Biologics—the pricey drugs transforming medicine

July 25 2017, by Ian Haydon

The cells inside this bioreactor are the real pharmaceutical factories. Credit: Sanofi Pasteur, CC BY-NC-ND

In a factory just outside San Francisco, there's an upright stainless steel vat the size of a small car, and it's got something swirling inside.

The vat is studded with gauges, hoses and pipes. Inside, it's hot – just under 100 degrees Fahrenheit. Sugar and other nutrients are being pumped in because, inside this formidable container, there is life.

Scientists are growing cells in there. Those cells, in turn, are growing medicine. Every two weeks or so, the hot, soupy liquid inside gets strained and processed. The purified molecules that result will eventually be injected into patients with Stage IV cancer.

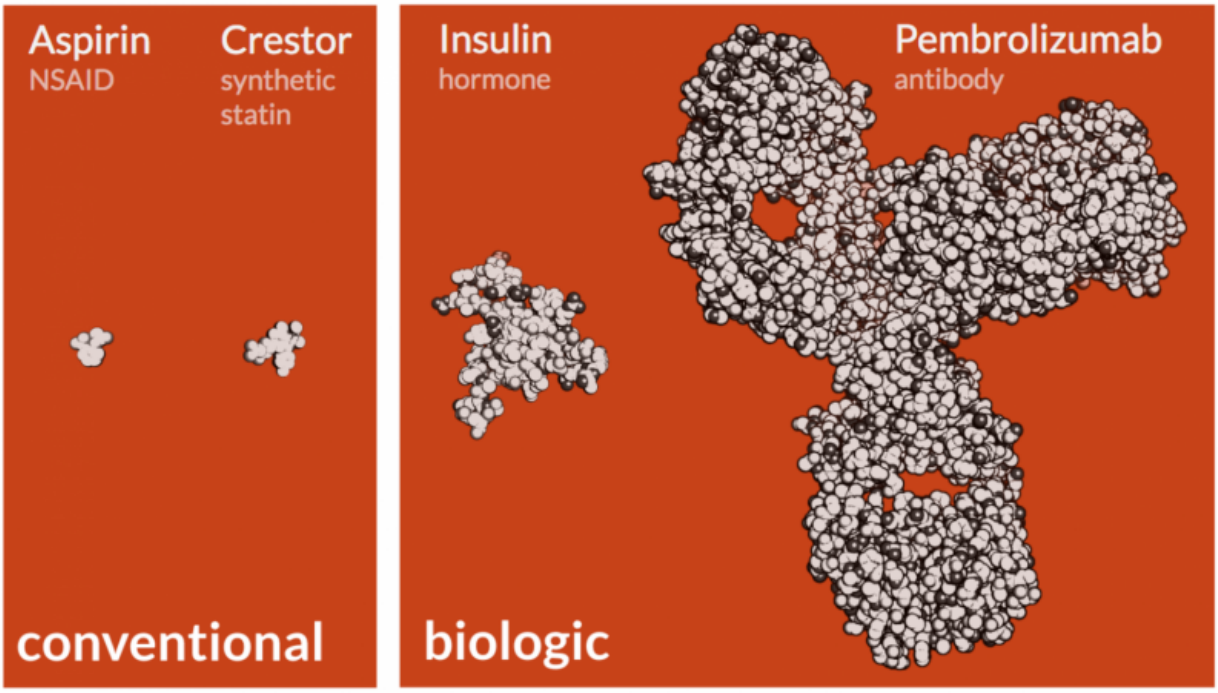
Drugs that are made this way – inside living cells – are called biologics. And they're taking medicine by storm. By 2016, biologics had surged to make up 25 percent of the total pharmaceutical market, bringing in US$232 billion, with few signs their upward trend will slow.

Distinct from conventional drugs

Common medicines such as aspirin, antacids and statins are chemical in nature. Though many were initially discovered in the wild (aspirin is a cousin of a compound in willow bark, the first statin was found in a fungus), these drugs are now made nonbiologically.

Conventional medicines are stitched together by chemists in large factories using other chemicals as building blocks. Their molecular structures are well defined and relatively simple. Aspirin, for example, contains just 21 atoms (nine carbons, eight hydrogens and four oxygens) bonded together to form a particular shape. A single aspirin tablet – even kid-sized – contains trillions of copies of the drug molecule.

Biologic drugs are a different story. This class of medication is not synthesized chemically – instead they are harvested directly from biology, as their name suggests. Most modern biologics are assembled inside vats – or bioreactors – that house genetically engineered microbes or mammalian cell cultures. Efforts are underway to make them in plants .



Biologics can dwarf conventional drugs in size, and that gives them added specificity. Credit: Ian Haydon, CC BY-ND

Biologic drugs can be whole cells, alive or dead. They can be the biomolecules produced by cells, like antibodies, which are normally secreted by our immune system's B cells. Or they can be some of the internal components of cells, like enzymes.

