GOODROBOT

Internet of Things

# Air Q

*Air Quality Measurement*
*For Safer Indoor Environments*
*During a Pandemic*

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# Summary

## *The Importance of Air Quality in a Pandemic*

*During a pandemic, providing a safe and comfortable place to work, shop, and socialize is of paramount importance. That means both actual risk reduction (of COVID-19 infections), as well as highly visible messaging that communicates the safety of these spaces. The result is a win for businesses, employees, and consumers - and something that benefits the Canadian economy as a whole.*

*The challenge of course is that the risk of COVID-19 is often invisible, as are many of the important practices required to counter it. So while some risk mitigation efforts are visible (e.g. mask usage, physical distancing, and cleaning practices), others, like managing air quality are not. And because COVID-19 is a respiratory illness, managing airborne transmission is one of the most effective ways to prevent spread. Yet air quality (and COVID-19 risk) varies dramatically among indoor locations (see Fig 1), and the relative risk (or safety) of indoor air is largely invisible, and poorly understood. Better management of indoor air quality is an essential (and easy) way to minimize risk.*

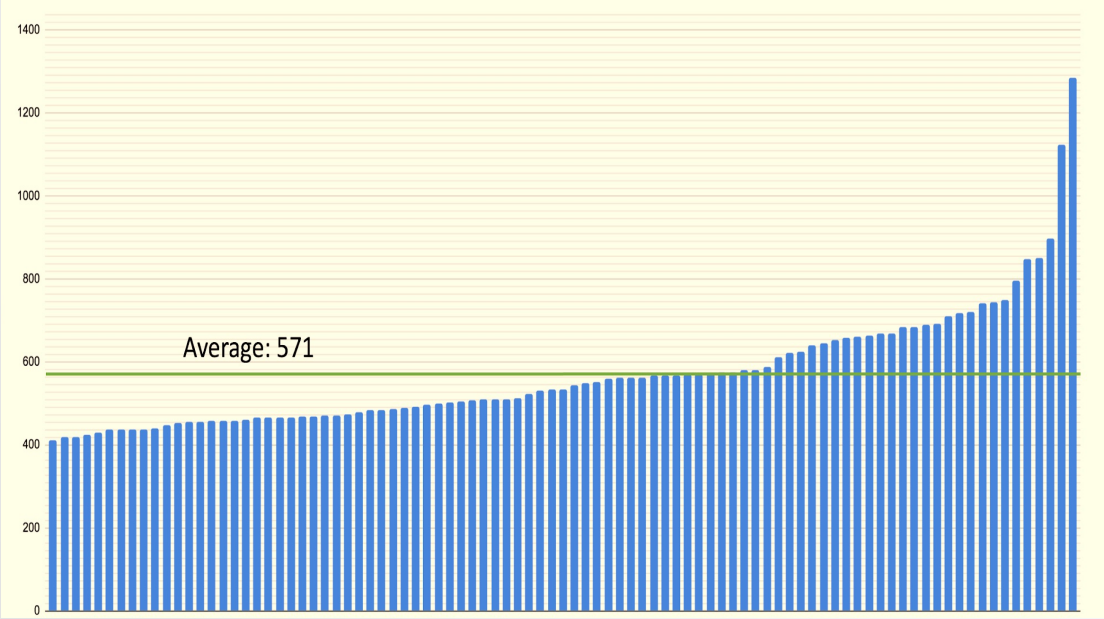


*Figure 1. Distribution of Air Quality Samples at Toronto Indoor Business Locations (2020)*

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# AirQ

## *The Science Behind Air Quality Measurement*

*Humans can shed viral particles that represent an infection risk to those around them. So measuring the concentration of exhaled air lingering within an enclosed space is therefore an excellent way to estimate the safety of air within a room. Even a single person within an enclosed room with limited ventilation produces exhaled air that can easily be detected, and the amount of exhaled air within that space often rises significantly over time. So measuring these exhalations is a useful tool to measure air quality within a given a space - air that others are breathing in.*

