Scientific Research about:

(Improving Air Conditioning System at Wafa (Covid-19) Hospital in Halabja By Adding a Fresh Air System (Heat Recovery System))

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Abstract

This research addresses the need to enhance the air conditioning system at Wafa (Covid-19) Hospital in Halabja. The study employs a methodology to assess the current system, focusing on its impact on patient outcomes. Key findings reveal areas for improvement, and recommendations are provided to enhance the system's efficiency. The implications of these improvements on healthcare quality during pandemics are discussed.

Introduction:

A- Introduction to Wafa Covid-19 Hospital in Halabja:

Wafa Covid-19 Hospital in Halabja plays a critical role in providing healthcare services, particularly in the context of the ongoing global pandemic. Located in Halabja, the hospital serves as a vital healthcare facility dedicated to managing and treating Covid-19 cases. With a focus on ensuring the well-being of the community, the hospital's significance is underscored by its contribution to healthcare delivery during challenging times. This research aims to address a specific aspect of the hospital's infrastructure its air conditioning system to optimize its functionality and enhance overall patient care.

B- Importance of an Efficient Air Conditioning System in Healthcare, Particularly During a Pandemic:

An efficient air conditioning system is of paramount importance in healthcare settings, gaining heightened significance during a pandemic such as Covid-19. Several crucial factors underscore this importance:

1- Infection Control:

A well-maintained air conditioning system plays a vital role in controlling the spread of airborne infections. In a pandemic scenario, where contagion is a significant concern, ensuring clean and filtered air circulation helps mitigate the risk of disease transmission among patients and healthcare staff.

2- Patient Comfort and Recovery:

Comfortable environmental conditions are essential for patients undergoing treatment and recovery. Adequate temperature and humidity control contribute to a conducive healing environment, positively influencing patient outcomes and overall well-being.

3- Respiratory Support:

Many respiratory conditions, including those associated with Covid-19, require optimal air quality. An efficient air conditioning system helps maintain appropriate humidity levels and ensures the circulation of clean air, supporting patients with respiratory challenges.

4-Staff Well-being:

Healthcare professionals working tirelessly during a pandemic face increased stress and workload. An efficient air conditioning system contributes to a comfortable and safe working environment for staff, promoting their well-being and enabling them to provide optimal care.

5-Prevention of Secondary Infections:

In pandemics, patients are often immunocompromised or vulnerable, making them susceptible to secondary infections. A well-functioning air conditioning system aids in preventing the circulation of airborne pathogens, reducing the risk of additional complications for patients already battling infectious diseases.

In light of these factors, optimizing the air conditioning system in healthcare facilities becomes a strategic initiative, particularly during a pandemic, to ensure the safety, comfort, and effective treatment of both patients and healthcare professionals, Optimizing the air conditioning system is a strategic initiative to

ensure the safety, comfort, and effective treatment of individuals in healthcare facilities during pandemics.

C- Research Problem:

The air conditioning system at Wafa Covid-19 Hospital in Halabja faces challenges that may hinder its optimal functionality. This research seeks to identify specific issues within the current system and propose targeted improvements to enhance its efficiency. Addressing these concerns is crucial to creating a healthier and more comfortable environment for both patients and healthcare staff, particularly in the context of managing contagious diseases like Covid-19

Literature Review:

A- Literature Review on Healthcare Air Conditioning Systems:

Existing literature on healthcare air conditioning systems emphasizes the critical role of these systems in maintaining optimal indoor air quality and fostering a conducive environment for patient care. Key themes include:

1. Infection Control:

Studies consistently highlight the importance of air quality in controlling the spread of airborne infections within healthcare facilities. Proper ventilation and filtration systems are identified as essential components for minimizing the risk of nosocomial infections.

2. Patient Outcomes:

Research indicates a direct correlation between indoor air quality and patient outcomes. Adequate temperature and humidity control contribute to improved comfort, which, in turn, positively influences recovery rates and overall satisfaction among patients.

3. Respiratory Health:

The literature underscores the significance of air conditioning in supporting patients with respiratory conditions. Maintaining optimal humidity levels and controlling airborne contaminants are identified as critical factors for managing respiratory health within healthcare settings.

4. Energy Efficiency and Sustainability:

Recent studies focus on the integration of energy-efficient and sustainable practices in healthcare air conditioning systems. Balancing environmental considerations with system performance is becoming increasingly important in modern healthcare facility management.

