Perspectives of Healthcare Providers and Challenges that They Face as Illnesses Related to Air Pollution Increases in Hong Kong

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Abstract

Given both the global threat of air pollution and environmental illnesses, this research investigates research, future projects and recommendations by healthcare providers to help environmental scientist and policymakers address the issues surrounding air pollution and human health. Through interviews with healthcare providers in Hong Kong, I gather health care perspectives regarding the air pollution and adverse health effects of port operations and the expansion of urban projects that have the potential for increasing air pollution and other health risks.

Introduction

Hong Kong is a Chinese name that translates to “fragrant harbor.” However, if one visits the vibrant city today, the name “fragrant harbor” would not make any sense due to the increasing science documenting hazardous air emissions. Ports and industries produce thick clouds of smog that mask nearly every mountain and skyscraper in sight. Hong Kong economists, industry, and policymakers argue that these types of economic activities serve as revenue builders contributing billions of dollars to the city’s economy, yet most industry leaders and policymakers often ignore the fact that ports and industries negatively impact the city’s healthcare system by increasing the number of illnesses and the rates at which individuals are affected by emissions released from these sources. Economist Sandra Casagrande asserts, “The healthcare system loses billions of dollars in researching ways to treat illnesses caused by emissions” (Casagrande, 2009). According to Kevin Lui, Reporting Health and Medicine Journalist, the city reportedly spent over HK$57 billion dollars on technology to diagnose and treat illnesses related to air pollution, such as cancer, lung disease, bronchitis and other illnesses (Lui, 2015). As a result of this negative impact to the economy and human health, scientists rank Hong Kong as the third most polluted city in Asia (Lee, 2009). Thus, this negative correlation
highlights the importance of working with healthcare providers to develop methods and policy to mitigate the effects of air pollution on human health.

**Literature Review**

### 2.1 Introduction

In 2012, the Clean Air Network (CAN) placed Hong Kong as the eighth highest in the world for mortalities due to air pollution and third most polluted city in Asia, citing marine and transportation emissions as primary sources (Lee, 2009). The network serves as an independent governmental organization exclusively focused on addressing the air quality issues in Hong Kong. According to CAN, marine emissions have increased since 2007 by 41% with the source of these emissions being particulate matter (PM) and sulfur dioxide (Lee, 2009). Particulate matter is a term used to describe a mixture of solid particles in the air. These particles are mostly produced by marine vessels and automobiles at various shapes and sizes. Professor Jimmy Fung, at Hong Kong University of Science and Technology, claims that there are coarse and fine particles (Fung, 2015). Coarse particles are larger than 2.5 micrometers, and Fine particles are less than 2.5 micrometers and usually come from fuel combustion, power plants, and transportation that rely on diesel. However, despite the difference in size and source, both particle types contaminate the air and undoubtedly affect human lung function (Fung, 2015).

In addition to the Clean Air Network’s report, the Hong Kong Environmental Protection Department (HKEPD) released data that ranked the shipping industry as the highest contributor of particulate matter through marine emissions (Lee, 2009). According to HKEPD data, sulfur dioxide, nitrogen oxide, and particulate matter account for 50%, 32%, and 37% of the contaminants found in the air (Lee, 2009). The ships in Hong Kong also account for 11% of total volatile organic compound emissions and 17% of carbon monoxide (Lee, 2009). These emissions
have health consequences that seem greater than the smog experienced in highly polluted cities in the United States, such as Los Angeles.

In Figure 1, it is clear that there is an unstable variance associated with the NO2 levels in Hong Kong. Thus, to explore these changes, a thorough analysis of recent developments relating to air quality in Hong Kong is necessary. This decline can be explained by the adoption of a new air quality index, which is discussed later in this report. The figure shows that from 2009 to 2013 there was a significant increase in NO2 levels; however, after the creation of the new air quality index in 2013, the country saw a decline in NO2 levels but still greater than the United States, London, and Singapore. Despite this slight decrease, most health care providers and
environmental scientists predicted that NO2 levels may continue to increase due to expansion in urban projects and transportation (Lee, 2009).

