

Review Article



Advanced Digital Therapeutics: Catalyzing the Recent Challenges and Future of Health

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ABSTRACT

Digital therapeutics are a new category of apps and tools that utilizes digital and often online technologies and deliver evidence-based interventions to patients that are driven by high quality software programs to prevent, manage or treat a medical disease. Digital therapy is a great boon to improve the patient's outcomes, particularly targeted on people facing chronic conditions like diabetes, chronic obstructive pulmonary disorder, autism spectrum disorder, obesity, mental illness etc. The home-based digital interventions typically combine telemedicine, wearables, smart gadgets, exercise, and cognitive behavioral therapy, education through a smart phone or tablet depending on their case. Digital therapeutics are the systems that provide great potential in maintaining the patient's lifestyle, wellness, therapy management, rehabilitation. Digital therapeutics also supports various stages of the patient healthcare journey. They can collect, synthesize and analyze patient data so clinicians personalize treatment and work with the patient to avoid complications. Digital therapeutics has the potential to prevent disease, reduce healthcare costs while helping the patients monitor and manage chronic conditions. Digital health technology assist health care users to be informed and empowered to participate in their own health. Digital therapeutics use digital tools to create treatments and programs that complement or replace clinical drugs. Digital therapy often includes clinical assessment, patient reported outcomes and clinician monitoring dashboards. Both for patients and health care providers, digital therapeutics will add new possibilities to clinical practice and treatment. Overtime, digital therapeutics are expected to be seamlessly integrated with most health related activities including medication regimens. These digital therapies often help and encourage patients to follow a strict diet or to stick to an exercise program. The aim of this review is to describe the role of digital therapeutics in treating chronic conditions.

Keywords: Digital interventions, smart devices, digital apps, chronic conditions, wearables, digital health.

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INTRODUCTION

Digital therapeutics was first introduced by Joseph Kvedar in 1995. The initial idea of introducing digital therapeutics was to overcome the restrictions like time, place, personnel limitations that a physician may face while providing effective medical care to patients. As chronic conditions require a proper care and treatment, digital therapeutics emphasize on lifestyle changes which improves the patient's outcome. Digital therapy clearly constructs a plan, set goals and tracks the behavior and monitors disease progression in order to increase the patient outcomes.¹ Digital therapy connects the patients to their physicians virtually and monitors them frequently. Digital health provides preventive measures and also the disease management. The

treatment provided by the physician to the patient in the hospitals is not enough as the physicians do not know the patient's condition and lifestyle in just a single visit. To prevent this confusion, the digital therapy is developed that connects the physicians and patients virtually and monitors them.² Digital therapeutics also supports various stages of the patient health care journey. Digital therapy might even become the standard of care, as digital therapeutics always need to go through vigorous clinical testing, leading to a regulatory approval to demonstrate safety and efficacy. Digital health has the potential to prevent disease and lower healthcare costs, while helping patients monitor and manage chronic conditions. It can also tailor medicine for individual patients.³ The digital therapy also enables the clinicians to provide personalized treatments to the patients and it avoids complications. Digital therapy uses digital tools to create treatments and programs that complement or replace the clinical drugs. These programs include telemedicine, wearables, smart gadgets, cognitive behavioral therapy based on the case.⁴ Digital therapy helps the patients to tackle the chronic conditions effectively. This technology connects the doctors and patients using a smart phone. The patients will get awareness about the lifestyle managements and



takes preventive measures in order to avoid chronic conditions.⁵

I. Digital therapy for the treatment of diabetes:

Digital therapeutics plays a vital role in managing diabetes mellitus. It improves the patient compliance and provides better outcomes to the patients. Digital therapy offers treatment to the patients by using smart gadgets, smart apps and wearable's etc.⁶

Digital devices include:

1. Blood glucose meter
2. Continuous glucose monitor
3. Insulin pumps
4. Smart insulin pens



Figure 1, 2, 3, and 4: Blood glucose monitor, Continuous glucose monitor, Insulin pumps, insulin pen

1. Blood glucose meter:

A blood glucose meter is a device for measuring the concentration of glucose in the blood, typically by placing a small drop of blood on a disposable test strip where a chemical reaction with glucose alters the electrical conductivity of the strip.⁷ The blood glucose meter is shown in the figure 1:

Working principle of glucose monitor:

- Glucometers are the devices which are used to check the blood glucose levels.
- Small amount of blood from fingertip is taken and the blood glucose levels are estimated by using glucose meters.

