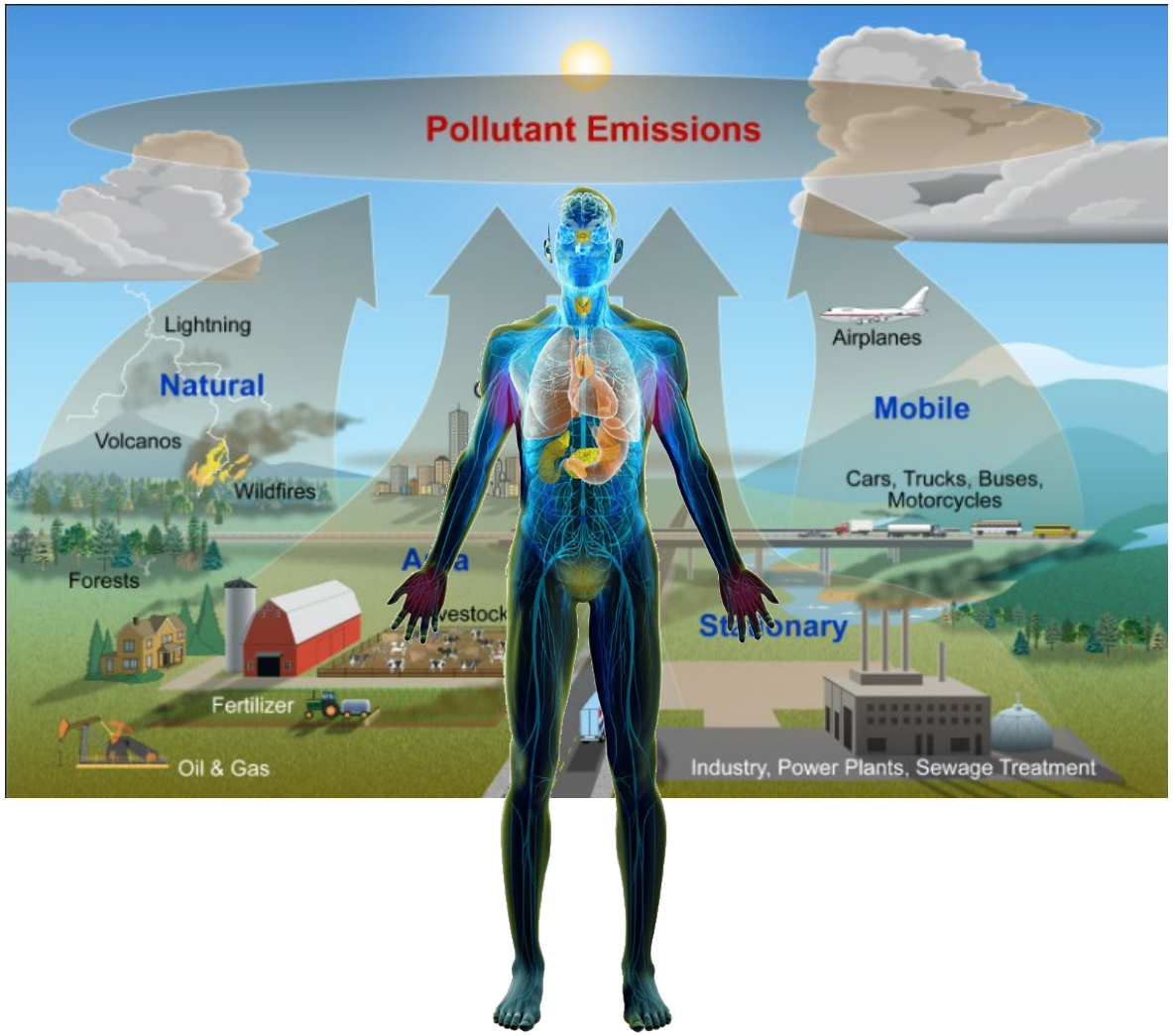
Air Pollution

Environmental Determinants of Health (EDoH)

By J P Systems, Inc.



