

PLANETARY PROTECTION AND REGULATING HUMAN HEALTH: A RISK THAT IS NOT ZERO

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INTRODUCTION

The first time humans were sent to the moon, the National Aeronautics and Space Administration (“NASA”) placed great emphasis on quarantining astronauts upon their return. A now-famous photo captures President Nixon looking into the quarantine chamber welcoming the Apollo 11 astronauts back to Earth.² By the 1990s, NASA’s concern for contamination from space travel had dissipated, primarily because as a nation we had decided to end human space travel. NASA formally withdrew its regulation requiring astronauts to be quarantined upon return to U.S. soil.³ NASA’s stated reason for the withdrawal of the regulation was simply that “it [had] served its purpose and [was] no longer in keeping with current policy.”⁴

Despite the cancellation of manned space missions, the United States has continued to send spacecrafts to explore the Moon, Mars, and asteroids. These exploratory trips require compliance with an international law and policy of planetary protection—the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (“Outer Space Treaty”)—that has been agreed to by all nations party to it.⁵ In general, “planetary protection” means both (1) forward contamination of other celestial bodies with biological material from Earth and (2) back contamination of Earth with potential life from other celestial bodies. Many spacefaring nations have given thoughtful consideration to forward-contamination policies, yet, to-date, the nations governed by the Outer Space Treaty do not have robust back-contamination policies that govern space travel. As a signing nation,

² See *President Nixon Greets the Returning Apollo 11 Astronauts*, APOLLO 11, NAT’L AERONAUTICS & SPACE ADMIN. (July 24, 2014), <https://www.nasa.gov/content/president-nixon-greets-the-returning-apollo-11-astronauts>.

³ See *Extraterrestrial Exposure*, 56 Fed. Reg. 19,259 (Apr. 26, 1991) (removing and reserving 14 C.F.R. § 1211.100–08).

⁴ *Id.*

⁵ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, *opened for signature* January 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter *Outer Space Treaty*].

the United States is a leader in planetary protection protocols for unmanned travel in space.

The United States' space policy has changed from its inception. NASA expects to travel to the Moon, to Mars, to asteroids, and to even further destinations in the future – exoplanets similar to the Earth. The number of spacefaring nations also continue to increase. These are two reasons, among many, that it is imperative spacefaring nations develop a back-contamination policy that specifically focuses on humans and large groups of humans returning from celestial bodies with samples.

This article will discuss the broad issue of the need for a universal robust back-contamination policy and will outline four major policy indications that show that the United States and other spacefaring nations are neglecting this area of back contamination with their current programs. The National Academies of Science, Engineering, and Medicine (“The National Academies”) wrote that NASA’s sample policy was “out of date”⁶ and that “priority” should be given to the back-contamination policy and program.⁷ NASA should draw from our lessons in biological life and create a legal framework to implement a new back-contamination policy and form collaborative relationships in the areas of public health. Further consideration should also be given to The National Academies’ question of how long we would need a planetary protection policy.

When drafting a back-contamination policy, the creators should pull from the lessons learned through the United States’ experience with quarantine and incorporate our understanding of the need for a public health infrastructure in the event of a catastrophic pandemic. The policy creators should draft the policy and its accompanying legal framework in such a way that addresses the need for a network of quarantine stations in light of the space tourism legislation that has begun to proliferate in the United States at the state level in anticipation of future space tourism and development of the space

⁶ NAT’L ACADS. OF SCI., ENG’G, & MED., REVIEW AND ASSESSMENT OF PLANETARY PROTECTION POLICY DEVELOPMENT PROCESSES 4 (Wash., D.C.: The Nat’l Academies. Press, 2018) [hereinafter NAS, REVIEW OF PLANETARY PROTECTION POLICY].

⁷ *Id.* at 9.

mining industry.⁸ Specifically, in creating a back-contamination policy, the creators should consider requiring a waiver of due process for agreed quarantine of returning travelers and miners who come in contact with other celestial bodies. This potential requirement is an importance factor in reducing back contamination. The recent Ebola outbreak is a good case study showing the importance of public health preparedness with respect to potential contamination, especially in light of the legal issues that emerged from forced quarantine of those exposed to the disease.

I. LESSONS FROM HUMAN HISTORY

Human history contains a plethora of unfortunate events that provide ample teaching lessons about the need to consider the implications that unregulated space travel could have on public health.

All of our earliest known histories have a similar theme in common—they tell of how humans were driven to explore the world around us and explain why the human race has an insatiable sense of adventure and discovery that drives us to explore the unknown. Even in the face of direct warnings, such as “Here be Dragons,”⁹ we still press on. The dragons our early explorers imagined turned out to be monsters undetectable to the human eye: scurvy, smallpox, cholera, typhoid fever, and the plague. Old ship records from these exploits reveal that there were many more deaths from diseases than from the battles for Great Britain.¹⁰ A similar fate can be said for the soldiers of

⁸ See Paul Alp, *Limitations On Liability As To Space Tourists*, Am. Bar Assoc. Aviation & Space Law Comm., COMM. NEWS (Summer 2011), <https://www.crowell.com/files/2011-limitations-on-liability-as-to-space-tourists.pdf>.

⁹ “Here be Dragons” is an idiom said to have originated from maps made during the 16th and 17th centuries to indicate danger or the location of monsters, typically in regions in the ocean. This origin has been in much dispute, but recently an old globe from 1504 made of an ostrich egg had the phrase on it. See Meeri Kim, *Oldest globe to depict the New World may have been discovered*, WASH. POST (Aug. 19, 2013), https://www.washingtonpost.com/national/health-science/oldest-globe-to-depict-the-new-world-may-have-been-discovered/2013/08/19/503b2b4a-06b4-11e3-a07f-49ddc7417125_story.html?utm_term=.a5d2767f6aa4.

¹⁰ Stephen Mortlock, *A Life on the Ocean Wave: Death and Disease in Nelson’s Navy*, BIOMEDICAL SCIENTIST, https://thebiomedicalscientist.net/sites/default/files/media/document/2017/28-32_bs_big_qamended.pdf (last visited Feb. 1, 2019).

the American Revolutionary War — out of the 25,000 American soldiers who perished, 8,000 died in military service, but 17,000 died from diseases.¹¹ A familiar pattern can be found in the statistics for the United States' Civil War — two out of every three deaths were caused, not by war, but by disease.¹²

The most catastrophic plague the world has ever seen, commonly called the Black Death, is believed to have started in Caffa with warriors from Asia who had become infected with plague.¹³ These warriors brought the Black Death with them to battle, and over the next few years, the plague killed off roughly one-third of the world's population.¹⁴ Another well-known example is the spread of the smallpox by Europeans exploring the New World.¹⁵ The Europeans brought smallpox to the indigenous population of the Americas, who had no previous exposure to the disease.¹⁶ Estimates suggest that the indigenous population of the Americas was decimated by as much as 90% as a result of exposure to the disease.¹⁷

In the wake of these disease-induced disasters, societies responded by instituting legal constraints to protect public health. Public health law originates from epidemics and outbreaks, and can be seen in use as far back as the mid-1300s in Italian port city-states, where the plague forced the local society to implement a quarantine-like system to protect public health.¹⁸ However, in the United States, the

¹¹ Tyler Rogoway, *The U.S. Revolutionary War: By the Numbers*, FOXTROT ALPHA (July 4, 2014, 9:49 AM), <https://foxtrotalpha.jalopnik.com/the-revolutionary-war-by-the-numbers-1600199390>.

¹² *Id.*

¹³ Mark Wheelis, *Biological Warfare at the 1346 Siege of Caffa*, 8 EMERGING INFECTIOUS DISEASES J. 971, 971 (Sept. 2002).

