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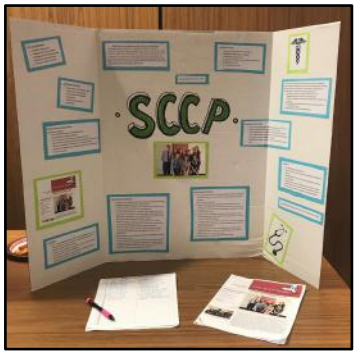
# NYS-ACCP Insider

D'Youville School of Pharmacy

## Special Points of Interest:



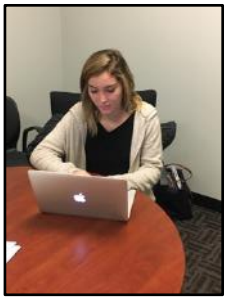
2019-2020 E-Board
**President:** Dupinder Dhaliwal
**President Elect:** Shea Bacon
**Membership VP:** Osumanu Amoo*
**Secretary:** Samantha Rowland
**Treasurer:** Natali Ninova*
*not shown in picture




*Poster board for P1 orientation*

## D'Youville School of Pharmacy: ACCP Chapter Synopsis

This year, our ACCP chapter at D'Youville has focused on re-aligning the goals of our chapter with ACCP's core values and mission. The main goal of our chapter is to provide students with the knowledge and resources to get involved with clinical pharmacy opportunities. Over the year, we have strived to support benchtop research at our school and provide students with information to help them prepare for residency opportunities post-graduation and promote the advancement of pharmacists in healthcare.



*Student, Shea Bacon working on research projects*

*Faculty talking to student at the annual research mixer*

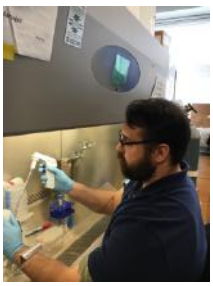
*Denise Harris facilitating a CV/Resume writing workshop at D'Youville School of Pharmacy*

To encourage interest in the field of clinical pharmacy, we collaborated with other organizations in our school to hold an informational mixer in the Fall. Here, we were able to provide incoming pharmacy students with information about our clinical pharmacist speaker series, research challenge, research mixer, benchtop research opportunities and annual newsletter publishing. This event was a turning point for our chapter as we were able to inspire almost 20 new student members.

*Photographed Above: Some of the student members who contributed to the Newsletter*

In February, we held our first résumé writing workshop with the help of Denise Harris, Director of Career and Professional Engagement Services at D'Youville. This event helped provide pharmacy students with knowledge about how to create strong résumés, create a positive social media presence, and develop skills to successfully seize new opportunities. It was a first-time event by our chapter but will likely be continued for years to come.

The spring semester came with some unforeseen circumstances that required the cancelling of some exciting events and fundraisers. With the coming year, our chapter aims to continue working to maintain and promote the core values of ACCP at D'Youville School of Pharmacy. We look forward to continuing our Guest Speaker Series, Annual Research Mixer, Fat Bob's Fundraiser, and Pharmacy Skills competitions. We hope to continue expanding the knowledge of our student members and encouraging involvement in research and publications. We look forward to seeing what our chapter will accomplish next and the direction in which it is headed here at D'Youville.



*Student, Chris Ford transferring cells in the lab*

**-Dupinder Dhaliwal, PharmD Candidate Class of 2021**

# Brief History of Biologics and Biosimilars

Biologic products are an expansive group of medications, vaccines, and gene therapy that are used to diagnose, prevent, and treat many different disease states.[1] Biologics can be chemically synthesized from combinations of sugars and proteins or come from living cells and tissues. Biologics are produced through biotechnology using natural sources like humans, animals, or microorganisms. The production of biologic products differs greatly from that of conventional drugs due to the need for aseptic technique and their susceptibility to heat and microbial contamination. Biologics represent a revolutionary facet of biomedical research that is manufacturing treatments for medical conditions that have been untreatable until now.

Biosimilars are biologic products that are highly similar to an existing biologic medicine.[2] These products are regulated by the FDA and are used to treat a variety of diseases and medical conditions. They may be produced through biotechnology in a living system and are more difficult to characterize than small molecule drugs. There are challenges in the manufacturing process of these biologic products. Small differences between manufactured lots of the same biological product are normal and expected. The FDA imposes control strategies to help ensure that the manufacturers produce biological products with consistent clinical performance.

Precursors to the biologics we know today began in Europe with biologists like Robert Koch and Louis Pasteur, who investigated and isolated organisms responsible for various diseases to create some of the first vaccines.[3] In the United States shortly after, biologists such as Theobald Smith and Daniel Salmon pioneered heat-killed vaccines against cholera. Eventually, more vaccines were created that treated and prevented some of the deadliest diseases affecting the population, like diphtheria and tetanus.