BETTER DATA, BETTER PATIENT CARE, BETTER OUTCOMES

JPSys Core Competencies

HL7 Standards Consulting: FHIR® & C-CDA	HL7 FHIR® Implementation Guides	Standardized Clinical Terminologies	Data Standards Development
Data Quality Improvement	Data Management & Standardization	Clinical Process Analysis	Interoperability Planning
Stakeholder Engagement	Business & Enterprise Architecture	Data Modeling	IT Strategy & Policy

JPSYS CAN PROVIDE

- ❑ **Expert teams with extensive professional experience**
  - **Clinicians**
  - **Terminologists**
  - **Patient Education materials**
  - **Data Scientists**
  - **Patient Safety**
  - **Clinical Data Quality**
  - **Clinical Trainers**
- ❑ **Program Management**
  - **Administration**
  - **Policy**
  - **Project Management**
- ❑ **Extensive federal program experience**
- ❑ **40-year experience as Women Owned Business**
- ❑ **Industry connections**
  - **Standards Development Organizations**
  - **Office National Coordinator**

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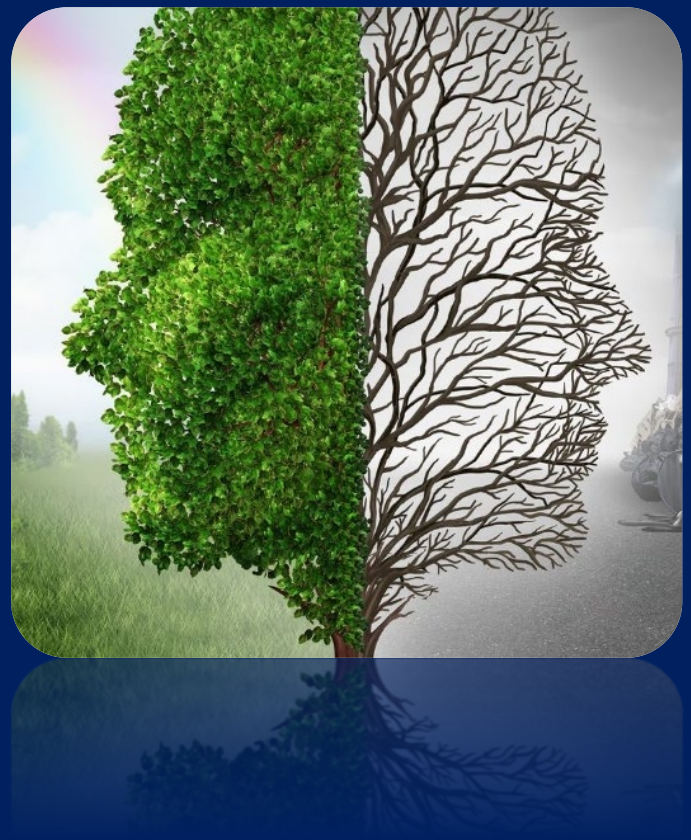