¹⁴ See generally Ole J. Benedictow, *THE BLACK DEATH, 1346-1353: THE COMPLETE HISTORY* (Boydell & Brewer, 2004). See also Ole J. Benedictow, *The Black Death: The Greatest Catastrophe Ever*, 55 *History Today* (Mar. 2005), <https://www.historytoday.com/archive/black-death-greatest-catastrophe-ever>; Wheelis, *supra* note 13, at 971.

¹⁵ PBS, *The Story Of . . . Smallpox — and other Deadly Eurasian Germs*, <https://www.pbs.org/gunsgermsteel/variables/smallpox.html> (last visited Apr. 11, 2019).

¹⁶ *Id.*

¹⁷ *Id.*

¹⁸ See Eugenia Tognotti, *Lessons from the History of Quarantine, From Plague to Influenza A*, 19 EMERGING INFECTIOUS DISEASES 254, 254–55 (2013).

recognition of natural rights and due process that has developed over the last couple of centuries has limited the use of quarantine and isolation to their narrowest applications as measures to protect public health, and its use must be balanced against the liberty interests of the affected individuals.¹⁹ Today, the federalism approach, which was conceived from the factors of slow transport modes of the 17th century, leaves all public health power to the states.²⁰ Air travel, which, in the United States, moves one million people per day between destinations at a speed of about 500 miles per hour, has increased more than 400% in volume between 1975 and 2017.²¹ Yet, the speed and efficiency of our public health legal framework has not kept pace because it is premised on modes of transportation by horse or ship. Air travel allows humans to travel around the globe at high speed, but it also allows diseases to travel with them, potentially spreading around the planet in mere days. In the future, humans will be able to travel to distant planets. The likelihood that diseases may travel back with them, while a low probability event, is not a zero risk.

In the future, humans hope to move just under the speed of light to and from other planets for tourism, research, and mining purposes.²² While at first there will only be a select few people traveling²³ similar to air travel, space travel will soon see masses of people crowding spaceports and moving in and out of Earth's domain.²⁴ How we plan for the public health of humans over the next

¹⁹ See generally *Jacobson v. Massachusetts*, 197 U.S. 11 (1905).

²⁰ See generally *Gibbons v. Ogden*, 22 U.S. 1, 203, 205–06 (1824) (discussing how quarantine laws are public health laws and are within the purview of the states' police power).

²¹ In 1975, 9,244,700 air passengers traveled worldwide, and in 2017, 35,42,803 passengers traveled by air, worldwide. This represents a 400% increase in air travel since 1975. See *Air Transport, Registered Carrier Departures Worldwide*, WORLD BANK DATA, <https://data.worldbank.org/indicator/IS.AIR.DPRT> (last visited Aug. 31, 2019).

²² See Adam Hadhazy, *How Fast Could Humans Travel Through Space?*, BBC (Aug. 10, 2015), <http://www.bbc.com/future/story/20150809-how-fast-could-humans-travel-safely-through-space>.

²³ See Jackie Wattles, *SpaceX will take Japanese billionaire on trip around the moon*, CNN BUSINESS (Sept. 18 2018, 5:20 PM), <https://money.cnn.com/2018/09/17/technology/spacex-moon-tourist-mission/index.html>.

²⁴ David J. Hill, *Spaceport America Ramping Up For Projected Space Tourism Boom*, SINGULARITYHUB (Aug. 22, 2013), <https://singularityhub.com/2013/08/22/spaceport-america-ramping-up-for-projected-space-tourism-boom/>.

several decades is well worth the investment, given the existential threat of returning to Earth with a space plague (think: *Andromeda Strain*²⁵). Such a potentiality begs a review of how we think about the legal framework needed for the space travel age.

A policy of planetary protection takes into consideration the possibility of biological contamination either by taking contamination to other parts of the universe or by biological contamination we might bring back to Earth.

NASA has described planetary protection to mean the practice of preserving planetary conditions for future biological exploration and protecting Earth and its biosphere, including the Moon, from potential harmful extraterrestrial sources of contamination.²⁶ This working definition for planetary protection is used on the NASA planetary protection website, but NASA has no formal regulatory definition for “planetary protection.” Rather, the working definition is derived from the language of the Outer Space Treaty.²⁷ The international intergovernmental organization of the United Nations, the Committee on Space Research (“COSPAR”),²⁸ is responsible for developing guidance for member nations for planetary protection.²⁹

This article focuses on the policies of back contamination, starting with an examination of the leadership of the United States in this area and continuing with a review of international law and guidelines for back contamination. There are four major policy indications that the United States and other spacefaring nations are neglecting the area of back contamination: (1) rescinding the U.S. quarantine policy; (2) lack of priority for back contamination in comparison to forward contamination; (3) observations from The National Academies’ report;

²⁵ Released in 1971, *Andromeda Strain* was a popular film based on a book by Michael Crichton about a microbe from space that threatened to destroy humankind. *The Numbers — Movies Released in 1971*, THE NUMBERS, <https://www.the-numbers.com/movies/year/1971> (last visited Mar. 30, 2019).

²⁶ See *Overview of Planetary Protection*, NAT’L AERONAUTICS & SPACE ADMIN., OFFICE OF PLANETARY PROTECTION, <https://planetaryprotection.nasa.gov/overview> (last visited Aug. 1, 2019) [hereinafter *Overview of Planetary Protection*].

²⁷ See Outer Space Treaty, *supra* note 5.

²⁸ *About*, THE COMMITTEE ON SPACE RESEARCH, <https://cosparhq.cnes.fr/about> (last visited Aug. 1, 2018).

²⁹ *Overview of Planetary Protection*, *supra* note 26.

and (4) absence of a legal framework for quarantine of travelers or public health preparation for space travel. While most scholars in the field consider the risk of finding harmful life beyond Earth a remote possibility, the consequences if life is found beyond Earth are existential. A cost-benefit analysis confirms the value of preparedness and planning policies for such an instance, despite its low probability.³⁰ The risk of finding biological life (and harmful life) in space is not zero.³¹

II. U.S. LEADERSHIP, INTERNATIONAL LAW, AND GUIDELINES FOR BACK CONTAMINATION – A SHORT HISTORY OF PLANETARY PROTECTION AND BIOCONTAINMENT

The earliest record of awareness that life might exist beyond Earth came from the Greek philosophers. In the Fourth Century B.C., Metrodorus of Chios, quoting his mentor, Epicurus, wrote, “[T]o consider the Earth as the only populated world in infinite space is as absurd as to assert that in an entire field of millet, only one grain will grow.”³²

Other great thinkers reprised the possibility of the existence of life beyond Earth. Arthur C. Clarke, a science fiction author, is famously quoted as saying, “Two possibilities exist: either we are alone in the Universe or we are not. Both are equally terrifying.”³³ In January 1920, Albert Einstein was quoted in a London newspaper interview saying, “Why should the [E]arth be the only planet supporting human life?” in response to the question of whether life beyond Earth existed.³⁴

³⁰ See generally Piers Millett & Andrew Snyder-Beattie, *Existential Risk and Cost-Effective Biosecurity*, 15 HEALTH SEC. 373 (2017).

³¹ See *About the Office of Planetary Protection*, NAT’L AERONAUTICS & SPACE ADMIN., OFFICE OF PLANETARY PROTECTION, <https://planetaryprotection.nasa.gov/about/> (last viewed Sept. 6, 2019).

³² MICHAEL MELTZER, *WHEN BIOSPHERES COLLIDE: A HISTORY OF NASA’S PLANETARY PROTECTION PROGRAMS* xv (Nat’l Aeronautics & Space Admin., 2011).

³³ MICHIO KAKU, *VISIONS: HOW SCIENCE WILL REVOLUTIONIZE THE TWENTY-FIRST CENTURY* 295 (1999) (Arthur C. Clarke is attributed in posthumous publication).

³⁴ Tony Reichhardt, *Einstein’s Thoughts on SETI*, AIR & SPACE (Dec. 17, 2014), <https://www.airspacemag.com/daily-planet/einsteins-thoughts-seti180953666/#3EGpVpSCOPIfwuop.99> (quoting an uncited London newspaper from January 1920).