Transportation is reportedly contributing nearly identical levels of pollutants. While scientists do not dispute the fact that transportation negatively impacts air quality in the city, they seem to debate the data regarding emission levels produced by cars and buses. According to Jake Spring, Environment and Global Energy Journalist, environmental scientists commonly argue that “vehicle emissions have previously been harder to measure than fixed sources of pollution such as factories and power plants” (Spring, 2016). The data used to develop mobile source (e.g. automobile) emission standards are from ride-hailing services and taxis, which the current laboratory testing arrangements to obtain this information has been considered unreliable due to major inaccuracies such as omitted variables, lack of data retrieved from poor communities in comparison to wealthy neighborhoods and divergent interpretations of medical patient data from non-practicing or certified healthcare providers (Spring, 2016).

2.2 Impact on Human Health and Healthcare Industry

Extensive studies indicate that air pollution significantly affects human health. Healthcare providers report that most patients experiencing issues such as declining lung function live near highly polluted, impoverished areas. Providers explain that the decrease in lung function occurs when a patient has a long-term exposure (10 years or more) to air pollutants like acid sulfate and O3 (Burnett et al., 1997). The combination of the two can cause acute lung failure and impairment. Also, pulmonologists document that air pollutants aggravate asthma. For instance, in Hong Kong, asthma in young adults and children increased from 4.8% to 17.2% between the period of 1989 and 2014 (Topal et al., 2014).
2.3 Why does the perspective of healthcare providers matter?

In any field, improving performance and accountability depends on having a shared goal that unites the interests and activities of all stakeholders. However, when dealing with issues regarding air pollution and human health, policymakers and providers have myriad, often conflicting goals (Topal et al., 2014). These conflicts seem to exist due to methods used to obtain data regarding issues associated with air pollution. Policymakers seem to “favor methods that positively reflect their work in office and do not significantly impact the government’s budget; however, providers primary goal is to assist patients with high-quality services” (Lui, 2015). These services place a weight on the budget for the government because services as such require additional tools and training resources.

The lack of access to resources, such as insufficient hospital budgets, has led to divergent approaches by providers to assist patients and conduct research because most providers “refuse to take short cuts and will find other ways to fund their work to produce reliable data” (Dr. Tak Hong Lee, 2016). This has slowed the progress in improving policies and projects to reduce air pollution and the effects on human health because “finding funding sources is challenging in Hong Kong” (Dr. Tak Hong Lee, 2016). That said, despite the slow progress, the perspectives of healthcare providers matter mainly because providers have no reason to misuse statistics to produce data that neglects individual variables. Also, healthcare providers, in contrast to environmental scientists and policymakers, have direct access to patient information that generates raw data. This information helps develop accurate data regarding the effects of air pollution, which can help influence policy, mitigate air pollution and health effects in Hong Kong.
For instance, Dr. Joseph Lee Kok-long, a healthcare provider in Hong Kong, used patient information to conduct an independent morbidity analysis using a unified analytic method to examine the association of particulate matter with the hospitalization of patients 65 years old or older (Long, 2016). The results were consistent with an approximate 1% increase in admissions for cardiovascular disease and an estimated 2% increase in admissions for pneumonia and chronic obstructive pulmonary disease for each increase in particulate matter (Long, 2016). Also, a greater estimate of the effect on hospitalizations at lower concentrations was found for three diagnoses considered. The study found that 10mg of particulate matter will cause two years of life expectancy lost (Long, 2016). In locations like Los Angeles, Hong Kong, and Chicago, there are 45mg to 50mg of such matter (Long, 2016). Theoretically, this means 5 to 10 years of life lost. Dr. Kok-Long’s research resulted in health policy and new medical practices developed to address morbidity in the country.

In essence, this data would be nearly impossible to obtain without direct access to patient information. Although there is substantial literature that reviews the impacts of air pollution, most information regarding the topic does not provide sufficient details that explain the full effects of air pollution on human health and the healthcare industry. Thus, there are several reasons why involving healthcare providers in the research can help achieve high-value service for patients and successful projects that could resolve the problems resulting from air pollution.
2.4 Relevance of a Hong Kong Case Study

Initially, this research outlined the importance of new environmental projects, such as Tree Biotechnology, that could reduce the effects of air pollution in impoverished communities. However, most of the sources and cited information were from scientists and government reports that were developed using information from experts contracted by the Hong Kong government. Interestingly, these reports exclude information produced by healthcare providers, even though there is a plethora of published research conducted by practicing medical providers who, unlike scientists and government agents, have on-going conversations with human subjects about individual reactions to pollutants instead of a smaller sample population. Therefore, my research question changed to: why not seek other data sources relating to air pollution from Hong Kong?

