

## **The Bright Path Ahead for Workplace Safety and Nanomedicine**

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### **Redefining the Stakeholders for Workplace Safety**

Nanotechnology's revolution for the global economy can also revolutionize public health, especially occupational health, return-to-work rehabilitation, and the delivery of workplace health services.

Scientists and governments agree that the application of nanotechnology to commerce poses important potential risks to human health and the environment, but the risks are unknown. Examples of high-level respected reports that express this concern include: the Swiss Federation (Precautionary Matrix 2008),<sup>1</sup> the Royal Commission on Environmental Pollution (UK 2008), the German Governmental science commission, public testimony sought by the U.S. National Institute for Occupational Safety and Health (NIOSH, Feb 2011), the Organisation for Economic Co-operation and Development (OECD) working group (since 2007), the World Health Organization (WHO) working group (in process of formation), as well as the World Trade Organization (WTO), several industrial groups, and various non-governmental organizations. Yet, qualitative data to protect exposed people and the greater ecological system that surrounds the human environment lags behind industrial use, research and application of nanotechnology to consumer products: Nanotechnology is expected to represent about three trillion dollars of U.S. GDP by 2015.

The sheer economic importance of nanotechnology will change several antiquated systems regarding industrial processes, scientific understanding, and categorization of chemical informatics, and ultimately, the healthcare delivery systems that must use or correct the end

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<sup>1</sup> Swiss National Science Foundation, "Opportunities and Risks of Nanomaterials;" Implementation Plan of the National Research Programme NRP 64 Berne, 6 October 2009, Royal Commission and Swiss Federal Office of Public Health (FOPH) and Federal Office for the Environment (FOEN), "Guidelines on the Precautionary Matrix for Synthetic Nanomaterials," Version 1.0 Berne 2008.

<http://www.bag.admin.ch/themen/chemikalien/00228/00510/05626/index.html?lang=en>

<https://www.epl.suva.ch/webshop/4D/4D212E53C9BB06F0E10080000A630358.pdf> Aufgrund der aktuellen Datenlage können folgende Richtwerte formuliert werden: Kohlenstoffnanoröhrchen und -fasern (Länge über 5 µm, Durchmesser weniger als 3 µm, Länge - zu Durchmesser - Verhältnis von über 3:1): 0.01 Fasern/ml; dieser Wert entspricht dem Grenzwert für lungengängige Asbestfasern.

products of these changes anyway. Therefore, nanomedicine's arrival in commerce provides an unprecedented excellent opportunity to change society for the better, especially benefiting aging and disabled populations.<sup>2</sup>

Nanomedicine will require society to rethink ancient notions that are the building blocks of social constructs regarding the nature of disease and its treatment, and the prejudices encountered by people who suffer from illness, as it forces collective rethinking about early diagnosis and prophylaxis of diseases. Therefore, an unprecedented opportunity exists to benefit from both the nanotechnology revolution and the revolutionary social change that recognizes individual human potential under international laws preventing discrimination against people with disabilities at the same time. Miraculous developments that sound like science fiction to those people who eagerly anticipate these medical products, combined with the emerging social system for implementing rights of people with disabilities will reshape civil society—permanently.

### How Patients Will Benefit from Nanomedicine

*“Everyone has a disability. Everyone has a gift. Your job is to find the gift and remove the obstacles of disability.”* Sylvia Feelus Levy 1974 (8)

The present state of the art makes their promises sound more like ancient science fiction rather than scientific fact. Nanomedicine is expected to change the shape of future diagnosis and treatment of circulatory diseases (such as myocardial infarction and stroke), some forms of cancer, and even inflammatory diseases because highly sensitive diagnostics, based on nanotechnology have the potential to detect small metabolic changes, thus offering information about disease progress at an unprecedentedly early stage. For example, improved analysis of minute amounts of blood in the laboratory or at the bedside, combined with molecular imaging technologies based on nanoscience, are expected to detect and precisely localize disease processes like cancer. Nanotech sensors may allow improved monitoring of patients in critical conditions in intensive care units. Therapies targeting only diseased organs and cells allow more efficient therapies, using nanometer size devices to repair damaged tissue.<sup>3</sup>