Once scientists developed the Drake Equation and used it to calculate that it was possible to find life, the idea that other life-supporting planets existed became more plausible.³⁵

The first time the possibility of contamination from potential extraterrestrial life arose was when Joshua Lederberg asked whether some precautions should be taken to prevent contaminating the surface of the moon.³⁶ Without such precautions, humankind would forever disturb the uncontaminated environment and make discovery of any indigenous life unknowable. Lederberg first wrote of these concerns in a private memorandum, but he later published his concerns about biocontamination in *Science* magazine in 1958.³⁷ It was not until 1961 that the first opportunity to use the planetary protection policy came with the United States' Ranger Project.³⁸

On May 7, 1966, President Lyndon Johnson proposed a treaty governing space activities, including to "avoid harmful contamination" of celestial bodies.³⁹ The United States submitted a draft of this treaty to the United Nations in June 1966.⁴⁰ This submission started a debate that led to a global consensus on how space exploration should be conducted. In January 1967, that global consensus was reached concerning space-faring nations and their responsibilities in avoiding biological contamination.⁴¹

The Outer Space Treaty embodied those principles. It was signed and quickly went into effect in October 1967.⁴² The treaty addressed

³⁵ The Drake Equation is a quantitative method for calculating the chance of finding extraterrestrial life. *Drake Equation*, SETI INSTITUTE, <https://www.seti.org/drake-equation-index> (last visited Oct. 30, 2018).

³⁶ Joshua Lederberg & Dean Cowic, *Moondust*, 127 *SCIENCE* 1473, 1474 (1958).

³⁷ *Id.*

³⁸ R. Cargill Hall, NASA SP-4210, *Lunar Impact: A History of Project Ranger*, NAT'L AERONAUTICS & SPACE ADMIN. 72 (1977), <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19780007206.pdf>.

³⁹ See Outer Space Treaty, *supra* note 5.

⁴⁰ Draft Treaty Governing the Exploration of the Moon and Other Celestial Bodies, in letter dated June 16, 1966 from the Permanent Rep. of the United States to the Chairman of the Committee on the Peaceful Uses of Outer Space, U.N. Doc.A/AC.105/C.2/L.12 (July 11, 1966).

⁴¹ See Outer Space Treaty, *supra* note 5.

⁴² *Id.*

specific responsibilities to avoid biological contamination, both forward and backward:

States parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter, and where necessary, shall adopt appropriate measures for this purpose.⁴³

Based on this binding provision of the treaty (Article IX), all nations who ratified the treaty are bound by its terms and must take these outlined precautions.⁴⁴

In the late 1960s, human health became an interest, and NASA called upon the Public Health Service of the Department of Health and Human Services (current title) and sought their expertise on the quarantine of astronauts returning from missions.⁴⁵ As a result, a policy was developed and published in the Federal Register based on statutory authority.⁴⁶

In 1984, the drafters of the “Moon Agreement” chose to include a provision to avoid contamination of the moon.⁴⁷ This provision required that all parties “take measures to prevent the disruption of the existing balance of environment, whether by introducing adverse changes in the environment by its harmful contamination through the introduction of extra-environmental matter or otherwise.”⁴⁸

In 1999, NASA developed a new policy for planetary protection.⁴⁹ The policy was revised in 2013, with an expiration date of February 19,

⁴³ *Id.* at art. IX.

⁴⁴ See *id.*

⁴⁵ MELTZER, *supra* note 32, at 55–56.

⁴⁶ Extraterrestrial Exposure, 34 Fed. Reg. 11,974, 11,974-76 (July 16, 1969) (to be codified at 14 C.F.R. pt. 1204).

⁴⁷ Agreement Governing the Activities of States on the Moon and Other Celestial Bodies art. 7, Dec. 5, 1979, 3 U.S.T. 1363 [hereinafter Moon Agreement].

⁴⁸ *Id.*

⁴⁹ See NAT'L AERONAUTICS & SPACE ADMIN., POLICY DIRECTIVE 8020.7G, BIOLOGICAL CONTAMINATION CONTROL FOR OUTBOUND AND INBOUND PLANETARY SPACECRAFT (Revalidated May 17, 2013 with Change 1), (Feb. 19, 1999), https://aerospace.csis.org/n_pd_8020_007g__main/ [hereinafter NPD 8020.7G].

2018.⁵⁰ Just before expiration, the policy was extended another year to February 15, 2019.⁵¹ On February 19, 2019, the policy was updated to once again extend the policy until May 19, 2019.⁵² The increasingly short extensions of the policy suggest that NASA is nearing a major revision. The National Academy of Sciences reviewed the planetary protection policy of NASA in a report in 2018,⁵³ and recommended several substantive changes to a policy they considered to be “outdated.”⁵⁴

A. International Law and Biocontainment Binding All Nations

International law for planetary protection, since 1967, has bound space-faring nations to minimize contamination that we might take to other planets, as well as contamination that we might potentially bring back to Earth.⁵⁵ The policy and practice of planetary protection is to prevent the back contamination (*i.e.*, bringing back to Earth biological contamination) and forward contamination (*i.e.*, taking biological contamination to other celestial bodies during contact through space travel).⁵⁶ Planetary protection, therefore, includes back and forward protection from bio-contamination.

The authority for this planetary protection policy was first established in international law in the Outer Space Treaty, an agreement to which the United States is party.⁵⁷ The Outer Space Treaty addresses this authority in Article IX:

States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the

⁵⁰ *Id.*

⁵¹ *Id.*

⁵² See NPD 8020.7G, *supra* note 49.

⁵³ See NAS, REVIEW OF PLANETARY PROTECTION POLICY, *supra* note 6.

⁵⁴ *Id.* at 12–14.

⁵⁵ Outer Space Treaty, *supra* note 5, at art. IX.

⁵⁶ These descriptions for “forward contamination” and “back contamination” are only operational. As recent as May 2019, neither COSPAR nor NASA have created legal definitions, or other definitions, for forward and back contamination.

⁵⁷ See Outer Space Treaty, *supra* note 5.

environment of the Earth resulting from the introduction of extraterrestrial matter, and where necessary, shall adopt appropriate measures for this purpose.⁵⁸

Responsibility for ensuring this Article IX is followed by both governments and non-governmental entities in their jurisdictions is embodied in Article VI of the treaty:

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental *agencies* or by *non-governmental entities*, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, *shall require authorization and continuing supervision* by the appropriate State Party to the Treaty.⁵⁹

A planetary protection policy would be completely ineffective if the practice did not include all types of space missions, not just government-funded ones.

The Outer Space Treaty applies only to nations and binds only nations.⁶⁰ The extent to which nations are obligated to require their citizens and corporations to meet the same standards has been in some controversy. This controversy is fueled by questions such as: Do nations only choose the things they wish to regulate based on their sovereign right to do so? Must nations regulate the private sector in every aspect of their space explorations? Planetary protections are only effective to the extent that a private company is regulated by the state in which it launches its space mission.⁶¹

The international protocol created by COSPAR has five levels, also referred to as categories, of increasing protection against contamination of the environment and protection of humans and Earth.⁶² Most missions in the past decade have not involved planets

⁵⁸ *Id.* at art. IX.

⁵⁹ *Id.* at art. VI (emphasis added).

⁶⁰ *See id.*

⁶¹ *See id.*

⁶² COMM. ON SPACE RESEARCH, PLANETARY PROTECTION POLICY (2002), 2 (amended Mar. 24, 2005), https://cosparhq.cnes.fr/sites/default/files/25_cospar_planetary_protection_policy_2011.pdf [hereinafter COSPAR PLANETARY PROTECTION POLICY].

with potential life until fairly recently when missions to Mars began.⁶³ The Mars missions called for invoking the highest level of planetary protection.⁶⁴

The United States has made planetary protections a policy and part of a checklist for approval of a launch for the private sector,⁶⁵ since all launches must be approved by the Federal Aviation Administration ("FAA").⁶⁶

Looking ahead, the infrastructure for addressing quarantine for humans returning from space travel in Category IV or V is necessarily part of needed preparation for missions currently being planned. Nevertheless, a broader policy is needed to not only develop a physical infrastructure but also a legal framework for space-faring humans in the coming space tourism, mining, and travel culture.

