



Biologics and Biosimilars

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What is a Biological Drug ?

- ▶ Biological drugs or biologics are a class of drugs that are **produced using a living system, such as a microorganism, plant cell, or animal cell.**
- ▶ Biologics are grown not chemically manufactured
- ▶ The current biologics and biosimilars include recombinant proteins, tissues, genes, allergens, cells, blood components, blood, hormones, and vaccines.

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- ▶ Aspirin 21 atoms
 - ▶ Enbrel 25,000 atoms

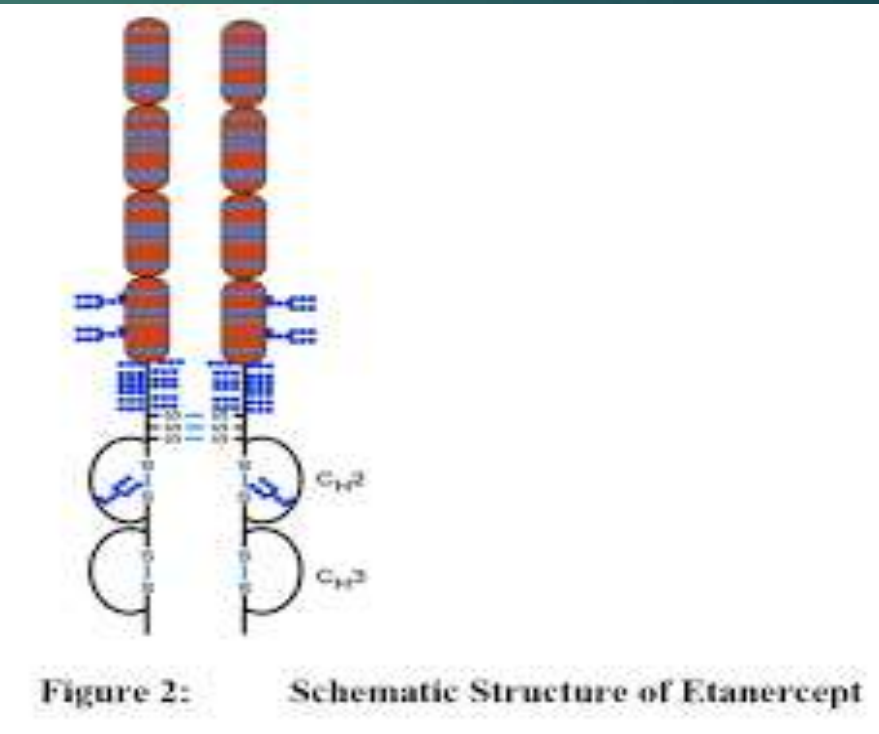
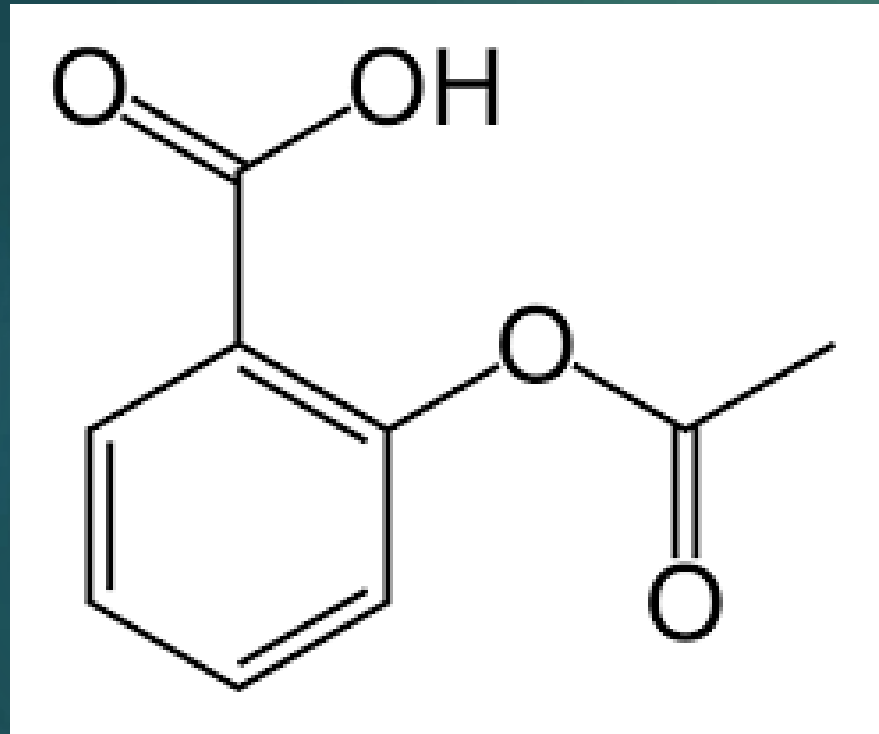
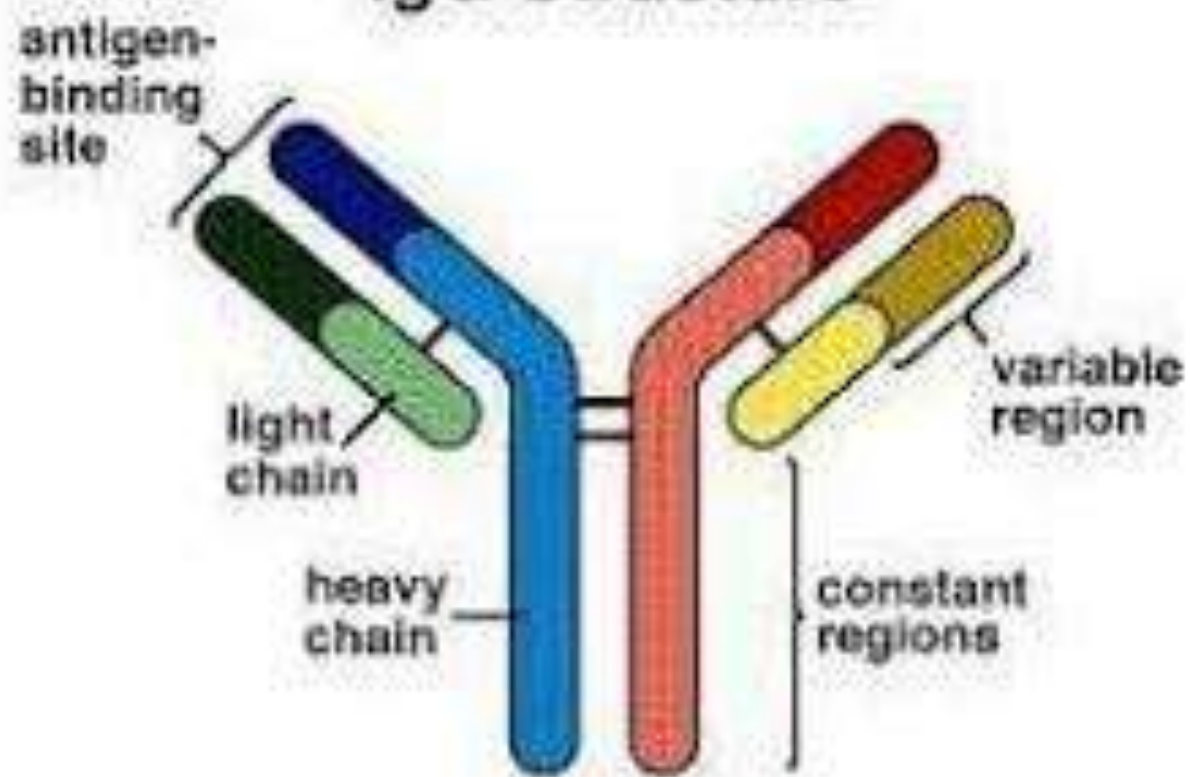
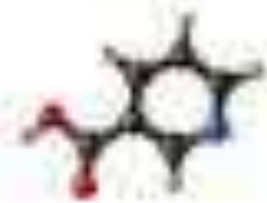