- Take a lancet and prick your finger using a lancet in order to obtain blood.
- Now the blood drop should be placed on the strip. Place the strip in the meter.
- The glucose meter will analyze the blood glucose level.

Advantages of glucose monitor:

- Glucometers provides long term goals and it is possible for dose adjustment using glucose meter.⁸
- It mainly provides us the scope to control diabetes without consulting doctor frequently.
- Glucometers enables the patients to know about their condition and minimizes the lethal conditions.
- These devices are easy to use and also increase the outcomes of treatment.

Disadvantages

- Glucometers are expensive and sometimes causes infections to patients.
- The glucometers are not accurate always and may show some deviations.

2. Continuous glucose monitor:

These devices are also used to check the blood glucose level.

CGM systems continually check glucose levels throughout the day and night and can alert you if your glucose levels go too high or too low. Continuous glucose monitor is shown in figure 2:

Working principle:

- Continuous glucose monitor contains a sensor which is inserted into the skin.
- This device measures the glucose levels of the interstitial fluid.
- The sensors frequently measure the blood glucose levels for each interval of time.
- This sensor sends the signals to the monitor and the monitor displays the blood glucose levels.
- As the name indicating, the blood glucose levels are continuously monitored using this device.

Advantages:

- Continuous glucose monitor is safe to use and easy to handle.
- It gives better outcomes and can be used to make therapy adjustments.

Disadvantages:

- The drawback of continuous glucose monitor is, it measures the interstitial glucose levels between the cells rather than measuring the blood glucose levels.

- Thus, there will be a delay in the treatment of hyperglycemia and hypoglycemia in patients.

3. Insulin pumps:

Insulin pumps are small, computerized devices that mimic the human pancreas by works by delivering small doses of short acting insulin continuously.⁹

It is used for the administration of insulin in the treatment of diabetes mellitus, also known as continuous subcutaneous insulin therapy. Insulin pump is shown in figure 3:

Working principle:

- Insulin pumps are a effective technique for delivering the insulin.
- Insulin pumps continuously send the insulin into the bloodstream of the patients.
- Insulin pumps are comparatively better when compared to insulin injections.
- It contains a plastic tube known as catheter with a tiny needle at the end.
- This plastic tube and a needle collectively known as insulin set which is inserted into your skin.

Advantages:

- It is possible for making dose adjustments.
- Insulin pumps reduce the frequency of insulin injections. They are consistent and very effective.

Disadvantages:

- Insulin pumps are very expensive and hence not affordable.
- Frequently checking should be done.

4. Smart insulin pens:

A smart insulin pens are the devices which are used for controlling diabetes and monitors and tracks the insulin delivery. These insulin pens are reusable and provide the effective outcomes. Insulin pen is shown in figure 4:

Working principle:

- Insulin pens are preloaded with the insulin.
- Insulin pumps are easy to handle.
- While using, insert a new needle into the insulin pump. Adjust the dose on the pen and inject it into the skin and after injecting throw the needle in a sharps container.⁹

Advantages:

- Insulin pens are much better than the injections and they are very simple to use.
- Dose adjustment is possible and improves patient compliance.

- The pain during taking insulin through the pen is less as compared to the injections.

Disadvantages:

- Insulin pumps are expensive than injections and vials.
- Insulin pens are specific only to some insulin types.
- Additionally needles should be purchased every time before using the pen.

a) Digital apps for diabetes:

- Wellthy diabetes
- Life in controls
- Apollo sugar
- Diabeto
- The medical apps logos are given below in figure 5:



Figure 5: Showing some digital app logos for Diabetes management

b) Role of digital apps:

- These digital apps provide us various advantages and provide awareness among the people. It also monitors the food intake and the physical activities and controls diabetes.
- Diabetic apps frequently check the blood glucose levels using sensors and tracks the insulin levels.
- These apps provide the information to the patients and engage the people towards self management.
- These apps allow the patients to be in contact with the clinicians at any time.

