Nanotechnology Advances Fight Against Alzheimer's Disease in United States

Author: Rapid Access International, Inc. February, 2014.

Alzheimer's disease is among the most common brain disorders affecting the elderly and some middle-aged population the world over, and is projected to become a major health problem with grave socio-economic implications in the coming decades. The total number of people afflicted by Alzheimer's disease (AD) worldwide today is about 15 million people, a number expected to grow by four times by 2050. The frank and scary truth is: Alzheimer's disease statistics are not getting better; they are getting worse. There is a growing interest into the research and development of new treatments and there are currently nanotechnology-enabled approaches that are being developed for early detection and accurate diagnosis of Alzheimer's, its therapeutic treatment, and prevention. These potential solutions offered by nanotechnology exemplify the growing significance that it holds for dealing with brain ailments in general.

How does nanotechnology help the fight against Alzheimer's?

The symptoms of AD are characterized by loss of neurons and synapses, resulting in gross atrophy across multiple brain regions, thereby dulling a once sharp and responsive mind. The disease is presently hard to reliably diagnose, especially in its early stages when it is often mistaken for more normal age-related or stress-related changes. While an accurate diagnosis can only be obtained post-mortem (via examination of brain tissue in an autopsy on a cadaver), current clinical methods involving brain imaging and neuropsychological testing are only about 85% accurate, and that too only at later stages.

Early detection of a disease is important as it can determine how efficacious any treatment would be, and also serve towards the evaluation of experimental treatments. Clinical symptoms of AD (in the form of cognitive/memory decline) usually appear much after the neural tissue begins to deteriorate. Therefore, reliable and sensitive molecular approaches are needed to detect the onset of the neurodegeneration underlying AD as early as possible.

This is where nanotechnology—the ability to manipulate and map matter on an atomic, molecular, and supermolecular scale—comes in to play. By digitally mapping and tagging areas of the brain of a particular patient, nanotechnology has the capacity to essentially turn a patient's brain into a barcode that can easily be scanned and looked at to determine the presents of the kinds of activity most often associated with AD. As time goes on and more methods of treating AD become available, the ability to detect symptoms at its early stages—just as with cancer or heart disease—will be crucial to warding off the nasty and life-threatening characteristics that are infamously associated with this disease.

Another use of nanotechnology in regard to AD is by how medicines and therapy are administered to patients afflicted with the disease. Presently, no cure exists that would reverse the neurodegeneration caused by the advancement of AD, especially when it is detected relatively late on. Medication available in the market today is mostly intended only for symptomatic benefit, for example to improve the disrupted communication between brain cells, but cannot stop the process of degeneration. Research efforts are, however, underway to develop "disease-modifying" strategies, i.e. those which can get to the root causes of AD with the aim of slowing down or halting the progressive degradation of the brain. What compounds this problem is the fact the brain itself works in a way that blocks foreign substances (i.e. medicine for AD patients) from entering and mixing with sectors of the brain. However, scientists and pharmaceutical engineers who work with nanotechnology have surmised that it may be possible to convert therapy into a neurotransmitter by way of nanotechnology. This would allow a kind of “Trojan Horse” scenario where the therapy would enter a patient’s brain chemistry by masking itself as something brain recognizes and is able to work with. This could drastically reduce the ill effects of AD and can only be accomplished through the use of nanotechnology.

A less invasive example of how nanotechnology can be used to improve the lives of those affected by AD is in “nanatechnology.” Coined by Professor Andrew Carle who is the director of the senior housing program at George Mason University, nantechnology uses GPS mapping to track where a person with AD is located. A chip in the patient’s shoes allows for constant monitoring and peace of mind for loved ones. When people with Alzheimer’s and other dementias walk off “they don’t think they’re lost,” Mr. Carle pointed out. “They may actually hide. Paranoia is a manifestation of the disease. So search and rescue is hard to do.” This play on nanotechnology is yet another way the fight against AD is being waged.

Professor Carle met with Patrick Bertagna, chief executive of GTX Corp., the Los Angeles-based maker of sports shoes and equipment. Based on the discussion, GTX brought in a whole management team to shift the focus of the company to develop the new shoes with tracking systems for Alzheimer patients.

By late 2011, a new GPS-equipped shoe was ready for people with a variety of cognitive disorders, including traumatic brain injury and autism. In 2012, a Swedish science museum named the shoe one of the “Top 100 Innovations of Mankind,” alongside the telephone and the internet.

Professor Carle is also reaching out to veterans groups, for those who suffered traumatic brain injuries at war, to autism groups, to medical groups monitoring transplant organs, and to law enforcement. Local police and sheriff’s departments frequently are tasked with searching for

missing seniors, deploying numerous resources to find someone before they die of exposure or dehydration.

The International Association of Chiefs of Police launched an Alzheimer's initiative for police departments several years ago because dementia patients are a serious concern for law enforcement. Amanda Burstein, director of the IACP initiative, said GPS-equipped devices such as the GTX shoe are "part of our options for law enforcement in our classroom training."

The GTX shoe uses an embedded chip in the sole of the shoe to track the Alzheimers patient. The location of the patient can then be monitored on a cell phone of the person trying to locate the patient and it gives the coordinates of the missing person so they can be found safely.

At the time this article is being written, a special subcommittee has been convened on Capitol Hill to discuss the future of Alzheimer's research and—more importantly—funding. Celebrities, victims, doctors, and neuropsychologists are testifying before Congress, urging the lawmakers to allocate much needed money to the further development of nanotechnologies in order to begin the process of trying to reduce the number of Alzheimer's cases in both United States and abroad. Right now, the consensus of those most directly involved with AD research contend that not enough is being done, but prospects are high as nanotechnology provides a glimmer of hope for patients, loved ones, doctors, and others as it aims to help curb the destruction of this terrible and rapidly growing disease.

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