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The Impact of the Storm Emma on Irish Emergency Department Attendances

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Abstract

Aim
The impact of severe weather events on Irish EDs has not yet been characterised. The aim of this study was to examine the impact of Storm Emma on the attendance patterns to an Irish ED.

Methods
Data was collected for 64hrs prior to the red alert (Pre-Red), 38hrs of the red alert (Red) and for the 256 hrs (10 days) post the red alert (Post-Red) during Storm Emma. A Comparison was made with the same time periods in 2017.

Results
There was a statistically significant decrease in attendance during the Red period in 2018, compared with 2017 (119 vs. 234, $p<0.001$), with a rebound surge in attendances in the Post-Red period (1,861 vs 1,578, $p<0.001$). Mean patient experience times were significantly longer in the Post-Red period in 2018 (9.5+/-9.5hrs vs 7.9+/-8.2hrs, $p<0.001$).

Conclusion
This study has detailed the impact of a severe weather event on an Irish ED and will help inform preparedness for the future.

Introduction

The emergency department (ED) must continually effectively manage finite resources in order to ensure safe and efficient service, even in times of extraordinary strain[1]. Surge capacity describes the ability of the ED and indeed, the health system as a whole, to respond to a sudden increase in service demand[2]. Severe weather events, global pandemics, natural disasters, major transport accidents and indeed common events such as influenza, can test the surge capacity of even the well-resourced and prepared EDs.

Severe weather patterns are known to impact substantially upon ED functioning[3-5]. To date, no large study has explored the manner in which severe weather patterns impact upon EDs in Irish hospitals. A recent prospective meteorological study examining future heat-waves, droughts and flooding events in more than 500 European cities, found that Ireland is expected to experience increased frequency of severe weather patterns in the coming decades, making the way in which we prepare for these events pertinent[6].

In March 2018, a status red alert was issued by the national meteorological service in Ireland (Met Éireann) as a low-pressure front encountered freezing, high winds from Siberia in the East resulting in a snow blizzard referred to as "Storm Emma". This was the most significant snow event to have occurred in Ireland in over three decades, significantly limiting transport and disrupting public services throughout the country.

The aim of this study was to consider the impact of a severe weather event and implementation of Status Red weather alert on attendances and care provision in an Irish ED.

Methods

Data was compiled comparing presentations to the ED at Cork University Hospital, analysing presentations during the 15-day period between February 27th and March 13th for 2017 and 2018 respectively. The following time periods were considered in this study: pre-red alert status (Pre-Red) (00:00 February 27th - 16:00 March 1st), red alert status (Red) (16:00 March 1st - 06:00 March 3rd), and post-red alert status (Post-Red) (06:00 March 3rd - 11:59 March 13th). Basic demographics, presenting complaint, mode of arrival, triage category and patient experience time for both admitted and non-admitted patients were analysed and compared with the corresponding period in 2017. In addition, an ED after-action review was conducted with the aim of continuing to improve Cork University Hospital's response to future similar incidents. Statistical analysis was performed with Statistical Package for Social Sciences v25 (IBM Corporation, New York, USA) and GraphPad Prism (GraphPad Software Inc., La Jolla, CA, USA). Admission data from 2017 and 2018 was grouped based on date and time of admission into the three aforementioned groups (Pre-Red, Red, and Post-red). Frequency of admissions, mode of referral, and types of presentation from 2018 were then compared with data from the same time period of 2017 using proportional data and a Chi-Square analysis to compare between years. Continuous data, including ED patient experience time for both admitted and non-admitted patients, was compared with a one-way ANOVA. Data are presented as mean ± SD unless otherwise noted, with $p<0.05$ considered statistically significant.

