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Air Aware: Improving Use of an Existing Air Quality and Health Tool

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Abstract

Exposure to air pollutants is a significant health risk for individuals with asthma, cardiovascular disease, and chronic obstructive pulmonary disease. Measures such as limiting time outdoors or performing less strenuous tasks when air quality levels are better can mitigate these risks, but only if people are aware of both these recommendations and how to know when air quality is best, and worst. Formative audience assessment determined that applications developed for mobile devices are the optimal way to provide this information, but knowledge of the existing United States Environmental Protection Agency (EPA) and partners' AirNow tool was minimal. We developed, field-tested, adapted, and implemented pilot efforts at both the national and local levels to address this knowledge gap, and present findings suggesting a concentrated local effort can heighten use of AirNow, leading to more pro-healthy behavior.

Several resources exist to educate and provide information about air pollution and air quality, including the Environmental Protection Agency's (EPA) AirNow.gov real-time database of air quality information and a substantial volume of tools from the Centers for Disease Control and Prevention (CDC). However, most consumers—including those with respiratory illnesses—are unaware that these tools exist or are unsure how to access them (Mirabelli et al., 2018; Mirabelli, Ebelt, & Damon, 2020; Ramirez, Ramondt, Van Bogart, & Perez-Zuniga, 2019; Spurr, Pendergast, & MacDonald, 2014). Likewise, most consumer-directed information about local air quality does not explain what protective measures might be taken or how exposure to air pollution can lead to long-term negative health effects (Ramirez et al., 2019). Thus, CDC's current challenge is to ensure that vulnerable populations are aware of the tools and resources available and use these tools to adopt protective behaviors that can prevent additional respiratory symptoms (e.g., changing physical activity routine, moving activities indoors, deactivating air intake on air conditioning units) (Petersen, 2002).

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The purpose of this project was to promote existing CDC and EPA resources for respiratory health through developing new materials and executing a dissemination plan that reaches the general public and connects them to those existing resources. By developing new communication materials, CDC can ensure that consumers take advantage of existing resources and can help vulnerable populations to reduce the negative effects of air pollution on their health. Exposure to indoor and outdoor air pollutants, such as vehicle emissions, wildfire smoke, industrial particle pollution, and ozone, is a significant public health concern and is especially a risk for individuals with asthma, chronic obstructive pulmonary disease (COPD), and cardiovascular disease (Hall, Brajer, & Lurmann, 2008; Samet & Krewski, 2007). Even short-term exposure to air pollution can lead to adverse respiratory and cardiovascular effects (Brugha & Grigg, 2014; Franklin, Brook, & Pope, 2015).

An extensive body of scientific evidence shows that exposure to air pollution can cause cardiovascular effects, including asthma attacks, heart attacks, heart failure, and strokes, which results in hospital admissions, emergency department visits, and, in some cases, premature death (U.S. EPA, 2021). The Environmental Protection Agency provides tiered advice, based on individual risk factors and air quality index readings, to guide physical activity decisions for both vulnerable groups and the general public, including such measures as limiting time outdoors and performing strenuous activities at certain times of day (AirNow.gov, Activity Guides, 2021).

Our project, ultimately known as “Air Aware,” is an audience-based effort to promote both those behaviors and how to access the air quality forecasts that facilitate them. Air Aware developed over several years, and we present it in three parts: (1) the initial formative phase that encompassed both qualitative and quantitative audience assessment, (2) iterative pre-testing of prototype messages and materials with representative samples from the target audiences, and (3) implementation of both a national effort and a targeted effort to disseminate messages in one chosen pilot market.

Methods

Phase 1: Audience Assessment

Quantitative findings reported elsewhere include data gathered in the 2014, 2015, and 2016 Consumer Styles surveys. Consumer Styles surveys the same 6,000 adults three times annually to discover trends in attitudes, purchasing behaviors, lifestyle values, technology use and their traditional and online media habits. In addition we used 2015 data from the associated “DocStyles” survey of clinicians. DocStyles surveys at least 1,000 health care providers every year to understand how they use social media channels inside and outside the exam room, how they stay informed and their approach to diagnosing and treating a range of patients. This data indicates that less than half of our target audience is aware of air quality alerts (Pennington et al., 2019). Individuals with asthma and COPD, both respiratory conditions, showed greater awareness of their personal health risks associated with exposure to poor air quality than did individuals with cardiovascular disease (Mirabelli et al., 2018). Findings from the 2015 DocStyles survey indicated that fewer than half of providers discussed air quality with any of their patients, with such conversations occurring with

only about a third of respiratory disease patients and fewer than one in five cardiovascular disease patients (Mirabelli, Damon, Beavers, & Sircar, 2018).

