Improving the Resilience of Healthcare Systems

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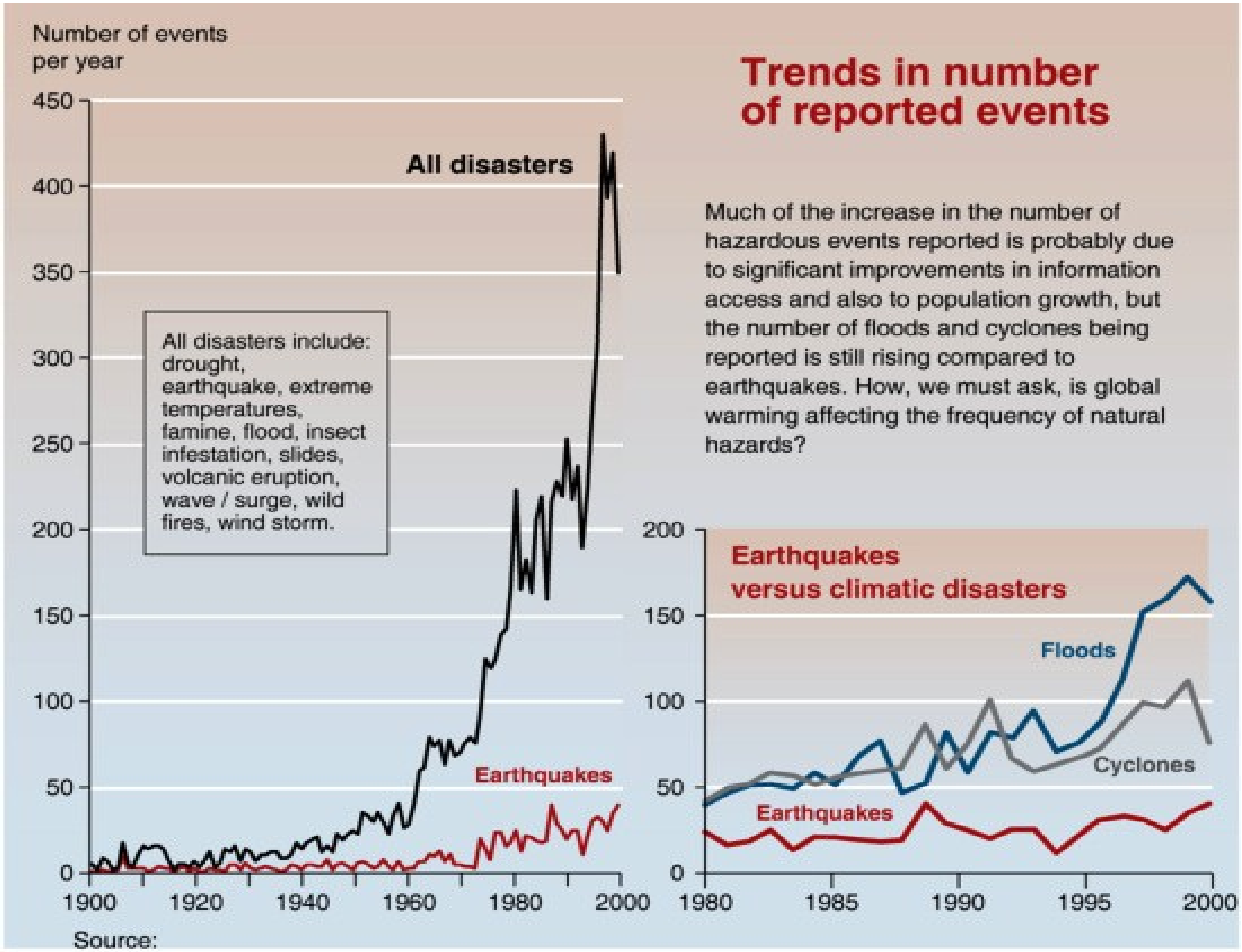
SUMMER LEADERSHIP SUMMIT 2017
EVOLUTION
REVOLUTION

Objectives

- Identify how healthcare institutions may be adversely affected by climate change
- Discuss strategies for gaining executive buy-in to study and address vulnerabilities to climate change
- Recognize key internal and external planning partners
- Review potential mitigation and response strategies

