

ABSTRACT

The CNNS (Carbon Nanotube Nutrition Sensors) is our proposal for monitoring and treating those who are diagnosed with the disease called Anorexia Nervosa. Our mission is to eliminate the need for tubal and intravenous feedings, and monitor how it progresses. Each patient would wear a color-changing carbon nanotube bracelet with a System Tracking Alarm Device which would have a special patch on the underside. The patch would release nanorobots implanted with RFID tags into the person's bloodstream where tests would be conducted and nutrients released based upon tests results. They would then send vital signs and nutrient levels to the bracelet. Once the bracelet picked up the nanorobot's radio frequency signals, the bracelet would display them to the patient on a display screen and send the data to the patient's doctor, nutritionist or dietician, and therapist. CNNS would make the road to recovery from Anorexia faster and less painful.

Carbon Nanotube Nutrition Sensor: A Sensible Treatment for Anorexia

A. Present Technology In a crowded school hallway, a girl passes through the hall. Feeling sad and alone, No one seems to notice her; she is invisible to the world. Blending in with her surroundings looking like a normal person. But, in fact she is getting smaller and smaller with each passing day, eating less and less. She is different from everyone else. The young girl is twelve years old and she has a disease called anorexia nervosa, a pursuit of thinness and unwillingness to maintain weight.

Anorexia is one of three diseases classified as an eating disorder; Anorexia Nervosa, Bulimia Nervosa, and the Binge Eating Disorder. When a person experiences disturbances in their eating behaviors, reducing their intake of food or increasing it, he/she experiences feelings of distress and concerns about their body, weight, or shape. The person has an eating disorder. An eating disorder is both a physical and mental disease. There is no known cause for an eating disorder, but there are a series of things that people think they are caused by; genetics, cultural pressures to be thin, history of obesity, and parental behaviors.

We did our project on anorexia nervosa. Anorexia nervosa is the pursuit of thinness and unwillingness to maintain a normal, healthy weight. Anorexics have a fear of gaining weight. They will lose weight by dieting, exercising extensively, eating only small quantities of food, and by taking laxatives, diuretics, or enemas.

There are many signs of anorexia. People will have a large weight loss unrelated to an illness and they will feel as though they have no energy. They will also complain about feeling cold. Their hair will be dry and lifeless, nails brittle, and skin will be a poor shade or tone. Anorexics have strange eating habits, such as restricting themselves from certain foods and cutting their food up into small pieces. They care about how much food others eat and complain about being fat.

Today the treatment for anorexia nervosa requires a “team approach.” Doctors, therapists, and nutritionists/dieticians will all have to work together to make sure that the patient recovers, seeing them on a regular basis to keep track of their progress in their recovery.

Anorexia is both a physical and emotional problem, so it needs to be dealt with as soon as possible, even if the patient is forced to do so. It is the job of an anorexic’s doctor to make sure that they remain healthy because many diseases and dangers can be caused or triggered by anorexia. Since the patients were depriving their bodies of nutrition for so long they became malnourished and dehydrated. Their bodies went into a starvation mode, shutting down all of the internal organs slowly to conserve energy. This causes their heart rates to become irregular, blood pressure to drop, hormonal changes, respiratory rates to lessen, low bone density, low body temperatures, electrolyte imbalances, and so much more. As a result doctors must see their patients on a regular basis to make sure that their patient’s medical condition doesn’t worsen.

Doctors will weigh their patients each time they see them to see if they lost, maintained, or gained weight. Because the patients in recovery from anorexia had lost so much weight they will now be on a weight gaining program. Doctors will also check their vital signs and height during each visit. The malnutrition caused their body to eat at their bones to get the nutrition it needed. Vital signs are checked because the patient’s respiratory rates, heart rates, temperature, and blood pressure had dropped severely before the treatment began and doctors want to see if they have risen or dropped. Doctors will also take urine tests every time they see their patients to check for an electrolyte imbalance, ketones, and proteins. Due to the fact that anorexics were malnourished and dehydrated, they may have an electrolyte imbalance which can lead to kidney failure, heart attack, and death. Ketones can accumulate in the blood rate quickly when the body is starved of food and nutrients. It indicates that the body is eating its own fat for energy. The accumulation of ketones in the blood can lead to Ketoacidosis which can cause coma and death.