Qualitative research began in 2016 with eight in-depth interviews (IDI) conducted online with physicians, nurse practitioners, and nurses serving the at-risk populations. IDI research questions are provided in Appendix A. This initial phase was conducted with the intention that it would inform the next formative phase, described below, as well as contribute to the eventual design of educational materials.

We conducted six in-person focus groups with individuals with asthma, diabetes, and/or cardiovascular disease and caretakers of children with asthma and/or diabetes in San Francisco ($n = 24$) and Washington, D.C. ($n = 20$). We selected these locations based on their relatively higher air pollution levels. Of the participants, 15 had asthma, 14 had diabetes or cardiovascular disease, and 15 were parents/caregivers of children with asthma or diabetes. Each group comprised 6 to 9 individuals, and we provided participants with a $75 incentive for completing the session. Focus group research questions are provided in Appendix B.

For both the in-depth interviews and the focus groups, all sessions were audio recorded and a notetaker took verbatim notes. The general methodology for analysis included synthesizing the audio recordings and verbatim notes recordings into key takeaways, overarching findings, and recommendations.

Phase 2: Field Testing

Based on both quantitative and qualitative findings, prototype materials were designed for field testing in 2018. These materials focused on raising awareness of the health effects of poor air quality and of the main existing tools for addressing it, the Air Quality Index and especially AirNow.gov. In this second phase of assessment, field-testing was conducted using “triad” focus groups (i.e., focus groups with 3–4 participants per session). We conducted nine sessions—three each for asthma, COPD, and cardiovascular disease, in Atlanta, Georgia (3 sessions); Washington, D.C. (3 sessions); Fort Collins, Colorado (2 sessions); and Raleigh, North Carolina (1 session). We selected these locations to achieve greater geographic diversity and to enroll participants from both large and medium-sized metro areas.

Prototype messages and materials were examined iteratively, with alterations made between each round of groups. During the sessions, we obtained open-ended feedback on the materials using a semi-structured moderator guide, and we also had participants individually rate the materials using a 7-item perceived effectiveness scale (e.g., “This material grabbed my attention”), with responses for each item ranging from 1 (strongly disagree) to 5 (strongly agree) (Table 1). A total of 31 individuals participated, with 10 individuals identifying as having asthma, 11 identifying as having COPD, and 10 identifying as having cardiovascular disease. We analyzed data from these triads using the same approach described in Phase 1.

Phase 3: Implementation

Air Aware was active March 18-June 21, 2019, in the Pittsburgh, Pennsylvania, market, supplemented by other efforts that were not geographically targeted, including leveraging existing resources, posting on CDC Twitter and Facebook pages. The overall goal of Air Aware was to raise awareness about the health effects of exposure to polluted air and thus to prompt behavior change. The local measurable objective of Air Aware was an increase in web traffic (i.e., visits and downloads) to the AirNow.gov website within the Pittsburgh market during the campaign timeframe (March – June 2019) compared to the same timeframe the previous year.

The Pittsburgh market was chosen due to the region's relatively poor air quality as measured by the number of "bad air days" reported annually on the EPA Air Quality Index (AirNow.gov, AQI, n.d.), higher than average rates of chronic respiratory conditions among the population (Hopey, 2019), the size of the market being commensurate with the resources available and the predominant use of English in the market (U.S. Census, 2021), as AirNow.gov is currently available in English only.

In Pittsburgh, Air Aware included locally targeted Facebook posts; advertising on and inside Port Authority buses and terminals; targeting of Pittsburgh-area clinicians in the fields of pulmonology, cardiology, allergy, immunology, primary care, and internal medicine through DMD (an opt-in medical professional e-mail network) and Epocrates (a medical reference smartphone app); and four print advertisements and digital advertisements carried by the main local daily newspaper, the *Pittsburgh Post-Gazette*. The Pittsburgh campaign was complemented by a concurrent national rollout. This included paid Facebook advertising and use of CDC Facebook and Twitter platforms and web "features," particularly during Air Quality Awareness Week (April 29 through May 3). Both national and local efforts were supplemented by postings on CDC's social media accounts and web pages.

