Disaster Preparedness and Response

September 26, 2024

NIH National Institutes of Health
Office of Laboratory Animal Welfare

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Speaker

Michael R. Holbrook, PhD
Associate Director for High Containment
National Institute for Allergy and Infectious Diseases
Integrated Research Facility (IRF), Ft. Detrick, Frederick, MD

Dr. Holbrook is the Associate Director for High Containment at the National Institute for Allergy and Infectious Diseases Integrated Research Facility (IRF) at Ft. Detrick in Frederick, MD. He is the current chair of the NIH High-Containment Task Force, as well as been involved in the development and activation of three BSL-4 facilities. Prior to his current position, he was the Director of the Robert E. Shope BSL-4 Laboratory at the University of Texas Medical Branch and the Emerging and High-Risk Pathogens (BSL-4) Core of the Galveston National Laboratory in addition to running his own research program focused on emerging and re-emerging viral diseases. While there, a key consideration was the annual threat of hurricanes that could impact the barrier island which has an average elevation of 7 feet above sea level. During this time, hurricanes Katrina and Rita came close to the island and hurricane Ike made a direct hit. Disaster planning and preparedness played a critical role in the ability to reduce storm impact.

The speaker(s) declare that they have no conflicts of interest for this presentation.

Disaster preparedness and management in high containment laboratories

Mike Holbrook PhD
Associate Director for High Containment
NIAID Integrated Research Facility
Frederick, Maryland

Disclaimer

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Objectives

- Discuss the overall objectives of disaster planning for biocontainment facilities
- Provide examples of risk mitigation strategies
- Discuss ‘lessons learned’ and how this reformulates risk planning strategies
- Describe real life situations where risk mitigation plans were implemented

Disaster planning and biocontainment facilities

External stakeholders

Biosecurity regulators:

- Primary objective should focus on security of any agents housed within the facility
- Secondary objective should focus on management and care of animals
  - Not really interested unless the animals are infected with something they care about

Animal welfare regulators:

- Primary objective should focus on management and care of animals
  - How will required euthanasia impact animal protocols?
- Secondary objective should focus on security of any agents housed within the facility

Disaster planning and biocontainment facilities

- Disaster planning for biocontainment facilities should fall within the overall scope of institutional disaster planning
- Specific considerations when institutional disaster planning includes biocontainment labs
  - Agents
    - Agents need to be properly stored and secured
    - Plan for keeping freezers cold in the event of a power loss?
  - Animals
    - Any animals in a biocontainment vivarium will require care and support if studies are on-going
    - Will animals need to be euthanized? When and by whom?
    - Carcass management
  - Infrastructure
    - Will HVAC remain operational? Humidity and temperature controls?
    - Will water be available?
    - Will waste management be available?
  - Security
    - Is the facility secure?
    - Can staff access with appropriate precautions?
  - Staff
    - Will staff have access to campus and buildings?
    - Basic needs for staff? Food, water, toilets?

Critical considerations

- Agent and animal management are similarly important but one is harder
- Agents can go into a freezer
- In all but extreme cases, animals will need to be managed
  - Will food be available/accessible?
  - Will water be available?
  - Will autoclaves be available and accessible
    - Waste management
    - Cage sterilization
  - Temperature/humidity controls
  - Power
    - Will elevators work?
    - Microisolator operation
  - Carcass disposal
    - Freezer space
    - Autoclaves
    - Tissue digester
- In the event of required emergency euthanasia
  - Carcass management

Risk Mitigation Step 1-Identifying Risks

- Most risks are to personnel or operational capacity of biocontainment laboratories
  - Risks that are predictable (e.g. some weather events)
  - Risks that are unexpected (e.g. BAS failure, breathing air failure)
- Some risks are ‘dynamic’ or ‘sporadic’
  - ‘Dynamic’-changing as a potential or actual risk evolves (e.g. changing weather events)
  - ‘Sporadic’-similar events occur but infrequently (e.g. IT ‘updates’)
- When considering risk, also consider the potential impact
  - Some risks have a probable greater impact than others
  - Scale risk to assume worst case scenario
- Where the weak links?
  - Highest likelihood points of failure
  - If something could go wrong, assume it will