According to most of the data retrieved, healthcare providers argue that Hong Kong will soon face the challenge of addressing mortality if air pollution increases (Long, 2016). This is surprising because previous studies demonstrate that urban projects developed in Hong Kong in the past decade have had positive effects on human health and countering air pollution. However, cases of sudden death reports continue to increase (Long, 2016). Healthcare associations, mostly made up of practicing medical professionals and educators, reported that air pollution caused more then 151,300 people to be hospitalized and 3,000 premature deaths, which is associated with a monetary loss of HK$39 billion in 2013 (Ying-kit, 2013). Therefore, it is critical that scientists and policymakers take a different approach to resolve the problem. Hong Kong scientists and government agents often obtain non-normal data and transform that data to make it easier to analyze the concentrations of particulate matter, nitrogen oxides, and sulfur oxide that are the causes of such high mortality rates; yet, they cannot seem to find solutions to reduce the
mortality rate in Hong Kong (Long, 2016). This gap in information, methods used to obtain the data and new urban projects is why Hong Kong is an interesting case study.
Methodology

My research question asks: what are the perspectives of healthcare providers and the challenges they face addressing issues relating to air pollution? To answer my research question, I focused on collecting qualitative data by conducting in-depth interviews with healthcare professionals and representatives from environmental, health research and advocacy organizations to understand the challenges they face and methods used to address air quality issues. Also, in-depth interviews were selected as they can provide reliable and comparable data and allow for control over the questions/topics to be covered in the discussion while leaving the interviewee the opportunity to tell their account of issues related to the selected topics.

My research began by working with Professor Jimmy Fung from the Hong Kong University of Science and Technology to collect data for my literature review to better understand the communication between providers and scientists and challenges that they experienced in the past in their attempts to address air pollution. The main problem I noticed was the lack of inclusion of health care providers in government air quality reports and lack of data relating to health effects in most of the policy. This inspired me to contact seven health care providers and conduct interviews with them to discuss inclusion, advocacy, research and relationship with policymakers. However, due to time constraints, I selected four out of the seven providers to conduct a full interview based on their expertise, time and recent work in their field. Two of the four providers worked in public hospitals; whereas, the other providers serviced private hospitals. The four interviews were conducted in-person for one hour per meeting with Dr. Tak Hong Lee, leading Pulmonologist/Respirologist and Immunologist at Hong Kong Sanatorium & Hospital, Dr. Fanny Ko, Respirologists at Prince of Wales Hospital and Chinese
University, Dr. Alfred Tam, Pulmonologist at Children at 818 and Dr. TW Wong at Shenzhen Port Hospital.

In addition to meeting with four leading healthcare providers in Hong Kong, I interviewed and worked with the Clean Air Network, one of Hong Kong’s most well-known environmental organizations, and Civic Exchange. Simon Ng, Chief Research Officer for Civic Exchange, helped me to develop a complete understanding of the issues surrounding air quality and human health.
Research and Discussions

4.1 Present findings: What the health care professionals say

Four in-depth interviews were conducted with health providers from two public hospitals and two private hospitals. I explored how the providers regard current policies and how policymakers and scientists are perceived by healthcare providers and the main effects of this on the perceptions of their role as providers. I then looked at the challenges faced by providers when offering care to patients. Several key themes emerged in the interviews:

Health care providers’ view and perspective concerning their inclusion in the health care policy and budget process.

Three out of the four respondents reported that the policy and budget process is not inclusive of health care providers and does not include data from practicing medical professionals. The three argued that most of the data collected in research projects conflict with issues they experience in their line of work; however, one provider disputed the claim that the policy and budget process is not inclusive. I was not surprised by this provider’s response because his work includes, but is not limited to, private practice and working with contracted companies who collect data on behalf of the Hong Kong government.

This health care industry is not known for its effort and research in prevention and I think we should be more involved. Many scientists are working hard on the problem and they are producing interesting results. However, we need the government to involve more clinicians to make a better impact on government. (Dr. Alfred Tam, Leading Pulmonologist at Children at 818)

Health care providers’ desire to advocate

The four respondents unanimously agreed that there is a desire to advocate in their field;

There is of course a desire to advocate. However, the present political climate is not facilitative to that goal. (Dr. Fanny Ko at Respirologists at Prince of Wales Hospital and Chinese University)
Most providers working in the Allergy field are involved in advocacy work. However, I do not feel that the same can be said about other medical fields. The issues regarding air pollution and the effects on respiratory health has become more important to providers in my field; however, we tend to do most of the work alone because there is not a strong relationship with policymakers and most scientists. (Dr. TW Wong at Shenzhen Port Hospital)

