United States Senate Hearing on Air Quality and Children's Health

Testimony of James E. Ginda, MA, RRT, AE-C, CHES

June 8, 2011

Washington, DC

Good morning! My name is James Ginda, and I am honored to have this opportunity to be here today to testify before you on this important topic. It is an opportunity for me to advocate for those who do not have a voice, but who are affected by air quality issues. The topic of air pollution and children's health is one that means a great deal to me. I am a Registered Respiratory Therapist, a Certified Asthma Educator, and a Certified Health Education Specialist, and have been in health care for more than 33 years. I have seen firsthand the impact of lung disease on the lives of patients I have cared for in both hospital settings and home care.

While educating children through the years about lifestyle choices such as cigarette smoking, I have come to realize the effects of environment on their lung health, and felt the need to try to make a difference upstream on a more macro level in health promotion. Environment is something that is too often beyond their individual control, whether it may be second-hand smoke, housing conditions, or outdoor air quality which I will focus on today. Beyond counseling them to remain indoors on the worst air quality days, they are susceptible to environmental triggers when outdoor air pollution makes its way indoors, and particularly for those in urban communities where air conditioning is not an option, and their vulnerability is compounded by other comorbid conditions and socio-economic factors.

Airborne toxins are problematic because of the gaseous components, acid aerosols, by-products of photochemical reactions such as ground level ozone, and the effects of inhaled particulate matter deposited within the lungs. Particulate matter is composed of black carbon soot, metals, volatile organic compounds, and crustal materials, from mobile and stationary sources such as diesel engines and power plants.

The lungs act as a highly efficient filter and trap inhaled particles within their structures. Black carbon fine particulates get past upper airway lung defenses even in healthy individuals and carry toxins deep into the lungs, including carcinogens. The black carbon in particulate matter has been shown to be a formidable opponent for alveolar macrophages, which are important for infection protection and a last line of lung defense. Chronic inflammation which is uncontrolled can lead to airway remodeling and a fixed degree of airflow obstruction.

Both the fine particle and gaseous components of air pollution are triggers in asthma, and can affect children even at levels below the National Ambient Air Quality Standards. Weather

events such as air temperature inversions can trap pollutants and compound this problem. Gaseous components such as sulfur and nitrogen oxides and acid aerosols are irritating to airways and can induce an inflammatory response in the lungs, and constriction of bronchial smooth muscle which narrows the airways and makes breathing difficult.

Asthma is the most common chronic disease of childhood and is responsible for a large amount of health care expenditures and lost school days. The burden extends to families who lose work days caring for sick children, and to the health care system with increased acute care visits, emergency department visits, and hospitalizations. Crisis-centered medical care and asthma education are not enough to preserve or improve the health of asthmatic children when environmental triggers are out of the control of the most vulnerable. Indeed, the Healthy People goals for improving the health of our nation recognize this in their respiratory disease and environmental objectives.

In 2010 after three years of study and careful consideration, the Rhode Island General Assembly passed a comprehensive clean construction bill as part of the Diesel Emissions Reduction Act *(RIGL 31-47.3)*. Known as "An Act Concerning Government Responsibility to Protect Public Health From Diesel Pollution," it is a shining example of a cooperative effort between concerned legislators, state agencies, environmental groups, industry representatives, and health advocates. Local action has also been taken by city councils to reduce diesel emissions. This cooperation and momentum to address controllable sources of pollution must continue nationwide to improve the health of our communities. Air pollution is not confined within local or state borders and children upwind can be affected by pollution from distant sources, so we also rely on the United States Environmental Protection Agency and Federal Clean Air Act to protect our children.

Children, and particularly children with asthma, are considered more vulnerable to air pollution with their higher respiratory rates and lung ventilation. Prevention has to be a focus in health care, and reducing the health burden of these toxins is within our grasp. On my own behalf as well as on behalf of the patients and families for whom I advocate today, I applaud you for holding this hearing and urge your support of regulations and legislation aimed at continuing to reduce this preventable health threat.