- Health Effects of Air Pollution
- Introduction to AVAIL Use Cases
- Use Case Development
- JPSys as Connective Tissue
- Pilot Phase 1: Identify populations
- Public Health Lens - Pollution Map
- Align Efforts with VA Priorities
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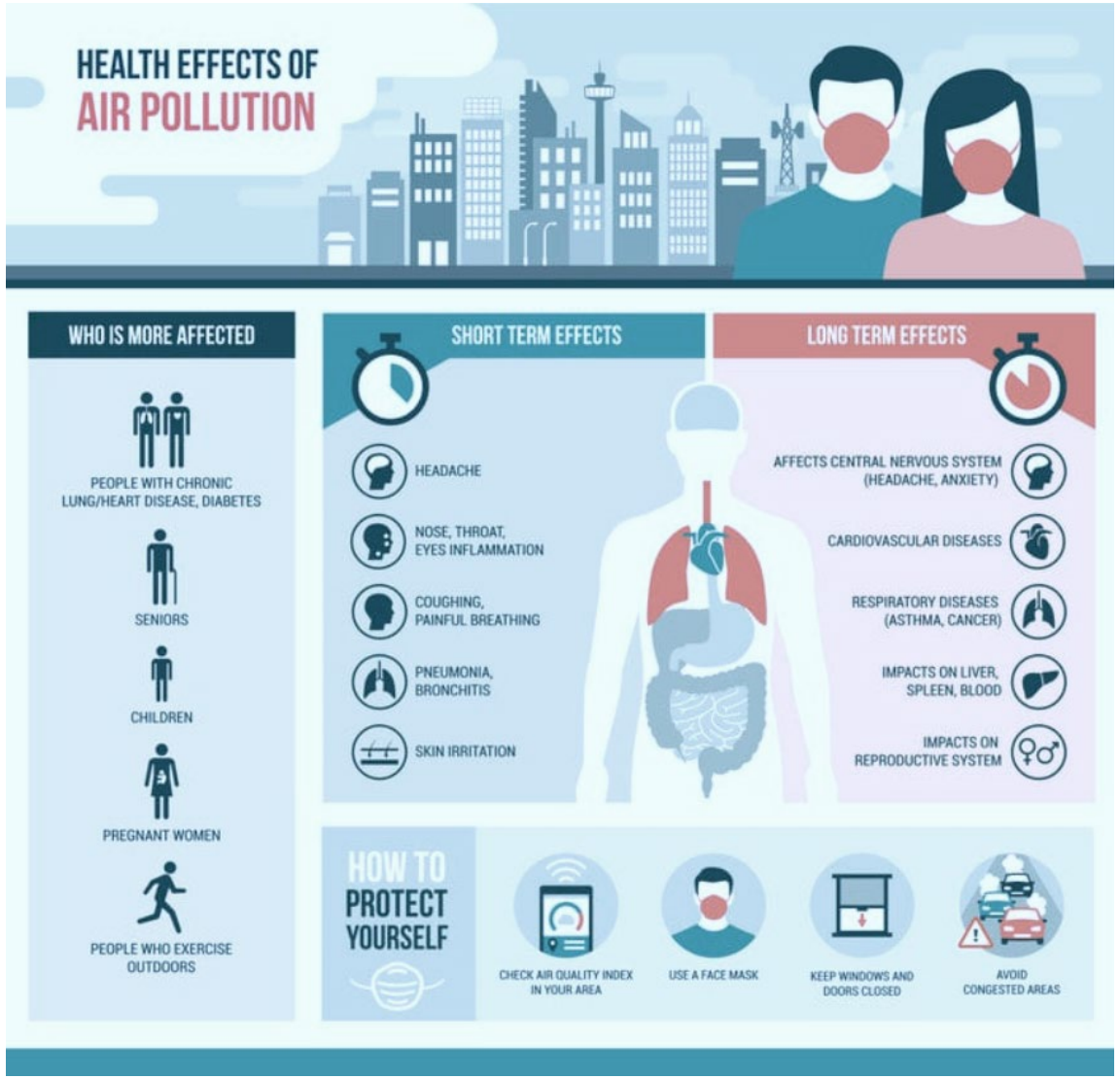
- Reference Material

Health Effects of Air Pollution

- Decrease in cognition
- Decreases cardiac function
- Reduces overall pulmonary function
- Increases inflammatory biomarkers

And more, see JPSys Use Cases



Source: https://www.howardluksmd.com/pm-2-5-levels-air-pollution-and-our-health/

AVAIL - ENVIRONMENTAL DETERMINANTS OF HEALTH (EDoH) - AIR POLLUTION USE CASES

Effects of Air Pollution are far reaching beyond those of the common pulmonary disorders including:

Early Alzheimer's Detection

Diabetes Management

Behavioral Health

J P SYSTEMS USE CASE DEVELOPMENT

Who
Veterans who have increased risk factors

Why
Moderate-high $PM_{2.5}$ air quality wreaks havoc on health

What
Environmental Determinants of Health (EDoH)

Where
Veterans who live in affected regions

When
Now, increasing environmental factors across the globe

How

- Identify populations for specific Use Cases
- Track patients at risk
- Identify/ Use air pollution monitoring data streams
- Enhance care team engagement
- Education, training, continuing education programs

AVAIL USE CASE #1

Air Pollution and Early Alzheimer's Detection

- **Scenario**:

  The patient lives or grew up in an area with poor air quality and changing weather patterns. There is no current evidence of pulmonary issues, but the patient is displaying early signs of dementia as expressed in the clinical notes, but not structured data. For the best patient outcomes, a doctor can know to order tests earlier if air pollution exposure is indicated. Then a care plan can be established earlier.

- **Use Case Overview:**

  J P Systems Clinical Data Quality Innovation (CDQI) team supports client's journey to become High Reliability Organizations (HRO) by improving the quality and reliability of clinical data exchanged. National Public Health analysis including air pollution, wildfires, weather patterns can be used to identify patients who may be experiencing early dementia. The usability value of the data is determined by the user roles (e.g., clinicians, care team, payers, AI, CDS, NLP).