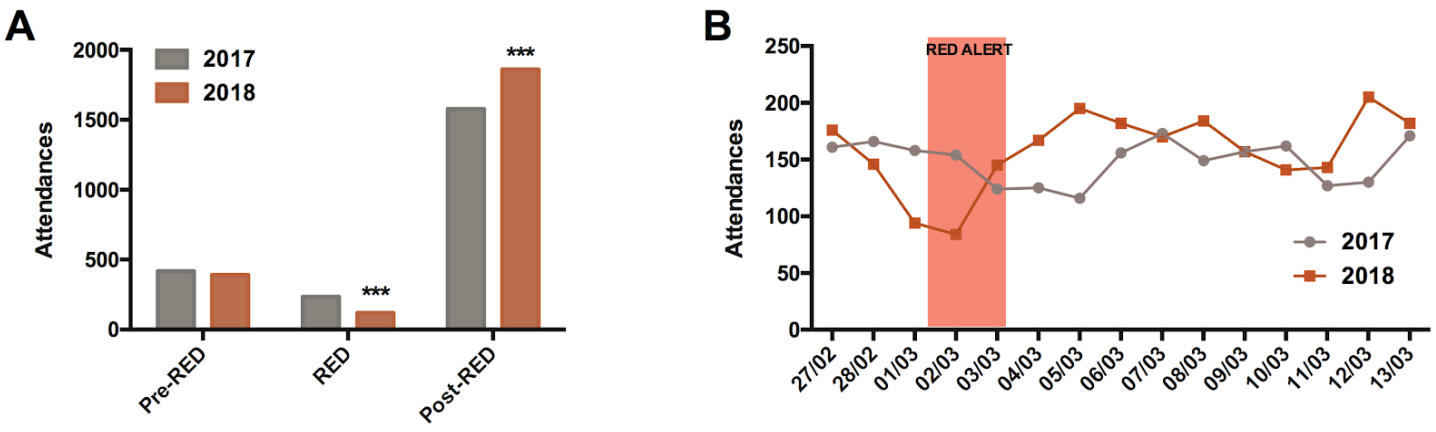
Results

2,371 patients presented to the ED during the time period of February 27 to March 13th in 2018 (Pre-Red: 391, Red: 119 and Post-Red 1861) and 2229 patients (Pre-Red: 417, Red: 234, Post-red:1578) presented during the corresponding time period in 2017 (**Table 1**)(Next Page), representing a significant decrease in presentations during the Red period with a rebound surge in attendances in the Post-Red period ($p<0.001$)

Table 1: Demographics, mode of referral, clinical presentations, triage category and patient experience time for attendances. *p<0.05, comparing 2018 with 2017 values.

		Pre-Red		Red		Post-Red	
		2018	***2017***	***2018***	***2017***	***2018***	***2017***
Demographics	*Age(+/-SD) (yrs)*	35±25	43±26	34±25	43±29	44±27	40±26
	Male %(n)	50(180)	48(219)	38(87)	44(130)	49(959)	49(815)
	Attendances	391	417	119*	234	1861*	1578
	Admissions	147	144	55	86	628	592
	Discharges	244	273	64*	148	1233*	986
Mode of arrival/referral %(n)	*Ambulance*	28.4(111)	18.9(79)	52.1(62)*	22.2(52)	24.9(463)*	21(332)
	Self-referral	26.3(103)	19.4(81)	35.2(42)*	22.6(53)	32.2(599)	25.1(396)
	GP-referral	32(125)	48(200)	2.5(3)*	41.5(97)	25.3(471)	32.1(507)
Presentations %(n)	*Limb problems/injury*	21(82)	17(73)	25(30)*	15(34)	19(355)	17(275)
	Abdominal Pain	12(45)	9(39)	7(8)*	15(34)	11(204)	13(204)
	Unwell Adult	14(53)	12(48)	14(17)	11(26)	12(226)	12(196)
	Chest Pain	7(29)	12(49)	8(9)	10(24)	10(180)*	8(121)
	Headache/Head injury	7(27)	10(40)	7(8)*	12(27)	8(149)	9(136)
	Other	40(155)	41(168)	39 (47)	38(89)	40(747)	41(646)
Triage Category % (n)	*1-Immediate*	1(2)	<0.5(2)	1(1)	1(2)	1(10)	1(9)
	2-Very Urgent	27(104)	29(121)	44(52)*	29(69)	30(561)*	26(417)
	3-Urgent	52(203)	53(221)	47(56)	54(126)	53(989)	53(830)
	4-Standard	17(65)	13(53)	7(8)*	13(31)	13(243)*	17(268)
	5-Non-urgent	1(5)	2(10)	1(1)	0(0)	1(10)	1(13)
Patient Experience time (PET) %(n)	*0-6 Hours*	60.6(237)	65.7(274)	53.8(64)	58.9 (139)	49.4(919)*	60.3(951)
	6-9 Hours	14.3(56)	11(46)	10.9(13)	16.7(39)	17.5(325)*	13.9(219)
	9-24 Hours	13.6(53)	13.4(56)	21(25)	20.1(47)	25.1(467)*	19.4(306)
	>24 Hours	11.5(45)	9.8(41)	14.3(17)*	4.3(10)	8.1(150)	6.5(102)
Non-admitted PET Time (hrs)		6.26 ± 8.27	4.63 ± 4.77	1.16 ± 3.98	2.65 ± 4.46	6.70 ± 5.56	5.03 ± 4.83
Admitted PET time (hrs)		149.69 ± 188.57	207.36 ± 839.90	95.66 ± 116.46	284.25 ± 1032.34	160.52 ± 172.59	292.66 ± 1158.01