Nanomedicine's novel approach to diagnosis at the molecular level offers the prospect of detecting and locating diseases, such as arteriosclerosis, at an early stage, already applying disease models, e.g., with transgenic mice. If this is confirmed in patients, there is a possibility that severe complications, such as stroke or myocardial infarction, may be avoided by means of prophylactic treatment of people at risk to reduce the occurrence of these expensive and life-defining events. Some researchers predict that nanomedicine may eradicate arteriosclerosis! One characteristic of nanomedicine is targeted use of very small quantities of substance both for diagnosis and for therapy. Miniaturization of diagnostic equipment can also reduce the amount of sampling materials. Industry leaders predict that nanomedicine will allow prevention and early disease detection/management, more precise diagnosis, and more effective therapies that will reduce costly hospitalisation, improve recovery, and enable some

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<sup>2</sup> See: Ilise L Feitshans, 2012. “Nanomedicine's revolution for Public health policy and ethics: Bringing Health to Work for People With Disabilities (PWD),” In: Bawa, R., G. Audette, I. and Rubinstein, eds. *Clinical Nanomedicine—From Bench to Bedside*, Pan Stanford Series in Nanomedicine, Volume 1. Singapore: Pan Stanford Publishing.

<sup>3</sup> Patrick Hunziker, CSO of the European Foundation for Clinical Nanomedicine, Nanomedicine: The Use of Nano-Scale Science for the Benefit of the Patient.

patients with previously untreatable or incurable illness to return to productive work, with a good quality of life.

Key public health policy questions to explore regarding nanomedicine include, but are not limited to:

1. Impact on access to high-quality care
2. Rethinking the distribution of public healthcare and delivery of health services
3. Rethinking the role of public health compared to private insurance
4. Rethinking the role of key illnesses and injuries in the global disease burden
5. Rethinking the societal image of *healthy* people and *disabled* people in society, as presymptomatic testing, diagnosis, and treatment becomes a reality
6. Rethinking notions of informed consent, as presymptomatic testing, diagnosis and treatment using nanomedicine becomes a reality
7. Rethinking the obligations of insurers and individuals regarding the acceptance of new treatments, as presymptomatic testing, diagnosis and treatment using nanomedicine becomes commonplace
8. Rethinking the role of patients and healthcare consumers when presymptomatic testing, diagnosis, and treatment becomes a reality
9. Changing paradigms for patient choices and "informed consent" in light of "personalized medicine," which applies nanotechnology techniques to pre-existing genetic and proteomic information about the individual patient
10. Discussion of the role of rehabilitation as a source of return to gainful work among aging populations that might not have considered working without the benefits of nanomedicine, a "revolving door" approach to long-term disability care and chronic illness treatment
11. Discussion of workplace exposures among healthcare workers and the responsibility of all parties concerned to develop methods for effective prevention
12. Enhanced public health registration and surveillance of exposed worker populations, in light of the larger exposure burden in all society
13. Clarification of the role of different exposure sources; workplace, home and ambient environment
14. In order to fully embrace the benefits of these new technologies, the role of public health in civil society must be re-examined in light of nanomedicine.

*Against a backdrop of pre-existing social change regarding the rights, nature, and social behaviors surrounding health and disability, nanomedicine will change the rules of the game of disability treatment, definition under law for insurance, and long-term prognosis for rehabilitation. Two key groups who had previously been excluded from the workforce will soon therefore swim in the mainstream of commerce, thanks to changes in the law and changes in diagnosis and treatment via nanomedicine. The revolution for commerce from nanotechnology, and the revolutionary social progress regarding the rights of people with disabilities, will converge to create a new employable workforce within the aging, disabled population.*

*Employers! Get ready for the new working population!*

## Shifting Paradigm of Legal Protections for the Disabled

*“Rights are not mere gifts or favors motivated by love or pity for which gratitude is the sole fitting response. A right is something that can be demanded or insisted upon without embarrassment or shame”<sup>4</sup>*

There was a time in world history when it was legal to segregate people with disabilities, which allowed gifts to be viewed as the polar extreme from disability, but the U.S. Congress, the United Nations Convention on the Prevention of Discrimination Against Persons With Disabilities (UN PWD, 2006) and hundreds of smaller legislative bodies have written new protections for workplace admission, promotion, and safety of people with disabilities,<sup>5</sup> with the stroke of the legislative pen. For millions of people in the U.S., the revolution came in July 1990 when the first President Bush signed into law the Americans with Disabilities Act (ADA), opening the floodgates for a host of state and local human relations laws prohibiting discrimination representing the end of that demarcation. This law also became the model for the international legislation by the UN. Around the world, laws now require equal opportunity, which means allowing the gifts of those with disabilities to be more apparent, and the disabilities of the gifted to gain greater acceptance; law has erased the fine line that, once upon a time, allowed legal justification for separating people based on disability or illness (see Exhibit 1).

