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## Safety of Cystic Fibrosis Patients at Health Care Facilities

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### Abstract

Cystic Fibrosis (CF) is one of the most common, life-shortening illnesses; it's a genetic disease that affects the transport of water and salt across cells and affects various organs such as lungs, liver, and pancreas [1]. Cystic fibrosis patients need safety more than anyone else during their visits to the hospital, so CF patients are classified among one of the most vulnerable groups to get infections from the hospital during their visits. The purpose of this qualitative research is to study the safety of cystic fibrosis patients at hospitals and whether they have the proper safety precautions that they need at the hospital or not. The methods used in the study were reviews, interviews, and surveys. Results showed that sometimes it's very challenging to protect the CF patients from getting infections and bacteria from hospital environments, also it showed that different hospitals and medical universities are taking proper and very strict safety precautions for CF patients due to mainly they are following the CF foundation guidelines. The study discussed the safety precautions for CF patients in the clinic, how does the hospital environments affect CF patients, hand hygiene, nebulizer care for CF inpatients, safety precautions for CF patients during COVID-19 and infection control strategies. Safety precautions and efforts of hospitals in dealing with CF patients have been discussed as well. Applying safety precautions for CF patients is challenging for hospitals due to the vulnerability of CF patients. Hospitals must take strict actions on safety precautions to ensure the patient's safety.

**Keywords:** Cystic Fibrosis (CF); environment; safety precautions; nebulizer; infection; COVID-19.

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## **1. Introduction**

Cystic fibrosis is a chronic genetic disease that causes permanent lung infections, liver cirrhosis, malnutrition, and poor growth. Mutations in the CF transmembrane conductance regulator (CFTR) gene cause the CFTR protein to become dysfunctional, which restricts the chloride movement to the cell surface. Without the chloride attraction water to the cell surface, the mucus in different organs becomes sticky and thick [2]. In the lungs, the mucus clogs the airways and traps germs, such as bacteria, leading to infections, inflammation, and respiratory failure that at the end will lead to limiting the ability to breathe, and at some point, CF patients will need lungs transplant, but unfortunately, that will not work for all patients since not all patients have the same immune system, also not all of them can have the ability to accept new lungs in their body (that's cellular rejection). For this reason, reducing contacts with germs is a top concern for CF patients [3]. Patient safety is avoidable harm to a patient during their visits to hospital and clinic from getting any infections or diseases while they are getting their treatments, so the safety concern for patients with CF will protect them from getting any germs from the hospital that will lead to serious respiratory tract infection, or from any other CF patient who are suffering from a very serious lungs infection, such as *Pseudomonas aeruginosa* [4]. Persons with CF have inherited two copies of the defective CF gene, one copy per parent. Both parents should have at least one copy of the defective gene (Autosomal recessive). People who carry one copy of the defective CF gene are called carriers, and they don't have the disease. Cystic fibrosis affects at least 30,000 people in the United State [5]. Studies proved the growth of different microorganisms in samples collected from office premises. Bacteria were found in computer keyboards, computer mice, door hands, and bathrooms [6]. Offices in health care facilities are not an exclusion. to control the infections and protect CF patients in hospitals, the safety is needed in all the health care facilities premises. According to the Centers for Disease Control and preventions (CDC) and Healthcare Infection Control Practices Advisory Committee. Precautions for disinfection and sterilization in healthcare facilities, such as sterilize and disinfect respiratory therapy equipment, hand hygiene in healthcare settings, like the use of alcohol-based antiseptic hand rubs, use of antimicrobial-consisting soap and awareness programs to promote adherence are suggested practices. Besides, environmental infection control in healthcare facilities by managing water, air, and surface to minimize the risk of transmission of infectious agents is a must [7]. The objectives of this study are to study the patterns of safety precautions in hospitals for CF patients, to determine the safety precautions needed for CF patients at hospitals, to raise awareness among the CF patients, and provide them with the suitable safety precautions they need to follow when going to the hospital.

