An Analysis of the Ethical and Sociotechnical Context of Biotechnology in the Military-Industrial Complex

A Research Paper submitted to the Department of Engineering and Society

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Connor Sandall

Spring, 2025

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Joshua Earle, Department of Engineering and Society

Introduction and Methods

Following both militaristic success in World War II and an unpopular Truman presidency, General Dwight Eisenhower easily won the United States presidency in 1952 (McAuliffe, 1981; McInerny, 1981). In strong contrast (or perhaps strong agreement) with his decorated military career, Eisenhower's term in office was defined by peace and stability (Kinnard, 1977). In his 1961 farewell address, Eisenhower famously warned of the dangers of the "permanent armaments industry of vast proportions" that arose after World War II, in the looming shadow of the Cold War (Eisenhower, 1961). He coined this phenomenon the "military-industrial complex." Additionally, Eisenhower acknowledged and warned of the expanding intersection between the federal government and scientific research amid the current "technological revolution" of the last few decades (Eisenhower, 1961).

Given the current shape of capitalism in the United States over 60 years after Eisenhower left office, it is clear that the intersection of government interests and wealth with the innovative capabilities of private corporations are the key components of the military-industrial complex. However, the creation, dissemination, and use of the technologies produced by the military-industrial complex are not self-contained. I will show that a greater range of social and political factors additionally shape the military-industrial complex, and that these factors are just as important to study as the technologies themselves. A particularly relevant industrial sector to the military-industrial complex is biotechnology, which is currently undergoing rapid growth. Carlson estimates an increase in the contribution of the biotechnology industry to the total GDP of the United States from 0.004% in 1980 to 2.0% in 2012, a 500-fold increase in proportional size in only 32 years (2016). The last few decades have seen much progress in biomedical knowledge and research, with applications ranging widely from therapeutics and diagnostics to agriculture and the environment. The military in particular has long sought to promote biomedical innovations with military applications, aligning with a long-standing national security state mindset. Thus, the last few decades have also seen much maturation of biotechnology in the military-industrial complex. However, the heightened pace of development of biotechnologies hinders the creation of relevant ethical frameworks. By analyzing the ethical and sociotechnical context of biotechnology, bioethics, and the military-industrial complex, I develop a new framework synthesizing biotechnology, bioethics, and the military to understand and predict ethical concerns of the future of biotechnology in the military. Using existing bioethical principles as a foundation, I will additionally outline the principles by which the military, legislators, and the biotechnology industry must act to strive for a more bioethical future.

Brief Histories

The Rise of the Military-Industrial Complex in the United States

Though there is a consensus about the origins and the rise of the military-industrial complex in the United States, the extent to which different groups of actors drove this rise is contested amongst economic and political scholars. At its earliest, the military-industrial complex began as an attempt by the Navy to modernize its fleet in the late 19th century. For many years following the American Civil War, American lawmakers paid little attention to the Navy, leading American naval strength to lag behind those of foreign powers (Wolters, 2011). However, a push towards the production of steel warships began a trend that ultimately positioned the United States as a naval superpower once again (Baack and Ray, 1985). The Naval Advisory Board cited, among other factors, the advantages of steel as a material, the success of steel vessels created in Europe, and competitiveness with foreign navies in its 1886 report on the use of steel in the construction of the first four new steel warships in 1882 and 1883 (Naval Advisory Board, 1886). Interestingly, the Board also cites a boost to the domestic steel manufacturing industry. The United States Congress apportioned an appropriately large increase in the budget of the Navy for this modernization effort: from the fiscal year 1880 through the fiscal year 1889, the average budget was $17.2 million; from the fiscal year 1900 through the fiscal year 1909, the average budget was $94.6 million, with a peak at $125.7 million in 1909 (inflation-adjusted from 1913[1] to 2024: $4.03 billion) (The Navy Department Library, 2017). In 1905, 40% of the Naval budget was spent on the construction of new ships alone, requiring a strong relationship between the government and the businessmen (mainly of shipyards and steel manufacturing) of the time (Baack and Ray, 1985). The budget trends make it clear that this economic relationship was primarily driven by a political push for an expensive upgrade to the American military. A core tenet of the military-industrial complex moving forward became evident during this era: that even in times of relative peace, the American military should strive for preparedness and technological dominance.

The construction of the new steel navy may be the root of the military-industrial complex, with the large-scale mobilization during World War I also shaping its development (Koistinen, 1967), but the post-World War II military-industrial complex took on a very different form. In 1956, C. Wright Mills, when describing the growing conflation between the powerful actors of the American military, political, and economic environments, argued that the 1886 Supreme Court case establishing corporate personhood was the beginning of increasingly unchecked power by corporations (Mills, 1956; *Santa Clara County* v. *Southern Pacific R. Co.*,

[1] Data are less reliable before 1913, so 1913 is the earliest date on most inflation calculators. The hope is that the slight adjustment in year does not detract from the fact that there was an absurdly large increase in Naval spending in this era.

1886). Furthermore, many scholars believe that this unchecked corporate power and elevated focus on international affairs during and after World War II led to a "permanent-war economy and private-corporation economy" with economic power dominant over political and military power (Adams, 1968; Bernstein and Wilson, 2011; Brunton, 1988; Mills, 1956, p. 276). The military-industrial complex of the mid- to late-20th century was now additionally driven by the powerful industrial institutions of advanced capitalism.