The COSPAR policy in its guidelines for Category V missions—the category of highest risk—concerning back-contamination specifies that there are two conditions where a change in protocol would preclude the spacecraft from returning to Earth:

[(1)] New data or scientific opinion arise that would lead to the reclassification of a mission classified as "Unrestricted Earth return" to "Restricted Earth return," and safe return of the sample cannot be assured, OR [(2)] The sample containment system of a mission classified as "Restricted Earth return" is thought to be compromised, and sample sterilization is impossible, then the sample to be returned shall be abandoned, and if already collected the spacecraft carrying the sample must not be allowed to return to the Earth or the Moon.⁶⁷

B. Private Space Travel Must Comply with Planetary Protection

As described earlier, planetary protection protocols require two aspects of enforcement to ensure they are followed: public and private sector space activities. The United States complies with the COSPAR

⁶³ See generally *id.*

⁶⁴ *Id.* app. at A-5.

⁶⁵ NAT'L AERONAUTICS & SPACE ADMIN., NASA PROCEDURAL REQUIREMENTS, NPR 8020.12D, SUBJECT: PLANETARY PROTECTION PROVISIONS FOR ROBOTIC EXTRATERRESTRIAL MISSIONS, APPENDIX D, https://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_8020_012D_&page_name=AppendixD (last visited Sept. 15, 2019).

⁶⁶ COSPAR Planetary Protection Policy, *supra* note 62, at 1.

⁶⁷ *Id.* app. at A-1-A-2.

protocol for planetary protection.⁶⁸ The objective of the COSPAR protocol for planetary protection is:

... for the reference of spacefaring nations, both as an international standard on procedures to avoid organic constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of this UN Space Treaty and other relevant international agreements.⁶⁹

C. Enforceability is a Weakness

The language of the Outer Space Treaty can be interpreted to specifically require that space-faring nations not contaminate the moon or any celestial body.⁷⁰ But the enforceability of the treaty has not yet been seriously tested. International law is soft law, so its enforcement requires as much diplomacy as enforcement. Enforcement tools can be harsh, such as trade restrictions and sanctions, but these tools are diplomatically driven and must be administered uniformly among all nations to make the sanctions or restrictions meaningful.

China, for example, has violated the Outer Space Treaty by creating unnecessary space debris by their space missions to target and explode satellites.⁷¹ Despite creating more than 3,000 pieces of debris, the United Nations has never forced China to pay for its actions or sanctioned it. Even the small enforcement power of The Outer Space Treaty was not used to enforce this very important requirement, and China's actions have disastrous consequences for all spacefaring nations, increasing the likelihood that their space debris will collide with other space debris or spacecrafts.⁷²

⁶⁸ See generally *Overview of Planetary Protection*, *supra* note 26 ("As described in the following section, the NASA policy, and its associated guidelines and requirements, are well aligned with the COSPAR Planetary Protection Policy, and is consistent with Article IX of the 'Outer Space Treaty.'").

⁶⁹ COSPAR Planetary Protection Policy, *supra* note 62, at 1.

⁷⁰ See *Outer Space Treaty*, *supra* note 5, at art. IX.

⁷¹ Carin Zissis, *Backgrounders, China's Anti-Satellite Test*, COUNCIL ON FOREIGN RELATIONS (Feb. 22, 2007), <https://www.cfr.org/backgrounders/chinas-anti-satellite-test>.

⁷² "Collisions with space debris" can mean penetration of a spacecraft, which potentially disables and/or destroys it.

III. POLICY INDICATIONS THAT A RENEWED FOCUS IS NEEDED FOR BACK CONTAMINATION

Four major policy shifts or absences indicate that the United States and other space-faring nations have currently neglected the issue of back contamination: (1) the United States' rescindment of its quarantine policy; (2) a lack of priority for back contamination in comparison to forward contamination by the drafters of planetary protocols; (3) The National Academies' observation of a need to focus on back contamination in its 2018 report on planetary protection policies; and (4) the lack of legal framework for the quarantine of travelers or any public health preparation for space travel.

A. The Elimination of Human Health and Quarantine from U.S. Planetary Protection Protocols

When humans first traveled to the moon, NASA considered it important to quarantine them upon their return to Earth. By the 1990s, however, NASA formally rescinded the regulations governing quarantine after space travel, as the fear of contamination from space travel was no longer a concern⁷³ and was "no longer in keeping with current policy."⁷⁴

The U.S. Public Health Service ("PHS") detailed the first "Planetary Quarantine Officer" to NASA in 1963.⁷⁵ The PHS is a branch of the Department of Health and Human Services (as it is now named) that is focused on public human health.⁷⁶ When writing its original quarantine policy, NASA utilized the PHS's expertise on human quarantine from diseases and drew on that experience when writing the policies for space biocontamination.⁷⁷

Similar to the misconceptions surrounding the "Here be Dragons" warnings in ancient explorations, where the real "dragons" were not ship-eating creatures found in the ocean but were diseases such as

⁷³ 14 C.F.R. §1211 (repealed 1991).

⁷⁴ Extraterrestrial Exposure, 56 Fed. Reg. at 19,259.

⁷⁵ MELTZER, *supra* note 32, at 55–56.

⁷⁶ See *History*, U.S. DEP'T OF HEALTH AND HUMAN SERVS., COMMISSIONED CORPS OF THE U.S. PUB. HEALTH SERV., <https://www.usphs.gov/aboutus/history.aspx> (last visited July 31, 2019).

⁷⁷ See MELTZER, *supra* note 32, at 55–56.

scurvy, smallpox, typhoid fever, and cholera,⁷⁸ the dragons we should fear in space travel are yet-to-be-named. However, the emergence of the study of extremophiles and astrobiology and new discoveries and studies in these burgeoning fields have advanced the plausibility of the theory that life may exist in extreme environments beyond Earth and have brought us closer to naming the “dragons” that may exist in space.⁷⁹

Our world history teaches us that we should focus on quarantine policies in drafting planetary protection protocols. Diseases discovered through exploration or exploits in war have resulted in more human death throughout history than any physical injuries sustained during war itself.⁸⁰ The possession of such historical knowledge urges the adoption of policies addressing public health at the outset of space tourism or conflict to mitigate the potential risks that could result.

B. Lack of Priority for Back Contamination Compared to Forward Contamination

In 2015 and 2016, NASA conducted workshops on planetary protection in accordance with the NASA Policy on Planetary Protection Requirements for Human Extraterrestrial Missions.⁸¹ The goals of the workshops were to “capture the current state of scientific and technological knowledge and to identify gaps.”⁸² From these workshops, NASA compiled information and conducted a gap analysis on knowledge that it developed into a report. Although forward contamination “[is] clearly important,” NASA has stated that “potential back contamination is the highest planetary protection

⁷⁸ See Mortlock, *supra* note 10.

⁷⁹ Nancy Merino et al., *Living at the Extremes: Extremophiles and the Limits of Life in a Planetary Context*, FRONTIERS IN MICROBIOLOGY (Apr. 15, 2019), <https://doi.org/10.3389/fmicb.2019.00780>.

⁸⁰ Vincent J. Cirillo, Two Faces of Death: Fatalities from Disease and Combat in America’s Principal Wars, 1775 to Present, 51 PERSPECTIVES IN BIOLOGY & MED. 121 (2008).

