Summary

The global burden of infectious disease outbreaks is increasingly recognized. In order to build capacity for diagnosis, laboratories have been built and are in use worldwide. Laboratory safety standards vary significantly between the developed and the developing world, and it is unclear whether it is imperative for global health protection that all countries reach the standards demanded in the most developed countries, as is the opinion of many. It is doubtful that such an approach is sustainable. Sufficient biosafety and biosecurity levels can be reached with a more context-sensitive risk-based approach and a smarter use of existing resources.

The concept of safety and security draws on an understanding of risks that reflects a context-sensitive process. This relative risk could be a useful starting point for regulators and policy-makers to rethink their current approach to biosafety and biosecurity in a globalized world. Rather than defining standards as universal endpoints, they could then adopt the alternative method of establishing and maintaining a productive discourse to relate risks to local settings.

A key barrier to reflecting on the complexity of biosafety and biosecurity lies in the isolated responses and conceptual cultures of health and security approaches. Health and security have been separately assessing, planning and responding to key aspects in their own fields. The key challenge for future activities is how to frame or re-frame the debate of health and security. A major task is to connect these thought, perception and action cultures.

The core recommendation of this paper is to convene and bring together the different cultures of health and security in meetings and joint working groups to develop policy for smart implementation in diverse environments.

Next steps include a meeting of stakeholders (regulators, policy-makers, architects, scientists) from low-, middle- and high-income countries to reflect and agree on a relative-risk-based approach. This scoping meeting should be followed by a two-day workshop bringing together the different perspectives (health, security, regulation, design) to suggest suitable approaches for developing countries. Recommendations from this workshop could guide stakeholders and donors to support the design and implementation of sustainable approaches reflecting the context and environment of laboratories worldwide.

Finally, this approach should to be taken to international organizations and working groups such as World Health Assembly, the Global Health Security Agenda and the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, to gain universal acceptance and support for it.
Introduction

The global burden of infectious disease outbreaks is increasingly recognized. The International Health Regulations 2005 (IHR) is a legally binding agreement that aims to strengthen the global capacity to prevent, detect and respond to public health threats.\(^1\) In order to develop this capacity, laboratories have been built and are in use worldwide. These play a key role in safely containing and handling pathogens, and their capability in this regard is critical to national capacity to prevent accidental release or deliberate use.

With increasing laboratory capacity, the safe and secure handling of pathogens has been in the focus of intense debates. This draws on two concepts: biosafety and biosecurity. In a common understanding, biosafety refers to principles, technologies, practices and measures implemented to prevent the accidental release of, or unintentional exposure to, biological agents and toxins. Biosecurity refers to the protection, control and accountability measures implemented to prevent the loss, theft, misuse, diversion or intentional release of biological agents and toxins and related resources as well as unauthorized access to, retention or transfer of such material.\(^2\)

The biosafety and biosecurity communities are necessarily interdependent and interlinked. The progress made in biosafety, which is a local and protective measure coordinated by international standards and benchmarks, has contributed greatly to biosecurity, which following the events of 9/11 and the global terrorism threat is a problem of international concern and responsibility.\(^3\)

Double standard

Laboratory safety standards vary across low-, middle- and high-income countries. They are based on the concept of biocontainment. This term expresses a relation between a ‘hot’ or ‘dirty’ interior of a laboratory, where work is being carried out under measures protecting personnel and the environment from contamination, and a relatively cleaner or less-pathogenic environment.

The developed world has high, so-called ‘Western standards’. These are categorized by Biosafety Levels 1–4. Despite these, accidental release and laboratory-acquired infections occur. For instance, the accidental release of foot-and-mouth disease (FMD) at the Pirbright Institute, United Kingdom, in 2007 caused a localized outbreak in the community (probably not the first) and became a proxy for lab accidents.\(^4\) The potential impact of a release of FMD virus in an FMD-free country is immense and can have a massive economic impact. Even under the highest Western standards – the BSL 4 standards and similar animal pathogen standards – laboratory-acquired infections with, for


example, Smallpox and Ebola virus have occurred. Laboratories themselves can be perceived as sources of infections.

Work in high-containment laboratories is also regulated by biosecurity measures. In the aftermath of the letters containing *B. anthracis* spores sent to politicians and media figures in 2001 in the United States, regulations to ensure the secure handling of pathogens have increased and some experts point to the downside of these measures in regards to collaboration and sharing information.