In 1902, the United States passed the Biologics Control Act.[4] The Biologics Control Act had major consequences for the Hygienic Laboratory. Laboratories now had to regulate the production of vaccines and antitoxins due to the danger that biological products and technologies posed. There were many possibilities of contamination at every step of the manufacturing process, thus standards were set by Congress. These standards ensured that laboratories and biologists were producing vaccines without the potential for contamination. Under the Biologics Control Act of 1902, the United Sates was able to take what Europe had pioneered and further the regulation and production of biologics. Due to this, the United States has been the leading source of innovations in biotechnology and biologic therapies in the 21$^{st}$ century. Newly developed treatments for cancer and rheumatologic disorders, like monoclonal antibodies (mAb), including the first FDA approved mAb, which was rituximab.

In the 1980s, a major development in the production of insulin was discovered, and synthetically manufactured insulin was created.[5] This newly discovered synthetic human insulin became one of the most widely marketed biologic products. In 1982, human insulin was manufactured using DNA technology and initially marketed by the pharmaceutical company Lilly. Now, major scientific breakthroughs have been made in the production of biosimilar insulins that may produce clinically relevant effects from synthetic human insulin. Currently, an example of a biosimilar insulin on the market is the long-acting human insulin analog Basaglar, which is a biosimilar of Lantus.[6] The FDA refers to it as a “follow-up” insulin and not an approved biosimilar product. This is because when insulin was first introduced in 1982, it was classified and

approved as a drug, not a biologic, under the Food, Drug, and Cosmetic (FDC) Act.

Biologics are a growing pharmacological category and, in the future, could potentially treat a variety of medical illnesses that have minimal treatment options available.[1] Biologics are costly with a projected global market expected to reach $360 billion in 2020.[7] This will account for 28% of the global market for pharmaceuticals. Since biologics and biosimilars are a large part of the market, the cost may be prohibitive for patients without adequate insurance coverage.

**References**


1. Biologics Evaluation and Research. (n.d.). What Are "Biologics" Questions and Answers. Retrieved from https://www.fda.gov/about-fda/center-biologics-evaluation-and-research-cber/what-are-biologics-questions-and-answers. Accessed on March 4, 2020.
2. Center for Drug Evaluation and Research. (n.d.). About Biosimilars and Interchangeable Products. Retrieved from https://www.fda.gov/drugs/biosimilars/biosimilar-and-interchangeable-products. Accessed on March 4, 2020.
3. Tariman, J. D. (2018). Biosimilars: Exploring the history, science, and progress. *Clinical Journal of Oncology Nursing*, *22*(5), 5–12. https://doi.org/10.1188/18.CJON.S1.5-12
4. A Short History of the National Institutes of Health. (n.d.). Retrieved from https://history.nih.gov/exhibits/history/docs/page_03.html. Accessed on March 4, 2020.
5. Heinemann, L., & Hompesch, M. (2014). Biosimilar Insulins: Basic Considerations. *Journal of diabetes science and technology*, *8*(1), 6–13. https://doi.org/10.1177/1932296813516958
6. Is Biosimilar Insulin Available? (n.d.). Retrieved from https://www.biosimilarsresourcecenter.org/faq/biosimilar-insulin-available/. Accessed on March 4, 2020.
7. Sourial M. PharmD., Strachan D. PharmD. PharmacotherapyFirst: A Multimedia Learning Resource; Vaccines and Biologics. May 2017 https://pharmacylibrary-com.dyc.idm.oclc.org/doi/full/10.21019/pharmacotherapyfirst.vaccines_overview. Accessed on March 4, 2020.



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# Summary of FDA Approval Process for Biologics and Biosimilars

Biologics have a unique approval process compared to small molecules. Under the Food and Drug Administration (FDA), both the Center for Drug Evaluation and Research (CDER) and the Center for Biologics Evaluation and Research (CBER) regulate products in accordance with the Public Health Service Act (PHSA) and the Food Drug and Cosmetic Act (FDCA).[1] All FDA-approved biologics and their biosimilars undergo rigorous evaluation to ensure that patients can rely on their efficacy, safety, and quality.

Biologics are the fastest growing class of therapeutic products which account for substantial increases in health care costs.[1] In light of this, congress created an abbreviated approval process through the Biologics Price Competition and Innovation Act (BPCIA) to provide the public with greater access to biologics which are both safe and effective.[2] By helping provide additional treatment options, the approval of biologics also helps incentivize healthcare costs through market competition.

