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The Effect of Climate Change on Respiratory Diseases

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The Impact of Climate Change on Respiratory Diseases

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Introduction

- As greenhouse gas emissions continue to rise, causing global climate change and severe weather patterns, research is being conducted to determine possible effects on human health. Climate change effects the concentration of pollutants in the air including ambient pollen and other allergens with the potential to trigger asthma attacks and other respiratory distresses. This issue is affecting humans on a global scale and the resulting damages to human health are expected to rise in the coming decades and continue well into the future.
- The Environmental Protection Agency (EPA) is making efforts to reduce respiratory health impacts, and reduce a major source of the climate change problem, carbon dioxide, through the Clean Air Act (1). Although regulated outdoor air pollution levels help to decrease the respiratory disease burden, multiple studies show a need for lower, safer levels. Safer pollutant levels would not only improve health, but prevent economic stress from increased medical expenses.
- *This study explores the relationship between global climate change and the affects on respiratory diseases in humans, as well as possible implications for the future. Additionally, the research looks at current methods of combating increased respiratory disease in order to protect human health in a changing climate.*

Respiratory diseases include, but are not limited to, chronic bronchitis, emphysema, asthma, and chronic obstructive pulmonary disorder (COPD). (Figure 2)

Data

- *All studies point towards an increase in the prevalence and severity of respiratory issues as the climate changes.*
- Urban communities experience a greater respiratory illness burden than do rural communities (2).
- Increased concentrations of NO₂ will result in more emergency room visits, increased allergic responses, and shortness of breath (2).
- Increased ozone exposure can contribute to premature death, especially in people with preexisting lung and heart disease(2).
- Increased particulate matter (PM) will spark an increase in both cardiovascular disease and respiratory diseases including asthma and lung cancer (3).
- In a study by Lin et al., rising temperatures in New York State could lead to increased respiratory issues (4).
- Related hospitalizations could rise up to 160% from 2046-2065, and up to 510% from 2080-2099.
- This will also increase the economic burden of disease in NY.
- A 1 degree Celsius temperature increase along a temperature health-effect curve found a 2.7-3.1% increase in that day’s hospital admissions.