One emergent property of the military-industrial complex during the Cold War era was a national security state mentality (Cox, 1998). The discovery of a new foreign threat after the 9/11 terrorist attack similarly effected a political shift in the United States towards a preemptive military hegemony (Leffler, 2005; Smith, 2015). The United States consistently spends more money on defense than the next nine countries combined, with a total of $916 billion spent in 2023 (*SIPRI Military Expenditure Database*, 2024). Military industry continues to be a key driver in this new military hegemony; several American military contractors earn a majority of their revenue from arms sales, and the total amount of money spent lobbying politicians by military contractors reached $148 million in 2024 (Cox, 2014; OpenSecrets, 2024). Eisenhower's prediction had proven undoubtedly true. A permanent armaments industry had taken root in the United States, existing as a system defined by the convolution of political power, military power, and economic power.

Bioethical Guidelines, Regulations, and Legislation

Modern medical ethics were born in the aftermath of the horrific human rights violations that took place during World War II. The numerous medical crimes committed by Nazi doctors and the subsequent Nuremberg Trials prompted the creation of the Nuremberg Code

(International Military Tribunal, 1949). The Nuremberg Code was a hallmark document in biomedical research ethics, widely viewed as the foundation upon which all future bioethical regulations and guidelines were built (Childress, 2000; Gaw, 2014; Moreno et al., 2017; Shuster, 1997). At the time, there was no such framework outlining ethical biomedical research, at least not published by any authoritative bodies, and many doctors believed that more was necessary to protect patients (Childress, 2000; Shuster, 1997). Following the Nuremberg Code was the Declaration of Helsinki, which was published in 1964 by the World Medical Association.[2] Amended seven times since then (most recently in 2024), the Declaration of Helsinki similarly outlines ethical principles for human subjects research and has been adopted as a standard for medical ethics worldwide (Ndebele, 2013; Williams, 2008).

Despite the Nuremberg Code and the Declaration of Helsinki, several instances of unethical research occurred in the United States in the following years (Beecher, 1966; Brandt, 1978). The most notable instance of this was the Tuskegee Syphilis Study. Black men in Alabama with syphilis were studied from 1932 to 1972, but were not informed to the true nature of the study and were not given treatment when penicillin became the standard of care in 1947; the Tuskegee Syphilis Study is one of the most egregious bioethical violations in United States history. The backlash following the publicization and termination of the study in 1972 prompted the passing of the National Research Act of 1974. It had become clear that an updated legal framework for bioethics in the United States was necessary (Friesen et al., 2017). In 1979, the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, established by the National Research Act, published the Belmont Report. The authors of the Belmont Report outlined three basic principles for ethical research: respect for persons,

[2] In 1946, representatives from 29 national medical associations, including the American Medical Association, met at the International Medical Conference in London. These 29 national medical associations became the founding members of the World Medical Association. (World Medical Association, 2025).

beneficence, and justice. These principles dictate that the autonomy of individuals should be protected, that the well-being of individuals should be protected, and that benefits and encumbrances of research should be fairly distributed, respectively. In 1991, the Federal Policy for the Protection of Human Subjects, also known as the 'Common Rule,' was published by the Department of Health and Human Services, essentially codifying the principles outlined in the Belmont Report. Following an update to the Common Rule in 2018, twenty federal departments and agencies, including the Department of Defense, are signatories of the Common Rule. While these principles have become canonical guidelines for human biomedical research in the United States, critics of the Belmont Report claim that the report is limited in scope and may no longer be applicable (Nagai et al., 2022; Siddiqui and Sharp, 2021), while other critics find that the regulations outlined in the Common Rule can be unnecessarily burdensome in low-risk scenarios (Friesen et al., 2017; Hudson and Collins, 2015).

Bioethical guidelines, regulations, and legislation are often reactive, not proactive, as evidenced by the numerous bioethical violations that sparked the creation of new bioethics documents. It should be a goal of organizations such as the World Medical Organization or the Department of Health and Human Services to be proactive in their approach, keeping pace with current research performed by bioethical scholars. As such, to understand what is needed to be proactive in studies of biotechnology and bioethics, an analysis of military medical ethics is required.

Modern Military Biotechnology and Bioethics

<u>The Ethics of Dual-Use Biomedical Research</u>

Strikingly, the increasing conflation of biomedical research with the military-industrial complex has led to increasing focus on the development and analysis of military medical ethics since the turn of the century (Bailey et al., 2022; Gross, 2013). Biomedical research and the subsequent creation of biomedical technologies for military applications is a complex and increasingly relevant domain of scientific research, with many open ethical and sociotechnical questions. The thick convolution of political, industrial, and military actors severely hinders the thorough answering of these questions, though that did not stop the office of the Surgeon General of the Army from such an attempt when it published a two-volume book titled *Military Medical Ethics* (Lounsbury and Bellamy, 2003). The purpose of this book was to draw in perspectives from various physicians in the Army, detailing various topics of military medical ethics with other service members as the intended audience. One chapter in particular, titled "Medical Ethics in Military Biomedical Research," is particularly insightful towards the philosophy of the Army at this time regarding the creation of biotechnology for use in combat settings (ibid., pg. 533-561). At the same time, the United States was deeply entrenched in the 'Global War on Terror' following the September 11th terrorist attacks. During this period, advanced biotechnology provided the United States with a distinct advantage over its adversaries. QuikClot, a novel hemostatic agent adopted by the U.S. military for use in Iraq, proved to be highly effective in reducing American combat fatalities over previous conflicts, demonstrating the tangible benefits of investment in biomedical technologies (Gegel et al., 2012; Malet, 2015; Rhee et al., 2008; Welch et al., 2020). The original formulation of QuikClot used zeolite in wound dressings to activate clotting factors. In pre-hospital settings, rapid and effective response to traumatic hemorrhage drastically improves survival rates, and QuikClot was a more effective hemostatic agent than anything else tested at the time (Cannon, 2018; Cap et al., 2018; Alam et al., 2003). QuikClot has also proven effective for non-military use and is commercially available (Mumtaz et al., 2023; Rhee, 2008).

