Emergency Mask Distribution Plan

Group Project

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Abstract:

Poor air quality is a problem that requires quick attention to safeguard our population from the negative health effects of breathing polluted air. A prime example of these concerns can be related back to the poor air quality situation that we recently endured in NYC caused by the Canadian wildfires. In this proposal, we outline a plan of action that includes stockpiling various types of high-quality masks, such as N95 and KN95 respirators, at various points throughout the five boroughs of NYC. We will utilize solicited locations throughout the city that will contain an extensive amount of N95s and KN95s stored and distributed by existing city infrastructure such as the MTA buses, emergency vehicles, or even sanitation trucks to be transported throughout the city during unforeseen circumstances. We can do so by employing existing artificial intelligence algorithms to determine the optimal way for dispatchers to send out masks to reduce the number of individuals exposed to hazardous air quality.

Introduction:

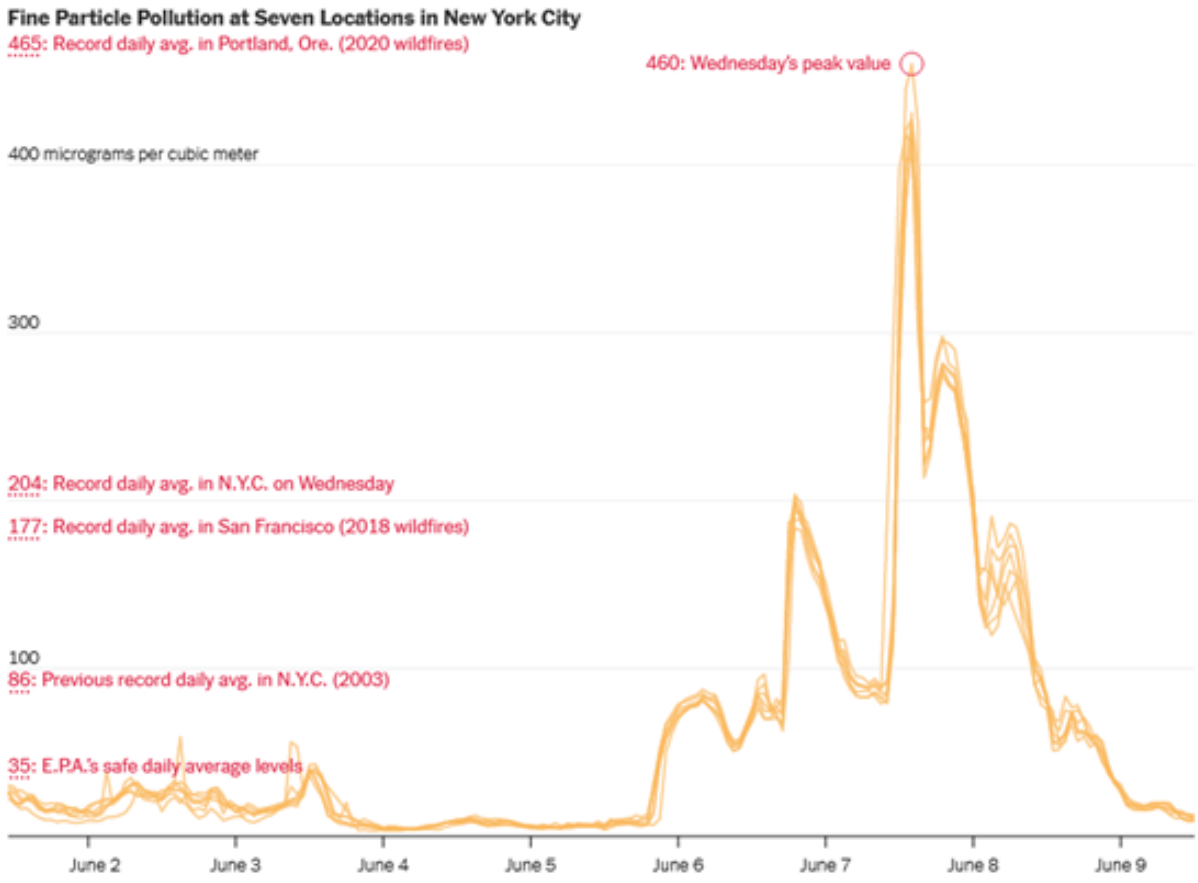
One does not have to look too far than a month from the time this proposal is sent out for an event that would have benefited greatly from an emergency plan such as ours. Starting around June 6th, 2023, and ending around June 9th, the air quality in NYC was one of the worst in the world [3] by many estimates. And for many other cities in the region such as Philadelphia and Washington DC, the worst quality air they had seen in their history. This prolonged period of bad air was brought about by fires taking place in the region of Quebec in southern Canada and brought to the Northeast United States by air currents [1]. For some time now, there have been ways of tracking air pollution in the air by groups such as NOAA and the EPA.