Figure 2: Schematic Structure of Etanercept

IgG Structure



SMALL
MOLECULE



LARGE BIOLOGICAL
MOLECULE



Aspirin
NSAID



Crestor
synthetic
statin



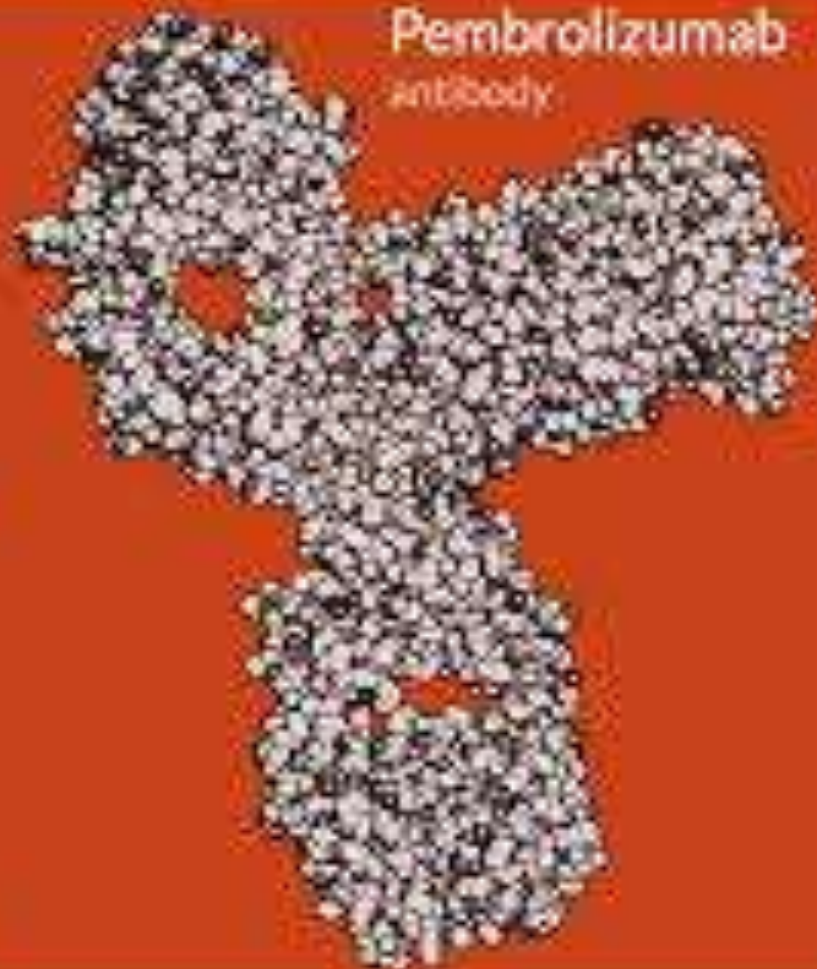