Therapists will give the patients in recovery from anorexia individual counseling which will focus on changing their way of thinking. They will help them to develop better attitudes towards food and the thought of gaining weight, which is something that they fear the most. Therapists will also help those in recovery from anorexia change the way they think of themselves as a person and the way they respond to difficult situations. The nutritionist or dietician that the patient in recovery sees will teach them how to improve their eating habits at their appointments. They will teach the patients how to incorporate healthy behaviors in everyday life and how they can promote a healthier relationship with food. They will also help their patients to develop healthy eating patterns and teach them the importance of nutrition in a healthy diet. They develop and use food plans for the food intake that would include enough calories for the patient to obtain a normal weight and be healthy again.

In some situations the weight loss of some patients in recovery from anorexia has become so severe that it has seriously impaired their body systems so they will need to be hospitalized. When, patients in recovery from an eating disorder are hospitalized they go there involuntarily. When their weight is 30% below their ideal body weight, depression is severe and they are suicidal. They may have medical complications resulting from anorexia. Patients with severe malnutrition will need intravenous feedings, meaning that a needle will be put into their veins and will infuse liquids containing glucose solutions into their blood stream. Those who can't or shouldn't get their nutrition through eating will be fed through a feeding tube that will go down into their stomach. The hospital treatment most important goal is the correction of malnutrition.

Some patients who are in recovery from anorexia are not able to remain hospitalized for a long period of time because of their insurance so they go into an inpatient program shortly after they have been released from their hospitalization. Inpatient programs require living at a facility for a certain period of time. The facility usually has therapists, doctors, dieticians, and volunteers

on staff to work with everyone everyday. It provides a safe environment for recovering from an eating disorder. Sometimes inpatient programs are the best way to treat anorexia because the patients will be able to talk to other people who are going what they are going through, know exactly how they feel, and they will be able to escape from their family members who are trying to force them to recover. There are also outpatient programs that patients in recovery from anorexia can go to without the overnight stays.

Treatments for anorexia are specifically made to fit the individual needs of the patient. The road to recovery is hard for those with anorexia. The pain they must endure is unbearable. They may experience relapses and difficulties. The patient must be willing to change for the recovery to truly work.

B. History It is 700 B.C. during the rule of Julius Caesar. Historical evidence leads us to believe that the ancient Romans of the upper class were bulimic because they overindulged at banquets and parties and to relieve themselves they vomited so that they return to the feast and continue eating. Six hundred years later in 383 A.D. the Romans also had eating disorders. During 383 A.D. the first recorded case of anorexia occurred. St. Jerome had become a spiritual leader of a group of upper class Roman women. One of the members of the group starved herself to death because of her religious beliefs, for she thought she needed to starve herself to be holy. During the Dark Ages, 500 - 1000 A.D., three cases of Anorexia were reported. In the time of Renaissance, 1300 A.D. - 1700 A.D., anorexic behavior seemed to have almost reached epidemic proportions. Women who were greatly impacted by their religious beliefs were canonized as saints for fasting. The women's culture valued spiritual health, fasting, and self-denial greatly. The women who fasted for spiritual purposes during the Renaissance are now referred to as "holy anorexics."

It was 1689 when anorexia was first identified by Richard Morton. He described it as being a condition caused by sadness and anxious cares. Five years later Richard Morton published the first medical case history of self-starvation that gave the specific symptoms of anorexia nervosa. About two centuries later Richard Morton's work was rediscovered. In the 1870s anorexia was officially identified and diagnosed. Charles Laseque published L'Anorexie Hysterique, in 1873 "the first real glimpse of the pressurized family environment in hysterical anorexia." He stated that hysterical anorexia typically began between the ages 15 and 20. In that same year a London physician named Sir William Gull had also published papers that described the treatments and causes of hysterical anorexia. He recommended that patients who needed to be treated for their hysterical anorexia be fed at regular intervals and be surrounded by people who have moral control over them, relations and friends generally being the worse attendance.

During the 20th century the treatment of anorexia nervosa changed to incorporate the new development within the medical and psychiatric practice. After World War II a new psychiatric view of eating disorders was shaped and they no longer recognized as just a medical disorder. Dr. Hilde Bruch delved into the work psyche of patients and Gerald Russell brought forth the information that patients with anorexia suffer from powerful and intractable urges to overeat. They seek to avoid the fattening effects of food by inducing vomit or abusing purgatives or both, and that anorexics have a morbid fear of becoming fat.

Karen Carpenter, a famous singer, died of anorexia in 1983 and raised the awareness of anorexia in the U.S. In 1974 the American media started to write about how young women refused to eat, but they never really explained how serious an eating disorder could be. In the 1980s slimness became the ideal feminine beauty, causing anorexia to occur more often. Right, now less than one percent of the people who live in the United States of America have anorexia and ten percent of the people who have anorexia never recover and pass away. With our

invention of the Carbon Nanotube Nutrition Sensors people recover from anorexia faster and easier.

