Human Research Ethics Considerations: A Precursor for Ethically Implementing Advanced Technologies into NATO Military Operations

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ABSTRACT

It is well recognized that future NATO military forces will rely extensively on advanced technologies to enhance their mission essential tasks. Of particular interest are those technologies that are referred to collectively as Human Performance Enhancement (HPE) technologies. As addressed in this paper, HPE refers to the augmentation of physiological, psychological, perceptual, physical, and operational abilities through technological means to enhance performance capability in military missions. HPE technologies include (but are not limited to) those employing drug and gene doping, stem cell involvement, cognitive psychology and neuroscience, medical nanotechnology, adaptive information technology, and non-lethal human effects. All of these have the potential for improving military operations, but there are legitimate concerns that applying these technologies may exceed the limits of human capability and/or infringe on the rights of individuals. This paper forewords the case that ethically such concerns should first be addressed at the research level. In that regard, HPE research ethics considerations are given in terms of areas having the most impact in addressing the issue, viz.: (1) prior animal and other pre-trial testing, (2) informed consent, (3) privacy and confidentiality, and (4) monitoring research.

The paper also touches on multi-jurisdictional HPE research where several NATO countries conduct a collaborative program of research. In particular, the paper points to a study undertaken by The Technical Cooperation Program (TTCP) [DOC-HUM-2-2008, 26 November 2008] that identifies and compares some of the essential components required in conducting such collaborative research.

1.0 INTRODUCTION

> ***"In each action we must look beyond the action at our past, present and future state, and at others whom it affects, and see the relations of all these things. And then we shall be very cautious."***
>
> *Blaise Pascal, French Mathematician and Philosopher, 1623-1662*

The insertion of projected, advanced, human performance enhancement (HPE) technologies into NATO military operations offers the promise of significantly aiding physical, physiological, cognitive and mental endurance, and resilience to injury of military personnel. At the same time, there is the legitimate concern that applying these technologies may exceed the limits of human capability and/or infringe on the rights of individuals. It is the responsibility of NATO defence research organizations to see to it that institutional human research ethics considerations are applied uniformly to assure that there are appropriate constraints on the military use of HPE technologies.

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14. ABSTRACT

It is well recognized that future NATO military forces will rely extensively on advanced technologies to enhance their mission essential tasks. Of particular interest are those technologies that are referred to collectively as Human Performance Enhancement (HPE) technologies. As addressed in this paper, HPE refers to the augmentation of physiological, psychological, perceptual, physical, and operational abilities through technological means to enhance performance capability in military missions. HPE technologies include (but are not limited to) those employing drug and gene doping, stem cell involvement, cognitive psychology and neuroscience, medical nanotechnology, adaptive information technology, and non-lethal human effects. All of these have the potential for improving military operations, but there are legitimate concerns that applying these technologies may exceed the limits of human capability and/or infringe on the rights of individuals. This paper forewords the case that ethically such concerns should first be addressed at the research level. In that regard, HPE research ethics considerations are given in terms of areas having the most impact in addressing the issue, viz.: (1) prior animal and other pre-trial testing, (2) informed consent, (3) privacy and confidentiality, and (4) monitoring research.

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Above all else, the overriding goal of human research ethics considerations is the protection of the individual research participant (subject) from harm. Furthermore, it goes without comment that the human participant is the most valuable resource that the research investigator has in conducting human science, so, for that alone, it is imperative that all steps be taken to assure his/her safety. The introduction of advanced technologies into military operations that stretch the limits of physical, physiological and cognitive capability to capacity calls for the need to carefully take into account the human research ethics considerations laid down by precedent organizations or activities to protect the research participant.

Modern human research ethics considerations stem from the outgrowth of concerns regarding the egregious Nazi experiments during World War II in hypothermia, extremes in body warming, high altitude, infectious diseases and other induced traumatic injuries on human captives. These concerns led to the Nuremberg Code with its embodiment of the protection of human research participants through informed consent and the right to withdraw at any time from an experiment [1]. The follow-on Helsinki Declaration, developed by the World Medical Association and widely used in all NATO countries, stipulates that the research obligations of the researcher to the research participant are paramount. In particular, it calls for the need of an institutional peer review body, which is independent of the research investigator, that reviews research protocols regarding the adequacy of experimental design and procedures in protecting human participants. (This document has been updated several times to keep up with scientific advances and the consequent ethical concerns that that entails [2].)

