Environmental and Public Health, Air Pollution and the Healthcare System

Wayne Cascio, MD, FACC
Acting Director
National Health and Environmental Effects Research Laboratory Office of Research Development, US EPA
Air pollution remains a Significant U.S. Public Health Problem

- Estimated excess mortality 125,000 deaths/year
- Over 20 million school days and work days lost
- Over 1 million life-years lost
- 122.5 million people living in counties with one or more pollutants exceeding the NAAQS in 2016

Foundation of PM’s Health Effect
Exposure Linked to Morbidity and Mortality

AHA Scientific Statement

Air Pollution and Cardiovascular Disease
A Statement for Healthcare Professionals From the Expert Panel on Population and Prevention Science of the American Heart Association

Robert D. Brook, MD; Barry Franklin, PhD, Chair; Wayne Cascio, MD; Yuling Hong, MD, PhD; George Howard, PhD; Michael Lipsett, MD; Russell Luepker, MD; Murray Mittleman, MD, ScD; Jonathan Samet, MD; Sidney C. Smith, Jr, MD; Ira Tager, MD

Abstract—Air pollution is a heterogeneous, complex mixture of gases, liquids, and particulate matter. Epidemiological studies have demonstrated a consistent increased risk for cardiovascular events in relation to both short- and long-term exposure to present-day concentrations of ambient particulate matter. Several plausible mechanistic pathways have been described, including enhanced coagulation/thrombosis, a propensity for arrhythmias, acute arterial vasoconstriction, systemic inflammatory responses, and the chronic promotion of atherosclerosis. The purpose of this statement is to provide healthcare professionals and regulatory agencies with a comprehensive review of the literature on air pollution and cardiovascular disease. In addition, the implications of these findings in relation to public health and regulatory policies are addressed. Practical recommendations for healthcare providers and their patients are outlined. In the final section, suggestions for future research are made to address a number of remaining scientific questions. (Circulation. 2004;109:2655-2671.)

Short-term and long-term exposure to ambient air particulate matter is causally associated with cardiovascular morbidity and mortality. (EPA ISA 2009)

EPA Integrated Science Assessment for Particulate Matter, 2009
Health professionals, including cardiologists, have an important role to play in supporting educational and policy initiatives as well as counseling their patients.

Newby DE et al. Eur Heart J 2014

PM\textsubscript{2.5} exposure is deemed a modifiable factor that contributes to cardiovascular morbidity and mortality.

Brook RD et al. Circulation 2010

Expert position paper on air pollution and cardiovascular disease

David E. Newby\textsuperscript{1}, Pier M. Mannucci\textsuperscript{2}, Grethe S. Tell\textsuperscript{3}, Andrea A. Baccarelli\textsuperscript{4}, Robert D. Brook\textsuperscript{5}, Ken Donaldson\textsuperscript{4}, Francesco Forastiere\textsuperscript{7}, Massimo Franchini\textsuperscript{8}, Oscar H. Franco\textsuperscript{9}, Ian Graham\textsuperscript{10}, Gerard Hoek\textsuperscript{11}, Barbara Hoffmann\textsuperscript{12}, Marc F. Hoyaerts\textsuperscript{13}, Nino Künzli\textsuperscript{14,15}, Nicholas Mills\textsuperscript{1}, Juha Pelkonen\textsuperscript{16,17}, Annette Peters\textsuperscript{18,19}, Massimo F. Piepoli\textsuperscript{20}, Sanjay Rajagopalan\textsuperscript{21}, and Robert F. Storey\textsuperscript{22*}, on behalf of ESC Working Group on Thrombosis, European Association for Cardiovascular Prevention and Rehabilitation and ESC Heart Failure Association
Personal Health Care Spending in U.S. for Chronic Disease is High

COPD $ 53.8 billion
Asthma $ 32.5 billion
Pneumonia $ 37.1 billion
Lung cancer $ 13.1 billion
Ischemic heart disease $ 88.1 billion
High blood pressure $ 83.9 billion
Stroke $ 43.8 billion
Heart failure $ 28.5 billion
Atrial fibrillation $ 27.7 billion
Peripheral vascular disease $ 2.7 billion
Diabetes $101.4 billion
Preterm birth $ 4.9 billion

½ Trillion Dollars in 2013

Dieleman JL et al. JAMA 2016

Air Pollutant Exposure is a Risk Factor
Susceptible populations include –
- those with pre-existing respiratory disease
- those with pre-existing cardiovascular disease
- older adults
- those with lower socio-economic status
- children & the developing fetus

Populations suspected to be at greater risk –
- those with chronic inflammatory diseases (e.g., diabetes, obesity)
- those with specific genetic polymorphisms (e.g., GSTM1)
Progress in Reducing Cardiovascular Mortality has Stalled in the U.S.