Climate-Related Disaster Patterns are Changing



Emmanuelle Bournay, UNEP/GRID-Arendal http://www.grida.no/graphicslib/detail/trends-in-natural-disasters_a899#

Historical Data No Longer Sufficient for Good Planning

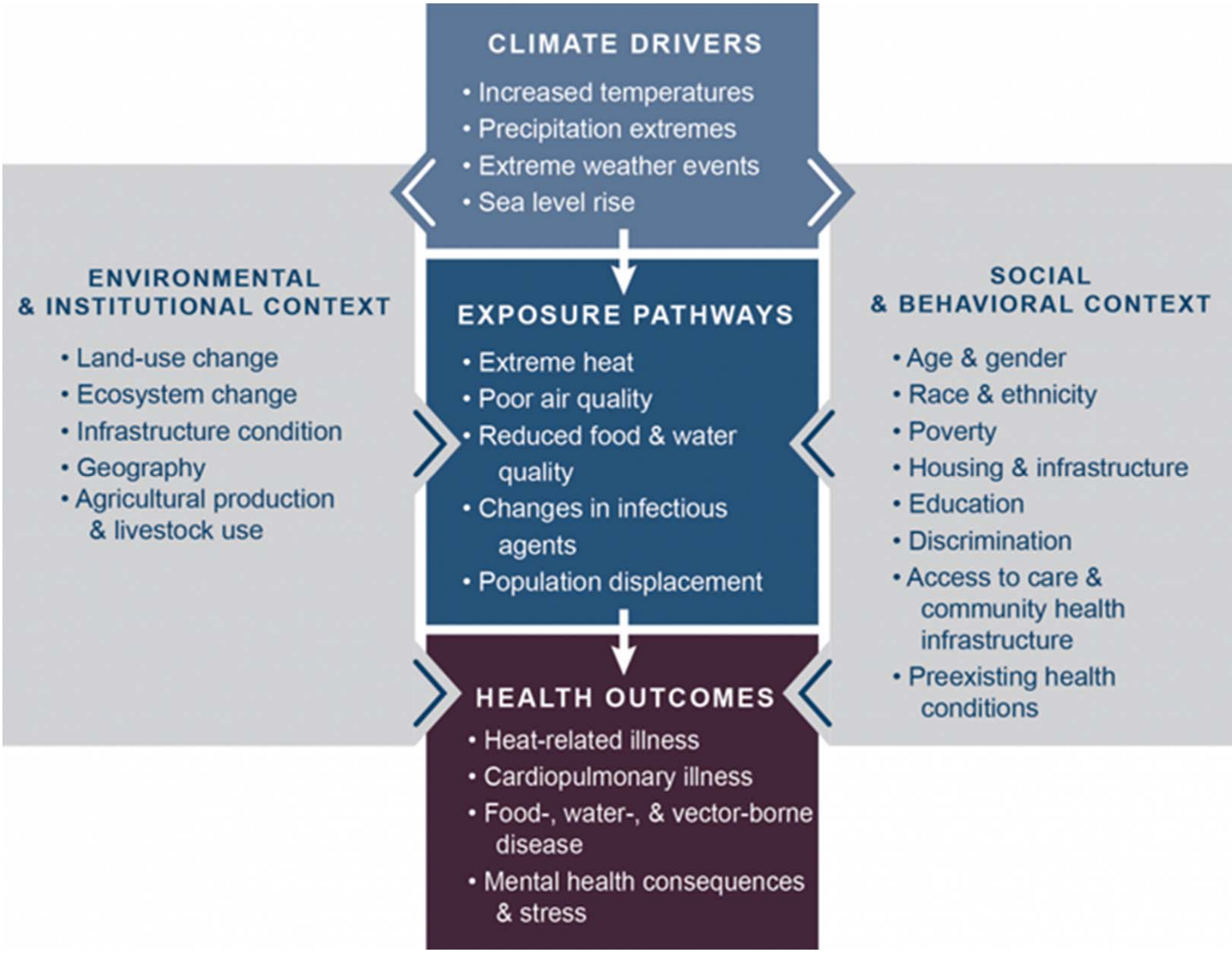
Massachusetts Historic Snowfall, 2015

Sgt. Michael Broughey, MA National Guard/Wikimedia
https://www.dvidshub.net/image/1782093

Louisiana Floods, 2016

Patrick Dennis/The Advocate via AP

Climate Change and Health



US Global Change Research Program (2016). The impacts of climate change on human health in the United States: A scientific assessment.