One of these metrics is known as the air quality index (AQI), which is a quantity used to communicate the level of air pollution and establishes different ranges that correspond to the

different levels of health concerns different groups of people can experience. The AQI focuses on the health effects that can occur whilst spending prolonged periods of time in that air. In the AQI there are five major air pollutants that are specified by the Clean Air Act. They are ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide [2]. During the time NYC was filled heavily with smoke the AQI went up higher than 400 on a scale that goes up to 500. Figure 1 tracks air quality at different times during the time interval of June 2nd and June 9th and it is not hard to see how much and how quickly the air quality deteriorated. Given how hazardous the air was for healthy people, not to mention vulnerable groups, it is a good idea to create a plan of action that the city can follow should this happen again.

It is now possible to get readings of the air quality readily from websites such as NOAA.gov and different private companies such as IQ-Air at a daily, even hourly rate. Given the speed at which air monitoring happened, it would be prudent for the City of New York to develop this plan of action for when these events should occur. We know that at least in the short term, events such as these are not only possible but increasingly likely.

Figure 1: Data from the New York City Community Air Survey and New York State Department of Environmental Conservation plotted by the New York Times showing the hourly concentration of PM 2.5 particles, measured in micrograms per cubic meter, for seven NYC locations.



Background:

Air pollution has emerged as one of the most pressing environmental issues of our time. The detrimental effects of poor air quality on human health and the environment have been recognized for centuries. From the early days of industrialization to the present, the history of bad air quality serves as a cautionary tale of the consequences of unchecked pollution. The history of bad air quality dates to ancient civilizations. The burning of fossil fuels, deforestation, and industrial activities have contributed to the release of pollutants into the atmosphere throughout history. However, it was during the Industrial Revolution in the 18th and 19th centuries that air pollution became a pervasive issue.

As industrialization spread across Europe and North America, the combustion of coal and the rise of factories led to significant air pollution. The rapid urbanization and concentration of industries in cities created a toxic combination of pollutants, including sulfur dioxide, particulate matter, and heavy metals. Cities such as London and Manchester experienced severe smog events, leading to thousands of deaths and widespread health problems.

One of the most infamous incidents related to air pollution was the Great Smog of London in 1952. A combination of weather conditions and widespread coal burning led to a thick layer of smog that enveloped the city for several days. The event resulted in an estimated 12,000 deaths and forced the government to address the urgent need for air pollution regulations.

The latter half of the 20th century witnessed a growing awareness of the environmental impacts of human activities. The publication of Rachel Carson's "Silent Spring" in 1962 highlighted the dangers of pesticide use and catalyzed the modern environmental movement. This awakening brought air pollution to the forefront of public consciousness and led to the establishment of environmental regulations worldwide.

The health consequences of air pollution are well-documented. Poor air quality is linked to respiratory diseases, cardiovascular issues, allergies, and increased mortality rates. Moreover, air pollution negatively affects ecosystems, causing acid rain, ozone depletion, and climate change. The economic costs associated with healthcare expenses and reduced productivity further underline the seriousness of this problem.

