Ethical Competence in Dual Use Life Science Research

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Abstract

Life scientists have with increasing intensity been requested to recognize and take responsibility for the potential dual use implications of their work. To assist in meeting these demands, a number of educational modules have been produced to raise awareness of relevant dual use and biosecurity issues. A main purpose of such efforts has been to nurture an active culture of dual use responsibility in the life sciences.

Despite the inherent ethical nature of the dual use dilemma, it has traditionally been conceptualized within a security framework and has largely been neglected in the bioethics discourse. This article introduces the concept of ethical competence in dual use and argues that a culture of responsibility cannot be realized unless awareness is accompanied by the capacities to reflect and act in dual use situations. Ethical competence may play a valuable part in developing a culture of dual use responsibility despite the unpredictable and open-ended nature of bioethical processes. However, such a competence is neither self-sustained nor self-sufficient. Organizational support and leadership are important to provide opportunities for building and sustaining dual use ethical competence (e.g., through education or mentoring). Moreover, other actors and their additional competences may occasionally be required to sufficiently safeguard dual use research.

Introduction

Increased security concerns have heightened a debate on how to manage the threat posed by the potential misuse of life science research for biological weapon purposes. The concern is spurred by the perception of a new range of security threats due to the changing nature of warfare and the possibility of new forms of mass-casualty terrorism. Additionally, the increasingly rapid developments in life science research and technology have raised concerns about novel biological weapons and created demands on scientists to recognize and take responsibility for the potential misuses of their work (Kuhlau et al., 2008; Wheelis & Dando, 2000). These perceived contextual changes, of both security and science, highlight some of the ethical challenges that appear when measures to protect security values clash with protecting core scientific values such as academic freedom to conduct and disseminate research. The possibility that civil and peacefully intended work also might find military or hostile applications is commonly referred to as the dual use dilemma. This basic definition will serve the purpose of this article. No generally accepted dual use definition exists. More elaborate definitions have been discussed that take account not only of the possibility of the dual use of life science research, technology, and material, but also of intentions and the context in terms of the actual capacities and desires to use them for nefarious purposes (Dando, 2010; Forge, 2010; Miller & Selgelid, 2007). However, despite the inherent ethical nature of the dual use dilemma, it has traditionally been conceptualized within a security framework and consequently primarily engaged the security community (and, to a lesser extent, the scientific community). Only quite recently has the dual use discussion also entered the field of bioethics (Selgelid, 2010).

The fact that scientific knowledge might aid those seeking to develop and produce biological weapons is a genuine ethical dilemma within life sciences research. To handle such a dual use dilemma, specific ethical competence, in addition to scientific competence, is needed. This article investigates and critically discusses what ethical competence would mean within a dual use context.

The Call for Ethics Education

Theoretical studies in bioethics have found moral arguments supporting scientific precaution and responsibility to confront the security challenges posed by the dual use dilemma (Kuhlau et al., 2008; Kuhlau et al., 2011). Additionally, a number of national and international organizations, governments, and academics have stressed the need for raising awareness about dual use and existing legal obligations to prevent the development and use of biological weapons (Dando, 2009a; NRC, 2010). Education has been identified as an important measure to ensure awareness among scientists about the potentially harmful applications of their research. This awareness-raising education is, moreover, envisaged to foster the development of a culture of responsibility among life scientists (Dando, 2009b; Revill, 2009).

The concern is that scientists may be unaware of the dual use potential of their research and of relevant national and international legislation outlawing biological weapons (Dando, 2011; Revill, 2009). Consequently, including life scientists in a “web of prevention” of biological weapons by raising awareness on dual use has in recent years been considered an important undertaking. The term “web of prevention” was coined by the International Committee of the Red Cross as part of launching its Biotechnology, Weapons, and Humanity initiative in 2002 (International Committee of the Red Cross, 2002). It refers to the need to address the risks that technologies from the life sciences could be used for hostile purposes and, among other things, the initiative recommended including education about such risks as part of ethical training for life scientists. Because education has been identified as instrumental in
raising awareness, a number of university programs and online modules on biosecurity and dual use have been developed (Federation of American Scientists, 2012a). For example, the Federation of American Scientists has a module on dual use stating, “It is important that biologists increase their awareness of biosecurity issues and learn to assess their research in terms of modern security concerns” (Federation of American Scientists, 2012b). Other modules, produced by the University of Bradford in England and Duke University in North Carolina, USA, aim to “support life scientists and educators in learning about biosecurity and dual use issues” (University of Bradford, 2012) and “assist those involved with the biological sciences in better understanding the dual use dilemma inherent in such research” (Duke University, 2012). Although the Bradford and Duke University modules devote sections to explicitly discussing ethics, “dual use” remains primarily conceptualized as a security matter.