Climate Change and Health

U.S. Climate Resilience Toolkit

Steps to Resilience | Case Studies | Tools | Expertise | Regions | Topics

Tools › Climate Change and Human Health Literature Portal ›

This knowledge management tool allows users to locate the most relevant scientific literature on the health implications of climate change, providing access to a database of studies from around the world published between 2007 and 2014.

The portal includes studies and other information sources about

Webpage:

Climate Change and Human Health Literature Portal ›

Topics:

Health › Extreme Heat—NIHHIS ›

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Climate Change and Healthcare

- Increased threats to health mean greater demand for healthcare services

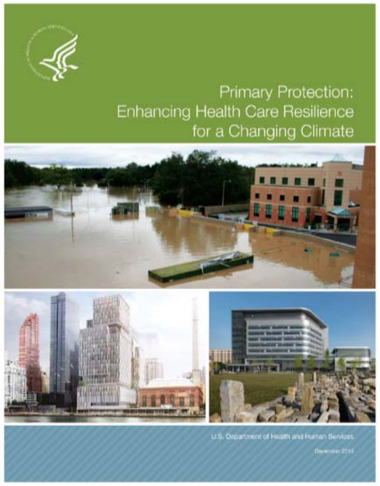
- During a disaster, health care facilities:
  - Care for the newly sick and injured
  - Must continue routine health care services
  - Sometimes serve as a place of refuge for those needing water or electricity

- Hospitals must strive to become more resilient given the impending threats of climate change
  - However, all rely on community infrastructure to some degree
  - Cannot become resilient alone

Paterson, J., et al. (2014) Health care facilities resilient to climate change impacts. *International Journal of Environmental Research and Public Health.* 11:13097-13116; doi:10.3390/ijerph111213097

Climate Change and Healthcare

- According to the US Department of Health and Human Services' 2014 report: there are several important planning considerations for healthcare with respect to climate change resilience:
  - Health care facilities and services cannot rely on community infrastructure
  - Hardening health care facilities, including hospitals and sub-acute facilities is vital
  - Resiliency includes planning for staffing and supplies in addition to physical structures
  - Green design serves a dual purpose
  - Protecting research must be part of the plan



US Department of Health and Human Services. (2014). Primary protection: Enhancing health care resilience for a changing climate. Retrieved from: https://toolkit.climate.gov/

Climate Change and Healthcare

U.S. Climate Resilience Toolkit

Steps to Resilience | Case Studies | Tools | Expertise | Regions | Topics

Sustainable and Climate-Resilient Health Care Facilities Toolkit

This toolkit includes a best practices document, a framework describing affordable measures that can help make health care facilities more resilient, and additional resources for responding to challenges associated with the impacts of climate change.

Tools › Sustainable and Climate-Resilient Health Care Facilities Toolkit ›

The U.S. Department of Health and Human Services' Sustainable and Climate Resilient Health Care Facilities Initiative (SCRHCFI) is an effort to help assure the continuity of quality health and human care before, during, and after extreme weather events. This web-based toolkit includes the SCRHCFI Best Practices document, a five-element framework that comprises a vulnerability assessment for medical facilities and suggestions for building resilience, checklists (coming soon) to walk facilities through the five elements, and additional resources that encourage practical steps for building resilience. The five elements of the framework are:

1. Climate Risks and Community Vulnerability Assessment
2. Land Use, Building Design, and Regulatory Context
3. Infrastructure Protection and Resilience Planning
4. Essential Clinical Care Service Delivery Planning
5. Environmental Protection and Ecosystem Adaptations

Last modified: 30 November 2016 - 12:45pm

Webpage:

Sustainable and Climate Resilient Health Care Facilities Toolkit ›

Regions:

Northeast › Infrastructure and the Built Environment ›

Topics:

Built Environment › Buildings and Structures ›

Health › Extreme Heat—NIHHIS ›

Health › Extreme Events ›

Health › Increased Levels of Air Pollutants ›

Health › Food- and Water-

Obstacles to Change

Skepticism about climate projections

Difficult to quantify consequential damage from broad data range

Long term cost-benefit analysis competing with short-term essentials

Making the Case

Confirm data sources, establish range of maximum/minimum projections

Assemble comparable case studies with financial quantification, business interruption, etc.

