The Radiation Oncology Experience

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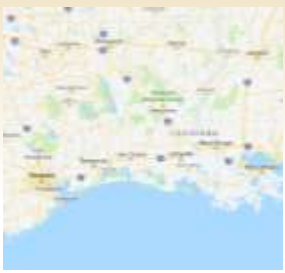
Objective

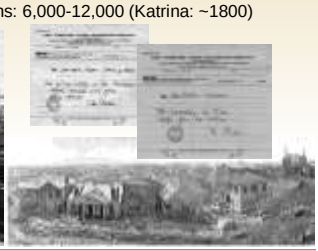
- To describe our experiences and lessons learned in surviving the impacts of various hurricanes and ensuring continuity of care for our patients
  - Applicable to radiation oncology centers throughout the nation, whether in historically “at risk” areas for earthquakes, wildfires, hurricanes, etc. or in “low-risk” zones, where an unexpected catastrophic event may occur

Where are we?



History

- 1900 Hurricane (September 1900)
  - Deadliest natural disaster in U.S. history
    - Estimated deaths: 6,000-12,000 (Katrina: ~1800)



History

- 10 miles of seawall (17 ft. high) added
- Dredged sand used to raise city by up to 17 ft.
- Similar 1915 storm resulted in 53 deaths
- Relatively safe until recent times

History

- Costliest U.S. Atlantic Hurricanes

Name	Damage (Billions USD)	Season	Storm classification at peak intensity
Katrina	$125.0	2005	Category 5 hurricane
Harvey	$125.0	2017	Category 4 hurricane
Maria	$91.6	2017	Category 5 hurricane
Sandy	$68.7	2012	Category 3 hurricane
Irma	$64.8	2017	Category 5 hurricane
Ike	$38.0	2008	Category 4 hurricane
Wilma	$27.4	2005	Category 5 hurricane
Andrew	$27.3	1992	Category 5 hurricane
Ivan	$26.1	2004	Category 5 hurricane
Rita	$16.5	2005	Category 5 hurricane

Hurricane Rita – September 2005

- 3 weeks after Hurricane Katrina
- Early projections as Cat 4 to make landfall near Galveston
  - Turned NE and downgraded to Cat 3

Hurricane Rita – September 2005

- Mandatory evacuation of Houston and surrounding areas
  - Planned as staged evacuation by zones

Preparations

- Began ~ 2 days before projected landfall
- Patients provided with treatment data
  - CD and hard copy
- Clinical workstations moved to linac treatment couches and elevated
- Equipment near windows covered with plastic

Preparations

- Office computers and equipment moved on top of desks and/or cabinets
- No general relocation of equipment or materials
  - No space, so “shelter in place”
- Employees released to prepare homes and wait for assigned evacuation day

What happened?

- ~3 million residents evacuated
  - One of worst traffic jams in U.S. history
- Many residents did not wait for assigned time to evacuate
- Contraflow lanes not opened in adequate time frame

What happened?

- Average travel times (normally 3-5 hours)
  - Dallas: 24–36 hours (one therapist 50 hours)
  - Austin: 12–18 hours (one therapist 48 hours)
  - San Antonio: 10–16 hours
- One friend traveled 65 miles in 24 hours
  - Turned around and went home
- Fortunately avoided direct hit along Galveston-Houston corridor

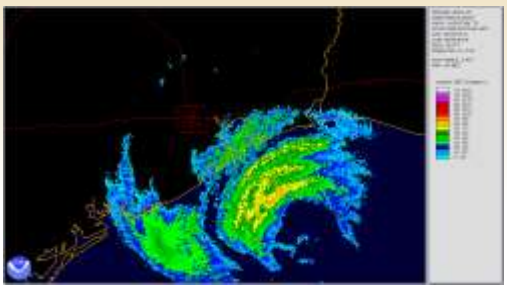
What happened?

- Did not ease for 48 hours
  - Many motorists ran out of gas or experienced breakdowns (vehicular, mental, and societal)
- Temperatures neared 100 °F
  - Study estimated ~10% of deaths from hyperthermia
- No damage to UTMB, but patients and employees stranded
  - Limited gas supplies heading toward Galveston
  - Clinic closed for approximately 1 week

Lessons learned

- Poor communication from local authorities on evacuation
  - Patients and staff couldn't get out, then couldn't get back
- No specific disaster preparation plan for protecting department equipment
  - No secure/protected location for hardware
  - No centralized storage for clinic/patient data
- Impromptu and improvised plans worked (?) in this case
  - Department not really tested