Awareness-raising education certainly appears valuable in providing scientists with dual use knowledge. However, if such education aims to foster a culture of (presumably active) dual use responsibility in the life sciences, additional ethical capacities seem necessary.

**Ethical Competence—More Than “Knowing Ethics”**

The term “competence” is dynamic and multifaceted. For the purposes of this article, it is tentatively described as the different capacities required to handle tasks and situations in the working life (Brytting, De Geer, & Silfverberg, 1993). Thus, ethical competence in dual use concerns the capability of life scientists to manage dual use research dilemmas. Capacity requires the presence of knowledge. Such knowledge can be explicit, that is, it can be codified, articulated, and easily communicated to others. This includes, for example, theoretical knowledge on existing ethical values, principles, guidelines, and legal obligations. Knowledge can also be tacit. This knowledge is based on character and wisdom, properties that are more difficult to articulate and communicate to others. Consequently, suggestions that ethical competence consists of tacit knowledge have been challenged on the grounds that such understanding risks reducing ethical competence to being unspoken experience and knowledge. The concern is that this may lead to poorly reflected and inconsistent ethical decisions (Eriksson, Helgesson, & Höglund, 2007).

Ethical knowledge does not, however, require that an individual possess ethical competence (Kälvermark-Sporrong, 2007). While both implicit and explicit ethical knowledge are important elements in ethical competence, further capacities are needed to enable individuals not only to acquire but also to develop and apply their knowledge in ethically challenging situations. Ethical competence can be said to involve three core capacities: 1) **awareness**, to initially recognize an ethically challenging situation; 2) **reflection**, to ethically reflect upon it; and 3) **action**, to adapt one’s behavior to it (Jormsr et al., 2005).

The first capacity, awareness, is a prerequisite for further ethical reflection and behavior. It is therefore considered an initial component in ethical competence building. The second capacity, reflection, can assist in articulating the intuitions that triggered recognition of the ethically challenging situation. The distinction between awareness and reflection must not be drawn too strictly as they are closely interconnected. Notably, awareness of potential harm, for example, presupposes some degree of initial ethical reflection. As such, reflection may enable individuals to systematize moral intuitions into coherent thoughts. This may provide the means by which they can justify and express ethical judgments and decisions that guide their behavior (Liszka, 2002). In this sense, ethical reflection may be considered to encompass several overlapping procedural elements—to reason, consider, judge, justify, express, and communicate ethical deliberations and decisions. Finally, the third capacity, action, can be considered a stage where awareness and ethical reflection result in informed decisions and competent behavior.

Ethical competence has both individual and collective attributes. Individual because being competent means assuming personal responsibility for the common best by continuously working on the capacity to recognize, reflect, and act upon ethically difficult situations (Höglund, 2005). Collective because ethical competence is also socially influenced and can therefore appear as a collective ability, particularly in the working life. The organizational leadership is important in this regard because it has the ability to influence the degree of both individual and collective ethical competence by creating opportunities for training and developing ethical reflection and dialogue skills (Brytting, 2002; Kälvermark-Sporrong, 2007). The dialogue is essential because it gives individuals an opportunity to share their thoughts and competence as well as further expand their understanding of other, different perspectives (and not merely knowing how to argue for their own opinion) (Granberg & Ohlsson, 2004). Both individual and collective ethical competences are, in the authors’ view, needed to form an ethical “culture” or “climate” of responsibility in a work life situation. Several proven measures to develop and train such ethical competences are available (Textboxes 1-4).

**Ethical Competence and Dual Use Responsibility**

Ethical competence is strongly connected to responsibility. Without competence, responsibility cannot be taken and without responsibility to take, competence is not needed. Having identified three capacities necessary for ethical competence (awareness, reflection, and action), this article now provides an analysis on how these capacities might contribute to a culture of dual use responsibility.
Education is a fundamental method for initiating awareness-raising. Education can be viewed as an ongoing development process that begins with a student but is also made available to recruits and senior researchers in the professional life. Moreover, different categories of employees may require different knowledge. For example, working in a research field with high dual use potential requires a different type of knowledge than working in a field with lower dual use potential. A basic dual use education can be provided to all life science students. This education can then be expanded and adjusted to meet the need of various professional roles and responsibilities.