Patient's story in their own words

AVAIL USE CASE #2

Air Pollution and Diabetes Management

- **Use Case Overview:**

  J P Systems Clinical Data Quality Innovation (CDQI) team supports client's journey to become High Reliability Organizations (HRO) by improving the quality and reliability of clinical data exchanged. Diabetes is the most expensive chronic condition in our nation. [1] $1 out of every $4 in US health care costs is spent on caring for people with diabetes.[2] $237 billion‡(a) is spent each year on direct medical costs and another $90 billion‡(a) on reduced productivity.[2] People with diabetes may be more sensitive to fine particles in smoke, especially in light of their high prevalence of heart disease, says Young. Indeed, air pollution has been shown to double the risk for hospital admissions for heart disease in people with diabetes, according to a study in *Epidemiology*.

- **Scenario**:

  This patient has many healthcare appointments, both at the local hospital and within the community. The wildfire season has started, and they are feeling lousy but do not understand why. The lab results for years have indicated the patient is pre-diabetic. The clinicians often use the clinical notes to exchange that information with the Care Team. The HL7 standard data exchange C-CDA document has both structured and unstructured sections, but the diversity in the HL7 standard has made it hard to monitor the advancing disease state. The clinicians keep ordering new lab tests, but often the clinical notes are hard to locate to track the disease status. Diabetic management programs could help to slow the disease progress with awareness and treatment. Bringing all this data to the Care Team's attention in a single display, report, and CDS hook is critical to tell the actual patient story and pull together a Care Plan.

Patient's story in their own words

AVAIL USE CASE #3

Air Pollution and Behavioral Health

- **Use Case Overview:**

  J P Systems Clinical Data Quality Innovation (CDQI) team supports client's journey to become High Reliability Organizations (HRO) by improving the quality and reliability of clinical data exchanged. Air pollution is a major environmental health risk — the links between air pollution and health conditions such as respiratory and cardiovascular diseases are well established. Though less well-understood, there is substantial evidence that air pollution also impacts mental health.

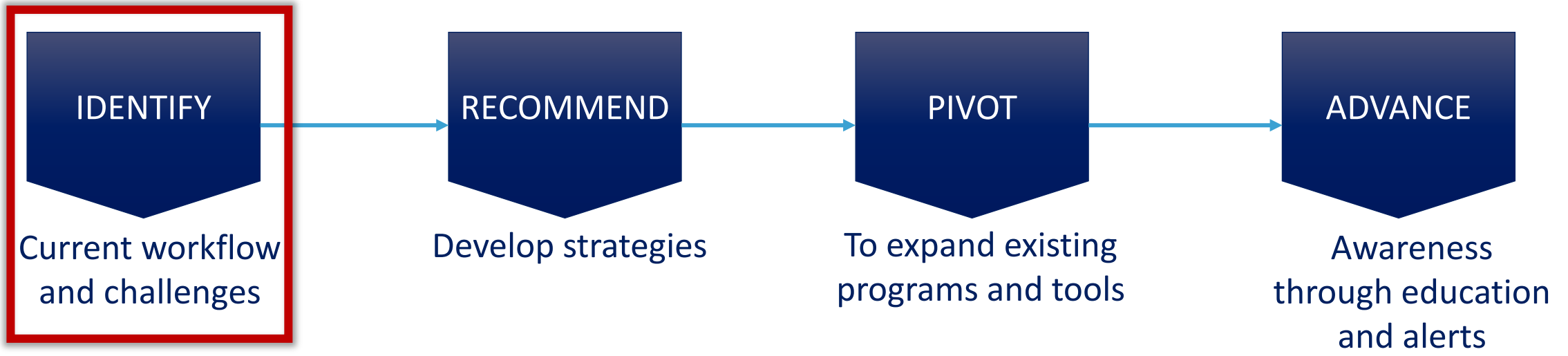
- **Scenario**:

  The patient has skipped several standing clinic appointments, but has responded to telemedicine events, where the details were captured in clinical notes. Care team members in other organizations provided hard copy clinical notes and faxes, and the forms were scanned into the EHR. The Care Team's is concerned about the behavioral health management strategy being followed and wants on onsite visit to level set the Care Plan with the patient.

Patient's story in their own words

JPSYS, THE CONNECTIVE TISSUE BETWEEN TODAY AND TOMORROW

High-level strategic sequence of steps and activities



- Engagement strategy
- Enhance processes
- Advance awareness campaign
- Training services
- Documentation / checklists
- New technology implementation services

JPSys making the health care systems opportunities visible to improve care team management and patient outcomes.