Hurricane Ike – September 2008



Preparations

- Institution preparedness updated after Katrina (2005)
  - Early relocation of all in-patients
- EMR data (dept. and hospital) backed up at off-site facility
  - TPS and physics data not backed up off-site
  - Still paper treatment chart environment
- All patients then under treatment were each given an envelope containing all their pertinent medical records, radiation oncology records, treatment plans, and contact information for UTMB staff and physicians

Preparations

- Existing partnership with St. Joseph Medical Center (SJMC) in Houston
- Patients advised to establish contact with us after the storm subsided, at UTMB, or depending on the extent of damage at UTMB, to contact us at SJMC
- In the event they were displaced to a remote location, or could not reach us for any reason, patients were advised to present their package to any radiation oncology center where their care could be continued

Preparations

- By 38 hours prior to landfall, all out-patient clinics, including radiation oncology, were closed
- Staff had time to make final preparations
  - Secure home, evacuate, etc.

What happened?

- Complete devastation!!
- Tidal surge flooded Galveston and the entire ground floor of UTMB Hospitals
  - Destroyed clinic facilities, three linear accelerators, an HDR brachytherapy unit, and associated equipment, furniture, and supplies

What happened?

- 3-4 feet of saltwater in radiation oncology (6 feet in other campus locations)
- The total rad onc damage estimated at $12.5M

What happened?

What happened?

What happened?

- Destruction and flooding of homes and businesses in Galveston, and displacement of the population
- Access to Galveston Island and the campus was limited immediately after the storm, and restricted for several days
- SJMC maintained continuous power supply, did not experience any break in services, and was the only hospital in Houston that provided continuous service

What happened?

Security was high, especially after Katrina experience observations

Post-natural disaster cleanup. little control over what stays, what goes…

What happened?

- Our physicians and staff relocated to SJMC, and arranged for treatment of all UTMB patients at SJMC or other facilities
- UTMB personnel worked tirelessly to ensure optimal treatment of patients, despite personal hardships and significant damage to their own homes
- SJMC Radiation Oncology was adequately staffed for their usual patient load of 20 to 30 patients under treatment per day, but not to accommodate an additional number of (40 to 60) UTMB patients

What happened?

- UTMB Medical School allowed us to retain all faculty (3 MDs, 3 physicists, and 3 biologists), while UTMB Hospital requested that all 19 hospital staff be laid off
- Through negotiations, we retained 6 of the 19 hospital employees – 2 therapists, 1 dosimetrist, 1 physicist, 1 secretary, and our IT person
- We were forced to lay-off 13 skilled and competent long-term radiation oncology staff members – 7 RTTs, 1 CMD, 2 RNs, 3 administrative support people

What happened?

- Almost all TPS data lost
  - What survived the flood was damaged by prolonged saltwater exposure (hard drives and storage media quickly failed)
  - Some equipment damaged by first persons on site
- Paper treatment charts destroyed
- Long-term environmental issues
  - Mold, water supply contamination, etc.

Lessons learned

- Everyone had become complacent with hurricane damage potential
  - Magnitude of devastation thought not possible
- Needed a centralized, secure, off-site DICOM storage solution for all patient data
- Needed secure location to store hardware for future events
- Needed physical flood protection for high-value equipment

The aftermath

- Patients treated at SJMC for 2 years
  - Galveston clinic opened in 2010
- Flood doors installed for all 3 vaults

The aftermath

- Department essentially rebuilt from scratch
  - New linacs, TPS, CT-sim, HDR, QA equipment,…
  - Limitation of FEMA funds is replace what was lost, not get what you might actually need (keep good inventory)
- Requirement that all 1st floor departments maintain 2nd floor space for flood risk mitigation
  - Not trivial in hospitals where space is at a premium
- No DICOM storage solution acquired
  - Point of weakness for future events

The aftermath

- Transition to EMR environment in 2012
- Clinical servers moved to 2nd floor space
- New UTMB treatment center opened ~20 miles north of Galveston
  - Linacs not matched to Galveston units, so still requires replanning at a minimum

Hurricane Harvey – August 2017

- Maximum of Cat 4 storm with 130 MPH sustained winds
- Rain forecast so high, National Weather Service had to add another color to their scale

Preparations

- No mandatory evacuation of Houston and surrounding areas
- Employees instructed to box up offices for move to 2nd floor space (earmarked after Hurricane Ike)
  - Moving company contracted to move boxes
- 4 hour notice from UTMB that clinics would close at 3 pm Friday, August 25, 2017
  - "Non-essential" rad onc employees released at 1 pm