⁸¹ NAT’L AERONAUTICS & SPACE ADMIN., POLICY INSTRUCTION 8020.7, NASA POLICY ON PLANETARY PROTECTION REQUIREMENTS FOR HUMAN EXTRATERRESTRIAL MISSIONS, http://nodis3.gsfc.nasa.gov/OPD_docs/NPI_8020_7_.doc [hereinafter NPI 8020.7].

⁸² James E. Johnson et al., NASA’s Path to Planetary Protection Requirements for Human Exploration Missions: Update on Recent Progress, INST. OF ELEC. & ELEC. ENG’G, 4 (2016).

priority for future human Mars missions” —a statement in keeping with COSPAR policy.⁸³ Curiously, the gaps identified in the workshops, called “Knowledge Gaps,” focused almost entirely on forward contamination. Of the 23 “Knowledge Gaps” identified in the report, only one of the 23 focused specifically on back contamination.⁸⁴ Two Knowledge Gaps had some relation to both forward and back contamination; while 20 of the 23 focused solely on forward contamination.⁸⁵

“Knowledge Gap 2.4” was the only gap identified solely for back contamination.⁸⁶ Knowledge Gap 2.4 asks the question: “What consideration should go into the design of quarantine facilities and methods (for uses on the way to Mars, on Mars, or returning from Mars)?”⁸⁷ Other identified gaps that indicate a relation to back contamination identify the need for technology to monitor risks to crew⁸⁸ and for knowledge about whether the length of time of a surface stay correlates with “time/duration and the density and spread of contamination.”⁸⁹

Since NASA’s abandonment of its quarantine policy in 1991, the agency appears to have wiped the policy from its institutional memory. No mention is made of NASA’s experience with or the history of an existing quarantine regulation for the Apollo missions in NASA’s official documentation. This is alarming because the information NASA gained from the quarantine program for the Apollo missions could be instructive to those needing to establish quarantine programs for space faring missions in the future. Another alarming issue is the lack of interagency cooperation that was present in the

⁸³ *Id.* at 2.

⁸⁴ See Johnson, *supra* note 82, at 5–6.

⁸⁵ *Id.*

⁸⁶ *Id.* at 5.

⁸⁷ *Id.*

⁸⁸ *Id.* (“Knowledge Gap 1.2, Identification of appropriate technology for microbial monitoring to mitigate risk to crew, ensure planetary protection and/or preserve scientific integrity.”).

⁸⁹ *Id.* (“Knowledge Gap 2.1. Does the duration of human surface stay (30 days v. 500 days) matter? Does it change the objectives of planetary protection during missions? (What is the relationship between human exploration time/duration and the density and spread of contamination?)”).

creation of NASA's first quarantine program. At the time, NASA sought the advice of PHS, the agency having experience with quarantine, but did not work with any other agencies—at least not publicly.⁹⁰ This lack of interagency consultation is particularly troubling because had NASA given this knowledge gap some attention at the time, they may have found a need to seek advice about human quarantine beyond their own experience.

C. The National Academies Speak to the Need to Revise the U.S. Planetary Protection Policy

The National Academies is a scientific leadership body, independent of, yet supported by, the federal government, that renders advice and oversight related to science and technology of interest to the federal government.⁹¹ The National Research Council ("NRC"), a division of The National Academies, recruits experts from across the United States in their assigned subject matter to review research projects, to create ad hoc committees that serve voluntarily, and to produce reports on science questions posed to them.⁹² The National Academies also provides independent advice and analysis to government agency programs, such as NASA's Office of Planetary Protection.⁹³

In 2018, the National Academies/NRC Committee to Review the Planetary Protection Policy Development Process ("Planetary Protection Committee"), which was appointed at NASA's request, created a report and list of recommendations related to planetary protection. The advice from the Planetary Protection Committee covered three areas: (1) general advice to NASA concerning planetary protection, (2) advice to NASA concerning the Office of Planetary

⁹⁰ This author has found no evidence that NASA worked with the Centers for Disease Control and Prevention or any unit in the Department of Health, Education and Welfare (now the Department of Health and Human Services) in 1963 when it created the quarantine program.

⁹¹ See *Organization*, NAT'L ACADS. OF SCI., <http://www.nasonline.org/about-nas/organization/> (last visited Sept. 6, 2019).

⁹² *History: The Organization of the National Research Council*, NAT'L ACADS. OF SCI., <http://www.nasonline.org/about-nas/history/archives/milestones-in-NAS-history/organization-of-the-nrc.html> (last visited Sept. 9, 2019).

⁹³ See NAS, REVIEW OF PLANETARY PROTECTION POLICY, *supra* note 6.

Protection, and (3) advice concerning sample return from human missions to Mars.⁹⁴ This last area of advice focuses on back contamination in space travel.

The Planetary Protection Committee wrote that “the future of space exploration will likely . . . create serious challenges to the development and implementation of planetary protection policy.”⁹⁵ Among the factors causing these challenges, the Planetary Protection Committee noted, was NASA’s loss of “special national priority” by the mid-1970s, which resulted in a drastic drop in the level of government funding received by NASA.⁹⁶ The most disruptive changes involve the “sample return from, and human mission to, Mars” and missions involving “water oceans” (which are more likely to be a habitat for lifeforms).⁹⁷ The need to develop legal frameworks to support the scientific policies around these challenges is important both in domestic law as well as international law. The Committee summarized its findings: “[T]he current planetary protection policy development process is inadequate to respond to progressively more complex solar system exploration missions, especially in an environment of significant programmatic constraints.”⁹⁸

The Planetary Protection Committee recommended that NASA develop a planetary protection strategic plan that addresses “[i]dentifying the agency’s strategy for dealing with major policy issues such as sample-return and human missions to Mars and private sector solar system exploration missions.”⁹⁹ Because of the long-neglected human component of space travel, the need to develop a legal framework to address human missions and sample-return processes should now also be part of the strategic plan. The United States and other space-faring nations can learn from our history with human exposure to disease risks and use the legal framework created

⁹⁴ See *id.* at 1–5.

⁹⁵ *Id.* at 1.

⁹⁶ *Id.*

⁹⁷ *Id.*

⁹⁸ NAS, REVIEW OF PLANETARY PROTECTION POLICY, *supra* note 6, at 2.

⁹⁹ *Id.*

for those risks as a model to instruct the creation of a legal framework that addresses back contamination in space travel.

D. Lack of Legal Framework for Public Health Preparedness for Space Travel

A closer examination of the scope of what the planetary protection policy actually protects is revealing.

Biosphere is not defined in any of NASA's glossary, but a common dictionary definition of "biosphere" is "the regions of the surface and the atmosphere of Earth or another planet occupied by living organisms."¹⁰⁰ Interestingly, a focus on human health and the microbiome of humans is oddly overlooked in the definition. The choice of the word "biosphere" in the definition for planetary protection and the plain meaning of this word do not reflect the 21st century of the concept of life, which includes the human microbiome and the scope of life within the human body, as well as around it.

The lack of reference to the protection of human health in the definition of planetary protection is striking because the human body comprises an entire system that hosts and transports microbes. Indeed, at one point in our space travel history, the main focus of planetary protection was on human health and back contamination of humans on Earth, but there was a dramatic shift away from that approach in the early 1990s toward an approach that currently focuses on the biosphere of Earth.¹⁰¹ The statutorily authorized regulations that contained quarantine precautions were withdrawn in favor of the new biosphere definition, with very little explanation – other than it was no longer needed.¹⁰²

¹⁰⁰ *Biosphere*, LEXICO, <https://www.lexico.com/en/definition/biosphere> (last visited Aug. 1, 2019).

¹⁰¹ See MELTZER, *supra* note 32 at 325–28.

¹⁰² See *Extraterrestrial Exposure*, 56 Fed. Reg. at 19,259.