Before being licensed under the Public Health Service Act or Food Drug and Cosmetics Act, biologics must first meet the development requirements of a new drug product.[3] Following extensive laboratory and clinical trial testing with animals to demonstrate investigational safety in humans, potential biological products can proceed to human clinical trials via an investigational new drug application (IND).[4] An IND application contains information about animal pharmacology and toxicology studies, manufacturing information and clinical protocols, and investigator information. Thirty calendar days following the submission of an IND, researchers may begin human trials. Using pharmacokinetic and pharmacodynamic data obtained during this stage, drugs can later be submitted for marketing approval through a new drug application (NDA) if they are subject to the Food Drug and Cosmetic Act or a biologics license application (BLA) if they are subject to the Public Health Safety Act.[5] Biologics are always subject to the BLA, which must include applicant information, product/manufacturing information, pre-clinical studies, clinical studies, and labeling. Finally, when the drug is determined to meet safety, purity, and potency requirements, biologics gain approval through the issuance of a biologics license and US license number, which must appear on all product labeling.[6] After approval, reports are submitted annually to summarize adverse effects, manufacturing changes, and labeling changes.

In order for a proposed biosimilar to be approved, its safety and efficacy must be tested against a previously approved biologic, which is referred to as the "reference product."[7] Reference products are selected based on a "standalone application," which contains information demonstrating safety and efficacy of the "reference product." Relevant data needed for the approval process includes, but is not limited to, analytical studies demonstrating biosimilarity, animal studies with toxicology analyses, clinical studies to demonstrate purity, potency and safety, and in some cases additional pharmacokinetic and pharmacodynamic assessments.[2]

Although biosimilars require safety and efficacy data for approval, the goal of a biosimilar development program is to demonstrate clinically meaningful biosimilarity between the product and its reference.[7] All FDA-approved biologics and biosimilars can be found in the Purple Book.[8]

**References**


1. Center for Drug Evaluation and Research. (n.d.). About Biosimilars and Interchangeable Products. Retrieved from https://www.fda.gov/drugs/biosimilars/biosimilar-and-interchangeable-products. Accessed on March 4, 2020.
2. PhRMA Organization (n.d.). Research & Development Biologics & Biosimilars. Retrieved from https://www.phrma.org/en/Advocacy/Research-Development/Biologics-Biosimilars. Accessed on March 4, 2020.
3. Center for Drug Evaluation and Research. (n.d.). Types of Applications. Retrieved from https://www.fda.gov/drugs/how-drugs-are-developed-and-approved/types-applications. Accessed on March 4, 2020.
4. Center for Drug Evaluation and Research. (n.d.). Investigational New Drug (IND) Application. Retrieved from https://www.fda.gov/drugs/types-applications/investigational-new-drug-ind-application. Accessed on March 4, 2020.
5. Center for Drug Evaluation and Research. (n.d.). Frequently asked questions about therapeutic biological products. Retrieved from https://www.fda.gov/drugs/therapeutic-biologics-applications-bla/frequently-asked-questions-about-therapeutic-biological-products. Accessed on March 4, 2020
6. Center for Drug Evaluation and Research. (n.d.). New Drug Application (NDA). Retrieved from https://www.fda.gov/drugs/types-applications/new-drug-application-nda. Accessed on March 4, 2020.
7. Center for Drug Evaluation and Research. (n.d.). Biosimilar Development, Review and Approval. Retrieved from https://www.fda.gov/drugs/biosimilars/biosimilar-development-review-and-approval. Accessed on March 4, 2020.
8. Center for Drug Evaluation and Research. (n.d.). Purple Book: Lists of Licensed Biological Products with Reference Product Exclusivity and Biosimilarity or Interchangeability Evaluations. Retrieved from https://www.fda.gov/drugs/therapeutic-biologics-applications-bla/purple-book-lists-licensed-biological-products-reference-product-exclusivity-and-biosimilarity-or. Accessed on March 4, 2020.



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# Ziextenzo® Drug Monograph

**Labeled Indications:**

Ziextenzo® (pegfilgrastim-bmez) was approved by the Food and Drug Administration (FDA) on November 5, 2019 as a biosimilar to Neulasta® (pegfilgrastim).[1] It is a granulocyte colony-stimulating factor (G-CSF) that stimulates the growth of neutrophils, and it is indicated to decrease the incidence of infection, as manifested by febrile neutropenia in patients receiving myelosuppressive chemotherapy, induction or consolidation chemotherapy for acute myeloid leukemia, bone marrow transplantation, or autologous peripheral blood progenitor cell collection therapy, and patients with severe chronic neutropenia.[1,2]

