

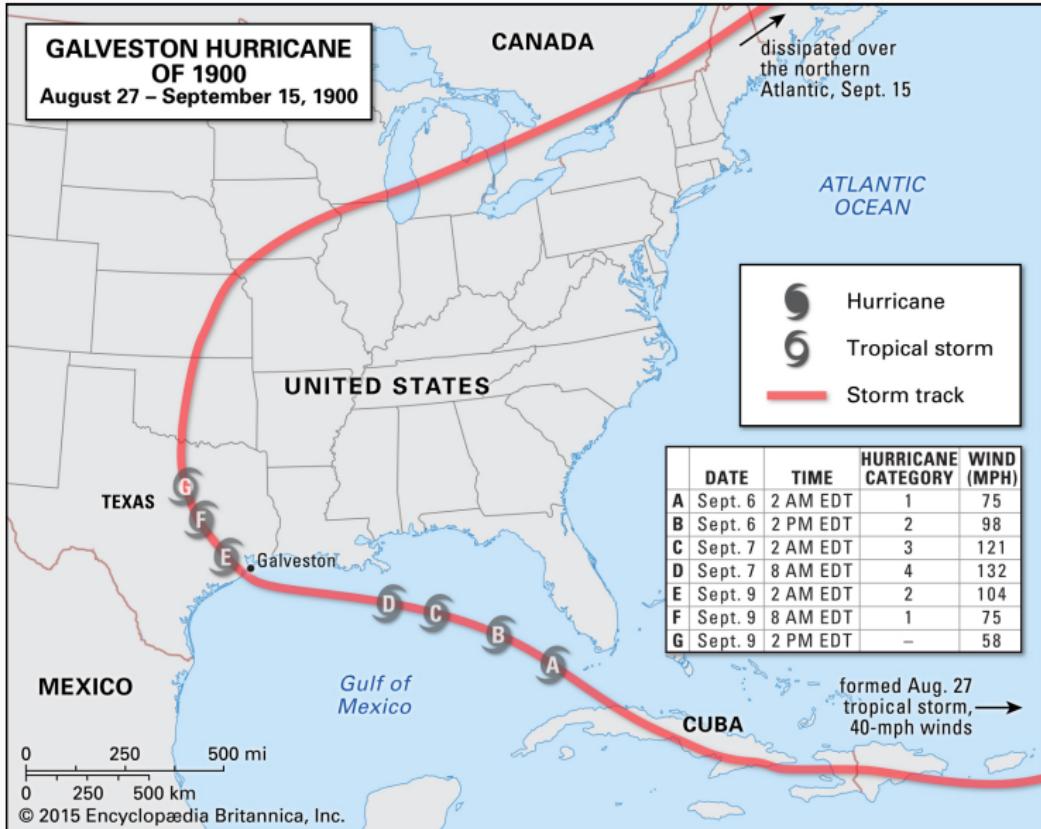
One Health Seminar

**Tropical cyclones and human
health**

Brooke Anderson
Colorado State University

October 11, 2019

Galveston Hurricane, 1900



Source: *Encyclopedia Britannica*

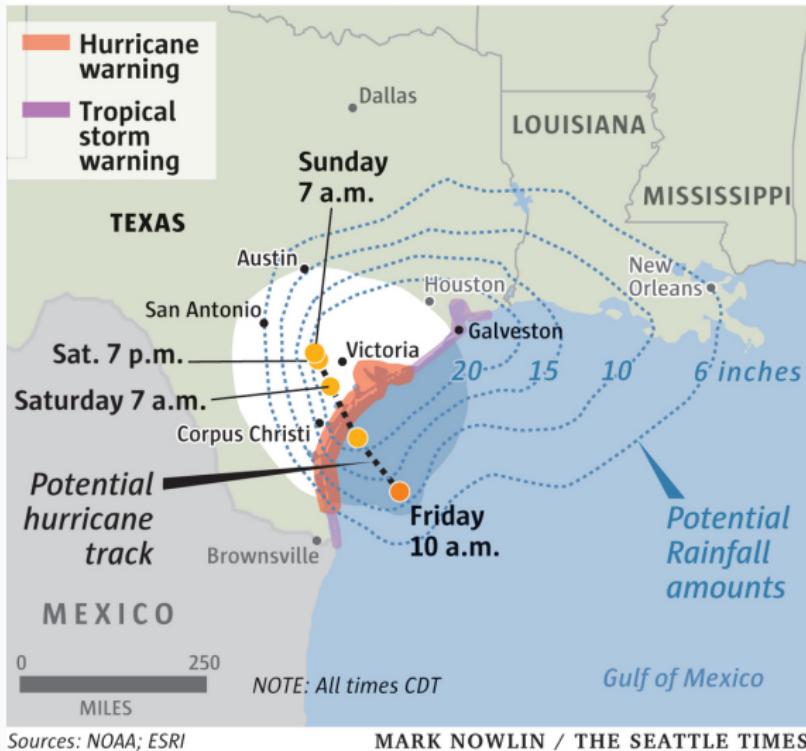
Galveston Hurricane, 1900



Source: *Library of Congress*

Advances in forecasting hurricanes

Hurricane Harvey's potential path



Source: *Seattle Times*

Advances in hurricane preparation



Source: *City of Norfolk, Virginia*

Advances in hurricane preparation

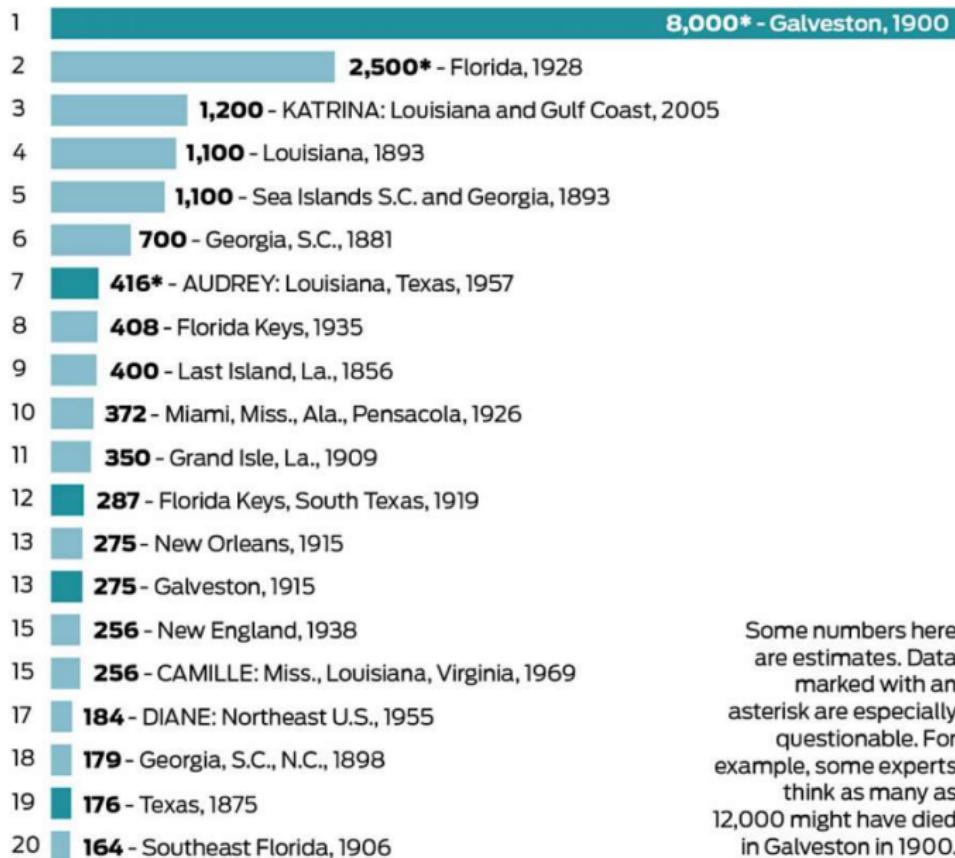


Nikki Haley @nikkihaley · Oct 5

To find out if you are in an evacuation zone, please visit: scemd.org/knowyourzone