Major risks for high and maximum containment laboratories

- Weather and other natural disasters
- Infrastructure
  - Equipment failures (e.g. building automation systems, air handlers)
  - Power failures
  - IT failure (See Crowdstrike, July 2024)
- People
  - Disgruntled employees
  - Protests
- Politics/Funding
  - Political attacks on our work
  - Cuts to operational or support funding

Weather

Weather events are perhaps the most recognized risk that could impact research laboratories with severe events occurring more frequently

Examples:

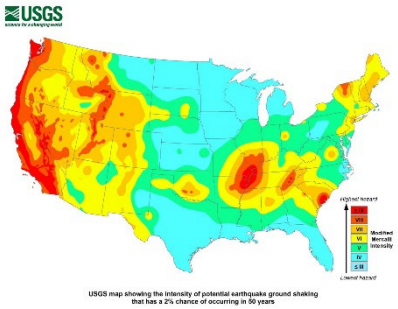
- Hurricanes
  - Research facilities on or near the US Gulf and East coasts must be prepared for hurricanes
  - June 1-November 1 although severe tropical events seem to be occurring later in the year as the ocean get warmer
  - Tropical storms can also significantly impact research facilities due to flooding- See Tropical Storm Allison, June 2001
- Tornados
  - Little advance warning
  - Typical range of large tornados seems to be increasing and moving eastward
- Blizzards
  - Not likely to damage properly built facilities, but may impact infrastructure and staffing needs, particularly for care of research animals

Natural disasters

- Wildfire
  - Laboratories in California and the mountain west at particular risk
  - Wildfire risks in the Great Plains are increasing due to drought
- Earthquake
  - Research facilities along the US west coast are at high risk for earthquake damage if not constructed properly
- Tsunami
  - Highest likelihood for a tsunami in the US is along the west coast

Dinosaur fire outside Boulder this year. Buildings are CU campus

Fukushima tsunami



USGS earthquake risk map

Not so natural disasters and other events

- Military activities
  - Three active USG biocontainment labs sit at Ft. Detrick so we think about ‘catastrophic’ events a bit differently

- Protests
  - Those working in animal research are aware of the potential impact of animal rights protests
  - Not likely to significantly impact facilities, but could impact staff

- Active shooter
  - Active shooter events can happen anywhere at anytime in the United States
  - Such an event occurred at Ft. Detrick in 2021 outside a Navy research laboratory

Potential impact areas that need to be considered

- Infrastructure
  - Central utility plant failure
  - Loss of electricity
  - Loss of chilled water
  - Loss of domestic water
  - Lost of sewage management
  - Phone system failure
  - IT system failure
    - Local or larger impact?