In the United States, two sets of observational experiments, the Tuskegee syphilis study on poor Afro-American men and the Willowbrook hepatitis study on institutionalized children [3], had a profound impact in moving that country toward a set of formalized standards in research ethics. In the former study, syphilitic men were observed over several decades, without benefit of an available treatment, to determine the course of the disease. In the latter study, mentally challenged children were deliberately infected with the hepatitis virus in a failed attempt to find a cure for this disease. Both studies breached research participants' rights, and both considered science above all else for personal and institutional gain. In particular, the fallout from these two studies led to the Belmont Report with its focus on the respect for persons, beneficence (risk of harm versus benefit) and justice as applied to human participant research [4].

With the acceptance of these declarations by the biomedical community, the concept of informed consent with its emphasis on physical risk mitigation has become well established and a fundamental principle of medical and physiological research. However, the application of such informed consent is less straightforward when conducting military research with HPE technologies that impact on genetic, cognitive, mental, and even moral, legal and social issues. For instance, in clinical trials of novel pharmacological agents, there are also issues surrounding equipoise (is one treatment better than another), multi subject participation, the need for independent monitors and the discrepancies in extrapolating animal findings to human evaluation among other concerns. Similarly, in the burgeoning field of medical nanotechnology, there are new concerns regarding safety and toxicity in such applications as disease diagnosis and drug delivery. Compounding all of this is the increased public scrutiny and potential legal ramifications that clinical trials, nanotechnology research and other HPE research must endure.

Much of behavioural and social science research now relies extensively on qualitative analysis to understand human behaviour. Paramount here is the risks associated with a lack of adequate privacy protection and the safeguarding of information (confidentiality). Approaches used to gain this understanding may include the use of paper- or Internet-based questionnaires, image recordings, focus groups, participant observation, penetrating interviews, etc., all leading to a new set of consent, privacy and confidentiality concerns. Issues raised include the following: deception by withholding information to participants; the use of oral- or

unsigned- instead of written-consent or even the waiver of consent in special circumstances; the capacity for stigmatization and the potential for consequential third-party effects if de-identification of data is faulty. (For example, these may occur when conducting research in NATO coalition operations where cultural differences may be a factor, in probing the unequal soldier/commander power structure, and from the residual emotional effects in achieving answers to penetrating questions in trust, leadership, and battlefield stress on the individual, group, family, community, etc.) A reasoned response is sometimes the only option available to such situations.

2.0 HUMAN PERFORMANCE ENHANCEMENT (HPE) TECHNOLOGIES

HPE in the context of this paper refers to the augmentation of physiological, psychological, perceptual, physical, and operational abilities through technological means to enhance performance capability in military missions. Enhancing human performance capability is multi faceted in terms of domain and application, and, with the view to attaining it, research is being conducted using a variety of technological means [5,6,7]. Such research endeavours requiring research ethics scrutiny would include (but are not limited to):

- Managing fatigue in sustained operations through special training regimens using novel devices and nutrition, and proper sleep - rest strategies that employ the use of stimulants and sedatives, such as modafinil, high dose caffeine, melatonin and advanced pharmacological agents that reverse sleep-deprived cognitive performance, and other counter fatigue techniques;
- Improving operator situational awareness through laser-assisted vision enhancement by means of corrective eye surgery and implanted intraocular rings and lenses;
- Clinical trials of novel immune boosters employing gene expression procedures including stem cell involvement for both healing (on returning ill troops) and mission enhancement (with operational troops);
- Augmenting human cognition and communication, both individually and collectively, by exploiting developments in cognitive psychology (computer training with reinforcement feedback, adaptive intelligent interfaces, etc.) and multiple sensory communication (visual, auditory, etc.) utilizing breakthroughs from the convergence of nanotechnology, neuroscience technology, information technology, and cognitive science;
- Enhancing physical capability and endurance through the use of intelligent on-demand exoskeletons, enhanced blood oxygen delivery through gene and drug doping, special drugs and dietary supplements to increase muscle strength, etc.;
- Enhancing behavioural ability through exploration with novel qualitative analytical techniques from cognitive science regarding moral and ethical dilemmas during deployment, coping with battlefield stress, handling post combat stress including post traumatic stress syndrome, inferring adversarial intent, assessing trust and leadership, etc.;
- Augmenting crowd control and reducing battlefield injury through the selective use of non-lethal weapons.