Solution Description:

Face masks are in high demand because of the coronavirus epidemic and the Canadian wildfires given worries about airborne contaminants. Nevertheless, there is no infrastructure in place to deliver high-quality masks rapidly and efficiently to targeted regions that require them to replenish existing mask stockpiles throughout the city. For our proposal, we identify solicited locations that will be equipped with numerous amounts of essential goods in the likelihood of

unprecedented events, such as bottled water, canned goods, and especially high-quality face masks. Table 2 highlights existing areas in the metro region that are suitable for storing such stockpiles.

Table 2: High-Quality Mask Storage Units

Regions of NYC	**Bronx**	**Manhattan**	**Queens**	**Brooklyn**	**Staten Island**
Stadiums	Yankee Stadium	Madison Square Garden	USTA Bille Jean King National Tennis Center	Barclays Center	Richmond County Bank Ballpark
CUNY Colleges	Bronx Community College	BMCC/CCNY	CUNY School of Law	Brooklyn College	College of Staten Island
Hospitals	Montefiore	Mount Sinai	NewYork-Presbyterian/ Queens	Maimonides	Staten Island University Hospital
Department of Sanitation (DSNY)	Bronx 6 Sanitation Department	DSNY Manhattan 8 Garage	DSNY Queens District 7 Garage	DSNY Brooklyn District 3 Garage	DSNY Section 12

https://www.youtube.com/watch?v=ee4K8BhyXUU&ab_channel=AeologicTechnologies

How it'll work:

"Artificial Intelligence (AI) is a computer system that can do tasks that humans need intelligence to do" (Healey, 2020). In its most basic form, AI is a field that combines computer science and large datasets to solve problems. To deploy KN95s and N95s during arbitrary circumstances current infrastructure such as MTA buses, sanitation trucks, and emergency vehicles as a form of delivery system. We will then utilize Distributed Artificial Intelligence (DAI) to determine the most efficient routes throughout the city to reach individuals who currently reside in shelters, orphanages, half-way-homes, and prisons. Artificial intelligence (AI) enables scientists and

engineers to construct self-contained technology that can adapt and respond to changing settings and circumstances, such changes contain;

Route Optimization: Artificial intelligence systems can examine real-time data on air quality, traffic, and road closures to determine the most efficient routes for moving important items. AI systems can dynamically change delivery routes to limit exposure to polluted areas by considering elements such as air quality indexes.

Inventory Management: By evaluating supply chain data, consumption habits, and external factors such as air quality, AI can optimize inventory management. AI can estimate future demand for masks and adjust inventory levels to avoid shortages or overstocking by using machine learning techniques.

Demand Forecasting: Using numerous parameters such as air quality data, historical consumption patterns, population density, and disease breakout trends, AI-powered demand forecasting algorithms can predict the number of masks and other vital items required in certain places. This contributes to a sufficient supply of masks in places afflicted by poor air quality or other situations.

Drone Delivery: Traditional transportation techniques may be restricted in locations with significant air pollution or during emergencies. AI may be used to automate drone delivery systems, assuring the safe and timely delivery of critical items like as masks. Drones fitted with AI algorithms can navigate difficult terrain and efficiently deliver supplies to affected areas.

Monitoring and Surveillance: Using Internet of Things (IoT) gadgets and sensors, AI may be used to monitor air quality in real-time. The intelligent systems can analyze the acquired data, identify places with bad air quality, and send out warnings for vital measures like delivering masks or other essential supplies to such locations.

While AI can improve the efficiency and effectiveness of transporting essential goods during poor air quality or emergencies, it must be used in conjunction with human

decision-making and oversight to ensure safety, ethical considerations, and regulatory compliance.

Why it'll work:

The density of the population in New York City is one of the highest in the United States, with over 8 million residents packed into a relatively small area. This density poses various challenges, including access to high-quality masks for protection. In 2023 New York has a most recent census, which recorded a population of 8,772,978 in 2020. Spanning over 468 miles, New York City has a population density of 26,261 people per square mile. As shown in Figures 3 and 4.

Figure 3: NYC Density Chart in 2010.