Hurricane Matthew is a strong storm, and now is the time to prepare. Residents and visitors in Beaufort and Charleston Counties and those in certain parts of bordering coastal counties – Berkeley, Colleton, Dorchester and Jasper Counties – should begin evacuating no later than 3:00 PM today. To find out if you are located in an evacuation zone, please visit www.scemd.org and click, "Know your Zone," to enter your home address.

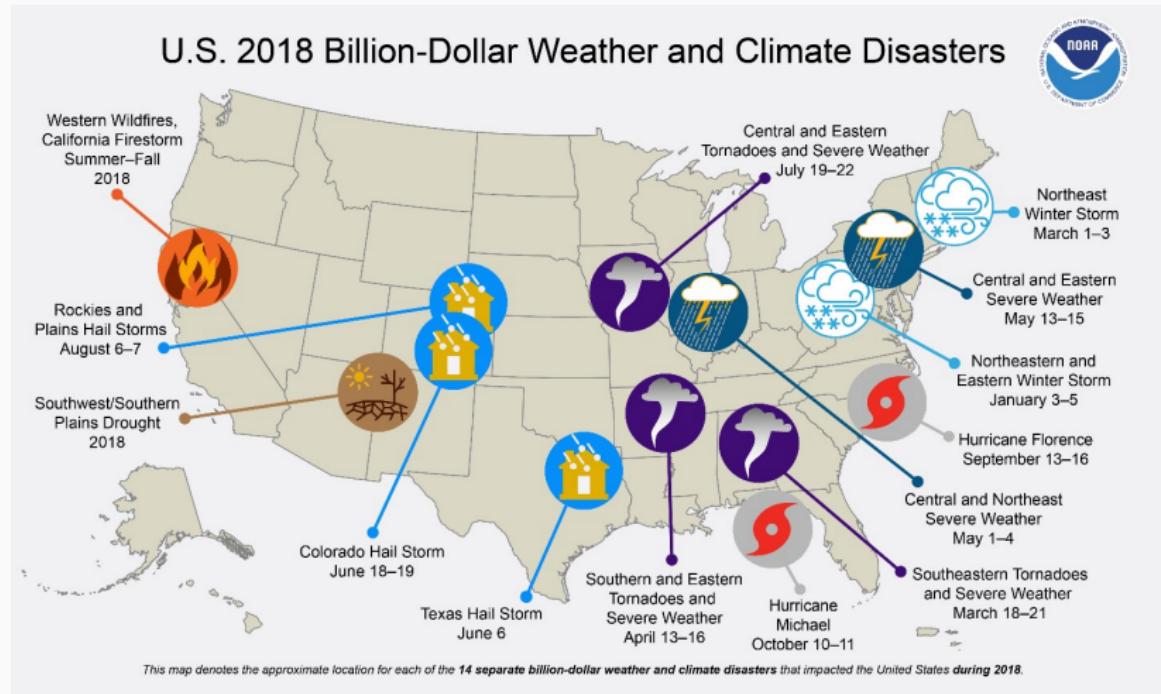
RANKED BY THE NUMBER OF FATALITIES ...



Some numbers here are estimates. Data marked with an asterisk are especially questionable. For example, some experts think as many as 12,000 might have died in Galveston in 1900.