conventional

Insulin
hormone



biologic

Pembrolizumab
antibody





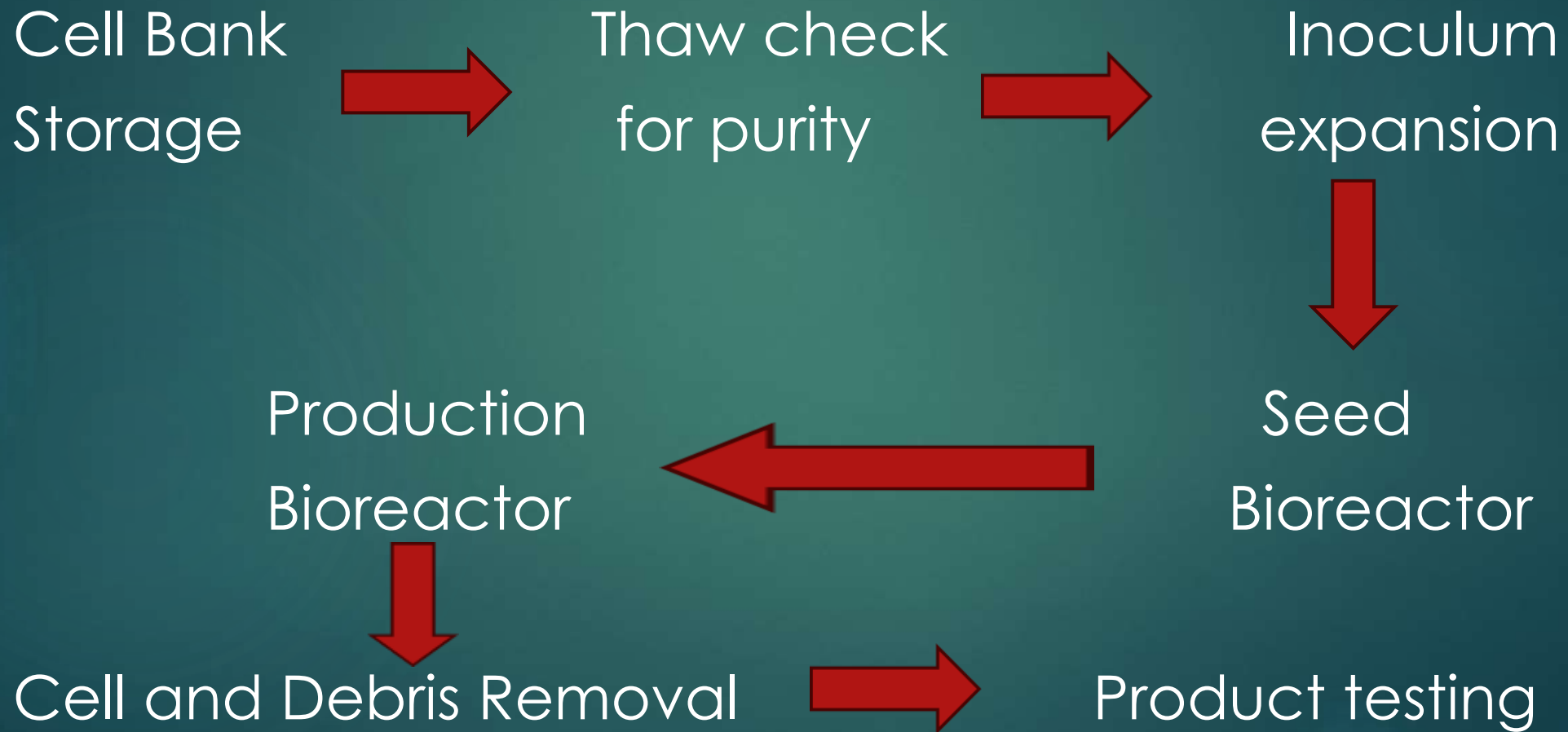
Eleyso (Gaucher)



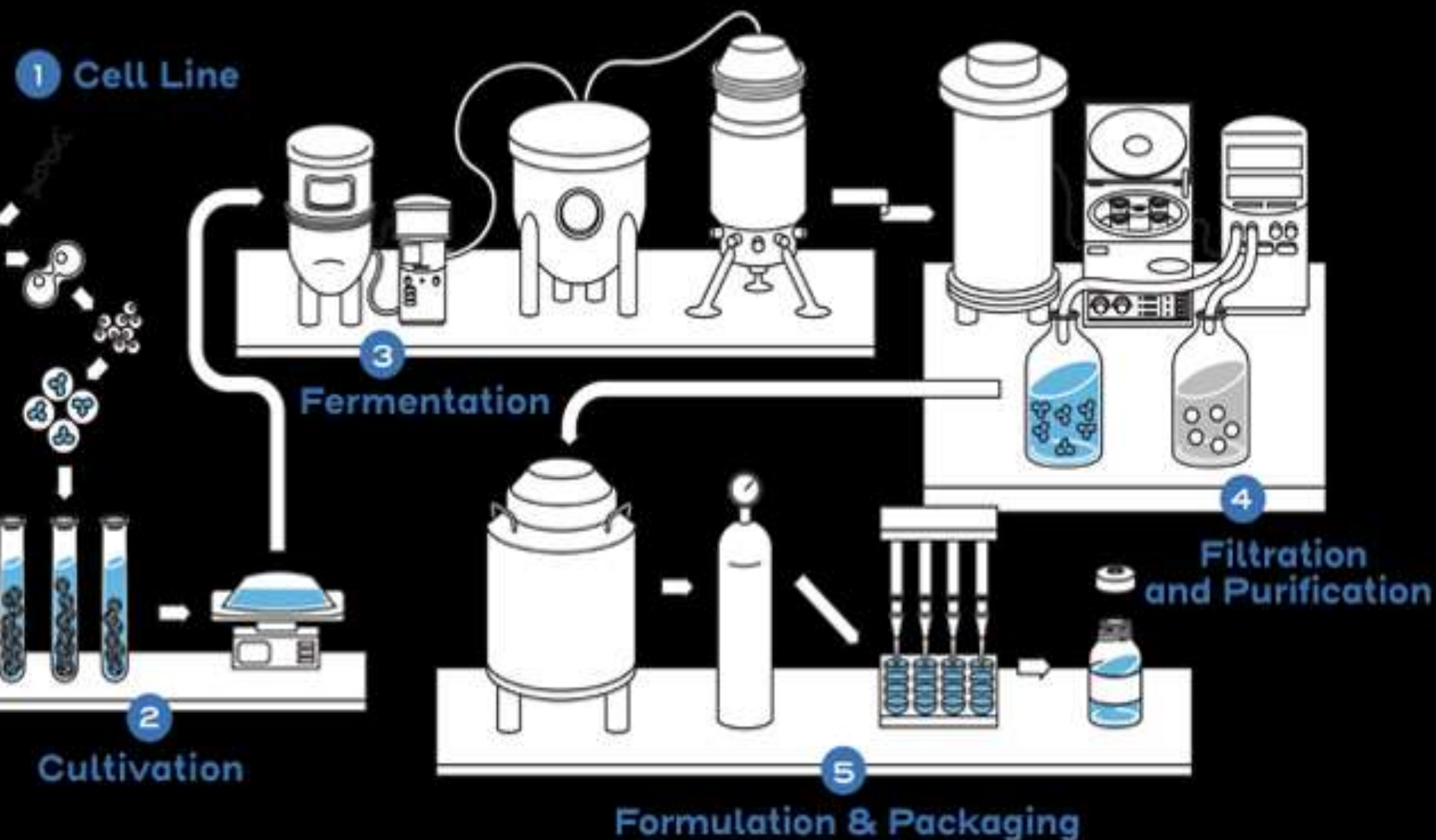
Atryn (antithrombin III - alpha)



