

ANALYZING THE LINK BETWEEN AIR QUALITY AND RESPIRATORY ISSUES: A RETROSPECTIVE STUDY OF EMS RECORDS, AIR QUALITY, AND SOCIOECONOMIC FACTORS

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INTRODUCTION

Air pollution is described as “One of the greatest environmental risks to health.” by the World Health Organization.¹ Exposure to poor air quality is a well-established factor for exacerbation of respiratory distress and hospital admissions.²⁻³ There is limited data on the impact of air quality and use of emergency medical services in relation to respiratory distress incidents. The objective of this study was to analyze data for public health services to better understand the burden that poor air quality may have on their communities. This will enable action to prevent and prepare for medical complications that may arise on poor air quality days.

METHODS

- Retrospective convenience sample of de-identified 9-1-1 response EMS Patient Care Reports (PCRs) from ImageTrend Collaborate for 2023 was utilized.
- Incidents were included if air quality index data (AQI) was available, along with a documented impression.
- Respiratory distress was identified as a primary outcome variable. Defined by impressions of asthma, dyspnea, unspecified orthopnea or shortness of breath.
- EMS intervention levels were grouped by less invasive (oxygen or nebulizer administration) and more invasive (Advanced airway, BVM, CPAP, BiPAP).
- Descriptive analyses were conducted based on patient characteristics, provider respiratory distress impressions, severity based on airway interventions, Social Deprivation Index (SDI), and highest daily reported AQI data.

Variable	AQI ≤50 ² (Cat 1)		AQI 51-100 ² (Cat 2)		AQI ≥101 ² (Cat 3)		Resp % Diff ⁴ (Cat 1 vs Cat 2)	Resp % Diff ⁴ (Cat 1 vs Cat 3)
	All Incidents	Respiratory Distress	All Incidents	Respiratory Distress	All Incidents	Respiratory Distress		
All Incidents	3,238,863	259,290(8.0%)	1,118,038	90,356(8.1%)	43,568	3,819(8.8%)	+1.2%*	+9.5%*
On Scene Time (Median[IQR])	14.3[10.0,19.9]	15.4[11.2,20.7]	14.9[10.2,20.9]	15.9[11.4,21.6]	13.6[9.6,18.7]	14.2[10.3,18.8]	-	-
Age in Years (Median[IQR])	57[35,75]	66[51,77]	57[35,73]	65[48,76]	59[36,75]	66[49,76]	-2.6%*	-1.5%*
Missing	9,303	253	3,984	72	56	3	-	-
Sex								
Female	1,650,534	134,545(8.2%)	567,228	46,851(8.3%)	22,034	2,023(9.2%)	+1.2%*	+12.2%*
Male	1,574,983	124,042(7.9%)	547,282	43,321(7.9%)	21,433	1,788(8.3%)	+0.0%	+5.1%*
Missing	13,346	703(5.3%)	3,528	184(5.2%)	101	8(7.9%)	-	-
Region								
West	1,358,443	98,970(7.3%)	448,564	34,989(7.8%)	25,897	2,338(9.0%)	+6.8%*	+15.4%*
Midwest	435,283	37,820(8.7%)	167,944	13,705(8.2%)	12,458	1,054(8.5%)	-5.8%*	+3.7%*
Northeast	294,658	21,837(7.4%)	29,066	1,973(6.8%)	2,039	126(6.2%)	-8.1%*	-8.8%*
South	1,150,479	100,663(8.7%)	472,464	39,689(8.4%)	3,174	301(9.5%)	-3.4%*	+13.1%*
Patient Disposition								
Transport	2,494,547	227,489(9.1%)	854,740	78,034(9.1%)	34,079	3,296(9.7%)	+0.0%	+6.6%*
No EMS Transport/Refusal	713,480	31,000(4.3%)	252,142	12,083(4.8%)	9,092	504(5.5%)	+11.6%*	+27.9%*
Death	29,978	713(2.4%)	11,117	238(2.1%)	397	19(4.8%)	-12.5%*	+100.0%*
Missing	858	88(10.3%)	39	1(2.6%)	0	0	-	-
Urbanicity ³								
Urban	3,110,592	247,752(8.0%)	1,103,478	89,121(8.1%)	42,568	3,731(8.8%)	+1.3%*	+10.0%*
Suburban	117,393	10,482(8.9%)	13,566	1,160(8.6%)	929	83(8.9%)	-3.4%*	0.0%
Rural	4,809	450(9.4%)	758	51(6.7%)	71	5(7.0%)	-28.7%*	-25.5%*
Missing	6,079	606(10.0%)	236	24(10.2%)	0	0(0.0%)	-	-
Social Deprivation Index Score by County ^{4,5}								
<25 (Least Deprived)	546,179	39,190(7.2%)	81,737	5,724(7.0%)	5,076	346(6.8%)	-2.8%*	-5.6%*
25-49	731,951	54,433(7.4%)	121,486	9,068(7.5%)	4,762	355(7.5%)	+1.4%*	+1.4%*
50-74	987,530	77,788(7.9%)	454,552	35,877(7.9%)	20,587	1,742(8.5%)	0.0%	+7.6%*
75+ (Most Deprived)	973,194	87,878(9.0%)	460,262	39,687(8.6%)	13,163	1,376(10.5%)	-4.4%*	+16.7%*
Missing	9	1	1	0	0	0	-	-

