IJBPAS, November, 2025, 14(11): 6126-6141

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

AN OVERVIEW OF BIOSIMILAR PRODUCTS REGULATORY REQUIREMENTS AND APPROVAL PROCESSES IN US AND EMERGING MARKETS BRICS-TM

SRIKANTH V [1] AND KAMARAJ R[2*]

[1,2*]Department of Pharmaceutical Regulatory Affairs, SRM College of Pharmacy, Faculty of Medicine and Health Science, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India-603203

***Corresponding Author: Dr. Raju Kamaraj: E Mail: kamarajr@srmist.edu.in**

Received 19th July 2024; Revised 26th Sept. 2024; Accepted 10th Nov. 2024; Available online 1st Nov. 2025

https://doi.org/10.31032/IJBPAS/2025/14.11.9593

ABSTRACT

Biosimilars are quickly becoming indispensable substitutes for biological medications made by original manufacturers, especially when treating serious and uncommon illnesses. The development of biosimilars is anticipated to pick up speed in the upcoming ten years as the patents for many biological medications are about to expire This paper analyzes the biosimilar product regulatory environment in the US and key emerging markets (BRICs-TM). The U.S. Food and Drug Administration (FDA) is a principal operator in facilitating the advancement of biosimilars by expediting the regulatory approval processes, as per the Biologics Price Competition and Innovation Act (BPCI). The FDA's strategy highlights the value of comparability to reference products and integrates quality-by-design principles without demanding precise replication. The biosimilar market is expanding quickly on a global scale; estimates suggest that sales could double to $15 billion by the early 2020s. While developed markets such as the United States and Europe have well-established regulatory frameworks, emerging economies present a combination of opportunities and challenges. These markets, which account for 70% of the world's population and a sizeable amount of pharmaceutical spending, provide an ideal environment for the development of biosimilars because of low biologic prevalence and cost limitations. However, there are a lot of challenges due to differences in regulations in emerging markets. These consist of discrepancies in the protocols for approval, the choice of reference products, the needs for clinical trials, and interchangeability guidelines. Regional variations in healthcare goals, policies, and financing mean that substantial gaps persist in emerging economies even

with the efforts of major regulatory bodies to establish standardized approval processes. Addressing these legal obstacles is essential to advancing the production of biosimilars in emerging markets. The study highlights the need for harmonized regulatory approaches, particularly in areas where the products may have the biggest impact on patient care and healthcare economics, in order to fully realize the promise of biosimilars in improving access to and affordability of healthcare globally.

Keywords: Biosimilar, USFDA, Emerging Markets-BRICs-TM, Regulatory requirement, Approval process

INTRODUCTION

The field of biotechnology has led to the creation of medicines for numerous severe, uncommon, and serious illnesses, such as autoimmune diseases, cancer, heart attacks, strokes, multiple sclerosis, diabetes, and rheumatoid arthritis. In the next ten years, a large number of biological medicines will expire. In response, similar biological medicines (SBMPs), also known as biosimilar medicinal products or "biosimilars," will be developed. A number of these SBMPs are already on the market in various parts of the world **[1]**.

An active ingredient in a biosimilar comes from an approved originating biological pharmaceutical product, sometimes referred to as the reference pharmaceutical product or RMP. It demonstrates comparable biological action, assurance, efficacy, and quality features to the RMP based on an inclusive comparability exercise **[1]**.

The United States Food and Drug Administration is in responsible for enhancing overall health by encouraging the quick development of innovations that raise a safe and efficient of pharmaceuticals and by helping the the broader population access accurate, factual information required to use pharmaceuticals to preserve and enhance public health. The regulatory requirements and assessment standards for biosimilar products in the US and emerging key markets (BRICs-TM) are summarized in this paper **[2]**. The FDA released a general advisory statement on innovations, difficulties, and solutions for new pharmaceutical products. In order to assure that medical advancements are as quickly as possible made available to those in need, it examines the critical path that must be followed to complete therapeutic products and how the FDA can collaborate with other parties throughout the process, from research to manufacturing to final utilization.

One of the most vital angles of modern medicine clinical applications is the quality-by-design (QbD) approach. The formulation, production processes, package closure properties, and

user instructions are all handled by the sponsor's drug product development team. According to FDA regulations, a biosimilar product needs to look like the brand-name biologic drug. sometimes known as a "reference product," but not be an exact replica of it.6–8 Pharmaceutical businesses must devise strategies to adhere to changing regulations, manage risks, and execute requirements for their clinical applications as more biosimilar drugs are created **[3]**.