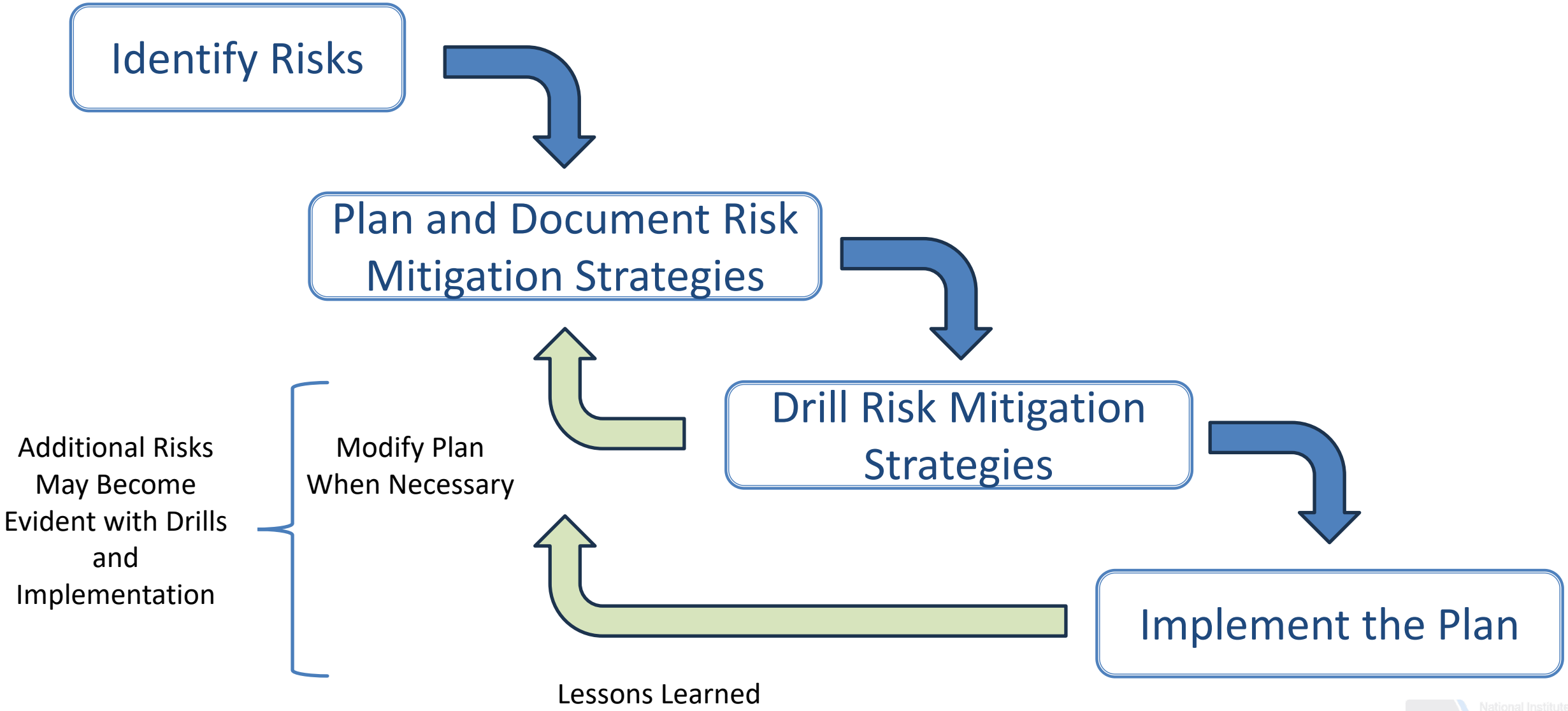
- Retaining containment barrier
  - BAS failure
  - Loss of security systems
- Staffing
  - Can staff still access the space despite certain failures?
    - Specifically relevant to management of animals
  - Can active work continue or must it be terminated? Somewhere in between?

- What resources, time and staffing are required to return to full operational capacity?
- Are there external entities that may have influence over your risk mitigation or recovery plans? (e.g. IRF-Frederick is an NIH facility located on a US Army installation and the Army has control over many aspects of our infrastructure)

Mitigating Risk (Planning)

- Once risks are identified, establish plans on how best to reduce the potential impact of an event if it occurs
  - Develop emergency response plans
  - Train staff on proper response
  - Drill similar scenarios if possible (e.g. active shooter, mysterious package)
  - Ensure to include all relevant parties, even if they seem minor or tangential
    - This includes external resources (e.g. fire and police, government officials and their aides)
- Ensure effective communication processes are in place.
  - Who? How?
  - Back-up contact(s)
  - What to do if cell phones don't work?
- When an event happens, it won't be as you planned
  - How to adapt?
  - Emergency response plans must be developed to anticipate the unexpected

