The Calm After the Storm? Burn Injury Incidence Following Hurricanes and Tropical Storms

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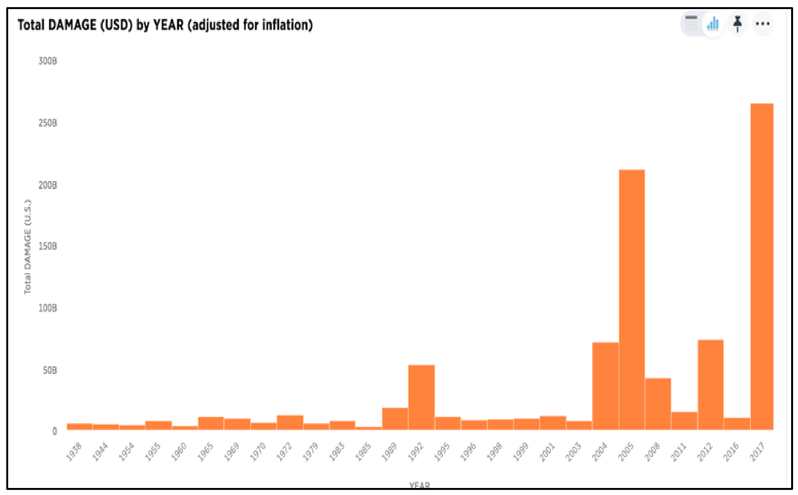
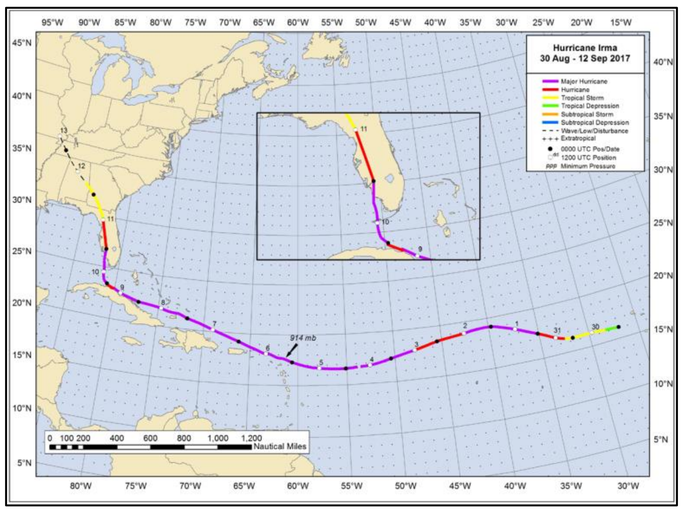
Introduction

- Studies suggest that the combination of natural wind shear variability and greenhouse gas driven erosion of the wind shear protective barrier (WSPB) along the eastern United States is projected to allow the intensification of hurricanes approaching the southeast in the years to come.
- It is hypothesized that as the frequency and intensity of storms hits the United States and causes more damage, the amount of “free-burning” of yard debris does as well. This in turn, leads to more accidental debris/post-storm related burn injuries.
- We hypothesized that an increasing significant association exists between burn-related injuries in the period immediately after tropical storms and hurricanes. This is especially important in the era of climate change and increasing greenhouse gas emissions.



The above graph demonstrates the amount in US dollars that storms (tropical storms and hurricanes) damages have cost the United States. There is an increasing trend in the in the cost of damages from higher intensity storms in recent years. The graph is adjusted for inflation. *Source: Are Hurricanes Getting Worse? A Story Told in 7 Charts. ThoughtSpot. https://www.thoughtspot.com/thoughtspot-blog/are-hurricanes-getting-worse-story-told-7-charts. Published September 12, 2018. Accessed February 23, 2020.*



The above image presents the track that Hurricane Irma took in 2017. The 2017 hurricane season included three of the most expensive storms in history (Harvey, Maria, Irma) all category 4 and above. Making the 2017 season the most expensive and one of the deadliest in history. Hurricane Irma was included in our data set as it hit the state of Florida. *Source: NESDIS News & Articles. NOAA National Environmental Satellite, Data, and Information Service (NESDIS). https://www.nesdis.noaa.gov/content/one-year-after-hurricane-irma-how-data-helped-track-storm. Published September 10, 2018. Accessed February 24, 2020.*

Methods

- Using a retrospective approach, we examined burn center admission data from 2007-2018 (N=4,637) to include burns three weeks after hurricane or tropical storm events (a storm window) in the state of Florida. This dataset only examined burns in which patients were admitted for greater than 20 hours to exclude any confounding follow-up visits.
- The years 2011, 2014, 2015 were used as controls because no tropical storms or hurricanes made landfall in the state of Florida in that time.