Source: *Houston Chronicle*

Climate-related disasters today



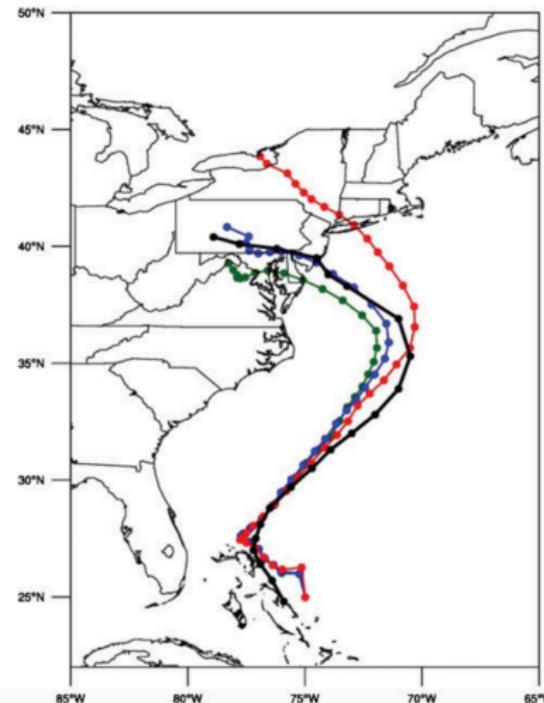
Source: NOAA

Hurricane hazards and impacts



Source: The New York Times

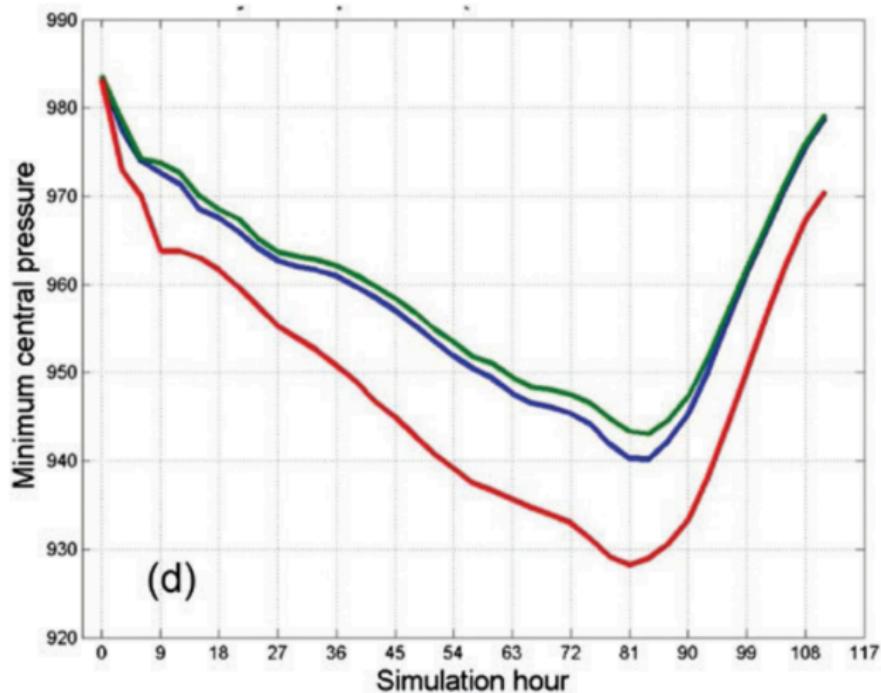
Hurricane Sandy event attribution



Under conditions in the 1880s (green), at present (blue), and
2090s (red)

Source: Lackmann 2015

Hurricane Sandy event attribution



Under conditions in the 1880s (green), at present (blue), and 2090s (red)

Source: Lackmann 2015

Hurricane health impacts

Hurricane health impacts that are **hard to prevent.**

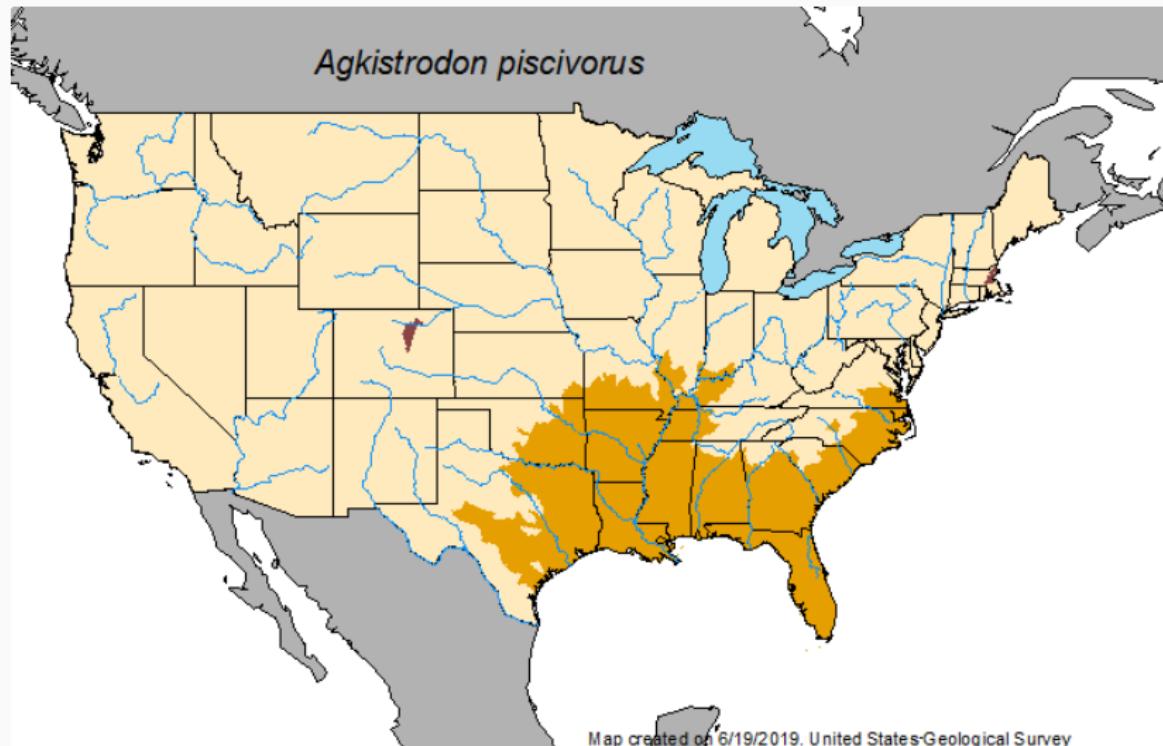
Hurricane health impacts that are **hard to detect.**