In comparison to other scientific fields, engineering research is exceptionally intertwined with military research. Both engineering research and military research are typically considered applied or need-driven research (as opposed to basic research[3]) (Melson, 2003; Nieusma and Blue, 2012; Rasmussen et al., 2020). Often, civilian and military needs align; technology able to exist within both of these spaces at once is labeled dual-use. QuikClot is a prime example of a dual-use technology; another example is the EpiPen, which is built upon the technology used by soldiers to administer nerve agent antidotes (Newark, 2007; Sherkow and Zettler, 2021). It is obvious why the U.S. military would have a vested interest in the development of dual-use technologies. With a yearly budget of over 4 billion dollars, the Pentagon's Defense Advanced Research Projects Agency (DARPA) focuses on funding novel research with military applications (Reardon, 2015). Especially in the last two decades, DARPA has funded research in the health and survivability of soldiers, human enhancement, food, infectious disease, and novel bioweaponry (Bonvillian, 2018; Bickford, 2019; Malet, 2015; Rasmussen et al., 2020). Biotechnology and biomedical research, while relatively new to the scene, have squarely found their niche within the military-industrial complex. Any technology is inherently inseparable from its ethical, political, and social underpinnings (Winner, 1980); this inseparability is then responsible for the complex entanglement of political, economic, and military interests so deeply characteristic of the military-industrial complex. Maintaining a secure tether to civilian industry

[3] Basic research, also sometimes called fundamental research, is typically focused on scientific exploration and is often driven by curiosity. That being said, basic research in any given field is almost always foundational and necessary for subsequent engineering research in complementary fields.

may help promote innovation and economic growth (Gansler, 1988), but the lines between civilian and military industry are also becoming increasingly blurred (Mahfoud et al., 2018), which has lengthy implications regarding the creation of such technologies, especially technologies with potentially malevolent uses. Dual-use research is therefore a topic of concern for researchers in the biomedical sciences who may have ethical objections to the advancement of those malevolent technologies (Ashcheulova and Ambrosova, 2019; Oltmann, 2014; Resnik et al., 2011). Michael Frisina articulates this point well in his chapter in *Military Medical Ethics*:

> "The idea is that military biomedical research that is constructive, which I take to mean supports the goals and ideals of the healing tradition of medicine, is ethically legitimate. Military biomedical research that is destructive, contributing to harming or directly supporting the killing of human life, would be unethical. The ethical tension derives from trying to determine what biomedical research is constructive and what is destructive." (pg. 535)

Imagining such crossroads in biomedical research is not difficult; studies into virus function can lead to cures of certain infections, yet may also lead to the development of a viral bioweapon; the design of drug delivery systems can create more efficient therapies and toxins alike. These are rather extreme situations, and there may often be much more ambiguity muddying the morals of a situation. Additionally, how dual-use research is conducted, whether or not it should be conducted at all, and the applications of dual-use research are all open ethical questions that require an analysis of the sociotechnical context behind them to answer. Therefore, I argue that an extension of military medical ethics is required to understand and analyze the modern era of biotechnology in warfare. A *military-industrial medical ethics* framework would be able to account for the unusual circumstances of combat-oriented research without losing sight of the origin of much of the technology critical to domination by the United States in times of war.

A Military-Industrial Medical Ethics Framework

As other scholars have called for or attempted previously (Bailey et al., 2022; Gross, 2013; Have, 2023; Mehlman and Corley, 2014; Rochon, 2015), a military-industrial medical ethics framework builds upon the original three principles of the Belmont Report. Firstly, respect for persons: this principle demands that the personal autonomy of patients and subjects be upheld at all times. In practice, this most often takes on the form of informed consent in research participants. Recent work in bioethics has emphasized protecting vulnerable groups, who are unable to fully protect their interests (Aldridge, 2012; Nijhawan et al., 2013; Zarowsky et al., 2013). While who does and does not count as a vulnerable group is variable and best practices in these cases often need to be determined on a case-by-case level, there is no debate on the fact that vulnerable groups require supplemental protections as research subjects and participants. Service members in the military are undoubtedly vulnerable groups. Protections for soldiers involved in medical research do exist under the Common Rule, even existing within the same power structure as those conducting the research raises concerns about true informed consent (Brear, 2018; Gross, 2013; McManus et al., 2005). Ruha Benjamin argues for the importance of informed refusal, a corollary of informed consent, which "institutional[izes]" the ability to refuse, as opposed to simply being able to opt out (2016, pg. 984). Historically, the protections of the Common Rule have failed in many instances. Beginning in 1998, the Department of Defense implemented a mandatory anthrax vaccine despite concerns from service members. The vaccine, a product of Emergent BioSolutions Inc.[4] and thus the military-industrial complex, was still experimental at the time. Service members who refused were subjected to court martials and less-than-honorable discharges. (Katz, 2001; Pica-Branco and Hudak, 2008; Nass, 2002).

