


Commentary

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How the James Webb Space Telescope Can Inform Health Security

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Introduction

In a moment when life on Earth has felt increasingly tragic and troubling based on what has become the background noise of the continued impacts of the COVID-19 pandemic, dangerous climate change impacts, and other international affairs challenges, NASA and its partners released images of the early universe from a historical space telescope. The launch of the James Webb Space Telescope in December, 2021 was the result of decades of innovation and challenges, but the images just beginning to be released are awe-inspiring. Not since the release of 'Earthrise' from the Apollo 8 mission has images from space highlighted how Earth is both grand and delicate. Against the vastness of the universe, the fragile nature of the Earth is overshadowed by the endless possibilities that exist within the galaxies around us. The images from the Webb telescope are an inspiration for scientific progress and for the next generation of scientists who will lead us into the future. The story of the James Webb Space Telescope and its creators serves as an important and informative lesson for the future of global health security which is still reeling from the continued threat of COVID-19 and the newly emerging Monkeypox threat. The necessary advancements in global health security will be a formulation of great failures such as the overall COVID-19 response, the result of never-ending commitment to progress from practitioners and policy makers, an effort of global collaboration, and one of increasing complexity that requires a diversity of thought to find innovative solutions; all themes which line the story of the James Webb Telescope and serve as an analogy for the mission towards the next great frontier in global health security, one free of global catastrophic biological risks.

Failure to launch

The unforgettable photos that NASA shared throughout the middle of July 2022 are iconic pictures that will define the new space age. However, the cosmic slide show of 'sharp and sublime technicolor mélange, staring back at the human species from 13 billion years in its past,'¹ almost did not happen.

The telescope began its journey initially in 1993 when a panel of 'astronomers proposed that NASA build an infrared space telescope with a mirror 4 meters (about 13 feet) in diameter' with a price tag of \$500 million USD.² Then-NASA Administrator Dan Goldin wanted something far more audacious, even going as far as stating the telescope should be 6 or 7 meters during a speech in 1996. NASA, however, settled on a 6.5 meter telescope with an estimated cost of \$4 billion USD.² The launch date was slated for 2007, but was moved from 2007 to 2011 to 2013 with costs rising above \$7.4 billion USD. In 2011, following an independent review of the program, the House Appropriations Committee recommended canceling the mission entirely.² Even with the authorization to continue, the telescope continued to face setbacks as during testing in 2018, errors with screws, and a solvent, as well as wiring, set the project back a year and 6 months, adding another \$600 million USD to the cost. When the telescope finally launched in December of 2021 the cost of the program had risen to an astronomical \$10 billion USD.

The uncertainty around whether the telescope would even get off the ground, literally, should not have been unexpected. Failure is the nature of doing ground-breaking science, as no matter the quality of innovation, it is always hard and unpredictable. The James Webb telescope had 344 potential 'single point failures.'³ Some of the key components, 'the vast segmented main mirror, the origami-like sun shield, and the cryocooler that keeps the ultrasensitive instruments just a few degrees above absolute 0, as well as the array of thousands of micro-shutters, each thinner than the width of a human hair, that will open and close to allow light from targeted objects to reach the telescope's sensors,' all had to be invented from scratch.² Acknowledging that there will be setbacks is an important part of innovation. One of 'humanity's greatest engineering achievements' (quoting Vice President Harris),⁴ was the product of delays, errors, and failures over a 20 year span.