**Dosing:**

Ziextenzo® is administered via a single-dose prefilled syringe.[1] The recommended dosage is a single subcutaneous injection of 6 mg administered once per chemotherapy cycle.[1,2] However, it should not be administered anytime between 14 days before and 24 hours after cytotoxic chemotherapy. The prefilled syringe should be removed from the refrigerator and allowed to reach room temperature 15-30 minutes before administration.[1] Since the prefilled syringe does not have graduation marks, it is not designed to allow for direct administration of doses less than 0.6 mL (6 mg).[1,2] Sandoz is currently working on preparing a vial formulation of the drug in order to use it for weight-based dosing. Refer to the table below for pediatric dosing in patients weighing less than 45 kg.[1,2] No clinical trials have been performed to test the safety and efficacy of Ziextenzo® in pediatric patients. Data for pediatric dosing has been extrapolated from the reference product, Neulasta®, and therefore, they do not recommend using the prefilled syringe in pediatric patients.

| Body Weight | Ziextenzo® Dosing | Volume to Administer |
|---|---|---|
| Less than 10 kg | 0.1 mg/kg | 0.01 mL/kg |
| 10 - 20 kg | 1.5 mg | 0.15 mL |
| 21 - 30 kg | 2.5 mg | 0.25 mL |
| 31 - 44 kg | 4 mg | 0.4 mL |

**Warnings, Precautions, and Drug Interactions:**

It is not recommended to administer Ziextenzo® in patients with a history of serious allergic reaction to pegfilgrastim or filgrastim products.[1] The most common adverse reactions with this drug include bone pain and pain in the extremities.[1,2] Less commonly noted adverse events include aortitis, capillary leak syndrome, hypersensitivity, glomerulonephritis, leukocytosis, acute respiratory distress syndrome, and fatal sickle cell crisis. Since this is a form of G-CSF, it carries a potential risk for stimulating tumor growth.

Concomitant use of Ziextenzo® and tisagenlecleucel, which is an antineoplastic agent, is not recommended due to a significant risk of enhancing the adverse and toxic effects of tisagenlecleucel.[2] This drug has also been shown to interact with pegloticase, pegvaliase, belotecan, bleomycin, and topotecan, requiring monitoring and/or therapy modification.

**Uses in Specific Populations:**

Available data for Ziextenzo® use in pregnant women are insufficient to establish whether there is a drug-associated risk of major birth defects, miscarriage, or adverse maternal or fetal outcomes.[1,2] No evidence of reproductive or developmental toxicity occurred in the offspring of pregnant rats that received approximately 3-10 times the recommended human dose.[1] However, signs of maternal toxicity and teratogenicity occurred in rabbits that received 4 times the maximum recommended human dose. Based on well-controlled studies using the reference product, Neulasta®, no overall differences in safety and efficacy were demonstrated in pediatric or geriatric populations.[2]

**Clinical Trials:**

The FDA approval of Ziextenzo® was based on data from PROTECT-1 and PROTECT-2 trials, which were randomized, double blind, parallel group, multi-center phase III studies.[3,4] Both studies were conducted to evaluate the efficacy and safety of Ziextenzo® in comparison to the refence product, Neulasta®, in women (≥18 years) receiving myelosuppressive chemotherapy for breast cancer. The results from PROTECT-1 and PROTECT-2 were combined and evaluated in a pooled analysis.[5] A total of 624 patients were randomized to receive Ziextenzo® (n=314) or Neulasta® (n=310) during each of the six chemotherapy cycles. The primary efficacy endpoint was the mean duration of severe neutropenia during cycle one of chemotherapy, which was defined as the number of consecutive days with an absolute neutrophil count $< 0.5 \times 10^9$/L. The primary endpoint was similar in both Ziextenzo® and Neulasta® ($1.05 \pm 1.055$ days vs $1.01 \pm 0.958$ days), with a treatment difference of -0.04 days [95% CI: -0.19 to 0.11] that met the equivalence criteria (the 95% CI were within the defined margin of ± 1 day). The PROTECT-1 and PROTECT-2 trials concluded that the efficacy and safety of Ziextenzo® are equivalent to Neulasta®.