NASA currently recognizes three other planetary bodies that could support life—Mars, Europa, and Enceladus.¹⁰³ Missions to these planetary bodies receive higher levels of planetary protection, but without a focus on human health. Anticipated travel to new planetary bodies that are more similar to Earth than currently recognized planetary bodies may indicate it is time to revisit a focus on humans, not just the biosphere, in planetary protection policy.

1. Federalism, National Security, and the Absence of a Federal Biosecurity Legal Framework

Currently, planetary protection is framed as a government activity or a private sector activity with federal government regulatory oversight. However, under the current framework, the matter of public health is at risk of being overlooked. Despite the threat of bioterrorism, our legal framework does not allow for a national biodefense approach; rather, biodefense is left to the states. That is, under the United States' federalism framework, the responsibility for public health falls to the states. This responsibility extends to any public health threat that may also pose a threat to national security. Considering how to address space travel and public health preparedness as a nation would be a significant step to developing a coordinated, national strategy and legal framework, rather than to relying on our existing outdated federal-state system.

Under the federalism approach to public health, quarantine law is under the states' purview because it "can be most advantageously exercised by the States themselves."¹⁰⁴ Even on international borders, the federal government delegates the authority to quarantine individuals to the states. Therefore, it would be in keeping with this practice to have states serve as the quarantine authority, delegated to

¹⁰³ NASA's Planetary Protection categories are identical to COSPAR's categories. The most restrictive category described in NASA's planetary protection program is Category V, which involves missions to the following planetary targets: "Mars, Europa, Enceladus, others TBD: 'restricted Earth return.'" *Planetary Protection*, NAT'L AERONAUTICS & SPACE ADMIN., OFFICE OF SAFETY & MISSION ASSURANCE, <https://sma.nasa.gov/sma-disciplines/planetary-protection> (last visited Sept. 6, 2019) (navigate to "Missions" section, then select the hyperlinked text, "planetary target and type of mission" for a drop-down list of planetary targets for all missions).

¹⁰⁴ *Gibbons*, 22 U.S. at 203.

them by the U.S. Centers for Disease Control and Prevention (“CDC”), for implementing quarantines from space travel.

2. Ebola as a Case Study: State Response to the Ebola Outbreak

Under the current federalism framework, issues of biosecurity remain within the realm of public health—the responsibility of the states—even where national security is at stake. If this framework remains in place, the first Ebola case in the United States serves as a case study of how a regulatory scheme might be implemented for space travel.

The first Ebola case in the United States occurred in Texas.¹⁰⁵ On September 25 2014, a 45-year-old male arrived in the United States from Ebola-stricken Liberia, and on October 8, 2014, the patient died in a Dallas, Texas hospital after being unsuccessfully treated there.¹⁰⁶ Because biosecurity was not defined as a national security issue, the issue of treating and dealing with the aftermath of this patient was jurisdictionally and constitutionally the sole responsibility of Texas. The role of the CDC was limited to an advisory one; the agency could only get involved in a public health issue upon request by a state’s governor.¹⁰⁷ Because public health is defined as a state issue, state sovereignty ensures no federal encroachment on that sovereignty—unless invited by the state.

In the Texas case, the CDC was ill-prepared to assist the state or the country with implementing a protocol for exposure to Ebola. To exacerbate the issue, Texas was slow to seek advice from the CDC, and Texas suffered liability for the lack of Ebola training and protocols of the hospitals. Learning from this experience, Texas has since taken steps to create a network of hospitals, including a pediatric-designated hospital, that will be designated to handle future public health

¹⁰⁵ See MICHELLE S. CHEVALIER, CTRS. FOR DISEASE CONTROL & PREVENTION, MORBIDITY & MORTALITY WEEKLY REPORT, EBOLA VIRUS DISEASE CLUSTER IN THE UNITED STATES—DALLAS, COUNTY, TEXAS, 2014, (Nov. 14, 2014), <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm63e1114a5.htm>.

¹⁰⁶ *Id.*

¹⁰⁷ *Data Collection and Reporting*, CENTERS FOR DISEASE CONTROL AND PREVENTION (2018), <https://www.cdc.gov/nndss/data-collection.html> (last visited Mar 30, 2019) (discussing that the CDC has no authority to act within a state jurisdiction with the exception of a short list of reportable diseases, and even then, the relationship is more one of cooperation).

emergencies related to similarly threatening diseases.¹⁰⁸ The designation means these hospitals will require additional training and resources. This action further shifts the responsibility of national security issues related to public health emergencies onto the states.

During the Ebola outbreak, other states, such as New York and New Jersey, implemented quarantines for travelers with symptoms and certain returning visitors.¹⁰⁹ These states also began to issue notices to travelers arriving from Ebola-stricken countries.¹¹⁰ The notices informed travelers that they should be aware of the symptoms of Ebola and report them immediately.¹¹¹

The creators of a back-contamination program for space travel should take instruction from the response of states during the Ebola outbreak as a model for the needs of public health preparedness. Some of the measures states took to address transmittable Earth-bound diseases can be duplicated or expanded to encompass potential disease brought back by space travelers. For example, in Texas, the same network of hospitals that have been designated for high-risk, high-consequence public health emergencies could also serve as the backbone of a network for space traveler-designated hospitals for travelers returning from high-risk space travel, such as Category IV and V trips.

3. Ebola as a Case Study: Biosecurity as a National Security Issue

When an issue is declared to be a national security issue, it falls under the jurisdiction of the federal government, not the states. Yet,

¹⁰⁸ See TEX. TASK FORCE ON INFECTIOUS PREPAREDNESS DISEASE & RESPONSE, REPORT & RECOMMENDATIONS 16 (Dec. 1, 2014), https://static.texastribune.org/media/documents/Task_Force_Recommendations_12-01-2014.pdf?_ga=2.213451602.772894339.1568604454-1944995883.1568604453.

¹⁰⁹ See *New Jersey Releases Nurse Quarantined for Suspected Ebola*, NBC NEWS (Oct. 27, 2014, 8:42 PM), <https://www.nbcnews.com/storyline/ebola-virus-outbreak/new-jersey-releases-nurse-quarantined-suspected-ebola-n234661>.

¹¹⁰ See generally Katrin Kohl et al., *United States Notifications of Travelers from Ebola-Affected Countries*, 15 *Health Security* 261 (2018) (discussing notifications submitted by New York City).

¹¹¹ See e.g., *Ebola: What You Need to Know*, ALBANY COUNTY DEP'T OF HEALTH, <http://www.albanycounty.com/Government/Departments/DepartmentofHealth/ebola.aspx> (last visited Sept. 6, 2019); *Ebola*, CITY OF NEW YORK DEP'T OF HEALTH, <https://www1.nyc.gov/site/doh/health/health-topics/ebola.page> (last visited Sept. 6, 2019).

the United States still lacks a federal regulatory framework when a biosecurity issue is also one of national security. The Ebola outbreak in West Africa in 2014 presented a challenge to the United States' legal framework. The need to respond to the Ebola outbreak exposed our country's lack of awareness of the impediments that our system of federalism presents to national security and revealed how a general lack of federal preparedness led to delays in responding to the Ebola outbreak.

The Ebola epidemic is a useful analogy when analyzing the use of quarantine as a biosecurity defense, and it can help us understand what is transferable knowledge and what requires new thinking. For example, the risk-balancing and due process considerations with respect to known infectious Earth-bound diseases are not congruent with the need for space-faring humans to be quarantined as a precaution against unknown extraterrestrial diseases. That is, the risks may be very small, but the consequences could be catastrophic—this calls for a different approach to quarantine considerations for both the government and the space-faring tourist. In planning for commercial space tourism, travelers will not only necessarily need to sign liability waivers, but also should be required to sign voluntary waivers of due process for quarantine. The need for a voluntary waiver of due process for quarantine and the right to challenge a quarantine should be assessed using a pre-determined risk-balancing test under due process theory.