The regulation of work in laboratories is intertwined with biosafety and biosecurity measures. The regulations and monitoring of biosecurity, however, have extended the focus from the laboratory work to the personality of staff working in labs and especially in the United States, but also in the Western world; regulations to control and implement biosurety are increasingly popular. Although these biosurety regulations still lack the evidence that these measures are effective in regards to preventing health and security threats, the qualification, training and personality of laboratory workers have been incorporated into policy and regulations. This triangle of people (biosurety), pathogens (biosecurity) and laboratories (biosafety) is controversial and currently under discussion.

In low- and middle-income countries, health and safety standards differ from Western ones, and questions have been raised as to how best to harmonize standards in the face of the need for laboratory capacity-building in areas of the world where dangerous pathogens occur naturally.

**Dual use**

This situation has been complicated by additional concerns about the dual-use character of biomedical sciences. Dual use is a term that describes the difficult attribution of and distinction between civil/peaceful or military/harmful material. Originating in the Cold War and nuclear threats, it has been primarily focused on the misuse of material. Biomedical innovations, however, have added another dimension to the dual dilemma: that is the misuse of knowledge and information.

The controversy around the experiments with mutant H5N1 influenza virus and other gain-of-function experiments, where scientists deliberately engineer mutant viruses to study which mutations would enable naturally occurring strains to modify transmissibility, has recently been in

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the focus of the global debate and ‘easy’ universal solutions are not yet in close reach. In fact, despite many high-level debates there has been little policy implementation.

Response

Biosafety and biosecurity also express different response mechanisms. While biosafety rests mainly in the hands of scientists, regulators and health policy-makers, biosecurity is the domain of arms control, proliferation policy and security intelligence. Although biomedical science and research marks a field where biosafety and biosecurity overlap, there is a missing link between health and security thinking. The two intelligence and response communities are only now beginning to work together.

A plethora of biosafety and biosecurity laws, regulations and practice regulate laboratory standards, and these can vary considerably by region. Double standards in developing and developed countries and dual-use dilemmas are further complicating the situation. To address this complex issue, the United Kingdom government has funded a Chatham House project to investigate the status quo and invited major stakeholders to discuss and identify ways forward.

This research paper gives an overview of current biosafety and biosecurity regulations and guidelines, providing examples from low-, middle- and high-income countries. Key aspects of this discourse are discussed to point out a way forward for framing future discussion and negotiations.

International policy

Biosafety – biosecurity

At the international level, obligations relating to biosafety and biosecurity are grounded in the Biological Weapons Convention, United Nations Security Council Resolution 1540, and the World Health Organization’s (WHO) International Health Regulations (2005). These three international instruments contain many overlapping and complementary requirements relating to biosafety and biosecurity, and together represent structures for addressing international health security and cross-cutting elements of biological non-proliferation. They provide basic structures for national legislation and frameworks in the area, as well as promoting international dialogue, cooperation and capacity building. Their content is outlined below.

The Biological Weapons Convention (BWC), which entered into force in 1975, was the first multilateral disarmament treaty to prohibit an entire category of weapons. The convention now has 165 state parties and 12 signatory states. However, these are geographically concentrated and the majority of African states parties have yet to implement effective national measures to ensure compliance with its obligations. Under Article IV of the convention, each state party is obligated to

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take any necessary measures to prohibit and prevent the development, production, stockpiling, acquisition, or retention of the agents, toxins, weapons, equipment and means of delivery specified in Article I of the convention, within the territory of such state, under its jurisdiction or under its control anywhere.11

Because of differing circumstances and legal systems, parties may approach implementation in different ways. The Seventh Review Conference in 2011 called upon state parties ‘to adopt, in accordance with their constitutional processes, legislative, administrative, judicial and other measures, including penal legislation,’ to enhance domestic implementation and to ensure the safety and security of microbial or other biological agents or toxins.12

United Nations Security Council Resolution 1540, unanimously adopted in 2004, establishes legally binding obligations on all UN member states to have and enforce appropriate and effective measures against the proliferation of nuclear, chemical, and biological weapons (WMD) and their delivery systems, including by establishing controls. The three key obligations on member states are to prohibit support to non-state actors seeking WMD and their means of delivery; to adopt and enforce effective laws prohibiting activities involving the proliferation of WMD and their means of delivery to non-state actors; and to have and enforce effective measures to reduce the vulnerability of many legitimate activities to misuse in ways that would foster the proliferation of WMD and their means of delivery to non-state actors.13 In 2011, Resolution 1977 extended the mandate of the Security Council committee established through Resolution 1540 for the purposes of preventing acquisition of WMD by terrorists and other non-state entities.

