

NANOTECHNOLOGY PATHOLOGY PROJECT:  
FUTURE DEVELOPMENTS

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PASS

RESEARCH PAPER

BASED ON

PATHOLOGY LECTURES

AT MEDLINK 2010 or MEDISIX 2011

## ABSTRACT

This paper is based on nanotechnology; this is when substances are built from atoms or molecules to form useful products.

In nanotechnology is a part of medicine which is called Nanomedicine: this is when nanoparticles and Nano robots are developed to repair cells. Nano robots are small technology which stops pathogens affecting the health of people.

I am suggesting future developments from current research or developments and I have thought of ways in which the nanotechnology can have a better affect. An example is that different substances (radioactive isotopes or Nanopores) can be transported for different purposes such as destroying cancerous cells or transport to DNA.

My conclusion is that nanotechnology can be used in many ways to improve health and advance medicine: many techniques such as injections can be replaced, cancerous cells can be destroyed and unwanted substances can be transported.

Other benefits are that many resources will not be needed; therefore, more people can be treated globally. Therefore, there is less risk of resources running out. These techniques also have less adverse effects; an example is that only cancerous cells are damaged. Furthermore, nanotechnology can be used in many ways.

## INTRODUCTION

My paper is about nanotechnology which is building substances at an atomic level to make useful products. In this field, structures which are between one to hundred nanometres are studied. Another fact is that the prefix 'Nano' means a billionth; therefore, a nanometre means one billionth of a meter. Nanotechnology can be applied to many areas such as the environment to improve the quality of air and water, electronics or even food. This could be a significant step for the advance in technology. However, there are also ethical issues involved. For more information please search on, <http://www.understandingnano.com/introduction.html>

Nanotechnology as a part of medicine is called 'Nanomedicine'. There are some applications of this technology, some are being tested and others are possibilities. Nanomedicine is about nanoparticles that are being developed and Nano robots that are being researched to repair cells. Nano robots are technology that can be used to help prevent the body from bad microorganisms. For more information please look at the website: <http://www.understandingnano.com/medicine.html>

Nanotechnology is being used to give drugs in a better way and is developing in nerve regeneration research to be used scaffolding. This technology is changing from structures which had to be controlled, to structures which do not need to be controlled. A reference is <http://www.nanotechproject.org/>. There are also other uses such as Nano crystal drug particles which inhibit nausea for patients who have chemotherapy. Other drugs can be found on <http://www.nanotechproject.org/inventories/medicine/apps/>.

Other research is about Nanopores; these are holes created in membranes which are one to one hundred nanometres in size. These are being used to investigate DNA; this is done by inserting proteins that form these pores, into liquids such as membranes made of lipids. Using an electric current the DNA can then be extracted.

Another development is using nanotechnology to transport medicine, light, heat to precise cells which could be cancerous. This could be done by the attraction of the nanoparticles to these cells; this makes the treatment precise. An example is transport of chemotherapy drugs to cells.

Innovations being developed are nanoshells: these absorb heat from infrared light; this would then treat cancerous cells. See figure 1. A type of nanoshells is gold nanoshells which may treat cancer. These particular nanoshells are silicon covered in gold.

Another development is that medicine that is injected may be taken orally. This is possible because the medicine is in a nanoparticle- this aids transport through the body.

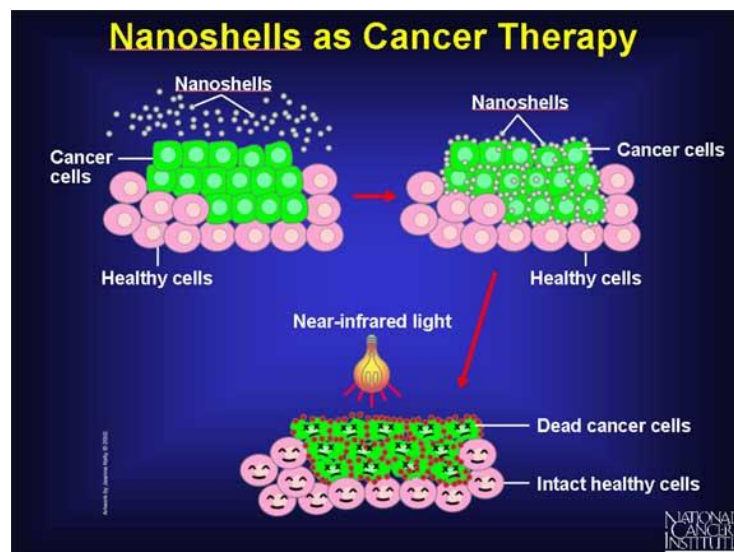


Figure 1

Things are happening to develop this for different medicine. This has so far developed to testing of patients in order to treat diseases of fungus by using cochleate which is a nanoparticle. Results of this drug's patient testing, first trial, can be found on this can be found by checking the website <http://www.understandingnano.com/clinical-study-bioral-Amphotericin-B.html> this was announced by Biodelivery Sciences International.

Nanotechnology is important; for example, using nanotechnology specific cancerous cells can be destroyed. This is done by providing medicine, light or heat- this precision is very good for making sure that other cells are not damaged. Another benefit is that faster diagnosis can be made.

An advantage for the oral medicine which could replace injections is that fewer resources need to be used because less medicine would need to be required for a nanoparticle. This is good for saving resources and there would be less global shortages of resources. Another advantage is that many drugs could be given. Other benefits for medicine are: precise treatments at the cellular level can be performed.

Another benefit of nanotechnology for medicine is that the nanoshells which are being developed could treat cancer patients without destroying the surrounding cells.