Future Technology The CNNS is our proposal for monitoring and treating those who are diagnosed with anorexia. Its main purpose would be to eliminate the intravenous and tubal feedings which can be extremely painful methods of treating the disease. It would also monitor any person's anorexia by performing various tests. Using many components including a carbon nanotube bracelet and titanium nanobots, this invention would be a very realistic and convenient medical aid to those who suffer from anorexia in the future.

The base of our invention is the color-changing carbon nanotube bracelet. The bracelet will be approximately two inches thick and carry close to 24 million nanobots. Three lithium ion batteries and solar panels will be used to power the bracelet's computer. The bracelet will be able to change color because it is made out of carbon nanotubes which emit light. A special chamber within the bracelet stores the nanobots. Those nanobots will be released into the bloodstream using a patch on the underside. Once inside the bloodstream, the nanobots will send information to the bracelet where the data will be organized and sent to the nutritionist/dietician, therapist, or doctor of the patient. RFID tags will store the information received by the bracelet. The wearer will also be able to communicate with the doctor, therapist, or nutritionist/dietician and their picture will be shown on the display. An alarm system will also be included to the bracelet in case the wearer tries to pull or rip it off. The patient's specialists have the control over how long the patient must wear the bracelet. In order for any of them to remove the bracelet, they must scan their retinas on the retina scanner on the bracelet. If the retina scan matches, then the bracelet will unhinge.

Once released into the bloodstream, the nanobots would travel through the body, powered by a Thermoelectric Generator. This generator would use body heat and put it through

thermocouples which would convert it to electricity. The nanobots would travel to the precise locations where they would release nutrients the body was lacking. It would also perform several tests that would help monitor the progression and development of the person's anorexia. These tests would include blood tests to find nutrient levels and electrolyte balance. They would also measure ketone levels. Each nanobot would have an RFID, or Radio Frequency Identification tag, implanted within its structure, which would store data from the tests conducted. A microchip inside the bracelet would pick up radio frequency signals from the nanobots. Once the microchip received the signals, the signals would be changed into text or any readable data through a transmitter. The microchip would be programmed to automatically send any data it receives to the patient's doctor, therapist, and nutritionist/dietician using radio signals. The nanobots are fabricated with nutrient solutions which would be stored in the medicine chamber. After nutrient levels are sent to the specialists, they will then decide which nutrients the patient truly needs. They will send this information to the bracelet which will alert the nanobots that carry these nutrients and release the nutrients.

D. Breakthroughs Some breakthroughs in this type of science will need to happen in order for this invention to work. Since nanobots have already been built to repair nerves in the human body this makes our idea viable. One thing that needs to happen for this to work is the nanobots would have to be built to carry loads. Nanobots can be built to carry and release molecular loads because they are only molecule sized themselves. This is a problem if any idea like this is going to happen but scientists are working on nanobots that can carry loads. These types of nanobots will be constructed and in use by 2025 which makes our idea even more likely to happen. As far as nanotechnology goes everything that's needed for this invention has already been made. The proposed method of the nanobots entering the bloodstream is a bracelet that releases C.N.N.S. through the skin somewhat like a nicotine patch. This patch has not yet been

invented but shouldn't be that hard to create. The nanobots will have to have nano-transmitters inside them which relay information picked up by the C.N.N.S. to the doctors office. The nanobots will have to do something amazing and that is communicating using radio signals. Radio signals are used on satellites to send audio and pictures from space. These signals work like a bat's sonar, the signals are sent out and when they hit something they bounce back. The satellite can tell by the angle in which the waves bounce back the size, shape and depth of the object. Satellites use the same principle when communicating with a space station or a base on earth. Satellites are simply used to relay signals sent out by a base on earth. These signals carry information that the satellites relay to another location in space or on earth, hence, satellite T.V. It seems like a lot of equipment to fit on a nanobot but crazier things have happened. The concept of nanotechnology seems difficult but when you get right down to it we really only need a nano radio signal transmitter. We also need to nano-size a Thermoelectric Generator. We need a nano-sized sensor that can measure vital signs, and we need a nano-sized electricity transformer. Those are all the breakthroughs needed for our invention.

E. Design Process Our team is one that is extremely enthusiastic and excited about our work. We all worked very hard not only to accomplish inventing the CNNS, but also to earn a spot on the team. Here is how our invention has developed since the very beginning.