- Obesity and diabetes are on the rise
- Since 2011, improvements in mortality from heart disease & stroke have slowed

Recent Trends in Cardiovascular Mortality in the United States and Public Health Goals

Stephen Sidney, MD, MPH; Charles P. Quesenberry Jr, PhD; Marc G. Jaffe, MD; Michael Sorel, MPH; Mai N. Nguyen-Huynh, MD; Lawrence H. Kushi, ScD; Alan S. Go, MD; Jamal S. Rana, MD, PhD

CONCLUSIONS AND RELEVANCE Deceleration in the decline of all CVD, HD, and stroke mortality rates has occurred since 2011. If this trend continues, strategic goals for lowering the burden of CVD set by the American Heart Association and the Million Hearts Initiative may not be reached.

JAMA Cardiol. doi:10.1001/jamacardio.2016.1326
Published online June 29, 2016.

Sidney S, et al. JAMA Cardiol 2016
Public Health Action Needed along with EPA Standards

- EPA’s PM air pollution standards provide the largest health benefits of any federal regulation.

- Greater engagement of:
  - Healthcare system will better help communities and individuals address environmental health risks.
Air pollution adversely affects:
- Health, Wellbeing, Longevity, and Resources

Most healthcare professionals & patients at-risk know of air pollution’s adverse health effects

Despite Knowledge of the Risks the Healthcare System is Not Engaged

Few healthcare professionals discuss the risks with their patients

At-risk patients don’t take action to reduce exposure
The World is Changing:
Opportunities to Improve Health

• Health Care Reform
  - Value-based payment
  - Electronic health records
  - Accountable care organizations
    – Focus on quality metrics & costs
      • Community benefits programs
      • Medicare/Medicaid (CMS)
    – Hospital readmissions reduction program

• Predictive risk models & population health surveillance

• Environmental and physiological sensors
Air Pollution and Readmissions

**EPA – Sensitivity to PM**

Populations showing increased sensitivity include those having:

- Cardiovascular disease
  - Ischemic heart disease
  - Heart failure
  - Ventricular arrhythmia
- Pulmonary disease
  - COPD
- Diabetes

**CMS Readmission Reduction Program**

Conditions evaluated for excess readmissions:

- Cardiovascular disease
  - Acute myocardial infarction
  - Heart failure
- Pulmonary disease
  - COPD
- Pneumonia
- Hip and/or Knee Arthroplasty
Healthy Heart
Promotes Environmental Health Literacy

www.epa.gov/healthyheart

Approach:
• Encourage adherence to secondary preventions guidelines
• Provide an environmental health message for patients who at high-risk for adverse cardiopulmonary outcomes from air pollutant exposure to limit exposure to PM

Goal:
• Decrease vascular and arrhythmic events, improve overall cardiovascular health and wellbeing and lower healthcare expenditures

* Khajou O, et al. RTI Project Number 0214680.003.001.001, 2017
Examples of Products Engaging the Public

Particle Pollution and Your Patients' Health

Helps health care providers advise their patients about particle pollution exposure.

Healthy Heart Toolkit and Research: Steps You Can Take

Steps You Can Take to Reduce Health Effects from Air Pollution

Studies show that air pollution can trigger heart attacks, stroke, and other health effects. Air pollution levels:
- Any time of year
- When weather is calm
- Near busy roads
- In urban areas
- In industrial areas

Efectos de los Contaminantes Comunes del Aire

Air Sensor Guidebook

Did you know that air pollution can trigger heart attacks, stroke, and other health effects?

Medical studies show that air pollution can trigger heart attacks, stroke, and irregular heart rhythms—especially in people who are already at risk for these conditions. Also, for people with a medical condition called heart failure, air pollution can further reduce the ability of the heart to pump blood. This can make it very difficult to get enough oxygen to the body. Once you learn about the pollutants of greatest concern for triggered effects, you can be better prepared to protect your health.

How can you protect your health?