PILOT PHASE 1: IDENTIFY

Pilot Phase 1: Activities

- Identify and prioritize EDoH sensitive cohort
- Identify current process gap/risk analysis
- Survey Care Team readiness and VA mobile apps
- Identify opportunities
- Investigate EDoH sources of data
- Clinical data quality review
- EDoH terminology review

Pilot Phase 1: Deliverables

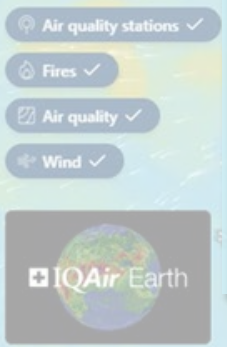
- Results briefing to summarize findings (quantitative)
- Preliminary strategies to leverage data/tools and target efforts
- Preliminary process design and diagrams

JPSys making the health care systems opportunities visible to improve care team management and patient outcomes.

PUBLIC HEALTH LENS

Identify & Prioritize | Explore & Pinpoint | Design & Implement

- Environmental Determinants of Health (EDoH) impact on health from local to national population level
- Environmental changes – disruption to physical, biological, and ecological systems (e.g., extreme weather events)
- Vulnerable groups:
  - Geographic
  - Comorbidities
  - SDoH



ALIGN EFFORTS WITH VA PRIORITIES

LEAD | SHAPE | INNOVATE

Delivery of HRO Values	Impact at Enterprise Level	Value to Clinicians and Patients	Fostering Trust: Common Data Quality Metrics and Thresholds
✓ Leadership Commitment ✓ Safety Culture ✓ Continuous Process Improvement	✓ Performs services and consultations affecting the entire Enterprise – building trust, respect, and inclusion	✓ Higher quality data exchange drives increased clinical adoption, reduces clinical burden, and avoids duplication of services	✓ Equip Clinicians with confidence in enhanced clinical data quality to improve outcomes and care coordination for patients

Contact JPSys for more info on this Use Case

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ADDITIONAL USE CASE

AVAIL - ENVIRONMENTAL DETERMINANTS OF HEALTH (EDoH) - AIR POLLUTION USE CASES

Effects of Air Pollution are far reaching beyond those of the common pulmonary disorders including:

Cardiac Disease

AVAIL USE CASE #4

Air Pollution and Cardiac Disease

❖ **Use Case Overview:**

J P Systems Clinical Data Quality Innovation (CDQI) team supports client's journey to become High Reliability Organizations (HRO) by improving the quality and reliability of clinical data exchanged. Research by EPA and others has found that exposure to increased concentrations of $PM_{2.5}$ (particulate matter) over a few hours to weeks can trigger cardiovascular disease-related heart attacks and death. Longer-term exposure can lead to increased risk of cardiovascular mortality and decreases in life expectancy.

❖ **Scenario**:

The Montana based patient has many healthcare appointments, both at the local hospital and within the community. The wildfire season has started, and they are feeling lousy but do not understand why. The lab results for years have indicated the patient is on the path to future cardiac problems. The clinicians often use the clinical notes to exchange that information with the Care Team.

The HL7 standard data exchange CCDA document has both structured and unstructured sections, but the diversity in the HL7 standards has made it hard to monitor the advancing disease state. The clinicians keep ordering new lab tests, but often the clinical notes are hard to locate to track disease status. Cardiac management programs could help to slow the disease progress with awareness and treatment. Bringing all this data to the Care Team's attention in a single display, report, CDS hook is critical to tell the actual patient story and pull together a Care Plan.

Caregiver story in their own words

APPENDIX

SOLUTION AVENUE – MOBILE ALERTS FOR AIR POLLUTION

- Automate Care Management and Research protocol "touches" using **mobile application** to keep patients on track to optimal health
  - ✓ **e.g., Alerts** for COPD patients when **air quality is high** in their location
- Organization level management of the configuration for these **patient care management "touches" and alerts**

REFERENCES – ENVIRONMENTAL AFFECTS ON HEALTH

Here are the factors researchers identified – and why they're associated with a higher risk.

- Education level. A lower education level is associated with an increased risk of Alzheimer's disease. ...
- Cognitive activity. ...
- Hypertension in mid-life. ...
- Orthostatic hypotension. ...
- Diabetes. ...
- BMI. ...
- Head trauma. ...
- Hyperhomocysteinaemia.

More items... • Jul 22, 2020

theconversation.com
https://theconversation.com › the-ten-factors-linked-to-in...