The WHO’s International Health Regulations (2005) form a legally binding agreement that significantly contributes to global health security by providing a new framework for coordinating the management of events that may constitute a public health emergency of international concern. They aim to improve the capacity of all countries to detect, assess, notify and respond to public health threats.14 The regulations, which entered into force in June 2007, require WHO member states to develop and implement certain core public health capacities by 2012, including with respect to laboratories, through changes to their national legislation.15 However, most countries have found themselves unable to meet this deadline and have sought a two-year extension as permitted under the IHR (2005).16

It should also be noted that there has been a tremendous proliferation of biosafety legislation in low-, middle- and high-income countries as part of the implementation of the Cartagena Protocol to the Convention on Biodiversity. This legislation is specific to genetically modified organisms (GMO) and therefore represents only a subset of the biosafety issues addressed in this paper. For many countries, only GMOs are addressed specifically by national biosafety legislation and other issues, such as laboratory protocols, are addressed through national committees. Additional trends in

16 A66/16 Implementation of the International Health Regulations (2005): Report of the Director-General. 5 April 2013,
national legislation include the promotion of inter-ministerial collaboration as well as a ‘whole of government’ approach. Some argue that the arms control approach endorsed by the BWC has been overtaken by trends including the criminalization of biological weapons, the regulation of the biological sciences, the management of the biodefense imperative and the preparation for biological weapons attack.

An overview of biosafety and biosecurity standards in both the developed and developing world is set out below.

**Standards, regulations and legislation in three G7 countries**

**Biosafety**

National regulatory authorities are responsible for developing the necessary safeguards for biorisk management and oversight, appropriate to their circumstances. Three approaches represented by G7 countries are outlined below.

In the United Kingdom, the 2007 Callaghan Review of the Regulatory Framework for Handling Animal Pathogens proposed that in order to improve the regulatory system for work involving animal pathogens, the Health and Safety Executive (HSE) should become the single regulatory body for human and animal pathogens, with responsibility for inspection and enforcement functions; and that the Department for Food, Environment and Rural Affairs should work with the HSE and others to bring the legislation encompassing GMOs, human pathogens and animal pathogens within a single regulatory framework. While this has proven an administrative challenge, relevant agencies and governments are examining possibilities to align where possible the requirements for dealing with risks from human and animal pathogens, streamline the licensing system and improve the consistency of the regulatory approach.

Similarly, in Canada the Laboratory Biosafety Guidelines, the Containment Standards for Veterinary Facilities, and the Containment Standards for Laboratories, Animal Facilities and Post Mortem Rooms Handling Prion Disease Agents have been streamlined into the 2013 Canadian Biosafety Standards and Guidelines, a single set of standards and guidelines for personnel who work with human and/or terrestrial animal pathogens, prions and biological toxins.

In the United States, there are a number of federal regulations relevant to laboratory biosafety and biocontainment. These include standards relating to working conditions under the Occupational Safety and Health Authority, regulations pertaining to select agents under the Department of Health and Human Services (HHS) or the Department of Agriculture (USDA), regulations under the USDA requiring permits for work with high-consequence animal and plant pathogens, and HHS/Centers for Disease Control and Prevention (CDC) regulations that require a permit for the...
import of any infectious agent known or suspected to cause disease in humans. Relevant federal guidelines include Biosafety in Microbiological and Biomedical Laboratories, and National Institute of Health Guidelines for Research Involving Recombinant DNA Molecules. Both of these are regularly updated to reflect scientific and technological advances.

Biosecurity

Because the release of pathogens from laboratories or other containment zones may pose a risk to health security, the handling and/or storing of infectious agents and toxic material within national laboratories necessitates the requirement of biosafety and biosecurity regulations and standardized practices. Many countries have developed and introduced legislation containing provisions on biosecurity that regulate possession, use and access to biological materials to permit their appropriate use.

