Indoor Environmental Quality – a Data-Driven Approach to Mitigate COVID Exposure in Indoor Spaces
(Technical Topic)

How Expert Communication Strategies Serve to Mitigate the COVID-19 Infodemic
(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

The COVID-19 pandemic has brought attention to potential venues for virus transmission in indoor environments. To alleviate this concern and mitigate the potential dangers of viral spread, studies have been conducted on indoor air quality factors and how they might contribute or alleviate the potential for viral spread. In working with air quality sensors that have been used in the Living Link Lab, the goal of our team's capstone project is to leverage Indoor Air Quality and Indoor Environmental Quality data to mitigate the spread of COVID-19 in indoor spaces, specifically with respect to departments within the UVA Hospital. Through analyzing trends on indoor air and environmental quality (IAQ and IEQ) data collected in these low-cost Awair sensors, installing new sensors within the UVA hospital emergency department, and establishing stake holder input in interviews with UVA and external hospital staff, our goal is to create a user interface to assist hospital staff in COVID-19 mitigation efforts within their hospital wing.

Through preliminary research to understand the factors behind the spread of COVID-19, our capstone advisor directed our team towards several twitter accounts of experts in the field of IAQ and IEQ, individuals vying to spread correct information via twitter concerning the airborne spread of the virus. In following and investigating these accounts, it was fascinating observing the ways in which these experts communicated complex research and findings through brief tweets or twitter threads. Even in the midst of widespread misinformation across social media and other commonly frequented platforms, these authors still prioritize conveying their findings to serve public health. By examining the role of public health experts' communication strategies over twitter in conveying scientific findings, relevant public health information, and garnering overall support amidst the COVID 19 Infodemic, the goal of this STS research project is to investigate how social media increases the accessibility of critical information through bridging the knowledge barrier between scientists and citizens

Technical Topic

Our capstone project consists of four key objectives: research, interviews, data collection and analysis, and UI design.

The research component of this project entails a review of existing literature on COVID-19. This literature review was conducted to establish an understanding of current mitigation strategies in place in indoor and hospital environments how the virus is spread and transmitted, and how different environmental quality factors contribute to the spread. Through this literature review, we've investigated how environmental conditions can alter the transmission rates and survivability of COVID-19 in indoor spaces. Virus half-life (Morris et. al, 2020), rates of airborne spread (Wang, 2020), and other variables relevant to the spread of COVID-19 change with respect to temperature, humidity, and other indoor environmental factors. Maximized levels of these factors could create ideal conditions to minimize the risk of virus transmission. Research has also been conducted into air quality impact on human behavior related to CO2 concentration (Satish et. Al, 2012), workplace productivity, and many others. Additionally, we've investigated different mitigation methods in hospital systems around the country to better understand how our project fits into existing COVID-19 mitigation strategies. Methodologies such as mechanical ventilation and filtration have been shown to dilute indoor air pollutants by introducing clean outdoor air (Lueng, 2006), while other more advanced approaches such as Ultraviolet Germicidal Irradiation (UVGI) serve to reduce exposure through inactivating airborne droplet nuclei (Reed, 2010). Ultimately, these other mitigation strategies can serve both as inspiration and possible venues for how the sensors we deploy can be utilized in a hospital setting.

The interview component of this capstone consists of establishing stakeholder input through interviews with individuals working in hospital settings and in the UVA hospital itself. Through utilizing well refined strategies (Constable, 2014) in interviewing these professionals, the team hopes to establish the functional requirements, information needs, and internal objectives for

different positions in the hospital that may benefit from the created UI display. Additionally, by establishing an understanding of different workflows within the hospital, we aim to pinpoint where this interface can be implemented without contributing to the information overload already experienced in the clinical setting. Finally, in conducting these interviews with hospital personnel, we are constantly iterating and refining our overall objectives to determine where these air quality sensors may best benefit the hospital as a whole.

The data analytics portion of this capstone project consists of analysis done on data collected both from Awair sensors installed in the living link lab and sensors installed in our own rooms in Charlottesville. In investigating trends in the variables collected from the Awair sensors (Temperature, Humidity, CO2, TVOCs, PM2.5, Light, and Noise), the team hopes to establish patterns in the data as well as potential indicators of how behaviors and actions impact these air quality metrics.