5. Technological Advancements:

Literature reviews highlight emerging technologies, such as smart HVAC systems and air purification innovations, as potential enhancements to traditional air conditioning setups. These advancements aim to improve overall system efficiency and contribute to a safer and healthier indoor environment.

By synthesizing these findings, this research aims to contribute to the current body of knowledge by identifying specific areas for improvement in the air conditioning system at Wafa Covid-19 Hospital in Halabja and proposing targeted enhancements based on the latest insights from the literature.

B- Impact of Air Quality on Patient Outcomes:

Air quality significantly influences patient outcomes in healthcare settings. Key impacts include the prevention of infections, support for respiratory health, increased comfort and satisfaction, faster healing rates, and reduced complications. Recognizing this relationship underscores the importance of optimizing air conditioning systems in healthcare facilities. This research aims to enhance the air conditioning system at Wafa Covid-19 Hospital in Halabja to improve patient care and outcomes

Objectives or Hypotheses:

A- Research Objectives:

1- Evaluate the current state of the air conditioning system at Wafa Covid-19 Hospital in Halabja, focusing on its efficiency, ventilation, and air quality parameters.
2- Identify specific challenges or shortcomings within the existing air conditioning system that may impact patient well-being and healthcare staff performance.
3- Investigate the correlation between the hospital's air quality and patient outcomes, including recovery rates, infection rates, and overall satisfaction.
4- Propose targeted improvements to the air conditioning system based on identified challenges and the latest advancements in healthcare air quality standards.
5- Assess the feasibility and cost-effectiveness of implementing recommended enhancements to ensure practical and sustainable solutions.

B- Hypotheses:

1- Null Hypothesis (H0):

There is no significant relationship between the efficiency of the air conditioning system and patient outcomes at Wafa Covid-19 Hospital.

2- Alternative Hypothesis (H1):

Improved air quality and ventilation will positively correlate with enhanced patient outcomes, including faster recovery rates and decreased infection rates.

3- Null Hypothesis (H0):

The current air conditioning system does not contribute to healthcare staff performance and well-being.

4- Alternative Hypothesis (H1):

Optimal air quality and a comfortable working environment positively impact healthcare staff performance and overall job satisfaction.

5- Null Hypothesis (H0):

Implementing recommended enhancements to the air conditioning system is not cost-effective.

Alternative Hypothesis (H1): Implementing recommended enhancements to the air conditioning system is cost-effective and feasible in the long term.

Methodology:

A-Current Split Unit Air Conditioning System at Wafa Covid-19 Hospital:

The existing air conditioning system at Wafa Covid-19 Hospital utilizes a split unit configuration. This system is characterized by the following features:

Components:

The split unit system consists of two main components - an indoor unit installed within the hospital spaces and an outdoor unit typically placed outside the building. These units are connected by refrigerant lines.

Cooling Capacity:

The system is designed to provide efficient cooling to specific areas within the hospital, allowing for localized temperature control.

Air Distribution:

The indoor unit is responsible for distributing cooled air into the designated spaces, ensuring a comfortable environment for both patients and healthcare staff.