Consistent with the observations of Brown and Tvaryanas regarding the introduction of projected HPE technologies into military operations [8], many of these examples (and others) impact on healthy individuals where the benefit is hypothetical, the benefit is hard to define quantitatively as is the risk, a sufficient number of participants is unlikely to be recruited to adequately assess risk of harm, long term health effects are inconclusive therefore requiring lifelong surveillance of participants, and they raise other societal, ethical and legal concerns that need to be handled with great caution to avoid unintended deleterious consequences.

The TGN1412 clinical drug trial at Northwick Park Hospital, London in March 2006 is informative in this regard and can stand as a benchmark for what can go wrong in HPE research. Six volunteers were given small doses of TGN1412, a monoclonal antibody genetically engineered from a mouse antibody to be immunologically accepted in humans. Almost immediately on drug administration intravenously, all volunteers became seriously ill with multiple organ failures: all survived, but there are concerns regarding the long-term risk to health because of seriously compromised immune system problems [9].

3.0 HUMAN RESEARCH ETHICS CONSIDERATIONS

3.1 Prior Animal and Other Pre-Trial Testing

The TGN1412 drug trial demonstrates the fact that pre-trial animal testing does not necessarily assure drug compatibility to humans. It also points to the importance of the proper use of surrogates to applicable HPE experimentation before participant testing commences. Experts have confirmed that the benign effects of a rodent monoclonal antibody tested on monkeys and then genetically altered does not necessarily extrapolate to human compatibility, particularly since it is known that TGN1412 is species specific and capable of causing a violent reaction. Common practice would indicate that the drug should have been given to only one volunteer first, and at low concentrations under the skin rather than intravenously, to assess the reaction [9]. Moreover, there is no evidence that the necessary, *in vitro*, blood cell compatibility testing between animal and human blood was determined pre trial [10]. As demonstrated by this example, the need for caution and proper planning cannot be overemphasized when conducting HPE research.

The use of pre-trial surrogates in research involving medical nanotechnology is also informative in this regard. To begin with, there are serious concerns regarding systemic toxicity resulting from the insertion of nanoparticulates (particles having dimensions much less than one micron) into the human body for HPE or disease control [11,12,13]. For example, the issue of biocompatibility and toxicity of administered nanoparticulates is raised in regard to their size, shape and composition because it is recognized that currently there is insufficient knowledge and data regarding physicochemical characterization, long-term persistence in the human body, and many other concerns. Characterization will also depend on whether the nanoparticulates are of biological or non-biological material. Persistence in body tissues may well require the lifelong monitoring of health status [8]. Experts agree that nanomaterials need to be evaluated for their risk on a case-by-case basis according to their intended use. *In vitro* assays and human cell culture studies in conjunction with some *in vivo* experimentation have been recommended for screening purposes for hazard assessment. *In vivo* animal studies for assessing short- and long-term health effects are vital and appropriate although there are concerns that specific toxicities may not be detectable in the conventional animal model. New equipment and methodologies may need to be developed to characterize and monitor nanoscale behaviour in human tissues before trials commence. Again, the need to progress slowly and cautiously is of utmost importance before conducting human trials.

