

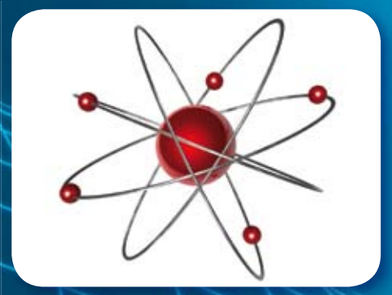
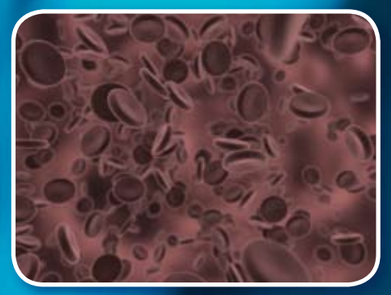

INNOVATION IN NANOTECHNOLOGY IS HELPING TO ADDRESS SOUTH AFRICAN HEALTH CHALLENGES

NANOTECHNOLOGY
PUBLIC ENGAGEMENT

In 2009, it was estimated that 5.7 million South Africans were living with HIV/AIDS and 9.2 million with TB (tuberculosis). These are staggering statistics and a cause for the major focus of government to address these diseases. Nanomedicine is an emerging field of medicine that involves the application of nanotechnology for the diagnosis, treatment and prevention of disease. It promises to have a big impact on the management of diseases such as HIV and TB.

One of the six key focus areas recognised in the National Nanotechnology Strategy (NNS), launched in 2005 by the Department of Science and Technology (DST), is health. The aim of the NNS is to coordinate nano research and development around the six key focus areas, and includes support for long-term nanoscience research, and the development of people and facilities relating to the field.

Nanotechnology has been hailed as the "leading technology of the 21st century". It is an enabling technology, recognised as an important tool for industrial development and as a means to improve the lives of ordinary people. Nanotechnology has enriched and in some cases altered our fundamental understanding of the material world. Its impact will be far-reaching and is set to affect most fields including health and medicine, energy, information technology, material and manufacturing, the environment, transportation, national security and space exploration.

Nanotechnology is the act of manipulating material at very tiny (nano) scales, essentially at the level of atoms and molecules. At these small sizes, the normal rules of physics and chemistry no longer apply and materials often display unique and surprising properties. In the field of health, nanotechnology is being used in:

- **Diagnostics:** Nanotechnology promises quick, early and accurate detection of diseases such as malaria, cholera, HIV/AIDS and even cancer. Portable, but highly sensitive point-of-care test kits are under development by scientists at Mintek which will offer all the diagnostic functions of a medical laboratory. Depending on how they are designed and the intended application, the hand-held kits could be used to test for viruses, bacteria or hormones. Thus they will be able to test – simply and quickly – for infectious diseases such as malaria, cholera, HIV/AIDS and other sexually-transmitted infections, and even cancer. Also known as the "lab-on-a-chip" because of their ability to emulate the services of a complete medical laboratory, these inexpensive, hand-held diagnostic kits can pick up the presence of several pathogens at once and could be used for wide-ranging screening in remote clinics. According to Robert Tshikudo, head of nanotechnology at Mintek, research on using the kits for infectious diseases is in the "final stages" and the ultimate goal is to make the kits available to government hospitals and clinics to reach those who need it.
- **Biomedical Imaging:** Nanotechnology applications are in development that will radically improve medical imaging techniques. For example, gold and silver nanoparticles have optical properties which make them extremely effective as contrast agents. Quantum dots which are brighter than organic dyes and need only one light source for excitation, when used in conjunction with magnetic resonance imaging, can produce exceptional images of tumour sites.
- **Therapeutics:**
  - **Targeted Drug Delivery Systems:** Nanostructures can be used to recognise diseased cells and to deliver drugs to the affected areas to combat cancerous tumours, for example, without harming healthy cells. In obesity, nanoparticles can target and inhibit the growth of fat deposits.
  - **Slow-release drug therapy:** Research shows that nano-sized biodegradable polymer capsules containing drugs for tuberculosis treatment are effectively taken up by the body's cells. The effect is a slower release of the drug into the body and a reduction in the frequency with which TB patients need to take their medication. In countries where drugs are not readily available and compliance is low, the technology holds great potential for increased drug compliance and a reduced chance of the development of drug resistance. Scientists at CSIR are working on this. The same concept has application in delivery of drugs for other diseases such as HIV/AIDS and malaria.
- **Photothermal and Hypothermal Destruction of Cancer:** Some nanoparticles, such as gold, possess therapeutic properties based on their magnetic wavelength or optical properties. They absorb light and heat up the surrounding area, killing the cancer cells.

In both diagnosis and treatment, nanotechnology holds the key to revolutionise health care, particularly in developing countries where access to health care is still a challenge for millions of people living in remote areas.

Some drawbacks of nanotechnology may exist. There are concerns that the same properties (size, shape, reactivity, etc.) that make nanoparticles so useful could also make them harmful to the environment and toxic to humans, for example, if they accumulate in drinking water supplies and the food chain. These concerns are exacerbated by the current poor understanding of the fate and behaviour of nanoparticles in humans and the environment. Risk assessment research is crucial for establishing the potential impacts of nanoparticles upon human health and the environment: the technology's benefits must be balanced against any unintended consequences. This is a massive challenge, since it is very difficult to monitor the possible impact of the huge volume of diverse nanoparticles being produced and used in different products and applications. Although there are currently no nanotechnology-specific regulations in South Africa due to the relative infancy of this emerging technology, the government, through the DST, is funding a research platform to investigate the environmental, safety and health aspects of nanotechnology.

The Nanotechnology Public Engagement Programme (NPEP) is an initiative funded by the Department of Science and Technology (DST) and implemented by the South African Agency for Science and Technology Advancement (SAASTA), a business unit of the National Research Foundation (NRF). Launched in early 2008, the NPEP aims to promote credible, fact-based understanding of nanotechnology through awareness, dialogue and education to enable informed decision making on nanotechnology innovations to improve the quality of life.

The objectives of the Nanotechnology Public Engagement Programme are to:

- Create awareness around nanotechnology;
- Educate the public on, and enhance their understanding of nanotechnology;
- Enable and stimulate meaningful public debate around nanotechnology;
- Stimulate interest in nanotechnology and nanoscience as a career in order to ensure long term capacity building in the field; and
- Get industry involved in the development of nanotechnology and take the lead in nanotechnology innovation.

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NRF National Research Foundation | SAASTA South African Agency for Science and Technology Advancement

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