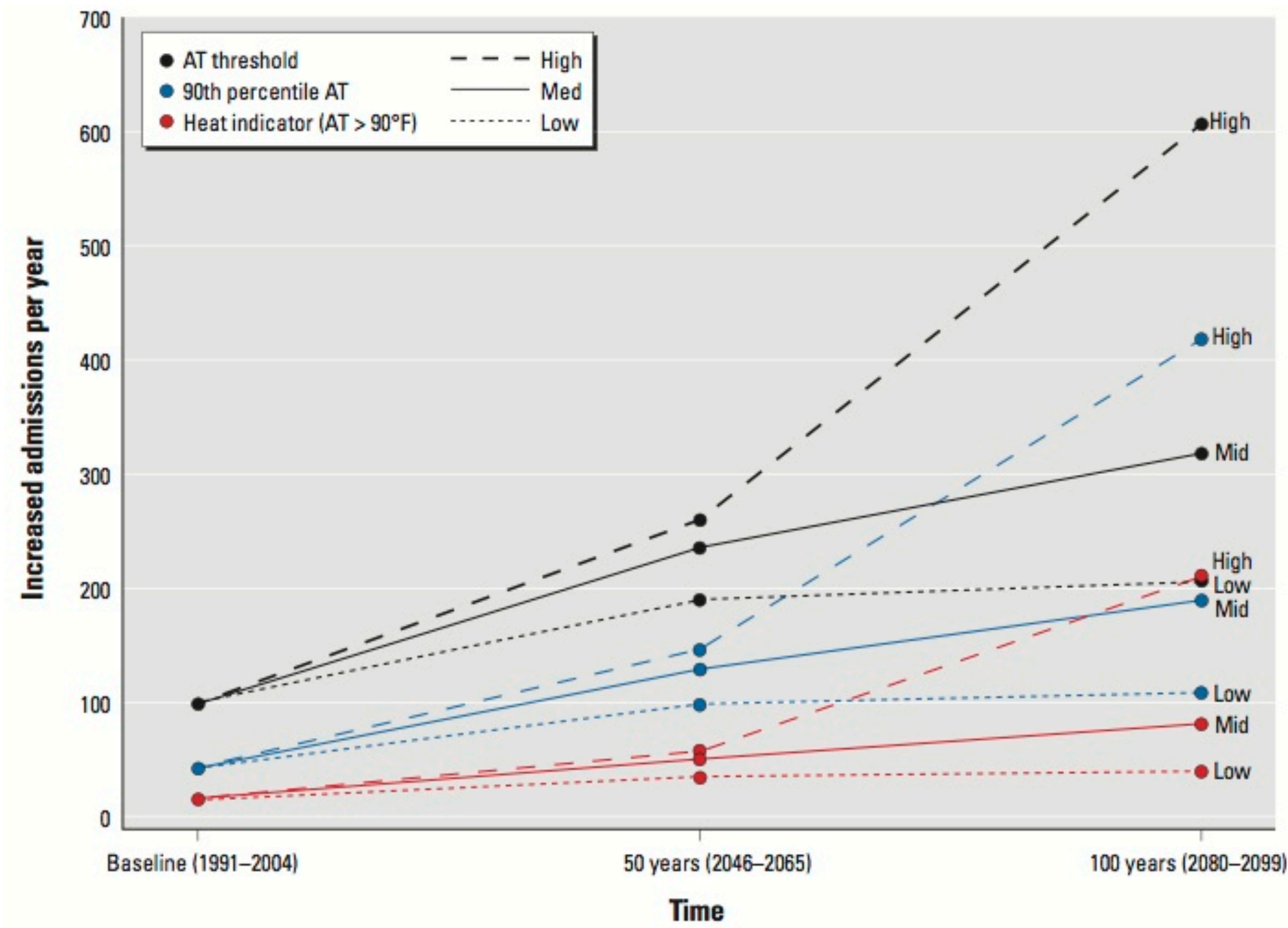


Figure 1. Current and projected number of summer hospital admissions per year due to respiratory issues in New York State. Modeled under different climate change scenarios (4).

Data

- Studies suggest that in the future, heat related hospital admissions from respiratory diseases will jump from 11,000 during the reference period in Europe to 26,000 annually (5).
- Plants growing at higher temperatures and in CO₂ enriched atmosphere have an increase in allergen content in the produced pollen (6).
- The changes in distribution and concentration of ambient pollen will increase morbidity of asthma and allergic diseases, as well as number of ER visits (6).
- Resulting from the increase in temperature over the last century, the burden of pollen results in impaired work fitness, sick leave, and prescription drugs (6).
- Short term exposure to extreme hot temperatures increases the risk of respiratory ER visits for patients with comorbid respiratory diseases, as a result of hot temperatures affecting airways and inducing systemic inflammation (7).
- Increased exposure to atmospheric levels of ozone, induce a decrease in lung function and higher reactivity to bronchoconstrictor agents associated with exacerbation of asthma (8).