"... most health curricula do not address the health impacts of air pollution..."
https://www.who.int/tools/air-pollution-and-health-training-toolkit-for-health-workers

HEALTH EFFECTS OF AIR POLLUTION

Health Topics | Countries | Newsroom | Emergencies | Data | About WHO

Home / Tools and toolkits / Air pollution and health training toolkit for health workers

Air pollution and health training toolkit for health workers (APHT)

Air pollution is a major environmental health threat and one of the main risk factors for noncommunicable diseases. Globally, air pollution is responsible for about 7 million premature deaths per year due to ischemic heart disease, stroke, chronic obstructive pulmonary disease and lung cancer, but also from acute lower respiratory tract infections.

Despite most of health curricula do not address the health impacts of air pollution, the international community recently recognized that health workers have a more prominent role to play in the battle for clean air.

Mandated by its Member States, WHO is developing the Air Pollution and Health Training (APHT) toolkit for health workers.

The APHT toolkit is a set of materials designed to enable health workers, in both the clinical and public health fields, to understand the health risks of air pollution and identify risk reduction measures. Health workers can use the health argument to advocate for clean air interventions and promote the collaboration between civil society relevant actors and governmental institutions for policy implementation. Using a train-the-trainer approach, the APHT toolkit also helps facilitate the organization of in-person workshops, online courses and other learning opportunities.

The main elements of the toolkit:
- OpenWHO online course
- training modules
- train-the-trainer manual
- clinical case scenarios
- job aids & flipcharts for community engagement

The full toolkit shall be available by the end of 2023.

OpenWHO Course on Air Pollution & Health

The target audience for this course is health workers which includes care-givers such as medical doctors, nurses, midwives, community health workers, and future health care professionals, as well as public health professionals and other representatives of the ministries of health.

https://www.who.int/tools/air-pollution-and-health-training-toolkit-for-health-workers

REPORTING REQUIREMENTS FOR ENVIRONMENTAL DISEASES

When a physician suspects an environmental or occupational factor may have contributed to clinical symptoms in a patient, in some cases those illnesses must be reported to the health department. These reportable illnesses are in two categories: infectious and occupational. The lists of reportable illnesses vary greatly by state, as illustrated in Table 37.5, which compares reportable infectious diseases in California and North Carolina as of December 2016. In general, the lists of reportable occupational conditions are much shorter than those for infectious disease. For example, North Carolina requires reporting of only three occupational diseases: silicosis, asbestosis, and elevated blood lead levels. The Council of State and Territorial Epidemiologists (CSTE) maintains web sites where physicians can look up infectious (http://www.cste.org/?StateReportable) and occupational illness reporting requirements (http://www.cste.org/group/OHWebsites) for their state. Reporting of suspected environmental or occupational causes of illness to federal agencies is not required. Nonetheless, state health departments routinely report selected infectious diseases specified by CSTE and CDC as “notifiable” to CDC in order to support monitoring of national disease trends and to inform national public health policies.

Gibson JM. Environmental Determinants of Health. Chronic Illness Care. 2017 Nov 7:451–67. doi: 10.1007/978-3-319-71812-5_37. PMCID: PMC7121497.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7121497/

REFERENCES – EARLY ALZHEIMER'S DETECTION

AMBIENT AIR POLLUTION AND ALZHEIMER'S DISEASE

Ambient air pollution and Alzheimer's disease: the role of the composition of fine particles

https://www.pnas.org/doi/10.1073/pnas.2220028120#:~:text=They%20conclude%20that%20annual%20average,and%20Alzheimer's%20disease%20(5).

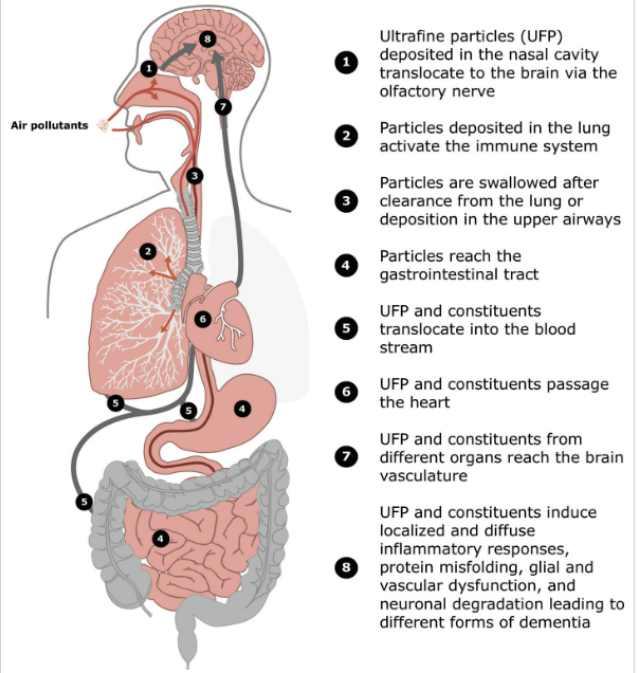
...Within the complex mixture of polluted ambient air, fine ambient particles defined as mass of particles smaller or equal to 2.5 µm in aerodynamic diameter ($PM_{2.5}$) are an established causal factor