Some salient work conducted on surrogates in terms of pre-trial testing for human effects to non-lethal weapons is also illustrative [14]. Human effects in this regard are the physical, physiological and psychological responses produced by non-lethal weapons on personnel, i.e., from those weapons having a low probability of causing permanent harm. Foremost here are the valuable data derived from cadavers and anesthetized animals to purported less-than-lethal blunt trauma on internal organs from which projected dose - response information may be extrapolated to the human condition. Animal research will also serve to demonstrate long term sensory, behavioural and other human health defects resulting from a variety of non-lethal weapons testing. In accordance with the work of the automotive industry in crash system testing, there is a role in developing human-like, sensor fitted manikins and representative mathematical models to mimic

injury criteria to selective non-lethal weapon impacts [15]. The effects, short- and long-term, of non-lethal trauma resulting from contact sports injuries and those sustained by combatants in theatre will also prove valuable in compiling a database of human effects to non-lethal weapons usage.

In the three examples cited above, and in other pre-trial HPE research, the judicious use of animal models is critical in assessing risk of harm to humans. It is important to emphasise, however, that all animal research must be conducted under stringent, institutional, animal care committee oversight. Of course, animal data should only be collected when there are no other means to ethically obtain pertinent information.

3.2 Informed Consent

Of cardinal importance to human research ethics considerations involving HPE technologies is the concept of informed consent. Informed consent, regardless of the type of research conducted and on whom, is inviolable in terms of respect at all costs for the human dignity of the participant [16]. Moreover, it is the responsibility of the investigative team to see to it that all aspects of informed consent are properly presented. This implies that those who act as participants in human research do so voluntarily, i.e., no coercion must be applied on them and self-withdrawal from the study may take place at any time. It also implies that they fully understand the purpose of the research; that protocols are written at a level that is comprehensible to them; and, to the extent possible, that they clearly understand all of the real and unforeseen risks of harm and potential benefits. With HPE research, where both the benefit and the risk may be hard to assess, a comprehensive informed consent takes on an added importance. If such research is approved by the institutional ethics review board, ongoing consultation by the research team will be required with the option being there of withdrawal by the participants at any time for whatever reason as the research progresses. Of course, it also means that the investigative team must stop the experiments if it finds even the slightest evidence for the possibility of harm. Since visual images enhance information retention, the suggestion put forward for written informed consent to be augmented in HPE research by video- or computer-aided consent to illuminate the benefits and risk of harm pictorially merits attention [17].

Informed consent that is not written is an option that may be invoked under special circumstances in HPE research [16]; in particular, when it comes to some qualitative research that behavioural and cognitive scientists undertake. Options may include unsigned consent, oral consent and even the waiver of consent depending on the type of study undertaken. However, there are strict conditions under which these options may be used:

- The research must involves no more than minimal risk, i.e., the risk of harm is no greater than that encountered by the participant in his/her daily life;
- The research will not likely adversely affect the well-being and welfare of the participant;
- The research could not be conducted practically otherwise; and
- As appropriate, a full debriefing following participation will be constituted.

The case for unsigned consent has been addressed in research ethics guidelines compiled by Defence Research and Development Canada [18], and are relevant to this paper, viz.: “In some research projects, obtaining a signed consent is very difficult and perhaps impossible. This may be the case where the nature of the data to be collected is sensitive, context dependent, and/or involves responses about people other than the subject (respondent) (e.g., reactions to stress or opinions about leadership). This may also be the case where the data are to be collected from a vast number of subjects by methods such as interviews or questionnaires delivered by mail or over the phone or the Internet. When collecting sensitive data is the issue, then having to sign a

consent form might prevent individuals from participating because of fear that the confidentiality of their data will be jeopardized in spite of any safeguards to confidentiality that the investigators might promise. When the number of subjects or the method of data collection is the issue, then obtaining a signed consent simply may not be logistically feasible." Unsigned consent may be instituted through a covering letter or password-protected electronic form for Internet users that indicates, in addition to the requisite components for written consent, that by returning the accompanying data collection survey, consent has been given to use the collected data.