Background

On March 23, 2010, the Biologics Price Competition and Innovation Act of 2009, or BPCI Act, was ratified. The BPCI Act provides a streamlined licensing process for biological products that are demonstrated to be biosimilar to or comparable in quality to an FDA-licensed reference product.[4] One of the elements that can be utilized to support the licensure of a biological product if it can be demonstrated to be strongly comparable" to an FDA-licensed biological product (the referencing product) is the FDA's previous ruling that the reference product is safe, pure, and potent When it comes to biosimilar biological products, the United States Public Health Service Act's (351(k) license pathway permits an accelerated licensure route with fewer preclinical and clinical data requirements than the comprehensive licensure process **[4]**.

The Rise of Biosimilars in Developing Emerging Markets

The use of biosimilars has grown significantly in recent years. By the early 2020s, global sales are expected to have more than doubled to $15 billion. Biosimilars were first introduced in the European market, where their success was largely attributed to extensive reimbursement coverage, high treatment rates, and particular regulatory frameworks. Over 40 biosimilars had received approval from the European Union by 2018; these had gone on to be successfully marketed in Australia, Canada, Japan, and South Korea. To date, over fifteen biosimilars have been approved in the US. The creation of biologic substitutes, including biologics that have not undergone a formal biosimilar comparability study, has shown emerging markets to be a fertile ground. There are more than 70 of these products available in India, and over 40 in China. These regions improved regulatory frameworks have improved the quality of their products significantly and made it easier for them to adapt to different markets. This shift in regulations highlights how biosimilars are becoming more widely accepted and integrated into the global pharmaceutical market **[5]**.

Seventy percent of the world's population lives in emerging economies, which make up thirty percent of worldwide GDP and more than thirty percent of pharmaceuticals expenditure. With a yearly rise of 5–8%, these regions are responsible for nearly one-third of the increase in drug demand worldwide. Biosimilars are expected to be crucial to the pharmaceutical industry because they can greatly improve options for therapy.

Significant regulatory gaps still exist in emerging economies, despite the fact that major regulatory bodies worldwide have largely adopted scientifically standardized approval processes for biosimilars. Regional differences in funding, legislation, and healthcare objectives are the main cause of these disparities. Major challenges include the absence of a standardized procedure framework, varying regulatory requirements for clinical efficacy trials, variations in the choice and acquisition of the RBP, and unclear protocols for substitution, interchangeability, and switching. As a result, the development and commercialization of biosimilars are hampered by the inconsistent regulatory environment **[6]**, **[7]**.

FDA, THE US FOOD AND DRUG ADMINISTRATION

Biosimilars present a safe and effective treatment option for various medical conditions, including ongoing dermatological and gastrointestinal illnesses (such as the condition, bloating, Crohn's illness, and diarrhea), osteoarthritis, renal pathologies, oncological diseases. Adoption of biosimilars has the potential to lower healthcare costs while improving access to necessary pharmaceuticals. Explore the website to obtain extensive information about biosimilars and make use of the FDA's educational resources specifically created for healthcare professionals and patients **[8]**. The term "biosimilars" has been defined differently by various regulatory authorities. Through its definitions, each regulatory body presents a slightly different picture than the others. Here are a few definitions from industry experts for related pharmaceutical products

The Food and Drug Administration (FDA) of the United States regulates biological Medicines, which are used in the diagnosis, treatment, and prevention of illnesses. This category encompasses molecules that are typically large and complex. These products can be created using biotechnological techniques within living organisms, such as microorganisms, plant cells, or animal cells. Characterization-wise, they frequently present greater challenges than small molecule drugs. The use of a number of biological product

categories, including therapeutic proteins (like filgrastim), monoclonal antibodies (like adalimumab), and vaccines (like tetanus and influenza shots) has been approved in the US **[9], [10]**.

The term "biosimilarity" as defined by the FDA describes a biological product that is nearly identical to the reference product, with the exception of a few minor differences in non-active ingredients. Furthermore, the product's safety, purity, and potency do not differ significantly from those of the references product **[11]**.