**References**


1. Ziextenzo (pegfilgrastim-bmez) [prescribing information]. Princeton, NJ: Sandoz Inc; August 2019.
2. Ziextenzo (pegfilgrastim-bmez). Hudson, Ohio: Lexi-Comp, Inc. http://online.lexi.com.dyc.idm.oclc.org/lco/action/doc/retrieve/docid/patch_f/7446?cesid=8BVpPpw2gVh&searchUrl=%2Flco%2Faction%2Fsearch%3Fq%3Dziextenzo%26t%3Dname%26va%3Dziextenzo. Accessed on February 28, 2020.
3. Harbeck N, Lipatov O, Frolova M, et al. Randomized, double-blind study comparing proposed biosimilar LA-EP2006 with reference pegfilgrastim in breast cancer. *Future Oncol.* 2016;12(11):1359-1367.
4. Blackwell K, Donskih R, Jones MC, et al. A comparison of proposed biosimilar LA-EP2006 and reference pegfilgrastim for the prevention of neutropenia in patients with early-stage breast cancer receiving myelosuppressive adjuvant or neoadjuvant chemotherapy: pegfilgrastim randomized oncology (supportive care) trial to evaluate comparative treatment (PROTECT-2), a phase III, randomized, double-blind trial. *Oncologist.* 2016; 21(7):789-794.
5. Blackwell K, Gascon P, Jones MC, *et al*. Pooled analysis of two randomized, double-blind trials comparing proposed biosimilar LA-EP2006 with reference pegfilgrastim in breast cancer. Ann Oncol 2017; 28:2272–7.


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# Trogarzo® Drug Monograph

**Overview**

Ibalizumab-uiyk, also known as Trogarzo®, is a pharmacologic agent approved for the treatment of multidrug-resistant HIV-1 in patients who have failed other therapies.[1] Ibalizumab is a humanized IgG4 monoclonal antibody that non-competitively binds to $CD4^+$ T cells, which blocks the entry of HIV-1.[2] Ibalizumab is available as an intravenous infusion and requires administration by a medical professional.[1] Those receiving ibalizumab require a loading dose of 2000 mg followed by a maintenance dose of 800 mg every two weeks thereafter. Ibalizumab must be reconstituted before administration and is only available in 2 mL vials. The 2 mL vials contain 150 mg/mL of ibalizumab. After reconstitution, the 2 mL of ibalizumab must be transferred to a bag of 0.9% sodium chloride, and that infusion bag must be used immediately after preparation.[1]

In regard to using ibalizumab in pregnancy, evidence suggests that ibalizumab has the ability to cross the placenta, but the effect of this is unknown.[1] It is not recommended to breastfeed while on ibalizumab because this medication is a humanized IgG4 monoclonal antibody and other IgG antibodies have been shown to be excreted into breast milk. As for pediatric and geriatric populations, there have not been any studies to support the safety and efficacy.

**How did ibalizumab get approved through clinical trials?**

In a phase 1b study, the pharmacokinetics of ibalizumab were assessed, and it was determined that the steady state clearance is 5.7 ml/day/kg.[3] The phase 2b study compared two different dosing schemes for ibalizumab.[4] Group 1 participants received 800 mg once every 14 days with an optimized background regimen, and group 2 received 2000 mg once every 4 weeks with an optimized background regimen. The results indicated that a 2000 mg dose every 4 weeks provided rapid drug exposure, and an 800 mg dose every 14 days provided steady drug exposure throughout the 24 week period. These findings guided the dosing scheme utilized in the phase 3 clinical trial, which included a 2000 mg loading dose followed by an 800 mg maintenance dose every 2 weeks.[2]

The phase 3 trial was a single-group, open-label study that utilized the above dosing scheme in addition to an optimized background regimen.[2] From days 0-6, patients were monitored while they received their current antiretroviral therapy. From days 7-13, patients received a 2000 mg loading dose on day 7 and continued their prior antiretroviral therapy. From day 14 to week 25, patients were initiated on an optimized background regimen on day 14 and received 800 mg maintenance doses every 14 days starting on day 21. The results showed that 83% of patients enrolled in the study met the primary endpoint, which was a decrease in viral load of at least 0.5 $\log_{10}$ copies per milliliter between day 7 and 13. After the maintenance phase, the target viral load was less than 200 copies per milliliter, which occurred in 50% of the participants. The most commonly reported adverse events were diarrhea, nausea, rash, and dizziness. In 28% of the participants, severe adverse events led to the discontinuation of therapy, and the most severe adverse event was immune reconstitution inflammatory syndrome (IRIS). This phase 3 trial led to the approval of ibalizumab.

