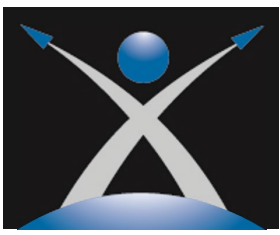


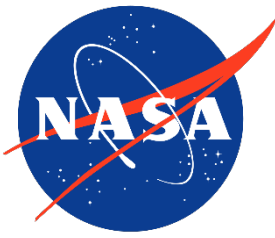
NASA Quarantine Program

Rob Mulcahy, MD, MPH

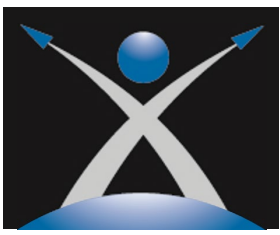
Lead Surgeon, NASA Health Stabilization Program



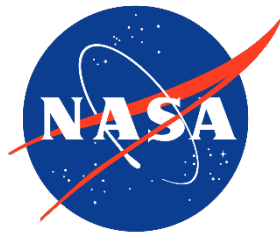
Overview



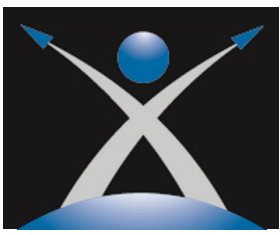
- Background
- History
- NASA Quarantine Program
- COVID Pandemic
- Russian Quarantine Program
- Private Missions
- Questions



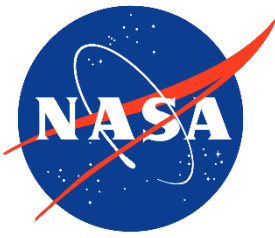
Background



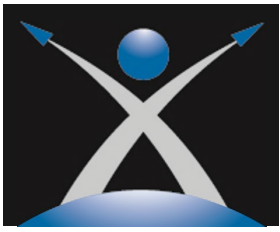
- Infections can adversely affect launch preparations or early on-orbit activities.
- Terrestrially, minor conditions such as URIs or gastroenteritis may sideline an individual for a few days.
- During a space mission, such conditions can be more impactful. Imagine:
 - An astronaut is unable to equalize his or her ears due to a respiratory infection and therefore cannot perform an emergency spacewalk.
 - Infection-related fatigue or malaise reduces an astronaut's productivity on exploration, research, or maintenance tasks in an environment where every moment is costly.



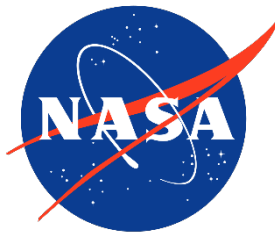
History



- Mercury
 - Short mission durations made infectious disease manifestation during a flight unlikely.
 - No organized quarantine.
- Gemini
 - Longer mission durations presented higher risk of infection emerging during the mission.
 - High ops tempo precluded development of a strict quarantine program.

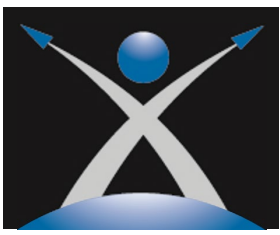


History

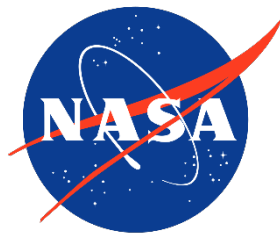


- Apollo
 - Several pre- and in-flight infections affected the early Apollo missions.
 - Pre-launch quarantine strictly implemented from Apollo 14.
 - Due to back contamination concerns, post-landing quarantine enforced for Apollo 11, 12, and 14 before being retired.





