Supplementary Table S1. Literature review summary.

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
General Literature Review				
1	Agarwal et al. (2021)	[14]	Indoor Air Quality Improvement In COVID-19 Pandemic: Review	A brief overview of parameters affecting IAQ during the COVID pandemic with emphasis on improvement techniques. An investigation of IAQ literature considering the COVID pandemic from multiple perspectives. An ontology chart breaks down the parameters influencing IAQ. Presents factors affecting both indoor air quality and improvement techniques. Improvement techniques include engineering controls such as ventilation (both mechanical and passive) and air cleaners. Reviews the latest literature on "non-pharmaceutical" measures such as social distancing, lockdown and facemasks. Offers recommendations for a sustainable future by advocating for the shift towards smart building design (to balance between healthy ventilation systems and sustainability—e.g., energy efficiency). The authors also recommend high-efficiency air purifying filters to improve indoor air quality.
2	Awada et al. (2020)	[7]	Ten Questions Concerning Occupant Health in Buildings During Normal Operations and Extreme Events, Including The COVID-19 Pandemic	Provides a multi-dimensional perspective on assessing and reviewing a building's spatial configuration to be both healthy and comfortable for occupants. Among the topics discussed: defining healthy buildings, codes and standards and, the degree by which they consider energy efficiency, the role of technology in improving building performance.
3	Lewis (2021)	[4]	Why Indoor Spaces are Still Prime COVID Hotspots	Presents the challenges of making the indoors safe, commenting on the WHO issuing guidance documents and ASHRAE standards. Improving ventilation strategies is essential for better indoor air quality both during and after the pandemic.
4	Hosseini et al. (2020)	[5]	COVID-19 Pandemic and Sick Building Syndrome	This paper's main argument is that symptoms of 'Sick Building Syndrome' are bound to increase during the pandemic. This is due to increased time spent indoors during the lockdown, increasing indoor air pollution. This is attributed to several activities, including cooking, smoking, and waste generation. Several brief recommendations were put forward, including regular household ventilation ensuring sufficient air exchange, cleaning surfaces, and using the kitchen hood for ventilation when cooking.

Supplementary Table S1. *Cont.*

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
COVID-19 Policy				
5	Afshari (2020)	[6]	Indoor Air Quality and Severity Of Covid-19: Where Communicable and Non-Communicable Preventive Measures Meet	Emphasizing the correlation between indoor air quality and a given population's health/immune system. Public communication—especially for the elderly—is necessary and should include aspects of indoor air quality management such as ventilation.
6	Scotford (2020)	[3]	Rethinking Clean Air: Air Quality Law And COVID-19	Offers justifications for why governments should shift their perception of air quality and pollution legislation. It addresses urban and indoor air quality, while recognizing lockdown measures as regulatory experiments. Calling upon governments to rethink the notion of 'Clean Air' and 'Air Quality Law'. Though the paper is addressed globally, it hints at background air quality policies in the U.K.
7	Nwanaji-Enwerem et al. (2020)	[50]	Another Invisible Enemy Indoors: COVID-19, Human Health, the Home, and United States Indoor Air Policy	The article comments on the role of indoor vs outdoor air quality regulations in the context of U.S. policy, commenting on the role of the EPA. Provides a set of simple preventative measures to improve indoor air quality at a household level.
8	OECD (2020b)	[1]	Regulatory Quality and COVID-19: Managing the Risks and Supporting the Recovery	The policy papers distinguish between legislative and non-legislative policies and regulations.
9	OECD (2020a)	[2]	Regulatory Quality and COVID-19: The Use of Regulatory Management Tools in a Time of Crisis	Recommendations for improving regulatory quality during the time of COVID.
Viral Transmission				
10	Azuma et al. (2020)	[22]	Environmental Factors Involved In SARS-CoV-2 Transmission: Effect and Role of Indoor Environmental Quality in the Strategy for COVID-19 Infection Control	The study presents a literature review summary on what was published related to environmental factors concerning COVID transmission within indoor air quality. The literature review examines environmental factors such as: temperature/ humidity, droplet transmission methods, and surface materials. Presents case studies with a focus on Japan's regulatory/preventative measures.
11	Lynch and Goring (2020)	[35]	Practical Steps to Improve Airflow in Long-Term Care Resident Rooms to Reduce COVID-19 Infection Risk	The two-page publication presents a practical technique to best adapt a room (the case study showed that of a nursing home) to improve air quality and airflow, thereby reducing viral transmission rates.