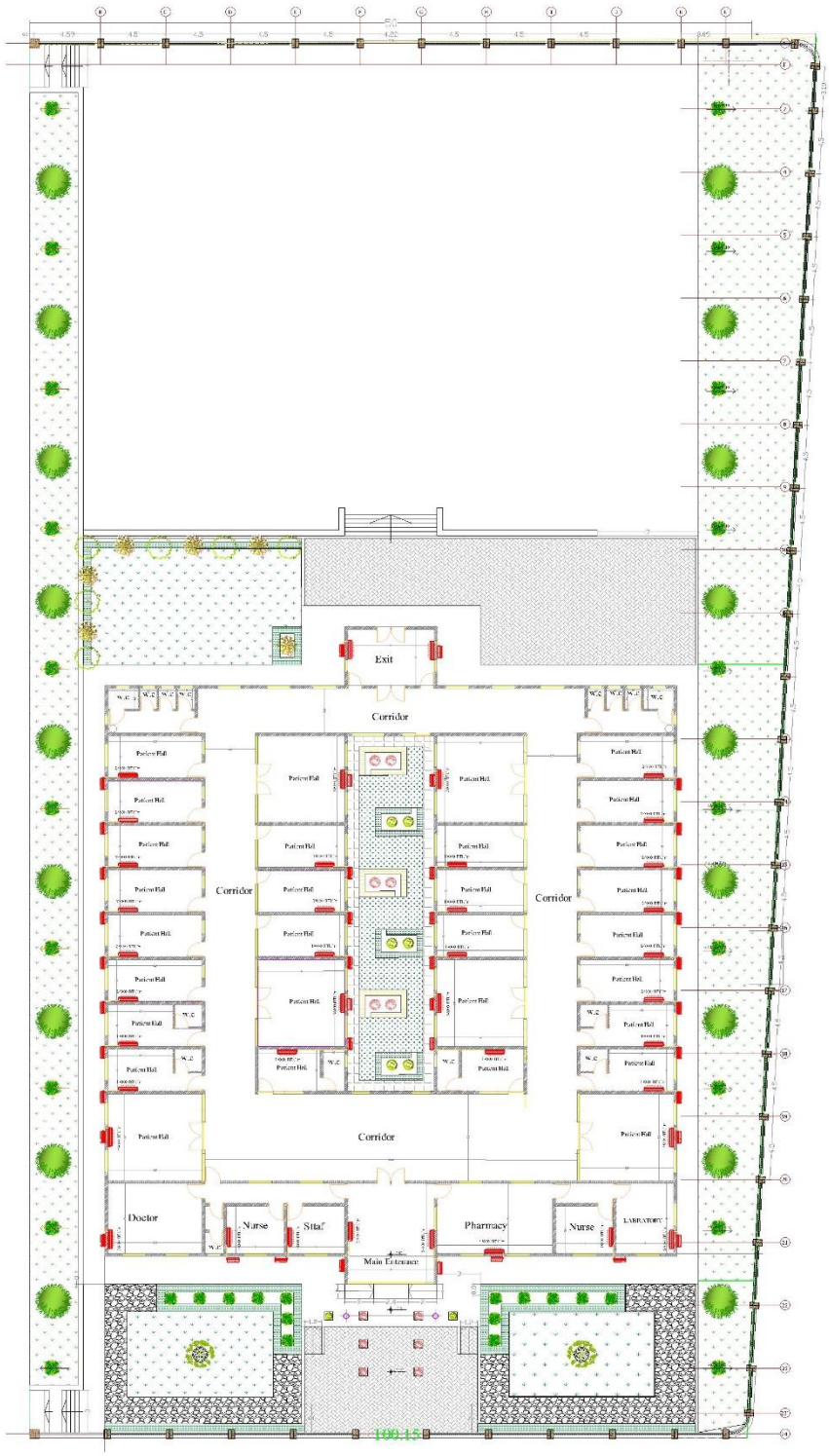
Ventilation:

While split units primarily focus on cooling, the ventilation aspects of the system are crucial for maintaining adequate air exchange within the hospital spaces. Proper ventilation helps mitigate airborne contaminants.

Maintenance:

Regular maintenance of the split unit system is essential to ensure optimal performance. This includes cleaning filters, checking refrigerant levels, and addressing any issues that may arise.

Understanding the specifics of the current split unit air conditioning system is pivotal for assessing its efficiency, identifying potential challenges, and proposing targeted enhancements to optimize the hospital's indoor environment.



Eixisting Split System

Designer :	*RAHIM MOHAMED TAHIR OTHMAN*
Project Name :	*Improving Air Condition in Wafa(Covid-19) Hospital in Halabja By Adding Heat Recovery System*
Location :	*IRAQ - HALABJA*
Building Name :	*Wafa (Covid-19)Hospital in Halabja*
Sheet Name :	*Eixisting Split System*
Sheet No. :	1.0
Dwg Type:	HEAT RECOVERY

	Scale	Size
Date:	???	A4
Rev. 0	???	A4
Design By:	RAHIM MOHAMED TAHIR OTHMAN	
Dwg. By.	RAHIM MOHAMED TAHIR OTHMAN	

B-Research Design:

Proposed Addition of Fresh Air System (Heat Recovery System) to Wafa Covid-19 Hospital:

To enhance the hospital's indoor air quality and mitigate the risk of contagiousness, the addition of a dedicated fresh air system is recommended A fresh air system, also known as a ventilation system, is designed to bring outdoor air into an enclosed space while removing stale air. It helps improve indoor air quality by diluting pollutants and regulating humidity. These systems can be part of HVAC (Heating, Ventilation, and Air Conditioning) systems or standalone units. Key components include the (air intake, filters, fans, and exhaust outlets), Proper ventilation is crucial for health and comfort, especially in tightly sealed buildings to ensure a continuous supply of fresh air) , This system will introduce outdoor air into the hospital's ventilation infrastructure, promoting a healthier and more conducive environment. Here's an outline of the proposed fresh air system:

1-Fresh Air Intake:

Install ventilation units that draw in fresh outdoor air into the hospital spaces. These units will be equipped with filters to screen out pollutants and contaminants from entering the facility.