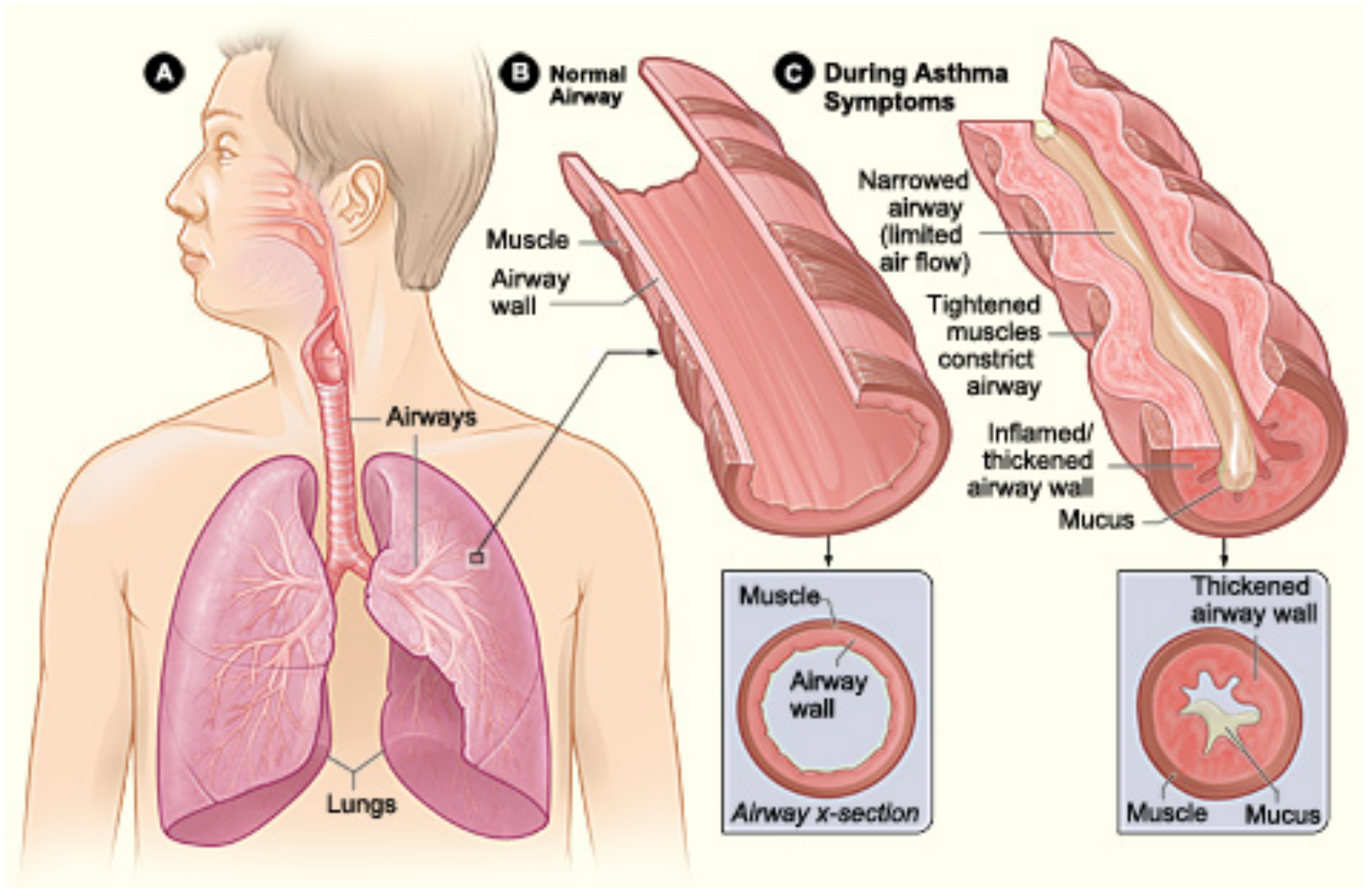


Figure 2. Illustration of the effect of asthma on the lungs. Asthma is commonly triggered by poor air quality (Image 2).

“More than 50% of the population of the United States live in areas where levels of ozone, nitrogen dioxide, sulphur dioxide, and particulates exceed current National Ambient Quality Standards” (2)

Policy

- Under the Clean Air Act, the Environmental Protection Agency is required to establish ambient air quality standards for certain pollutants including particulate matter, ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead (9). Current nationwide greenhouse gas emissions are seen in Figure 3.
- One of the purposes of this act is to minimize pollution resulting from the growing number of motor vehicles and industrial plants. Despite action of the Clean Air Act, air pollution continues to harm the health of people and the environment. Greenhouse gasses trap heat and cause more intense heat waves that increase death rates, especially among the poor and elderly (9).
- In 2013, President Obama announced a series of executive actions to reduce carbon pollution, in order to lead international efforts to address climate change. The president is directing the EPA to establish carbon pollution standards for power plants, as well as increasing funding for clean energy technology (9). (Figure 4)
- Section 111 of the Clean Air Act issues standards, regulations or guidelines to address carbon pollution from new and existing power plants, by reducing national limits of emission (1).