¹Includes NEMSQA definition of Respiratory Distress excluding T17.9 (Foreign body in respiratory tract) and including all J45 (asthma)
² 3 day average of daily Air Quality Index high
³ RUCC USDA Rural-Urban Continuum Code. Metro Area includes counties located within a metropolitan area that has over 250,000 residents. Non-Metro Area includes urban counties with at least 2,500 residents, that may or may not be adjacent to a metropolitan area. Rural denotes counties that are completely rural or urban with less than 2,500 people in an urban area.
⁴<https://www.graham-center.org/rge/maps-data-tools/sdi/social-deprivation-index.html>

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Top Respiratory Primary Impressions								
Abnormalities of Breathing (R06)	-	65,370(25.2%)	-	22,770(25.2%)	-	563(14.7%)	+0.0%	-41.7%*
Acute Resp Distress Syndrome (J80)	-	64,527(24.9%)	-	24,878(27.5%)	-	1,392(36.4%)	+10.4%*	+46.2%*
Other Resp Disorder(J98)	-	36,970(14.3%)	-	11,972(13.2%)	-	679(17.8%)	-7.7%*	+24.5%*
Chronic obstructive pulmonary disease (J44)	-	16,100(6.2%)	-	4,054(4.5%)	-	152(4.0%)	-27.4%*	-35.5%*
Asthma (J45)	-	11,361(4.4%)	-	3,861(4.3%)	-	143(3.7%)	-2.3%	-15.5%*
Severity based on Intervention ³								
Monitoring Only	-	228,869(89.3%)	-	80,800(90.7%)	-	3,255(86.9%)	+1.6%*	-4.2%*
Less Invasive Intervention	-	9,693(3.8%)	-	2,737(3.1%)	-	238(6.4%)	-18.4%*	+106.5%*
More Invasive Intervention	-	17,616(6.9%)	-	5,697(6.4%)	-	251(6.7%)	-7.2%*	+4.7%
Missing	-	3,112	-	1,222	-	75	-	-

¹Includes NEMSQA definition of Respiratory Distress excluding T17.9 (Foreign body in respiratory tract) and including all J45 (asthma)
² 3 day average of daily Air Quality Index high
³ Intervention: More Invasive: Advanced airway, BVM, CPAP, BiPAP; Less Invasive Intervention: Oxygen administration (via nonrebreather, nasal canula, blow by mask), Nebulizer; Monitoring Only: documentation of SpO2 or respiratory rate
*Significant p-value <0.05

RESULTS

- Among 4.4 million PCRs, 353,000 incidents of respiratory distress were identified.
- On days where AQI was high (> 100), there was a 9.5% increase in respiratory distress incidents.
- Among respiratory distress incidents on high AQI days, incidents increased involving:
 - Females (+12.2%)
 - Patient transports (+6.6%)
 - Less invasive airway interventions (+106.5%)
- As SDI increased (more deprived), so did the rate of respiratory distress incidents, regardless of AQI. Additionally, there was a 16.7% increase in respiratory incidents on high AQI days for the most deprived SDI group.

CONCLUSION

There was increased burden on EMS systems for respiratory distress and significantly more interventions being required when the AQI was >100. Communities that are more socioeconomically deprived are more likely to utilize 911 for respiratory distress, with a marked increase on poor AQI days. This information can help public health systems prepare for the burden of poor air quality on their communities.

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