Hurricane Andrew damage



Source: *New York Times*

Cottonmouth snake range



Source: USGS

Snake bites



City of Jacksonville (COJ)

@CityofJax



There have been reports of an increased number of snake bites in the city! Please be aware of displaced wildlife & be safe!
#HurricaneIrma [twitter.com/HealthyFla/sta...](https://twitter.com/HealthyFla/status/899071110380162816)

Florida Dept. Health @HealthyFla

After #Irma, be alert to wildlife – snakes, alligators, etc. may have been displaced as a result of strong winds or rain.

164 9:17 AM - Sep 12, 2017



293 people are talking about this



Snake bites

'Snakes and other critters' join flooding, tornadoes as Barry's latest threat

John Bacon and Doyle Rice, USA TODAY

Published 8:19 a.m. ET July 15, 2019 | Updated 4:16 p.m. ET July 15, 2019

WEATHER NEWS

Hurricane Dorian's new danger: Copperhead bites Hilton Head woman cleaning up the yard

BY DAVID LAUDERDALE

SEPTEMBER 08, 2019 02:25 PM, UPDATED SEPTEMBER 08, 2019 02:39 PM



Exotic animals



ANIMALS

Why Hurricane Andrew had a lot to do with our python problem in Florida

As the number of pythons grows, they're expanding their territory.

Source: WTSP

Domestic animal bites

BRIEF REPORT

Increased Incidence of Domestic Animal Bites following a Disaster Due to Natural Hazards

G. Scott Warner, MD, FACP



HURRICANES

Protect Yourself from Dog Bites, West Nile Virus, and Carbon Monoxide Poisoning in Hurricane Disaster Areas

West Nile neuroinvasive disease

Increase in West Nile Neuroinvasive Disease after Hurricane Katrina

Kevin A. Caillouët,* Sarah R. Michaels,* Xu Xiong,* Ivo Foppa,* and Dawn M. Wesson*

After Hurricane Katrina, the number of reported cases of West Nile neuroinvasive disease (WNND) sharply increased in the hurricane-affected regions of Louisiana and Mississippi. In 2006, a >2-fold increase in WNND incidence was observed in the hurricane-affected areas than in previous years.



Figure 1. Hurricane Katrina track and hurricane-affected Louisiana parishes and Mississippi counties. Affected parishes and counties (gray) were defined as those in which >50% of the total area was ≤50 miles of the hurricane track coordinates.

Domestic animal bites

Supplementary Issue: Disease Vectors

Emergency Mosquito Control on a Selected Area in Eastern North Carolina After Hurricane Irene

Jonathan W. Harris, Stephanie L. Richards and Alice Anderson

Department of Health Education and Promotion, East Carolina University, Greenville, NC, USA.

Hog farms and hurricanes



Source: NC State College of Agriculture and Life Sciences

Hog farms and hurricanes



Rick Dove, Neuse Riverkeeper (© 1999 Rick Dove)

Giving way. Hog waste seeps from a flooded lagoon into the Neuse River watershed.

Source: Schmidt, *Environmental Health Perspectives* (2000)

Hog farms and hurricanes



Source: *Raleigh News and Observer*

Hog farms and hurricanes

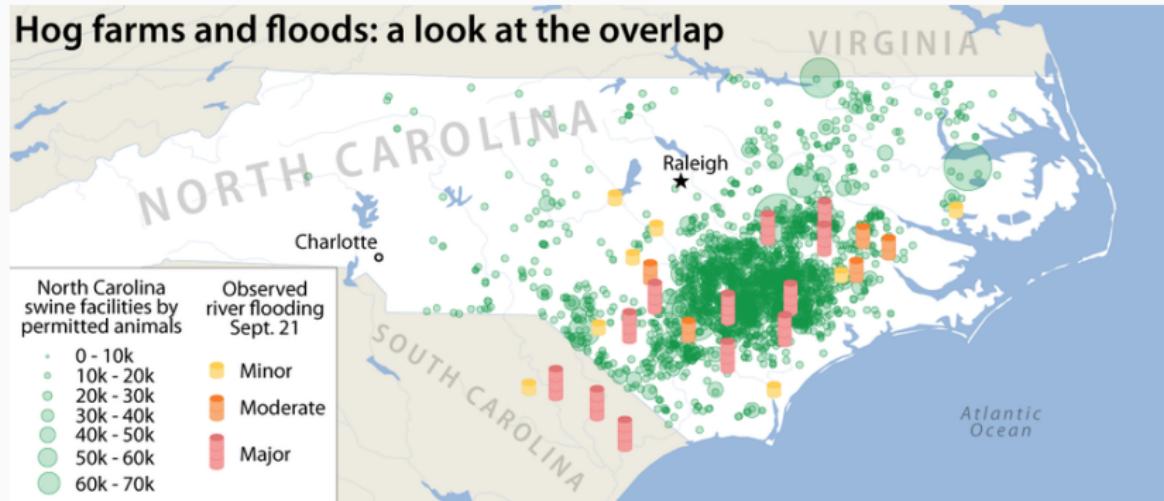
Medicaid Outpatient Utilization for Waterborne Pathogenic Illness Following Hurricane Floyd

CHRISTIAN SETZER, MSPH^a

MARISA ELENA DOMINO, PhD^b

Results. Small increases in Medicaid-covered outpatient visits were found in severely affected counties for two of the six pathogens selected for analysis, relative to unaffected counties. Larger increases in visits were found for nonspecific intestinal infections in both severely and moderately affected counties following the hurricane, relative to unaffected counties.