Definition: Reference Product

A particular biological product that has already been approved by the FDA is known as a reference product. It acts as the benchmark for assessing and contrasting a proposed biosimilar product **[9]**

BIOSIMILAR PRODUCT APPROVAL PROCEDURE

In order to ensure patient confidence in the safety, efficacy, and quality of biosimilar products, the approval process is meticulously designed. The FDA-approved biological product known as the reference product serves as a benchmark for assessing suggested biosimilars. Approval of the reference product is contingent upon a comprehensive application demonstrating its efficacy and safety. A biosimilar product, while not identical to its reference counterpart, closely imitates the FDA-approved reference product and does not show any clinically significant disparities in terms of safety, potency, purity, or effectiveness. Instead of carrying out independent evaluations to confirm the safety and efficacy of the reference product, the primary objective of a biosimilar development program is to show how the suggested biosimilar is similar to it.

A comprehensive set of comparative data is provided by the manufacturer along with the reference product in order to establish biosimilarity. The procedure starts with a careful examination and evaluation of the biosimilar's composition and performance. Comparative clinical trials are the last step in the process, after which animal studies could be carried out if needed **[12]**.

DATA REQUIREMENT FOR APPROVAL OF BIOSIMILARS PRODUCTS

In order to apply for biosimilar products, one must submit comprehensive data demonstrating the product's resemblance to the comparable product. Typically, this consists of the following components:

Analytical Investigations

Extensive comparative studies demonstrating the biosimilar and reference product's striking similarity. An example of the functional and molecular similarities, even with minor

variations in the clinically inactive ingredients.

Preclinical Evaluation

Comprehensive in vivo investigations, including rigorous toxicological assessments. Conducting comparative pharmacological profiling in order to determine biological equivalence.

Clinical Investigations

Strict clinical studies carried out to confirm the suggested biosimilar's efficacy, safety, and purity in one or more authorized indications of the reference product.

A detailed analysis of the immune response profiles.

Detailed studies of how drugs are metabolized within the body, often with assessments of how they affect the body in tandem **[13]**.

REGULATORY APPROVAL PROCESS FOR BIOSIMILARS

Every biologic kind of biological product that receives FDA approval must pass a stringent evaluation procedure. This ensures that the high caliber, safety and efficacy of these products can be trusted by both patients and medical professionals. The FDA authorizes reference products and biosimilar products (biosimilars) through various legal approval procedures.

An individual 351(a) Biologics License Application (BLA) is required to approve a reference product. This application must contain extensive data to prove the effectiveness and safety of the product.

Typically, clinical trials involving particular patient populations that are pertinent to all of the treatment indications that the manufacturer wishes to see are where this data comes from. A product is considered a biosimilar if it closely mimics an FDA-approved reference product and has the same potency, pureness, and safety levels with no discernible clinical differences.

In order to maintain safety and efficacy while streamlining biologic development, biosimilars are subject to an accelerated approval process. Though the 351(a) pathway verifies a biologic's safety and efficacy independently, the main goal of a biosimilar development program is to show that the product is comparable to the reference product. Therefore, all biosimilar and interchangeable biosimilar products are approved through the shortened 351(k) pathway, which mainly relies on a comparative analysis with a reference product **[14], [15]**.