Prioritize critical items vs. medium-term actions integrated in regular budgetary cycle

About Partners HealthCare

- Boston-based non-profit integrated health system
  - Academic medical centers, community and specialty hospitals, a managed care organization, a physician network, community health centers, home care, long-term care, and more
- Primary teaching affiliate of Harvard Medical School
- National leader in biomedical research
- By the numbers (2016)
  - 68,000 employees
  - $12.5 billion total operating revenue
  - $1.7 billion academic and research revenue
  - -0.9% operating margin

Partners’ Climate Resiliency Study

Initial Influences

- Resilient design for Partners’ Spaulding Rehabilitation Hospital situated on Boston harbor (http://returnsonresilience.uli.org/case/spaulding-rehabilitation-hospital/)
- Superstorm Sandy’s near-miss to Boston
- Nearby Boston and Cambridge, MA municipal climate assessments

Initial Goals

- Identify climate risks
- Identify vulnerabilities
- Review and refine operational protocols
- Prioritize remedial action

Key to Gaining Buy In #1: Phased Approach

PHASE 1

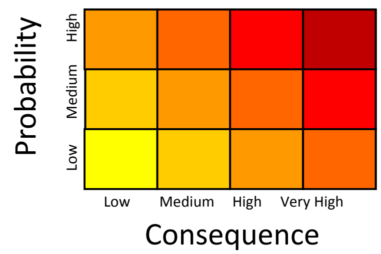
Climate Scenarios
Hazard Assessment

Climate analysis Hazard priorities

- SLR / Storm Surge
- Precipitation
- Temperature
- Wind
- *Seismic*

PHASE 2

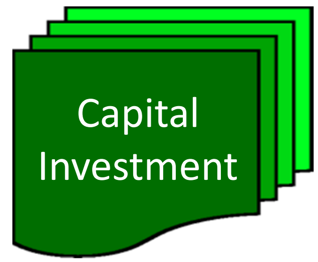
Vulnerability Assessment



- Critical Facilities and Operations
- Checklist for Risk Assessment
- Prioritize Needs Across System

PHASE 3

Implementation

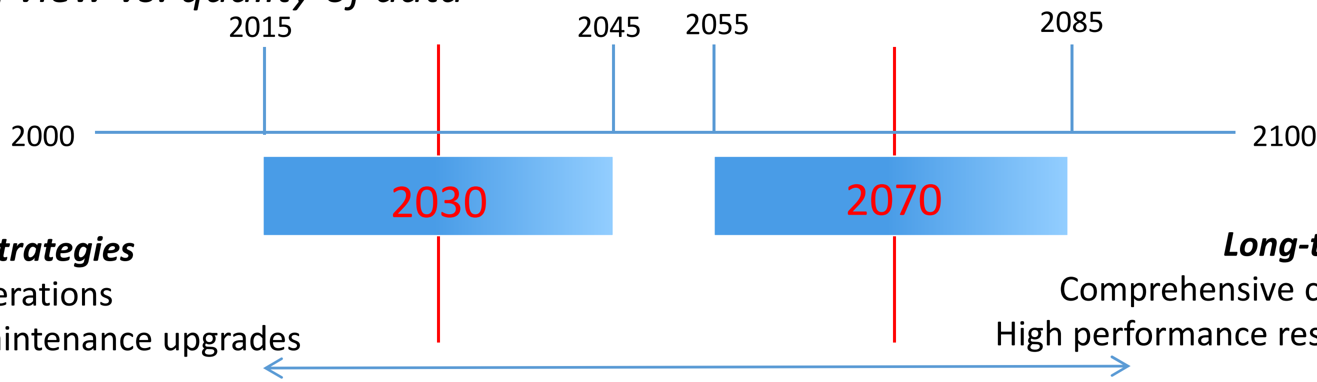


- Facility Resilience
- Operations Enhancement
- Community Engagement
- Capital Prioritization
- Long-term Adaptation
- Arrange and Align Insurance as needed

Key to Gaining Buy In #2: Dual-Time Horizons

Climate analysis projections

Value of long view vs. quality of data



Near-term strategies

Enhance operations

Deferred maintenance upgrades

Long-term strategies

Comprehensive capital planning

High performance resilient buildings

Risk = Probability x Consequence

Where to place the emphasis?

