



## Safety Issues of Biosimilar Products

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### Letter to the Editor

Biologics are complex molecules that are manufactured using living cells and used in the treatment of several chronic inflammatory diseases and cancer [1]. As biosimilars offer the potential for lower acquisition costs versus the originator biologic, evaluating the economic implications of the introduction of biosimilars is of interest [2]. As the costs of biologics are high, biosimilars offer the potential of greater choice and value, increased patient access to treatment, and the potential for improved outcomes [3]. By providing more-affordable treatment options and introducing price competition to the market, biosimilar medicines can generate significant savings. The cumulative savings between 2016 and 2020 in the EU5 and the USA are estimated to range between 49 billion Euros and 98 billion Euros [4]. The Biologics Price Competition and Innovation Act (BPCIA) grants 12 years of exclusivity to originator or reference biologics; therefore, by law, the FDA cannot approve a biosimilar until this period has elapsed [2,5]. Patents for many branded biologics will expire during the next few years, allowing biosimilars manufacturers to seek FDA approval for generic versions of these agents [2]. The Biologics Price Competition and Innovation Act (BPCIA), which is part of the patient protection and affordable care act, were passed to facilitate the entry of biosimilar drugs into the market [6]. There has been an increasing trend toward the approval of biosimilars in the USA and the EU. The original goal of legislation to approve biosimilars through a fast-track process that would lead to more competition and price reductions is starting to be realized [7]. According to the BPCIA, a biologic product is deemed biosimilar to the already approved, originator biologic if the available data show that it is highly similar to the reference product, “notwithstanding minor differences in clinically inactive components, and there are no clinically significant differences between the biologic product and the reference product in terms of safety, purity, and potency of the product” [8-10]. Approval of biosimilars requires comprehensive assessment of all stages of the research and development process, including evaluation of analytical, preclinical and clinical data, to establish bio-similarity to their reference products. The goal of biosimilar comparability studies is not to re-establish efficacy and safety for the proposed biosimilar, but to demonstrate similarity to the reference product [11,12]. The biosimilar development pathway consists of a comprehensive comparability exercise between the biosimilar candidate and the reference product, primarily focusing on data from analytical studies. Clinical studies for biosimilar candidates follow a different design to those for a new biological, as the aim is not to independently establish clinical benefit, but to confirm bio-similarity between the two agents [4]. Physician awareness and perceptions towards biosimilars are important factors in their adoption to clinical practice [11]. A biosimilar applicant has to provide a considerably larger package of comparative data than a generic applicant to ensure that the biosimilar can indeed rely, for the purpose of licensing, on the efficacy and safety experience gained with the reference product. While for a generic, the demonstration of similar in vitro dissolution and in vivo bioavailability (so-called bioequivalence) is sufficient to conclude therapeutic equivalence with the reference product, for a biosimilar, comparable physicochemical, biological and functional characteristics as well as efficacy and safety/immunogenicity with the reference product must be demonstrated. In addition, unlike generics, any extrapolation to other indications of the reference product must be scientifically justified [12]. The approval of biosimilars is a highly regulated and detailed process. The European Medicines Agency (EMA) and the US FDA guidance documents stipulate that a biosimilar manufacturer must perform a series of extensive similarity assessments in order to demonstrate bio-similarity to the reference product, and to ultimately gain regulatory approval or licensure [13]. Difference between generic biotech and biosimilar products are: a) Biologic medicines are not made using a set of standard materials, but are developed using unique biological systems and living cells. As a result, the active ingredient is impossible to recreate exactly and the selected cell lines from which the biologic medicine originates are unique to each manufacturer b) The manufacturing process for biologic medicines is generally more complex than manufacturing processes for chemical drugs. Unlike small molecule drugs, biologic medicines are produced in genetically-engineered living cells that are sustained in a highly-controlled environment.

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The protein produced by the cells will be influenced by individual cell characteristics as well as the environment and nutrients provided c) Each manufacturer has different processes that create distinctive characteristics in the product, which are specific to the manufacturer. This creates a unique relationship between a biologic's manufacturing process and the final product approved by regulators [14-21]. Despite the undeniable advantages of such procedure, some concerns (such as the absence of switching studies or the evaluation of efficacy and safety in all therapeutic indications) still exist about it. In particular, the European regulatory framework on biosimilars approval does not include the conduction of switching studies demonstrating the interchangeability to be carried out before marketing authorization. This is one of the main aspects that negatively affect healthcare professionals' clinical decisions on switch [22]. The FDA has accepted the concept of extrapolation of indications; we just need additional high-quality research on nonmedical switching and the risk of immunogenicity. FDA recently released a white paper indicating the types of trial designs that would be required before nonmedical switching of biosimilars in stable patients could be endorsed in distinction to substitution by a pharmacist in patients starting therapy. These types of trials would involve multiple crosses between an originator biologic agent and a biosimilar. Thus, we need more studies on switching; especially multiple-switch studies [23-25]. A survey of 470 European physicians belonging to various specialties including rheumatology, nephrology, oncology and dermatology from five European countries (France, Germany, Italy, Spain and the UK) showed insufficient understanding of biosimilar. Only 22% responded that they were very familiar with biosimilars, and could define what it is. While a majority (54%) had a basic understanding of biosimilars, 24% of them answered that they had never heard of biosimilar before. Due to insufficient understanding of biosimilars, half of them thought that biosimilars have to use different International Non-proprietary Names (INN) from the originator biologic agents. However, this understanding of international non-proprietary name is misleading and is definitely different from regulatory authorities [26]. Biosimilar market uptake greatly depends on health care provider willingness to promote, prescribe, and use biosimilars in clinical practice. US and European health care providers still approach biosimilar medicines with caution, citing limited biosimilar knowledge, low prescribing comfort, and safety and efficacy concerns as main deterrents for biosimilar use. To realize the full cost-saving potential of biosimilar medicines, clinician-directed biosimilar education will be imperative to address gaps in biosimilar knowledge, facilitate prescribing changes, and ultimately increase biosimilar use. An overall lack of biosimilar familiarity in US and European health care settings accompanied concerns about biosimilar safety, efficacy, extrapolation, and interchangeability [27]. One of the most significant safety concerns with biosimilars is the potential risk of immune-based adverse reactions. Because of their molecular size, biologics can directly induce anti-drug antibodies which may have significant consequences for both safety and efficacy [28]. Registries should be employed to monitor use of biosimilars and to identify potential adverse effects. The price of biosimilars should be significantly lower than that of reference products to enhance patient access. Biomimics are not biosimilars and, if they are to be marketed, they must first be evaluated and approved according to established regulatory pathways for novel biopharmaceuticals [29]. It is important to be clear about whether a specific product has been evaluated through a rigorous evaluation procedure based on the criteria defined in the EMA, FDA, or WHO biosimilar guidelines. It is also important

for prescribers to understand what happens when a particular biosimilar receives a designation of 'interchangeable' with the originator and when substitution may occur, as these designations/policies may impact patient outcomes [30].

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