*Because the technology to measure actual viruses present within indoor air is prohibitively expensive, exhaled air is a more practical proxy that has been used in a variety of studies (e.g. Rudnick and Milton at Harvard) to measure infection risks. So, measuring and tracking lingering exhaled air is a cost effective strategy to help measure and manage infection risks indoors. The fresher the air provided to a space, the smaller the readings of exhaled air will be. By combining the science and research related to the quantity of viral particles that produces an infection (as well as amounts exhaled by potential carriers) you arrive at a better understanding of the level of risk present within any given indoor space.*

*However, some spaces may have higher than average levels of exhaled air, but nevertheless be safe if the air in that space is being treated or filtered. So, for locations that are filtering air, another useful measure is the degree to which these spaces are filtering small airborne particles. There are always tiny particles floating in the air (even on a clear day outdoors), so it's possible to use these ambient particles as a baseline measure of how well an air filter is performing. This is also an excellent way to demonstrate and measure the effectiveness of filtration systems directly, noting differences between air intake and air output. So a combination of measuring indoor exhaled air and small particle counts is a useful strategy to help measure the infection risks of indoor spaces. Good Robot uses a variety of sensors to capture and log both these factors continuously. AirQ, our custom all-in-one sensing units not only monitor and log the concentrations of exhaled air within a space, but they measure and count airborne particles as small as .3 µm. Particles 5 µm or smaller may stay airborne for many minutes or even hours (source), and quality filtration systems can measurably reduce these small airborne particles, reducing COVID-19 risk.*

*Last, other factors such as humidity have also proven to impact infection control measures, so our sensing units log and monitor humidity and other measures to aid the management of key emerging safety factors also. The outputs on each sensing unit can also trigger other devices automatically too (e.g. fans or annunciators).*

*Figure 2. AirQ, air quality sensors by Good Robot (far left and far right) and third parties (middle)*

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## *Mitigation: Improving Air Quality is Easy*

*Businesses that are contending with the impact of the pandemic already have a lot on their plate. That's why it's critically important to address infection control measures that have a large impact but a relatively low cost burden. Managing air quality is one of the most economic measures possible, having a large impact on risk reduction, while invoking very little cost or effort. Measuring air quality and collecting data is an essential step for guiding your own risk mitigation strategy (something Good Robot is happy to assist with if required). But for most businesses there are many simple and low cost mitigation efforts that are extremely easy to implement on your own including*

- *Patios and outdoor spaces: Leveraging outdoor space is amongst the best solutions (especially during summer months). Outdoor air rapidly dilutes exhaled breath, even when very little wind is present. Our outdoor measurements confirm this, often detecting very little exhaled air, even when someone is as close as 1 meter.*
- *Windows and doorways: Even a single open window with a fan in it can have a dramatic impact on the amount of exhaled air lingering within a space. In many cases a single fan can decrease lingering exhaled air by more than 50%.*
- *Existing vents and fans: many bathrooms or kitchens have fans in place already that can evacuate indoor air. Open doors or windows allow these systems to help draw in fresh air from outside, .*
- *Air Filters (especially HEPA): As fall and winter approaches, air filters will become increasingly important. Particle counters confirm that a filter can produce an order of magnitude reduction in small airborne particles. So the addition of these filter(s) within a space can help remove airborne risks of infection. In addition, some filters come with built-in UV-C disinfection which can also kill viruses directly. While many good filters are available for $100-$250, it's possible to DIY a high quality filter in minutes for less than $50 in cases where finances are tight (see Fig 3).*
- *Wearing masks (of course): studies confirm that even homemade masks can filter a significant portion of small particles. Our own work with particle detectors confirms this, suggesting that most masks will filter between 20% and 80% of small particles depending on the mask*
- *Reducing occupancy: Many businesses are already taking steps to reduce occupancy or increase spacing amongst people in indoor spaces. AirQ, air quality measurement provides data to help guide these decisions.*


*Figure 3. Effective Do-It-Yourself filters can be built in minutes at a minimal cost (source)*

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