Now, the space program is no stranger to failure. Even the now successful Hubble Space Telescope, the predecessor to the James Webb, was initially an embarrassment for NASA which

sent Hubble into orbit with a misshapen mirror.⁵ However, unlike the Hubble, the Webb telescope cannot be repaired in space as it was not modular and is 'placed more than 4 times farther from Earth than the moon.'²

The mission for health security is like that of the James Webb as there is little to no room for error without drastic impacts on human life and safety. The COVID-19 pandemic has highlighted how a number of unanticipated failures can accumulate to dramatically impact global stability and human life. The failures in health security should be expected in various innovative efforts, such as pharmaceutical countermeasure improvements, as they were with the James Webb, but not in response to a novel threat. The pandemic is closer to the post-launch stage of the telescope where the globe needs near perfection in order to reduce the impact on humanity. The scientists working on the James Webb conducted a number of tests, found failures, and made improvements to ensure future success. The COVID-19 pandemic was a real world test which we objectively failed from an overarching perspective. Now is the time for global health security experts and stakeholders to make improvements to our capabilities, forging new partnerships so when the next health security threat is launched, either by nature, or a human-caused event, we have no failures and only successes that will define the next generation of health security.

Aiming for the stars

The successes seen with the James Webb are the result of a never-ending commitment to progress. Prior to the James Webb, the Hubble Space telescope defined astronomy for 3 decades. The Hubble and its exploration have 'fundamentally changed our perception of the universe.'⁶ James Webb's concept was inspired by Hubble, but picks up where Hubble fell short.⁷ The James Webb is the 'biggest, most complex, and most expensive science mission that NASA has ever attempted.'⁸ The scientists involved with the project had the vision to dream bigger and the administration and Congress committees involved were willing to take necessary risks to yield such an incredible payoff. Health security needs such vision, innovation, and acceptable funding risks in order to prepare for the next emerging threat, and to respond to the on-going impact of COVID-19 more adequately.

While few would argue that the pandemic response was anywhere near positive around the globe, there were some objective successes that should also be recognized within the field. Against the backdrop of tremendous amounts of death and suffering around the globe, the 'development of several highly efficacious vaccines against a previously unknown viral pathogen, in less than one year from the identification of the virus, is unprecedented in the history of vaccinology.'⁹ The rate at which a vaccine was successfully developed for COVID-19 was historical, but also the result of years of advance research in which researchers had been working on new kinds of vaccines related to other coronaviruses of SARS (severe acute respiratory syndrome) and MERS (Middle East respiratory syndrome).¹⁰ The success of vaccinations are just a small sample of the tremendous successes in public health and other health security components, but like those involved with the James Webb, health security practitioners need to continue to strive to go bigger and better. The strengthening of health systems and governance, along with the creation of tools for cross-border risk communication, early warning detection systems, and on-going research programs are all lofty targets that must become the James Webb of health security.

A shared frontier

The James Webb Space Telescope was the largest space telescope humanity ever conceived.¹¹ In order to achieve such a successful feat, albeit with a number of challenges, an international collaboration was needed. The telescope was the product of collective investments from the US, EU, and Canadian Space Agencies.¹¹ Each of the countries involved were willing to make extensive investments to reach the edge of the universe and to open the door for the next generation of space research. The project consisted of over 1000 people each working on individual segments of the telescope that all needed to come together in the void of space after launch.¹¹ While the telescope was primarily built to find the 'first galaxies that formed in the early universe, and peer through dusty clouds to see stars forming planetary systems,'¹² it is also being used by a group of scientists on their quest to find another earthlike planet among the stars.¹¹ Using the transit technique researchers will look for other Earth like planets by detecting small changes in starlight from planets passing in front of a star.¹¹

The various stakeholders leveraging the same technology for different projects, and the global collaboration should serve as a prompt for all those in health security to recognize that regardless of background, they all have a stake in health security. Internationally, everyone is working on pieces of the global health security puzzle which requires that each piece comes together perfectly for the world to be truly safe from global threats. The James Webb was a result of collective genius in which every piece of hardware, 500 pieces of ground support, and the variety of human capital involved all had a story and a team devoted to the success of the mission.¹¹ The COVID-19 pandemic revealed how unprepared the world was for such an event. Many national responses to the pandemic ignored multilateralism and collective action which is necessary to respond to an infectious disease threat. The reductionism of national responses, especially high-income countries, that prompted countries to frequently adopt hostile, nationalistic policies that eliminated collective action, were the cause of a number of failures in the response. All countries around the world have a shared frontier which is the global health security space. Collaboration and solidarity within a global-focused response are necessary to ensure that the world is prepared to address the next biological threat. In an ever-connected world, no country has the ability to achieve public health and health security on its own. A shared frontier of health security requires collective investments to improve detection, warning, collaboration, and coordination within systems that promote shared values of collective responsibility and equity.