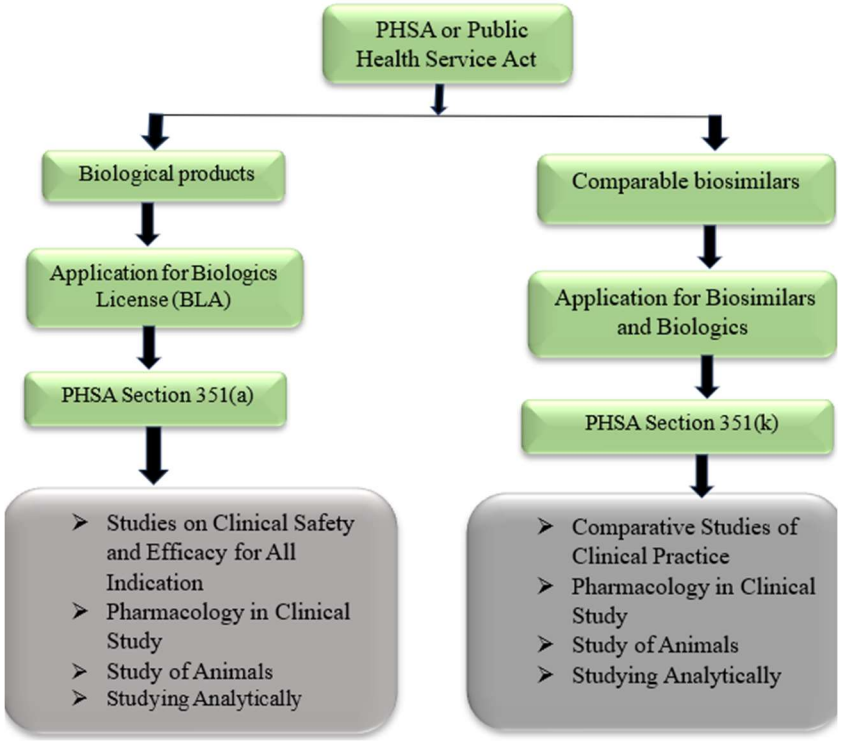

Figure 1: FDA Approval for Biosimilar Products

PRODUCING DATA ON ANALYTICAL SIMILARITY

To assess possible ramifications of observed variations and identify research to address remaining uncertainties, analytical similarity data generation is crucial. Analyzing and describing the reference product's variations and quality attributes is essential. The suggested biosimilar's manufacturing procedure has to be planned to guarantee that there are few, if any, differences in the product's quality characteristics from the reference. It is easier to evaluate biosimilarity uncertainties and forecast expected "clinical similarity" using quality data when one is aware of the relationship between quality attributes and the clinical safety and efficacy profile **[4]**.

REQUIREMENT FOR ANIMAL STUDY DATA

When doubts about a proposed product's safety exist before clinical trials are started, data on animal toxicity may be helpful. Data from the biosimilar application and/or publicly available information about the reference product and the proposed biosimilar product, as well as the degree of known similarities or differences between the two, will determine the scope and number of animal toxicity studies. It could be helpful to

compare Pharmacokinetic and Pharmacodynamic in an animal model **[4]**.

STUDY CONSIDERATIONS FOR HUMAN PK AND PD

Examine the referring product's and proposed biosimilar's pharmacokinetic (exposure) and, if relevant, pharmacodynamic (response) profiles to bolster the notion that their efficacy and safety are comparable.

Usually regarded as the most sensitive data point to bolster the claim that there are no clinically significant variations **[16]**.

AMENDMENTS TO THE BIOSIMILAR USER FEE

Under the FD&C Act, as amended by the Biosimilar User Charge Provision of 2022 (BsUFA III), the FDA is allowed to charge fees for biosimilar biological products from October 2022 to September 2027. These fees expedite the processing of applications, particularly in the postmarket safety domain. Biosimilars have the potential to significantly enhance public health by saving or changing lives at a reduced cost. The development of safe and effective biosimilar products is encouraged by BsUFA for the benefit of the broader American population **[17]**.

Table 1: User Fee Levels for the Financial Years 2023 and 2024

Type of Users Fees		Financial Year 2023	Financial Year 2024
Biosimilars' Biological Product Development (BPD) Fee	Initially Biological Product Development (BPD)	$ 47,325	$10,000
Applications Fee	yearly BPD	$ 47,325	$10,000
	Activation again	$ 94,650	$20,000
	Need for Clinical Data	$ 1,746,745	$1,018,753
	No Need for Clinical Data	$ 873,373	$509,377
Program Charge		$ 304,162	$177,397

EXCLUSIVITY OF REFERENCE PRODUCTS

The exclusivity periods for reference products are defined by Sections 351(k)(7) of the PHS Act and begin on the date the product is first licensed under Section 351(a). If the product meets the requirements for exclusivity, a 351(k) application may be submitted to the FDA for review no later than four years following the reference product's initial license; approval cannot be given until twelve years following the first licensure. Consult the

FDA guidelines for more information on how the FDA determines first licensure and reference product exclusivity **[18]**.

BIOSIMILAR APPROVAL AND REGULATORY REQUIREMENT IN BRICS

Participants in the investigation

Regulatory authorities from BRICS-TM (Brazil, Russia, India, China, South Africa, Turkey, and Mexico) countries which are acknowledged as developing nations with considerable regional influence participated in the study. Annual summits have been held since the BRICS were formed in 2009; the most recent virtual summit was hosted by Russia on November 17, 2020, because of the COVID-19 pandemic. Regulatory experts from these countries were invited; they were found via agency websites, LinkedIn, and local contacts. Those with senior positions, regulatory consulting experience, and knowledge of biologics or biosimilars were the main selection criteria. An email outlining the project's goals, the study's parameters, and a request for their involvement was sent to them **[6], [19]**.