Hog farms and hurricanes



Source: *Christian Science Monitor*

Hog farms and hurricanes



Florence Flooding Hits North Carolina Hog Farms Hard

More than 5,000 animals have died and dozens of waste lagoons have overflowed

Source: *Wall Street Journal*

Counting tropical cyclone fatalities

Exposure to forces of nature: ICD-10 X30—X39

X30	Exposure to excessive natural heat
X31	Exposure to excessive natural code
X32	Exposure to sunlight
X34	Earthquake
X35	Volcanic eruption
X36	Avalanche, landslide, and other earth movements
X37	Cataclysmic storm
X38	Flood
X39	Exposure to other forces of nature

Reporting cause of death

CAUSE OF DEATH (See instructions and examples)		Approximate interval: Onset to death
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.		
IMMEDIATE CAUSE (Final disease or condition -----> resulting in death)		
a. <u>Acute respiratory failure</u> Due to (or as a consequence of): _____		<u>4 hours</u>
b. <u>Severe emphysema</u> Due to (or as a consequence of): _____		_____
c. <u>Heat and loss of air conditioner power from hurricane</u> Due to (or as a consequence of): _____		_____
d. _____		_____
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I.		33. WAS AN AUTOPSY PERFORMED? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
		34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
35. DID TOBACCO USE CONTRIBUTE TO DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> Probably <input type="checkbox"/> No <input checked="" type="checkbox"/> Unknown	36. IF FEMALE: <input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death <input type="checkbox"/> Unknown if pregnant within the past year	37. MANNER OF DEATH <input checked="" type="checkbox"/> Natural <input type="checkbox"/> Homicide <input type="checkbox"/> Accident <input type="checkbox"/> Pending Investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined

Source:

https://www.cdc.gov/nchs/data/dvs/hurricane_certification.pdf

Counting tropical cyclone fatalities

TABLE 1—*Direct deaths.*

On land (12):	
Blunt Trauma (8)	
12 year old WF	Struck by falling roof beam
25 year old WM	Collapsing roof
74 year old WM	Ejected from turning trailer
49 year old WM	Ejected from turning trailer
46 year old WM	Collapsing home
49 year old WM	Collapsing barn (debris)
68 year old WF	Collapsing townhouse
54 year old WM	Collapsing roof
Mechanical Asphyxia (4)	
47 year old BM	Pinned by tree inside truck
62 year old WM	Found in destroyed mobile home
67 year old WM	Collapsed ceiling of retirement home
80 year old WF	Destroyed trailer
On water (3):	
37 year old WM	Struck by flying debris and knocked overboard
32 year old WM	Found in canal after trying to secure boat
56 year old WM	Washed overboard—body not recovered