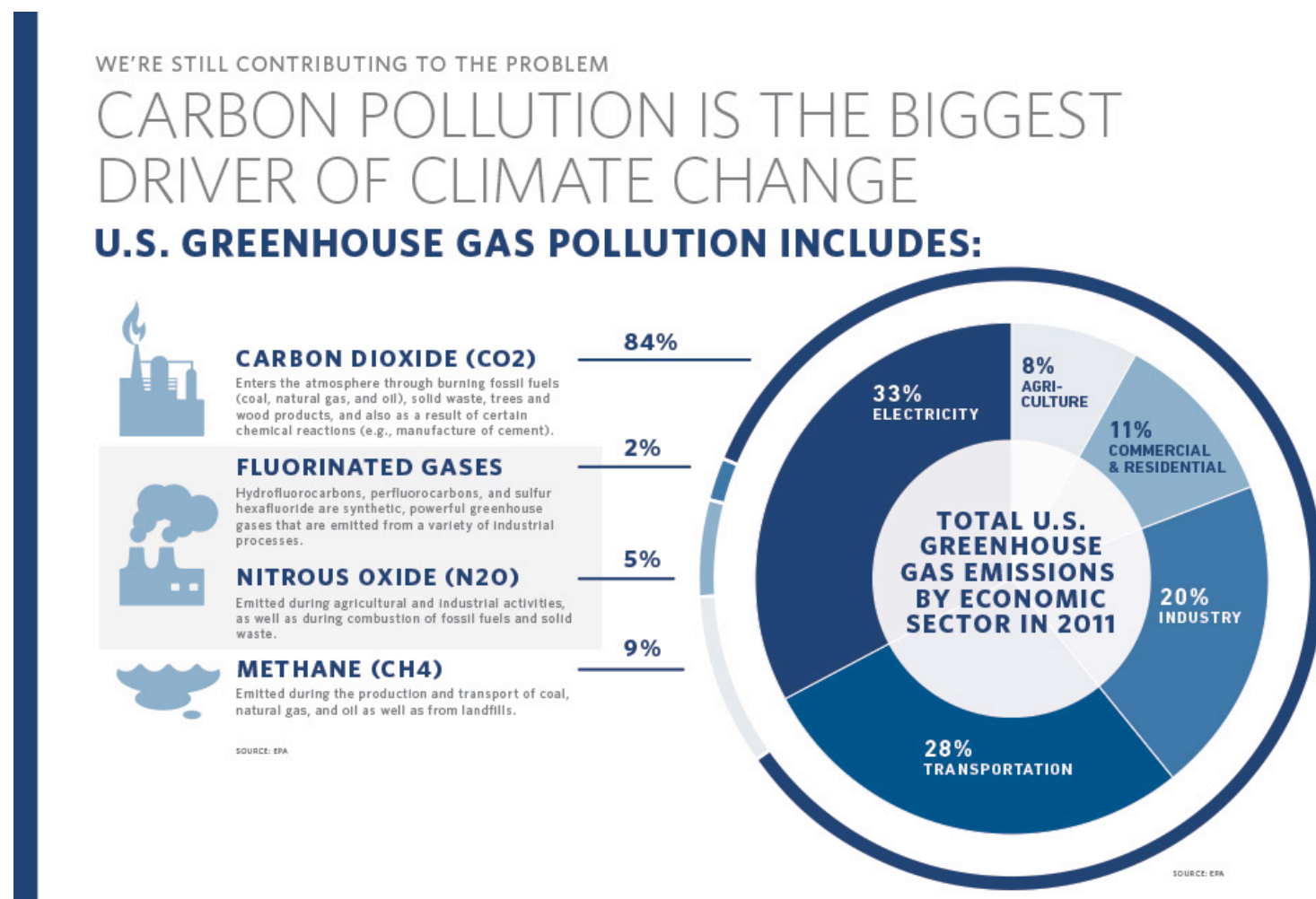


Figure 3. United States greenhouse gas emissions (9).