## **2. Literature review**

### ***2.1. Safety Precautions for CF patients in the clinic***

The safety precautions for all CF patients in all healthcare settings, such as;

- Practicing appropriate hand hygiene; Health care providers should wash their hands before and after all patients contact, after touching blood, body fluids, secretions, excretions, contaminated items, upon entering and leaving patients room, after interaction contact with patient care equipment, and immediately after removing gloves [7].

- Wearing Personal Protective Equipment (PPE) such as gloves, gowns, and by both patients and healthcare workers, and by wearing these PPE both-patients and healthcare workers-they will be protected from transferring infections to each other [8].
- Patients with CF must wear a mask in the waiting room and throughout the health facility except in their examination room (clinic or hospital room), the stethoscopes should be cleaned between every patient [9]. According to CF Foundation Guidelines for Infection Prevention and Control for Cystic Fibrosis: (2013 update) In CF clinics, it's recommended to implement the contact precautions, such as;
- Separate all people with CF from others with CF, at least (2 meters) in all settings, to reduce the risk of droplet transmission of CF pathogens;
- All people with CF, regardless of respiratory tract culture results, should wear a surgical mask when in healthcare settings to reduce the risk of acquisitions or transmission of CF pathogens, and perform pulmonary function tests (PFTs) to minimize transmission of pathogens from one person with CF to another person with CF by;
- Implementing the test in one in each of the subsequent ways: within the exam room at the start of the clinic visit, allowing half-hour to elapse among CF patients : in a negative pressure room ( airborne infection isolation room) or in a PFT laboratory with high-efficiency particulate (HEPA) filters; or in a PFT without HEPA filters, allowing 30 minutes to elapse between individuals with CF [10]. Instruction to caregivers and families for clinical care to adult CF patients and pediatric (University of Michigan)
- Dealing with CF patients by avoiding gatherings of patients; not allowed having two patients with cystic fibrosis to use the same examination room on a single afternoon;
- Each night, the rooms undergo additional cleaning and disinfection/sterilization before the next day;
- The university has waterless alcohol-based hand sanitizers placed in the exam rooms in the clinic, to limit the spread of germs from one patient to another in the outpatient clinic;
- Regarding the inpatient hospital, they are following strict contact isolation protocols - hospital-wide. These strategies have been quite effective in limiting and preventing the spread of germs at the cystic fibrosis center in the University of Michigan, and for more information about the measures that the hospital is taking to prevent the spread of germs, the patient & their family can speak with any member of the care team. They are a core cystic fibrosis center, fully accredited by the Cystic Fibrosis Foundation [11].

## ***2.2. How does the hospital environments affect CF patients?***

The risk of contact or inhalation of pathogenic organisms from hospital environments will relate to the number of organisms within the hospital environment. Patients and even healthcare workers of CF (HCWCF) may be exposed to pathogenic organisms by direct or indirect contact in hospital, airborne modes of transmission. There are numerous reports of HCWCF contracting infection while at work from the hospital, so they can get the germs from the hospital environments and these germs, such as *Mycobacterium tuberculosis*, rhinovirus, and parainfluenza. Bacterial infections could be *Burkholderia cepacia* complex and *Staphylococcus aureus*, and they

could develop these bacteria from the environments of the hospital by direct or indirect contact, or it can be inhaled from the air. The infection of specific risks to the HCWCF from the workplace is bacterial infection and mycobacterial infection. The bacterial infection, like *Pseudomonas aeruginosa* and *Clostridium difficile* infection. Patients with CF could also be at an increased risk of *Clostridium difficile* infection (CDI) because of the greater exposure to antibiotics. The mycobacterial infection (*Mycobacterium abscessus*) could pose a cross-infection risk within CF centers [12].