Risk Mitigation Planning Process

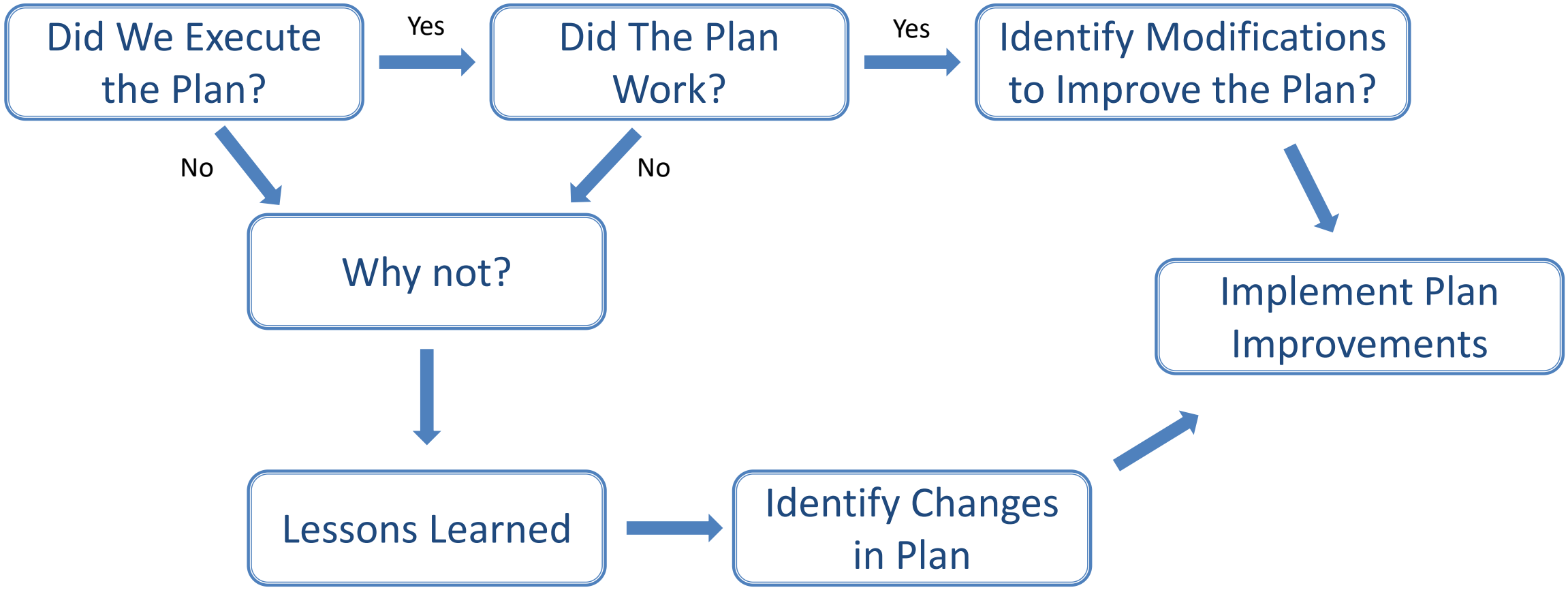


Implementing risk mitigation plans

- Begin implementation of response plans as early as practicable
  - Start with communication
    - Alert required staff and their back-ups
    - Establish communication structure with external partners
    - Alert external regulatory agencies as necessary
    - Institutional media relations people need to be involved
  - Acquire required resources
    - Think worst case scenario
    - It is better to be over prepared than under prepared
  - Initiate specified activities
  - Begin infrastructure modifications, if necessary
  - Document actions as necessary
- Ensure that all appropriate participants are involved

Post event analysis

- After any drill or event, After Action Reviews (AAR) are critical to building and implementing risk mitigation strategies
- Focus on the facts



Adapted from Patriot Technologies Group, LLC

Root causes of plan failure

Fundamentals

- Leadership
- Organization
- Teamwork
- Communication

Planning

- Were objectives clear?
- Were drills/exercises appropriate?
- Were resource needs clearly identified?
- Was approach for implementation clear?

Support

- External partners engaged?
- External resources available?