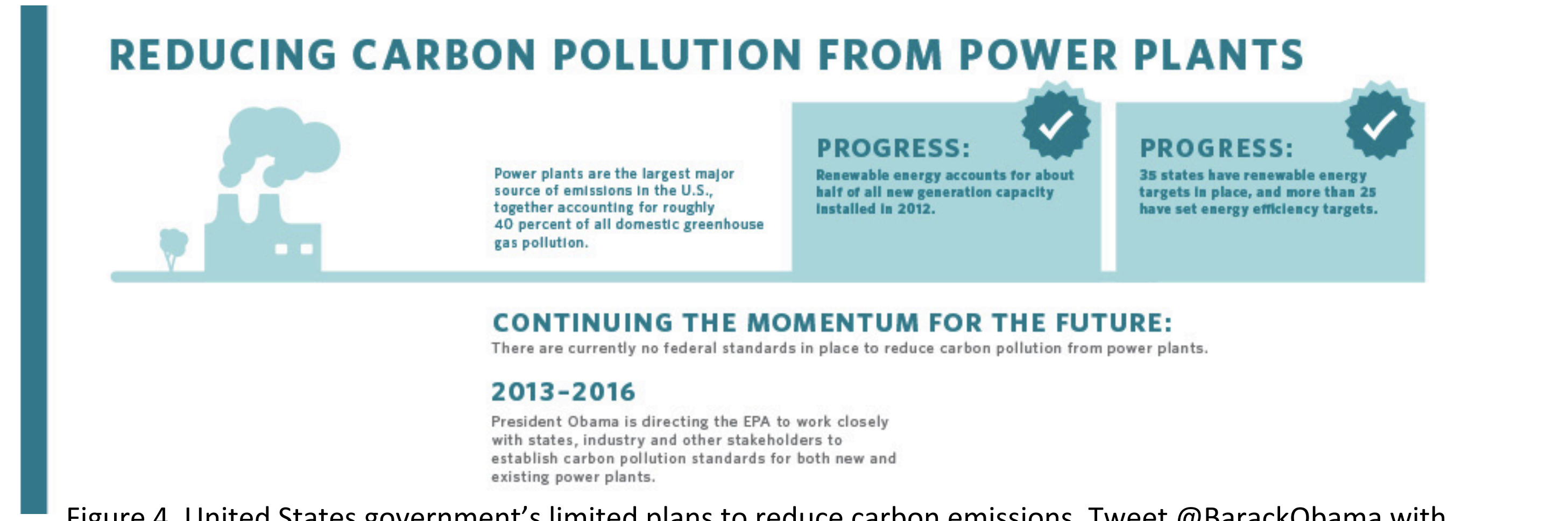


Figure 4. United States government’s limited plans to reduce carbon emissions. Tweet @BarackObama with #ActOnClimate for any input. (9)

Future Research and Action

- Because there is no set standard for measuring health effects, and climate change is unpredictable, a method of how best to analyze potential negative impacts on respiration due to climate change needs to be implemented (10).
 - Ensembles of models that take into account multiple possible future climate scenarios will be most beneficial.
- Physicians will need to adapt to patients experiencing different environmental conditions and having increased illness burdens due to climate change (11).
- The current regulations and standards set in place in the United States and across the globe to combat climate change are not sufficient. As population size and temperature continue to grow, so does energy consumption.
- The best way to fix this issue is to create higher standards and devote more time and money into renewable energy resources. President Obama’s Action Plan on Climate Change also outlines many steps that need to be taken in the coming decades, including doubling the generation of wind and solar energy by 2020, and reducing fuel consumption by heavy-duty vehicles (9).
- The US, along with other nations, must work to cut energy waste, remove subsidies that encourage wasteful consumption of fossil fuels, reduce emissions from deforestation, and finance cleaner energy. Without removing these harmful practices, respiratory disease will continue to affect lives both nationally and globally (Tables 1 and 2).

1 Dietary risks	1.0 (1-1)	33% (30 to 36)
2 High blood pressure	2.0 (2-2)	29% (22 to 36)
3 Smoking	3.0 (3-3)	20% (6 to 26)
4 Household air pollution	5.5 (4-9)	-22% (-31 to -12)
5 High fasting plasma glucose	5.8 (4-8)	60% (42 to 78)
6 High body-mass index	5.8 (4-8)	72% (63 to 83)
7 Ambient PM pollution	6.5 (4-8)	11% (6 to 16)
8 Physical inactivity	6.7 (4-9)	No estimates
9 Alcohol use	8.8 (8-9)	38% (19 to 57)
10 High total cholesterol	10.0 (10-10)	4% (-12 to 19)

Table 1. Both household air pollution and ambient particulate matter pollution are in the top 10 risks related to death globally (Image 1).

1 Dietary risks	1.0 (1-1)	-8% (-14 to 5)
2 Smoking	2.3 (2-3)	-5% (-14 to 2)
3 High blood pressure	2.7 (2-4)	-17% (-32 to -1)
4 High body-mass index	4.0 (3-4)	41% (27 to 58)
5 Physical inactivity	5.2 (5-6)	No estimates
6 High fasting plasma glucose	5.8 (5-7)	36% (7 to 76)
7 High total cholesterol	7.0 (6-7)	-38% (-54 to -18)
8 Ambient PM pollution	8.2 (8-9)	-33% (-39 to -24)
9 Alcohol use	8.8 (8-9)	18% (-31 to 124)
10 Drug use	10.2 (10-11)	174% (39 to 346)

Table 2. Ambient particulate matter pollution is in the top 10 risks related to death in the United States (Image 1).

Conclusions

- The release of greenhouse gases and other pollutants into our atmosphere is causing a global climate change that is not only warming the planet and harming the environment, but also having a negative effect on human health. The occurrence of respiratory issues, and the comorbidity of various respiratory diseases is on the rise, impacting the ability to function properly, increasing medical costs, and decreasing the ability to work. Stricter government regulation needs to be implemented within a relative short time frame in order to protect the health of humans as the climate warms.

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Images:
1. <http://www.healthmetricsandevaluation.org/gbd/visualizations/gbd-arrow-diagram/>
2. <http://www.nhlbi.nih.gov/health/health-topics/images/asthma.jpg>