

Title: Preventing Ambulance Crashes in Massachusetts

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Introduction: Ambulance crashes harm EMS providers, their patients, their services, and their communities. Those onboard the ambulance, especially unrestrained providers caring for their patients, are at significant risk of injury in a crash¹, while the occupants of the other vehicles are at higher risk of death². Crashes take essential personnel and vehicles out of service, exacerbating staffing shortages and cause more than \$500 million of damage nationwide each year². While ambulance safety research is a growing field, state-specific analyses of crash trends and risk factors are rare.

Objective: The purpose of this study was to evaluate data from 128 Massachusetts ambulance crashes, and create mitigation strategies tailored to the needs of providers, patients, and communities in the Commonwealth.

Methods: The team conducted a retrospective analysis of deidentified data from ambulance crashes that occurred between August 2018 and August 2021. Variables of interest included lights and sirens (L&S) use, injury, and driver years of licensure. Baselines for comparison were gathered from MATRIS (MA NEMSIS), peer-reviewed literature, and the publicly-available MA EMS personnel registry. Descriptive statistics were generated in Excel, and chi-squared tests were conducted in STATA.

Results: Most reported crashes (59%) occurred during patient transport, and slightly more than half (55%) of all crashes occurred while the ambulance was using L&S. Ambulances that were driving L&S were 2.8 (95% CI 1.3 – 6.5; $p \leq 0.01$) times more likely to have a patient onboard when they crashed, compared to ambulances that were not using L&S.

Crashes that occurred at intersections were 3.79 (95% CI = 1.6 – 8.8; $p \leq 0.01$) times more likely to be using L&S, and 2.5 (95% CI = 1.1 – 5.6; $p \leq 0.01$) times more likely to have an injury, compared to crashes not at intersections. There was no significant relationship between L&S use and injuries ($p > 0.05$). Details are in Table 1.

The first two years since certification have the most disproportionate crash rates: providers who have been certified less than 1 year make up 5.8% of the total, and accounted for 10.3% of crashes, while the 10.5% of providers with 1-2 years since certification accounted for 22.4% of crashes.

There were 33 runs marked in MATRIS as delayed due to a “Vehicle crash involving this unit” that had not been reported to MA OEMS. In addition, only 5 out of the 128 reported crashes had been marked in MATRIS using this delay. During the study sample window, we estimate that 73-85% of crashes were not reported to MA OEMS (details in Table 2).

Conclusion: To reduce the incidence and severity of ambulance crashes, MA OEMS may consider:

1. Incentivizing ambulance operator training, especially for new EMS personnel.
2. Modifying lights and sirens protocols to reduce use during patient transport.
3. Sending an advisory reminding services of crash reporting requirements.
4. Improving post-crash data collection using the Ambulance Crash Questionnaire.

Table 1. Associations between L&S Use, Patient Onboard, Intersection, and Injuries

	Odds Ratio	95% CI	p-value
L&S and patient onboard	2.8	1.3 – 6.5	0.006
Intersection and L&S	3.8	1.7 – 8.8	0.001
Intersection and 1+ injuries	2.5	1.1 – 5.6	0.01
Intersection and 2+ injuries	2.4	1.0 – 6.1	0.03
L&S and 1+ injuries	0.8	0.3 – 1.7	0.47
L&S and 2+ injuries	0.8	0.3 – 1.9	0.50

Table 2. Estimation of Crashes Not Reported to MA OEMS

Year	Total Runs (MATRIS)	Crashes reported	Additional Found in MATRIS	Expected Total *	Percent Missing
2019	1,757,491	58	5	217	73%
2020	1,560,955	28	12	193	86%
2021	1,315,884	38	16	163	77%

* The expected total number of crashes was calculated using Watanabe et al.'s³ estimated risk of 12.4 ambulance crashes for every 100,000 ambulance runs.

References:

1. Kupas, D. (2017). Lights and Siren Use by Emergency Medical Services (EMS): Above All Do No Harm, US Department of Transportation, National Highway Traffic Safety Administration, Office of Emergency Medical Services.
2. Murray, B. and R. Kue (2017). "The use of emergency lights and sirens by ambulances and their effect on patient outcomes and public safety: a comprehensive review of the literature." *Prehospital and Disaster Medicine* **32**(2): 209-216.
3. Watanabe, B. L., et al. (2019). "Is Use of Warning Lights and Sirens Associated With Increased Risk of Ambulance Crashes? A Contemporary Analysis Using National EMS Information System (NEMSIS) Data." *Annals of Emergency Medicine* **74**(1): 101-109.