Preparations

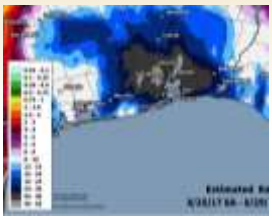
- Informed that UTMB IT would handle move of all computer equipment
  - We retained control of all clinical systems (TPS, MOSAIQ sequencers, QA computers, etc.)
- Assumed worst-case scenario of catastrophic flooding and prolonged power outage
  - High value equipment was moved into treatment vaults behind flood doors

Preparations

- I became *de facto* head of emergency preparedness
  - Decisions on what systems we handled vs UTMB IT
  - Decisions on what was moved and what stayed
  - Decisions on when it got moved
  - Decisions on when staff could leave
- Rad onc IT and I last to leave at 5 pm
  - Weather already poor: heavy rain, high winds (did I mention I work on a barrier island with only 1 way off?)

What happened?

- Up to 50" of rain in Houston and surrounding areas
  - Catastrophic (apocalyptic?) flooding



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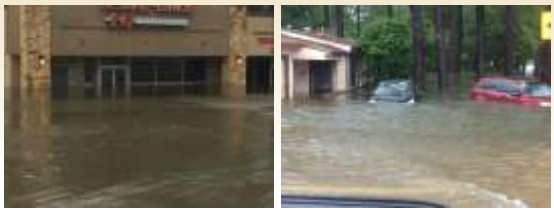

What happened?

- No damage to UTMB or department
  - Some staff had homes flooded
- Galveston ok, but staff and patients could not get out of their areas to reach it
- Confusing communication from UTMB and department on when would open
- Clinic closed for 4 days

What happened?

- Items returned to dept. by UTMB IT in complete disarray

- Took approx. 0.5 days to bring linacs back up
- Limited staff, limited equipment, limited functionality
  - Physician wanted SRS sim on 1st day back

Lessons learned

- Lack of command chain led to inefficient preparations
- Lack of assigned responsibilities
  - Department, institution (e.g., IT)
  - Admin giving tours of emergency prep to other dept.
- Lack of preparation time
- Maintain control of situation as much as possible
  - You don't have to do it yourself, just determine how it will be done

Lessons learned

- Dry-runs are invaluable in identifying gaps in your plan
  - Attempting to get emergency generator power plugs installed in vaults
- Implement changes to BCP as soon as possible after event
  - Example: we will retain control over all department IT systems, color coded all systems and labeled with staff name, office location, priority for return, etc.
  - Experience recollection degrades over time

Conclusions

- Risk analysis needed to identify threats and response plan specific to you

EVENT	PROBABILITY				RISK					PREPAREDNESS			TOTAL
	HIGH	MED	LOW	NONE	LIFE THREAT	HEALTH/ SAFETY	HIGH DISRUP-TION	MOD DISRUP-TION	LOW DISRUP-TION	POOR	FAIR	GOOD	
SCORE	3	2	1	0	5	4	3	2	1	3	2	1	
NATURAL EVENTS													
Hurricane	X				X						X		30
Flood, Storm Surge	X				X						X		30
Drought	X					X					X		24
Extreme Heat	X					X					X		24
Disease Outbreak / BT		X			X						X		20
Severe Thunderstorm	X						X					X	9
Tornado		X				X						X	8
Earthquake			X			X					X		8
Urban Fire		X				X						X	8
Ice/Snow		X					X					X	6

Conclusions

- Hurricanes gave us time to prepare
  - Fire, tornado, etc. will not
  - Plans need to be in place ahead of time
- Harden facilities as much as possible against most likely threats
- Plans need to consider facilities, patients, and employees
  - Can't return to service without all 3

Conclusions

- Last event no indication of what will happen this time
  - Rita evacuation in response to Katrina
  - No Ike evacuation in response to Rita outcome
  - No Harvey evacuation due to minimal threat expectation
- Agreement with outside institution in emergency situations
  - SJMC partnership allowed UTMB to continue patient care
  - We were lucky it was already in place

Conclusions

- Effective and consistent communication before, during, and after event is vital
  - Federal, state, local, institutional, departmental
- Clear chain of command
- Advance preparation is key
  - Rehearse if possible
  - Organization will save time

Conclusions

- Assignment of duties
  - Everyone should know what they are responsible for
  - Checklists to document when tasks complete
- Clear expectations of return to operations
  - Time, capabilities, capacity
- Established and practical BCP essential
  - Living document that needs to be reviewed and updated regularly

Conclusions

- Operational debriefing after incident is essential
  - What worked, what didn't, what didn't we plan for, …
- Can't control threats, only preparation and response
  - There will be surprises
- ***"No plan of operations extends with certainty beyond the first encounter with the enemy's main strength"***
  - Helmuth von Moltke the Elder, Chief of Staff of the Prussian army


Thank you!