They noted, however, it is difficult to do advocacy work due to the lack of communication between policymakers and academics. While most providers share responsibilities with academic scholars and environmental scientists in Hong Kong, they tend to disagree with those who are not actively practicing medicine. Thus, there are myriad opinions on the “best” ways to advocate and discourage most healthcare providers’ desire to participate in advocacy work, especially with other professionals. Their lack of desire to participate in advocacy work is highlighted in environmental organization reports. According to HKEPD reports, less than 15% of practicing healthcare providers participate in advocacy work involving government related issues.

Providers’ review on the healthcare industry engaging in new air pollution projects

Generally, it is difficult for us healthcare providers to engage in or review new air pollution projects because most new projects do not include the data we collect from our practice. (Dr. Alfred Tam, Leading Pulmonologist at Children at 818)

Two out of four of the respondents positively reviewed the healthcare industries new developments but recognized the need for government resources and conversations to engage in the project reviews. Dr. Alfred Tam specifically addressed the challenges for healthcare providers to engage in new projects. Out of the four respondents, Dr. Tam seemed to argue that the reviews for new projects do not request for health data.

There are new projects in the works to address the concerns related to air pollution. However, the process could be more efficient and effective if there were more conversations happening between the government and providers. It is would be helpful if
the government funded more proposals. (Dr. Tak Hong Lee, leading Pulmonologist/Respirologist and Immunologist at Hong Kong Sanatorium & Hospital)

Of the two who provided positive reviews, one respondent was selected to work on the project and the other provided data to initiate a new development. However, the other two were not asked to participate, which impacted their review on new projects. An issue that all respondents agreed on was methods that could improve the project development process such as creating a group that includes practicing healthcare providers, academic professionals, and policymakers.

**Challenges of providers becoming more involved**

The four respondents agree that "becoming more involved" is desired; however, a challenge for most providers is finding the time to engage in conversations, develop new projects, and educate patients.

*Generally speaking, providers are not as interested in becoming more involved because of our work load and disinterest to engage in a debate with policymakers. (Dr. Fanny Ko at Respirologists at Prince of Wales Hospital and Chinese University)*

*The challenge for many healthcare providers is finding ways to work with policymakers to link health issues caused by air pollution to industries and hold them accountable for negative health effects of workers and residents who live near pollution producing industries. (Dr. Tak Hong Lee, leading Pulmonologist/Respirologist and Immunologist at Hong Kong Sanatorium & Hospital)*

**4.2 Discussion of findings:**

Through my research in Hong Kong, I discovered that most medical professional are uncomfortable with speaking about the social environment involving policymakers and professionals from other fields such as environmental scientists. This became evident to me after I made multiple attempts to schedule interviews with providers who asked me to briefly review my objectives and questions that I planned to ask. Most providers explicitly expressed that they
were not comfortable with speaking about their relationships with contracted scientists and the Hong Kong government. On the other hand, other medical providers hesitated before accepting my interview request. This inspired me to shift my main objective from inquiring about urban projects and health affects to focus on the initial hesitation. Most of the providers, formally and informally interviewed, spoke negatively about the policies addressing air pollution and the government attempts to mitigate the health effects caused by air pollution; however, they would not allow me to record their concerns or grievances. Nevertheless, there was a general consensus that the current methods that are being used to reduce air pollution and human health effects are insufficient.

These tensions seem to be the result of poor communication and the exclusion of healthcare providers from formal conversations. Although the providers I interviewed have a desire to develop new projects to address the health effects of air pollution, they face opposition when any attempt to participate in conversations around policy occurs. There is general consensus among the health care providers I spoke with that there is a disconnect between the Hong Kong government in regards to conversations about policies and budgets that affect the healthcare industry. One would assume that policymakers would solicit advice and research information from practicing healthcare providers; however, the Hong Kong government mainly collects data from academic sources and government-contracted organizations. While providers do not contest the validity of academic research, the consensus is that academic research with an absence of raw medical data obtained from patients is insufficient. Providers have access to raw data because of their interactions with patients, which they appear to argue is the missing link in majority of the work published by the government.
In addition to poor communication, most new ideas and policies are not successfully introduced to the public because providers usually lack sufficient knowledge about them. According to Dr. Lee, “it is difficult to educate patients about new ideas and policies when these things have not been fully explained to providers.” Thus, the lack of communication between providers and policymakers has, and still does, impact the community. In 2014, healthcare providers worked together to increase public awareness about the Air Quality Index. According to the HKEPD and WHO (World Health Organization) reports, 87% of healthcare providers interacted with patients who were unaware of the existence of air quality tools (WHO, 2015). In comparison to the reports, when asked, all respondents agreed that few to none of their patients are knowledgeable about air quality tools such as the Air Quality Index and Air Pollution Maps. That said, the lack of patient knowledge emphasis the fact that health care providers are critical sources of information for the public about the impacts of air pollution on health.
4.3 Current and Future Projects