Before 9/11, biosecurity safeguards received little attention. In the space of ten years, however, most developed countries have designed and implemented counter-terrorism legislation that encompasses biosecurity measures. Such legislation often promotes the use of highly secure physical containment of biological threat agents – new buildings, new high-tech security systems and personnel training – that require extensive resources. Such an approach may not be possible for resource-poor developing nations without sound existing health infrastructure and regulatory capacity.

Developed-country legislation tends to emphasize protection against deliberate misuse of certain pathogens and biological toxins that have the potential to be used in terrorist activity. These approaches focus on the outcomes sought from controls, rather than the detailed methods to be used.

In the United Kingdom, the Anti-terrorism, Crime and Security Act 2001 regulates access to materials (the Schedule 5 List of Pathogens and Toxins) that can be used to produce biological or chemical weapons. Any possession, use or storage of these pathogens, toxins or relevant genetic material must be notified to the Home Office.

The US Public Health Security and Bioterrorism Preparedness and Response Act of 2002 and the Agricultural Bioterrorism Protection Act of 2002 require entities to register with the HHS or USDA if they possess, use or transfer biological agents or toxins (i.e. select agents and toxins) that could pose a severe threat to public health and safety, to animal or plant health, or animal or plant products. The acts also require increased safeguards and security measures for these agents, including controlling access, screening entities and personnel (i.e. security-risk assessments), and establishment of a comprehensive and detailed national database of registered entities. The acts also impose criminal and civil penalties for the unlawful possession, use and transfer of select agents and toxins.

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19 HHS and USDA Select Agent Regulations, 42 CFR part 73, 9 CFR part 121, 7 CFR part 331 (for more information, see http://www.selectagents.gov/) and HHS/CDC Foreign Quarantine Regulations, 42 CFR § 71.54.

20 Laboratories are used for clinical medicine, research, the development of pharmaceutical products, the diagnosis of diseases and the confirmation of biological findings.

The 2009 Canadian Human Pathogens and Toxins Act similarly requires mandatory registration of all persons responsible for activities involving human pathogens or toxins, with a ban on any activity with pathogens or toxins listed in Schedule 5 (currently only smallpox is on this list).22

Standards, regulations and legislation in seven low- and middle-income countries

To contrast the developments in the three G7 represented nations, seven low- and middle-income countries (Nigeria, Sudan, Pakistan, Yemen, Afghanistan, Thailand and Mexico) were investigated in an in-depth analysis approach and summarized as case studies to further leverage insight about their biosafety and biosecurity approaches.

Regulations and guidelines

Biosafety

Information regarding biosafety regulations is patchy and difficult to retrieve in low- and middle-income countries.

African countries have started to coordinate activities by building authorities and a framework. In Nigeria, the National Authority on Chemical and Biological Weapons coordinates measures in different sectors, and the legislation is handled by relevant agencies. However, the Ministry of Justice has been mandated to produce draft legislation that will bring all the sectoral laws under the National Authority for effective domestication and implementation of the BWC in Nigeria. While Sudan has coordinated a multisectoral approach – covering human, animal and plant health – to develop a comprehensive national strategy on IHR (2005) compliance, it has yet to establish a National Biosafety and Biosecurity Committee that can meaningfully coordinate standards in this area.23 Yemen and Sudan have developed a National Biosafety Frameworks.

South Asian and Asian countries seem to approach biosafety mainly through the use and regulation of GMOs.

Pakistan has issued National Biosafety Guidelines and Rules in May 2005. The non-profit Biological Safety Association of Pakistan assisted in the development of national and international biological safety standards, guidelines and regulations, and is a recognized resource for professionals and scientific expertise in biological safety and security. While the government issued the National Biosafety Guidelines, these are targeted towards GMOs and address specifically ‘a national need to develop biosafety guidelines to control laboratory research, field studies and commercial release of GMOs and products thereof’.

Afghanistan has no guidelines or regulations for biosafety, but ratified the Cartagena Protocol in February 2013, covering the use and creation of GMOs. Yemen and Thailand have no biosafety

22 Canada Human Pathogens and Toxins Act (S.C. 2009, c. 24).
regulations but Thailand has revised its Pathogen and Animal Toxin Act (B.E. 2544) for all agencies (including regulation of the producing, processing, distributing, export, import and transit).

Mexico implemented its Law of Biosafety of Genetically Modified Organisms in 2005. This was drafted by the Mexican Academy of Sciences in response to the Cartagena Protocol and public concern involving transgene ingression into indigenous maize varieties. As a result of the Cartagena Protocol, Mexico launched the Global Environmental Facility project on national biosafety frameworks. The country has also developed a roster of biosafety experts as required by the Protocol.