Basic Process for a Biologic



BIOLOGICAL DRUG PROCESS



SMALL MOLECULE DRUG PROCESS









Biologics and Biosimilars

- ▶ First Biologic
 - ▶ Human Insulin (Humulin)
 - ▶ FDA approved in 1982
 - ▶ Produced in E coli
 - ▶ Utilized recombinant DNA technology

- ▶ First Biosimilar
 - ▶ 2015
 - ▶ filgrastim-sndz (Zarxio, Sandoz, Inc.)
 - ▶ Biosimilar for Neupogen (filgrastim)

FDA Definition of Biosimilar

A biosimilar is a biologic that is highly similar to and has no clinically meaningful differences in terms of safety, purity, and potency (safety and effectiveness) from an existing FDA-approved biologic, called a reference product.

Regulated by the Center for Biologics Evaluation and Research (CBER) in the FDA

BIOSIMILAR

- ▶ Made from the same type of living source
- ▶ Are given in the same manner
- ▶ Have the same strength
- ▶ Have the same dosage
- ▶ Have the same benefits
- ▶ Have the same potential side effects
- ▶ Biosimilars are not the same molecule

Similarities: Biologics and Biosimilars

- ▶ Because biologics and biosimilars are organic proteins they are rapidly destroyed when ingested
- ▶ Route of administration is typically I.M. or I.V.

Comparison to Generic Drug

Non-Biosimilar Generic Medication

- ▶ Made chemically
- ▶ Must have the **same active ingredient** as the brand name
- ▶ Has the same chemical structure as the brand name
- ▶ Functions the same as brand name (Bioequivalent)
- ▶ Manufacturer must prove its drug is the same

Biosimilar Medication

- ▶ Grown in a living organism
- ▶ Varies from name brand in structure
- Functions the same as brand name (Bioequivalent)
- ▶ Data submitted to the FDA shows no clinically significant difference in safety and effectiveness

Can a Biosimilar be used interchangeably with a brand name????