[4] Emergent BioSolutions Inc. is perhaps better known today as the distributor of Narcan, an emergency treatment for opioid overdose. Narcan has its own rich history of sociotechnical conundrums, which is far outside the scope of this work but is well covered by Fudin et al. (2019) and Kavanaugh (2022).

Considering the deep integration between all parts of the military-industrial complex, Emergent BioSolutions cannot be seen as an independent actor in this bioethical failing. To extend military medical ethics to military-industrial medical ethics, the producers, and not just the users, of any given biotechnology must be proactive in bioethical considerations.

While obviously unethical, secret experimentation done by the Army and the Central Intelligence Agency does happen. The most well-documented example of this is when the Army and CIA experimented with lysergic acid diethylamide (LSD) on unknowing and unconsenting subjects (Disbennett, 2014; Ross, 2017). A previous Supreme Court decision determined that military personnel were subject to different legal protections than civilians and were thus unable to file suits in instances of constitutional violations by superior officers (*Chappell v. Wallace*, 1983). This case was used to justify protecting the government from negligence when a service member suffered extreme long-term side effects of the secret LSD testing performed on him (*United States v. Stanley*, 1987). While the Common Rule had not been codified yet, the Nuremberg Code, the Declaration of Helsinki, and the Belmont Report were all well established at the time. Still, the Supreme Court set a precedent of legal protections for parties that had committed bioethical violations. A strengthening of the legal protections for soldiers, in such a way that it will be upheld not only by the Department of Defense but also by the biotech industry and the justice system, is necessary to maintain the principle of respect for persons under military-industrial medical ethics.

Secondly, the principle of beneficence demands that harm to patients/subjects be minimized while the benefit gained from the research is maximized. Given how biomedical military research is solely focused on developing improvements to soldier health, survivability, and combat ability, in line with military objectives, beneficence is already limited with military-medical ethics. Here, dual-use technology provides a strong avenue for increasing overall beneficence. Technologies that can improve civilian and military lives equally well maximize the benefit to be gained from biomedical research. A focus on dual-use technologies also aligns with one of the original benefits of the military-industrial complex itself: boosting civilian industrial sectors. Thus, it would be more ethical to pursue research projects with dual-use applications over research projects that only the military would benefit from. Some military medical ethics scholars fold benefit to military objectives into overall beneficence (Mehlman and Corley, 2014). However, this viewpoint is almost entirely antithetical to the original intent of bioethical frameworks; perhaps it does well to integrate ethics with the military, but that does not inherently make it ethical.

Conversely, dual-use biomedical research beginning in civilian sectors with potential military applications should be subject to the same ethical scrutiny that military biomedical research is. Methods of responsible development of dual-use technologies are often unclear, as the potential application of dual-use technologies is also sometimes unclear. Thus, individual organizations, corporations, and institutions should be able to adequately self-regulate. Institutional review boards, for example, already regulate biomedical research. As civilian and military technologies and industry continue to merge in the military-industrial complex, a greater emphasis on the ethics of potential dual-use technology is required (Ashcheulova and Ambrosova, 2021; Brandt, 1994; Cao et al., 2020).

Finally, the principle of justice demands that both the risks and benefits of biomedical research be fairly distributed. In other words, no single group of individuals should be disproportionately affected by biomedical research, either negatively or positively. In the context of military research, this may not be an easily achievable goal. In cases where the only benefit of the research goes to the military and its personnel, justice claims that the burden of the research should also be on the military and its personnel. If the research is dual-use and has both civilian and military applications, the burden of the research should be evenly distributed. In either civilian or military research alone, proper distribution of the burden of research is not a new concept and should not be difficult to implement. However, coordination between industry and the military is required to prevent the discriminatory distribution of the burden of research.

The Future of Biotechnology in the Military

The 2023 North Atlantic Treaty Organization (NATO) Science and Technology Trends Report asserts that, in relation to potential implications for NATO operations and capabilities, technology will be increasingly sourced from the commercial sector (i.e., dual-use technologies) (NATO, 2023). The report also labels biotechnology and technology related to human enhancement as emergent technologies:

> "Emerging technologies represent *creative destruction*, as originally described by the economist J. Schumpeter, and are characterised by the potential of shifting paradigms. The term emerging indicates novel scientific discoveries in the early stages of development, technologies that embody an uncertain and risky nature, and insecurity of their potential impact on military capability." (ibid., p. 57)

Modern biologically derived or centered technologies and innovations, including those that improve the body and biological functions beyond baseline performance (human enhancement), are expected to greatly displace outdated biotechnologies in the next two decades (hence the term "creative destruction"[5]). Citing the impacts of a post-information revolution world, the novelty of many areas of biotechnological research, and "physical, biological, ethical, legal, and moral constraints," NATO highlights the unique complications associated with military biomedical research (ibid., p. 64). However, nations with access to superior biotechnologies are poised to

[5] Not to be confused with destructive biomedical research, as previously described by Michael Frisina.