Probability based

Informs capital investment cycle

10 year	10%
100 year	1%*
500 year	.2%
1000 year	0.1%

Consequence based

'Worst case scenario' for emergency operations management. Based on 5 storm models.

* 1% probability of an event occurring in any one year = 26% in 30 years = 39% in 50 years

Key to Gaining Buy In #3: Multi-Disciplinary Approach

- Real Estate, Facilities, and Engineering
  - Long-term capital planning
  - Energy planning
- Emergency Preparedness/Emergency Management
  - Operational enhancements and business continuity planning
  - Hazard Vulnerability Analysis (HVA) data demonstrated high risk associated with climate disasters
- Risk and Insurance Management
  - Informs, arranges, and aligns insurance coverage as needed
  - Opportunity to identify financial incentives to become more resilient

Identifying Interventions

Discussing the threats

Facility Operations

- Ambulatory Care
- Ambulatory – Surgical/Procedural
- Emergency Care
- Inpatient Care
- Intensive Care
- Research
- Administration

Infrastructure Vulnerability

- Power – main grid
- Power – emergency
- Natural gas
- Medical gasses
- Fuel oil
- HVAC
- Water – potable/non
- Storm water
- Waste water
- Medical waste
- IT/Communications
- Transportation

Continuity Considerations

- Patient transfers
- Staff availability/ accommodations
- Patient surge
- Medical supplies
- Lab & Pharmacy
- Food/Nutrition
- Hospital as community anchor

Results……

Increasing frequency and length of heatwaves pervasive across all study sites

Extreme Heat

Extreme Heat Projections - City of Cambridge

	1971-2000 (average)	2030 (low)	2030 (high)	2070 (low)	2070 (high)
Annual Days > 90 ºF	11	29	31	47	68
Annual Days > 100 ºF	<1	2	2	6	16

Data: Katharine Hayhoe

+ 20 days per year with temps > 90 ºF (2030)

+ 30-50 days per year with temps > 90 ºF (2070)

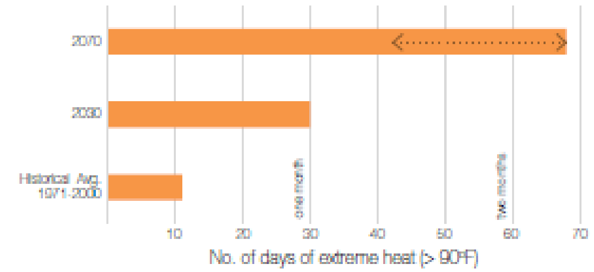
Extreme Heat Projections - City of Boston

	2006-2015 Actual	2006-2015 Model	2030 Model
days > 90 ºF	13	12	19

Data: Argos Analytics

+ 6 days with temps > 90 ºF

- In both analyses, the number of days of extreme heat increases significantly by the 2030 time frame, i.e. near term.
- By 2030, 30 days / one month of the year or 1/3 of the summer will have temperatures > 90 ºF
- By 2070, close to two months of the year or 1/2 of the summer will have temperatures > 90 ºF



Recent Events (per scenario 1 definition)

- The summer of 2013 was one of the warmest in Boston history. It had three heat waves in the first 30 days of summer, each one longer than the first; June 23-25 (three days), July 3-7 (five days), and July 14-19 (six days) with a record high of 99 ºF.
- July 16-21, 1977 & July 16-21, 1991 had heat waves of six days.
- July 15-21, 1983 & August 9-15, 1988 had heat waves of seven days.
- July 19-26, 1994 & August 11-18, 2002 had heat waves of eight days.
- The longest heat wave ever recorded in Boston was nine days, July 3-11, 1912.