Additionally, aspects of the states' regulation of public health during the Ebola epidemic can be instructive analogies to assist with the development of a forward-looking policy for a civilian space-faring population. The lessons we learned from the Ebola epidemic in West Africa and the disease's appearance in the United States have provided us with some sense of how quarantine and hazardous clean-ups can be used within our existing federalism legal framework.

The Ebola outbreak in West Africa was declared a national security issue by President Obama, in his September 16, 2014 Executive Order to deploy troops to West Africa.¹¹² In his remarks accompanying

¹¹² Pres. Barack Obama, Remarks by the President on the Ebola Outbreak at the Ctrs. For Disease Control and Prevention (Sept. 16, 2014), <https://obamawhitehouse.archives.gov/the-press-office/2014/09/16/remarks-president-ebola-outbreak>.

the Executive Order, President Obama explained why the Ebola epidemic was an issue of national security:

If the outbreak is not stopped now, we could be looking at hundreds of thousands of people infected, with profound political and economic and security implications for all of us. So this is an epidemic that is not just a threat to regional security—it's a potential threat to global security if these countries break down, if their economies break down, if people panic. That has profound effects on all of us, even if we are not directly contracting the disease.¹¹³

President Obama's remarks describe the existing federalism system for public health in the United States, but they do not reflect an accurate description of the allocation of the governmental responsibility under the Constitution when there is an issue of national security.

The language of the Executive Order itself lack reference to "security," but stated that the purpose of the deployment of troops to West Africa was "humanitarian."¹¹⁴ No mention of security issues here in the United States were made in the Executive Order, even though the President's remarks implied that local security was an underlying concern.

Domestically, the responsibility to address Ebola victims, exposure, quarantine, treatment, training, and post-outbreak clean-up efforts fell entirely to the states. This reality was confirmed by a directive for how state and local governments should address post-deployment in a memorandum from the Under Secretary of Defense for Personnel and Readiness for the Department of Defense, Sec. Jennifer Wright, issued on October 10, 2014. This memorandum stated that "[t]he services will establish procedures for local authorities to carry out monitoring and evaluation of returning individuals."¹¹⁵ The

¹¹³ *Id.*

¹¹⁴ Exec. Order. No. 13,680, 79 Fed. Reg. 63,287 (Oct. 16, 2014).

¹¹⁵ Memorandum from Jessica L. Wright, Under Sec'y of Def. for Pers. & Readiness, U.S. Dep't of Def., to Gen. Counsel of Dep't of Def. et al., on Pre-Deployment, Deployment and Post-Deployment Training, Screening and Monitoring Guidance for Dep't of Def. Pers. Deployed to Ebola Outbreak Areas (Oct. 10, 2014), https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Personnel_Related/15-F0199_USDP_Memo_Guidance_for_DoD_Personnel_Deployed_to_Ebola_Outbreak_Areas_10_Oct_14.pdf [hereinafter October 10, 2014 Memorandum from Under Sec'y of Def. for Pers. & Readiness].

effect of this memo—to shift the burden of national security to the states—was arguably unconstitutional, as national security is traditionally a federal government obligation.

Undoubtedly, after some debate about the constitutionality of this directive, the Secretary of Defense issued a replacement directive, which stated that the Department of Defense (“DOD”) was replacing the October 10, 2014, directive.¹¹⁶ This new directive, dated October 31, 2014, differed from the original only in its direction regarding the post-deployment monitoring of personnel, correcting the unconstitutional shift in burden in the previous memorandum.¹¹⁷ The new directive began the section on post-deployment as follows: “Once individuals depart the Ebola outbreak area, regardless of any previous monitoring in theater, they will be monitored for 21 days IAW” using specified measures outlined in the memorandum.¹¹⁸ Following the October 31st memorandum, the Joint Chiefs of Staff of the DOD issued a memorandum on November 14, 2014, that specified the locations for the monitoring.¹¹⁹ Finally, on December 17, 2014, the Joint Chiefs of Staff issued a memorandum that set forth restrictions for movement and other limitations for post-deployment for personnel.¹²⁰

The series of directives issued by the DOD provide two insights on the responsibilities of the federal government versus the state government with respect to national security. First, the series of

¹¹⁶ Memorandum from Jessica L. Wright, Under Sec’y of Def. for Pers. & Readiness, U.S. Dep’t of Def., to Under Secretaries of Def., Dep’t of Def., et al., on Pre-Deployment, Deployment and Post-Deployment Training, Screening and Monitoring Guidance for Dep’t of Def. Pers. Deployed to Ebola Outbreak Areas — Change 1 (Oct. 31, 2014), <https://archive.defense.gov/home/features/2014/1014 Ebola/docs/Pre-Post-Deployment-Training-Screening-Monitoring-Guidance-for-DoD.pdf>.

¹¹⁷ *Id.*

¹¹⁸ *Id.*

¹¹⁹ *See generally* Memorandum from David L. Goldfein, Dir., Chairman of the Joint Chiefs of Staff, Post-Deployment Policy for 21-Day Controlled Monitoring of Dep’t of Def. Serv. Members and Civilian Emps. Returning from Ebola Virus Disease Outbreak Areas in West Africa (Nov. 14, 2014), <http://archive.defense.gov/home/features/2014/1014 Ebola/docs/CJCSI4220.01.pdf>.

¹²⁰ *See generally* Memorandum from David L. Goldfein, Dir., Chairman of the Joint Chiefs of Staff, Post-Deployment Policy for 21-Day Controlled Monitoring of Dep’t of Def. Serv. Members and Civilian Emps. Returning from Ebola Virus Disease Outbreak Areas in West Africa (Dec. 17, 2014) (on file with author).

directives show that the federal and state governments were clearly confused about their respective constitutional obligations as they related to national security because the federal government attempted to shift post-deployment monitoring to states and local governments, even though this is the responsibility of the federal government. Second, the series of directives show that the DOD understood that post-deployment troops would endanger the lives of civilians who resided in the states and communities to where the troops would return.

The other lesson that the deployment of troops during the Ebola outbreak teaches us is how the federal government treats the military different from civilian DOD personnel deployed to the same West African regions and exposed to the same risk of exposure to the Ebola virus. Under military policy, military personnel could be ordered to undergo a mandatory 21-day quarantine or risk court martial and/or a dishonorable discharge.¹²¹ However, civilian personnel with the same exposure and risk, were given the option to be monitored instead of quarantined.¹²² Obviously, Ebola does not distinguish between civilian constitutional rights and military diminished constitutional rights! The only difference between these two scenarios is that civilians have due process rights related to government monitoring or quarantine that require exhibited symptoms or other probable cause to detain them for monitoring or surveillance. The DOD's civilian directive read as follows:

5. May a DoD civilian employee who is asymptomatic decline to use the military controlled monitoring?

Yes, as this is a voluntary option, an employee may decline to participate in the military "controlled monitoring" program. However, they must still comply with mandates from applicable public health authorities, which could include the Centers for Disease Control and Prevention ("CDC"), State and local public health agencies.¹²³

¹²¹ *Id.*

¹²² *Id.*

¹²³ Memorandum from Paige Hinkle-Bowles, Deputy Assistant Sec'y, Office of Assistant Sec'y of Def. for Readiness and Force Mgmt., on Civilian Pers. Guidance for Dep't of Def. Civilians Deployed to Ebola Outbreak Areas (Nov. 7, 2014), https://archive.defense.gov/home/features/2014/1014_ebola/docs/DASD-CPP-Guidance-for-DoD-Civilians-Deployed-to-

The language of the civilian directive reflects that the constitutional analysis is different for civilians than for military personnel and that mandatory quarantine or monitoring could not be ordered for civilians, even if they are DOD employees. During the Ebola outbreak, a nurse who returned from West Africa and was quarantined in New Jersey sued the state for detaining her in violation of her constitutional rights.¹²⁴ During the time, a survey showed that an overwhelming number of New Jersey and New York residents (79%) supported the *mandatory* quarantine of individuals returning from West Africa during the Ebola outbreak.¹²⁵ However, the nurse asserted in her suit that she had no symptoms of the virus, and, thus, she had been unconstitutionally held in violation of her constitutional due process and liberty rights.¹²⁶

If the citizens of states with spaceports were asked a similar question as to whether the United States should have mandatory quarantine for space travelers returning to their state, then it would be likely that those questioned would have a similar level of support to the support for quarantine during the Ebola outbreak. If mandatory quarantine becomes a policy for space travel, then every civilian space traveler would need to execute a waiver of due process rights to challenge a quarantine in order to effectively institute mandatory quarantine. In general, a person can waive his or her constitutional rights as long as such waiver is informed and not contrary to public policy or law.¹²⁷ Waiver of tort liability is already required of space travelers by law in several states.¹²⁸ Waiver of due process rights to

Ebola-Outbreak-Areas.pdf.