establish (or further maintain) military dominance (Malet, 2015). From a strategic viewpoint, the United States should expect to continue its trend of investment in biotechnology if it wishes to maintain its status as a military superpower.[6]

The rapid and sometimes unpredictable growth of the biotechnology industry limits the predictive power of the military-industrial medical ethics framework presented here. For example, the novelty of human enhancement technologies has limited the study of the bioethics of human enhancement, but one thing is clear: biological modification (physical, genetic, or otherwise) cannot be presented to soldiers as necessary for combat if respect for persons is to be maintained. Consider the case of the mandatory anthrax vaccine; even if evidence exists that such modifications will improve the survivability or combat ability of the soldier, mandating them denies the autonomy of the individual. It appears likely that specific legal restrictions will have to be written and enforced for human enhancement; the idea that specific frameworks will be necessary is not novel (Sattler et al., 2022), but legislation must be enacted proactively, lest the United States follow the trend of committing bioethical violations and then writing the rules prohibiting them after. The principles of beneficence and justice can be applied here as well. Consider two hypothetical, similar areas of human enhancement research: one being a genetic modification that slows the degradation of eyesight over time, and the other a genetic modification that improves eyesight over baseline levels. The former sees wide benefits for both civilians and military personnel, yet the latter, which would provide soldiers with a combat

[6] It would be beyond the scope of this paper to analyze in depth each modern and future biotechnology with military implications. However, per the NATO report, here I will provide a brief list of militarily-relevant areas of biotechnology: pathogen detection/identification, counter-pathologic processes for biologic agents, novel drugs, biometrics, wound care and regeneration, food and water testing, bioengineering/biomanufacturing, biomaterials, AI for biomedical research, systems biology/bioinformatics, biosensors, human enhancement through implants, brain-computer interfaces, physical enhancements, cognitive enhancements, and social enhancements. The report also offers some speculation into the potential of biotechnology in the far future, and while this verges on the realm of science fiction more than anything else, I will include some highlights here anyway: bio-databases, super soldiers (body self-repair, enhanced senses, genetic enhancement), airfields and other structures discreetly grown from bio-concrete, and remote induction of mass hysteria or hallucinations.

advantage, would be innovative but not therapeutic in civilian medicine. Thus, it would be more ethical to pursue the former area of research; the distribution of the burden of research should be distributed to both groups. Of course, human enhancement technologies are not the only biotechnologies for which beneficence and justice should be a focus; military biotechnology, especially when directly sourced from civilian sectors, should continue to promote dual-use technologies to maximize the benefits of biomedical research. It will also be important for policy-makers and medical organizations to keep a close eye on the military-industrial complex, so that they may accordingly update official bioethical legislation and guidelines.

Conclusion

It would be prudent to revisit Frisina's chapter in *Military Medical Ethics* through the lens of this military-industrial medical ethics framework. Frisinia opens his concluding remarks with the motivation for military medical ethics:

> "The ultimate mission of military medical research is to provide preventive and therapeutic products for the welfare of the soldier." (pg. 557)

This is perhaps reminiscent of the Hippocratic Oath, which predates the Belmont Report by over 23 centuries. However, Hippocrates, the authors of the Belmont Report, or even Frisina could not have predicted the form that the military-industrial complex would inhabit in the current age of warfare and biotechnology. Decades of global conflict and advanced capitalism have produced an entity that so uniquely fits in the center of political, economic, and military interests. However, by first analyzing the histories of the military-industrial complex and bioethics in the United States and then outlining a new military-industrial medical ethics framework, we can still strive to accomplish the goals laid out by the Belmont Report and understand the ethical and sociotechnical questions at hand as we move forward into a new age of integration between a rapidly developing biotechnology industry and the United States military.

References

Adams, W. (1968). The Military-Industrial Complex and the New Industrial State. *The American Economic Review*, *58*(2), 652–665.

Alam, H. B., Uy, G. B., Miller, D., Koustova, E., Hancock, T., Inocencio, R., Anderson, D., Llorente, O., & Rhee, P. (2003). Comparative Analysis of Hemostatic Agents in a Swine Model of Lethal Groin Injury: *The Journal of Trauma: Injury, Infection, and Critical Care*, *54*(6), 1077–1082. https://doi.org/10.1097/01.TA.0000068258.99048.70

Aldridge, J. (2014). Working with vulnerable groups in social research: Dilemmas by default and design. *Qualitative Research*, *14*(1), 112–130. https://doi.org/10.1177/1468794112455041

Ashcheulova, T., & Ambrosova, T. (2019). Dual-Use Technologies of Concern in Context of Biosafety (review). *Inter Collegas*, *8*(1), Article 1. https://doi.org/10.35339/ic.8.1.4-9

Baack, B., & Ray, E. (1985). The Political Economy of the Origins of the Military-Industrial Complex in the United States. *The Journal of Economic History*, *45*(2), 369–375. https://doi.org/10.1017/S0022050700034069

Bailey, Z., Mahoney, P., Miron, M., & Bricknell, M. (2022). Thematic Analysis of Military Medical Ethics Publications From 2000 to 2020—A Bibliometric Approach. *Military Medicine*, *187*(7–8), Article 7–8. https://doi.org/10.1093/milmed/usab317

Beecher, H. K. (1966). Ethics and clinical research. *Bulletin of the World Health Organization*, *79*(4), Article 4.