Results……

Extreme Heat

Implications

- Ability to cool buildings
- Likelihood of brownouts
- Hospital as place of refuge

Interventions

- Adding chillers to emergency power
- Street connections for supplemental emergency power & chillers
- Energy efficiency initiatives

Results……

Significant differences in design wind speed at time of construction and future projections

Wind Risk Assessment and Future Predictions

Wind Risk Assessment

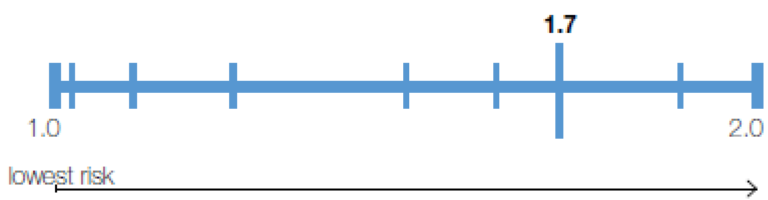
The wind risk assessment focuses on the design wind speed for each facility location. Each facility is given a wind risk assessment factor based upon the difference between the design wind speed per the governing code at time of construction and the current Massachusetts building code (780 CMR, 8th Edition).

Modern design wind speeds are stated as a wind speed (mph) and are tabulated on a town-by-town basis. In previous versions of the building codes, the wind pressures were provided directly based on location, surrounding site conditions and building height. Using the historic pressures and their related building heights, an equivalent historic wind speed has been estimated.

The occupancy category, is included in the determination of pressure through the use of an importance factor. This factor increases the pressure for a given wind speed to account for buildings of higher importance, such as hospitals or emergency facilities.

The wind risk assessment factor is determined from a comparison between the equivalent historic wind speed and the current design wind speed. The lowest risk factor (1.00) is with buildings which have an equivalent historic wind speed equal to or greater than the current design wind speed.

Equivalent wind design at original construction = 93 mph
Current wind design speed = 120 mph



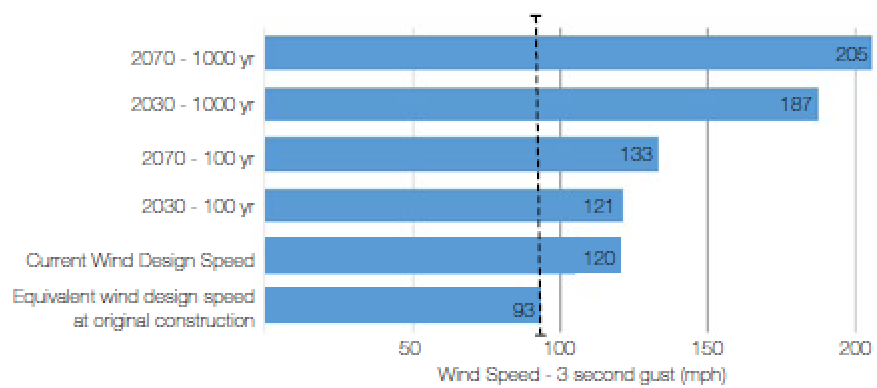
Future Predictions

Compared with the other climatic parameters, wind is the most difficult to project with confidence and is still a nuanced field. Previous estimates have been made which predict that winds speeds are expected to go up 5% for each 1 degree increase in sea surface temperature (team communication, K. Bosma, 3.4.16).

Approximate 2070 wind speeds are projected based on the storm projections used for the flood models. Predicted change for 2030 was deemed negligible.

Return Period	2013 / 2030 Wind Speeds (mph)		2070 Wind Speeds (mph)	
	Sustained Maximum	Gust (3 sec)	Sustained Maximum	Gust (3 sec)
100 year	94.8	121.3	104.2	133.3
1000 year	135.7	187.3	149.1	205.8

Data: Woods Hole Group



Results……

Wind Risk

Implications

- Hazards from slate or ballasted roofs
- Wind-driven rain entering through windows, under cladding, and roofs

Interventions

- New roof, window replacement, and similar are high cost
- Wind resiliency engineering assessments