There is a strong tradition of a principle-based approach to bioethics and medical ethics and substantial attention has been given to a “four principles” framework developed by Beauchamp and Childress (2001). The four principles are: 1) respect for autonomy; 2) beneficence (“do good”); 3) non-maleficence (“do no harm”); and 4) justice (Beauchamp & Childress, 2001). This focus on principles has been criticized because the individual’s practice has not necessarily changed when being taught the relevant principles (Hovland, 2003). This highlights the importance of pre-determining the aim of dual use ethics education. Educational methods that aim to enhance dual use ethical behavior are likely to be different from methods aimed at increasing dual use awareness (Elster, 2003). Although principle-based knowledge seems important, it does not necessarily consider the particular real-life research circumstances where the actual dual use problems occur. Complementary methods that aim to influence ethical behavior, such as real-life case studies, are therefore desired. Realistic scenarios to which students can relate may assist students in learning how to identify dual use dilemmas as well as nurturing a capacity to ethically reflect and reason upon them.

**Textbox 1**

**Ethics Education as a Method to Build Dual Use Ethical Competence**

Dual Use Awareness

Dual use awareness, foremost, implies an ability to recognize and identify a dual use dilemma. This recognition is a prerequisite to even begin considering and foreseeing potentially harmful implications. Knowledge in how to identify a significant dual use dilemma can be facilitated by, for example, making information available about existing dual use norms and guidelines as well as biological agents and experiments that are considered of particular dual use concern. Such agents and research have been identified and listed. Biological agents of concern include, for example; smallpox, ricin, anthrax, and botulinum toxin (CDC, 2012). Similarly, although there appears to be a lack of agreement on what dual use research of concern constitutes, research activities with a high potential for misuse may include enhancing the virulence of a pathogen and demonstrating how to render a vaccine ineffective (NRC, 2004; Zmorzynska et al., 2011). Competence, in the authors’ view, should go beyond being aware of and adhering to the above-mentioned lists of agents and research of concern. Rather, awareness-competence requires additional skills to recognize future and unlisted dual use agents and research with potential areas for harmful misuse. Education is one method that can be used to raise such awareness-competence. Textboxes 1-4 illustrate some of the practical methods used for competence building in other fields, such as business ethics and medical ethics, and to suggest that similar methods may be considered for building dual use ethical competence in the life sciences. Once awareness has been achieved, a process of reflection can begin.

Dual Use Reflection

The World Medical Association (WMA, 2002) states that: “All who participate in biomedical research have a moral and ethical obligation to consider the implications of possible malicious use of their findings.” Considering an ethically difficult situation can include two arguably overlapping objects of reflection. First, it means to reflect upon the situation, for example, concerning potential outcomes, the principles and values involved, as well as existing guidelines and rules. Second, it means to reflect upon who or what may be affected by the situation in an ethically relevant way (VanSandt, Sheppard, & Zappe, 2006). Moreover, to consider implications implies skills both to foresee and to assess the risks of harm involved in one’s research. Undoubtedly, it is difficult to describe what is reasonably foreseeable and how potentially harmful implications of research may be foreseen (Kuhlau et al., 2008). However, it should not be perceived as impossible. By reflecting upon and reasoning about ethically challenging dual use situations, individually and collectively, the perception of what is foreseeable may mature and change.

