Agilent InfinityLab

The Journey to Biopharma— Get Ready for Change.

TOP 5 best-selling drugs launched in 2020

Remdesivir*	$873 Million?
Teprotumumab-trbw	$476 Million
Luspatercept-aamt	$159 Million
Rituximab-pvvr	$78 Million
Sacituzumab govitecan-hziy	$73 Million
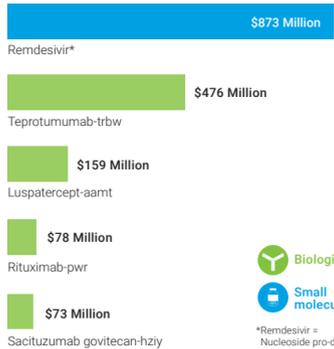
Biologics
Small molecules

*Remdesivir = Nucleotide pro-drug

On average, biologics were more successful than small-molecule drugs.

Source: genengnews.com

Manufacturing expense

$200–$500 Million
$30–$100 Million
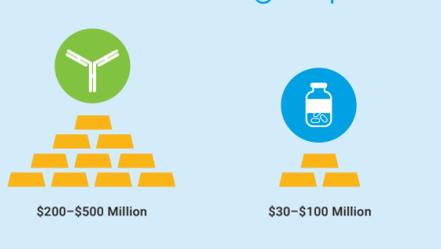
Biotechnology manufacturing facilities are more expensive to build than small-molecule facilities of a similar scale.

Source: mckinsey.com

Did you know?

Biologics can be costly therapeutics

While a small-molecule drug is priced at US$1 per day on average, a biological drug costs an average of US$22 per day. Biologics are often used to treat chronic illnesses, increasing their typical expense.

Source: gabionline.net

Market success

	Humira	
$73304 Million	→	$69239 Million
$64289 Million	Lipitor	$62644 Million
Cumulative sales in first 10 years		Cumulative sales in the subsequent 5 years
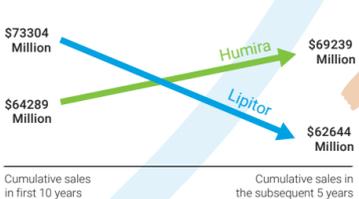
Humira, a monoclonal antibody-based drug, was the world's best-selling drug in 2020. However, the all-time most successful drug is Lipitor, a small-molecule drug.

Source: sqlobal.com

Biologics compared with small molecules

Produced by living cell or organism in reactor	Predictable chemical reaction, synthesized in lab
High molecular weight	Low molecular weight
Complex, heterogeneous structure	Well defined structure
Strongly process dependent	Mostly process independent
Not entirely characterizable	Completely characterizable
Unstable	Stable
Immunogenic	Non immunogenic

Source: technologynetworks.com

Did you know?

Proteins can be strong

Small molecules are highly stable, making them easier to produce than biologics. Even so, biologics can show remarkable stability: some extremophile proteins—resistant to extreme heat, pressure, or pH—can withstand pressures of up to 1300 bar.

Source: microbiologyresearch.org
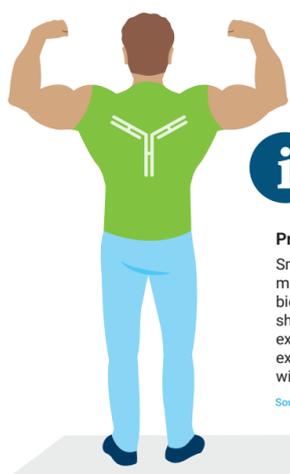
Did you know?

Proteins can be large

Titin's chemical name, arguably the longest word in the English language, features 189,819 letters and can take around 3.5 hours to say.

Source: washingtonpost.com

The majority of biopharma molecules are monoclonal antibodies

- 33 mAbs
- 3 Others
- 9 Amino acids
- 18 Natural products
- 11 Peptides
- 11 Combined drugs
- 7 Oligos
- 4 ADCs
- 9 Enzymes & proteins
- 70 Small molecules
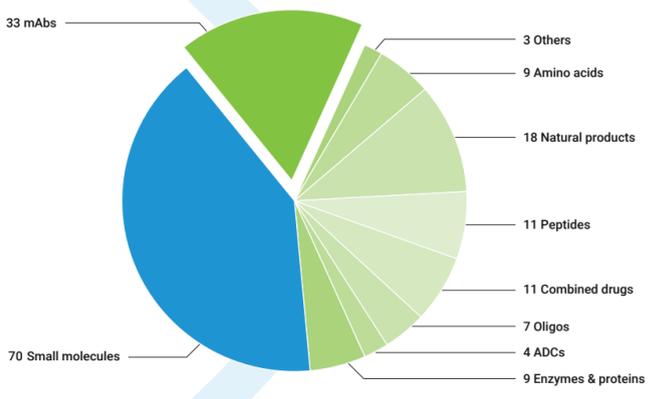
A total of 175 new drugs approved by the FDA from 2016 to 2019.

Source: Pharmaceuticals 2020, 13(3), 46

Different physico-chemical properties

Biologics and small molecules vary from each other physicochemically, which influences:

- Pharmacological aspects of the drug*
- Safety
- Efficacy
- Product manufacturing
- Quality considerations

*e.g., mechanism of action, pharmacodynamics (PD), pharmacokinetics (PK)
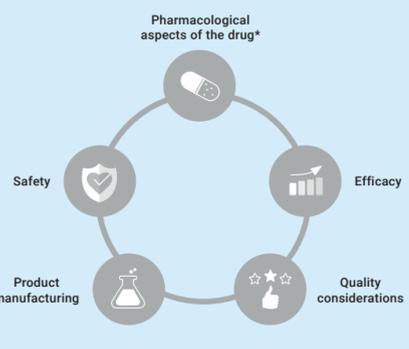
Classes of biologics
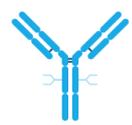
Antibody therapeutics

Antibodies can be adapted to target certain proteins with high specificity and potency. Monoclonal antibodies, antibody drug conjugates, bispecific antibodies, and fragment antibodies are examples of antibody-based therapeutics.

Peptide or protein therapeutics

Because of their large size, proteins are often directed at extracellular targets. Example therapeutics are fusion proteins, created by joining two or more genes that encode for separate proteins. Peptides are smaller molecules that can be engineered to be very selective and specific.

Nucleotide-based therapeutics

Progress in genomics research has both revealed several new drug targets and opened the way for therapeutics based on nucleotides. These include antisense oligonucleotides, messenger RNA, small interfering RNA, and therapeutic gene editing.

Did you know?

DNA can store a lot of data

Up to 700 TB of data can be stored on 1g of DNA, and read-write DNA technology can be developed. It's estimated that, if stored on DNA, all the world's information could fit into a van.

Source: usatoday.com

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