**Biosecurity**

As the overall situation of biosecurity regulations is very difficult to retrieve from literature searches, analysis was carried out by surveying country-representative knowledge and opinion as case studies.

Afghanistan’s only existing biosecurity framework relates to outbreaks of infectious disease. With regard to biosecurity and food security, the USDA’s Foreign Agriculture Service (FAS) has projects in Afghanistan to support the agricultural sector. FAS as well as the USDA’s Animal and Plant Health Inspection Service and National Institute of Food and Agriculture provide technical support and training to help build Afghanistan’s capacity to detect and control animal diseases. Pakistan’s Biosafety and Biosecurity Association, relaunched in 2009, is made up of experts in science, environment, atomic energy and foreign affairs. This group works to regulate bioscience research, monitor for bioterrorism and introduce biosafety in university bioscience syllabi. Sudan, as mentioned above, has implemented a National Biosafety and Biosecurity Committee that can develop and implement standards.

**Case studies**

A series of case studies were conducted in developing countries to improve understanding of the main challenges faced on a day-to-day basis and complement the larger picture of the national biosafety and biosecurity regulations in these countries’ settings. Key issues were identified that need to be addressed in defining what standards should be maintained and what this means for laboratories and biocontainment facilities around the world in terms of management and financing.

**Method**

To better understand the difficulties of complying with national and international biosafety and biosecurity regulations, survey participants were asked to describe their national capacity (Sudan (1 respondent), Nigeria (1), Yemen (1), Afghanistan (3), Pakistan (1), Thailand (1) and Mexico (1)). Countries and interview partners were selected through their networks and in a convenience sample of recruiting at the Chatham House meeting ‘Safe and Secure Biomaterials,’ which was held on 17 May 2012.

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25 'Biosafety back on the agenda in Pakistan'.

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This survey was conducted via personal communication between November 2012 and January 2013. Questions and answers were distributed and received by email.

Findings

Three of seven respondents claimed their countries have regulations on biosafety standards in their country while all have professional associations. All respondents declared that they organize internal programmes for professional training in biosafety and biosecurity practices, though there appeared to be confusion regarding the principle of the word ‘internal’. Many examples cited revealed the assistance of external groups in organizing local training programmes. In light of this, it is unsurprising that all respondents reported having had external input for professional training in biosafety and biosecurity practices. External sources of input included the CDC, Canada’s Public Health Agency, the WHO, Pan American Health Organization (PAHO) and Sandia National Laboratories.

Four of the seven respondents claimed their countries have BSL-3 laboratories operating (Thailand 23, Mexico 8, Nigeria 3 and Pakistan 3); none claimed to have BSL-4 laboratories operating.

Respondents revealed a variety of challenges with their infrastructure in the running and performance of laboratories: from lack of local training to excessive heat and natural disasters, intermittent power supply, and lack of coordination and commitment from the government. The issues can be categorized into human resources, climate or physical and political infrastructure.

Similarly, when asked to prioritize improvements needed in biosafety and biosecurity, the majority of needs could be categorized as either human resources or physical and political infrastructure. The human resources recommendations focused on increasing training and education: implementing theoretical training, technical training, and ‘legitimate, challenging and local career opportunities’ in conjunction with national tertiary education. Physical infrastructure issues centred on building and maintaining laboratories suited to the local environment and stocked with the appropriate equipment. Political infrastructure issues centred on not only national guidelines, but the commitment, coordination and enforcement necessary to ensure compliance with the guidelines. Other needs included enhancing stakeholder ownership and ethics, instituting an interactive, knowledge-sharing network and encouraging freedom of trade.

Conclusion

Despite local differences, there are important commonalities: local difficulties and identified national priorities can be grouped into the categories of human resources and physical and political infrastructure. There is a clear target to reflect this local perspective when considering biosafety and biosecurity guidelines and laboratory capacity. A multitude of external biosafety and biosecurity training programmes are held in partnership with host countries. However, the sustainability of this practice is subject to further discussion, as this offers an influx of Western standards and guidelines that simply do not make much sense given local realities.