Results

	Number of cases with LOS≥20	Volume difference from storm window	P value for t- or Wilcox test of mean difference not equal to 0
Storm window 2007 (6/2-6/28)	22		
Mean (median) difference		6.8 (8.5)	.200
Storm window 2008 (8/18-9/12)	31		
Mean (median) difference		-0.75 (-2)	.826
Storm window 2009 (8/17-9/7)	33		
Mean (median) difference		-8.25 (-5)	.0007
Storm window 2009 (11/9-12/1)	29		
Mean (median) difference		0.08 (-4)	.346
Storm window 2010 (7/23-8/12)	19		
Mean (median) difference		4.7 (4)	.008
Storm window 2012 (5/7-5/26)	23		
Mean (median) difference		-3.0 (-2.5)	.027
Storm window 2012 (6/27-7/16)	17		
Mean (median) difference		4.6 (4.5)	.008
Storm window 2013 (6/5-7/26)	37		
Mean (median) difference		21.6 (21.5)	<.0001
Storm window 2016 (6/9-6/28)	22		
Mean (median) difference		-1.3 (-0.5)	.254
Storm window 2016 (9/2-10/4)	55		
Mean (median) difference		-19.3 (-19)	<.0001
Storm window 2017 (7/30-8/20)	30		
Mean (median) difference		-4.2 (-4.5)	.026
Storm window 2017 (9/10-10/1)	36		
Mean (median) difference		-12.0 (-13)	<.0001
Total mean (median) difference across all comparisons		-0.92 (-1)	.367

Table 1: Comparison of volume during storm windows to volumes in similar non-storm periods
The table above shows a clear increase in volume following six storms in 2009, 2010, 2012, 2013, 2016 and 2017, but no difference or even a significant decrease in volume following other storms. However, the above analysis assumes that the total case volume 2007-2017 is constant.

- Using Poisson regression to evaluate the effect of the storm window has on the number of daily admissions, there was found to be no significant association in respect to daily case totals (p=.165) when comparing across all years in respect to storm windows. This may be due to the constant increasing volume of patients admitted over time.
- However, for the 2015, 2016, & 2017 (storm years where the storms were more intense and frequent) storm windows, it is significantly associated with increased volumes. It is estimated that days in the window have 1.39 times the number of cases (ie. 39% more) as days outside the window for those years. (95% CI= [1.01, 1.89], p=.039)
- The types of injuries varied throughout the storm window years, the most common type of injury being accelerant use on debris. This is likely explained by increased vegetative and artificial debris that accumulates after storms. The incidence of burn-related injuries slightly affected males more at 54%. The mechanism of accelerant on debris burn injuries resulted in higher body surface area burns on average.

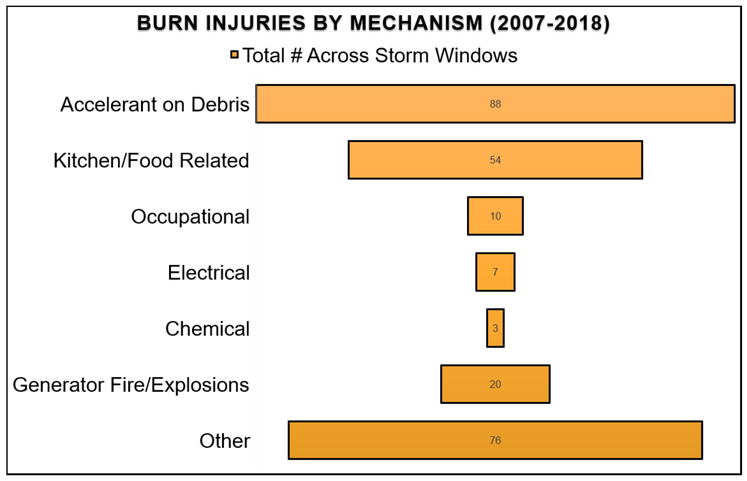


Table 2: Burn Injuries by Mechanism across all storm windows.
The table above outlines the presented burn mechanisms and incidence. The highest incidence being accelerant on debris burns followed by other and kitchen/food related burns. The increase in the number of burns related to occupation, accelerant use, generator usage/explosions may have an association with the period of “clean-up” and repair that often follows tropical storms and hurricanes.

Discussion

- When examining data from 2016 and 2017; years in which severe storms (category 4+) hit the state of Florida, there was found to be a significant increase in the number of daily burn admissions during the storm window by about 39% (p=0.039) as compared to 2015 when no storms hit the state.
- While the data seems to suggest that increasing the storm frequency, intensity, and cost of damage associated with it may have an impact on the number of burn-related injuries, there needs to be further analysis on the relationship between the two.
- The most common type of burn related injury in the three weeks after a storm seems to be accelerant use on debris in this data-set. This may suggest that there needs to be further assessment of the current laws and practices of debris handling in the State of Florida. Better legislation and public health messaging of safe debris clean-up may reduce the number of burn-related injuries.
- Current legislation mandates post-storm debris to be burned at designated disaster management sites no later than 10 days after storms. subsection 62-256.700(8)

Conclusion

“Public awareness should be directed to the dangers of burns and related injuries in the wake of major weather events, i.e. after storms. “