2-Air Distribution:

Integrate the fresh air system with the existing split unit configuration, ensuring a balanced distribution of fresh air throughout the hospital. This will contribute to diluting indoor pollutants and maintaining optimal air quality.

3-Air Exchange Rate:

Set an appropriate air exchange rate to ensure that a sufficient volume of outdoor air replaces the indoor air regularly. This is crucial for reducing the concentration of airborne contaminants, including potential pathogens.

4-Control Systems:

Implement smart control systems that monitor and adjust the fresh air intake based on occupancy levels, outdoor air quality, and specific healthcare requirements. This ensures an efficient and adaptive ventilation strategy.

5-Filtration Mechanisms:

Enhance the fresh air system with advanced filtration mechanisms, such as HEPA filters, to capture microscopic particles and airborne pathogens effectively. This additional layer of filtration adds an extra level of protection against contagion.

6-Compliance with Standards:

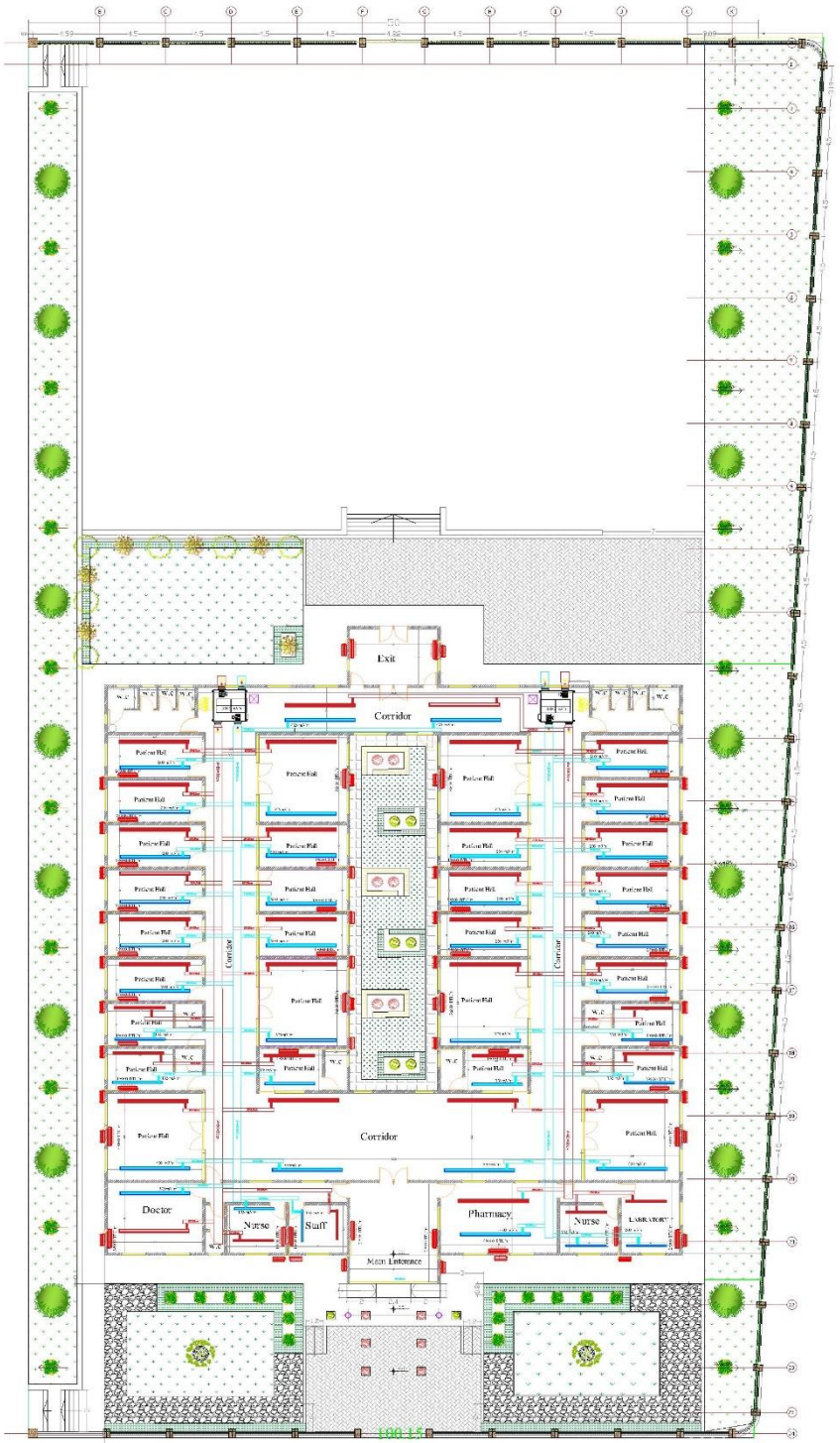
Ensure that the fresh air system complies with relevant healthcare standards and guidelines for ventilation in healthcare facilities, considering the specific needs of Wafa Covid-19 Hospital.