Benjamin, R. (2016). Informed Refusal: Toward a Justice-based Bioethics. *Science, Technology, & Human Values*, *41*(6), Article 6. https://doi.org/10.1177/0162243916656059

Bernstein, M. A., & Wilson, M. R. (2011). New Perspectives on the History of the Military–Industrial Complex. *Enterprise and Society*, *12*(1), 1–9. https://doi.org/10.1093/es/khq148

Bickford, A. (2019). “Kill-Proofing” the Soldier: Environmental Threats, Anticipation, and US Military Biomedical Armor Programs. *Current Anthropology*, *60*(S19), Article S19. https://doi.org/10.1086/700028

Bonvillian, W. B. (2018). DARPA and its ARPA-E and IARPA clones: A unique innovation organization model. *Industrial and Corporate Change*, *27*(5), 897–914. https://doi.org/10.1093/icc/dty026

Brandt, A. M. (1978). Racism and Research: The Case of the Tuskegee Syphilis Study. *The Hastings Center Report*, *8*(6), Article 6. https://doi.org/10.2307/3561468

Brear, M. (2018). Ethical Research Practice or Undue Influence? Symbolic Power in Community- and Individual-Level Informed Consent Processes in Community-Based Participatory Research in Swaziland. *Journal of Empirical Research on Human Research Ethics*, *13*(4), 311–322. https://doi.org/10.1177/1556264618761268

Brunton, B. (1991). An historical perspective on the future of the military-industrial complex. *The Social Science Journal*, *28*(1), 45–62. https://doi.org/10.1016/0362-3319(91)90043-4

Brunton, B. G. (1988). Institutional Origins of the Military-Industrial Complex. *Journal of Economic Issues*, *22*(2), 599–606. https://doi.org/10.1080/00213624.1988.11504790

Cannon, J. W. (2018). Hemorrhagic Shock. *New England Journal of Medicine*, *378*(4), Article 4. https://doi.org/10.1056/NEJMra1705649

Cao, X., Yang, X., & Zhang, L. (2020). Conversion of Dual-Use Technology: A Differential Game Analysis under the Civil-Military Integration. *Symmetry*, *12*(11), Article 11. https://doi.org/10.3390/sym12111861

Cap, A. P., Pidcoke, H. F., Spinella, P., Strandenes, G., Borgman, M. A., Schreiber, M., Holcomb, J., Tien, H. C.-N., Beckett, A. N., Doughty, H., Woolley, T., Rappold, J., Ward, K., Reade, M., Prat, N., Ausset, S., Kheirabadi, B., Benov, A., Griffin, E. P., … Stockinger, Z. (2018). Damage Control Resuscitation. *Military Medicine*, *183*(suppl_2), 36–43. https://doi.org/10.1093/milmed/usy112

Carlson, R. (2016). Estimating the biotech sector's contribution to the US economy. *Nature Biotechnology*, *34*(3), 247–255. https://doi.org/10.1038/nbt.3491

Chappell v. Wallace, 462 U.S. 296 (1983).

Childress, J. F. (2000). Nuremberg's Legacy: Some Ethical Reflections. *Perspectives in Biology and Medicine*, *43*(3), 347–361. https://doi.org/10.1353/pbm.2000.0015

Cox, R. W. (2014). The Military-Industrial Complex and US Military Spending After 9/11. *Class, Race, and Corporate Power*, *2*(2), 1–20.

Disbennett, B. M. (2014). An Analysis of CIA and Military Testing of LSD on Non-Consenting U.S. Service Members and Recovery through the VA Disability System. *Tenn. J. Race Gender & Soc. Just.*, *3*, 173.

Friesen, P., Kearns, L., Redman, B., & Caplan, A. L. (2017). Rethinking the Belmont Report? *The American Journal of Bioethics*, *17*(7), Article 7. https://doi.org/10.1080/15265161.2017.1329482

Fudin, J., Persico, A. L., Bettinger, J. J., & Wegrzyn, E. L. (2019). The state of naloxone: Access amid a public health crisis. *Medicine Access @ Point of Care*, *3*, 2399202619847639. https://doi.org/10.1177/2399202619847639

Gansler, J. S. (1988). Integrating Civilian and Military Industry. *Issues in Science and Technology*, *5*(1), Article 1. JSTOR.

Gaw, A. (2014). Reality and revisionism: New evidence for Andrew C Ivy's claim to authorship of the Nuremberg Code. *Journal of the Royal Society of Medicine*, *107*(4), 138–143. https://doi.org/10.1177/0141076814523948

Gegel, B., Burgert, J., Gasko, J., Campbell, C., Martens, M., Keck, J., Reynolds, H., Loughren, M., & Johnson, D. (2012). The Effects of QuikClot Combat Gauze and Movement on Hemorrhage Control in a Porcine Model. *Military Medicine*, *177*(12), 1543–1547. https://doi.org/10.7205/MILMED-D-12-00165

Gross, M. L. (2013). Military Medical Ethics: A Review of the Literature and a Call to Arms. *Cambridge Quarterly of Healthcare Ethics*, *22*(1), Article 1. https://doi.org/10.1017/S0963180112000424

Have, H. T. (2023). Bioethics and War. *Hastings Center Report*, *53*(3), Article 3. https://doi.org/10.1002/hast.1482

Hudson, K. L., & Collins, F. S. (2015). Bringing the Common Rule into the 21st Century. *New England Journal of Medicine*, *373*(24), 2293–2296. https://doi.org/10.1056/NEJMp1512205

International Military Tribunal. (1949) Trials of war criminals before the Nuernberg Military Tribunals under Control Council law no. 10 Nuernberg, October -April 1949. [Washington, D.C.: U.S. G.P.O., to 1953] [Web.] Retrieved from the Library of Congress, https://lccn.loc.gov/2011525364.