Source: Lew et al., 1996

Counting tropical cyclone fatalities

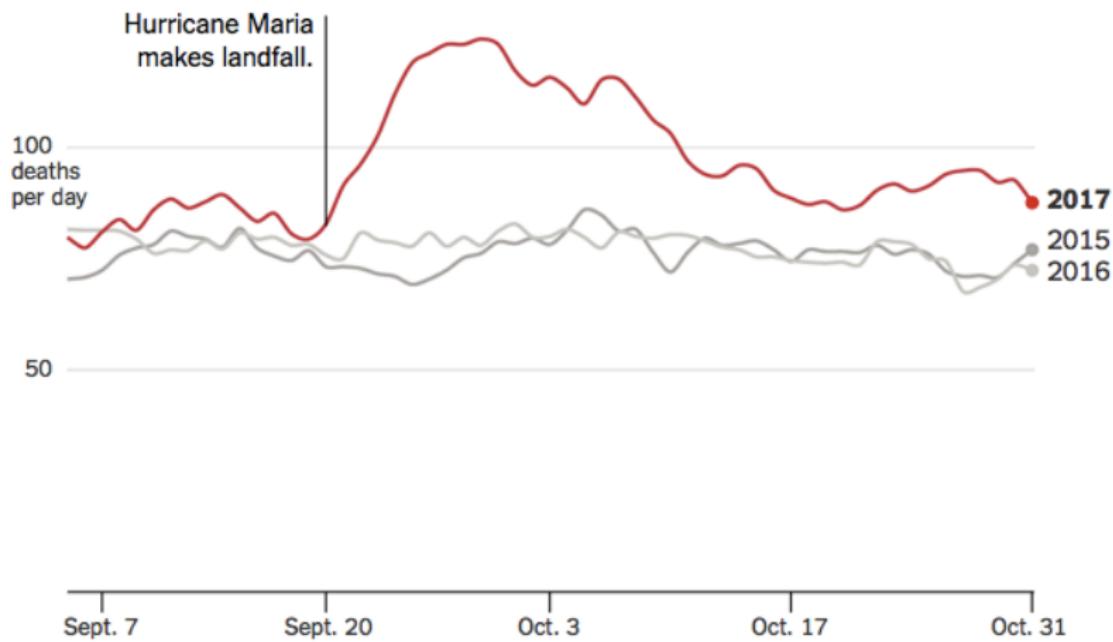
TABLE 2—*Indirect deaths (15).*

81 year old WF	During storm (3): Acute MI during evacuation
63 year old BF	Found in dining room after apparently fleeing bathroom
22 year old WF	Intracerebral hemorrhage due to eclampsia associated with third trimester pregnancy
Cardiovascular deaths during two week period after storm (12):	
67 year old WM	Chest pains while sealing a window
73 year old WM	Trimming trees
51 year old WM	Collapsed upon seeing damage to business
76 year old WM	Collapsed getting plywood
72 year old WM	During evacuation from damaged home
94 year old WF	During evacuation from damaged home
81 year old WF	During evacuation from damaged home
80 year old WF	During evacuation from damaged home
66 year old WM	Collapsed during cleanup
40 year old WM	Collapsed while driving to bring supplies
42 year old WM	Working 15 hrs/day for 13 days restoring electrical power
36 year old WM	Schizophrenic hyperactivity episode initiated by lack of ice

Source: Lew et al., 1996

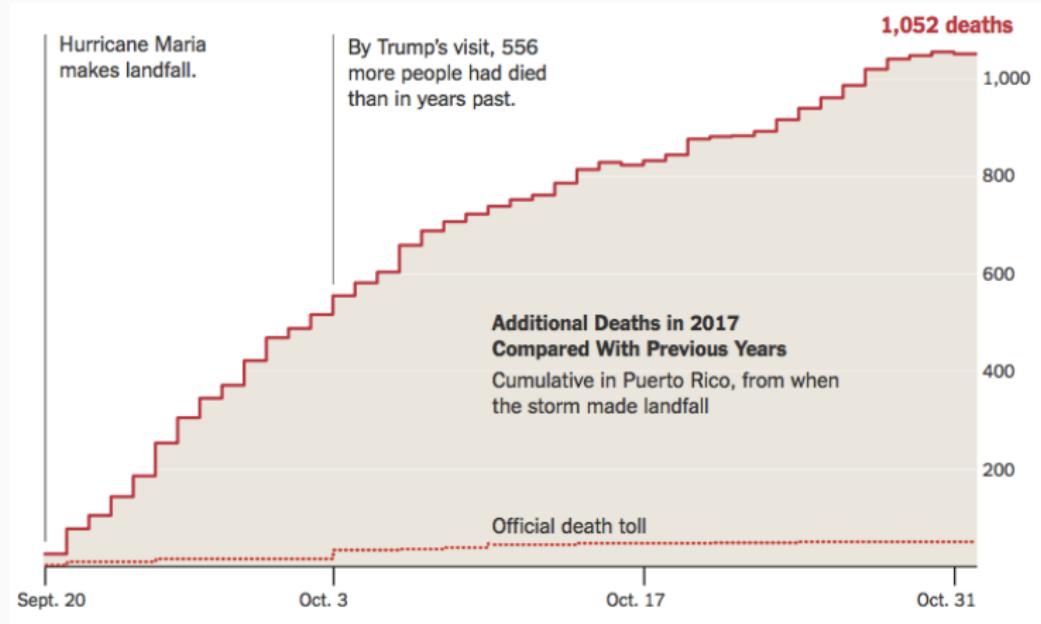
Beyond official death tolls

Average Daily Deaths in September and October



Source: The New York Times

Beyond official death tolls



Source: The New York Times

Excess deaths, Hurricane Maria

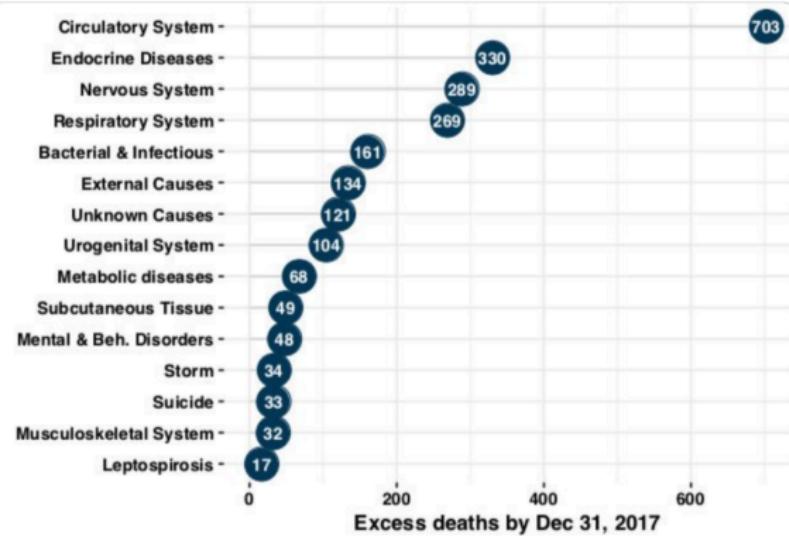


Rafael Irizarry @rafaLab · 5 Sep 2018

The causes of death that increased after María are consistent with a collapsed health system: lack of access to insulin and bacterial infectious diseases.

