DUAL USE RESEARCH CONCERN (DURC)

Our aim is to promote the responsible conduct of research to prevent potential negative use of technological advances.

Definition

Dual Use Research of Concern (DURC) is research that can be reasonably anticipated to provide

- knowledge
- information
- products, or
- technologies

For legitimate scientific applications but …

that could be also directly **misapplied** to pose a significant threat with broad potential consequences to :

- ✓ public health and safety
- ✓ agricultural crops and other plants
- ✓ animals
- ✓ environment or
- ✓ national security

e.g., the qualities of a pathogen or toxin intentionally misused as a biological weapon to cause disease (e.g., bioterrorism)

How to identify DURC in biohazard projects

A research that :

- Enhances the harmful consequences of a biological agent or toxin
- Disrupts the immunity or the effectiveness of an immunization without clinical and/or agricultural justification
- Confers to a biological agent or toxin, resistance to clinically and/or agriculturally useful prophylactic or therapeutic interventions against that biological agent or toxin
- Facilitates the biological agent or toxin's ability to evade detection methodologies
- Increases the biological agent or toxin's stability, transmissibility, or their ability to disseminate
- Alters the host range or tropism of a biological agent or toxin
- Enhances the susceptibility of a host population
- Generates a novel pathogenic agent or toxin or reconstitute an eradicated or extinct biological agent

Brief History of Dual-Use dilemma

1) In 2001, Australian researchers inserted the mouse IL-4 gene into the mousepox virus

- They hoped that the altered virus would sterilize mice and thus provide a means for pest control to resolve mice infestation
- To their surprise, they had produced a super strain of mousepox that killed mice that were naturally resistant to, and mice that had been vaccinated against, ordinary mousepox
- This discovery implies that the same technique might enable production of **vaccine-resistant smallpox**

2) In 2002, researchers at the State University of New York at Stony Brook artificially synthesized a "live" polio virus from scratch.

- Following the map of the polio virus RNA genome, they stitched together corresponding strands of DNA, purchased via mail-order
- Upon publication of results, the researchers said they "made the virus to send a warning that terrorists might be able to make biological weapons without obtaining a natural virus".
- Similar techniques might enable **production of smallpox or Ebola**.

3) In 2005, researchers from the US centers for Disease Control and Prevention, employed techniques of synthetic genomics to "reconstruct" Influenza virus

- i.e. Spanish Flu virus, (which had killed between 20 and 100 million people in 1918-19)
- This was a similar technique to those used in the polio study
- Though further research on the reconstructed virus may facilitate development of drugs and vaccines that provide protection against a major influenza pandemic, such a virus could also be used for nefarious purposes by malevolent actors

4) In 2006, a paper was published describing the identification of a gene from *Yersinia pestis*

- causative agent of plague- that confers resistance to several common antibiotics, including those typically used to treat infection
- This gene could be intentionally misused as a biological weapon to cause and spread disease in the general public

