa biološkim i biosličnim lekovima, međutim, njihovo izmereno znanje je bilo manje opsežno od njihovog samoprocenjenog znanja. Znanje i stavovi farmaceuta prema biološkim lekovima pokazuju velike varijacije.

Nedovoljno kliničkog iskustva i potreba za dodatnom edukacijom identifikovani su kao preduslovi za veće uključivanje originalnih bioloških i biosličnih lekova u kliničku praksu.

Ključne reči: biološki lekovi, biosimilar, farmaceuti, znanje, stavovi
