



Pursuing biological advances, *safely*

Gigi Kwik Gronvall, PhD
UPMC Center for Health Security
ggronvall@upmc.edu

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Dual-use research management

- **Dual use:** advances that lower the barriers to misuse
- **Dual use research of concern:** “Life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security.”
- **Conundrum:** Legitimate scientific inquiry, often with medical benefits, and not everyone sees the risks and benefits in the same way.

There is strong interest in managing dual use research

- USG Moratorium on Gain-of-Function influenza research.
- Yet: Misuse by **whom** and to what degree?
- Dual use research of concern can be identified, but can the risks and benefits be truly quantified?
 - More likely they will be experiment-dependent, context-dependent, and time-dependent
 - Not all nations will balance the risks and benefits the same way
 - Consensus will remain difficult, particularly as experts view the threat differently

Risk of a consequential accident

- Major concern about gain-of-function influenza research– laboratory acquired infection
- Also a concern for gene drives, remediation, agriculture
- Biosafety often undervalued or underfunded, even in well-resourced laboratories.
- Good biosafety guidance and training is available

SYNOPSIS OF BIOLOGICAL SAFETY AND SECURITY ARRANGEMENTS

Summaries of key international treaties, agreements, instruments, guidelines, multilateral engagement mechanisms, and information resources intended to guide national approaches to biosafety in research, clinical, and industrial laboratories.

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Addressing the Gap in International Norms for Biosafety

Gigi Kwik Gronvall^{1,*} and Michelle Rozo¹

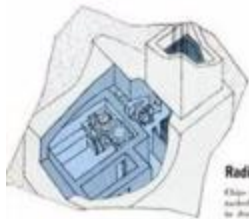
There is currently a lack of national-level norms for biosafety. Considering that a laboratory accident involving a contagious pathogen could have long-term consequences that extend beyond an individual incident into the practice of science more broadly, it is in the interests of scientists everywhere that international norms are developed.

international concern. However, laboratory-acquired infections (LAIs) with particularly transmissible pathogens, including noncirculating human influenza strains, the severe acute respiratory syndrome (SARS) coronavirus, or other contagious pathogens, could have consequences that go well beyond the laboratory. In large part, it was these biosafety concerns that fueled the decision by the US government in early 2015 to pause funding for influenza gain-of-function (GOF) research while the risks and benefits of that research are analyzed (<http://www.whitehouse.gov/blog/2014/10/17/doing-diligence-assess-risks-and-benefits-life-sciences-gain-function-research>). Investigators first touched off the controversy in 2011–2012 with their development of a form of the

In recognition of the fact that individual laboratory workers carry the most personal risk from LAIs, resources have been committed to boost biosafety at the local level. There is excellent guidance available for researchers, laboratories, and research institutions to adhere to high biosafety practices, and provide biosafety professional training pertaining to each individual discipline and type of work. There are also standards classifying pathogens at varying levels of biocontainment [Biosafety level-1 (BSL-1), BSL-2, BSL-3, and BSL-4] and what corresponding engineering controls should be in place to manage biorisks within a research institution, whether they pose risks to humans, livestock, or plants. The World Health Organization (WHO), the Food and Agri-

Anatomy of the Lunar Receiving Lab

Waste lines (hydrogen) isolated sections of the Lunar Receiving Lab are shown here by red lines. It supports basic tests plus service and waste lines to various systems and these lines are shown in isolation (left). Other systems (red) are for a different, for the command module, for food and laundry. Lines at far right show where personnel enter and go through airlocks in the building.



Radiation Laboratory

Edge from the first lunar landing will be used in a radiation laboratory (blue) to study the effects of radiation on the building.

Lunar Sample Laboratory

More than 100 scientists and technicians would perform tests with lunar materials in the lab area, shaded green.

- 1 Vacuum system where lunar samples will be received and processed
- 2 Containers for storage and transfer of lunar material
- 3 Control for vacuum system
- 4 Equipment for preflight test equipment
- 5 Gas analysis laboratory
- 6 Special air conditioning system to provide an entering and leaving building
- 7 Control
- 8 Working room for participating scientists
- 9 Pump room and electrical support equipment for vacuum system
- 10 Transfer tubes for moving samples directly from vacuum system to lab
- 11 Physical-chemical test equipment: petrology, geochemistry
- 12 Bio-printer for to produce and analyze lunar material for distribution
- 13 Bio-analytical lab for blood tests and other tests on man

- 14 Holding lab for germ-free mice
- 15 Holding lab for experimental mice
- 16 Lunar microfilm lab to receive, identify and possibly give some more information
- 17 Space support lab and defense laboratory in 112
- 18 Bird, fish and insect laboratory where plants, fungi, reptiles, insects and other creatures are exposed to lunar material
- 19 Microbiology lab for test cultures of lunar and extraterrestrial material
- 20 Egg and tissue culture lab (support and additional facilities for 21)
- 21 Gene storage lab for sunlight and ultraviolet rays of asteroids
- 22 Plant lab where germination, growth, sprouts and seedlings are exposed to lunar material
- 23 Microbiology lab for test cultures of lunar and extraterrestrial material
- 24 Transfer tubes for moving samples directly from vacuum system to lab
- 25 Physical-chemical test equipment: petrology, geochemistry
- 26 Bio-printer for to produce and analyze lunar material for distribution
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Astronaut Reception Area

Overseer area where astronaut file is checked (yellow). In an emergency, lab workers could also be questioned there.

- 1 Crew reception area (connected to transfer lab)
- 2 Medical and dental examination room
- 3 Medical examination room
- 4 Operating room
- 5 Bio lab room for physiological testing
- 6 Tissue work where data can be passed into computer and electronically
- 7 Biomedical lab—clinical specimens and monitoring of astronauts and sub-space team
- 8 Bio lab room
- 9 Bio-analytical lab room connected to space family living room
- 10 Directory for support personnel

- 11 Office for astronaut and director
- 12 Fixed seating sample for three astronauts and their three standard diets
- 13 Lounge and dining room
- 14 Kitchen
- 15 Reception area for food and laundry and other material in and out
- 16 Computer room for data storage from biomedical lab (2)
- 17 Spacecraft, storage connected with control panel for emergency
- 18 Microbiology lab for clinical tests of man and personnel
- 19 X-ray room with film storage and personnel



Thank you!

ggronvall@upmc.edu