Results

Phase 1: Audience Assessment

IDI findings supported the DocStyles findings, reiterating that physicians rarely conducted comprehensive discussions with patients about air quality and that some clinicians were not fully aware of how air pollution could adversely affect cardiovascular disease patients. Clinicians noted a lack of resources on air quality and health for their use in patient education, with most being unaware of existing tools such as the Air Quality Index and AirNow.

Internal Medicine Physician: "The time we have with patients is limited, so we have to prioritize what we say and how much time we spend saying it. I think [outdoor air quality] is important, but there's 65 other important things to tell patients."

Nurse: "There's nowhere we can tell [patients] to go and say, 'Look here, do this.' There are not enough resources [about outdoor air quality] for people. I'm sure they're out there, but I don't know what they are."

The focus group population was for the most part aware of air quality alerts in the popular media but rarely sought out this information actively. Individuals in the focus groups were enthusiastic about integrating checking air quality into their daily routine using smartphone apps. Alerts presented in plain language with clear calls to action were preferred by several participants.

Adult with asthma, San Francisco: "I check air quality alerts before I go out—usually on the morning news before I leave the house, so I know what I need to gear up for."

Perception of personal risk greatly influenced information-seeking behavior among focus group participants, with cardiovascular disease and diabetes patients being less likely than respiratory disease patients, or parents of children with asthma, to actively seek out air quality information. This finding was borne out as well in the pre-testing phase of the study.

Parent, Washington DC: "If you ask [children] to stay indoors, they'll be really upset, and it'll be hard to convince them. They won't understand. They'll say, 'Everyone is playing outside, why not me?'"

Few focus group participants recalled air quality conversations with clinicians, and some reported that those conversations were initiated by the patient or child caretaker, not the clinician. Many recommended self-protective behaviors, including exercising indoors instead of outdoors, closing windows, and spending less time outdoors on poor air quality days were seen as broadly feasible with some being more difficult to integrate into daily routines than others due to work routines or other conflicts.

Phase 2: Field Testing

Small group discussions (n = 3-4 per session) are an ideal methodology for balancing data quality, timing, and audience segmentation (Giacomini, 2000; Morgan, 1998). Like larger focus groups, small group discussions (e.g., triads) generate interactive dialogue and enable rapid assessment of audience perceptions and behaviors. However, small group discussions also enable us to reach numerous audience segments within relatively limited sample sizes and to schedule and conduct sessions more quickly than is possible with larger focus groups.

Triad participants reviewed the materials favorably overall, with perceived effectiveness ratings ranging from 3.27 to 3.89 on a 5-point scale. Most participants clearly understood the main messages and largely agreed that the materials were intended for people like them. Key findings included reinforcement of the earlier preference for simplified text and messages, preference for a positive message over a negative one (e.g., enjoy good air days rather than avoid bad air days), a general lack of familiarity with the Air Quality Index and AirNow.gov, and learning of poor daily air quality from either news media sources or their own personal experience (e.g., difficulty breathing or eye irritation).

Heart Disease/COPD Group: "I think their target audience is definitely [the people mentioned in] yellow print. I think they're trying to reach as many people with COPD, asthma, and heart disease and offer them the chance to sign up for this text alert thing."

Asthma Group: "I've actually never heard of [AirNow.gov], and I like the fact that it has text alerts, 'cause who … would be like, 'Hey. You need your inhaler because the air quality's poor today.'"

Heart Disease/COPD Group: "The little part here: 'I love being outside when the air is healthy, that's why I use the AirNow.gov.' I've always thought more about getting these alerts on bad days, and knowing which days were bad. I was never really considering getting an alert and saying, 'Oh, the air's great. Today's a good day to go out and do that.' It made me kind of want the AirNow.gov application a little more."

Multiple suggestions for improvement were offered in each round of testing, and material designs evolved from, for example, displaying multiple individuals, or no individuals, to displaying a single individual enjoying clear air. Other specific recommendations incorporated into the final design included making the call to action of visiting AirNow.gov more explicit, using racially diverse models, and changes to background and text colors. Finally, the tagline "I'm Air Aware" was chosen over other taglines tested.