Supplementary Table S1. *Cont.*

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
Viral Transmission				
12	Wardhani and Susan (2021)	[13]	Adaptation of Indoor Health and Comfort Criteria to Mitigate Covid-19 Transmission in the Workplace	Reviews relevant literature on indoor health and comfort criteria that require revision to reduce infection rates of COVID within a confined space. The Greenship Interior Space rating system adopted in Indonesia is the criterion of focus, with a focus on indoor health and comfort. The recommendations for adjusting indoor health and comfort criteria include:“ introducing outside air, stopping air recirculation, reducing indoor user capacity, and reducing indoor biological and chemical pollutants.”
13	Noorimotlagh et al. (2021)	[36]	A Systematic Review of Possible Airborne Transmission of the Covid-19 Virus (Sars-Cov-2) in the Indoor Air Environment	The research paper provides a systematic review of literature discussing possible airborne transmission methods of the COVID-19 virus in the indoor environment. The authors provide recommendations to indoor air quality experts to improve the indoor environment: The provision of ventilation systems, especially displacement ventilation To attempt to redesign the space to increase the existing ventilation rate and efficiency. More stringent prevention and control policies (air quality and ventilation techniques) should be applied within hospital wards of COVID-19 patients to reduce infection rates. A recommended strategy is to isolate early-stage diagnosed patients who are most likely to contribute to airborne transmission. Promoting social distancing—as per the WHO recommendations—and avoiding over-crowding.
14	Dolgikh (2020)	[23]	COVID-19 Transmission: Environmental Approach to Effective Control in Closed Indoor Environments	The paper presents a hypothesis to decrease COVID transmission rates by controlling environmental factors. The hypothesized environmental factors that are directly linked to lower rates of viral transmission include: Air temperature above 30C Dry weather; low relative humidity Dynamic airflow pattern Limited by a lack of cited research supporting the hypothesis.

Supplementary Table S1. *Cont.*

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
Viral Transmission				
15	Anchordoqui and Chudnovsky (2020)	[33]	A Physicist View of COVID-19 Airborne Infection through Convective Airflow in Indoor Spaces	The research paper—written by physicists—simulates the droplet/COVID virus in aerosol form and tracks its motion within a room. The virus can stay suspended in the air for hours and spread beyond the recommended 6 ft of social distancing. Central air conditioning enables transmission of the virus to distant locations. The general recommendation is to further research HVAC (re)design considering the viral load and airflow dynamics.
Ventilation				
16	Ding et al. (2020)	[45]	HVAC Systems for Environmental Control to Minimize the COVID-19 Infection	The study presents the main standards / guidelines governing the design of HVAC systems and gives a brief overview of the HVAC preventative design measures. The article recommends using CFD modelling – integrating machine learning methods and A.I.- for more stringent and timely control of ventilation and airflow requirements within a given space.
17	Bhagat et al. (2020)	[34]	Effects of Ventilation on the Indoor Spread of COVID-19	Breaks down the many parameters influencing the transmission of the COVID virus within an indoor space. This includes ventilation types, airflow pattern types, people's behaviour or influence within a space, droplet size, and means of transmission. Discussion points are backed up by either mathematical models, visual simulation, or quantitative evidence. It does not provide recommendations as much as it examines the parameters to understand the means of viral transmission.
18	Tzoutzas et al. (2021)	[27]	Indoor Air Quality Evaluation Using Mechanical Ventilation and Portable Air Purifiers in an Academic Dentistry Clinic During the COVID-19 Pandemic in Greece	Studies the effect of air purifiers in parallel to mechanical ventilation within a dentistry clinic. It illustrates that mechanical ventilation plays a more significant role in diluting pollutants, whereby air purifiers improve indoor air quality by lowering PM 2.5 and TVOC.
19	Chen et al. (2021)	[17]	Recommendations for Ventilation of Indoor Spaces to Reduce COVID-19 Transmission	The purpose of the paper is to provide recommendations for the ventilation of indoor spaces to reduce transmission rates of the COVID-19 virus. Proposes a mathematical model to "determine the required ventilation rate of an indoor space based on the activity type", and further propose "methods to achieve adequate ventilation rates". Provides alternatives for when previous attempts are unachievable and adequate ventilation volume cannot be reached.

Supplementary Table S1. *Cont.*

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
Ventilation				
20	Lakhouit et al. (2021)	[24]	Study the Impact of Engineering Ventilation on Indoor Air Quality in Hospitals During COVID-19	The research paper presents the results after comparing two scenarios for air ventilation in a hospital ward, one is evaluated for optimal HVAC design results.
21	Mousavi et al. (2021)	[26]	The Effect of Door Opening on Air-Mixing in a Positively Pressurized Room: Implications for Operating Room Air Management During the COVID Outbreak	Presents a comprehensive analysis after systematically reviewing recent literature on air circulation and air filtration within hospital settings. The paper presents both short and long-term recommendations from reviewed literature to improve air circulation and filtration in hospitals.
22	Nembhard et al. (2020)	[29]	Ventilation Use in Nonmedical Settings during COVID-19: Cleaning Protocol, Maintenance, and Recommendations	Provides recommendations or more of a “cleaning protocol” for the maintenance of HVAC systems in nonmedical settings.
23	Sodiq et al. (2021)	[28]	Addressing COVID-19 Contagion through the HVAC Systems by Reviewing Indoor Airborne Nature of Infectious Microbes: Will an Innovative Air Recirculation Concept Provide a Practical Solution?	Presents literature findings on the air circulation and airflow dynamics of HVAC systems. Recommends using innovative solutions such as integrating “UGVI in combination with nano-porous air filter” to effectively reduce the spread of the COVID virus and other harmful microbes in indoor spaces.
Technology and Simulation				
24	Mumtaz et al. (2021)	[43]	Internet of Things (IoT) Based Indoor Air Quality Sensing and Predictive Analytic—A COVID-19 Perspective	Presents a proof-of-concept study devising an indoor air quality sensors-system that detects 8 types of indoor pollutants, together with metrological measurements. The system provides real time results that are projected on the web as well as a mobile application. The proposed solution is to “offer several advantages including remote monitoring, ease of scalability, real-time status of ambient conditions and portable hardware”.