¹²⁴ *Hickox v. Christie*, 205 F. Supp. 3d 579, 590 (D.N.J. 2016).

¹²⁵ A poll conducted by *The Economist* and *YouGov* contained the following question: “Do you approve or disapprove of the policy of New York’s and New Jersey’s governors to require a mandatory 21 day quarantine for medical personnel returning from treating Ebola patients in west Africa?” The responses were 79% Approve, 8% Disapprove, and 13% Not Sure. *The Economist/YouGov Poll, YOUGov 2* (Oct. 25–27, 2014), https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/sqyquubzea/econToplines.pdf.

¹²⁶ *Hickox*, 205 F. Supp. 3d at 597.

¹²⁷ See *D.H. Overmyer Co. v. Frick Co.*, 405 U.S. 174, 187-88 (1972) (finding that a petitioner corporation, which knew the legal consequences of waiver, validly waived its due process right to prejudgment notice and hearing).

¹²⁸ See *e.g.*, TEX. CIV. PRAC. & REM. CODE Ann. §§ 100A.001-004 (West 2019) (Chapter 100A is entitled “Limited Liability for Space Flight Activities:); Space Flight Liability and Immunity

challenge a quarantine upon return by space travelers would likely be a reasonable way to implement a mandatory quarantine policy for space travelers.

With foresight, better planning, or changes the federalism model for public health in the area of space travel, the United States could better insure against catastrophe. Actions such as requiring waivers of due process and acceptance of quarantine as pre-requisites to space travel for civilians may provide a means for shifting the constitutional analysis for due process rights for U.S. citizens. The public health legal framework might see a shift in federalism, similar to the 1970s shift in federalism in the area of environmental law for many of the same reasons.

IV. INVASIVE SPECIES AS A CASE STUDY: ANOTHER POSSIBLE SOURCE FOR REGULATING SPACE TRAVEL

One final important aspect to consider in the creation of a back-contamination policy are the lessons learned from the efforts to combat invasive alien species introduced into the United States and other countries where they are not native. Invasive alien species can often destroy an ecosystem where they are newly introduced because (1) they have no predators, (2) they have an over-abundant food supply, or (3) both.¹²⁹ For example, in the Great Lakes region, a ship must empty its ballast water before entering a lake.¹³⁰ This requirement is an effort to combat the invasiveness of the zebra mussel and to avoid introducing another invasive species like the zebra mussel to the United States. Zebra mussels have turned out to be an impossible-to-eradicate invasive species.¹³¹

Act, VA. CODE ANN. §§8.01-227.8-.10 (2019); COLO. REV. STAT. § 41-6-101 (2019); FLA. STAT. §331.501 (2019) (addressing informed consent in spaceflight and limits on liability of spaceflight entities); and Space Flight Informed Consent Act, N.M. STAT. ANN. §41-14-3 (2010) (repealed effective July 1, 2021).

¹²⁹ See generally NANAOKO SHIGESADA & KOHKICHI KAWASAKI, BIOLOGICAL INVASIONS: THEORY AND PRACTICE (1997).

¹³⁰ See *Invasive Species in the Great Lakes*, ENVTL. PROT. AGENCY, <https://www.epa.gov/greatlakes/invasive-species-great-lakes> (last visited Aug. 2, 2019).

¹³¹ See generally *Non-Indigenous Aquatic Species: Dreissena polymorpha*, U.S. GEOLOGICAL SURVEY, <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5> (last visited Aug. 2, 2019).

While the efforts to contain zebra mussels have been retroactive measures, protection against invasive species includes taking proactive measures, such as the requirements in place in the Great Lakes. Researchers believe that the introduction of zebra mussels to the Great Lakes was done during the ballast exchange of a commercial vessel that entered the Great Lakes regions from the northern shore of the Black Sea, where zebra mussels are native.¹³² The efforts in the Great Lakes can inform our creation of a back-contamination policy. Even if we do not know if an invasive species is present, proactive measures are still an effective means to combat what could be introduced to the Earth's ecosystem via a returning spacefaring vessel.

While the United States has not ratified the Convention on Biological Diversity ("CBD"), which was organized for the purpose of controlling or eradicating alien species in non-native ecosystems,¹³³ it historically has had in place policies and regulations that follow the guidelines and principles of the treaty.¹³⁴ The International Union for Conservation of Nature ("IUCN") Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species,¹³⁵ requires precautions for the invasive pathways that include: trade, tourism and ballast water.

CONCLUSION

The evolution of planetary protection has been driven by concerns for the protection of the Earth and other planets from the possibility of biocontamination. NASA's withdrawal of regulations governing

¹³² *Id.*

¹³³ See generally *The CBD and Invasive Alien Species*, The CBD and Invasive Alien Species (2009), <https://www.cbd.int/idb/2009/about/cbd/> (last visited Mar 27, 2019) ("Article 8(h) of the CBD states that, 'Each contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.'").

¹³⁴ See Gloria Dickie, *The US is the only country that hasn't signed on to a key international agreement to save the planet*, QUARTZ (Dec. 25, 2016), <https://qz.com/872036/the-us-is-the-only-country-that-hasnt-signed-on-to-a-key-international-agreement-to-save-the-planet/>.

¹³⁵ *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species*, INT'L UNION FOR CONSERVATION OF NATURE, SSC INVASIVE SPECIES SPECIALIST GROUP http://www.issg.org/pdf/guidelines_iucn.pdf (last visited Sept. 1, 2019).

quarantine for space travelers coincided with its discontinuation of sending humans to the moon. Now that vision has been re-animated as the potential for humans to travel into space in the tourism¹³⁶ and mining industries¹³⁷ is becoming a reality.¹³⁸

Even if each mission is carefully planned for planetary protection, and the civilian space travel industry is sufficiently regulated to enforce planetary protection protocols, the near future—we can expect—will contain space-faring travelers—whether that travel be for industry, mining, tourism, or the military. Currently, we have too many knowledge gaps related to the necessary public health infrastructure for humans beyond the federal and highly regulated commercial sector. The federalism model that leaves public health as the responsibility of the states should be re-analyzed, and the United States should consider whether we should continue the existing constitutional framework or whether we should create a different legal framework that (1) addresses all the risks associated with increasing civilian space travel and (2) properly addresses potential public health and national security concerns with respect to quarantine and due process protocols for space-faring civilians. The future of space travel demands that NASA consider all of these concerns when developing their strategic plan for a new 21st century planetary protection policy. By addressing these concerns now, NASA could position the United States as a global leader for space-faring planetary protection policies.

¹³⁶ Jonathan O'Callaghan, *2019 is the year that space tourism finally becomes a reality. No, really*, WIRED (Jan. 24, 2019), <https://www.wired.co.uk/article/spacex-blue-origin-space-tourism>.

¹³⁷ *Making space mining a reality with Asteroid Mining Corporation*, MINING TECHNOLOGY (Oct. 24, 2018), <https://www.mining-technology.com/features/making-space-mining-reality-asteroid-mining-corporation/>.

¹³⁸ *Id.*