



Shaping Society Therapeutic Proteins

Over the past few decades medical care has been revolutionised by the introduction of a new class of drugs; therapeutic proteins.

These large macro-molecules occur naturally in our bodies but only in very minute quantities. For use in therapy we have to devise efficient means to generate much larger amounts. It is necessary to ensure the product is incredibly pure and then supply it to the patient as a therapeutic drug.

The list of new proteins being made for medical use grows each year as we learn more about the role of these highly specialised molecules in our bodies. As our knowledge increases so does the challenge for those whose job it is to devise the means for making these materials: the biochemical engineers.

Type of Therapeutic Protein	Use
Monoclonal antibodies (mAb)	Passive immune protection against disease
Tissue plasma activator (tPA)	Dissolves blood clots
Factor VIII	Blood clotting agent
Insulin	Diabetes

Examples of therapeutic proteins and their medical use

Some, like Factor VIII for the treatment of haemophiliacs, are sourced from human plasma but most are now manufactured in the bacterium *E.coli* using genetic recombination. So just how difficult is it to create quantities of proteins so that whole populations of patients can be treated? What are the problems? What are the costs?

The Challenges to be overcome

Let's take the example of insulin for the treatment of diabetes; this disease is very much on the increase especially in the Western world but is fast becoming a major global issue. Insulin used to be extracted from pigs but that material was not identical to the human form and the number of animals available limited supply! Since the latter part of the last century it has been possible to place the genetic code for the expression of authentic human insulin into a strain of *E.coli*. These bacteria are only a few microns in length but if we can devise ways to grow many billions of them in vast stirred and aerated bioreactors, we have the basis for production of insulin

on a metric tonne scale! A special kind of science and engineering is needed to achieve this: biochemical engineering. Purification is complex but you can imagine that in order to make insulin at 99.99% purity and free of toxic by-products that *E.coli* generates at the same time, is a tall order. Biochemical engineers have to devise a whole series of processing steps which include physical as well as chemical methods to tease away the very delicate product from many thousands of impurities, often very similar to the product.

Creating a process for making such a therapeutic protein can take many years of careful development and testing. So whilst data is being generated to prove the clinical use of the drug, the biochemical engineers are working flat out to ensure that the molecule can be made at large scale, consistently and of course at a price we can all afford. Development costs can be huge, exceeding \$1 billion!

Revolutionising Healthcare

The future prospect always is that these new molecules will revolutionise healthcare; and we are seeing this for example in the case of a whole class of molecules, the so-called monoclonal antibodies (mAb). These incredibly powerful agents are produced in animal cells cultures in vessels the size of a double decker bus. Their unique properties make them powerful tools in our fight against killers such as cancer. Over the next decade it is projected that a further five hundred such drugs will reach the patient and that many hundreds of thousands will benefit from access. As we discover yet more precise ways to intervene in human health so the role of the biochemical engineer in devising and delivering the processes necessary for the aspirations to be come reality will be ever more important and the need for individuals trained in this discipline will grow. Already biochemical engineers have provided the way for life-saving new therapies worldwide. The challenge will be to increase this rate of delivery and to assure the step change reductions in drug costs can be achieved so that the huge potential of these life-saving medicines can be felt globally!