Disability poses profound challenges to the workings and conceptual underpinnings of the apparatus for protecting individuals under international human rights laws.<sup>6</sup> Every individual in society may be ill, recuperate, and regain health or lose health again many times in their lifetime. So the population, to be considered “disabled,” will change across time, even for people with long-term conditions that are disabling; no person lives an entire lifetime devoid of illness, infirmity or physical disability or impediments to their quality of life from genetic conditions or the accidents of nature, daily modern life or war.<sup>7</sup> Disability is therefore a universal, ubiquitous, and pervasive facet of the human condition: Universality is a fundamental cornerstone of all human rights’ norms, so disability protections, including the freedom from prejudice that harms the implementation of civil rights for persons with disabilities, would seem natural, if not positively codified, under human rights norms. But this is not the case.

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<sup>4</sup> Henry Shue. “Basic Rights: Subsistence, Affluence and U.S. Foreign Policy.” p 58-59, citing Feinberg, who was citing Wesley Hohfeld, *Fundamental Legal Conceptions*, New Haven: Yale University Press 1923. It is useful to recall too that when this text was first published, women in the U.S. had obtained suffrage only four years before. It is easy to imagine some very dignified, strident women demanding their right to vote in Hohfeld’s then-recent experiences.

<sup>5</sup> United Nations, Standard Rules on the Equalization of Opportunities for Persons with Disabilities, Gen. Assembly Res. A/RES/48/96 (Dec. 20, 1993) (available at <<http://www.un.org/esa/socdev/enable/dissre00.htm>>; United Nations, Ad Hoc Committee on a Comprehensive and Integral International Convention on the Rights and Dignity of Persons With Disabilities, Gen. Assembly Res. 56/168 [P 1] (Dec. 2002) (available at <http://www.ohchr.org/english/issues/disability/convention.htm> (accessed Apr. 1, 2005)), UN GAOR, 56th Sess. Agenda Item 119(b), UN Doc A/RES/56/168 (2002). Revised August 2006, Ad Hoc Committee on a Comprehensive and Integral International Convention on the Protection and Promotion of the Rights and Dignity of Persons with Disabilities, Eighth session, New York, 1425 August 2006, DRAFT CONVENTION ON THE RIGHTS OF PERSONS WITH DISABILITIES and the Draft Optional Protocol to the International Convention on the Rights of Persons with Disabilities.

<sup>6</sup> Ilise L. Feitshans “Speakers Corner: Embracing the University.” Invited submission to *Journal of Epidemiology and Community Health*

<sup>7</sup> Ilise Feitshans, "Law and Health: A Global Perspective on Workplace Protection" Society of Medical Jurisprudence, New York City, April 10 1995; Columbia University Seminar on Death and Dying: "Preventing Death in the Workplace," Columbia University Faculty House, April 12, 1995. Those presentations form the underpinnings of Chapter 23, “Occupational Health as a Human Right” In *ILO Encyclopaedia of Occupational Health and Safety*. (Jeanne Stellman, Ed.) Fourth Edition, International Labour Office, Geneva Switzerland (1997).

## EXAMPLE OF LEGISLATIVE CHANGE

**IT WAS OK TO FIRE PEOPLE WHO ARE SICK**

Taking the legislative pen in hand-



**The next day it is ILLEGAL not to hire them!**

- Americans With Disabilities Act (ADA), following the Individuals With Disabilities Education Act (IDEA), and a host of state and local human relations laws prohibiting discrimination  
law now requires equal opportunity !