Children are the future of our nation—healthy children in safe and healthy communities. The yellow caution signs for children playing can serve as a reminder of all childhood health threats. Creating a healthier environment by controlling air toxins from mobile and stationary sources will benefit not only those most at risk, but indeed all of us who depend on breathing clean air for optimal health.

Thank you!

Chronic Disease Manager

Diesel Fumes and the Respiratory Patient

by James E. Ginda, MA, RRT, AE-C

Lifestyle modifications are often necessary in chronic disease management. Respiratory patients are counseled to stop smoking and to recognize and avoid triggers. However, environment is a factor that is often beyond individual control. Beyond staying indoors or reducing outdoor activity on days with known poor air quality, individuals with respiratory diseases may have little control over pollutants in the air they breathe.

While particularly problematic for respiratory patients, air quality is important for everyone. HEPA filtration and respiratory protective equipment are mandated under circumstances where occupational exposure is likely. But what about when exposure to air pollution is likely with activities of daily living? Just like with clean water, the public health solution is not downstream with consumers, but upstream with protecting the public water supply. The public health solution to air pollution is not to issue everyone an N-95 mask, but to keep from putting toxins into the air to the greatest extent possible.

The U.S. Environmental Protection Agency has stated that "Reducing emissions from diesel engines is one of the most important air quality challenges facing the country." They point out that: "Even with more stringent heavy-duty highway engine standards set to take effect over the next decade, over the next 20 years, millions of diesel engines already in use will continue to emit large amounts of nitrogen oxides and particulate matter, both of which contribute to serious public health problems. These problems are manifested by thousands of instances of premature mortality, hundreds of thousands of asthma attacks, millions of lost work days, and numerous other health impacts."[1]

about the author...

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Toxicity of diesel emissions

The smell of diesel fumes and the characteristic black cloud of exhaust from older engines that have not been retrofitted with pollution control devices make one take notice of something bad in the air. Diesel exhaust consists of two major component groups. The first are the gaseous pollutants such as carbon monoxide, nitrogen oxides, sulfur dioxide, and ozone. The second group is the particulate matter, which forms a heterogeneous aerosol of small particles with an elemental carbon core and layers including nitrates, sulfates, metals, and toxics.

Diesel particles can be understood by respiratory therapists familiar with medical aerosol terminology and deposition. The particles in the 10 micron range (PM 10) are the larger particles that deposit primarily in the tracheo-bronchial tree. The fine particles in the 2.5 micron range (PM 2.5) deposit primarily in the small airways and alveoli. With diesel aerosols, there is another group to consider — the ultra-fine particles. These are less than 0.1 microns in diameter, or viral size, and make up a major portion of airborne particulate matter from diesel exhaust.

The level of exposure to airborne toxins, duration of exposure, and genetic variations in individual susceptibility all factor into the respiratory effects of air pollution. Exposure to airborne environmental toxins may result in short-term or long-term ill effects like bronchospasm, inflammation, cytokine release, an invoked allergic response or carcinogenesis. The black carbon in diesel particulate matter has been shown to be a formidable opponent for macrophages, which provide a last line of lung defense at the alveolar level. "More than half of U.S. black carbon emissions come from diesel

engines: 41% from on-road diesels and 16% from off-road diesels."[2]

The clinical and economic impact of diesel exhaust toxicity is substantial. In a review article titled "The Toxicity of Diesel Exhaust: Implications for Primary Care," Krivoshto et al note, "In 2006 the California Air Resources Board estimated that diesel exhaust pollution directly accounts for 2,400 deaths and, annually, nearly 3,000 hospital admissions for respiratory and cardiac-related diseases, at a total cost of $19 billion."[3]

Airway inflammation is a primary concern in asthmatics, and exposure to diesel exhaust particles can affect inflammatory mediator activity. Interleukin-8 (IL-8) is a pro-inflammatory chemokine, and exposure to diesel exhaust particles with varying organic content has been shown to differentially induce expression and promotion of IL-8 in human airway epithelial cells.[4] Another pro-inflammatory mediator is granulocyte macrophage colony stimulating factor (GM-CSF). Diesel exhaust particles stimulate production of GM-CSF along with IL-8 in airway epithelium.[5]