AGENCY ORGANIZATION AND FUNCTIONS IN THE REGULATION OF BIOLOGICAL PRODUCTS

Brazil (ANVISA)

The biological division makes up about 1.6% of the organization. Internal assessments are carried out by highly skilled assessors who are all PhD holders. The agency's primary method is a Type III data assessment, which involves a thorough examination of applications for marketing authorization.

Russia (Russian Ministry of Health)

The same internal assessors evaluate marketing authorization applications, biological or not. The approval procedure uses the Type III review methodology and is based only on the assessors' internal evaluations.

India (CDSCO)

Within the biological division of the CDSCO in India, which makes up 2% of the organization, internal assessors are required to possess a master's degree in pharmacy. Clinical and non-clinical dossiers are evaluated by external assessors. The Department of Biotechnology develops regulatory guidelines (DBT). Clinical data is reviewed by the RCGM, while non-clinical data is reviewed by the Subject Expert Committee (SEC). If a biosimilar is approved by more than one accredited agency China, or any other country it is not subject to Type II (abridged) review.

South Africa (SAHPRA)

SAHPRA is a South African organization that employs about 200 people, five of whom are

reviewers with a focus on biological applications. External evaluators handle the Chemistry Manufacturing Control, non-clinical data, and clinical data evaluations during Type III full dossier reviews conducted by the agency.

Turkey (TITCK)

The organization consults outside assessors and uses the Type III review methodology for Chemistry Manufacturing Control, non-clinical data, and clinical data evaluations.

Mexico (COFEPRIS)

The biological section of COFEPRIS, which employs 1% of the workforce in Mexico, mandates that internal assessors hold a bachelor's degree or above. The organization uses outside knowledge from SEPB, NMC, TGA, USFDA, and EMA in addition to Type I data assessment models **[6]**.

DEVELOPING STANDARDS FOR BIOSIMILARS

Sequential steps are involved in determining biosimilar similarity: quality characterization, in vitro analytical testing, toxicology studies, Pharmacokinetic/Pharmacodynamic studies, non-clinical comparative pharmacology, and safety and efficacy clinical trials. International development initiatives face substantial obstacles due to the disparate regulatory requirements for dossiers in six emerging economies, even though they are in line with WHO principles **[6]**.

CHARACTERIZING COMPARATIVE QUALITY

Selecting Reference Biologic Products (RBPs)

It is necessary to use locally authorized references when choosing Reference Biologic Products (RBPs), which are ascertained by thorough dossier submissions on quality, safety, and efficacy. Authorities such as CDSCO, TITCK, and COFEPRIS allow RBPs from ICH/reference countries in case local RBPs are not available. For certain clinical and non-clinical research, TITCK additionally permits RBPs that are not permitted locally as well as local sources. Unauthorized RBPs are typically prohibited by CDSCO, with rare exceptions. Multiple RBP batches with distinct expiration dates are required by agencies in Brazil, India, South Africa, and Turkey. ANVISA, in contrast to the Russian MoH and COFEPRIS, allows RBPs to be modified during development and comparative research **[6]**.

Clinical Study

All six regulatory bodies in these emerging economies mandate that biosimilar applicants include clinical safety and efficacy studies, as well as pharmacokinetics/pharmacodynamics data in their applications **[6]**.

PK/PD

Research planning, endpoint location, fingerprinting, and integrating Pharmacokinetic/pharmacodynamic studies are all done according to established protocols in these developing countries. These procedures strictly adhere to EMA regulations **[6]**.

Immunogenicity

Comparative immunogenicity data are required by all agencies (with the exception of the Russian Ministry of Health) for biosimilar applications. CDSCO accepts immunogenicity data from the third phase of efficacious trials or Pharmacokinetic/Pharmacodynamic studies. Additionally, subject to the approved indications of the reference biologic product (RBP), all authorities allow extension of immunogenicity investigations to other indications. In its 2016 Biosimilar Guidance, CDSCO set forth its expectations for these investigations, even though it is still unclear what other regulatory bodies in these developing economies will specifically require **[6]**.

STUDIES OF COMPARING CLINICAL EFFICACY

Scientific Trial Designing

In general, all of these developing countries' regulatory bodies require a parallel-group, double-blind, randomized trial with enough power that utilizes efficacy results. COFEPRIS and ANVISA accept both non-inferiority and equivalency designs for clinical trials. The Russian Ministry of Health favors equivalency designs, while CDSCO recognizes non-inferiority designs **[6]**.

