

# From Wearing Nanotechnology To Treating Patients To Nanoinformatics – We Are Just Beginning

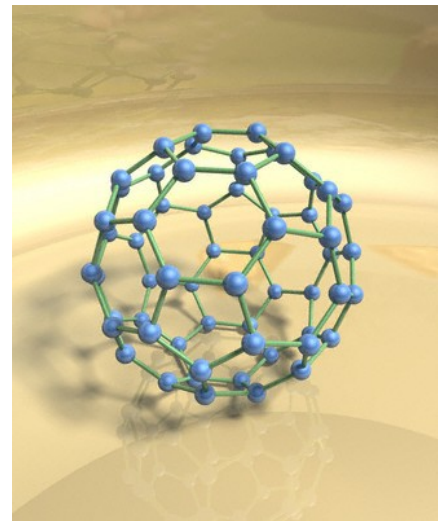
by....

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I read a terrific article by Staggers, McCasky, Brazelton and Kennedy (2008) about nanotechnology. They really made me think about this new frontier we have been exploring. In their conclusions, they state “The potential benefit of these devices is tremendous because nanomaterials bridge the health sciences and engineering in novel and provocative ways. The implications of this technology are diverse, impacting consumers, clinicians and the practice of informatics” (p. 273). Those words really made me reflect on informatics in relation to this new nano-enhanced world.



Well of course, we have an informatics term for this new phenomenon: nanoinformatics. This is a term that is beginning to be used to refer to the

development of effective mechanisms for collecting, sharing, visualizing and analyzing information relevant to the nanoscale science and engineering community. It also involves the utilization of information and communication technologies that help to launch and support efficient communities of practice. Nanoinformatics is necessary for comparative

characterization of nanomaterials, for design and use of nanodevices and nanosystems, for instrumentation development and manufacturing processes” (Niemann, 2007, p. 2)

Perhaps I got a bit ahead of myself.... Let’s take a very brief stroll through the world of nanotechnology, we will not even scratch the surface but I hope it piques your interest as the Stagers et al article did mine! This should give you the basics to begin to comprehend the possibilities of nanoinformatics.

What is nanotechnology? Crowe (n.d.) describes how definitions vary among experts.

Two of the experts who presented to the Council spent considerable time explaining what nanotechnology is. As is often the case in this burgeoning field, though, they emphasized two distinct notions of the technology: one described nanotechnology as the art or the process of making very small materials; the other claimed it is the very small artificial materials themselves. While different, each of these definitions captures an important aspect of what constitutes any technology, whether it is biotechnology, nuclear technology, information technology, or nanotechnology. In each of these cases, the technology is both the process of creating a product and the product that is made; one notion of the technology always implies the other. As such, even though the two speakers emphasized different things, their accounts are insightful, and together offer a solid foundation for a more comprehensive definition (§ 3).

It is both a science and an art of creating minuscule (very tiny) things.

Breazeale (2009) maintains a Web site called *nanularity*. What is nanularity? Breazeale coined the term to mean "All things change at the scale of the very small, but while their differences become different, their ability to become one becomes possible. To describe that possibility, no, destiny"(§ 2) in 2006. The site’s mission is “To build hope & optimism, one atom at a time” (§ 1) and it was designed to increase “awareness and understanding of nanoscience, nanotechnology and the concept of “Singularity”” (§ 1).

What does that mean to you as a consumer? Guess what -- you might be wearing nanotechnology right now.

Eddie Bauer introduced Nano-Tex® khakis that resist wrinkles and stains and claimed to be the first brand to use it in 2002 (Bauer, n.d.). This patented nano-enhanced cotton has become a clothing staple since it is smooth and crisp right from the dryer.

Greenfieldboyce (2006) asserts that the Woodrow Wilson International Center for Scholars has a “Web site with a searchable list of 212 commercially available nano-products. Thirty-one of those products are cosmetics” (¶ 1). There is a question raised as to the safety of using nano-enhanced products especially when these highly engineered nanostructures can penetrate our skin. What is the potential risk from them entering and interacting with our cells, blood, tissues, organs or immune system?

Illuminato (n.d.) and Friends of the Earth warn

Sun worshippers beware. While slathering up with sunscreens to block dangerous ultra-violet (UV) rays you may be exposing yourself to a new danger. Sunscreen manufacturers are adding nanoparticles to sunscreens to make sun-blocking ingredients like titanium dioxide and zinc oxide rub on clear instead of white. These nanoparticles are being added without appropriate labeling or reliable safety information. To cut through the confusion Friends of the Earth asked more than 120 sunscreen manufacturers to describe their companies policies regarding nanotechnology and whether their products contain nanoparticles. Only nine manufacturers said they were selling products that are nanoparticle free (p. 3).

Not only are our personal lives being invaded but also our professional lives are being impacted. What are the benefits and risks to us and our patients?

According to EnviroSystems, Incorporated (2006), they have developed a nano-enhanced disinfectant, EcoTru.

Conventional disinfectants must be dissolved in a solvent such as water or alcohol and made to flood – in effect "drown" – the host organism with a toxic chemical. This method of infection control requires a tradeoff. To ensure microorganisms are killed, the

toxic chemical must be present at levels that create health and contamination risks. EcoTru's nanoemulsion formulation works very differently. Nanospheres of oil droplets are suspended in water to create a nanoemulsion requiring only miniscule amounts of EcoTru's active ingredient, PCMX Nanosphere penetration. The nanospheres carry surface charges that efficiently penetrate the surface charges on microorganisms' membranes, much like breaking through an electric fence (¶ 1).