Results……

District-level flooding interrupts operations even when facilities remain dry

District Map: 2070 Probability-based Flooding

Infrastructure Legend

- Police Station
- Fire Department
- Electric Substation
- Generating Facility

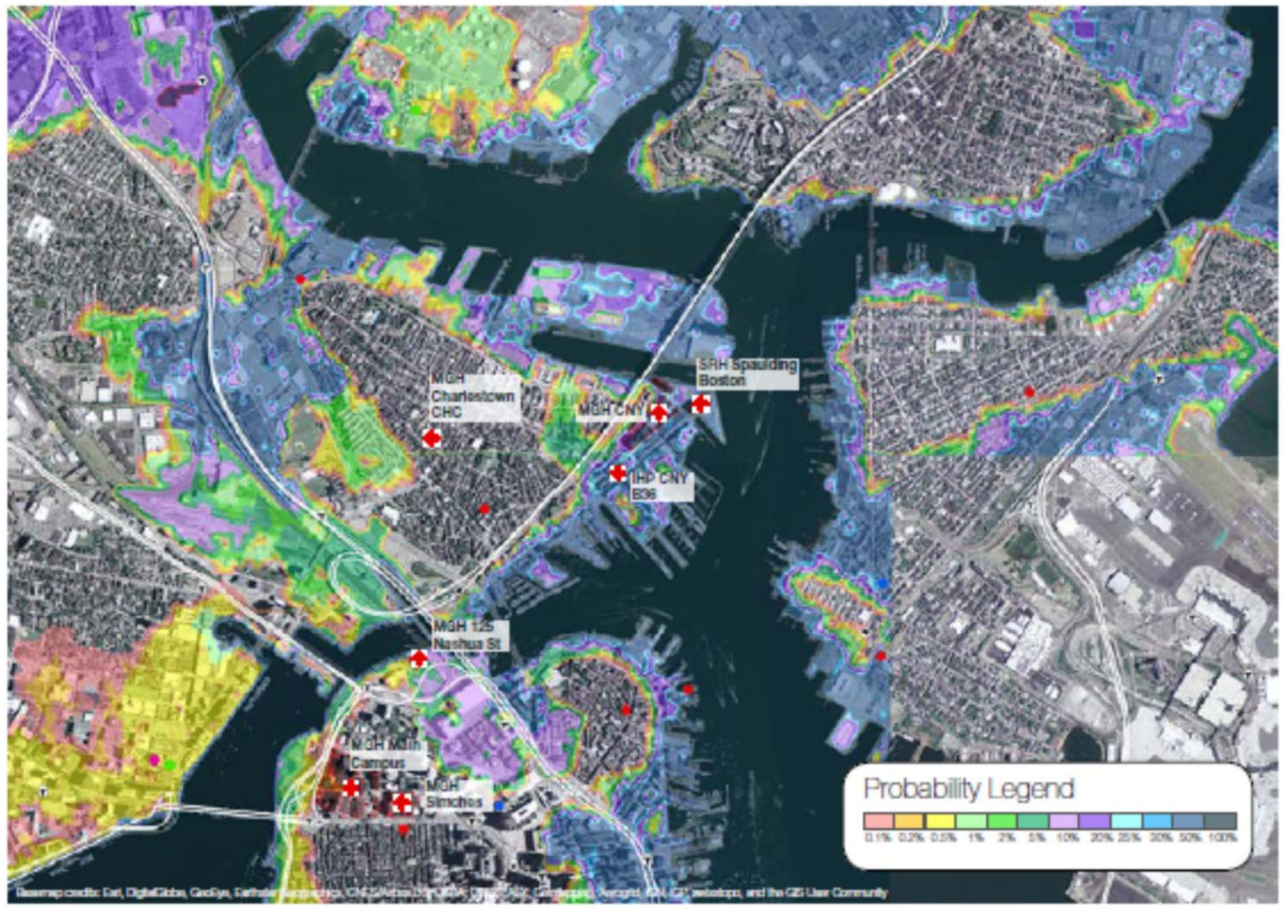
In the greater Boston area, the Amelia Earhart Dam at the Mystic River and Charles River Dam provide significant flood protection for the area.

Current modelling indicates that by 2040, the Amelia Earhart Dam will be breached and flanked by coastal storm events.

The Charles River Dam is expected to be able to hold back coastal impacts before becoming compromised in 2065.

These two structures have obvious regional importance as it relates to flooding.

To note, there are discussions to increase the pumping capacity of both damns.