However, I believe that there are limited uses of nanotechnology in medicine and that the scope for its uses and techniques can be developed.

### DISCUSSION

At the moment developments are being made by using nanotechnology for scaffolding in nerve regeneration. If nanotechnology can be used to help regenerate nerves, this can be used to help other cells join to form tissues. This can help restore damaged cells because of an accident or damage by burns when the dermis has been destroyed; therefore, using skin grafting can be replaced. This could also help other cells regenerate which do not normally regenerate such as brain and heart cells. This can be used by doctors when tissue damage is being caused when the person has myocardial infarction.

Another future development is that Nano crystal particles can be used to treat nausea as well as other symptoms such as vomiting; this can be used to treat side effects from other treatments other than chemotherapy. A treatment called blood transfusions (which can be used for preventing stroke in sickle cell anaemia patients or blood loss caused by surgery and accidents) can cause allergic reactions which can lead to nausea. The Nano crystal particles can be used if this symptom is caused. Therefore, this idea can be applied for many treatments and diseases.

Rather than using nanoparticles to transport light, heat or medicine to certain cancerous cells radioactive isotopes can be transported. The radiation emitted could destroy cancerous cells. Alpha radiation could be used because the radiation would not spread because this radiation stops a few centimetres in air. Another benefit is that if specific cells are targeted the tumour that has spread can be targeted this could prevent ill health and cells that are not cancerous will not die. If cancerous cells are destroyed by radioactive isotopes, nanotechnology surgery will not be needed and the patient would be treated faster. Another benefit is that chemotherapy will not be needed

This same method can be used, but a further development is that the nanoparticles can be consumed orally rather than being injected. A future development is that medicines can be stored in nanoparticles and a specific dose depending on how much the patient needs can be given. This is especially useful for diabetics who need to inject insulin into their body to control their blood sugar levels because the insulin can be consumed orally.

A future development for the Nanopores is that these can be used to analyse the DNA in other living organisms; therefore, the organisms can be transported to sequence the organisms' genome. This can help know the genetics of diseases and who has the diseases. This could also be used for somatic therapy in order to insert DNA into the nuclear pores by the proteins which form pores. This will help the cells to replace faulty genes with new genes using this vector or, instead of inserting the genes into the cell the proteins could transport these vectors to the cells. This could be used for stem cell transplant therapies where the bone marrow needs to be replaced in order to produce normal red blood cells for

sickle cell anaemia patients. Another development for Nanopores is that holes can be created in some chlorine channels of epithelium cells. This can allow chlorine to go out of the cells so that water can also be drawn out. This will mean that sufferers of cystic fibrosis will not have sticky mucus because the mucus contains water and, the symptoms which result from the genetic disorder will not be expressed.

The type of nanoshells (gold) can be merged with some radioactive isotopes which can emit alpha radiation (this can stop by a few centimetres of air therefore will not penetrate into other cells and would target only a small area). This radiation can be used to destroy cancerous cells.

Another development for the drugs which can be taken orally is that many of these can be sold commercially to countries where there is a crisis; this will help make sure that the countries resources do not run out. These nanoparticles can also be made for children because injections can be painful. This can be done by placing some of the nanoparticles under the tongue where substances are dissolved faster. These can be given to people with phobias of injections.

### CONCLUSION

My ideas are that, as nanoparticles are being used to help nerves cells, other cells can connect to form tissues. This can replace skin grafting. Where the tissue has been destroyed the skin may not generate; in this case the nanoparticle can act as glue in skin grafting. Another idea is Nano Crystal Particles can treat vomiting and nausea; this can treat side effects of treatments such as blood transfusions. Some religious groups may reject blood transfusions; however, this can be used for other treatments such as chemotherapy.

Another method is using nanoparticles to transport radioactive isotopes to destroy cancerous cells- this method targets specific cancerous cells. This can be done by using gold Nanoshells which is silicon covered in gold. The radiation may destroy non-cancerous cells when the particles are being transported around the body. This can be prevented by releasing only when the isotope reaches the cancerous cells. This is the reason why alpha radiation is beneficial because if the radiation can be stopped by a something thin as paper, if the encasing is made by thick enough nanoparticles the radiation cannot be emitted to non-cancerous cells. Another development is that medicine can be stored in nanoparticles; diabetics can use this to have insulin rather than being injected. This is not good if a certain dose has to be given to patients; however, it can be measured depending on how much medicine the patient needs by the engineer (who can do the role of the pharmacist).

Nanopores can be developed using proteins to analyse DNA in other organisms. Another use is somatic therapy for this therapy vectors which carry the good genes can be transported and these can be inserted into the holes created. This can revolutionise bone marrow transplants. These proteins which form pores can form pores in chlorine channels of epithelium cells in people suffering from cystic fibrosis. These channels are always closed in

people who suffer from this disease; therefore, by forming the pores the chlorine can be passed out of the cells as well as water. The water would prevent the mucus lining the epithelium cells from becoming sticky; therefore, the symptoms caused by sticky mucus will not be present. In a person who does not have cystic fibrosis the chlorine channels open and close; however, in people who have cystic fibrosis if the pores are made using nanotechnology, the pores will always be open. A concern is that the chlorine will always pass out of cells and therefore even the water will be continuously drawn out of the cells. This will cause the person's cells to dehydrate faster. This can be overcome by consuming a lot of water in order to prevent dehydration. However, the pores will be very small because nanotechnology is being used therefore not a lot of water would be drawn out of the cells and the cells do not have the potential to severely dehydrate.

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