White Swan Uniforms (2008) "has incorporated nanotechnology to protect nurses' uniforms from unsightly stains. Nanotechnology means the "control of matter on an atomic or molecular scale." They have engineered a fabric that will repel all water and oil based stains. Liquids will simply bead up and wipe off" (¶ 3).

We are seeing nanotechnology creeping up all over the healthcare arena. From products we wear and use to diagnostics to enhancing targeted drug delivery to new medical devices to new wound care techniques to the forefront of the anticancer arsenal and beyond.

UC Davis (2008) researchers searched for a molecular treatment to target glioblastomas. A glioblastoma is a common, destructive and aggressive type of brain tumor in adults. Its ill-defined borders and invasion into adjacent tissues makes it difficult to surgically remove.

Therefore, they wanted

a molecule that could be injected into a patient's bloodstream and deliver high concentrations of medication or radionuclides directly to brain tumor cells while sparing normal tissues. Through their study, they identified a molecule — called LXY1 — that binds with high specificity to a particular cell-surface protein called alpha-3 integrin, which is overexpressed on cancer cells (¶ 4).

Chu (2006) reports that "A nano-sized drug capsule designed to seek-and-destroy malignant cells shows signs of being able to significantly shrink ovarian cancer tumors" (¶ 1).

We have all heard about magnet therapies but the University of Sheffield (2008) researchers have brought it down to the nano level with "A revolutionary cancer treatment using microscopic magnets to enable 'armed' human cells to target tumours" (¶ 1). Their research

shows “That inserting these nanomagnets into cells carrying genes to fight tumours, results in many more cells successfully reaching and invading malignant tumours” (¶ 2).

Cooking spices that have been found helpful in the treatment of disease can also be nano-enhanced. Johns Hopkins University (2007) has been experimenting with

Curcumin, an element found in the cooking spice turmeric has long been known to have positive effects against certain types of cancer. Effective treatments based on curcumin however have been limited due to its poor dissolving capabilities in water based substances, leading to low absorption rates when ingested. Researchers affiliated with the Institute for NanoBioTechnology at Johns Hopkins University report to have overcome this problem by encapsulating free curcumin with a polymeric nanoparticle, creating nanocurcumin (¶ 1).

Curcumin has also been found helpful with Alzheimer's and cystic fibrosis, therefore, more research should be done on nanocurcumin for these diseases as well as cancers.

Fayerman (2008) describes the anti-cancer smart bomb weapon developed by Scientists at the B.C. Cancer Agency. It is “not unlike a cruise missile, which is meant to hit targets with precision. It's been tested in mice and they say it's now ready for testing in humans” (¶ 2). The scientists “are calling their drug Irinophore C; its compounds are originally derived from a somewhat stubby tree called Camptotheca (or happy tree), which was found 40 years ago to have anti-cancer properties that were eventually extracted and synthesized” (¶ 3). She explains that

The nanoscale technology aspect of the system relates to the fact that the fat molecules are so microscopically tiny (one-fifth the size of a red blood cell), which allows the drug to be infused into patients' veins and then travel to cancer cells where it kills them and also disrupts the vascular system that feeds the growth of tumours (¶ 11).

Now that we have briefly discussed the nanotech invasion, what about the risks from the proliferation of nano-enhancements?

Subcommittee on Nanoscale Science, Engineering, and Technology, Committee on Technology, National Science and Technology Council. (2007) Strategic Plan indicated in “Goal 4: Support responsible development of nanotechnology. The NNI aims to maximize the benefits of nanotechnology and at the same time to develop an understanding of potential risks and to develop the means to manage them” (p. 9). They are committed to “formulation of research strategies that accelerate progress towards understanding the risks and benefits of nanotechnology and that lead to practices that protect human health and safety as well as the environment” (p. 42).

Maynard (2007) asserts that nanotechnology will continue to evolve and “By 2014 an estimated \$2.6 trillion in manufactured goods around the world.... If current projections are right, nanotechnology has the potential to have an impact on nearly every industry and virtually every aspect of our lives” (¶ 3). However, how do we make sure that it is safe? Maynard describes several concerns over our perspectives of safety in relation to the newness of nanotechnology and our lack of experience with its implementation.

Nanotechnology is also shaking up our understanding of what makes something harmful. At the nanometer scale (about 50,000 times smaller than the width of a human hair), matter behaves in unusual ways: weak materials become strong, inert materials become active, and benign materials become harmful. In the same way that iron can be made into products as different as skillets and swords, the usefulness or harmfulness of nanotechnology products depends on how they are crafted at the nanometer scale. As a result, we can no longer rely on conventional ways of managing risk that are based on the raw materials alone (¶ 4).

Think about the role of nurses in understanding the benefits and risks of this new frontier on ourselves, our patients, healthcare delivery system, environment, society and its effects on nursing informatics. While you reflect on nanoinformatics, let me leave you with this futuristic vision that is becoming reality.

ScienceMode (2009) describes the biological materials and nano-sized real-life structures that might take a fantastic voyage in your body to eliminate faulty proteins or even kill cancer cells

with nano-enhanced drug therapies. The major benefit of this Nano-GPS System is that it will target specific cells and leave the healthy cells unharmed. Just imagine....

Ever since the 1966 Hollywood movie, doctors have imagined a real-life Fantastic Voyage — a medical vehicle shrunk small enough to “submarine” in and fix faulty cells in the body. Thanks to new research by Tel Aviv University scientists, that reality may be only three years away (¶ 1).

Made from biological materials, the real-life medical submarine’s Fantastic Voyage won’t have enough room for Raquel Welch, but the nano-sized structure will be big enough to deliver the payload: effective drugs to kill cancer cells and eradicate faulty proteins (¶ 3).

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