3.3 Privacy and Confidentiality

Respect for privacy (individual rights) and confidentiality (safeguarding information) in human science research is widely recognized as being an international cornerstone to conducting ethical research. The topic is now drawing increasing attention as the need for behavioural and cognitive qualitative research into such HPE issues as trust, leadership, adversarial intent, contentious decision making, battlefield stress, etc. becomes more prevalent. Privacy and confidentiality issues arise in a number of ways in human science research that, if not addressed appropriately, may cause harm or stigmatization to the participant if an individual identity is known [16,19]. For example, if applicable and not protected properly, sensitive information exposed during research could relate to an individual's:

- Sexual practices and orientation,
- Past history of substance abuse and/or physical abuse,
- Past history of being abused,
- Past illegal activities,
- Current and past health status including mental state,
- Judgemental responses to issue such as leadership or unequal power structure queries, and/or
- Identifying genetic information.

Identifying information of participants may also have dire implication to family members, social contacts and/or the military community if privacy and confidentiality are breached. Genetics research that took place at Virginia Commonwealth University in the late 1990s is instructive in this regard [20]. This case concerned a female participant involved in a survey in which sensitive questions were asked regarding the health of family members. Family members objected to having their medical history form part of the project without their consent as it was felt that such information posed a threat to the collective privacy of the family members. Review by the U.S. National Institutes of Health led to the conclusion that the institutional review board should have considered whether or not family members were participants because of the nature of the information being sought. The outcome was that the institutional review board was found to be negligent in its review process resulting in the temporary suspension of human science research at the University. Though illustrating the impact on family members of such breaches, this case could equally well apply to other situations where private information on one individual impacts on others. Bodkin [20] provides useful recommendations for determining if secondary members can be considered as human participants, and, if so, has suggested that informed consent may be waived if the conditions cited above in paragraph 2 of Section 3.2 **Informed Consent** are met.

The control of identifying information regarding the re-use of data for other research purposes (secondary use) or the sharing of data by NATO countries is also relevant to this discussion [16]. The secondary use and sharing of data are extremely important as they avoid the cost of duplicating expensive trials or executing new

research endeavours (e.g., in non-lethal weapon research). Sharing also enables investigators to assemble the adequate sample sizes required to draw meaningful conclusions from the data (e.g., in a meta analysis of fatigue techniques in sustained operations).

The key to handling sensitive information whether from a participant, secondary member, secondary use data or shared data lies in the ability to remove or obscure identifying information to provide suitable protection [16]. When participant identifiers are not required (e.g., in some benign Internet surveys), then these identifiers can be removed from the data. However, technological advances in database linkages with other information mean that the re-identification of participants is a possibility. This is the case, in particular, in genetics research, where re-identification is a serious concern to investigators because the information obtained may provide damaging biological insight on ancestral shared genetics. When identifying information is required, then several steps need to be taken [21]. Firstly, to the extent possible, all participant identifiers should be removed as soon as possible and replaced with a suitable code name that can be reconstituted and linked to the data by the investigators if necessary. Then the data should be encrypted or otherwise protected by technological safeguards such as passwords, access codes, no Internet connections, etc. Physical safeguards such as using locked filing cabinets, etc. should be implemented. Limited personnel access to the information is a necessity. Only aggregate reporting should be conducted. Common sense would indicate that a proportionate approach should be implemented that dictates the extent to which participant information and data should be protected: the greater the sensitivity, the greater the need for stronger security safeguards.

3.4 Monitoring HPE Research and the Participant

As indicated earlier, research involving HPE technologies that stretch the limits of capability to capacity calls for the need for good planning and great caution in instituting a work program. In particular, this is the case in HPE research where the potential for great benefit to the military and the risk of causing great harm to the participants, during experimentation and long term, are both hard to define quantitatively. Because of this fact, it may be necessary to go beyond the recommended checks required of institutional research ethics boards in monitoring HPE research during the conduct of the work. To the extent possible, the goal should not be to limit HPE research, but to promote and facilitate the conduct of the work in ways that respects the dignity and preserves the well being of the human research participant. This implies that a suitable stepwise program of monitoring should be instituted to take into account not only the effect of the research on the participant before, during and after experimentation, but also on the conduct and safety aspects of the research program itself as it develops and progresses.