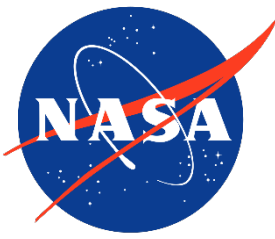
History



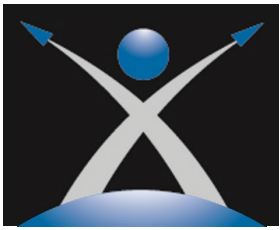
Mission	Illness	Crew Involved	Outcome
Apollo 7	Upper respiratory infection	3	
Apollo 8	Viral gastroenteritis	3	
Apollo 9	Upper respiratory infection	3	
Apollo 10	Upper respiratory infection	2	
Apollo 12	Skin infection	2	
Apollo 13	Rubella infection	1	Backup crewmember substituted
Apollo 13	Urinary tract infection	1	
Apollo 14	<- HSP Implemented ->		
Apollo 17	Skin infection	1	
Skylab 3	Skin infection	2	
Skylab 4	Skin infection	2	
Salyut 7	Prostatitis	1	Early end of mission
STS-36	Upper respiratory infection	1	Launch delay
STS-128 / ISS Expedition 20	Upper respiratory infection	Numerous	On-orbit crew infected
Crew-3	Upper respiratory infection (non-COVID)	1	Launch delay



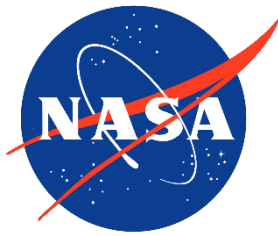
NASA Quarantine Program



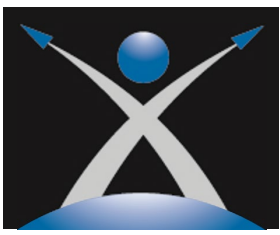
- Health Stabilization Program (HSP) = pre-launch quarantine
- Evolved over time to meet program needs and latest medical knowledge
- Key pillars remained remarkably stable:
 - Training
 - Immunizations
 - Medical screening and surveillance
 - Quarantine
 - Food safety



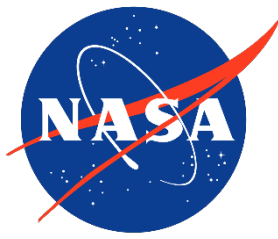
HSP



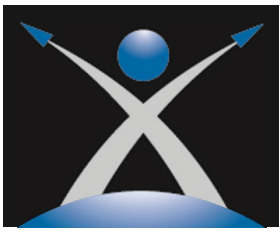
HEALTH STABILIZATION PROGRAM NASA



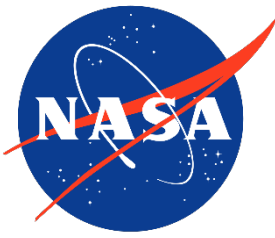
HSP Evolution



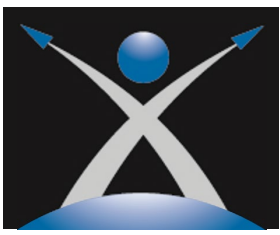
	Apollo	Skylab	Shuttle	ISS	Contemporary
Training			Yes	Yes	Yes
Immunizations	Yes for Astros & Family	Yes for Astros & Family	Yes for Astros; Flu for all	Yes	Yes
Medical Evaluations	Yes	Yes	Yes	Yes	Yes
Surveillance	Yes	Yes	Yes	Yes	Yes
Quarantine	21 days	21 days	7 days	14 days	14 days



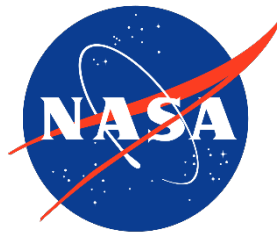
Contemporary HSP



- Quarantine begins 14 days prior to launch
- Houston-based portion can occur at home
- “HSP participants” = personnel in quarantine
- Precautions based upon risk posed by role
 - Group A (close crew contact without masking)
Examples: crew, families, quarantine facility residents
 - Group B+ (close crew contact with one-sided masking)
Examples: closeout crew, suit room personnel
 - Group B (close crew contact with universal masking)
Examples: food service, medical teams
 - Group C (6 ft social distance + universal masking)
Examples: quarantine facility admin personnel, housekeeping, pad workers



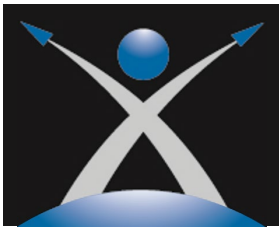
Why 14 Days?