The final objective of this project is to implement a user interface in the hospital setting to display the collected data in a digestible, readable, and easily-interpretable format. Basing our designs off of strategies in existing health care displays and the current EPIC platform used by the UVA system, our team hopes to design an interface easily integrable into the existing systems.

This project is conducted in under the direction of and in collaboration with faculty and graduate students in the UVA Living Link Lab, and plans to be implanted in collaboration with the UVA Hospital. In devising team roles, David Wang conducts and leads continued research throughout the project and maintains organized research notes, Jacob Rantas conducts data management and delegates different data analysis tasks to the rest of the group, Will Jarrard leads the design implementation and execution of the ultimate interface, and I have led the interview process through handling communication with our contacts, leading the creation of interview questions, and organizing the notes from the conversations.

STS Topic

The COVID-19 Infodemic

In the face of the COVID-19 global pandemic, access to accurate information is critical for promoting public safety practices, sharing critical resources, and sharing cutting edge research among scientific and community leaders. Although recognizing the importance of information distribution "understand the nature of the threat and to develop new medical countermeasures", laboratories often enter periods of overdrive in which the demand to perform immediate critical research overshadows the follow up of sharing and distributing this information in a meaningful way (Elbe, 2017). Conversely, the excess of unreliable and potentially inaccurate information has also become a concern. According to the Director-General of The World Health Organization, "We're not just fighting an epidemic; we're fighting an infodemic" or an overabundance of information that makes it increasingly difficult to access trustworthy, accurate data and knowledge in the midst of uncertainty (Tangcharoensathien et al, 2020). In the face of an infodemic, information is spread to the public at a rapid pace with little fact checking and gate keeping, muddying the waters of decision making in public health practices and individual actions on a daily basis.

Although the COVID-19 infodemic poses a problem for the way in which critical public health messages are shared with the greater population, the existence of these rapid information sharing platforms such as social media can serve as easy venues to communicate with the greater public opinion. Tangcharoensathien et al. note that these social media platforms "can help us gauge public sentiment towards different public health measures, analyze adherence to prevention approaches, develop effective public health campaigns, … and detect and combat misinformation" (Tangcharoensathien et al, 2020).

The Targets Audience of Scientific Communication

Scientific communication strategies evolve depending upon the target audience. In "tailoring messages to specific audiences" (Tangcharoensathien et al, 2020), field experts dictate different messages accordingly. Scientists often strategically choose their word choice depending on the group of individuals they are referring to. These groups can be defined as Peer-Groups (other scientists, predominantly in their respective fields but also in other neighboring fields), or Out-Groups (journalists, politicians, civilians, and others). While some studies suggest that scientists predominantly communicate with peer groups through the usage of twitter functionalities such as retweets, hashtags, and link sharing (Letierce, 2010), studies have also conveyed that communication with journalists, civil society, and political actors are equally as important and utilized through examining network of communications and connections over twitter (Walter et al, 2019). Finally, studies have shown that individuals with "higher profile profiles" have higher interaction rates with the greater public (Letierce, 2010), suggesting that their communication strategies may be tailored differently to address more citizens whereas other experts may tweet to predominantly address peers in the field. Ultimately, experts clearly span the scope of their targeted network to individuals working in their own professions as well as greater civic society.

Using Tone to Convey Essential Public Health Messages

Scientific experts carefully choose the tone and style in communication to different social groups. Scientists have been found to use more negative emotions when addressing out-groups such as politicians, journalists, and other public groups, while scientists are likely to use more neutral language in addressing peer networks and affiliations (Walter et al, 2019). This type of behavior may suggest that scientists need to use more expressive words and language to better capture the attention of civil groups, whereas they can communicate more clearly and directly

with other circles of established peers. In these finding, language used was compared to certain encoded dictionaries to encapsulate emotions conveyed in the communication strategies.

Sources of evidence will include but are not limited to twitter accounts of experts in the field of environmental air quality; Linsey Marr (@linseyMarr), Jose-Luis Jiminez (@jljcolorado), and Shelly Miller (@ShellyMBoulder). The language used in these authors tweets, the presentation of findings using graphics and colloquial language, and the sharing of tweets from their peers and other news media sources could all serve as empirical evidence in the scope of this problem.