### **Exhibit 1. Legislative Change Affecting Discrimination Against Disabled**

Paradoxically, disability presents the inherent challenge of understanding, accepting and allowing society to benefit from the most individualized of all individual rights.<sup>8</sup> Disability, although universal in its likely incidence in the lifespan of any given human being, also challenges the operationalization of a fundamental tenet of equality: that every person is the same and consequently, equal rights for all people—men, women, and children (as protected in separate international conventions) have equal rights and should be treated the same. The problems of disability among humans therefore compel the international system to squarely and candidly confront the unique nature of individual differences that cannot be replicated, which make each individual a human with their own set of memories, gifts, limits and experiences. Everyone is different yet everyone must have the opportunities to be treated the same. These issues will come to the fore in occupational safety and health law and the best practices of occupational medicine practice in the next thirty years in a manner that is unprecedented under U.S. and international laws. Specifically, the implementation of laws promoting the rights of people with disabilities have not only expanded the definition of disability and the concomitant obligations of employers to create opportunities for them, such laws consistently and emphatically state that cause of injury does not matter. This was a mini-revolution in the workplace when the notion that a worker could not be expelled because of an on-the-job injury or a pre-existing injury or even a “substantial impairment of one or more major life activities” that did not arise out of employment, in the late twentieth century. But that was just the beginning.

Now for the first time, there exists a new cohort—an entire generation of people with identified disabilities who would have been living in institutions a generation or two ago. These young people, raised and educated with a wider range of opportunities than institutionalized living, thanks to the laws preventing discrimination based on disability, will approach the workforce for the very first time en masse. The field of occupational and

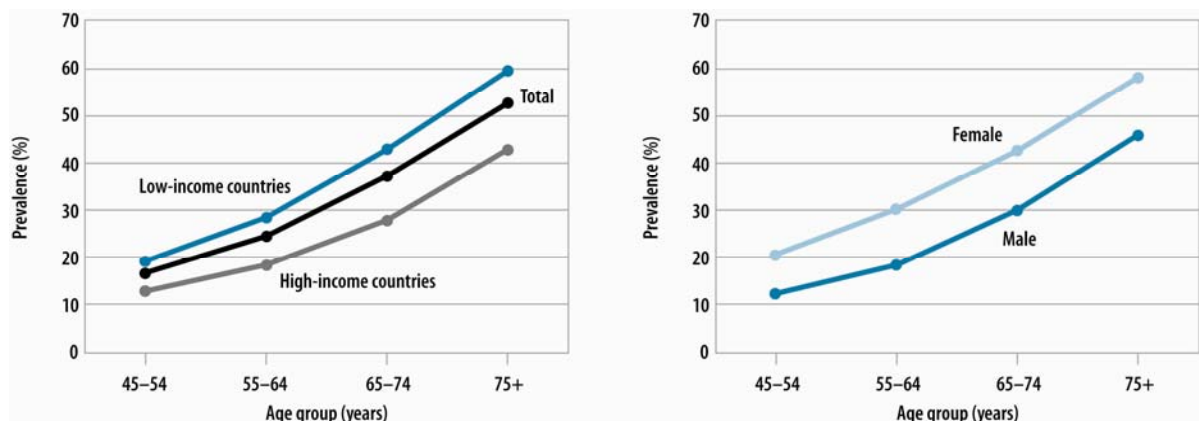
<sup>8</sup> On November 1, 2006, this paper was presented at the Columbia University Human Rights Seminar invited paper speaker series, “Protections for Neurodiversity and Physical Disabilities Under International Human Rights Law.”

environmental epidemiology must pause to consider the implications of this important social change on a mass scale for the future of epidemiological studies for the new generation. The most pressing challenges involve the integration of a new generation of disabled workers, protected by law, into the cultural matrix of occupational health and safety—a field that rarely had the opportunity to work with people after the onset of disability until recent changes in national statutory protections for people with disabilities, and also the development of the UN Draft Protocol on Rights for People With Disabilities. This problem presents the greatest challenge for the new generation of epidemiology and the occupational, environmental, and public health sciences. It is an exciting opportunity to bring together the disciplines of the health sciences, policymaking, and law. It also is a time for innovative thinking and proactive discussion of existing best practices in corporate compliance, as well as labor standards under employment law, in order to operationalize the goals of laws preventing discrimination based on disability.

