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EDITORIAL

Learning about "cause" and "effect" through well-designed studies of air quality interventions

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There is growing interest in conducting studies before and after interventions that were designed to improve traffic and air quality with the aim of using these discrete actions to more effectively determine whether and how air pollution might cause health effects (Van Erp et al. 2012; Zigler and Dominici 2014). Perhaps nowhere has there been more interest in pursuing such studies than in the area of potential effects of traffic related air pollution on health, where a considerable literature has grown and been reviewed in recent years (HEI 2010).

The concept, also called accountability research, involves rigorous efforts to examine as much actual data as possible on what effect the intervention had on activity (e.g., traffic flow) and emissions, how those emission changes affected air quality and exposure, and then how any exposure change might have affected health. The importance of exploring this full "chain of accountability" (HEI 2003) is illustrated by two studies that were undertaken of the traffic changes initiated to reduce congestion during the 1996 Olympics in Atlanta Georgia. The first, Friedman et al. (2001), reported a 10–15% reduction in morning traffic, significant reductions in ozone, and reductions in asthma hospitalizations during the period of the Olympic Games. However, a second much more detailed analysis (Peel et al. 2010) found that while morning traffic did decline, overall traffic volumes were unchanged. They also found that the ozone reductions were seen throughout the Southeast United States (in many areas unaffected by the Atlanta traffic patterns) and that hospitalizations, when adjusted for seasonal patterns for earlier and later years, showed no decline that could be tied to the reduced ozone.

The cautions raised by this example offer valuable context for the innovative and useful study by Park and Sener (2017, this issue). In this analysis, the investigators have thoughtfully designed a study making use of data that was available to examine what the effects on air quality and health might have been after the introduction of light rail transit (LRT) in a particular corridor in Houston, Texas in January 2014. They carefully follow one key principle of designing such studies—to identify both a population likely to be most affected by the intervention (a "treatment" group) and two other populations not likely to be directly affected by the intervention (i.e. "control" groups). Further, they identify a reasonable air quality indicator of traffic activity that was measured before and after the intervention, and a health outcome—stroke mortality—that has been associated with short term changes in air quality. Their results are intriguing, finding associations of reductions in stroke mortality with seemingly improved traffic-related air pollution in the period after the intervention, reductions which were not seen in the control populations. The investigators should be applauded for applying all readily available data to conduct a thoughtful and useful analysis.

At the same time this interesting example raises some important questions and needs for the broader scientific community hoping to investigate such interventions.

First, despite the investigators best efforts, they were not able to obtain before and after traffic and mode use data from the transportation officials, data that would have been very useful to understanding the actual effects of the change (as the Atlanta example illustrates). Too often

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interventions for traffic, as well as many other targeted air quality measures, are designed and implemented without building in from the beginning a plan for comprehensive before and after tracking of what changes in behavior, activity, and emissions actually take place.

Second, while the inclusion of control populations was a strength of the study, the absence of information on possible secular differences in the populations (e.g., underlying socioeconomic and health status) makes it more difficult to interpret how big the changes due to the intervention actually were. They may have been accurately found, but another recent example of a study of a coal ban across Ireland, which included carefully identified comparison populations, found that, in contrast to an earlier study, improvements in heart health occurred across the entire country and resulted in no difference in cardiovascular mortality between the populations who experienced the air pollution reductions and those who did not, likely due at least in part to more general improvement in drug therapies and treatments for cardiovascular disease (Dockery et al. 2011).

These comments do not take away from the interesting and valuable way in which these investigators addressed the important question of what happens in the wake of a transportation intervention. But they do point the way, as all good studies should, toward continuing to work to enhance the design of interventions and the collection of data to ensure that future such accountability studies can follow the full chain of accountability to improved understanding of whether and how air quality and other interventions are having the benefits we all desire.

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Compliance with ethical standards

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