Asthma is one of the leading causes of school absenteeism, with an estimated 12.3 million school days missed in 2003.[6] In one study relating to asthma, O'Connor and Neas et al from the Boston University School of Medicine analyzed data from 861 children with persistent asthma in seven U.S. urban communities. They compared asthma symptom reporting, pulmonary function results, and aerometric pollution data. They found that higher levels of NO_2 and PM 2.5 were associated with asthma-related missed school days, and higher concentrations of NO_2 with increased asthma symptoms. It was interesting that almost all pollutant concentration levels were below the National Ambient Air Quality Standards.[7]

Exacerbation of COPD has been associated with short-term exposure to air pollution, and long-term exposure to traffic-related air pollution may contribute to the development of COPD.[8] In a recent cohort study of 52,799 eligible subjects, COPD incidence was associated with the 35-year mean NO_2 level, and susceptibility was possibly enhanced when there was diabetes or asthma as a comorbid condition.[9] Clearly a paradox exists for patients with respiratory diseases faced with the dilemma of trying to be active outdoors to the greatest extent possible when environmental factors beyond their control influence their lung function and health.

Nowhere to hide

What about leaving it all behind and escaping to the great outdoors for clean, fresh air? Maine is a state known for its outdoor recreational activities. It is home to Mount Kahtadin, the northernmost peak of the Appalachian Trail that runs from Maine to Georgia and home to Acadia National Park on the northeast coast. Over a 10-year period the best visibility was 87 miles and the worst was 16 miles. The reduction in visibility is a result of air pollution in the form of haze.[10] The haze on one of the worst days was composed of sulfates (73%), organic carbon particles (13%), nitrates (6%), elemental carbon (4%), and crustal materials (4%).[11]

In 2005, Maine had the second fastest growing rate of asthma in the nation, affecting 9.4% of the adult population and one out of eight children.[12] In a study of biologically soluble metal ions from particulate matter (PM 10) by researchers from the department of environmental science at the University of Southern Maine in Gorham, a key determination was that most of the PM 10 did not originate from local crustal material.[13] Even when envi-

ronmental aerosols are generated from transportation sources in the northeast corridor and power plants to the south, weather conditions like the location of the jet stream can impact where they end up; and they can still affect respiratory patients many miles away.

Reducing the burden

The diesel engine has been referred to as the economic workhorse of an industrialized society. The good thing about diesel engines is that they last a long time, with the average useful life being nearly 30 years. Unfortunately, that is also the bad thing about diesel engines. The air pollution levels of older technology are the downside of such a long, useful life.

Diesel engines release 10 times the amount of NO_2, aldehydes, and breathable PM compared to unleaded gasoline engines and more than 100 times that produced by catalysed gasoline engines.[14] Diesel retrofits, ultra-low sulfur fuels, and anti-idling ordinances can significantly reduce the level of toxins in the environment and make a difference to respiratory patients now. Respiratory patients do not have time to wait for 30-year replacement cycles.

Healthy People 2020, the latest public health blueprint for America, includes a goal to "reduce air toxic emissions to decrease the risk of adverse health effects caused by airborne toxics."[15] At a time when health care expenditures are at an all-time high and COPD was recently named by the Centers for Disease Control and Prevention as the third leading cause of death in the United States, funding for clean air health initiatives such as the Diesel Emissions Reduction Act pays long-term dividends in the health of the nation. For every $1 invested, an average of $13 is realized in health and economic benefits.[16] This makes it one of the most cost-effective federal programs, and one with bipartisan support.

Respiratory patients may have some control over certain environmental factors (e.g., avoiding secondhand smoke), but there are still others beyond their control (e.g., poor air quality) that may exacerbate breathing difficulties. Respiratory therapists can play an important role in advocating for air quality initiatives. Clean air is not a political issue but rather an important public health issue, particularly for those with chronic respiratory diseases. ■

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