Hong Kong, much like other countries around the globe, is taking an active approach to address air pollution and the related health effects. However, although the government is taking steps, as previously stated, health professionals are left out of the discussions - preventing important patient information from influencing policy and important information about air pollution from getting to the patients.

After interviewing multiple healthcare providers, it is apparent that they have many ideas that can, and has, positively impacted public and environmental health. For instance, one of the many projects healthcare providers and scientists worked together to developed is the Air Quality Index. Prior to 2013, the country mostly relied on the Air Pollution Index. According to the HKEPD, the previous index, the Air Pollution Index, categorized air quality into different levels according to the values of the Air Quality Objectives (HKEPD, 2013). However, many providers challenged the tool by claiming that it was ineffective due to their inability to translate the index’s variables to patients and agreed with scientists about other issues relating to the tool. Also, most healthcare providers expressed that the API did not provide reliable and sufficient data to address air pollution. As a result, the Hong Kong Environmental Protection Department composed a team of healthcare providers and environmental science experts from the Chinese University of Hong Kong and the Hong Kong University of Science and Technology to conduct a review of the API system. The experts concluded that the API did not clearly communicate the health risk to the public from the data collected. Thus, in 2013, the team adopted the Air Quality Health Index which is “a health risk-based reporting system based on the relationship between local air pollution and hospital admissions, providing an index that is a more useful health reference” (HKEPD). This system provides a better way to communicate health risk, improve the
protection of public health and serves as a good example of the positive results that occur when health care providers work with government agents, policymakers, and academic professionals.

In addition to adopting the Air Quality Health Index, the University of Hong Kong School Of Public Health collaborated with healthcare providers to develop a new project that focuses on publicizing information related to air pollution in the country. This newly developed index is referred to as the Hedley Environmental Index (HEI). The HEI is a tool that monitors and publishes real-time data about Hong Kong’s air pollution and its public health impacts. The data is sourced from physical tools used to test the air for specific pollutants such as PM, NO2, SO2, and O3. Healthcare providers and environmental scientists mostly interpret this information. Figure 2 indicates “Very Dangerous” levels, meaning that an individual’s health risk increases when they are outdoors in Hong Kong.

*Figure 2: Hedley Environmental Index*

*Source: University of Hong Kong Hedley Environmental Index*
According to the HEI, it has been over eleven months since Hong Kong experienced a clear day (WHO, 2015). Moreover, the index reflects the constant change in mortality and hospital admission rates. This increase in public health and healthcare industry impacts is evident in the figures below.

*Figure 3: Hedley Environmental Index via Web (live feed 1)*

Figure 4: Hedley Environmental Index (live feed 2)


Figure 5: Hedley Environmental Index (live feed 3)
Figure 6: Hedley Environmental Index (live feed 4)

Figure 7: Hedley Environmental Index (live feed 5)
Figure 8 uses information obtained from the index to provide live updates regarding the number of deaths, hospital bed-days, doctor visits and economic loss impacted by air pollution. This information is updated daily from midnight to 5am and includes data regarding the loss of tangible cost and healthy life value (HKD) (University of Hong Kong, 2016). The decline in tangible cost include direct healthcare cost and value of loss of productivity due to work absence caused by sickness or early death, while the decline of healthy life value is attributable to pain and suffering from illnesses related to air pollution. According to three of the four providers interviewed for this research, tangible cost and decline in work productivity are the main concerns that patients communicate. However, prior to this resource, most providers struggled to address these concerns.