Mission critical diversity

The successes of the James Webb extend far beyond the decades of space-based discoveries that are only just beginning. The researchers who are looking to leverage the James Webb to find other Earth-like planets are a pioneering group of female scientists who are also the focus of the film, 'The Hunt for Planet B.'¹¹ Within the film, a female scientist, Natasha Batalha, told a story of her childhood when her mother, who is also a scientist within the program, had her and her siblings draw pictures of astronauts. Natasha remarked about how excited she was to show her mother the picture. The picture depicted a white man (although her mother was a female scientist and her father was a Latin scientist).¹¹ Much like many other fields, it is crucial that health security becomes more diverse and representative of our globe's true

demographics. Even for those who are white males in the field, their role now needs to include serving as a vocal advocate for change by promoting equity and diversity within their work. Additionally, health security and its solutions cannot exist within the collective minds of just the global north. Global health security is just that, a global initiative to promote and protect the health of the world. Innovative solutions out of necessity require representation of all parties, especially those that have traditionally been restricted from having a voice. Diversity extends beyond just human capital, into the construction of the stakeholders which are invited to the table.

The James Webb's construction involved a number of diverse, multidisciplinary teams with various experts traversing a number of different fields such as engineering, astronomy, and mathematics. Health security necessitates that all stakeholders have a voice in the future efforts of the field. To best address the multitude of biological threats that we will face in the near future, our solutions need to consider a variety of contexts such as economics, public health, and politics, as well as international relations, medicine, and security to name just a few. COVID-19 has highlighted how complicated new health security threats will be. With increasing complexity, there will be drastic public health, social, economic, and political impacts; all of which require stakeholders, even non-traditional, to be included in the future of the field. The solutions for global health security cannot reside in a single brain or even a single country. Only together, through diplomacy, and collaboration, can we truly advance health security.

Choose to go to the moon

COVID-19 will not be the last biological threat humanity will face. The world can no longer consider a devastating biological event like the COVID-19 pandemic to be a rare, once-in-a-century, occurrence. The future threats, even naturally occurring, may be more deadly and transmissible than SARS-CoV-2. Our world is evermore interconnected with air networks that allow people to span the globe in less than a day. Our food production methods, land use changes, climate change, and urbanization, as well as novel human-wildlife interfaces, directly contribute to the increasing risk and frequency of naturally occurring biological events with pandemic potential, on top of the ever present accidental or intentional biological threats.

In 1961, launching the Apollo space program, President John F Kennedy said '[w]e choose to go to the Moon and do the other things not because they are easier, but because they are hard.' President Kennedy made an impossible challenge sound possible.¹³ His words were the inspiration for a generation of innovation and successes. Ending pandemics is more achievable today than landing on the Moon was in 1961, but it will take conscious efforts from those around the globe to collectively achieve this mission globally.

Health security is not a field in which practitioners are just doing a job to make a living. The impact of the work has direct effect on the lives and well-being of humanity. It can certainly be a challenge for humans to think far into the future. However, if we are going to have a long future as a species, humanity must outgrow the norms of inequities that are pervasive throughout the world, and humans must value a world in which people actually value all life and take care of one another.

There is no doubt that the planet is facing a number of real challenges. When it comes to health security, every moment matters

since there are human lives on the line. It is crucial that we as a field, reflect on how we can tackle these global problems which will actually affect our own survival as a species. It is going to take a collective endeavor with the type of groups that we are beginning to put together in the health security field, and which follow the multidisciplinary teams that helped make the launch and use of the Webb telescope a success. It is a necessity that these collaborative groups of even non-traditional partners come together to address what is a shared problem. We must change the way that we operate in the world and the way that we approach health security now and in the future. Everyone in health security, no matter the expertise or scope, must confront the disturbing data in front of us, no matter how uncomfortable, to be able to begin the work needed to make improvements globally in equity, health, and security. It will require a better version of the field and those in it to help get to a more perfect future for the entire world.