**References**


1. Trogarzo (ibalizumab-uiyk) [prescribing information]. Irvine, CA: TaiMed Biologics USA Corp; May 2018.
2. Emu B, Fressel J, Schrader S, *et al.* Phase 3 study of ibalizumab for multiple-drug resistant HIV-1. *New England Journal of Medicine.* 2018; 379: 654-45.
3. Jacobson J, Kuritzkes D, Godofsky E, *et al.* Safety, Pharmacokinetics, and Antiretroviral
4. Activity of Multiple Doses of Ibalizumab (formerly TNX-355), an Anti-CD4 Monoclonal Antibody, in Human Immunodeficiency Virus Type 1-Infected Adults. *American Society for Microbiology*. 2009; 53(2): 450-457.
5. Khanlou H, Gathe J, Schrader S, Towner W, Weinheimer S, Lewis S. Safety, efficacy and pharmacokinetics of ibalizumab in treatment-experienced HIV-1 infected patients: a phase 2b study, abstr H2-804. Proc 51st Intersci Conf Antimicrob Agents Chemother. *American Society for Microbiology.* 2011



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# The SORELLA 2 Study

## Introduction

Insulin lispro (Ly-Lis) is the active ingredient of Humalog®.[1] Humalog® was the first rapid-acting insulin approved in the United States and several other countries.[2] SAR342434 (SAR-Lis) is a biosimilar to Humalog®. Physicochemical analyses have demonstrated that SAR-Lis is highly similar to Ly-Lis in terms of pharmacokinetics and pharmacodynamics. The SORELLA 2 study was a multinational, open-label, randomized, two-arm parallel-group, controlled phase 3 trial which assessed the safety and efficacy of SAR-Lis compared to Ly-Lis in patients with type 2 diabetes mellitus.

## Methods

This study included adult patients with a hemoglobin A1c between 6.5% and 10%.[2] These patients must have had type 2 diabetes mellitus for at least 12 months and were previously receiving an insulin lispro or aspart product three times daily in addition to insulin glargine in the prior 6 months. This study excluded patients with morbid obesity, the use of alternative injectable therapies, history of severe hypoglycemia, or poorly controlled glucose requiring hospitalization within the prior 6 months. In addition, patients with hyperglycemic complications were excluded. To be included in this study, women of childbearing age were required to be on contraception.

The study contained a screening period of up to 2 weeks, a 26-week treatment period, and a 1-day safety check.[2] After the screening period, 480 patients were randomized to receive either treatment while also using insulin glargine. No titrations were used for the insulin glargine, and the starting dose was the same as the dose they received before the study. New dose adjustments for insulin glargine were made to achieve blood glucose values of 80-140 mg/dL when necessary. The study assessed hemoglobin A1c, fasting plasma glucose (FPG), and self-monitored plasma glucose (SMPG). Blood samples for anti-insulin antibodies (AIA) were taken at least 8 hours after mealtime insulin. Adverse effects were also documented.

The primary objective of the study was to compare the change in hemoglobin A1c from baseline to end of treatment between SAR-Lis and Ly-Lis.[2] This was a noninferiority study with margin of 0.3% and a one-sided alpha level of 0.025. The secondary objectives included FPG, 24-hour plasma glucose concentration, the proportion of patients who achieved hemoglobin A1c values less than 7% by week 26, and those who obtained hemoglobin A1c values of 6.5% or less by week 26. In addition, AIA levels and safety were also assessed.

## Results

A total of 505 patients were randomized and treated with SAR-Lis (n=253) and Ly-Lis (n=252).[2] A total of 280 patients completed the treatment period, and the most common reasons for discontinuation were consent withdrawal or the development of adverse events. Among the two groups, demographic and baseline characteristics were similar. For the primary endpoint, the SAR-Lis group had a mean change in hemoglobin A1c from baseline to week 26 of −0.92% (standard error 0.051) compared to the Ly-Lis group which had a change of −0.85% (standard error 0.051). Of note, this change primarily occurred during the first 12 weeks of treatment. Noninferiority of SAR-Lis versus Ly-Lis was demonstrated. The mean FPG, 24-hour plasma glucose concentrations, AIA levels, and adverse effects were similar between the groups.

## Conclusion

Overall, SAR-Lis demonstrated noninferiority to Ly-Lis for the control of hemoglobin A1c and other glycemic parameters in patients with type 2 diabetes mellitus. SAR-Lis and Ly-Lis also had similar safety and immunogenicity profiles.

## References


1. Humalog (insulin lispro). Hudson, Ohio: Lexi-Comp, Inc. http://online.lexi.com.dyc.idm.oclc.org/lco/action/doc/retrieve/docid/patch_f/320046?cesid=2ZlvosZkYE9&searchUrl=%2Flco%2Faction%2Fsearch%3Fq%3Dlispro%26t%3Dname%26va%3Dlispro. Accessed on February 28, 2020.
2. Derwahl, K., Bailey, T., Wenicke-Panten, K., et. al. Efficacy and Safety of Biosimilar SAR342434 Insulin Lispro in Adults with Type 2 Diabetes, Also Using Insulin Glargine: SORELLA 2 Study. *Diabetes Technology & Therapeutics.* Vol 20 (1). 2018. 49-58.