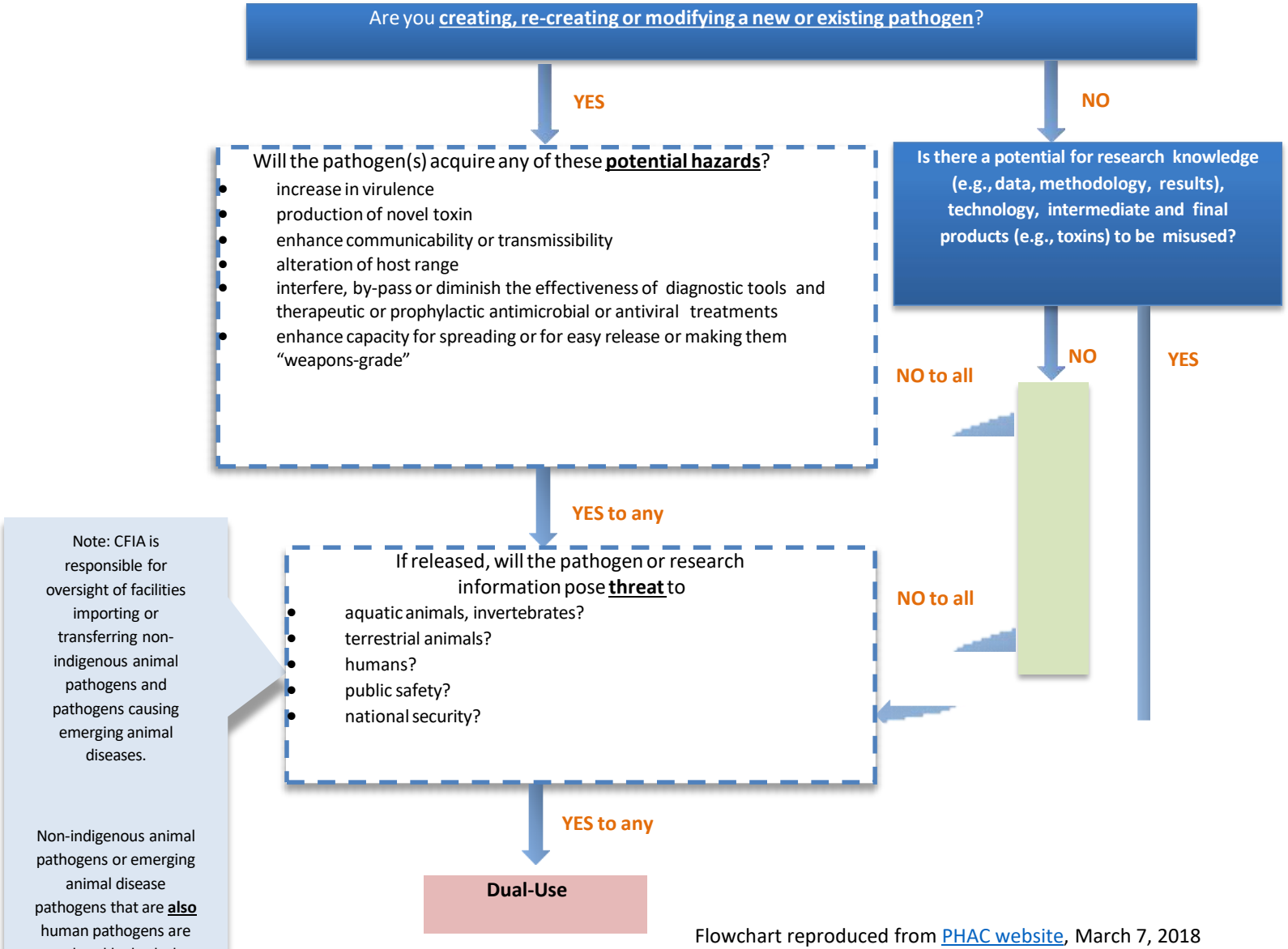
5) In 2010, Craig Venter and his colleagues designed and synthesized the first synthetic bacterium *Mycoplasma mycoides* from chemical building blocks

- This was a major milestone in the use of DNA synthesis
- However, it has the potential to create more complex organisms, including harmful agents.

- Two research groups in 2011, led by Dr. Yoshihiro Kawaoka (University of Wisconsin, U.S.) and by Dr. Ron Fouchier (Erasmus Medical Center, The Netherlands), independently submitted research papers to two leading academic journals
    - The research described the creation of highly pathogenic strains of A/H5N1 avian influenza virus with enhanced transmissibility in mammals
    - The research would enable others to study mammal-to-mammal airborne transmissibility, raise awareness of the significant threat of H5N1 to public health, and assist in the development of influenza vaccines
    - There were concerns that the research would raise the risk of an accidental release of the pathogenic virus from a laboratory, or that information in the manuscripts could be misused to endanger public health or national security

- In 2017, scientists led by Dr. Floyd Romesberg from the Scripps Research Institute in California generated the first stable semisynthetic organism
    - This semi synthetic harbored an unnatural base pair, expanding its genetic alphabet from four letters (A,G,T,C) to six (including X,Y)
    - The new bases were inserted into *Escherichia coli* and replicated, without fault, over the course of 60 generations
    - This research could lead to potential new ways to use bacteria to create new classes of drugs to treat disease
    - However, it could also lead to potential difficulty in detecting novel pathogenic agents using existing diagnostic tools
    - Alteration to pathogens may render the current methods to prevent, treat and control infectious diseases ineffective

Decision Tree: Identification of Dual-Use Potential in Life Sciences Research



Flowchart reproduced from PHAC website, March 7, 2018

Resources

- For additional information regarding Dual-Use in Life Sciences Research please refer to the Public Health Agency of Canada's e-learning course: Introduction of Dual-Use in Life Sciences Research