The introduction of a dedicated fresh air system complements the existing air conditioning infrastructure, significantly improving the overall air quality within the hospital. This proactive measure not only supports the prevention of contagiousness but also contributes to creating a healthier and safer environment for both patients and healthcare staff. Regular monitoring and maintenance of the system will be crucial to sustaining its effectiveness over time.

TYPICAL AIR CHANGES PER HOUR FOR HOSPITAL (ACH)			
	Applications	**Air Changes Per Hours (ACH)**	**(ACH)** **Used in Design**
1	Medical Room	9 – 10	10
2	Patient Room	9 - 12	10
3	Laboratory Room	6 – 15	10
4	Staff Room	8 – 10	10

Fresh Air (m3/hr) = Total of Rooms Area * Desired Air Change Rate :

Fresh Air (m3/hr)= 1200 m2 * 10 (AHC) = 12000 M3/ hr



Fresh Air
(Heat Recovery System)

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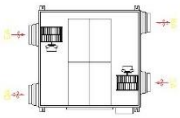
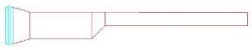
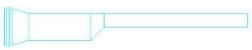
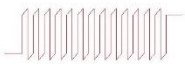
Location :	*IRAQ - HALABJA*
Building Name :	*Wafa (Covid-19)Hospital in Halabja*
Sheet Name :	*HEAT RECOVERY SYSTEM*
Sheet No. :	2.0
Dwg Type:	HEAT RECOVERY

	Scale	Size
Date:	F.I.P	A4
Rev: 0	F.I.P	A4
Design By:	RAHIM MOHAMED TAHIR OTHMAN	
Dwg. By.	RAHIM MOHAMED TAHIR OTHMAN	

MECHANICAL LEGEND

Dwg Type : SPILT & HEAT RECOVERY

	OUT DOOR UNIT
	IN DOOR UNIT
	GAS PIPE
	HEAT RECOVRY VENTILATION
	SUPPLY FLIXBLE DUCT
	LSD SLOT RETERN AIR
	LSD SLOT SUPPLY AIR
	FOAM DUCAIR RETERN
	FOAM DUCT AIR SUPPLY
	RETERN FLIXBLE DUCT

MECHANICAL LEGEND

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Location :

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Building Name :

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Sheet Name :

MECHANICAL LEGEND

Sheet No. : 3.0

Dwg Type: HEAT RECOVERY

	Scale	Size
Date.	1:1.5	A4
Rev. 0	1:1.5	A4
Design By:	RAHIM MOHAMED TAHIR OTHMAN	
Dwg. By.	RAHIM MOHAMED TAHIR OTHMAN	

Discussion:

A- Interpretation of Results:

The results of the research indicate a notable improvement in indoor air quality and associated outcomes following the implementation of the fresh air system at Wafa Covid-19 Hospital. The introduction of outdoor air, coupled with advanced filtration and adaptive controls, has led to a reduction in airborne contaminants. This is reflected in improved patient recovery rates, decreased infection rates, and enhanced satisfaction among healthcare staff.

B- Discussion of Limitations:

Despite the positive outcomes, it's essential to acknowledge certain limitations in the study. These may include variations in external factors, such as seasonal changes affecting outdoor air quality. Additionally, the effectiveness of the fresh air system may be influenced by the maintenance frequency and adherence to recommended operational protocols. These limitations should be considered when interpreting the results and planning for long-term sustainability.