Local Clinical Studies

ANVISA does not require local clinical studies, but it does mandate legal advice to clarify applicable regulations for global research. It accepts foreign patient data if there are no expected biological variations between Brazilian populations and the study population. TITCK follows similar protocols. International studies must include Russian patients, and local clinical investigations are required for Phase III trials according to the Russian Ministry of Health. In addition to requiring local Phase III trials in India with no fewer than of 100 patients per arm and prohibiting the submission of biosimilars containing data on patients abroad, CDSCO also provides non-binding pre-submission advice. COFEPRIS may choose not to conduct local clinical trials in light of the quality of previous clinical investigations, as well as the demonstrated comparability at the Chemistry Manufacturing Control and non-clinical levels. It enables patients from other countries to participate in clinical efficacious trials with the aim of demonstrating biosimilarity **[6]**.

Table 2: Requirements for conducting clinical trials in emerging economies for the development of biosimilars

Standards	BRAZIL	RUSSIA	INDIA	SOUTH AFFRICA	TURKEY	MEXICO
Pharmacokinetic/Pharmacodynamic Investigations carried out in Phase I Integrated Pharmacokinetic /Pharmacodynamic study	✓	✓	✓	✓	✓	✓
Immunogenicity research is required.	✓	✖	✓	✓	✓	✓
Phase III efficacy studies Research design: Randomized, double-blind, parallel group study with sufficient power utilizing efficacy endpoints	✓	✓	✓	✓	✓	✓
Acceptance of the clinical study design	✓	✓	✓	✓	✓	✓
Design of equivalency	✓	✖	✓	✖	✖	✓
Non-deficiency design						
local clinical trials	✖	✓	✓	✖	✖	✓
necessary for the elderly and pediatric populations	✖	✓	✓	n/d	✖	✖
Patients from third countries are included	✓	n/d	✖	n/d	✓	✓

REGULATORY APPROVAL PROCESS FOR MARKETING AUTHORIZATION

There are various steps involved in the approval process for biosimilar applications: Regulatory agencies are consulted by applicants seeking scientific advice regarding the scientific aspects of developing biosimilars. Getting early input on the development plan, study design, and other important scientific factors are part of this step.

Clinical Trial Application (CTA) Approval: In order to ensure regulatory compliance, the CTA approval process involves the submission and subsequent approval of clinical trial applications. This stage confirms that the suggested clinical trials follow the necessary guidelines and legal specifications. The dossier review process is a thorough process that includes multiple important steps, including validating the application, holding it up for review, carrying out a scientific review, examining samples, certifying Good Manufacturing Practice (GMP) to maintain strict production standards, and approving the finished product. When all of these procedures are taken, biosimilar products are guaranteed to go through a thorough regulatory review process prior to being approved for commercialization **[6], [20]**.