Adapted from Patriot Technologies Group, LLC

Lessons Learned

- Identify recurring events or trends
- Identify a problem, but also identify a solution
- Consider multiple perspectives
- Identify best means for preventing a recurrence
  - Single points of failure?
  - Will improved training be of benefit?
  - Are certain tasks too complex/cumbersome?
  - Are sufficient resources (people or stuff) provided to individual tasks?
  - Improved communication strategies?

Courtesy CNN

Real life examples

Disclaimer part 2

- As a faculty member at the University of Texas Medical Branch (UTMB) from 2005-2009, I have views on what I experienced. However, I have no current knowledge about risk mitigation plans, strategies or otherwise so my views represent my opinion based upon my experience and should in no way reflect upon the current operational strategies at UTMB.

Personal experience-Biocontainment labs on the Gulf of Mexico

Courtesy Wikipedia

The University of Texas Medical Branch

Courtesy UTMB

Recognizing Risks

- Hurricanes
  - Galveston sits on a barrier island off the coast of Texas
  - Hurricane season is June 1-November 1 with peak for the upper Texas coast in late summer
  - City is protected by a 17 foot seawall along the gulf that was built after the 1900 storm that devastated the island
    - The seawall prevents the ocean from moving rapidly across the island
  - Wind, rain and flooding are the causes of destruction in a hurricane event
- Flooding
  - Large rain events and tropical storms can cause flooding across the island
- Large wind and rain events can disrupt power, water and sewage services to the island

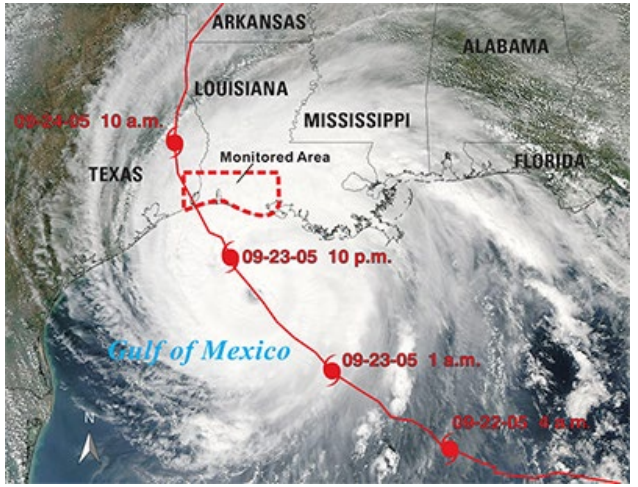
Mitigating Risk (Planning)

- Emergency response and hurricane preparedness plans at the State, City, University and laboratory levels
  - Federal entities are also involved but focused on broader issues
- Aspects of the response to hurricane event can be drilled but many can only be discussed in tabletop exercises
- Hurricanes don’t come in a ‘on size fits all’ package
  - Small differences in landfall location can significantly impact local effects
  - Nearly impossible to account for all contingencies

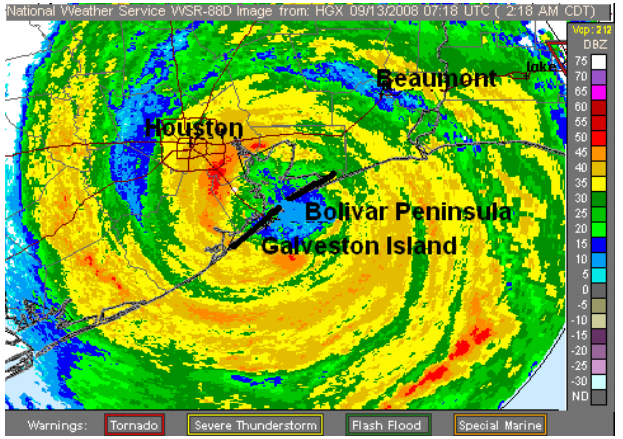
Real life testing of our plans

Four years at the University of Texas Medical Branch (UTMB) in Galveston as Director of the Shope BSL-4 lab, before the Galveston National Lab opened