Supplementary Table S1. *Cont.*

No.	Paper ID	Ref.	Study Title	Summary of Findings and Recommendations
Energy and Building Performance				
25	Bazant et al. (2021)	[40]	Monitoring Carbon Dioxide to Quantify the Risk of Indoor Airborne Transmission Of COVID-19	Proposes to adapt an existing standard into a new timeframe for mitigating indoor airborne viral transmission of COVID based on carbon dioxide monitoring. Mathematical model supplements the paper to enable the "prediction of airborne transmission risk from real-time CO_2 measurements". Examples are provided to showcase how the data can be presented within university classrooms and office spaces as per the guideline requirements.
26	Anastasi et al. (2021)	[41]	Optimized Energy and Air Quality Management of Shared Smart Buildings in the COVID-19 Scenario	Elaborates on the challenge of achieving energy efficiency and thermal comfort within "smart buildings". The analysis of results is based on case study(s) in the University of Pisa to aggregate environmental data.
27	Settimo and Avino (2021)	[37]	The Dichotomy Between Indoor Air Quality and Energy Efficiency in Light of The Onset of the COVID-19 Pandemic	Emphasizes the "dichotomy between indoor air quality and energy efficiency'' during the pandemic. Presents governments' high-level strategies and recommendations in attempting to resolve such an impactful challenge.
28	Aviv et al. (2021)	[44]	A Fresh (Air) Look at Ventilation for COVID-19: Estimating the Global Energy Savings Potential of Coupling Natural Ventilation with Novel Radiant Cooling Strategies	Attempts to solve the dilemma of maximizing HVAC ventilation within enclosed spaces and saving on energy. Presents an innovative HVAC design that attempts to decouple ventilation and thermal control. The results show that "increasing outdoor air in standard systems can double cooling costs, while increasing natural ventilation with radiant systems can halve costs".
29	Balocco and Leoncini (2020)	[39]	Energy Cost for Effective Ventilation and Air Quality for Healthy Buildings: Plant Proposals for a Historic Building School Reopening in The COVID-19 Era	Studies the ventilation design of a historical school building balancing energy savings and ventilation conditions to reach an optimized indoor air quality scenario that ensures the school's sustainability as a healthy building.
30	Alonso et al. (2021)	[38]	Effects of the COVID-19 Pandemic on Indoor Air Quality and Thermal Comfort of Primary Schools in Winter in a Mediterranean Climate	Studies the effect of international guidelines' recommendations to "over-ventilate" with a fresh outdoor air supply, especially in educational facilities. Emphasis on effects on thermal comfort and indoor air quality in winter for two classrooms in Southern Spain. The research shows that regarding the analysis of standards, 60% of operational hours cause thermal discomfort conditions.

Supplementary Table S2. Instigated consequences related to IAQ and COVID-19 reviewed literature.

Category	Consequence	Based on (Reference)	Expected Impact		Type of Consequence	
			Short-term	Long-term	Intended	Non-Intended
Spatial Design	Reducing viral transmission	[4,17,23,36]		√	√	
	The number of occupants decreased within a space	[7,17,41]		√		√
Occupant's Health and Thermal Comfort	Prioritizing the physiological health of occupants	[7,13,39]		√	√	
	Thermal comfort is becoming a secondary priority, second to eliminating or reducing viral transmission.	[22,38]	√			√
	Building certification systems might have a larger market in the future	[7,13]		√		√
Building Performance and Ventilation	Energy inefficiencies as a result of excessive reliance on HVAC systems	[37,39,41,44]	√			√
	Increase in carbon footprint of buildings	[37,39,41,44]	√			√
	Social distancing might not be an effective precautionary measure in indoor environments relying on mechanical ventilation.	[33]	√		√	
Technology Use and Energy Efficiency	Unintentional invasion of privacy due to dynamic monitoring aspects	[43]		√		√
	HVAC design innovations	[28,45]		√		√
Health and Social Equity	(In) Affordability of Solutions to decrease viral transmission (technology use and mechanical ventilation)	[1–3]		√		√