## Nanotechnology and the Rehabilitation of Aging and Disabled

Nanotechnology, nanomedicine and nuclear energy applications of nanotechnology not only bring substantial social benefits but also introduce potentially catastrophic hazards. More importantly, the social transformations precipitated by the application of nanotechnology will cause society to redefine key long-standing concepts, such as, but not limited to: "stakeholder access to information," "availability of emerging technology for use and for decisionmaking," "health," and "disability," thereby universally enhancing the quality of life. Key areas of nanomedicine research have a disproportionately high impact on the health of aging populations:

- cancer research
- Alzheimers
- Parkinsons
- bone regeneration



**Exhibit 2. Scope of the aging population of people with disabilities (PWD) who may be patients or consumers of nanomedicine** (Source: World report on Disability, World Health organization (WHO June 2011))

Implementation of laws promoting the rights of people with disabilities have not only expanded the definition of disability, and the concomitant obligations of employers to create opportunities for them, such laws consistently and emphatically state that cause of injury does not matter. In the late 20<sup>th</sup> century, there was a mini-revolution in the workplace when the concept was born that a worker could not be expelled because of an on-the-job injury, a pre-

existing injury, or even a "substantial impairment of one or more major life activities" that did not arise out of employment. Now, for the first time, there exists a new cohort—an entire generation of people with identified disabilities who would have been living in institutions a generation or two ago. These young professionals, who were raised and educated with a wider range of opportunities than institutionalized living, thanks to laws preventing discrimination based on disability, will approach the workforce for the very first time en masse. For a generation raised with special education as a right, and taught to advocate for their rights perhaps before they could fully read or write, the impact of the first wave of disabled youth into the mainstream workforce will have four ramifications for science and health services.

National and local laws prohibiting discrimination based on disability, and the UN Convention of 2006 that complements them, typically also protect people who are otherwise considered *healthy* from discrimination if another person or institution has harmed them because of a mistaken belief that the person is disabled or if the illness or disease is *not manifest*. Such terms will take on a whole new meaning in a generation when treatments may be required or commonplace, using medicines that depend upon nanotechnology. According to the chart in Exhibit 2, above, from the World Health Organization (WHO) “World Report on Disability” (June 2011), the largest single demographic variable for the global burden of disease is aging. According to this chart, depending on income, disability will impact between forty per cent and sixty per cent of the aging population:

1. The new workforce that is implicitly different compared to the totally “able-bodied” workforce of the older generation, which had erroneously excluded opportunities for people with learning disabilities, visual processing issues or auditory processing impairments, needs new strategies for training regarding compliance and prevention. *CDs of “books on tape” and multi-sensory format training materials will be needed in order to ensure the safe and healthful employment of people with disabilities throughout our workforce.*
2. The rightful presence of an identified disabled population within the workforce will change the nature of many job descriptions, because only the "essential functions" of the job will be necessary. Jobs will then be custom-tailored to accommodate deficits and to maximize individual productivity. *This holds important implications for traditional areas of occupational health sciences, such as prevention through job design, rethinking the traditional tools for risk assessment, and questioning the methods of job hazard analysis.*
3. This demographic change will require refinement, if not necessarily a different methodology to tease apart the cause and effect between workplace or environmental exposure and health outcomes. *Co-morbidity must be taken into account in a new dimension when measuring the effectiveness of health protection programming.*
4. Co-morbidity may also be exacerbated or diminished under certain working conditions and therefore, a new methodology will need to be developed to take into account these variables when measuring overall worker health status and the effectiveness of occupational health programs. *The presence of a large population of people with disabilities will, therefore, require the development of different data sets compared to existing data, with new working assumptions to protect the special needs segment of the working population.*

Consequently, long-standing assumptions regarding safety and health and the format of preventive programs will be challenged by the presence of an entire new cohort of people with disabilities, who are empowered by refined tools of self-advocacy under law and the technology, to operationalize their rights to safe and healthful employment through access to reasonable accommodations. These issues will come to the fore in occupational safety and

health law<sup>9</sup> and the best practices of occupational medicine practice in the next thirty years in a manner that is unprecedented under U.S.<sup>10</sup> and international laws. The international system governing labor and the conditions of work needs a new tool to deal with this unprecedented set of issues.