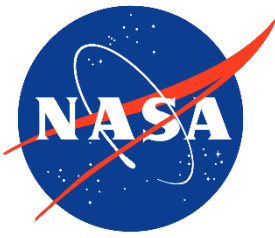
- Most common pathogens of concern = respiratory and gastrointestinal.
- Several respiratory pathogens have incubation periods up to or longer than 7 days (e.g. adenovirus 4-8 days, COVID 2-14 days, RSV 1-8 days).
- 14 days is approximately twice the longest incubation period of the pathogens of concern.
- This allows an HSP participant to enter quarantine at the start of an incubation period, manifest symptoms and begin shedding virus at the end of the incubation period (~7 days into quarantine), possibly infect others before isolating, and have those others declare their infection by the end of another incubation period, all before launch.
- It is significantly simpler to handle infections on the ground than on orbit.

References for incubation periods:

- Lessler J, Reich NG, Brookmeyer R, Perl TM, Nelson KE, Cummings DA. Incubation periods of acute respiratory viral infections: a systematic review. *The Lancet infectious diseases*. 2009 May 1;9(5):291-300.
- Lee RM, Lessler J, Lee RA, Rudolph KE, Reich NG, Perl TM, Cummings DA. Incubation periods of viral gastroenteritis: a systematic review. *BMC infectious diseases*. 2013 Dec;13(1):1-1.
- Liu Y, Zhao S, Ryu S, Ran J, Fan J, He D. Estimating the incubation period of SARS-CoV-2 Omicron BA. 1 variant in comparison with that during the Delta variant dominance in South Korea. *One Health*. 2022 Dec 1;15:100425.
- Hay JA, Kissler SM, Fauver JR, Mack C, Tai CG, Samant RM, Connolly S, Anderson DJ, Khullar G, MacKay M, Patel M. Quantifying the impact of immune history and variant on SARS-CoV-2 viral kinetics and infection rebound: a retrospective cohort study. *Elife*. 2022 Nov 16;11:e81849.



Immunizations and Medical Screening/Surveillance



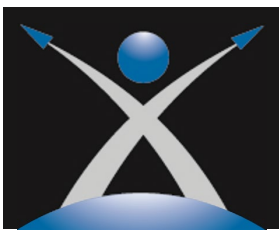
- Immunizations

- COVID
- influenza
- measles/mumps/rubella
- diphtheria/pertussis
- polio
- varicella (chicken pox)
- hepatitis A and B

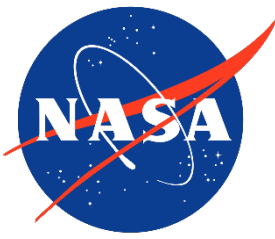
- Medical screening/surveillance

- Brief electronic or in-person health screening between L-21 and L-14 days
- Daily electronic surveys from L-14 days

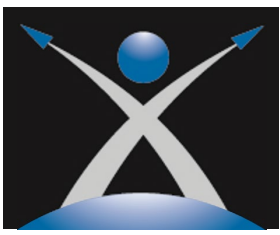




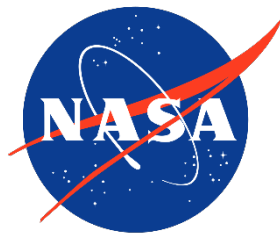
Quarantine Measures for Group A



- Treat your home as though it is a quarantine facility.
- Use only delivery or contactless pick-up for food, groceries, or supplies.
- Do not go out to the store or other locations, even while wearing a mask.
- Cohabitants should not attend in-person work, school, or other activities.
- Social distancing.
- Hand hygiene.