- Get up-to-date information about your area's air quality

ORD's Social-Environmental Science Exchange:

Social Environmental Dialogues
Pilot 1: Collaboration & Coordination of Public Health Approaches and Integrating Environmental Health with Public Health
Parting with Million Hearts®

EPA’s contributes the **Healthy Heart** program
- to the National Prevention Strategy
- and the fight against heart attacks and strokes

http://millionhearts.hhs.gov/aboutmh/partners/epa.html
**HHS’ Million Hearts® 2022 Priorities**

### Keeping People Healthy

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<thead>
<tr>
<th>Keeping People Healthy</th>
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<tbody>
<tr>
<td>Reduce Sodium Intake</td>
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<tr>
<td>Decrease Tobacco Use</td>
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<td>Increase Physical Activity</td>
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### Optimizing Care

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<tr>
<td>Improve ABCS*</td>
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<tr>
<td>Increase Use of Cardiac Rehab</td>
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<td>Engage Patients in Heart-healthy Behaviors</td>
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### Improving Outcomes for Priority Populations

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*Aspirin when appropriate, Blood pressure control, Cholesterol management, Smoking cessation

**Joint initiative of CMS and CDC**
Support includes: Counseling on risks of particulate matter

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<tr>
<th>Goals</th>
<th>Effective Health Care Strategies</th>
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<tr>
<td><strong>Improve ABCS</strong>*</td>
<td><em>High Performers Excel in the Use of...</em></td>
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<tr>
<td>Targets: 80%</td>
<td>- Technology — decision support, patient portals, e- and default referrals, registries, and algorithms to find gaps in care</td>
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<td>- Teams — including pharmacists, nurses, community health workers, and cardiac rehab professionals</td>
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<td>- Processes — treatment protocols; daily huddles; ABCS scorecards; proactive outreach; finding patients with undiagnosed high BP, high cholesterol, or tobacco use</td>
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<tr>
<td>Increase Use of Cardiac Rehab</td>
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<tr>
<td>Target: 70%</td>
<td>- Patient and Family Supports — training in home blood pressure monitoring; problem-solving in medication adherence; counseling on nutrition, physical activity, tobacco use, risks of particulate matter; referral to community-based physical activity programs and cardiac rehab</td>
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<tr>
<td>Engage Patients in Heart-healthy Behaviors</td>
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<td>Targets: TBD</td>
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*Aspirin when appropriate, Blood pressure control, Cholesterol management, Smoking cessation*
### Improving Outcomes for Priority Populations

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<th>Priority Populations</th>
<th>Major Strategies</th>
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<tr>
<td>Blacks/African Americans</td>
<td>Improving hypertension control</td>
</tr>
<tr>
<td>35- to 64-year-olds, because event rates are rising</td>
<td>• Improving hypertension control and statin use</td>
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<td></td>
<td>• Increasing physical activity</td>
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<tr>
<td>People who have had a heart attack or stroke</td>
<td>• Increasing cardiac rehab referral and participation</td>
</tr>
<tr>
<td></td>
<td>• Avoiding exposure to particulate matter</td>
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<tr>
<td>People with mental illness or substance use disorders</td>
<td>Reducing tobacco use</td>
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The Environmental “Buckets” of Prevention Framework

Total Population Community-Wide Prevention

- Attain & maintain NAAQS Stds
- Improve built-environment:
  - Places for physical activity
  - Create healthier near-road environments
- Improve overall CV health status

Innovative Clinical Prevention

- Optimize clinical care of the at-risk priority population
- Increase awareness of health effects of PM among physicians, health care professionals, and the at-risk population
- Provide guidance to lower exposure & associated risk

Traditional Clinical Prevention

- "evidence-based" clinical prevention management strategies

Forecast-based interventions predicted to reduce the health and economic burden of wildfires


Cost effectiveness is improved by intervening only in the homes of those at highest risk, e.g. older persons

Health benefits and costs of filtration interventions that reduce indoor exposure to PM2.5 during wildfires

Fisk WJ, Chan WR Indoor Air 2017

“… we believe that the time is ripe to definitively test the efficacy of personal-level interventions…”

Brook RD, et al. JAMA Cardiol. 2017
Summary

- Particle pollution increases short- and long-term pulmonary & cardiovascular morbidity & mortality
- Improvements in air pollution levels reduce health impacts and increase life expectancy
- Many regions of US fail to meet EPA standards
- Older people, those with pre-existing heart & lung disease, & diabetes are at higher risk from air pollution
• High-risk patients should be educated about risks of air pollution and educated about measures to reduce exposure

• Randomized controlled trials are needed to prove effectiveness of interventions to reduce exposure

• Health risks need to be addressed through integrated efforts of public health and health care at the community and individual level

• Decreased short-term exposure in high patients is predicted to mitigate adverse health effects
Thank you

Wayne E. Cascio, MD, FACC
Acting Director
National Health and Environmental Effects Research Laboratory
ORD/U.S. Environmental Protection Agency
Email: cascio.wayne@epa.gov