Competence to assess risks can be developed through clearly defined procedures for risk assessments, including guidelines on how to analyze risks and benefits. It should be noted, however, that neither risk assessment procedures nor guidelines can possibly be designed to cover everything, which implicates a certain degree of subjectivity to processes and outcomes. Risks may, however, include a broad range of possible economic, social, and security effects generated by the misuse of research by others. Therefore, much of the “risk reflection,” arguably, falls outside the realm of ethical competence as additional competencies would be required. Such competence would, for example, require extraordinary security/intelligence information about the prevailing situation concerning the very likelihood for misuse. Scientists should, in the authors’ view, be required to have the competence to make security-risk assessments. Rather, dual use competence would be limited to
Today ethics consultant services are used in various fields such as health care, business, law, and scientific research. Consultation occurs on an individual and flexible basis. It is argued that ethics consultants can contribute to solving practical moral problems because of their professional ability to apply their knowledge to concrete ethical questions and help clarify, systematize, and extend the moral views lay persons hold (Varelus, 2008). In the life science setting, a consultant could provide assistance in communication, mediation of conflicts, and informal education on relevant aspects of dual use ethical issues and alleviate some of the moral distress the scientist may experience when trying to deal with a difficult dilemma (Scanlon, 1997). This method would presumably influence the enhancement of both the competence to act and to reflect. The method is criticized for being incompatible with individual autonomy because responsibility for ethical decision-making is removed from the individual. However, a counter argument is that a process where the consultant refrains from providing a single prescription for ethical action or final solution does not necessarily compromise the ethical decision that belongs to the individual. If properly arranged, the individual would retain the autonomy by making a choice among several permissible solutions to an ethical problem provided by the consultant (Varelus, 2008). In the dual use life science context, consultants would preferably be knowledgeable on aspects of both ethics and security.

**Textbox 2**

Ethics Consulting as a Method to Build Dual Use Ethical Competence

Today ethics consultant services are used in various fields such as health care, business, law, and scientific research. Consultation occurs on an individual and flexible basis. It is argued that ethics consultants can contribute to solving practical moral problems because of their professional ability to apply their knowledge to concrete ethical questions and help clarify, systematize, and extend the moral views lay persons hold (Varelus, 2008). In the life science setting, a consultant could provide assistance in communication, mediation of conflicts, and informal education on relevant aspects of dual use ethical issues and alleviate some of the moral distress the scientist may experience when trying to deal with a difficult dilemma (Scanlon, 1997). This method would presumably influence the enhancement of both the competence to act and to reflect. The method is criticized for being incompatible with individual autonomy because responsibility for ethical decision-making is removed from the individual. However, a counter argument is that a process where the consultant refrains from providing a single prescription for ethical action or final solution does not necessarily compromise the ethical decision that belongs to the individual. If properly arranged, the individual would retain the autonomy by making a choice among several permissible solutions to an ethical problem provided by the consultant (Varelus, 2008). In the dual use life science context, consultants would preferably be knowledgeable on aspects of both ethics and security.

Reflecting upon and assessing risks of harm in a narrower scientific-ethical capacity. Such competence would involve capacities to recognize and anticipate, for example, the potential of a laboratory-made virus to spread among humans and its potential public health consequences, rather than the likelihood of the virus being misused as a biological weapon and its broader economic-security implications. This does not, however, mean that scientists, who know their work best, should not provide their scientific expertise to assist in security risk-assessments. On the contrary, a dialogue between the scientific and security communities on dual use concerns is likely to generate more informed assessments.

Concerns have also been raised that dual use obligations requiring scientists to reflect on the potentially harmful implications of their research may cause unnecessary anxiety and result in a risk-aversive behavior that hampers research (Kuhlau et al., 2008). In the authors’ view, this is not necessarily the case; first, because not being able to reflect upon and discuss ethical dual use concerns may equally cause individual moral anxiety and overly cautious behavior, and second, because a valuable outcome of collective reflection may be that coherent ethical motivations and justifications for dual use research decisions are formulated and communicated. This would strengthen the perception of the life science community as serious and responsible and lead to increased trust in science from both the security community and the public, so that external and unnecessary constraints may be avoided.

**Dual Use Action**

One important demarcation needs to be made concerning an assumed life science responsibility to assist in preventing the proliferation and misuse of biological weapons. The term “prevention” is problematic in the dual use context because it presupposes that knowledge exists about the anticipated threat and that a specific approach to circumvent it is possible (Kuhlau et al., 2011). On the contrary, peacefully intended dual use research is permeated by great uncertainty about consequences because they are determined by external and unpredictable factors such as the willingness, capacity, and opportunity of others to misuse scientific knowledge for harmful purposes. This suggests that direct prevention of harmful implications falls outside a scientist’s possible area of competence. However, actions involving precautionary behavior may contribute to, and hence indirectly result in, preventing misuses of research by decreasing the likelihood for misuse.