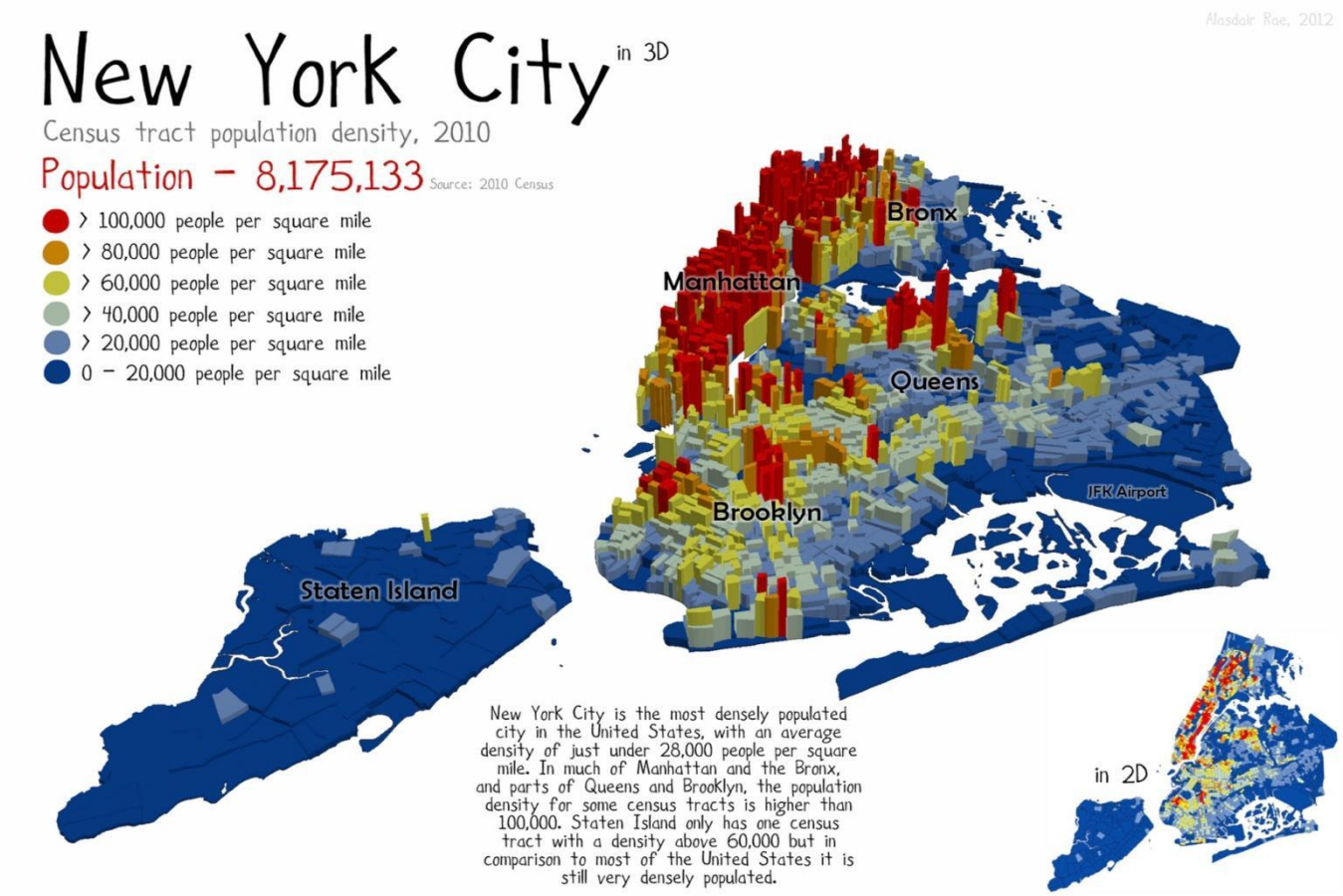