MGH Charlestown Navy Yard | Boston MA 02129 Lobby Elevations: MGH CNY B79/96: 12.0' | B149: 16.0' | All others: 12.0' Latitude/Longitude: 42.38/-71.05

Results……

Sea Level Rise and Extreme Precipitation

Implications

- Critical infrastructure interruptions (transit, energy, telecom)
- Supply chain disruption
- Personal impact to workforce
- Loss of critical services on lower levels (utilities, pharmacy, food services)
- Water contamination

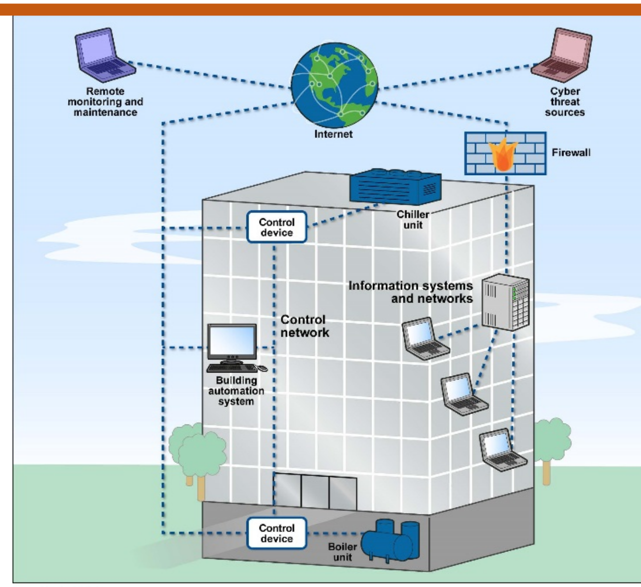
Interventions

- Short-term:
  - Business continuity planning
  - Flood barriers
  - Utility hardening
  - Storm water management systems
- Mid/long-term:
  - Advocate and partner for district/public utility improvements
  - Incorporate flood projections into new building design or relocation

Unique Continuity Considerations

Sophisticated building control systems

- Require highly specialized operators
- Limited number of staff and vendors able to operate
- Consider cross-training among sites



Protecting Medical Research

- Powering -80 freezers
- Alternate animal habitats
- Movement of hazardous materials

Other Considerations for Facility Resilience….

- Sheltering in place
  - Air handling adjustments
  - Warehousing of supplies on-site
  - Housing staff and others on-site

- Security concerns
  - Access controls
  - Perimeter security
  - Blast-proofing glass

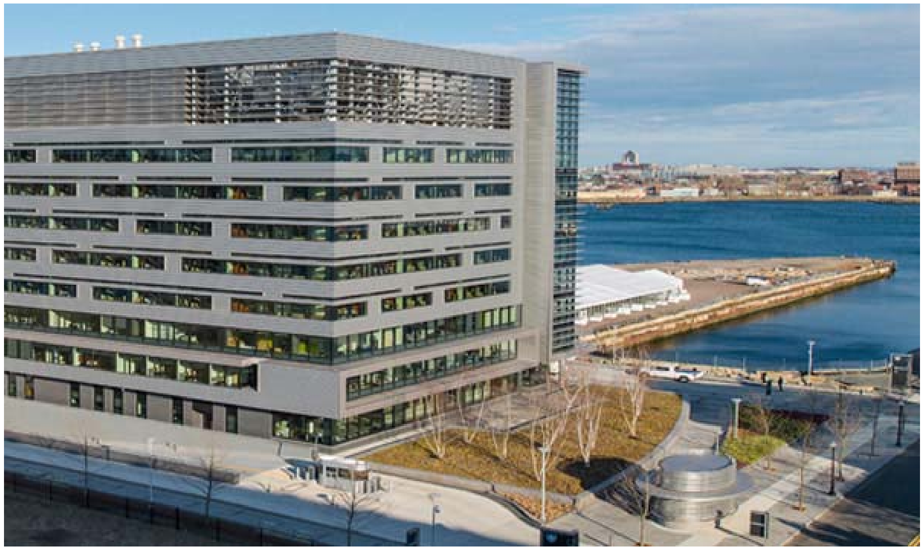
- Infectious disease outbreaks
  - Surge capability
  - Isolation capabilities with and without cohorting

- Hazardous materials events
  - Patient decontamination

- Others….

Future Actions

- Monitoring and improving our patients' health in the face of climate change
- Advocacy at all levels to combat climate change
- Enhanced enterprise emergency planning
- Medium to long-term capital renovations
  - Consider energy redundancy/independence
- Future construction anticipating change



Conclusions

- Strive to achieve multiple goals through a single project/investment
  - Capital planning
  - Operational enhancements
  - Sustainability
  - Insurance coverage and risk management assumptions

- Challenge long-held assumptions by grounding all phases of the project in data
  - Assumptions may be held by executives, facilities managers, emergency managers, others