Elevated heart attacks and suicide rates point to stress as a problem. Here are the estimates for the 9/20-12/31 period

3/4



Health risks associated with Hurricane Sandy (2012)



Source: NOAA / NASA GES Project

Change in patterns of emergency department visits (Kim et al. 2016)

Increased outpatient cases of food and waterborne disease among elderly (Bloom et al. 2016)

Increased rate of myocardial infarctions (Swerdell et al. 2014)

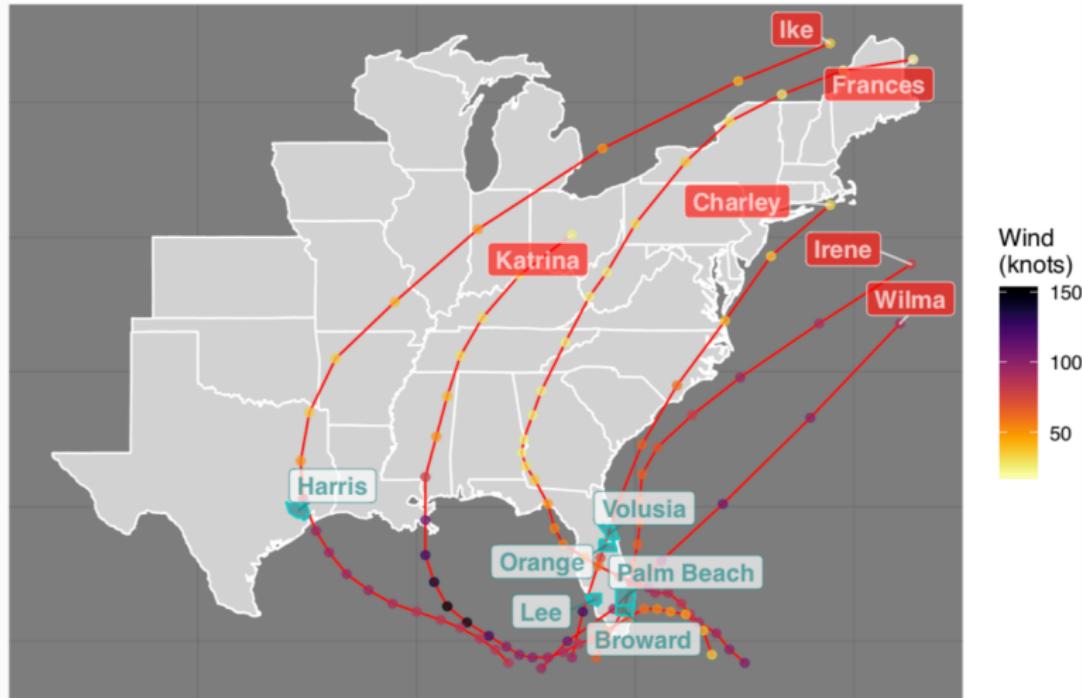
Increased hospitalizations for dehydration (Lee et al. 2016)

Difficulty obtaining medical care, medications, and medical equipment (Davidow et al. 2016)

Medicare hospitalizations

Storms and counties for top 10 wind-based exposures

Color of points corresponds to storm's maximum 1-minute sustained surface winds



Medicare hospitalizations

Respiratory hospitalization risks during the top 10 wind-based storm exposures compared to matched unexposed days

Tropical cyclone	County	Wind ^a	Percent increase ^b
Wilma (2005)	Palm Beach County, FL	52	38 (-3, 95)
Charley (2004)	Lee County, FL	45	25 (-10, 73)
Charley (2004)	Orange County, FL	41	44 (4, 99)
Ike (2008)	Harris County, TX	39	44 (25, 65)
Charley (2004)	Volusia County, FL	37	8 (-15, 38)
Wilma (2005)	Broward County, FL	37	66 (36, 104)
Katrina (2005)	Broward County, FL	34	36 (19, 57)
Frances (2004)	Palm Beach County, FL	33	35 (15, 59)
Irene (1999)	Broward County, FL	33	10 (-14, 41)
Irene (1999)	Palm Beach County, FL	33	40 (-3, 100)

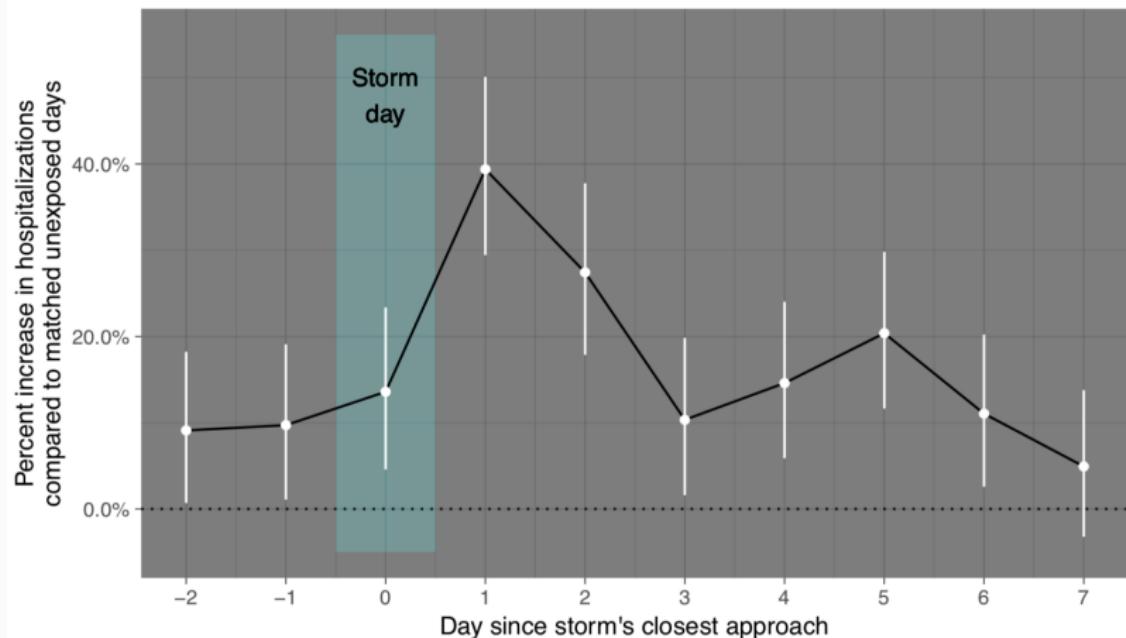
^a Modeled maximum sustained surface wind (m/s) at county center