### ***2.3. Separating cystic fibrosis patients from each other***

According to Dr. Mike Boyle, senior vice president of therapeutic development at the CF Foundation; he mentioned that people who are affected by cystic fibrosis are more susceptible to getting sick from germs than everyone; they are at high risk for spreading infections from each other. It's suggested that individuals with CF remain a minimum of six feet away from each other, as that's how far respiratory droplets can travel when someone sneezes or coughs. Because people with CF are considered immunocompromised and are prone to get infected with various types of bacteria in their bodies, not staying six feet apart will put other individuals with CF who don't have that strain of bacteria at danger for contracting it. People with CF disease spread these various strains of bacteria to each other, which is known as cross-contamination or cross-infection, they can develop serious and potentially life-threatening complications. People with CF also need to take care of exposing themselves to common diseases such as flu and cold. According to Betsy Bryson, a pediatric nurse practitioner who works with CF patients at Akron Children's Hospital in Ohio she said that to minimize the risk of spreading one's germs or getting them, it is recommended that not only should they keep a six-foot distance from other people with CF, but also avoid other activities that would put them in close physical contact (with those who are sick). This includes shaking hands. People with CF are also discouraged from using the same objects that others use. Another way pathogens can spread is from sneezing or coughing is when the respiratory droplets land on a horizontal surface. Pathogens can stay alive on these surfaces for hours, even days. For this reason, CF patients should not share common objects such as computers, toys, and pens, nor touch the table or desktop surfaces. Dr. Gregoy Omlor mentioned that people with CF have very thick mucus in their lungs. It is so thick that coughing cannot completely clear it so germs do not come out either, so the frequent use of antibiotics to fight these infections can lead to antibiotic resistance. Dr. Drucy Borowitz, senior vice president of community partnerships at the CF Foundation said that patients with CF don't have to stay six feet away from individuals without the disease unless they have a cold or other contagious disease. Following these protocols can help people who are affected by CF disease stay healthy, which can increase the life expectancy for CF patients. According to the CF Foundation, in the 1950s, most people diagnosed with CF didn't live to 18 years old, but now half of all CF patients are over 18 years old [13]. According to infection control guidelines for Cystic Fibrosis patients (Cystic Fibrosis Australia) all CF inpatient should have single rooms with their washing facilities whenever possible, and if this is not possible the patient will be placed in a shared room with other individuals with CF who have the same pathogens as the patient (except those with *B. cepacia* complex) or people who do not have CF, also patients of CF they don't have to sit on the bed of other patients, or visit rooms of other people with CF on the ward, particularly if they are having physiotherapy or nebulizer treatment, and if group activities are allowed they must sit a minimum of one meter apart, also they should take care when coughing and avoid touching so that they don't pass to others any respiratory pathogens that they may be

carrying [14].

#### **2.4. Hand Hygiene**

According to Cystic Fibrosis Foundation, CF patients can catch germs from airborne, or when they touch something with germs already on it, such as a doorknob or handrail, and then touch the eyes, nose or mouth, so in order to minimize getting germs and bacteria, patient should wash and clean hands with soap and water or with an alcoholbased hand gel, before handling food, eating or drinking, and beginning CF treatments. Also they should wash their hands after using bathroom, touching shared objects, and finishing CF treatment [15]. According to CDC (Centers for Disease Control and Prevention) improved hand hygiene practices have been associated with a sustained reduction in the incidence of methicillin-resistant staphylococcus aureus (MRSA) and vancomycin-resistant enterococcus (VRE) infections especially in the intensive care unit (ICU) [16].

#### **2.5. Nebulizer care for CF inpatients**

Cystic fibrosis patients are using the nebulizer mask every day; for taking the inhaled medications, examples of these medications: Albuterol, Hypertonic Saline Solution, Dornase Alfa, and some antibiotics. It is very important to clean and disinfect the nebulizer, and if the nebulizer isn't cleaned properly the patients will easily get the germs from the mask of the nebulizer which will lead at the end to lungs infection. According to the CF foundation its recommended that masks of the nebulizer should be clean by clean the nebulizer parts with dish detergent soap and water, disinfect, rinse, and air dry [17]. According to the University of California, Los Angeles germs and bacteria can get on respiratory equipment and cause lungs infection. Cleaning and sanitizing all instruments utilized for inhaled medications or airway clearance by utilizing the guidelines by the cystic fibrosis foundation and in the manufacturer's instructions. It is very important to clean and disinfect equipment such as nebulizers that have been in contact with mucous membrane and sputum, so to clean and disinfect the nebulizer for CF inpatients, the hospital should provide the patients with handheld nebulizers or small volume nebulizers, should be air-dried (RT flowmeter through a nebulizer to aid in drying) Rinse all nebulizers with sterile water after medications and air dry between treatments. Suggested to wipe mouthpiece or mask off with alcohol pad (70% or 60% of Isopropyl BP Alcohol). Rinse the nebulizer with sterile water and shake overabundant water into the sink, then place the nebulizer on clean paper towels to dry in the plastic bin, so bin should be stored in an area in the room that is away from the sink, after that cover the drying nebulizer parts with a clean paper towel, and leave the tubing at the flowmeter. Mesh nebulizers should be changed out per with the entire ventilator every 30 days manufactures instructions. Sterile waters should contain the date, time, RT initials on all Sterile waters opened by respiratory and disposed of after 24 hours. CF nebulizers should be changed out daily [18].