- Hurricane Rita
  - Landfall at Johnson's Bayou, LA on September 24, 2005
  - Category 3 at landfall
  - Storm surge estimated up to 15 feet
- Hurricane Ike
  - Landfall at Galveston, TX on September 13, 2008
  - Category 2 at landfall
  - Storm surge estimated up to 18 feet, 13 feet in the City of Galveston



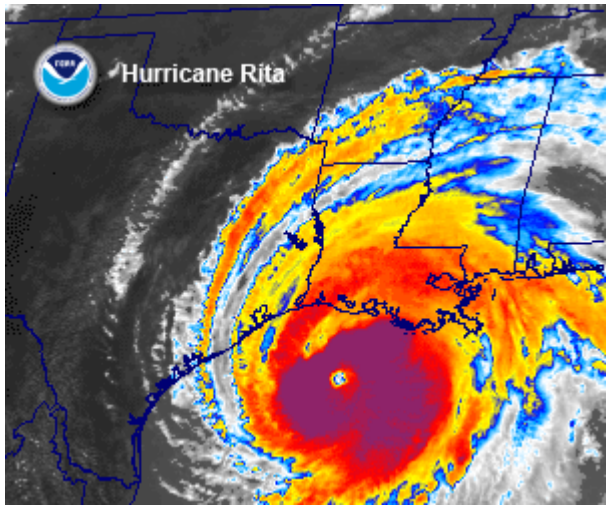
Courtesy USGS



Courtesy NWS

Implementing risk mitigation plans-Rita

- Early tracks for Rita had her making landfall southwest of the island which put Galveston in exactly the wrong place for a Category 5 hurricane



Courtesy NOAA

- Following the BSL-4 laboratory emergency response plan
  - All work was stopped
  - Animals (mice-fortunately not many) were euthanized
  - Freezers locked
  - Laboratory gas decontaminated
- BSL-2 and BSL-3 vivaria were in the basement
  - BSL-3 animals (rodents) were euthanized and the space surface decontaminated
  - BSL-2 animals (mice-long term prion studies) were moved to higher floors

Impact

- Rita ended up being a significant rain/wind event in Galveston, with little damage
- Post-Katrina panic evacuation was the most significant problem throughout SE Texas
  - Colleague took ~36h to get to N Texas, normally a 5-6h drive
  - Evacuating nursing homes and similar in buses was catastrophic
  - Ad hoc shelters were unprepared

Courtesy ABC

Courtesy Gadeson Times

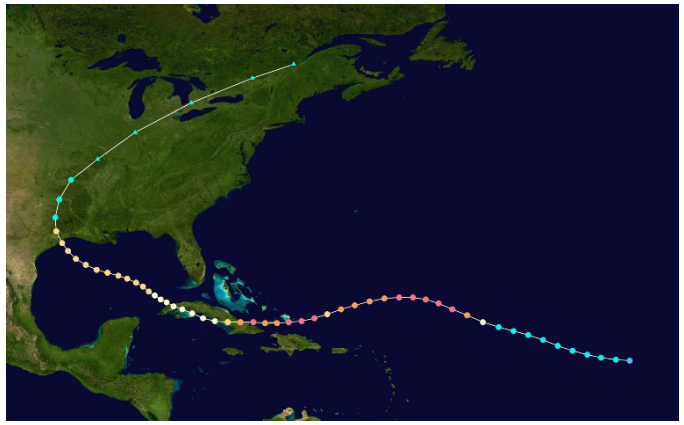
Lessons learned

- More efficient evacuation processes were required
  - Installation of contraflow capacity on interstates
  - Progressive evacuations based on risk
  - Staging of fuel and other supplies added to state emergency management plan
- Internal lessons at UTMB largely focused on hospital evacuations and how to improve that process
- The ‘non-event’ with Rita may also have instilled some complacency that impacted future decision-making

Courtesy Wikipedia

Implementing risk mitigation plans-Ike

- Tracking suggested Ike would make landfall in the central Texas coast as a Category 2 hurricane
  - Assumed we would be back to work as usual on Monday
  - About 12h prior to landfall, it was clear that the storm surge was more than anticipated with water coming over the 17ft seawall and rapidly backing up through the storm drains