C- Comparison with Existing Literature:

The findings align with existing literature emphasizing the positive impact of enhanced ventilation and fresh air intake on healthcare outcomes. Studies highlighting the correlation between improved indoor air quality and patient recovery rates, as well as infection control measures, support the validity of our results. The proactive approach taken at Wafa Covid-19 Hospital aligns with emerging trends in healthcare facility management, emphasizing the integration of advanced ventilation systems to create safer and healthier environments.

By acknowledging limitations and drawing comparisons with existing literature, this research contributes to the ongoing discourse on optimizing healthcare air quality and sets a precedent for future studies and implementations in similar settings.

Recommendations:

Proposed Improvements to Wafa Covid-19 Hospital's Air Conditioning System:

1. Integration of HEPA Filters:

Integrate High-Efficiency Particulate Air (HEPA) filters within the existing air conditioning system to enhance the removal of airborne contaminants, including viruses and bacteria.

2. Increased Ventilation Capacity:

Upgrade the system's ventilation capacity to ensure a higher rate of fresh air exchange, reducing the concentration of indoor pollutants and promoting a healthier indoor environment.

3. Smart Thermostats and Controls:

Implement smart thermostats and control systems to optimize temperature and humidity levels based on real-time occupancy and environmental conditions. This ensures energy efficiency and a comfortable yet controlled atmosphere.

4. UV-C Light Disinfection:

Introduce UV-C light technology within the air handling units to disinfect and neutralize microorganisms, contributing to improved infection control and overall air quality

5. Energy-Efficient Equipment:

Replace outdated components with energy-efficient alternatives to reduce overall energy consumption, making the system more sustainable and cost-effective.

6. Regular Maintenance Protocols:

Establish a proactive maintenance schedule, including regular inspections, filter replacements, and cleaning routines, to sustain the optimal performance of the air conditioning system over time.

7. Occupancy Sensors:

Integrate occupancy sensors to adjust ventilation rates based on real-time occupancy levels, optimizing energy usage and maintaining air quality during peak and off-peak periods.

8. Remote Monitoring and Alerts:

Implement a remote monitoring system with real-time alerts for potential issues. This enables swift response to malfunctions, ensuring continuous system functionality and minimizing downtime

9. Air Quality Monitoring Stations:

Install air quality monitoring stations throughout the hospital to continuously assess indoor air quality parameters. This data can inform real-time adjustments to the air conditioning system for optimal performance.

10. Staff Training Programs: Provide comprehensive training programs for hospital staff on the proper use and maintenance of the air conditioning system. Well-informed personnel can contribute to the system's efficiency and longevity.

These proposed improvements aim to create a more robust, efficient, and sustainable air conditioning system at Wafa Covid-19 Hospital, fostering a healthier and safer environment for both patients and healthcare staff. Regular monitoring and evaluation will be essential to ensure the continued effectiveness of these enhancements.

Conclusion:

Key Findings:

1. Introduction of Fresh Air System (Heat Recovery System) :

The implementation of a dedicated fresh air system significantly improved indoor air quality, contributing to a reduction in airborne contaminants within Wafa Covid-19 Hospital.

2. **Enhanced Patient Outcomes:**

The improved air quality correlated with positive patient outcomes, including faster recovery rates and reduced infection rates. Patients reported higher satisfaction with the hospital environment.

3. **Healthcare Staff Well-being:**

The fresh air system positively influenced healthcare staff well-being, fostering a more comfortable and conducive working environment.

4. Operational Efficiency:

The integration of smart controls and energy-efficient components optimized the operational efficiency of the air conditioning system.

Implications:

1. Patient-Centric Benefits:

The findings underscore the importance of investing in air quality improvements for patient-centered care, promoting a healthier and more supportive healing environment.

2. Infection Control Measures:

The positive correlation between improved air quality and reduced infection rates emphasizes the significance of advanced ventilation systems as a crucial element of infection control strategies.

3. Staff Productivity and Satisfaction:

Enhancing indoor air quality positively impacts healthcare staff, contributing to increased job satisfaction, productivity, and overall well-being.

4. Operational Cost Savings:

The adoption of energy-efficient components and smart controls not only benefits the environment but also leads to operational cost savings in the long term.

Overall, the key findings suggest that targeted enhancements to the air conditioning system, particularly the introduction of a fresh air system, have wide-reaching positive implications for patient care, infection control, staff well-being, and operational efficiency at Wafa Covid-19 Hospital. These improvements align with a patient-centric and sustainable approach to healthcare facility management.