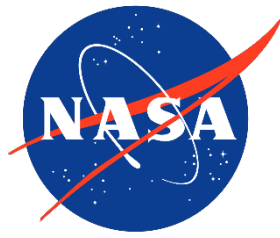
HSP Summary



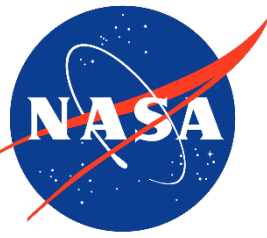
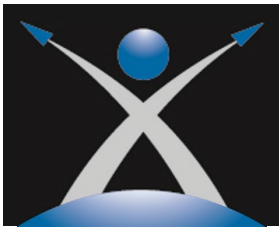
REQUIREMENT	GROUP A	GROUP B+	GROUP B	GROUP C
Education	Y	Y	Y	Y
Pre-Quarantine Medical Screening (Electronic or In-Person)	Y	Y	Y	Y
Periodic Medical Screening (Electronic or In-Person)	Y (Daily)	Y (Daily)	Y (Daily)	Y (Daily)
Immunizations	Y (Exception unlikely)	Y (Exception case-by-case)	Y (Exception case-by-case)	Y (Limited; Exception case-by-case)
Sequestered Housing	Y	N	N	N
Masking	N (Except when in close contact with personnel outside of Group A)	Y	Y	Y
Social Distancing	N	N	N	Y
Quarantine Entry After L-14 days Permitted	N	N	Y (With Observation Period)	Y (Without Observation Period)



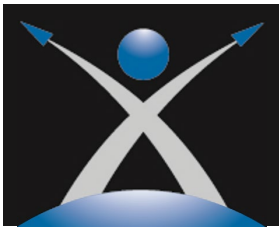
HSP Timeline Highlights



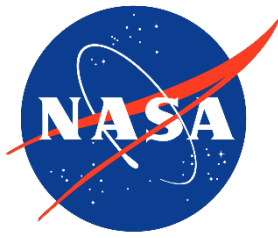
Date	Activity
L-28	Immunization completion
L-21	Training completion
L-21/14	Medical screening (electronic or in-person)
L-14	Quarantine begins
L-14	Daily surveys begin
~L-7	Crew and other key personnel travel to KSC via private aircraft
L-0	Quarantine ends after launch

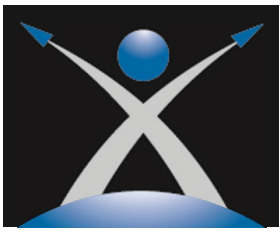


HSP in Action

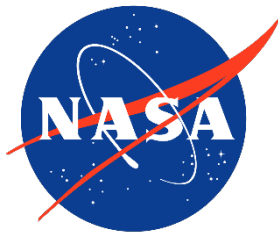


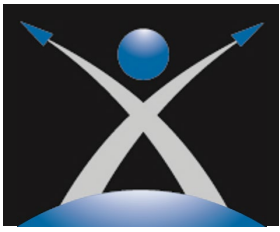
SpaceX Demo-2 Walkout



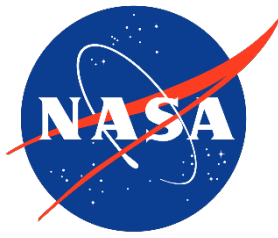


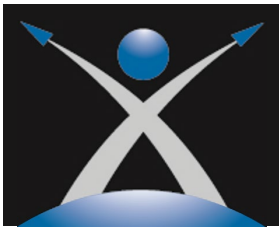
KSC Astronaut Crew Quarters Glass Window