In addition to Figure 3, Figures 4 through 8 serve as visual references to the levels of air pollutants compared to the World Health Organization levels. Healthcare providers in Hong
Kong report that these data graphs are successful in educating the public and produces more reliable information compared to past tools such as the Air Pollution Index (WHO, 2015). Dr. Tak Hong Lee asserts, “There is a notable increase in public awareness regarding the Hedley Environmental Index and website, compared to the Air Pollution Index.” The increase in public awareness could be explained by the accessibility of the modern air quality-measuring tool. For instance, individuals can simply search for a location while holding constant the pollutant (i.e. PM, NO2, SO2, O3) and use the key provided in the graph to identify the risk level in the selected area. This tool has made it easier for providers to educate patients and communicate why they are experiencing symptoms related to air pollution (WHO, 2015). This project is the result of scientists involving healthcare providers. Thus, if policymakers and scientists included more healthcare providers in new developments, then one could assume from recent results that the number of new projects to successfully counter air pollution and human health effects will increase.

**Connections**

Air pollution and human health are two of the most important environmental and public health issues globally. Thus, there are common arguments and challenges experienced by healthcare providers in other locations. In comparison to the Hong Kong healthcare providers in the United States seem to share similar grievances and concerns regarding their participation in new developments and policies that address air pollution. While medical providers in the United States tend to play multiple roles, which include educating post-secondary students, they seem to lack a strong voice in policymaking. This is evident in the numerous failed attempts to hold cosmetic, fuel, and other major pollution producing industries accountable. In 2014, medical provider Dr. Jody Krukowski with The University of Kansas Hospital argued that cosmetics in
the United States have more than a thousand ingredients banned in other countries, such as Sodium lauryl, Toluene, Parabens, Phthalates, and Triclosan (Ferrell, 2014). However, similar to healthcare providers in Hong Kong, Dr. Krukowski’s research and concerns did not result in policy changes nor did her research initiate new projects to improve cosmetic products to reduce adverse impacts on human health. The United States government did not hold the cosmetic industry accountable, despite the negative impact on human health and air quality due to the excessive amounts of pollutants released from the products after disposal. On the other hand, unlike providers in Hong Kong, there seems to be more organizing around issues that medical professionals face in the United States and advocacy groups with individuals who have access to others with decision-making powers. Nevertheless, providers in Hong Kong and the United States are working hard to develop a highly efficient healthcare system and achieve important health outcomes for the public.

**Conclusion**

In essence, despite advances in Hong Kong’s air quality policymaking, healthcare professionals need to be more engaged in discussions to be able to provide data about how air pollution impacts human health; and provide information about air quality and prevention measures to patients who suffer from pollution related illnesses. The data obtained from medical providers are raw and comes directly from patients. Thus, by collecting the perspectives of healthcare providers and information regarding the challenges they face as illnesses related to air pollution increase, the complex relationship between air pollution and human health becomes easier to understand and develop policy solutions.
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APPENDIX A

Interview Questions:

Front-End Questions:
1. How long have you conducted research/work in this field?
2. Does your research focus on health issues related to air pollution? If so, how did you come to do research in this field?
3. Are there abundant opportunities to incorporate environmental health into a physician’s training and practice in Hong Kong with your patients?

Industry Questions:
1. Do you see any changes in the field as a result of the increase in air pollution and projects developed by environmental scientists and policymakers?
2. Do you feel that the healthcare policy and budget process is inclusive of healthcare providers? Why or why not? Is your desire to advocate affected by relations with environmental scientist and policymakers?
3. How do you see healthcare providers in Hong Kong engaging in new air pollution projects?
4. In your opinion, what are the challenges that may impact a healthcare provider's decision to become more involved in developing projects relating to air pollution and participating in conversations with policymakers to create stronger policies that hold industries accountable?

**Policy Questions:**

1. On a scale from 1 to 10, how would you grade the current policies addressing air pollution in Hong Kong?

   -Do you think that regulations are sufficient? If not, how can they be strengthened?

2. Do you think that your research has been able to influence industry regulations?

3. Do you think tools like the Air Quality Health Index reflect what you see with your patients and what you see in your field? Could it be improved? Are there other tools that may be useful?

4. Are your patients or their legal guardians aware of the Air Quality Health Index? If so, do you believe that there is a greater awareness for the Air Quality Health Index compared to the Air Pollution Index? Explain.

5. Does the Hong Kong government request and use data from healthcare providers? If so, on a scale from 1 to 10, how satisfied are you with their use of the data?

**Engagement Questions:**

1. Have the roles of doctors and healthcare professionals shifted over time? How?

2. How are you or other providers in your field connected with researchers and government officials who study air pollution? Are there conversations happening?