Phase 3: Implementation

Although we cannot directly connect Air Aware activities to AirNow.gov traffic, Pittsburgh-based visits to AirNow.gov did rise during the campaign period and began to taper off in early July when the local pilot campaign's final activities came to an end (Figures 1 and 2). Specifically, EPA web data indicate that AirNow.gov had 12,853 Pittsburgh-based visit sessions for the period of March to July 2019, as compared to 8,821 for the same period in 2018, a 46% increase. As compared to Buffalo, NY, a market of similar demographics and size, Pittsburgh had approximately eight times as many visitors in the March to July 2019 timeframe (12,853 vs. 1,603). Noticeable peaks in AirNow.gov traffic in the Pittsburgh market occurred during periods of active paid advertising and social media outreach—including increases in visit volume coinciding with the second and third rounds of transit advertising—and AirNow.gov visits tapered off noticeably after the campaign ceased in later June. A large, albeit short-lived, peak in traffic coincided with Earth Day (April 22), an annual commemoration of environmental awareness. It is unclear why website visits were lower during the last three weeks of May 2019 even though the campaign was active. In some cases, diminished audience behavior (e.g., website visits) can be caused by message saturation, and it is possible individuals reached in the final weeks of the campaign had already been exposed to the materials and had already made a decision about whether to visit the website. Web traffic picked back up in early June, suggesting the campaign remained effective in driving traffic to AirNow.gov.

Reach data for Air Aware are summarized in Table 2

Discussion

Individuals in this study with respiratory conditions such as asthma and COPD were generally more attuned to air quality risks but were not always aware of the Air Quality Index and all the ways they can protect themselves. Individuals with CVD were less aware of the risks posed to them by poor air quality, although self-protective actions are equally

important for them (American Heart Association, 2020). Although limited in resources and scope, Air Aware demonstrated that research-based communication targeting at-risk patients and appropriate clinicians can improve self-protective behaviors related to air quality. Utilizing a mixed platform of social media (both national and local), print media, transit advertising, and media specifically targeting relevant clinicians we raised the profile of AirNow, the source of relevant and actionable information, for the intended audience. Continued and expanded messaging targeted both to discrete markets and to wider audiences may yield similar success.

Limitations

This initiative demonstrates the value of using audience input to develop educational materials and outreach activities related to air quality. However, the initiative does have several limitations worth noting. First, although we conducted both qualitative and quantitative formative research with consumers, most qualitative sessions were hosted in a handful of U.S. metro areas, which limits the generalizability of the findings. Second, we conducted the pilot campaign in a single city (Pittsburgh, PA), which we selected based on its relatively poor air quality and higher than average rates of chronic respiratory conditions. This means that results of the pilot campaign may not be generalizable to other cities and geographic areas.

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Appendix

Appendix A. In-depth Interview Research Questions

These questions guided the in-depth interviews with physicians, nurse practitioners, and nurses serving the at-risk populations during Phase 1 of the project:

- Are clinicians who serve at-risk populations aware of the Air Quality Index and the specific protective behaviors recommended in the AQI?
- To what extent do clinicians who serve at-risk populations talk to patients about outdoor air quality?
- What are the information needs of clinicians around the AQI and related protective behaviors?
- How can CDC better support clinicians in making behavioral recommendations for at-risk populations related to poor outdoor air quality?
- What kinds of outdoor air quality resources do clinicians desire for use with at-risk populations?

Appendix B. Focus Group Research Questions

These questions guided the focus group interviews with individuals with asthma, diabetes, and/or cardiovascular disease and caretakers of children with asthma and/or diabetes during Phase 1 of the project:

- To what extent are at-risk populations aware of the AQI?
- Are at-risk populations aware of the specific self-protective behavioral recommendations in the AQI?
- What motivates at-risk populations to take the protective health actions to minimize exposure to poor outdoor air quality?
- What are the barriers for at-risk populations in taking action to protect their health from poor outdoor air quality?
- How can CDC better reach at-risk populations with tailored behavioral recommendations to minimize health effects associated with poor outdoor air quality?