Katz, R. (2001). Friendly Fire: The Mandatory Military Anthrax Vaccination Program. *Duke Law Journal*, *50*(6), Article 6.

Kavanaugh, P. R. (2022). Narcan as biomedical panic: The war on overdose and the harms of harm reduction. *Theoretical Criminology*, *26*(1), 132–152. https://doi.org/10.1177/1362480620964779

Kinnard, D. (1977). President Eisenhower and the Defense Budget. *The Journal of Politics*, *39*(3), Article 3.
Koistinen, P. A. C. (1967). The "Industrial-Military Complex" in Historical Perspective: World War I. *The Business History Review*, *41*(4), 378–403.
Leffler, M. P. (2005). 9/11 and American Foreign Policy*. *Diplomatic History*, *29*(3), 395–413. https://doi.org/10.1111/j.1467-7709.2005.00491.x
Lounsbury, D. E., & Bellamy, R. F. (2003). *Military Medical Ethics, Volume 1* (Vol. 1). Office of The Surgeon General, Department of the Army, United States. https://medcoeckapwstorprd01.blob.core.usgovcloudapi.net/pfw-images/borden/ethicsvol1/Ethics-front-matter.pdf
Lounsbury, Dave E., & Bellamy, R. F. (2003). *Military Medical Ethics, Volume 2* (Vol. 2). The Office of The Surgeon General, Department of the Army, United States. https://medcoeckapwstorprd01.blob.core.usgovcloudapi.net/pfw-images/borden/ethicsvol2/Ethics-front-matter-2.pdf
Mahfoud, T., Aicardi, C., Datta, S., & Rose, N. (2018). The Limits of Dual Use. *Issues in Science and Technology*, *34*(4), Article 4. JSTOR.
Malet, D. (2015). Captain America in International Relations: The Biotech Revolution in Military Affairs. *Defence Studies*, *15*(4), Article 4. https://doi.org/10.1080/14702436.2015.1113665
McAuliffe, M. S. (1981). Eisenhower, the President. *The Journal of American History*, *68*(3), Article 3. https://doi.org/10.2307/1901942
McInerney, T. J. (1981). Eisenhower Governance and the Power to Command: A Perspective on Presidential Leadership. *Presidential Studies Quarterly*, *11*(2), Article 2. JSTOR.
McManus, J. (2005). Informed Consent and Ethical Issues in Military Medical Research. *Academic Emergency Medicine*, *12*(11), 1120–1126. https://doi.org/10.1197/j.aem.2005.05.037
Mehlman, M. J., & Corley, S. (2014). A framework for Military Bioethics. *Journal of Military Ethics*, *13*(4), Article 4. https://doi.org/10.1080/15027570.2014.992214
Melson, A. R. (2003). Bioterrorism, Biodefense, and Biotechnology in the Military: A Comparative Analysis of Legal and Ethical Issues in the Research, Development, and Use of Biotechnological Products on American and British Soldiers. *Albany Law Journal of Science & Technology*, *14*(2), Article 2.
Mills, C. W. (with Wolfe, A.). (1956). *The Power Elite* (2nd ed). Oxford University Press USA - OSO.
Moreno, J. D., Schmidt, U., & Joffe, S. (2017). The Nuremberg Code 70 Years Later. *JAMA*, *318*(9), 795. https://doi.org/10.1001/jama.2017.10265
Mumtaz, M., Thompson, R. B., Moon, M. R., Sultan, I., Reece, T. B., Keeling, W. B., & DeLaRosa, J. (2023). Safety and efficacy of a kaolin-impregnated hemostatic gauze in cardiac surgery: A randomized trial. *JTCVS Open*, *14*, 134–144. https://doi.org/10.1016/j.xjon.2023.03.016
Nagai, H., Nakazawa, E., & Akabayashi, A. (2022). The creation of the Belmont Report and its effect on ethical principles: A historical study. *Monash Bioethics Review*, *40*(2), Article 2. https://doi.org/10.1007/s40592-022-00165-5
Nass, M. (2002). The Anthrax Vaccine Program: An analysis of the CDC's recommendations for vaccine use. *American Journal of Public Health*, *92*(5), 715–721. https://doi.org/10.2105/ajph.92.5.715

NATO Science and Technology Trends Report Volume 1. (2023). NATO Science & Technology Organization. https://ec.europa.eu/newsroom/cipr/items/787028/en

Naval Advisory Board. (1886). *Report of the Naval Advisory Board on the Mild Steel Used in Construction of the Hulls, Boilers, and Machinery of the* Dolphin*,* Atlanta*,* Boston*, and* Chicago*, Four Steel Vessels Constructed Under the Acts of August 5, 1882, and March 3, 1883*. https://digitalarchives.powerlibrary.org/papd/islandora/object/papd%3A247657