...Today, Alzheimer's disease and other dementias are globally the seventh leading cause of mortality according to the World Health Organization (19). Of the approximately 55 Mio cases, 60 to 70% are Alzheimer's disease. These numbers highlight that the paper by Shi et al. (5) has important implications for regulatory action. The finding that black carbon particles per µg/m³ have an approximately 10-fold larger effect size than the $PM_{2.5}$ mixture calls for action to further limit emissions of soot particles from their sources. It also calls in my mind for intensified monitoring of ultrafine particles. The finding that aged regional transported particles are associated with dementia including Alzheimer's disease strongly highlights that air pollution mitigation strategies need to be part of regional and national agendas.

"In PNAS, Shi et al. investigated the association between constituents of $PM_{2.5}$ and the incidence of dementia and Alzheimer's disease."

documented between PM2.5 and vascular dysfunction (18). Therefore, it is also plausible that PM2.5 impairs endothelia in the brain and induces vascular dementia (Fig. 1:8). Taken together, the hypothesized pathways could promote various types of dementia (10, 17).

Fig. 1.



Schematic overview on ambient fine and ultrafine particle deposition and interaction with organs and the circulation contributing to the development and progression of dementia and neurodegeneration. Orange lines and arrows: Particle paths through the upper airways into the lung. Dark red lines: Particle paths through the esophagus into the gastrointestinal tract. Gray lines and arrows: Paths of ultrafine particles and constituents from the barrier organs to the brain.

ALZHEIMER'S ASSOCIATION 2021

- Improving air quality may improve cognitive function and reduce dementia risk, according to several studies reported today at the **Alzheimer's Association International Conference® (AAIC®) 2021** in Denver and virtually.

- Previous reports have linked long-term air pollution exposure with accumulation of Alzheimer's disease-related brain plaques, but this is the first accumulated evidence that reducing pollution, especially fine particulates in the air and pollutants from the burning of fuel, is associated with lower risk of all-cause dementia and Alzheimer's disease.

https://aaic.alz.org/releases_2021/air-pollution-dementia-risk.asp

Aging and Alzheimer's risk

The number of people with Alzheimer's disease doubles about every 5 years beyond age 65. About one-third of all people age 85 and older may have Alzheimer's disease.

Dec 24, 2019

nih.gov

https://www.nia.nih.gov › what-causes-alzheimers-disease

REFERENCES – DIABETES

A FRIGHTENING NEW REASON TO WORRY ABOUT AIR POLLUTION – THE ATLANTIC - 2018

- It's fairly well known that a bad diet, a lack of exercise, and genetics can all contribute to type 2 diabetes. But a new global study points to an additional, surprising culprit: the air pollution emitted by cars and trucks.

- Though other research has shown a link between diabetes and air pollution in the past, this study is one of the largest of its kind, and it's unique because it both is longitudinal and includes several types of controls. What's more, it also quantifies exactly how many diabetes cases in the world are attributable to air pollution: 14 percent in 2016 alone. In the United States, it found, air pollution is responsible for 150,000 cases of diabetes.

- The study, published in *The Lancet Planetary Health*, linked data from 1.7 million American Veterans who had been followed for a median of 8.5 years with air data from the EPA and NASA. It also aggregated past international research on diabetes and air pollution to devise a model to estimate diabetes risk based on the level of pollution, and it used the Global Burden of Disease study to estimate how many years of healthy life were lost due to this air-pollution-induced diabetes. Globally, 8.2 million years of healthy life were lost in 2016 to pollution-linked diabetes, it showed.

https://www.theatlantic.com/health/archive/2018/07/a-frightening-new-reason-to-worry-about-air-pollution/564428/

AIR POLLUTION MAY CONTRIBUTE TO DIABETES, PARTICULARLY AMONG AFRICAN AMERICANS, STUDY FINDS

- Diabetes is a public health issue affecting more than 34 million people in the United States. (CDC.gov article)
- At Environmental Pollution Agency (EPA), one epidemiologist has explored another potential contributing risk factor—air pollution.
- However, this is one of the first studies that explores the association between air pollution and higher rates of diabetes in African Americans living in the southern United States.
- Weaver's research indicates air pollution may play a role in the development of diabetes in African Americans, with some evidence showing an association between long-term exposure to ozone and fine particulate matter ($PM_{2.5}$) and those who have diabetes.
- Ultimately, this line of research will help inform environmental justice efforts, help doctors better treat patients with diabetes, and help people make more informed decisions to protect their health.