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**- Sandra Labib, PharmD Canadidate Class of 2023**
**- Samuel Gerardi PharmD Candidate Class of 2023**

# Cost Comparison of Retacrit and Other Epoetin Alpha Agents

Anemia is a complication of advanced chronic kidney disorder or it can be secondary to chemotherapy.[1] Anemia requires treatment with erythropoietin analogs, such as epoetin alfa.[2] Erythropoietin analogs stimulate the body to create new red blood cells, raise the hemoglobin level, and reduce the need for red blood cell transfusion.[3]

Biopharmaceutical agents or biologics represent a great advancement in the treatment of several diseases.[4] However, their high cost directly impacts healthcare budgets around the world and is the leading expenditure in healthcare. In cancer care, epoetin accounts for approximately 10% of the overall direct cost.[1] Biosimilars provide alternative options to these expensive biologic agents, and they may potentially decrease the overall cost of therapy for these patients.

Epoetin alfa is a recombinant human erythropoietin that is marketed in the United States as Epogen® and Procrit®.[5] It was the first exogenous erythropoiesis-stimulating agent to receive approval from the US Food and Drug Administration. In May 2018, Retacrit® (epoetin alfa-epbx) was approved by the US Food and Drug Administration as a biosimilar to Epogen®/Procrit® for the treatment of anemia caused by chronic kidney disease, chemotherapy in cancer patients, zidovudine in patients with HIV infection, and reduction of allogeneic red blood cell transfusion in patients undergoing elective surgery.[5,6]

The average wholesale price for preservative-free Epogen® injectable solution is approximately $39.79 per 1 mL for a 2,000 units/mL package size.[7] The average wholesale price for Procrit® is approximately $64.15 per 1 mL for a 2,000 units/mL package size.[7] In comparison, the average wholesale price for preservative-free Retacrit® injectable solution is approximately $26.47 per 1 mL for a 2,000 units/mL package size. These prices are based on out-of-pocket costs to patients and may vary between pharmacies. Assuming we have a chronic kidney disease patient who does not require hemodialysis and has an average weight of 70 kg and a hemoglobin value less than 10 g/dL, the initial dose of these agents would be 3,500 units (50 units/kg) once weekly. Therefore, a 1-month supply would cost approximately $278.53 for Epogen®, $449.05 for Procrit®, and $185.29 for Retacrit®. Overall, the use of Retacrit® can decrease the cost by approximately 33% and 59% in comparison to Epogen® and Procrit®, respectively.

When compared to epoetin alfa, Retacrit® demonstrated no clinically meaningful difference in efficacy or safety in patients on hemodialysis with end-stage kidney disease and anemia.[8] Therefore, Retacrit® is a reasonable choice for these patients and has the added benefit of cost savings.

**References**


1. Marchetti, M., & Barosi, G. (2004). Clinical and economic impact of epoetins in cancer care. *Pharmacoeconomics*, *22*(16), 1029-1045.
2. Shah, H. H., & Fishbane, S. (2019). Biosimilar Erythropoiesis-Stimulating Agents in Chronic Kidney Disease. *Advances in chronic kidney disease*, *26*(4), 267-271.
3. Schoener, B., & Borger, J. (2019). Erythropoietin. In *StatPearls [Internet]*. StatPearls Publishing.
4. Jha, A., Upton, A., Dunlop, W. C., & Akehurst, R. (2015). The budget impact of biosimilar infliximab (Remsima®) for the treatment of autoimmune diseases in five European countries. *Advances in therapy*, *32*(8), 742-756.
5. Commissioner, O. of the. (n.d.). FDA approves first epoetin alfa biosimilar for the treatment of anemia. Retrieved from https://www.ajmc.com/newsroom/fda-approves-epoetin-alfa-biosimilar-for-anemia. Accessed on February 28, 2020.
6. U. S. Food and Drug Administration. Center for Drug Evaluation and Research. (2018). Approval Package for: APPLICATION NUMBER: 125545Orig1s000. Washington, DC: U.S. Food and Drug Administration. Retrieved from https://www.accessdata.fda.gov/drugsatfda_docs/nda/2018/125545Orig1s000OtherR.pdf. Accessed on February 28, 2020.
7. Procrit (epoetin alfa). Hudson, Ohio: Lexi-Comp, Inc. http://online.lexi.com.dyc.idm.oclc.org/lco/action/doc/retrieve/docid/patch_f/6831?cesid=9bHxA0SoNK8&searchUrl=%2Flco%2Faction%2Fsearch%3Fq%3Dprocrit%26t%3Dname%26va%3Dprocrit. Accessed on February 28, 2020.
8. Thadhani, R., Guilatco, R., Hymes, J., Maddux, F. W., & Ahuja, A. (2018). Switching from epoetin alfa (Epogen®) to epoetin alfa-epbx (RetacritTM) using a specified dosing algorithm: a randomized, non-inferiority study in adults on hemodialysis. *American journal of nephrology*, *48*(3), 214-224.