With respect to studying the tone of these different authors, the types of emoji's, punctuation, word choice, and other components used to communicate could serve to group the type of communication used by these different actors. Additionally, the habits of these different authors in what accounts they reference, individuals they tweet at, out how many times they tweet within and outside of their group could demonstrate how these actors communicate. These actants, IAQ research professionals running these twitter accounts, convey information to other stakeholders, other PhD researchers, and the greater public as well.

Methods to locate more information could include the study of common or popularly used hashtags and interaction rates with hashtags, as well documenting all tweets over a relevant time frame (beginning of pandemic), noting key words used or words that appear multiple times in these communications, the lengths of twitter threads themselves, the frequency of posts in a certain time frame (day, week, month), and the prevalence of scholarly articles appearing in these postings. Other methods include mapping key words and phrases to certain expressive emotions, measuring tone usage to determine the emotions attached with these scientist's twitter behaviors. In moving forward, several questions to address include are there variations in communication strategies within this group of IAQ experts, are there specific key groups these stakeholders

address more frequent than others, and what knowledge is actually prioritized and transferred to the general public?

Next Steps

Expected Completion Time Period	*Technical Project Next Steps*	*STS Thesis Next Steps*
Nov – Jan, 2020	Continue interview process, finalize implementation goals and functional requirements, continue data analysis work	Narrowing in on twitter accounts to examine and characteristics through which these accounts will be examined
Jan – March, 2020	Finalize interview process, data analysis, and begin creating feasible interface	Gather evidence on these accounts and solidify methodology for analysis
March – April, 2020	Finalize data analysis, link interface and data collection tools, create feasible interface product	Analyze patterns, trends, and begin to formulate conclusions
April – May, 2020	Have implementable interface/product available and functional for review	Finalize STS research paper

References

Constable, G., Rimalovski, F., Fishburne, T., & Blank, S. G. (2014). Talking to humans: Success starts with understanding your customers. Place of publication not identified: Giff Constable.

Elbe, S., & Buckland-Merrett, G. (2017). Data, disease and diplomacy: GISAID's innovative contribution to global health. Global challenges (Hoboken, NJ), 1(1), 33–46. https://doi.org/10.1002/gch2.1018

Letierce, Julie & Passant, Alexandre & Decker, Stefan & Breslin, John. (2010). Understanding how Twitter is used to spread scientific messages.

Leung, M., & Chan, A. H. (2006). Control and management of hospital indoor air quality. Medical science monitor : international medical journal of experimental and clinical research, 12(3), SR17–SR23.

Morris, D. H., Yinda, K. C., Gamble, A., Rossine, F. W., Huang, Q., Bushmaker, T., . . . Lloyd-Smith, J. O. (2020). The effect of temperature and humidity on the stability of SARS-CoV-2 and other enveloped viruses. doi:10.1101/2020.10.16.341883

Reed N. G. (2010). The history of ultraviolet germicidal irradiation for air disinfection. Public health reports (Washington, D.C. : 1974), 125(1), 15–27. https://doi.org/10.1177/003335491012500105

Satish, U., Mendell, M. J., Shekhar, K., Hotchi, T., Sullivan, D., Streufert, S., & Fisk, W. J. (2012). Is CO2 an indoor pollutant? Direct effects of low-to-moderate CO2 concentrations on human decision-making performance. Environmental health perspectives, 120(12), 1671–1677. https://doi.org/10.1289/ehp.1104789

Tangcharoensathien, V., Calleja, N., Nguyen, T., Purnat, T., D'Agostino, M., Garcia-Saiso, S., . . . Briand, S. (2020). Framework for Managing the COVID-19 Infodemic: Methods and Results of an Online, Crowdsourced WHO Technical Consultation. Journal of Medical Internet Research, 22(6). doi:10.2196/19659

Walter, S., Lörcher, I., & Brüggemann, M. (2019). Scientific networks on Twitter: Analyzing scientists' interactions in the climate change debate. Public understanding of science (Bristol, England), 28(6), 696–712. https://doi.org/10.1177/0963662519844131

Wang, J., Tang, K., Feng, K., & Lv, W. (2020). High Temperature and High Humidity Reduce the Transmission of COVID-19. *SSRN Electronic Journal*. doi:10.2139/ssrn.3551767