First, our coach and ARL teacher assigned the whole class to come up with an invention, using present technology and how it might develop over the next 20 years. We were given many lectures and explanations as to what Exploravision was and what it would be like to participate on the team. We were told again and again how much hard work we would need to put into this project. When our essays were due, we were informed that those who were interested would be given the opportunity to join the Exploravision team. Since there was a limit to the number of people on a team, only the four best essays were selected. So in order to get to

where we are today, all four of us on this team worked very hard on a class essay just to be accepted on the team.

We made our own inventions using very different technologies and concepts. One invention was the CNNS (Carbon Nanotube Nutrition Sensors), the original idea for our team's very own invention. The purpose of this invention was to prevent people suffering from eating disorders from being force-fed through tubal and intravenous feedings. Another member of our group came up with the invention of the Plutonium battery, which would allow energy to be generated through heat from decaying plutonium. The NHA, or Nano Health Aid, was another invention, which used technologies very similar to the CNNS such as nanobots. The concept of this invention was to rid the world of disease. Although that may seem like a far-fetched goal, that proposal is very realistic. This invention would be an injection given to everybody at birth that would eject nanobots into the body that would fight off germ cells, like white blood cells. The only difference between the NHA bots and white blood cells would be that the NHA nanobots would never fail because they would be programmed to attack harmful cells as soon as they enter the body, and they would be programmed to win every battle. This invention would not only rid the world of disease, but it could also make life expectancies longer. The Virtual Admin was the final invention which combined multiple existing technologies with developing technologies. It used microchips to store software for a voice-activation system. The Virtual Admin would be a Bluetooth headset that would connect to a business man/woman's home and work's PC, function as a cellular phone, and project holographic images all by using voice commands. This device was made to be portable so it could increase the productivity of business people on their way to work, and while traveling.

Choosing the topic for our invention was a fairly involved process. We began by listing as many inventions as we could think of, always keeping our four original inventions in mind.

That list consisted of some pretty outrageous inventions. Some of our first suggestions included shoes that fly, books that emit light and RFID tags that teach you everything you needed to know. We continued to analyze and add to our list, before we decided that we wanted to choose something for our invention that had an important purpose. Eventually, we chose two of our original inventions for the main structure of our team's invention. Our invention is the CNNS, which uses the concept of the original CNNS. We use many of the NHA's technological concepts such as releasing nanobots into people's bloodstreams.

Since the time that we chose our subject, we have all worked extremely hard to accomplish success of finishing our final product. We have all spent major amounts of time researching, and writing. Combined we have spent hundreds of hours working on this project. We have been told innumerable times that right now, the work may not seem like it is worth it, but that once we are done, it will pay off and the feeling will be unbelievable. We trust our coach when he says that, and none of us can wait for that feeling.

F. Consequences Like every other new invention, the CNNS would have both good and bad consequences, and it is extremely important that these are carefully considered. For one, this product could be expensive. At first the price may be high until it is mass-produced. Another bad thing that could come out of this invention is criminal interception with the product. An intelligent criminal could use one of two ways to intercept radio frequency signals traveling from the nanobots to the bracelet. One method, called Eavesdropping, occurs when a person reads the frequencies being emitted from the RFID chip as it is scanned by an official reader. Skimming is the other method for a criminal to use and this happens when somebody uses an RFID reader to scan data from an RFID without the owners knowledge. With the CNNS, these possibilities would be very dangerous because the hacker could change the information from the tests being sent from the nanobots to false information. It would be very unsafe for the therapist,

nutritionist/dietician, and doctor to be monitoring false information about the patient. It could lead to critical medical issues for the patient. Another issue that could occur would be the nanobots functioning incorrectly. This would be unlikely unless problems arose in the programming of the nanobot. That could mean the nanobots release wrong types of nutrients or send information from wrong areas or wrong sets of data. Another problem is that the patch may release the wrong number of nanobots into the bloodstream. When these problems are fixed our invention will be approved by the F.D.A.

After listing those possible flaws, the thought of the CNNS working successfully may be discouraging and unlikely, but it truly is possible. Our product may have some bad consequences, but there are also many beneficial ones which exceed the flaws in importance by far. After the initial flaws are overcome, this invention could lead to even more medical inventions further yet into the future. For example, people wouldn't need to eat meals, they could use this invention to eat food solutions, and have more time to do important things. It could also be developed into a medical aid that could rid the world of all diseases. The possibilities are endless!

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