References

Activity guides publications.(2021,March 8). AirNow.gov. Retrieved from https://www.airnow.gov/activity-guides-publications/

Air quality index. (2021, March 8). AirNow.gov. Retrieved from https://www.airnow.gov/aqi/

American Heart Association. (2020) Personal-level protective actions against particulate matter air pollution exposure: AHA scientific statement. Retrieved from https://www.ahajournals.org/doi/

Brugha R, & Grigg J (2014). Urban air pollution and respiratory infections. Paediatric Respiratory Reviews, 15(2), 194–199. [PubMed: 24704510]

Franklin BA, Brook R, & Pope CA (2015). Air pollution and cardiovascular disease. Current Problems in Cardiology, 40(5), 207–238. [PubMed: 25882781]

Giacomini MK, & Cook DJ (2000). Users guides to the medical literature: XXIII. Qualitative research in health care B. What are the results and how do they help me care for my patients? Evidence-Based Medicine Working Group. JAMA, 284(4), 478–482. [PubMed: 10904512]

Hall JV, Brajer V, & Lurmann FW (2008). Measuring the gains from improved air quality in the San Joaquin Valley. Journal of Environmental Management, 88(4), 1003–1015. [PubMed: 17590260]

Hopey D (2019. April 24). Pittsburgh region's air quality gets an 'F' grade. Pittsburgh Post-Gazette, https://www.post-gazette.com/local/2019/04/24/Pittsburgh-regional-air-quality-gets-failing-grades-again/stories/201904230099

Mirabelli MC, Boehmer TK, Damon SA, Sircar KD, Wall HK, Yip FY, … Garbe PL (2018). Air quality awareness among U.S. adults with respiratory and heart disease. American Journal of Preventive Medicine, 54(5), 679–687. [PubMed: 29551329]

Mirabelli MC, Damon SA, Beavers SF, & Sircar KD (2018). Patient–provider discussions about strategies to limit air pollution exposures. American Journal of Preventive Medicine, 55(2), e49–52. [PubMed: 29903566]

Mirabelli MC, Ebelt S, & Damon SA (2020). Air quality index and air quality awareness among adults in the United States. Environmental Research, 183, 109185. [PubMed: 32007750]

Morgan D (1998). The focus group guidebook. Thousand Oaks, CA: Sage Publications.

Pennington AF, Sircar K, Hsu J, Zahran HS, Damon SA, & Mirabelli MC (2019). Communication channels for air quality alerts in the United States. Preventive Medicine Reports, 14, 100860. [PubMed: 30989035]

Petersen D, Stein L, Berol D, Usherson J, & Parez A (2002). Risk communication in action: environmental case studies. Cincinnati, OH: Environmental Protection Agency; Retrieved from https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=64244

Ramirez AS, Ramondt S, Van Bogart K, & Perez-Zuniga R (2019). Public awareness of air pollution and health threats: challenges and opportunities for communication strategies to improve environmental health literacy. Journal of Health Communication, 24(1), 75–83. [PubMed: 30730281]

Samet J, & Krewski D (2007). Health effects associated with exposure to ambient air pollution. Journal of Toxicology and Environmental Health. Part A, 70(3–4), 227–242. [PubMed: 17365585]

Spurr K, Pendergast N, & MacDonald S (2014). Assessing the use of the air quality health index by vulnerable populations in a 'low-risk' region: A pilot study. Canadian Journal of Respiratory Therapy, 50(2), 45–49. [PubMed: 26078611]

U.S. Census Bureau.(2021, March 8).Language spoken at home. Retrived from https://data.census.gov/cedsci/table?q=pittsburgh%20AND%20language&tid=ACSST1Y2019.S1601&hidePreview=false

U.S. EPA.(2021, March 8). Particle pollution and your patients' health. https://www.epa.gov/pmcourse/course-developers