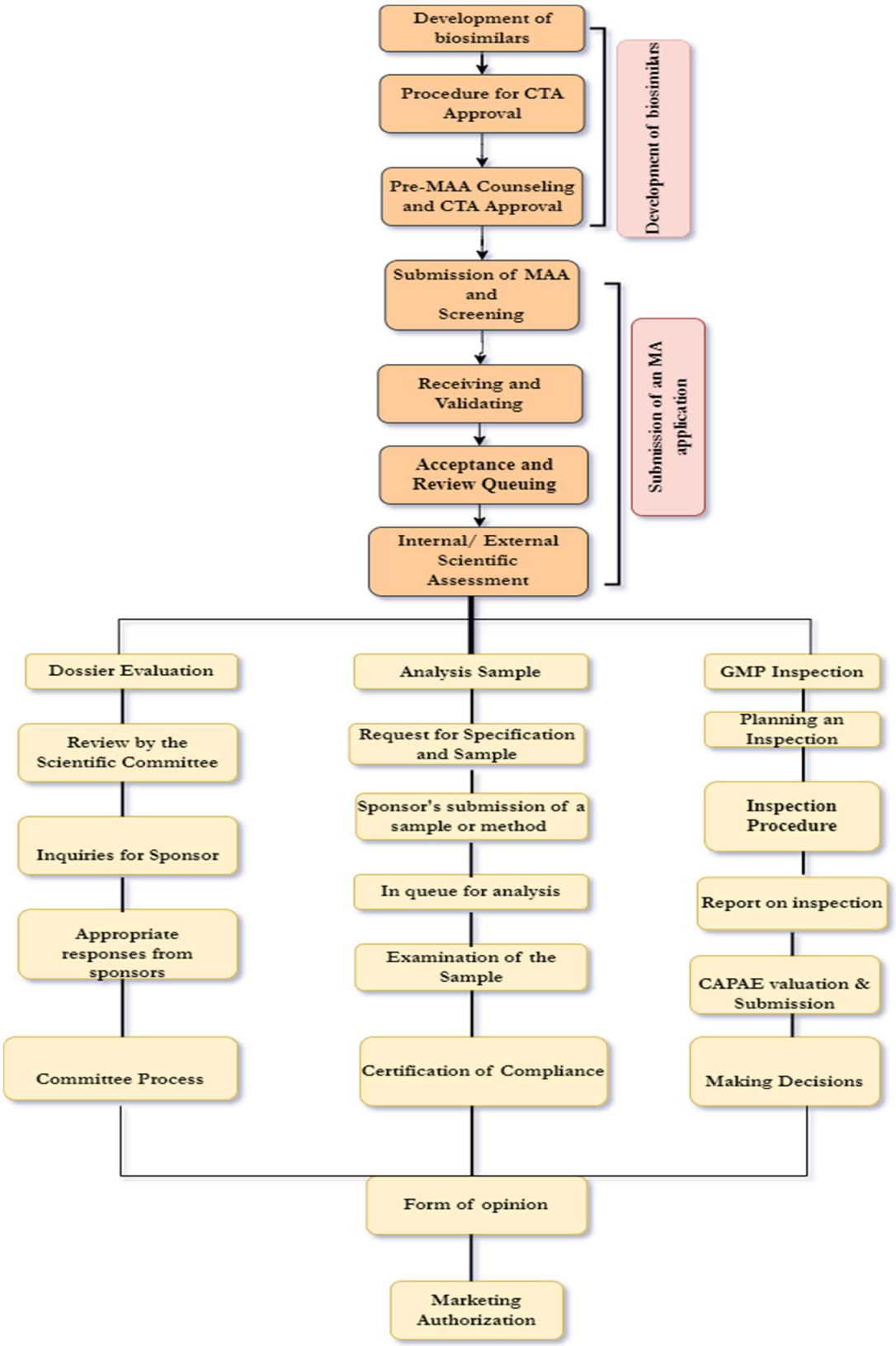

Figure 2: Key stages in the Approval process for marketing authorization

CONCLUSION

Since the US and emerging markets (BRIC-TM) have different market conditions and regulatory development stages, the laws governing biological and biosimilar products are complex and multifaceted. The US FDA's 351(k) Pathway is an extremely strict framework that requires a significant amount of data in order to guarantee biosimilarity. This process has set a global standard for biosimilar approval.

ANVISA in Brazil, Roszdravnadzor in Russia, CDSCO in India, and NMPA in China are just a few of the regulatory bodies in emerging markets that are actively working to improve and develop their regulatory frameworks in order to bring them into compliance with international standards. These markets are making significant strides toward developing strategies that reconcile the need for thorough analysis with the pragmatics of entering the market. Conditions for local clinical trials to be carried out: Certain BRICS-TM markets China and Russia, in particular have laws requiring clinical trials to be conducted domestically. This may result in increased costs and extended lead times for foreign companies engaged in pharmaceutical research and development. Not included in the BRIC group, but nonetheless exhibiting positive regulatory developments, Turkey and Mexico highlight a broader trend of improving biosimilar regulations in developing nations. Even though there has been progress, issues still need to be resolved, particularly when it comes to coordinating regulatory requirements among different regions. Lack of international standardization can make it more difficult to enter new markets and complicate the process of developing new products. International organizations like the WHO and ICH, however, are vital in promoting harmonization, which has the potential to enhance regulatory requirements in the future by streamlining and increasing their efficiency.

Biosimilars have a lot of potential advantages, such as more market accessibility and less expensive biological treatment costs. These products have the ability to significantly lower healthcare costs and address unmet medical needs, especially in settings with limited resources. However, obstacles like patent infringement, production difficulties, and market acceptance must be addressed in order to reap these rewards.

Innovation in manufacturing procedures, analytical techniques, and regulatory science are essential for the biosimilars field to grow. To support the research and authorization of biosimilars that are reasonably priced, safe,

and effective, academic institutions, industry players, and regulatory agencies must collaborate effectively.