- ▶ Generic medications can be used interchangeably
- ▶ Biosimilar medications are not interchangeable
 - ▶ Individual patient response may vary as to
 - ▶ Efficacy
 - ▶ Side effects

Biologics and Biosimilars

- ▶ Biologic
- ▶ Biosimilar
 - ▶ Same mechanism of action
 - ▶ Same route of administration
 - ▶ Same dosage
 - ▶ Same strength
- ▶ Interchangeable Biosimilar
 - ▶ Must produce the same clinical response
 - ▶ Switching back and forth causes no added patient risk
 - ▶ Can be substituted by a pharmacist (depending on state law)

Biologics and Biosimilars

- ▶ 340 FDA approved biologics
- ▶ 42 FDA approved biosimilars as of August 24, 2023 with Tyruko (natalizumab-sztn) biosimilar for Tysabri for relapsing MS
- ▶ Biologics are 2% of all prescriptions 40-50% of all U.S. Prescription costs
- ▶ 13 new biologics approved in first 9 months of 2023

Biologics and Biosimilars

- ▶ U.S. Pharmaceutical costs in 2022 - 633.5 billion dollars
 - ▶ 9.4% increase over 2021
 - ▶ Utilization 5.9%
 - ▶ New medications 1.8%
 - ▶ Price increases 1.7%
- ▶ Biologic Medications
 - ▶ 2% of all prescriptions
 - ▶ Percent of total pharmaceutical costs
 - ▶ 2017 37%
 - ▶ 2019 43%
 - ▶ 2020 50.1%




- ▶ Boston Consulting group

- ▶ Average cost to manufacture a 1 month supply of a small molecule medication \$5.00
- ▶ Average cost to manufacture a 1 month supply of a biologic \$60.00

- ▶ Largest sales for medication 2022

- ▶ mRNA Covid Vaccines 55.9 billion dollars
- ▶ Humira 21.2 billion dollars
- ▶ Keytruda 20.9 billion dollars

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- ▶ Humira \$6,273 - \$7,650 September 2023 pricing for 1 month supply
 - ▶ (\$6922 wholesale)
 - ▶ 8 FDA approved Biosimilar drugs
 - ▶ Amjevita \$6755.00 (good Rx) \$11,642 - \$12478 (singlecare)
 - ▶ Cyltezo 6536.66 (good Rx) for 1 month supply

Current Usages

- ▶ Cancer
- ▶ Autoimmune diseases
- ▶ Chronic Migraine
- ▶ Wet Macular Degeneration
- ▶ Hepatitis B
- ▶ Immunizations
 - ▶ Respiratory Syncytial Virus (RSV) prophylaxis
 - ▶ Human Papillomavirus (HPV) prevention
 - ▶ Covid-19

Biologics and Biosimilars

- ▶ Home self injection
- ▶ In office injection
- ▶ I.V. infusion therapy
 - ▶ In home
 - ▶ Outpatient

Injection Site Reactions

- ▶ Erythema
- ▶ Swelling
- ▶ Pain/tenderness
- ▶ Lump at injection site
- ▶ Pruritis

Anaphylaxis



- ▶ Hypotension
- ▶ Airway swelling
- ▶ Peri oral swelling
- ▶ Rash/hives
- ▶ Pruritis
- ▶ Abdominal/Pelvic pain
- ▶ Loss of bladder control
- ▶ Headache/confusion

Anaphylactoid Reaction

Nonimmunologic Anaphylaxis

- ▶ Fascial edema
- ▶ Shortness of Breath
- ▶ Rash/erythema
- ▶ Hypotension
- ▶ Laryngeal edema

Infusion Reactions

- ▶ Pruritis
- ▶ Rash
- ▶ urticaria,
- ▶ erythema,
- ▶ throat irritation,
- ▶ oropharyngeal pain,
- ▶ Dyspnea
- ▶ Nausea
- ▶ Tachycardia
- ▶ pharyngeal or laryngeal edema
- ▶ Redness
- ▶ Hypotension
- ▶ pyrexia
- ▶ Fatigue
- ▶ Headache
- ▶ Dizziness

Biologics and Biosimilars

- ▶ Infusion reaction
- ▶ Immune reaction
- ▶ Anaphylaxes reaction
 - ▶ Occurs after sensitization
 - ▶ Allergic reaction
- ▶ Anaphylactoid reaction

Biologics and Biosimilars

- ▶ Barriers and concerns
- ▶ Immune response inactivating drug
- ▶ Infusion and injection reactions
- ▶ Cost
- ▶ Mode of administration



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