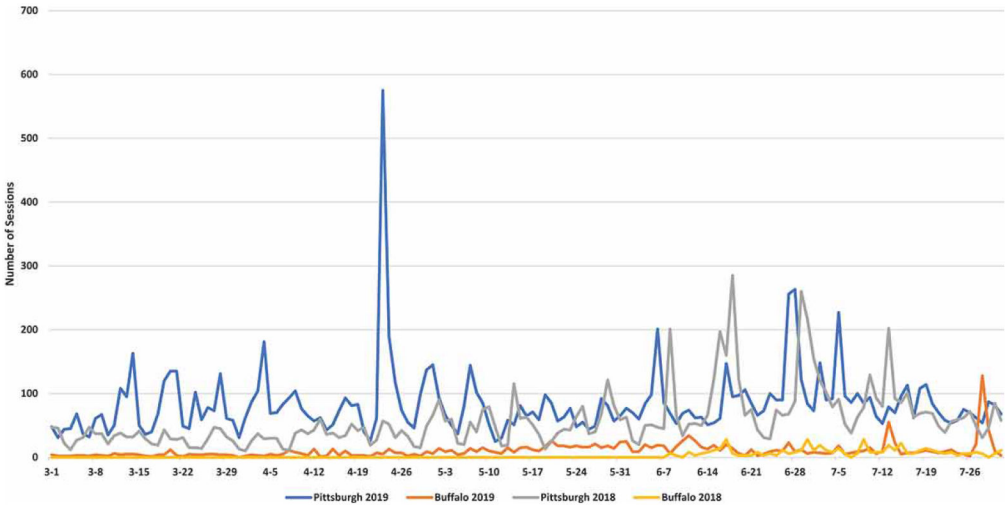

Fig. 1.

AirNow.gov Website visit sessions by City and year.

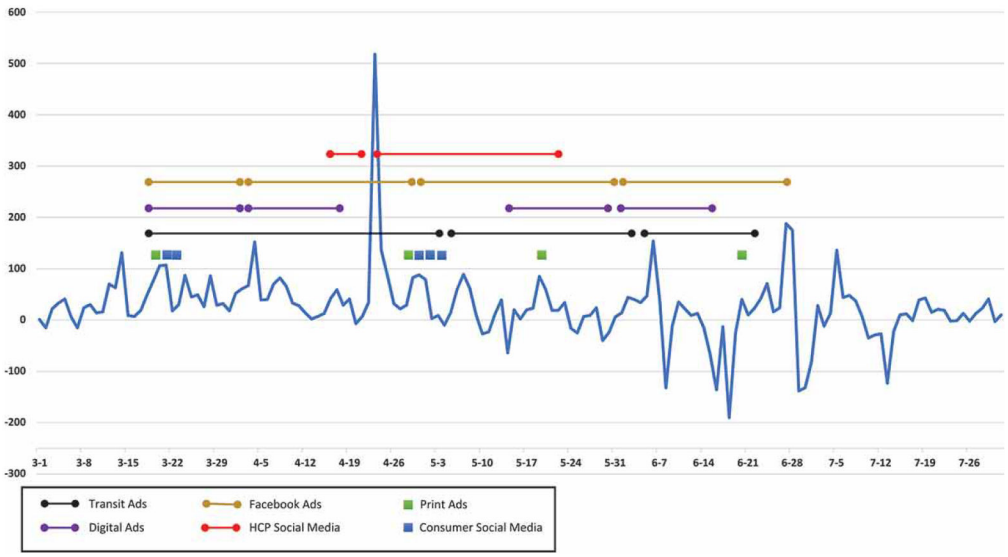

Fig. 2.

Pilot campaign activities and change in AirNOW.GOV WEBSITE visit sessions between 2019 and 2018 in Pittsburgh.

Table 1.

Perceived effectiveness scale for rating materials

Scale Sub-items	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Overall, I liked this handout.	1	2	3	4	5
This handout grabbed my attention.	1	2	3	4	5
This handout was confusing.[1]	1	2	3	4	5
The information in this handout would convince me to change my behavior.	1	2	3	4	5
The information in this handout was relevant to me.	1	2	3	4	5
I learned something new from this handout.	1	2	3	4	5
This handout spoke to me personally.	1	2	3	4	5

[1] Indicates reverse coded item.

Table 2.

Reach data for Air Aware

Medium	Impressions/Reach*	Comment
Print—Pittsburgh *Post-Gazette*	1.5 million	Four advertisements run in Sunday and Wednesday editions near weather forecasts
Transit	35.1 million	Advertising on side, ends, and interior of buses
Digital—Pittsburgh *Post-Gazette*	143,000	
Paid social media	800,000	Geo-targeted Facebook
Health Care Provider Media	41,000	Epocrates, Doximity
CDC Twitter	119,000	@CDCEnvironment, retweets from @CDCasthma and other CDC accounts
CDC Facebook	26,000	Air Quality Awareness Week

*Print and digital estimates rounded to nearest hundred thousand, other estimates rounded to nearest thousand