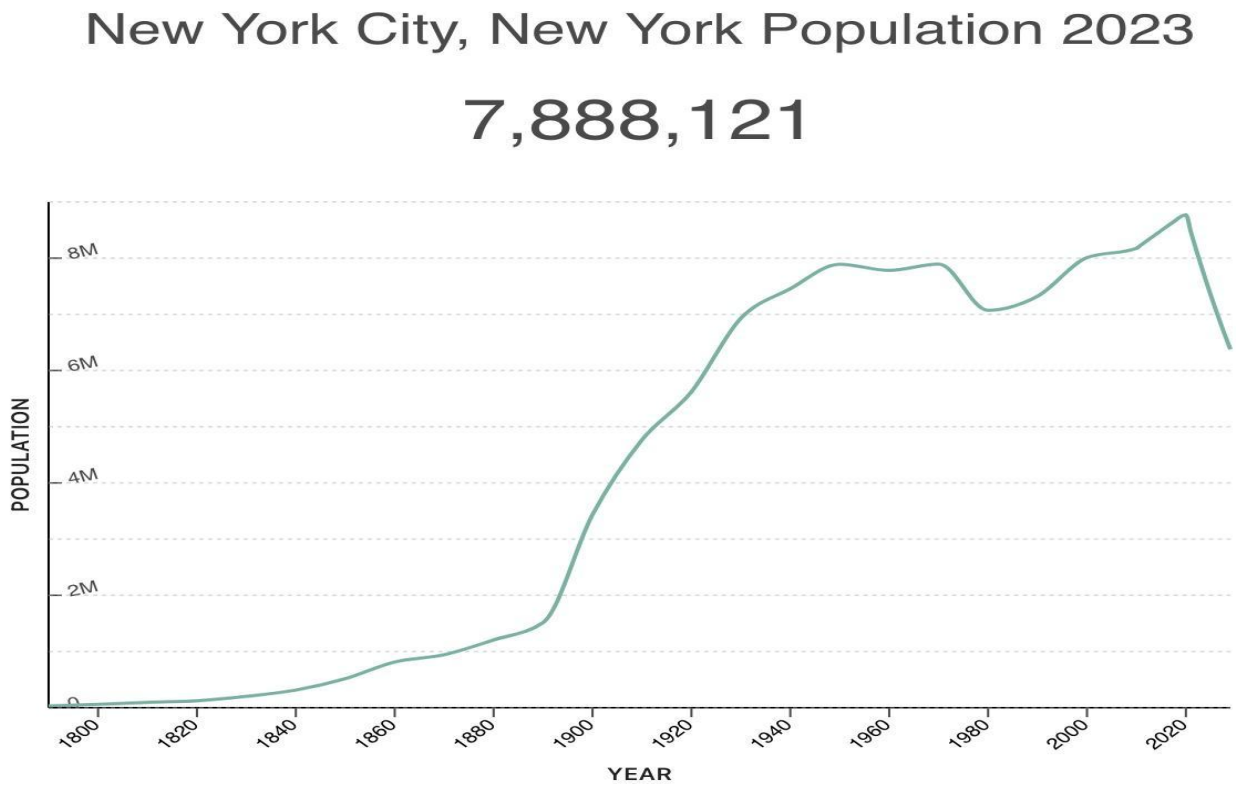