From a research ethics perspective and in line with the practice of monitoring participants before a complex HPE research experiment is approved, a “readability” test is one method for determining whether or not a research protocol is clearly written and understood. Such a test was applied by the University of Leeds, United Kingdom on members of the public using the approved protocol of the TGN1412 drug trial. The test results indicated that, given the time constraints imposed by the investigators and because of the complexity of key factors as presented, the TGN1412 participants would not have passed such a test [22]. An analogous method could be developed and instituted to screen potential participants for suitability in HPE research. Moreover, the institutional review board could play a key role in this regard too by placing a community member such as a fireman, policeman, automotive manager or clergyman on its Board to address issues of protocol readability and other practical matters.

An independent advisory body made up of subject matter experts working co-jointly with the institutional research ethics board might be an option for assessing warning signs of harm pre-trial, during the trial at critical milestones, and afterwards in specific HPE research. Having the authority to make unannounced

inspections of the research would add an additional safety perspective to this body. In an analogous way, it is noteworthy that the Joint Non-Lethal Weapons Directorate, Quantico, Virginia has established two boards to help facilitate non-lethal human effects research review, interpretation and recommendation [23]. The first of these, the Human Effects Review Board, provides the program managers with a milestone, independent assessment of health risks and recommendations for mitigating potential risks. The composition of this Board consists of senior medical officers, safety officers, legal and other Department-of-Defense representatives. The second independent board, the Human Effects Advisory Panel, consists of non-governmental, senior subject matter experts from academia, the medical community, and law enforcement. Its mandate is to review plans, provide assessment, make risk mitigation recommendations, advise on addressing technical challenges, and address bioeffects issues identified by the other Board.

4.0 MULTI-JURISDICTIONAL COOPERATIVE HPE RESEARCH

At another level, there is the multi-jurisdictional issue of ethics review when several NATO countries hosting one or more institutions conduct a collaborative program of HPE research. Each country will have its own national and legal policies on what constitutes human research and the ethical treatment of human research participants, liability in case of research-related injury, informed consent, and other data acquisition issues. Therefore, the question should be asked: will each institution in such an endeavour conduct its own ethics review, will there be multi-institutional reviews, or will another arrangement be adopted? Whatever the arrangement, HPE research ethics review must be instituted and abide by the dictates laid down by international law for protecting human participants in research. To provide insight to this issue, The Technical Cooperation Program (TTCP) has produced a document that identifies and compares some of the essential components that must be followed in conducting multi-jurisdictional collaborative military research by Australia, Canada, New Zealand, the United Kingdom and the United States [24]. Special focus is given to the different national policies for conducting human research, research liability, data collection, data sharing and use, and harmonizing informed consent documentation.

5.0 CONCLUDING REMARKS

HPE technologies offer the promise of significantly aiding human performance and safety in NATO military operations. However, there is concern that the application of HPE technologies may exceed the limits of human capability and/or violate individual rights. This paper contends that the onus to first determine that appropriate limits are placed on the military use of HPE technologies rests with the institutional ethics review boards of the different NATO defence research organizations. Taking into consideration that the role of the institutional review board is to protect the dignity and welfare of the research participant in HPE research, this paper discusses the issue from the perspective of: (1) pre-trial animal and other surrogate testing, (2) informed consent, (3) privacy and confidentiality, and (4) monitoring the research and the participants.

6.0 REFERENCES

[1] Shuster, E. (1997). *Fifty Years Later: The Significance of the Nuremberg Code.* The New England Journal of Medicine, 337:1436-1440 (November 13).

[2] World Medical Association (WMA) (1964 plus updates). *Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects.* http://www.wma.net/e/policy/b3.htm

[3] Rothman, D.J. (1982). *Were Tuskegee & Willowbrook 'Studies in Nature'?* The Hastings Centre Report, 12 (12): 5-7.