In the end, emerging markets and the US have different regulatory frameworks and approval procedures for biological and biosimilar products. Still, there appears to be a trend toward improving and harmonizing these models. Through addressing the existing challenges and leveraging the benefits of biosimilars, stakeholders can significantly enhance global health outcomes and ensure greater accessibility to essential biological therapies.

REFERENCES

[1] I. Kathuria and K. Srivastava, "Biosimilars: Opportunities, Challenges, And The General Principles Governing Their Development Around The Globe," vol. 9, p. 2021, 2021, doi: 10.22159/ijls.2021v9i6.43430.

[2] P. By: Kaiser J. Aziz, *Biosimilar Biological Products: Development & Applications*.

[3] I. Gherghescu and M. B. Delgado-Charro, "The biosimilar landscape: An overview of regulatory approvals by the EMA and FDA," *Pharmaceutics*, vol. 13, no. 1, pp. 1–16, Jan. 2021, doi: 10.3390/pharmaceutics13010048.

[4] S. Lim, "Overview of the Regulatory Framework and FDA's Guidance for the Development and Approval of Biosimilar and Interchangeable Products in the US."

[5] Y. Chen, A. Lehmann, and J. Santos da Silva, "What's next for biosimilars in emerging markets?"

[6] H. Rahalkar *et al.*, "Current Regulatory Requirements for Biosimilars in Six Member Countries of BRICS-TM: Challenges and Opportunities," *Front Med (Lausanne)*, vol. 8, Sep. 2021, doi: 10.3389/fmed.2021.726660.

[7] H. Malhotra, A. Krishnan, and R. Mody, "Global regulatory landscape of biosimilars: emerging and established market perspectives," *Biosimilars*, p. 19, Feb. 2015, doi: 10.2147/bs.s44052.

[8] "BIOSIMILAR." Accessed: Jul. 26, 2024. [Online]. Available: https://www.fda.gov/drugs/therapeutic-biologics-applications-bla/biosimilars

[9] U. Food and D. Administration, "Biological Product Definitions." [Online]. Available: www.fda.gov

[10] L. Christl and S. Lim, "Biosimilar and Interchangeable Products in the United States: Scientific Concepts, Clinical Use, and Practical Considerations."

[11] U. Food and D. Administration, "WHAT IS A BIOSIMILAR?" [Online]. Available: www.FDA.gov

[12] U. Food and D. Administration, "Biosimilar Product Regulatory Review and Approval What is the approval process for biosimilar products?" [Online]. Available: www.fda.gov

[13] L. Christl, "FDA's Overview of the Regulatory Guidance for the Development and Approval of Biosimilar Products in the US."

[14] U. Department of Health, H. Services, U. Food, and D. Administration, "Biosimilar Regulatory Approval Pathway." [Online]. Available: http://www.fda.gov/biosimilars

[15] M. Epstein, "Food and Drug Administration guidances on biosimilars: an update for the gastroenterologist," Jan. 01, 2018, *SAGE Publications Ltd*. doi: 10.1177/1756284818799600.

[16] D. of Health, H. Services, U. Food, and D. Administration, "Biosimilar Development Process." [Online]. Available: www.FDA.gov/biosimilars

[17] "U.S. Food and Drug Administration. (n.d.). Biosimilar user fee amendments. FDA."

[18] Fda and Cder, "Guidance for Industry Reference Product Exclusivity for Biological Products Filed Under Section 351(a) of the PHS Act DRAFT GUIDANCE." [Online]. Available: http://www.fda.gov/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/default.htm

[19] H. Rahalkar, A. Sheppard, C. A. Lopez-Morales, L. Lobo, and S. Salek, "Challenges Faced by the Biopharmaceutical Industry in the Development and Marketing Authorization of Biosimilar Medicines in BRICS-TM Countries: An Exploratory Study," *Pharmaceut Med*, vol. 35, no. 4, pp. 235–251, Jul. 2021, doi: 10.1007/s40290-021-00395-8.

[20] H. Rahalkar, A. Sheppard, and S. Salek, "Comparison of BRICS-TM Countries' Biosimilar Regulatory Frameworks With Australia, Canada and Switzerland: Benchmarking Best Practices," *Front Pharmacol*, vol. 12, Aug. 2021, doi: 10.3389/fphar.2021.711361.