Figure 4: New York Population 2023 depicts the gradual population of New York beginning since 1800.



To begin, the sheer number of people nearby increases the risk of virus transmission. With more individuals in confined spaces, such as crowded streets, public transportation, or apartment buildings, the potential for infectious diseases to spread rapidly is heightened. In such a densely populated environment, it becomes crucial for individuals to have access to effective masks to reduce the risk of contracting or spreading illnesses.

However, the high demand for masks in a densely populated city like New York can lead to supply chain issues. When a large number of people in a limited area are seeking the same protective equipment, it can strain the availability of high-quality masks. During times of crisis, such as the COVID-19 pandemic, demand often outpaces supply, creating a shortage that affects everyone, especially those living in densely populated areas.

Additionally, the high cost of living in cities like New York can make it difficult for some residents to afford high-quality masks. Premium masks with better filtration capabilities and a comfortable fit tend to be more expensive. In an already expensive city, individuals may have to make trade-offs between other essential expenses and purchasing these higher-quality masks. This financial constraint can prevent some people from obtaining masks that provide better protection, leaving them more vulnerable to airborne diseases.

Moreover, the density of the population can also contribute to misinformation and confusion. In a city where information spreads rapidly, it can be challenging to ensure that accurate and reliable information about mask usage and effectiveness reaches everyone. This can lead to a lack of awareness or misunderstanding about the importance of masks or the types that offer the best protection. Consequently, individuals may unknowingly choose masks that are less effective or fail to follow proper mask-wearing protocols, further exacerbating the risk of disease transmission.

This is what prompted our entire idea, a robust plan of action is essential to ensure that residents have access to masks that provide optimal protection. By proactively stockpiling a significant quantity of N95 and KN95 respirators and strategically distributing them throughout the five boroughs, the city can swiftly respond to emergencies, minimize the impact of infectious diseases, and safeguard the health and well-being of its residents. This proactive approach acknowledges the unique challenges posed by high population density and aims to mitigate them by ensuring the availability of high-quality masks when they are most needed.

Materials:

The main idea behind this section was regarding what sort of face masks would be distributed to the public. Our proposal decided on using N95 and KN95 masks due to their efficiency. According to Sara Berg's article "What Doctors wish patients knew about wearing N95 masks" for the American Medical Association, she talks with physician and member of the AMA Louito Edje, MD, who notes that "N95 masks offer the highest level of protection because they protect against both large and small particles rather than just large particles." and if worn as instructed, they can block 95% of particles in the air. In addition to its highly efficient protection, these masks were specifically designed to fit on the user's face as noted by this article from the United States of America's Food and Drug Association.

"An N95 respirator is a respiratory protective device designed to achieve a very close facial fit and very efficient filtration of airborne particles. Note that the edges of the respirator are designed to form a seal around the nose and mouth."

- The U.S. Food and Drug Association, "N95 Respirators, Surgical Masks, Face Masks, and Barrier Face Coverings"

We will also be relying on using existing infrastructure to stockpile these masks, such as MTA buses, street cleaners, garbage trucks, and emergency vehicles. We will additionally need storage to store the spare mask reserves that will not be immediately placed onto these aforementioned vehicles. These reserves would be mainly found in places with a higher risk of air pollution and with fewer than enough resources to combat it.

Reference

World Health Organization. (2021). Air pollution. Retrieved from https://www.who.int/news-room/air-pollution

Environmental Protection Agency. (2021). Air pollution history. Retrieved from https://www.epa.gov/history/air-pollution-history

National Geographic. (2021). Air Pollution. Retrieved from https://www.nationalgeographic.com/environment/article/air-pollution

Healey. (2020). *Artificial intelligence* (Healey, Ed.). The Spinney Press. https://ebookcentral.proquest.com/lib/ccny-ebooks/reader.action?docID=6034013

Bhatia, A., Katz, J., & Sanger-Katz, M. (2023, June 8). Just How Bad Was the Pollution in New York? *The New York Times*. https://www.nytimes.com/interactive/2023/06/08/upshot/new-york-city-smoke.html

US Department of Commerce, N. (2018, March 26). *Air Quality index*. National Weather Service. https://www.weather.gov/safety/airquality-aqindex

NOAA satellites tracked historic levels of harmful smoke, impacting millions in the eastern U.S. National Environmental Satellite, Data, and Information Service. (n.d.). https://www.nesdis.noaa.gov/news/noaa-satellites-tracked-historic-levels-of-harmful-smoke-impacting-millions-the-eastern-us

Sara Berg, (2022, June 24). What doctors wish patients knew about wearing N95 masks American Medical Association. :https://www.ama-assn.org/delivering-care/public-health/what-doctors-wish-patients-knew-about-wearing-n95-masks#:~:text=There's%20added%20protection%20with%20N95s,-%E2%80%9CNow%2C%20more%20than&text=%E2%80%9CThis%20is%20the%20reason%20that,rather%20than%20just%20large%20particles.%E2%80%9D

The U.S. Food and Drug Association (2023, March 10) N95 Respirators, Surgical Masks, Face Masks, and Barrier Face Coverings :https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/n95-respirators-surgical-masks-face-masks-and-barrier-face-coverings#:~:text=An%20N95%20respirator%20is%20a,around%20the%20nose%20and%20mouth.