II. Digital therapy for the treatment of mental illness:

Approximately 10% of people are facing mental health issues. Digital therapy offers a effective treatment to such patients by using a simple technology and mobile

applications. The medical apps contain the sensors which are used to check the vitals and behavioural modifications. Digital therapy provides a safe and effective treatment to the mental illness patients and enables the patients to monitor themselves. Some of the digital technologies are given below.¹¹

1. Wearables:

- Wearables are the device which usually provide good mental health to the patients by making them positive and removes the stress.
- wearables detects the heart rate and body temperatures frequently and suggests the patients according to that. If it notices high temperature and higher heart rates then it suggests the patients to practice deep breathing and prevents the stress episodes.
- If a person is stressed, the wearable might not be as helpful to have an app telling you every point in the day.
- Wearables are easy to handle and they are comfortable even while sleeping.
- Figure 6 showing smart wearable.



Figure 6: Smart Wearable

a) Some smart wearable technologies are:

- Smart helmets
- Smart clothing with sensors
- Smart earphones
- Medical wearables

How does wearable work:

- Wearables are the electronic devices that can be easily worn on the body and they track the information time to time.
- These wearables contain the sensors through which it displays the collected information on your smart phone or a computer.

- These devices frequently checks the heart rates, body temperature and activities of the some organs like brain and analyses it.¹²

i) Anxiety bracelets:

- Bracelets are the things that can be worn. These are made with a colourful beads into a spherical shape which represents the chakra of the body
- These bracelets when worn by an individual it spreads the positivity to the person and removes the stress.

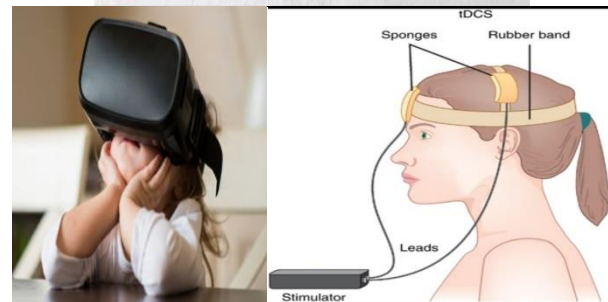


Figure 7, 8, and 9: Anxiety bracelet, Virtual reality, Transcranial direct current stimulation.

ii) Virtual reality:

- Virtual reality is a very effective way to treat the mental health issues.
- Virtual reality reviews the brain of a person and makes that person to be relaxed and recovered and increases the treatment outcomes.
- Virtual reality mainly treats the anxiety disorders and makes them relaxed.
- Virtual reality is the very effective one to treat the people who are suffering from psychological disorders.
- A psychologist at the forefront of this research tells us how virtual reality is helping people literally face their face and learn to overcome them.
- It can treat stress, anxiety.

Figure 8 showing virtual reality

iii) Transcranial direct current stimulation [TCDs]

- TCDS are used to treat the depression, anxiety, Parkinson's disorder and chronic pain.
- TCDS acts by sending the currents directly into the brain of the person who is suffering from this disorder.

- The current or shocks are sent to a specific disorder site.
- TCDS can be used to overcome various conditions like fear, anxiety, stress, depression etc and makes the individual better by promoting positiveness.
- These TCDS provides a effective treatment to overcome major depressive disorder, as it have a capability of cortical excitability and gives the prolonged actions.
- TCDS is a novel treatment option for major depression which could be provided as a first line treatment. Figure 9 represents transcranial direct current stimulation.¹³

b) Some more technologies used in the mental illness disorder are:

Computer program, Social networks, Telephone, Video conferencing, Computer games.

c) Apps for treating mental illness:

- Moodkit
- Talkspace
- Happify

Some of the app logos are shown in the figure 8:



Figure 10: Mental health management app logos

d) Role of these apps:

- These digital apps spread the awareness among the people and make the individuals move towards self-management by habituating the healthier habits.

- These digital apps are easy to use and mainly provide the information on anxiety, stress, fear, major depression. These digital apps are convenient to use and patient can seek the information from the physician at any time using the video conferences, chats etc.

CONCLUSION

Digital health is a promising way to engage people through online technology to for instance monitor their behaviour or to help to improve their health. It can also be called as digitally guided therapy. Improving the quality of life is one of the main goals of integrating new innovations into medicine. Digital therapy aims to improve the quality of life by using the technology. The digital therapy is already valued by many patients and the future of digital therapy has just begun.

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