^b Percent increase in hospitalizations compared to matched unexposed days

Medicare hospitalizations

Respiratory hospitalization risks by lag day

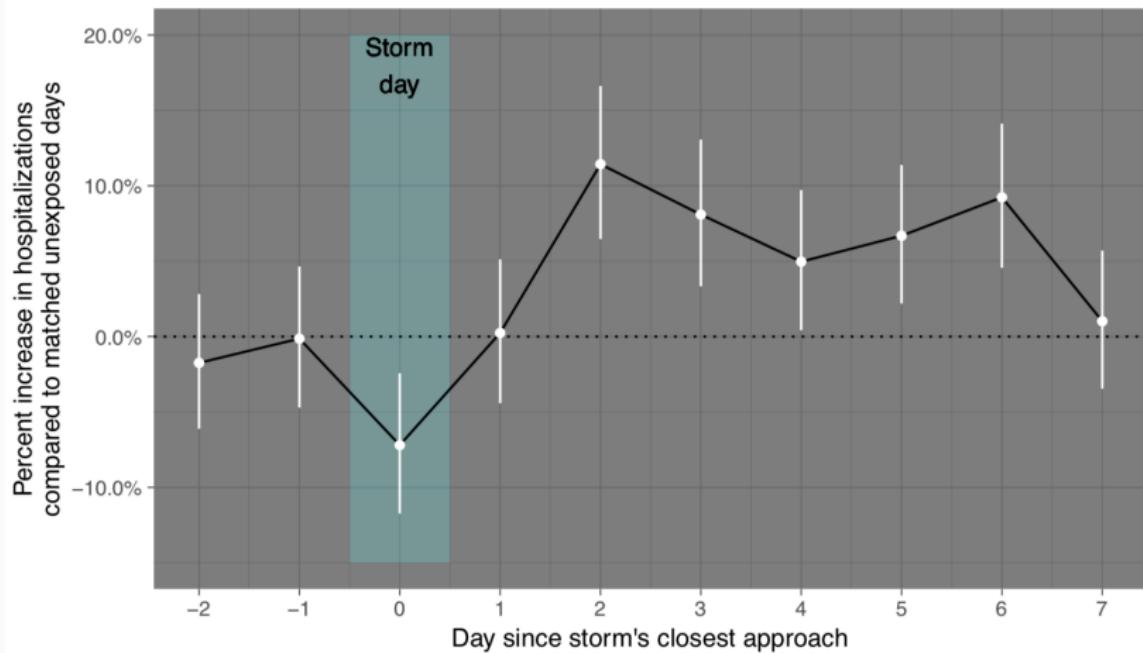
Storm exposure assessed as maximum sustained winds in the county of 21 m/s or higher



Medicare hospitalizations

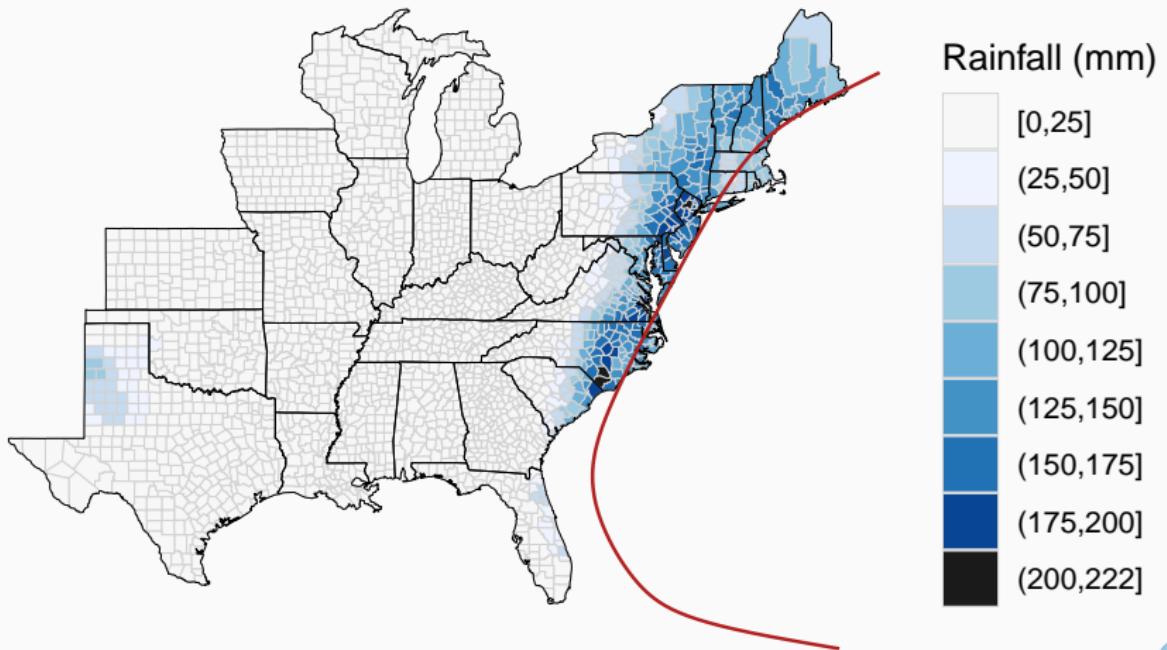
Cardiovascular hospitalization risks by lag day

Storm exposure assessed as maximum sustained winds in the county of 21 m/s or higher



Open-source software

```
library(hurricaneexposuredata)
library(hurricaneexposure)
map_counties(storm = "Floyd-1999", metric = "rainfall")
```



Questions



"Remember that hurricane a thousand miles away? That was me!"

Source: *The New Yorker*