International challenges

Despite widespread heightening of biosecurity regulations worldwide in response to terrorist attacks and innumerable laboratory-acquired infections, many disparities exist between countries
when it comes to the existence of national regulations on biosecurity standards, the availability of appropriate laboratory facilities and national priorities intended to improve existing biosecurity capacity. In recent years, there has been increased recognition of such differences in standards and biomaterial security across the world.

A number of international biological threat reduction programmes have made significant efforts to address existing imbalances and build capacity in more vulnerable areas, including those of the WHO and World Organization for Animal Health. In addition, the International Federation of Biosafety Association’s Biological Engineering Working Group, created in 2010, aims to identify practical and sustainable solutions for biocontainment in laboratories handling dangerous pathogens in resource-limited countries.

Reflecting on ‘Western’ standards

The current standards in many developed countries are primarily tasked with isolating biological agents in highly secure environments. These measures include new buildings, high-tech security systems and personnel training. A conventional approach suggests exporting the Western standards to low- and middle-income countries to ensure the same laboratory safety standard worldwide. The high cost of these systems is often only one of the limitations for implementation in low-resource settings; poor health infrastructure – such as a dearth of laboratories or the use of laboratory equipment ill-suited to the environment – and lack of enforcement capacity also restrict the impact of biosafety and biosecurity regulation. It has also become clear that some security elements are simply not suited to all contexts: for instance, laboratory location conditions vary widely in temperature, elevation, remoteness and in the endemicity of supposedly restricted biological agents.

Biosafety

Biosafety concerns have been raised in various Western laboratory settings despite the existence of high-standard laboratories. Despite a plethora of regulations and guidelines in the high-income world, laboratory accidents and laboratory-acquired infections happen and the ‘anthrax letters’ appear to have a Western origin. This emphasizes that the Western standard is not an uncontroversial one.

In addition, it is unclear whether it is imperative for global health protection that all countries reach the standards demanded in the most developed countries and whether such an approach is sustainable, or whether sufficient biosafety and biosecurity levels can be reached with a more context-sensitive approach and smarter use of existing resources. The concept of biocontainment as a relation between a higher pathogenic interior compared with a lower pathogenic exterior encourages a different approach to reflect on appropriate safety and security standards worldwide.

Biosecurity

Biosecurity thinking is challenged by the new dual-use dilemma and the information base of possible misuse; these aspects have not yet been adequately addressed in either the G7 countries or the low- and middle-income countries examined.
**Conclusion**

A key barrier to reflecting on and responding to the complexity noted above seems to lie in the isolated responses and conceptual cultures of health and security sector approaches. The health and security sectors have been examining, planning and responding to key aspects in their own fields separately. The key challenge for future activities is to frame or re-frame the debate to include health and security. A major task for the future is to connect these thought, perception and action cultures.

The concept of safety and security relates to a concept of risk. The concept of risk, however, is context-sensitive. The introduction of the biocontainment rationale, i.e. the difference between a ‘dirty’ inside of the lab and a relatively less pathogenic environment, could lead to a more appropriate, contextual assessment of risks. This relative risk concept could be a useful starting point for regulators and policy-makers to rethink their current approach to global biosafety and biosecurity. Rather than defining standards as endpoints, regulators and policy-makers could establish and maintain a productive discourse to relate risks to local settings. A next step is to bring together the different cultures of health and security in meetings and joint working groups to develop policy options for more context-responsive biosafety and biosecurity standards that can be applied in diverse environments.

This includes:

- A meeting of stakeholders (regulators, policy-makers, architects, scientists) from low-, middle- and high-income countries to reflect and agree on a relative risk-based approach;

- A two-day workshop that brings together the different approaches (health, security, laboratory designers, scientists, donors) to develop suitable approaches for developing countries; and

- Recommendations from this workshop that could guide stakeholders and donors to support the design and implementation of sustainable approaches reflecting the context and environment of laboratories worldwide.

Finally, this alternative approach, and the results and recommendations of the meetings, should be taken to international organizations and working groups such as the World Health Assembly, the Global Health Security Agenda and the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, in order to gain universal acceptance and support for such an approach and connect with global health security policy.
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Additional material

Additional material covering biocontainment incidents 2000–12 (Annexe 1), acts and regulations on biosafety and biosecurity (Annexe 2) and on overview of national regulators (Annexe 3) can be made available upon request. Please contact Petra Dickmann (pdickmann@dickmann-drc.com) or Claire Muñoz Parry (CMunozParry@chathamhouse.org).