Having the capacity to act ethically is an important part of dual use competence. However, application does not automatically follow. This capacity is highly influenced by contextual factors, such as the prerequisites determined by the work organization (Brytting, 2001). Therefore, one may have reached a competent ethical decision but lack the opportunity to execute it. For example, a scientist might suspect that a collaborator in an international research project is participating to gain access to dual use sensitive information and material with the assumed intention to use them for harmful purposes. In such a scenario, the scientist needs the space to discuss his/her concerns with others as well as the organization’s support when implementing the decision, whether it is to move forward with or terminate the collaboration.

Another relevant question to consider is “When should scientists act?” Because being competent implies a capacity to act, this question would emerge in cases when the requested responsibility and the prevailing competence do not conform. The decision in such circumstances should be made either to delegate the responsibility to act or to acquire additional competence before acting. One illustrative example is the 2005 handling of manuscripts on the reconstruction of the 1918 Spanish influenza virus. Before publication in the journals Nature and Science, the research had gone through both peer-review and the journal’s own security review system. In addition, the Science article was scrutinized by external security expertise, namely the
In ethics rounds realistic cases are used to stimulate discussion and reflection about ethically problematic work situations. Repeated ethics rounds are thought to provide an opportunity for individuals to put forward and discuss ethical aspects of their professional work. This is considered important in maintaining a high level of ethical competence (Kälvemark-Sporrong, 2007). Subsequently, ethical awareness already exists because participants themselves choose which ethically problematic real life cases should be raised. There are similarities between rounds facilitated by an ethicist and ethics consulting. However, consultant services, contrary to rounds, may be considered more short-term, problem-specific, and individually oriented. Organizationally supported ethics rounds provide a forum for dialogue and critical reflection, which constitute important aspects of ethical competence building (Eriksson, Helgesson, & Höglund, 2007). Therefore, continuous evaluation of dual use ethical questions in life science research will presumably assure higher levels of confidence to act, broadened ethical reasoning, insight into dual use responsibilities, and reduction in moral distress (Höglund, Helgesson, & Eriksson, 2010; Svantesson et al., 2008). It is important to note that the goal is generally not to provide practical solutions, but rather to stimulate reflection and learning on ethical problems. The exercise may produce an understanding that several permissible solutions exist for how to act on an urgent ethical dilemma as well as enhance reflective skills beneficial to future ethical decision-making (Svantesson et al., 2008).

U.S. National Science Advisory Board for Biosecurity (NSABB). A decision was then made that the benefits outweighed the potential security risks, and the piece was published (Rappert, 2007). A more recent example of the involvement of external competences is illustrated by the controversy over whether and how to publish two research articles on the H5N1 influenza virus (causing bird flu). In this case, the NSABB unprecedentedly recommended that the journals delete details regarding both scientific methodology and specific viral mutations before publishing (AAAS, 2011). A voluntary pause in any research involving the viruses for 60 days was agreed to by 39 leading influenza scientists to “provide time for discussion” (Malakoff & Enserink, 2012). On 29-30 March 2012, the NSABB recommended publication of the revised papers (one in full and the other after further scientific clarifications in the manuscript) (NIH, 2012; NSABB, 2012). Presumably, this pause was used to allow different competences to inform the decision to support publication.

Accordingly, in extraordinary dual use situations where beneficial research may also pose a significant threat to health and security, the decision should be made by scientists to seek additional security advice to inform a decision or, if necessary, delegate the decision-making. The answer to the question of when scientists should act is, consequently; when the demanded responsibility and the available competence conform. Therefore, as the ethical competence may not always suffice to fulfill the demanded responsibility, realizing one’s competence shortcomings becomes an equally important part of competent behavior.

**Discussion and Conclusion**

In this article the concept of ethical competence has been described and applied in a dual use context. Three main conclusions can be drawn from the analysis of dual use ethical competence: 1) it is necessary in developing and sustaining a culture of dual use responsibility; 2) it requires organizational support; and 3) it is insufficient to safeguard all dual use research.

**The Role of Bioethics**

Given the inherent ethical nature of the dual use dilemma, bioethicists’ interest in the life science dual use debate has been surprisingly limited (Selgelid, 2010). Bioethics has, however, received attention from researchers in other disciplines. For example, a survey has been conducted in the European Union on the provision of dual use and biosecurity education for life scientists. This research reported that few universities offer such education and that considerably more courses are given on biosafety and bioethics (Mancini & Revill, 2008). Due to findings that bioethics courses already are incorporated into life science education, it is not surprising that suggestions have been made to extend the content of bioethics education to include dual use discussions. As Mancini and Revill note (2009, p. 14): “[Bioethics] could be a useful vehicle for the promulgation of biosecurity in the short-term.”