**- Cherish Adesola, PharmD Candidate Class of 2023**

**- Minahil Malik, PharmD Canadidate Class of 2023**

**- Uyen Nguyen. PharmD Candidate Class of 2022**

# Clinical Faculty Spotlight:

## *Dr. Mario V. Beccari, PharmD, BCPS, AAHIVP*

*Clinical Assistant* Professor at D'Youville School of Pharmacy & Infectious Diseases Pharmacist

### Tell us about your career as a pharmacist so far.

"When I was in my P3 year of pharmacy school, I realized that I wanted to become a clinical pharmacist. Therefore, after graduation, I applied for postgraduate training. I completed my PGY1 Pharmacy Residency at Buffalo General Medical Center in Buffalo, NY, where I learned how to be a well-rounded clinical pharmacist. Throughout my PGY1 Pharmacy Residency training, I developed a significant interest in infectious diseases, so I decided to pursue PGY2 Infectious Diseases Pharmacy Residency training. I completed my PGY2 Infectious Diseases Pharmacy Residency at SUNY Upstate University Hospital in Syracuse, NY. Throughout my PGY2 Infectious Diseases Pharmacy Residency training, I developed a great interest in educating pharmacy students, pharmacists, and physicians. Once I completed my PGY2 Infectious Diseases Pharmacy Residency training, I began working at the D'Youville School of Pharmacy as a Clinical Assistant Professor. I now am fortunate to teach infectious diseases pharmacotherapeutics to the P3 students didactically in the classroom and at my clinical practice site."

"*Success comes when people act together; failure tends to happen alone.*"
– Deepak Chopra

### What are your current roles and responsibilities?

"I am a Clinical Assistant Professor and an Infectious Diseases Clinical Pharmacist. I am responsible for teaching infectious diseases pharmacotherapeutics to the P3 students at the D'Youville School of Pharmacy. In addition, I take P4 students to my clinical practice site and teach them about infectious diseases in actual patients so that they can see and smell the infections. While at my clinical practice site, my students and I work with the infectious diseases consult team to manage patients who are acutely ill from different bacteria, fungi, and viruses."

### What organizations were you involved with in pharmacy school and which organizations did you maintain involvement in after graduating pharmacy school?

"In school, I was involved with APhA, SPSSNY, SPAWNY, Italian-American Pharmacists Society, ASCP, and American College of Cardiology. After graduation and throughout my PGY1 Pharmacy Residency training, I maintained involvement in all of those professional organizations in order to become a well-rounded clinical pharmacist. After completion of my PGY2 Infectious Diseases Pharmacy Residency training, I became involved with infectious diseases-specific organizations, such as IDSA, SIDP, and MAD-ID, as well as ACCP due to their beneficial resources."

## Why did you initially get involved with SCCP in your career and how did it help you achieve your goals?

"I became involved with ACCP because they are an elite organization developed for clinical pharmacy practice. They provide many beneficial resources for clinical pharmacists, offer multiple continuing education programs, and hold discussion boards for important topics. ACCP helped me achieve my goals as a clinical pharmacist through their professional service opportunities. Through ACCP, I am a member of the Infectious Diseases PRN Publications Committee, which is responsible for developing and publishing newsletters that are distributed to all ACCP members."

## How do you keep up with the latest findings and advancements in clinical pharmacy?

"ACCP provides many resources to clinical pharmacists that are useful for keeping up with the latest developments in clinical pharmacy. ACCP has two journals associated with them, which are Pharmacotherapy and JACCP. ACCP sends out emails for the newest volumes of these journals, and all members have access to the articles in these journals. In addition, twitter has been growing as an arena for professional communication and dissemination of new information. ACCP has several twitter pages that will distribute new articles and information available for clinical pharmacists."

## What advice would you give to a student pursuing a career in clinical pharmacy?

"For any student pursuing a career in clinical pharmacy, I would recommend that they keep their mind open and aim to experience as many aspects of clinical pharmacy as possible throughout their IPPEs and APPEs. To become a clinical pharmacist, it is necessary for the student to complete at least a PGY1 Pharmacy Residency. When pursuing residency training, the students should assess which aspects of clinical pharmacy that they enjoy, so that they can choose a program that meets all of their desires."

**- Natali Ninova, PharmD Candidate Class of 2022**

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