Ndebele, P. (2013). The Declaration of Helsinki, 50 Years Later. *JAMA*, *310*(20), 2145. https://doi.org/10.1001/jama.2013.281316

Newmark, J. (2007). Nerve Agents. *The Neurologist*, *13*(1), Article 1. https://doi.org/10.1097/01.nrl.0000252923.04894.53

Nieusma, D., & Blue, E. (2012). Engineering and War. *International Journal of Engineering, Social Justice, and Peace*, *1*(1), Article 1. https://doi.org/10.24908/ijesjp.v1i1.3519

Nijhawan, L., Janodia, M., Muddukrishna, B., Bhat, K., Bairy, K., Udupa, N., & Musmade, P. (2013). Informed consent: Issues and challenges. *Journal of Advanced Pharmaceutical Technology & Research*, *4*(3), 134. https://doi.org/10.4103/2231-4040.116779

Oltmann, S. (2015). Dual Use Research: Investigation Across Multiple Science Disciplines. *Science and Engineering Ethics*, *21*(2), Article 2. https://doi.org/10.1007/s11948-014-9535-y

OpenSecrets. (2024). *Federal Lobbying: Defense* [Dataset]. https://www.opensecrets.org/federal-lobbying/sectors/summary?id=D

Pica-Branco, D., & Hudak, R. P. (2008). U.S. Military Service Members' Perceptions of the Anthrax Vaccine Immunization Program. *Military Medicine*, *173*(5), Article 5. https://doi.org/10.7205/MILMED.173.5.429

Rasmussen, T. E., Kellermann, A. L., & Rauch, T. M. (2020). A Primer on the Military Health System's Approach to Medical Research and Development. *Academic Medicine*, *95*(11), Article 11. https://doi.org/10.1097/ACM.0000000000003186

Reardon, S. (2015). The Pentagon's gamble on brain implants, bionic limbs and combat exoskeletons. *Nature*, *522*(7555), Article 7555. https://doi.org/10.1038/522142a

Resnik, D. B., Barner, D. D., & Dinse, G. E. (2011). Dual-Use Review Policies of Biomedical Research Journals. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, *9*(1), Article 1. https://doi.org/10.1089/bsp.2010.0067

Rhee, P., Brown, C., Martin, M., Salim, A., Plurad, D., Green, D., Chambers, L., Demetriades, D., Velmahos, G., & Alam, H. (2008). QuikClot Use in Trauma for Hemorrhage Control: Case Series of 103 Documented Uses. *Journal of Trauma: Injury, Infection & Critical Care*, *64*(4), Article 4. https://doi.org/10.1097/TA.0b013e31812f6dbc

Rochon, C. (2016). Dilemmas in Military Medical Ethics: A Call for Conceptual Clarity. *BioéthiqueOnline*, *4*. https://doi.org/10.7202/1035513ar

Ross, C. A. (2017). LSD experiments by the United States Army. *History of Psychiatry*, *28*(4), 427–442. https://doi.org/10.1177/0957154X17717678

Santa Clara County v. Southern Pacific R. Co., 118 U. S. 394 (1886).

Sattler, S., Jacobs, E., Singh, I., Whetham, D., Bárd, I., Moreno, J., Galeazzi, G., & Allansdottir, A. (2022). Neuroenhancements in the Military: A Mixed-Method Pilot Study on Attitudes of Staff Officers to Ethics and Rules. *Neuroethics*, *15*(1), 11. https://doi.org/10.1007/s12152-022-09490-2

Sherkow, J. S., & Zettler, P. J. (2021). EpiPen, Patents, Life, and Death. *New York University Law Review Online*, 164–180.

Shuster, E. (1997). Fifty Years Later: The Significance of the Nuremberg Code. *New England Journal of Medicine*, *337*(20), 1436–1440. https://doi.org/10.1056/NEJM199711133372006

Siddiqui, W., & Sharp, R. R. (2021). Beyond the Belmont Report. *The American Journal of Bioethics*, *21*(10), Article 10. https://doi.org/10.1080/15265161.2021.1972649

Smith, D. T. (2015). From the military-industrial complex to the national security state. *Australian Journal of Political Science*, *50*(3), 576–590. https://doi.org/10.1080/10361146.2015.1067761

The Navy Department Library. (2017). *Budget of the US Navy: 1794 to 2014* [Dataset]. https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/b/budget-of-the-us-navy-1794-to-2004.html

United States v. Stanley, 483 U.S. 669 (1987).

Welch, M., Barratt, J., Peters, A., & Wright, C. (2020). Systematic review of prehospital haemostatic dressings. *BMJ Military Health*, *166*(3), Article 3. https://doi.org/10.1136/jramc-2018-001066

Williams, J. (2008). The Declaration of Helsinki and public health. *Bulletin of the World Health Organization*, *86*(8), 650–651. https://doi.org/10.2471/BLT.08.050955

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), Article 1.

Wolters, T. S. (2011). Recapitalizing the Fleet: A Material Analysis of Late-Nineteenth-Century U.S. Naval Power. *Technology and Culture*, *52*(1), 103–126. https://doi.org/10.1353/tech.2011.0023

Zarowsky, C., Haddad, S., & Nguyen, V.-K. (2013). Beyond ‘vulnerable groups’: Contexts and dynamics of vulnerability. *Global Health Promotion*, *20*(1_suppl), 3–9. https://doi.org/10.1177/1757975912470062