Fifty years ago during the explosion of the space missions, we went looking for the moon and we found the Earth. The Earthrise photo taken on December 24, 1968, on the Apollo 8 mission showing the Earth from the moon, inspired within 18 months, the modern environmental movement.¹¹ All those within the field of health security must ensure that COVID-19 is that inspiring; enough to launch a collaborative movement for improvement. There is no better time than the present to begin to make connections and create multidisciplinary, collaborative teams to approach the challenges that we face in health security. The efforts to inspire global change necessitates that each person start where they are, using what they have, and doing what they can. To look into other worlds, the James Webb required we start by working together on our own planet. International collaboration yielded the most powerful space telescope ever made, allowing humanity to get the deepest infrared views of the universe ever seen. It will take ambitious scientific, financial, and political investments to build upon the successes of our past to push the boundaries of health security successes even further. The James Webb Telescope was able to break the mold of what was thought to be possible, to search for the formation of the first galaxies and horizons of other worlds. What lies just beyond the horizon for health security may just require the spark of an idea to launch us into a collective future truly safe from biological threats.

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References

1. **The Bloomberg Editorial Board.** Commentary: bold and risky, the Webb mission is already a success. *Bull.* 2022. https://www.bendbulletin.com/opinion/commentary-bold-and-risky-the-webb-mission-is-already-a-success/article_ef11d830-02cd-11ed-9897-df51609e0455.html
2. **Kaplan S, Achenbach J.** NASA's next great space telescope is stuck on Earth after screwy errors. *Washington Post.* Published 2018. <https://>

- www.washingtonpost-com.proxygw.wrlc.org/national/health-science/nasas-next-great-space-telescope-is-stuck-on-earth-after-screwy-errors/2018/07/24/742f17d4-8e93-11e8-8322-b5482bf5e0f5_story.html
3. **NASA**. *Summary of NASA responses to Webb independent review board recommendations*; 2018. https://www.nasa.gov/sites/default/files/atoms/files/webb_irb_report_and_response_0.pdf
 4. **Achenbach J**. NASA unveils first images from James Webb Space Telescope. *Washington Post*; 2022.
 5. **Overbye D, Chang K, Sokol J**. Webb telescope reveals a new vision of an ancient universe. *New York Times*; 2022. <https://www.nytimes.com/2022/07/12/science/james-webb-telescope-images-nasa.html?smid=url-share>
 6. **NASA**. *About - The Hubble story*. <https://www.nasa.gov/content/about-the-hubble-story>. Published 2022. Accessed July 16, 2022.
 7. **Kim SE**. The five big ways the James Webb Telescope will help astronomers understand the universe. *Smithson Mag*. 2021. <https://www.smithsonianmag.com/science-nature/five-big-ways-james-webb-telescope-will-help-astronomers-understand-universe-180978303/>
 8. **Clery D**. Building James Webb: the biggest, boldest, riskiest space telescope. *Science*. 2016;(80). <https://www.science.org/content/article/building-james-webb-biggest-boldest-riskiest-space-telescope>
 9. **Fauci AS**. The story behind COVID-19 vaccines. *Science*. 2021; 372(6538):109-109. doi: [10.1126/science.abi8397](https://doi.org/10.1126/science.abi8397)
 10. **Ball P**. The lightning-fast quest for COVID vaccines — and what it means for other diseases. *Nature*. 2020.
 11. **Kahn N**. The hunt for planet B. CNN Films; 2021.
 12. **NASA**. *James Webb space telescope*. https://www.nasa.gov/mission_pages/webb/main/index.html. Published 2022. Accessed July 16, 2022.
 13. **Bipartisan Commission on Biodefense**. Making the impossible possible. The Apollo Program for Biodefense. <https://www.thenextapollo.org/>. Accessed July 16, 2022.