Figure 1: Attendance pattern. Effect of status red alert on total hospital attendances (A) and the daily attendance (B) for 2017 (grey) and 2018 (red). Data are absolute and statistical differences, as assessed by Chi-Square, are represented as follows: *** = p<0.001.

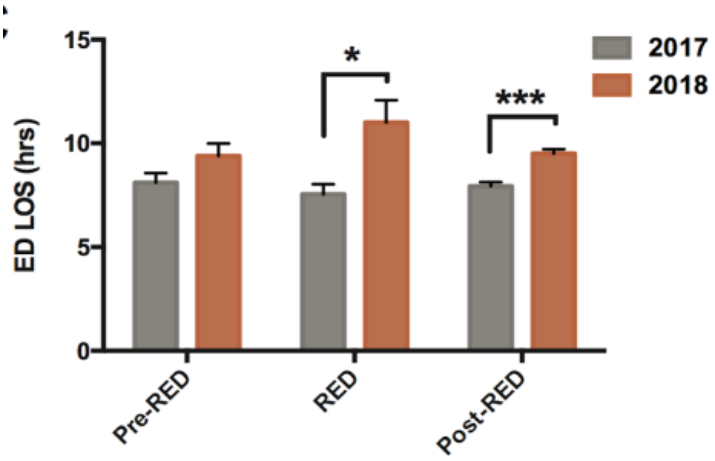


During the Red alert period, a significantly greater proportion of patients presented to the ED by Self-Referral (35.2%, n=42) and via ambulance (52.1%, n=62) than in 2017 (22.6%, n=53 and 22.2%, n=52 respectively) (p<0.001) (**Table 1).** In addition, a significantly larger proportion of patients presented via ambulance during the Post-Red alert phase in 2018 (24.9%, n=463), than the same time period in 2017 (22.6%, n=332) (p<0.05).

The 5 most common presentations during the 2018 status red alert period (**Table 1**) were limb problems/injury (25%, n=30), followed by the triage categories "unwell adult" (14%, n=17), chest pain/injury (8%, n=9), abdominal pain/trauma (7%, n=8), and headache/head injury (7%, n=8) respectively. There was a significantly greater proportion of patients with limb problems/injury (25% vs. 15%, p<0.05) during the status red alert in 2018 when compared to 2017.

Patient experience time for both admitted and non-admitted ED patients during the Red alert 2018 was 11±11.8hrs, compared with 7.5±7.4hrs during the corresponding time period in 2017 (p<0.05). During the Post-red alert phase patient experience time was 9.5±9.5hrs in 2018, compared with 7.9±8.2hrs in 2017 for the same time period (p<0.05) (**Figure 2**).

Figure 2: Patient Experience Time. Data are presented as pre-RED, RED, and post-RED patient attendances for 2018 (n=2371) and the respective admissions from the same dates in 2017 (n=2229). Significance as determined by one-way ANOVA is represented as follows: * = p<0.05; ** = p<0.01; *** = p<0.001.