Biologics are typically much larger molecules than those found in conventional pharmaceuticals, and in many cases their exact composition is unknown (or even unknowable). You're unlikely to find biologic drugs in tablet form – they tend to be delicate molecules that are happiest in liquid solution.

While biologics are one of the fastest-growing drug categories in the U.S., they aren't exactly new. The Biologics Control Act, passed in 1902,

was the first law aimed at ensuring the safety of some of the earliest biologics – vaccines. Congress was moved to pass the law after a contaminated batch of diphtheria shots left 13 children dead. Jim, the horse from which the diphtheria antitoxin had been extracted, had contracted tetanus.

Fortunately, scientists have dramatically improved the way they manufacture biologic drugs since then. For starters, the recombinant DNA revolution of the 1970s means that drug makers no longer have to extract many of the most important biologics from whole animals.

The gene that codes for human insulin, for example, can be pasted into a microbe which will happily churn out the drug in bulk. After a multi-million dollar purification process, the injectable insulin that results is indistinguishable from the version a healthy human body would produce. This is how some forms of insulin are made today.

The biologic advantage

Both conventional and biologic drugs work by interacting with our own biology. Most conventional drugs function as inhibitors – they're just the right size and shape to jam themselves into some molecular cog in our cells. Aspirin's pain-reducing power comes from its ability to disrupt an enzyme in the body called cyclooxygenase, an important player in pain signaling.

Conventional drug discovery largely consists of finding new compounds that specifically disrupt only disease-associated processes. Because these drugs are quite small, and because the inside of any cell is a sea of other molecular components, finding a new small drug that blocks only problematic processes is tricky. Off-target interactions can produce side effects of all types.

Aryogen in Iran produces a biosimilar form of Blood Coagulation factor VII Novoseven called AryoSeven. Credit: Asemi, CC BY-SA

The large size of biologic drugs can be an asset here. An antibody, for example, has lots of specific points of contact with its target. This enables therapeutic antibody drugs to bind with extreme precision – only their target molecule should be an exact match. This binding can lead to inhibitory effects, much like a conventional drug might. In some cases, therapeutic antibodies can also stimulate the immune system in a problem area, like at a tumor, prompting the body to take it out.

Many biologics target molecular processes that no conventional drug can, and they can treat a growing list of diseases. Cancer treatments dominate

the list, but since 2011 the U.S. Food and Drug Administration has approved new protein-based biologics for the treatment of Lupus, Crohn's disease, rheumatoid arthritis, multiple sclerosis, kidney failure, asthma and high cholesterol.

New types of biologic drugs continue to emerge as well. In late 2015, the FDA approved a first-of-its-kind treatment for patients with advanced melanoma: an engineered herpes virus. Researchers genetically programmed the virus, called T-VEC, to target only cancerous cells, and it can also prompt the immune system to start wiping out cancer. Additional virus-based therapies are currently working their way through the lengthy U.S. drug approval process.

Crippling costs

Amgen, the company that produces T-VEC, estimates it will cost an average of $65,000 per patient – and that doesn't come close to topping the list of priciest biologic medications. The most expensive drug ever made recently won approval by the FDA. Brineura, a biweekly enzyme replacement therapy produced by BioMarin Pharmaceutical, delays the loss of walking in individuals with a rare genetic disorder. Its price tag? $27,000 per injection, or more than $700,000 for a full year's treatment.

The steep prices of biologic drugs are alarming to many patients, physicians and researchers. In an effort to drive costs down, provisions of the Obama administration's Affordable Care Act accelerated the approval process for new biologics intended to compete with already approved medicines. Like generic drugs, so-called biosimilars are designed to be interchangeable with the biologic they seek to replace.

Unlike generic versions of conventional drugs, however, biosimilar drugs are often only similar to – not identical with – their competition. This means these complex drugs still require lengthy and expensive trials of

their own to make sure they're effective and safe. Because of this, the Federal Trade Commission estimates that biosimilars may only produce an overall 10 to 30 percent discount for patients.

Cost-cutting innovations in the biologic production pipeline are desperately needed. The FDA has called on scientists and drug developers to invent biosimilars that resemble FDA-approved medicines and to develop the tools needed to quickly demonstrate their safety.

As this promising class of drugs continues to grow in number and popularity, their lifesaving power will be limited if costs make them inaccessible to patients who need them.

This article was originally published on The Conversation. Read the original article.

Provided by The Conversation

Citation: Biologics—the pricey drugs transforming medicine (2017, July 25) retrieved 10 April 2024 from https://medicalxpress.com/news/2017-07-biologicsthe-pricey-drugs-medicine.html