Although dual use discussions have a natural place within bioethics, the results of the engagement may not be what the security community expects or desires. This concern is noted by Revill (2009), who concludes that unlike science, bioethics inherently involves evaluation of competing values and interests without necessarily producing quantitative answers. The fear is that the outcome of a bioethical analysis of the dual use dilemma may not support the approach and goals envisaged by the security community and that the effect may be different than that intended by proponents of biosecurity education. This concern is of course valid; there are no guarantees and, in the authors’ view, there cannot and should not be any. Pre-deciding on a best theory and practice for dual use bioethics goes against the fundamentals of ethics, where discussions and final
Mentors to students and early career researchers could provide an opportunity for the latter to engage in a relationship with a senior scientist who can then observe their behavior and instruct students on how to manage research ethical matters. A mentorship would moreover require senior scientists to keep up-to-date with contemporary dual use ethical concerns and dilemmas. Research indicates that mentoring will go beyond training on the “classic” misconduct areas and provide guidance on actual behavior (Anderson et al., 2007). There is, however, a risk for dysfunctional mentoring relationship that can even be harmful in influencing behavior (for instance due to a poor internal research culture). Mentoring is moreover not necessarily good and beneficial to the mentor and not everyone has the capacity or wishes to become one (Mertz, 2004). Mentorships can, moreover, be formally or informally structured. Formal mentoring programs may assure that mentors participate and provide clear expectations of what they are to accomplish. In informal mentorships, by contrast, mentors participate voluntarily. Formal mentors, that are involuntarily tasked, may, arguably, be less motivated and possibly also not ready to become mentors (Anderson et al., 2007; Allen, 2003). Dual use bioethics is a recently emerging field, which implicates that it may take time before any system of mentorship can be exercised. Although many benefits can be assumed from mentorships it requires willingness, dedication and adequate dual use ethical competence from senior scientists.

The organizational leadership is essential in creating opportunities for these activities and for providing a work climate that allows and encourages scientists to discuss dual use concerns and also supports implementation of their decisions. Since ethical competence should be perceived as a circular rather than a linear process, continuous support is required. Moreover, to ensure a certain degree and quality of competence, instruments could be developed by which ethical competence in dual use is measured. Such instruments have been used in other disciplines, such as health care, to measure ethical work climates, which presumably share many of the traits envisaged for a culture of responsibility (for example, see Arnaud, 2010; McDaniel, 1997).

Is dual use ethical competence sufficient to safeguard dual use research and protect health and security? The answer depends on the expectations on the scientific responsibility and the actual competence that can, or reasonably should, be obtained to match that responsibility. According to the authors’ analysis, certain dual use situations may require security competences in addition to ethical competence. External advice and assistance from the security community are, therefore, occasionally required. Such security involvement need not be limited to situations where scientists lack the competence to make an independent decision. For example, by being allowed an advisory role in ethical dual use competence-building and practice, security competence can be incorporated. Moreover, such involvement may constitute an opportunity to protect a system of dual use self-governance in the life sciences, as open and continuous communication with relevant authorities is likely to increase confidence from the security community and the public that dual use matters are seriously managed. Furthermore, additional legitimacy and predictability could be gained by concretizing ethical competence by, for example, empirically and theoretically studying what may constitute reasonable dual use responsibility and what competence is required from scientists to actively take that responsibility. Such studies would also indicate whether, when, to what extent, and in what way external security expertise is needed.

Limitations, Challenges, and Opportunities

The hesitation to use bioethics as a promoter for biosecurity and dual use responsibility may be based not only on a concern that the outcome might not correspond with the expectations. Another possible concern is whether ethical competence is sufficient for life scientists to independently govern and safeguard dual use research, or if it merely provides an ethical label, legitimizing the scientific community to mind its business as it sees fit. Whether or not ethical competence is sufficient can depend on both the quality of competence and the required degree and type of competence.

Ethical competence demands organizational support to facilitate opportunities to develop and nurture the capacities to recognize, reflect, and act upon dual use situations. To this end, a number of proven methods are available, such as ethics rounds, mentoring, and consulting (Textboxes 1-4).
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