### Genetic Information as a Precursor for Requiring Treatment Using Nanomedicines

Genetics poses hard questions. Genetics is hard to understand but it is important. Genetics is a cross-cutting issue, but it has particular importance in specific industries, in agriculture, in the global scientific community, and for small business that will look perhaps a tad more closely at healthcare and insurance costs compared to larger scale employers. The greatest challenge is in the area of definition of terms. Specifically, the greatest challenge will be defining basic areas of social protection that will ensure access and fair use to nanomedicine for all. Lastly, the convergence of new genetic technologies, as applied through path-breaking nanotechnology methods, may redefine society's collective understanding of *safety, health, or disability*, and may challenge both the fundamental fairness and scientific underpinning of existing standards. The role of genotype, genetic propensities, and the very nature of the interaction between these genetic players and the work environment ultimately plays a role, if not controls, individual ability to perform daily tasks, including work. The emerging field of so-called "personalized medicine" relies very heavily on genetic information as applied to the available treatments using nanomedicine. The role of genetic testing, monitoring, and research provokes a discourse fraught with painful social questions about eugenics, social engineering, stigma, genetic discrimination, and allocation of healthcare costs. Such concerns must be addressed without bankrupting employers, or saddling them with undue liability, but also without creating an underclass of people who lose their employability due to stigma, discrimination, potential future injury based on genetic propensity, insurance costs or potential liability from genetic factors, combined with personally harmful workplace exposures that were previous unexplained or misunderstood.

In sum, "The protection and promotion of the health and welfare of its citizens is considered to be one of the most important functions of the modern state." It is not surprising, therefore, that, throughout history, precautionary principles of science have been embedded in many laws and public health policies, both within specific nations and across the borders of international laws. Taken together, the dynamic component of social changes from the combined application of nanotechnology to personal medicine and the new revolutionary rights under disability laws may soon require redesigning the workplace. It is possible, therefore, with forethought, to create opportunities that maximize *the benefits of both the social change in disability laws and the economic and scientific changes to society through nanotechnology*. Nanotechnology provides the perfect opportunity to correct long-standing system problems in the access, public awareness and delivery of services associated with public health. If applied with forethought when rethinking these vital social values, two sets of benefits can be realized by civilization at the same time; not as competing interests, but as one invaluable social change.

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<sup>9</sup> See: Ilise L. Feitshans, Testimony before NORA NIOSH Town Hall, Houston, Texas, January 2006, "The Challenge Facing Digital-2000 WHS In NORA NIOSH WRT: Bringing Health to Work While Promoting Rights of People With Disabilities."

<sup>10</sup> In 1990, the Americans with Disabilities Act (ADA) in the U.S. opened new vistas for employment of people with disabilities by requiring "reasonable accommodation" for any employee who has "significant impairment of one or more major life activities." Because the ADA is a so-called "technology-forcing" statute, the employer's requirement to provide such accommodations cannot be limited due to expense to the employer, and may require rewriting the job description so that the required tasks are limited to "essential functions" that can be performed by a given individual.. See "Designing and Effective OSHA Compliance Program" (Westlaw.com) for detailed discussion of case law.



*Nanomedicine confronts civil society with new challenges and exceptional opportunities for advancing human progress, when answering these millennial questions!*

## **Conclusion**

Soon, if not already, every worker and employer and health professional in this audience will need a nanomedicine planning strategy in order to maximize their company's benefits from shifting social paradigms regarding health and disability. The arrival of nanotechnology, praised and heralded as a welcome revolution reshaping industry, also provides the perfect opportunity for rethinking rehabilitation design, followed by drafting of special laws that will deliberately strike the workplace safety balance to protect and promote:

- The new workforce, which that is implicitly different compared to the totally “able-bodied” workforce of the older generation
- The rightful presence of an identified disabled population within the workforce, with attendant changes in nature of many job descriptions
- Taking into account co-morbidity, which may also be exacerbated or diminished in the workplace

This demographic change will require refinement, if not necessarily a different methodology to separate the cause and effect between workplace or environmental exposure and health outcomes, and may result in the advent of a revolving-door approach to nursing home care, chronic care and the rehabilitative treatment of long-term illness and injuries, previously without hope, but miraculously overcome thanks to nanomedicines.