Nanotechnology Regulation in Armed Conflict

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Before any means or method of warfare is deployed in armed conflict, the legality of its use should be confirmed by legal review, at the stage of "study, development, acquisition or adoption." This review should ensure that new means and methods of warfare comply with international law. International law is comprised of treaties, international custom, and general principles of law [1].

This legal review ensures that all new or modified means or methods of warfare comply with general legal principles, for example, the requirement that they are not "of a nature to cause superfluous injury [2]." Examples of treaty-based obligations include prohibitions on poisons [3], or biological [4] or chemical weapons [5], just to name a few.

"Nano" is a prefix meaning "a billionth" (a factor of 10^{-9} of a meter) derived from the Greek νᾶνος, meaning, "dwarf". By way of illustration, a nano-sized object is to an apple, what an apple is to the size of the earth. Or to give another example, one nanometer particle could fit approximately 80 000 time across a human hair [6].

Nano-sized particles have always existed, and are not new. Nanoparticles occur naturally in the environment, such as in volcanic ash, sea spray, clay, and milk, and in man-made substances, such as depleted uranium. It is at the nanoscale where the human nervous system exists, the pigment molecules in the eye allow sight, and the gap that facilitates the flow of neurotransmitters within the brain takes place. What is new is the ability to deliberately create, manipulate, or modify nanoparticles to specific scientific ends, particularly within the human body. Just to give one example, the same science that will enhance the function of the human heart may be used to stop it from functioning by nanoparticles invisible to the human eye [7]. Another example is of the potential applications of optogenetics, undertaken with the assistance of increasingly precise nanolasers, that are being developed to help to restore sight [8]. The same technology could be relied upon cause blindness.

There is enormous interest from governments and industry in harnessing the benefits of nano-scale research [9].An extraordinary amount is being invested by both the military and civilian sectors. The U.S. 2015 Federal budget alone provided more than $1.5 billion [10] for a U.S Government research and development initiatives involving nanotechnology-related activities of 20 departments and independent agencies involving academia, government, and industry laboratories across the United States.

Given that many biological functions occur at the nanoscale (a DNA molecule is approximately 3 nm in width) [11], increased knowledge in nano-scale science will inevitably reflect a greater understanding of our cells and their potential enhancement or modification [12]. Much biotechnology today involves nano-sized science. Coupled with synthetic biology, the ability to manipulate and enhance human functions, both for civilian and military purposes, will only increase in the coming years.

Altman, an expert scientist on the potential military uses of nano-sized materials, predicts that:

> New agents may remove previous operational difficulties of biological warfare. Advanced capabilities may include the use of genetic markers to target an ethnic group or even a specific individual. New options for nuclear weapons might include NT [nanotech]-based materials extraction and processing, weapons production, and perhaps new types of nuclear weapons. NT manufacturing based on self-replication could produce conventional weapons in such large quantities that they acquire the character of mass-destruction weapons [13].

In addition to Altman's concerns, there is an issue of dual use research of concern (also called DURC). DURC, where a particular capability might be beneficial, or also could potentially be damaging and destructive – for example with mimicking pathogens – has particular resonance with nanotechnology. The question of how to manage dual-purpose research raises many potential challenges for those involved. One example of potential dual use is that of nanoparticles being used to penetrate the blood-brain barrier of mice without the use of any drugs, for the sole purpose of targeting brain cancer cells. This type of progress has obvious potentially malevolent and undetectable applications.Nano-sized materials are impossible to see with the naked eye, are difficult to contain, and are easy to aerosolize, particularly with current technology [14].
The author is in agreement with Boothby that "[n]anotechnology is most unlikely to be the subject, as such, of a legal review under the law of armed conflict," but that a weapon system or means of warfare including nanotechnology will increasingly require review [15].
In conclusion, new ways of reviewing nano-enhancement must be considered to ensure compliance with the existing law of armed conflict. This will require an individualized approach to different technologies. Questions still remain as to when and how reviews should take place to ensure compliance with International Law.

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References

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[3] *Protocol for the Prohibition of the Use of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare*, opened for signature 17 June 1925, 94 LNTS 65 (entered into force 8 February 1928).
[4] *Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction*, opened for signature 10 April 1972, 1015 UNTS 163 (entered into force 26 March 1975).
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Footnote:

[1]"The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;b. international custom, as evidence of a general practice accepted as law; c. the general principles of law recognized Hi civilized nations;and d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law" [1].