Courtesy Wikipedia

- All studies in BSL-4 and ABSL-3 were stopped and the labs closed
  - Animals in ABSL-3 were euthanized
  - BSL-4 was NOT gas decontaminated

Courtesy UTMB

- Animals in ABSL-2 were moved from the basement to other facilities on campus
- UTMB evacuated the hospital for the second time in three years at a cost of ~$20 million

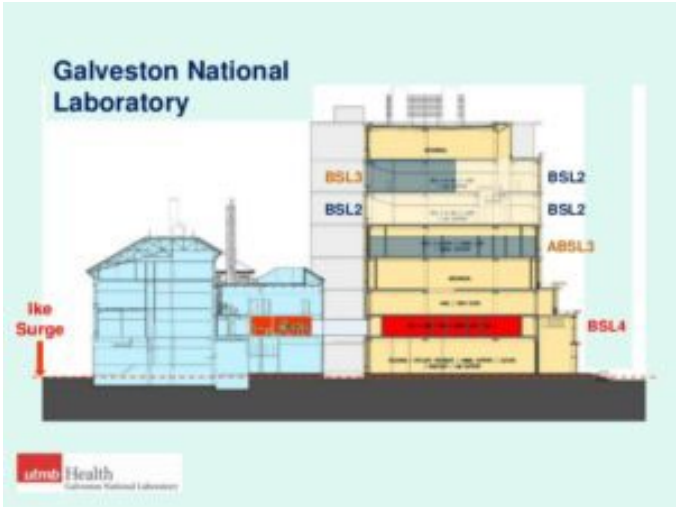
Impact

- Hospital
  - UTMB hospital had up to 6 feet of water in parts of the hospital
  - Hospital was closed in all capacities for several months
    - Emergency department closed for ~1 year;
    - Medical education on the island moved to remote sites for >1 year
- Animals (mostly mice) in ABSL-2 were euthanized
  - No A/C and no medical waste disposal
  - First floor of main animal care facility had flooded and ruined the elevator
- For campus recovery staff there were porta-johns and outside handwashing stations, and no showers for several weeks
- Minimal electricity until some portable generators could be brought on site
- The island and campus were closed for ~1 month while utilities were brought back on-line
- Research was significantly reduced for several months

Impact-Biocontainment facilities

- Galveston National Laboratory was not yet operational as a research facility but some administrative and facility spaces were occupied
  - 'Substantial completion' of construction was achieved in early August 2008
  - Minimal impact to the GNL; Some water ingress at the back dock, front door and a side door
- Adjacent Keiller building suffered significant flood damage to the basement where ABSL-2, ABSL-3 and BSL-2 insectary spaces were housed along with offices and BSL-2 labs
  - Keiller sump pumps were generally effective until the support generator flooded and lost power
- Shope BSL-4 lab lost all power
  - Bioseals on the ventilation system closed and the lab was sealed
  - Back-up bottled air kept air-pressure resistant doors sealed
- ~Two days after Ike, construction company that built GNL connected a high voltage power line from the GNL generators to Keiller/Shope to repower the emergency power to the space
  - Freezers back on
  - Ventilation systems operational but not climate controlled

Personal Photo



Courtesy UTMB

Lessons learned

- ‘Category’ of hurricane did not correlate to the storm surge associated with the storm
  - In 2009, the National Hurricane Center changed the Saffir-Simpson scale to be reflective only of wind speed and to exclude consideration of storm surge and barometric pressure
- UTMB developed a new infrastructure plan that would reduce the impact of hurricanes on facilities
  - Critical capabilities moved to higher floors of the hospital
  - Emergency generators elevated
  - Critical utilities upgraded and made more resilient
  - Construction of new ‘District Heating and Cooling Plant’ to improve resiliency
- No hurricane or tropical storm should be underestimated in regards to its potential impact on critical laboratory or health care systems
  - See the impact of hurricane Beryl in Houston

Questions?

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Winter 2024-2025

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