For the Pre-Red, Red and Post-Red time period in 2018,1%(n=2), 1%(n=1) and 1%(n=10) of presentations were triaged as Category 1, respectively, corresponding to 0.5%(n=2), 1%(n=2) and 1%(n=9) for the same time periods in 2017. There was a slight increase in the proportion of Category 2 (very urgent) attendances during the red alert phase in 2018 (44.1%, n=52), compared with 2017 (30.1%, n=69). 47.5% (n=56) of attendances in 2018 red alert were triaged as Category 3 (urgent) in contrast to 55% (n=126) in 2017. 11.8% (n=41) were triaged as Category 4 & 5 in 2018, closely correlating with 14% (n=32) of presentations in 2017.

After Action Review

An after action review conducted provided many essential learning for the ED and Cork University Hospital. Suggestions for future events, arising from this review included that the health service must consider its transport strategy, both for patients and staff, for future similar events. The early declaration of a major incident is crucial, with clear designation of roles and the establishment of a hospital incident room. Greater clarification is needed in relation to the meaning of a "Red alert" for the army, Emergency Medical Services and Emergency Medicine personnel, as there was significant confusion amongst the different services on this occasion. Lastly, the establishment of local control centres within regions, with national visibility and support, may be more appropriate to ensure local knowledge and local solutions are utilised effectively.

Discussion

Severe weather events, such as Storm Emma, have significant effects on ED attendance patterns and challenge the capacity of our EDs and hospital systems. The "Health Service Capacity Review 2018 Executive Report" states Ireland has an acute-bed occupancy rate of 95-100%, inferring significant under-capacity for surges in presentations associated with severe weather events and those seen severe influenza outbreaks. This study found a significant decline in ED attendances during "status red" compared to the corresponding period in 2017. This is likely due to transportation difficulties and adherence to the government-recommended restriction of unnecessary journeys, which severely limited hospital access during this period. Despite lower number of attendances, admitted patients had significantly longer experience times in the ED during the red alert phase owing to the impact this weather event had on overall patient flow. In the 10-day period following the storm event, there was a surge in ED attendances, with a residual impact on patient experience times. This emphasis these events, although themselves short-lived, impact the health service for much longer periods of time than the event duration. In preparing for Hurricane Sandy, Staten Island University Hospital made a significant effort to facilitate the discharge of patients who were near hospital discharge, or the transfer suitable patients to step-down fascilities[8]. Future protocols preparing for major weather events and surges in attendance must ensure the availability and prompt usage of step-down facilities, to increase availability of acute hospital beds. In addition, the postponement of elective procedures in hospitals close to capacity in the days preceding the severe weather event may ensure more acute beds are at hand prior to the expected surge.

Anecdotally, it was felt that those who attended the ED during Storm Emma were more acutely unwell than those presenting on an average day. We found no significant difference in the triage category of those presenting to our ED during the red alert phase. However, during the post-red alert phase there was a trend towards increased numbers of category 1 or category 2 attendees, compared with the corresponding time period in 2017. Although the reason for this is not known, there was significant barriers for patients to access medical attention, prescription medication and even life sustaining treatments such as dialysis during the red alert phase. In addition, those unwell possibly delayed their presentations to the ED due to the aforementioned obstacles and therefore were sicker when presenting. The inability to access medical care, including prescription medications and home care services has previously been implicated in the deterioration of patients with chronic conditions during major weather events and may explain one aspect contributing to the surge in attendance and increased acuity of those presenting following the red alert[4]. These findings highlight the need for an organised and integrated approach to primary and community healthcare provision around the times of future severe weather events to prevent deterioration of vulnerable patients.

Despite advice to remain indoors and public health awareness efforts, there were significantly more trauma-related limb injury attendances attributed to the severe weather and snow. This is in keeping with previous studies also demonstrating significantly more limb injuries and trauma when compared with standard presentations following severe weather alerts [3, 7, 8]. Public health campaigns could raise awareness of the dangers of snow and icy footbath and road conditions, with advice against dangerous activities such as sledding on icy snow-covered roads.