[4] The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1979, 1998 update). *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*. http://www.ohsr.od.nih.gov/guidelines/belmont.html

[5] Roco, M. C. & Bainbridge, W. S., eds. (2004). *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science.* New York: Springer. ISBN 1402012543

[6] Belland, K.M. (2003). *Aircrew Performance Cutting-Edge Technology: Emerging Human Performance Enhancement Technology Vision in Support of Operational Military Aviation Strategy.* Center for Strategy and Technology, Air War College, Air University, Maxwell Air Force Base, Alabama. Occasional Paper No. 35.

[7] Bess, M. (2008). *Icarus 2.0: A Historian's Perspective on Human Biological Enhancement.* Technology and Culture , 49 (1): 114-126.

[8] Brown, L. & Tvaryanas, A.P. (2008). *Human Performance Enhancement: Überhumans or Ethical Morass?* Air & Space Power Journal, 22(4): AFRP 10-1.

[9] Ho, M.-W. (2006). *Lessons from TGN1412.* Science in Society, No. 31 Autumn. http://www.i-sis.org.uk

[10] Cohen, A.F. & Kenter, M. (2006). *Authors' Reply* to Hanke, T. (2006) *Lessons from TGN1412.* The Lancet, 368 (9546): 1569-1570.

[11] Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) (2006). *Synthesis Report on the Public Consultation of the SCENIHR Opinion on "The Appropriateness of Existing Methodologies to Assess the Potential Risks Associated with Engineered and Adventitious Products of Nanotechnologies".* http://ec.europa.eu/health/ph_risk/documents/synth_report.pdf

[12] Department of Environmental, Food and Rural Affairs (2007). *Characterizing the Potential Risks Posed by Engineered Nanoparticles.* http://www.defra.gov.uk

[13] Michanetzis, G.P.A K., Missirlis, Y.F. & Antimisiaris, S.G. (2008). *Haemocompatability of Nanosized Drug Delivery Systems: Has it been Adequately Considered?* Journal of Biomedical Nanotechnology, 4 (3): 218-233.

[14] North Atlantic Treaty Organisation Research and Technology Organisation (NATO RTO) (2006). *The Human Effects of Non-Lethal Technologies.* RTO-TR-HFM-073. http://www.rta.nato.int

[15] North Atlantic Treaty Organisation Advisory Group for Aerospace Research & Development (NATO AGARD) (1996). *Anthropomorphic Dummies for Crash and Escape System Testing.* AGARD-AR-330. http://www.rta.nato.int

[16] Interagency Advisory Panel on Research Ethics (December 2008). *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.* Draft 2nd Edition. http://www.pre.ethics.gc.ca

[17] Henry, J., Palmer, B.W., Palinkas, L., Glorioso, D.K., Caligiuri, M.P., & Jeste, D.V. (2009). *Reformed Consent: Adapting to New Media and Research Participant Preferences.* IRB: Ethics & Human Research, 31(2): 1 – 8.

[18] Defence R&D Canada – Toronto (2003). *DRDC Guidelines for Human Subject Participation in Research Projects.* http;//www.toronto.drdc-rddc.gc.ca

[19] Canadian Institutes of Health Research (September 2005). *CIHR Best Practices for Protecting Privacy in Health Research.* http://www.cihr-irsc.gc.ca

[20] Botkin, J.R. (2001). *Protecting the Privacy of Family Members in Surveys and Pedigree Research.* JAMA, 285(2): 207 – 211.

[21] Canadian Institutes of Health Research (2002). *Secondary Use of Personal Information in Health Research: Case Studies, November 2002.* http://www.cihr-irsc.gc.ca/e/1475.html

[22] TGN1412 – "informed consent" (22 October 2008) http://pharmagossip.blogspot.com/2008/10/tgn1412-informed-consent.html

[23] Joint Non-Lethal Weapons Directorate (2009). *Non-Lethal Human Effects.* https://www.jnlwp.com

[24] The Technical Cooperation Program (26 November 2008). *A Comparison of National Policies on Research Involving Human Subjects to Facilitate Review and Approval of Collaborative Research.* DOC-HUM-2-2008. http://www.dtic.mil/ttcp/