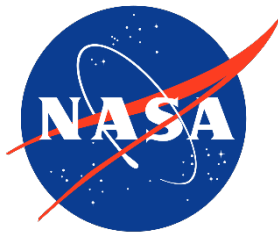


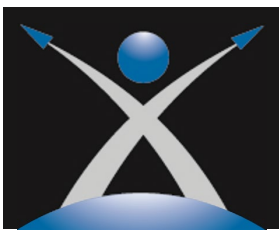
SpaceX Crew-1



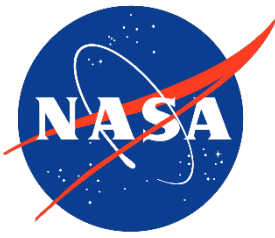


SpaceX Crew-1

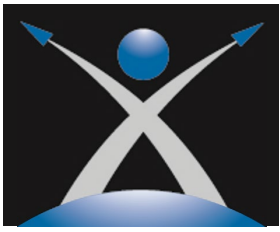




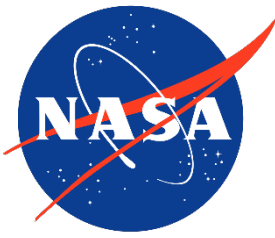
COVID Pandemic: Pre-Launch



- Standard HSP is robust
- However, in response to the pandemic, several changes implemented:
 - COVID training added in early pandemic
 - COVID testing performed
 - COVID vaccination required once available
 - Surveillance via daily symptom surveys
 - Late entry into quarantine prohibited
 - Temperature screening used in early pandemic
 - Surgical masks replaced with N95s
- Tapered with phases of pandemic

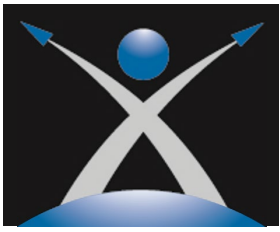


COVID Pandemic: Post-Flight

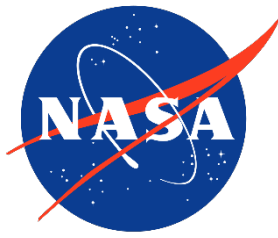


- No post-flight quarantine before COVID
- Post-Flight COVID Countermeasures (PFCC) during pandemic
- Program included:
 - COVID testing
 - COVID vaccination
 - Daily symptom surveys
 - Varying degrees of quarantine
 - PPE
- Tapered with phases of pandemic



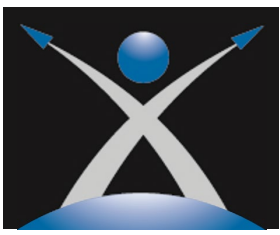


Russian Quarantine Program

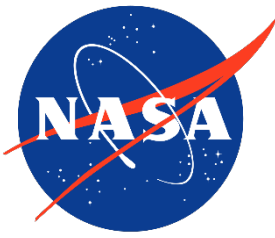


- Similar in design and scope to NASA HSP (all ISS partners follow the same quarantine agreement).
- Uses quarantine compound model (all personnel quarantine at controlled facilities and travel via private aircraft).
- Occurs in Star City, Russia and Baikonur Cosmodrome, Kazakhstan.

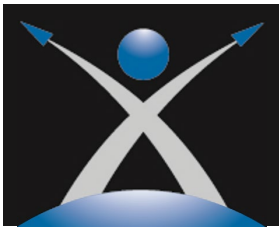




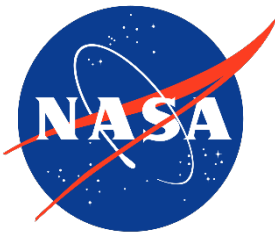
Private Missions



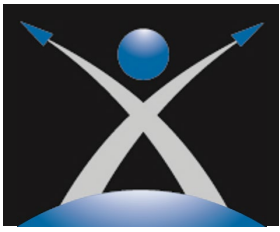
- Private missions that visit ISS follow the same requirements as NASA missions due to the infection risk posed to NASA and partner astronauts.
 - For such missions, quarantine is administered by the provider with oversight from NASA.
- Private missions that do not visit NASA assets or include NASA astronauts do not fall under the purview of the HSP.
 - Recommend that providers consider mission parameters (e.g. duration and planned activities) when determining the need for or scope of quarantine.
 - May consider differing levels of quarantine stringency for crew vs passengers to account for safety criticality of role.



Relevant Documents



- JSC 22538 – Flight Crew Health Stabilization Program
 - <https://ntrs.nasa.gov/citations/20230012738>
- OCHMO-TB-006 – Health Stabilization Program (HSP)
 - <https://www.nasa.gov/wp-content/uploads/2023/03/health-stabilization-program-technical-brief.pdf>
- SSP 50480-ANX1 - Guidelines and Procedures for the Prevention of Infectious Disease Transmission to ISS Crewmembers



Questions?