Transport to and from hospital, of both staff and patients, was possibly the single most difficult obstacle during this event, and possibly had the largest impact. Unsurprisingly, most presentations during the Red alert period were via ambulance. This was secondary to very poor road conditions and the inability of patients to self-transport to hospital. Ambulance transport was also challenged during the severe weather and required support from the army and local volunteers to access and deliver patients to hospital from isolated areas. Transportation difficulties also proved to be a significant difficulty in enabling patients who had been discharged from the ED, and indeed acute hospital beds to get home safely, with patients fit for discharge unable to vacate their current acute hospital bed for newly admitted patients. There was significantly less discharges from acute hospital beds during the red alert period, decreasing patient flow and conversely increasing patient experience time significantly in the ED, despite significantly less attendances. As mentioned, future protocols preparing for major weather events and surges in attendance must ensure the availability and prompt usage of step-down facilities, to increase availability of acute hospital beds and prevent this situation occurring again.

Following Storm Emma an After-Action Review (AAR) was conducted to identify areas of improvement in our EDs preparedness for future severe weather events. These reviews facilitate continuous department improvement and enforce feedback from multidisciplinary teams involved in dealing with future attendance surges, whether from weather

events, natural disasters or disease outbreak. One highlight of the AAR surrounded staffing challenges both during and after the storm. The impact of severe weather events on hospital staffing patterns has previously been highlighted as a significant challenge in managing post-storm attendance surges[8]. Staff transportation significantly impacted our ED, with some staff unable to attend work for scheduled shifts. Formalising protocols for hospital staff transportation would be essential in the preparation for similar events in the future to avoid the difficulties seen during Storm Emma. Suggestions include providing collection for all staff from their homes in appropriate Army or Civil Defence vehicles, which would be organised in advance of the red alert. For those living further afield, accommodation in the vicinity of the hospital should be provided with transport to the hospital from there. In addition, staffing patterns should be amended to account for decreased attendances during severe weather events and the surge in attendances following such an event.

This study has provided information on the impact of a severe weather event on an Irish ED. Lessons learnt from this event will enable Irish EDs and the health service to better prepare for similar events in the future. We have identified the need for developing increased surge capacity, developing transportation protocol for extreme weather events, adjusting staffing to meet predicted surge in acute care demands and promoting public health campaigns for the public during these events.

Declaration of Conflicts of Interest:
The authors report no conflict of interest for this study.

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References:

1. Chang G, Weiss AP, Orav EJ, Smallwood JA, Gonzalez S, Kosowsky JM, et al. Bottlenecks in the emergency department: the psychiatric clinicians' perspective. Gen Hosp Psychiatry. 2012;34(4):403-9.
2. Hick JL, Koenig KL, Barbisch D, Bey TA. Surge capacity concepts for health care facilities: the CO-S-TR model for initial incident assessment. Disaster Med Public Health Prep. 2008;2 Suppl 1:S51-7.
3. Bischoff-Ferrari HA, Orav JE, Barrett JA, Baron JA. Effect of seasonality and weather on fracture risk in individuals 65 years and older. Osteoporos Int. 2007;18(9):1225-33.
4. Gotanda H, Fogel J, Husk G, Levine JM, Peterson M, Baumlin K, et al. Hurricane Sandy: Impact on Emergency Department and Hospital Utilization by Older Adults in Lower Manhattan, New York (USA). Prehosp Disaster Med. 2015;30(5):496-502.
5. Ho VP, Towe CW, Chan J, Barie PS. How's the weather? Relationship between weather and trauma admissions at a Level I Trauma Center. World J Surg. 2015;39(4):934-9.
6. Selma B Guerreiro RJD, Chris Kilsby, Eizabeth Lewis, Alistair Ford. Future heat-waves, droughts and floods in 571 European cities. Environmental Research Letters. 2018;13(3).
7. Tenias JM, Estarlich M, Crespo E, Roman-Ortiz C, Arias-Arias A, Ballester F. Short-term relationship between hip fracture and weather conditions in two Spanish health areas with different climates. J Environ Public Health. 2015;2015:395262.
8. Greenstein J, Chacko J, Ardolic B, Berwald N. Impact of Hurricane Sandy on the Staten Island University Hospital Emergency Department. Prehosp Disaster Med. 2016;31(3):335-9.