https://www.epa.gov/sciencematters/air-pollution-may-contribute-diabetes-particularly-among-african-americans-study

REFERENCES – BEHAVIORAL HEALTH

AMERICAN PSYCHIATRIC ASSOCIATION

Air Pollution's Impact on Mental Health - 2023

- For example, a large study of people in the U.S. and Denmark found that exposure to air pollution "is significantly associated with increased risk of psychiatric disorders," including depression, schizophrenia, bipolar disorder and personality disorder, (Kahn, et al). While studies have found associations between air pollution and mental health problems, how it might influence mental health is not well understood. The authors of the U.S. and Danish study suggest their research points to neuroinflammatory mechanisms linking air pollution and psychiatric consequences.[1]

- The lead author of the study, Clara G. Zundel, Ph.D., concluded in a World Economic Forum report: "People who breathe polluted air experience changes within the brain regions that control emotions, and as a result, they may be more likely to develop anxiety and depression than those who breathe cleaner air."

https://www.psychiatry.org/news-room/apa-blogs/air-pollution%E2%80%99s-impact-on-mental-health

ENVIRONMENTAL HEALTH NEWS - 2022

- According to the American Lung Association's 2021 State of the Air report , about four in 10 US residents live in counties with unhealthy levels of air pollution. But what counts as “unhealthy” is based only on how pollution affects physical, not mental, health.
- Only much later, researchers discovered that air pollution also causes changes in the brain that increase the risks of mental illness , dementia , Alzheimer's , and learning problems . Even small increases in air pollution have been linked to depression and anxiety.
- A large 2019 study of people in Denmark and the US found people exposed to high levels of air pollution are much more likely to suffer from a psychiatric illness such as depression, schizophrenia, bipolar disorder, or personality disorder.

https://www.ehn.org/air-pollution-and-mental-health-2656823544.html

REFERENCES – CARDIAC DISEASE

AMERICAN HEART ASSOCIATION

“Air pollution exposure may cause heart attack within an hour” [heart.org]

- "The adverse cardiovascular effects of air pollution have been well documented. But we were still surprised at the very prompt effects," said Haidong Kan, a professor in the School of Public Health at Fudan University in Shanghai. He led the study published Friday in the American Heart Association's journal Circulation.
- "Another surprise was the non-threshold effects of air pollution," he said. "In other words, any concentrations of air pollutants (such as fine particulate matter, nitrogen dioxide, sulfur dioxide and carbon monoxide) recorded in the present study may have the potential to trigger the onset of a heart attack."
- "The cardiovascular effects of air pollution should be a serious concern for all, including policymakers, clinicians and individuals," Kan said. "For policymakers, our findings underline the need of further tightening air quality standards, more stringent air pollution control and prompt public health response."
- The study is the first to establish a link between pollution exposure and heart attacks on an hourly basis, said Dr. Sanjay Rajagopalan, director of the Cardiovascular Research Institute at Case Western Reserve University in Cleveland. Rajagopalan was not involved in the study.

https://www.heart.org/en/news/2022/04/22/air-pollution-exposure-may-cause-heart-attack-within-an-hour

AMERICAN HEART ASSOCIATION – JULY 2023

“Extreme heat mixed with air pollution may double risk of fatal heart attack” [heart.org]

- Fine particulate matter in the air may "interact synergistically" with extreme temperatures to adversely affect cardiovascular health, Liu said. "Our findings provide evidence that reducing exposure to both extreme temperatures and fine particulate pollution may be useful to prevent premature deaths from heart attack, especially for women and older adults."

- Fine particulate matter pollution comes from burning fuels and includes vehicle exhaust, factory emissions and wildfire smoke. Particles less than 2.5 microns can be easily inhaled deep into the lungs, where they can cause irritation to the lungs and blood vessels around the heart. Prior research has linked exposure to fine particulate matter pollution to heart disease, stroke and other health issues.

- Extreme temperatures were measured using the daily heat index, which reflects the combined impact of heat and humidity

https://www.heart.org/en/news/2023/07/26/extreme-heat-mixed-with-air-pollution-may-double-risk-of-fatal-heart-attack