

Nucleic Acids and Proteins—Disease Treatment Innovations

UNIT 3 RECAP

The focus in Unit 3 was on how we diagnose and treat disease. Research and collaboration by doctors and biomedical scientists are crucial parts of unlocking the secrets of cellular mechanisms that threaten human health such as diseases caused by genetic mutations. Knowledge of how proteins are produced and how they function or fail to function

can help create ways to prevent, treat, and/or even cure diseases caused by genetic errors. Medical breakthroughs such as CRISPR technology have given scientists new ways to modify DNA and novel capabilities in genetic engineering. The ability to detect and quantify nucleic acids and proteins through assays allows us to gain new information for diagnostics and

treatment of disease. After new disease innovations have been shared and tested, these treatments must go through a rigorous series of checkpoints in the drug development process to gain FDA approval, including collecting data, determining the best ways to deliver the drug to patients, and providing a plan for education and health equity.

INSPIRATION 1

Until 20 years ago, the only way for diabetics to get insulin was to inject themselves multiple times a day. The development of insulin pumps gave diabetics freedom from needles and more consistent monitoring of glucose levels. While this improved treatment, scientists are working on using technology such as microneedles and nanoparticles to deliver insulin in new ways. Could these new techniques open the door for better treatments of other diseases?

PROBLEM

Are there ways to improve the delivery of insulin that don't require injections or wearing an insulin pump and how could this improve the treatment of disease as well as the patient's quality of life?

SOLUTION DESIGN DRIVING QUESTIONS

Why do people with diabetes need to take insulin?

What are the challenges for people living with diabetes?

What are the most widely used drug delivery methods for insulin?

How do insulin pumps compare to insulin that is taken in by injection?

What are the drawbacks to using insulin pumps?

What are nanoparticles and how can they be used as a drug delivery vehicle?

What would be the benefits of insulin delivery and monitoring in non-invasive ways for children and adolescents?

RESOURCES

[Statistics About Diabetes | American Diabetes Association](#)

[4 Ways To Take Insulin | Diabetes | Centers for Disease Control and Prevention](#)

[Impact of insulin pump on quality of life of diabetic patients | PubMed Central | National Library of Medicine](#)

[Insulin nanoparticles may become an alternative to insulin injections for diabetic patients | News-Medical](#)

[Microneedle-based insulin transdermal delivery system: current status and translation challenges | PubMed Central | National Library of Medicine](#)

[Teenagers with diabetes--management challenges | PubMed Central | National Library of Medicine](#)



Nucleic Acids and Proteins—Disease Treatment Innovations

INSPIRATION 2

Cancer, the second leading cause of death in the U.S. impacts millions. As with many diseases with both environmental and genetic components, risk evaluation and early detection are paramount to patient treatment and survival. Traditional cancer screenings can involve invasive procedures like biopsies and blood tests after detection of tumors through imaging. How could wearable technology be designed to help people monitor biomarkers for cancer from biofluids such as sweat or saliva?

PROBLEM

Are there innovative ways to improve the way drugs are delivered to children and adults that are less invasive and have less risk than traditional methods that use needles such as injections and IVs?

SOLUTION DESIGN DRIVING QUESTIONS

What types of drugs are typically delivered using needles?

What are the risks or drawbacks of using needles to deliver drug treatments or vaccines?

What other methods are there for drug delivery and how does the effectiveness compare to traditional drug delivery methods?

Can innovative drug delivery methods, such as ones using nanoparticles, target disease more efficiently than traditional ones?

What are the deterrents for using innovative methods of drug delivery (such as nasal sprays, microneedle patches)? Cost? Education? Availability?

RESOURCES

[Needle-free and microneedle drug delivery in children: a case for disease-modifying antirheumatic drugs \(DMARDs\) | PubMed Central | National Library of Medicine](#)

[Meeting Challenges of Pediatric Drug Delivery: The Potential of Orally Fast Disintegrating Tablets for Infants and Children | PubMed Central | National Library of Medicine](#)

[New Patch Inspired by Octopus Suckers Could Deliver Drugs Without Needles | Smart News | Smithsonian Magazine](#)

[A puff of air could deliver vaccines needle-free | ScienceNews](#)