#### **2.6. Safety Precautions for CF Patients During COVID-19**

COVID-19, short coronavirus sickness 2019, is an infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is a newly identified virus that has not previously been seen in

human beings and is extremely infectious. Though it belongs to the same group of viruses as SARS coronavirus (SARS-coV) and Influenza Viruses, SARS-Cov-2 is a various strain with its characteristics. The first case of COVID-19 was reported in Wuhan, China, in December 2019, and the outbreak has spread very fast around the world, prompting the World Health Organization (WHO) to announce COVID-19 as a pandemic. The symptoms of COVID-19 begin 2 to 14 days after exposure. They include dry cough, tiredness, fever, and shortness of breath. Preventive measures that can help minimize the spread of COVID-19 are, washing hands with soap for at least to 20 seconds, or use a sanitizer that contains at least 60% alcohol, avert close contact with someone who is ill or feel sick (Maintain a distance of at 1.8 meters or at least 6 feet), Stay at home if you are sick, use a mask if you are sick to cover the mouth and nose, do not touch any surfaces and if that happened clean and disinfect the surfaces properly, and avoid touching the mouth, eyes, and nose with unwashed hands. Cystic Fibrosis patients need more extra safety precautions than those discussed above because COVID-19 affects the epithelial lining of the lungs, which is already damaged in conditions such as cystic fibrosis, so CF patients should be isolated from anyone who is affected by COVID-19. If CF patients had to leave their homes for a hospital visit or something urgent, they should wear a labeled N-95 face mask, which can filter out respiratory droplets potentially carrying the virus, CF patients also should stocking up with enough quantity of medications that can last for many weeks, avoiding crowds and non-essential travel, staying at home as much as possible [19]. According to the CF Foundation, CF patients should discuss with their doctors about if they capable to take the covid-19 vaccine or not, also they should discuss with their care team about the side effects of the vaccine, or if there is any interaction between their medications and the vaccine. The types of vaccines that are available (Pfizer-BioTech, Moderna, and Janssen, a subsidiary of Johnson & Johnson, but the FDA has recommended a pause in use of Janssen vaccine due to the agency reviews data involving six reported U.S. cases of a rare and severe type of blood clot in people after they received the vaccine). All COVID-19 vaccines work by causing the body to create an immune response to SARS-CoV, the virus that causes COVID-19, so the vaccines are not protecting from getting the virus, CF patient can still get the virus, but they will have mild symptoms, and the vaccine will protect them from the critical situations and death. Due to the vaccine will not protect CF patient from the virus , people who are affected by CF should protect themselves from the infection in order to stay healthy and not being sick more, so they should not travel to any country with COVID-19 . The CDC suggested that people at increased risk for COVID-19 avoid traveling by airplane and on cruise ships. Traveling during the pandemic can increase the chances for CF patients to become infected with COVID-19, so they can be exposed to the virus from the air, and surfaces in places, such as train stations, bus, and rest stops. It may also be harder to keep a six-foot distance from other people in these environments & places. It's recommended that CF patients travel by car as it avoids them from continuous contact with people who are unknown to them. CF foundation advises people who want to travel inside the U.S to take the Centers for Disease Control and Prevention (CDC) recommendations into consideration, so learn how widespread is COVID-19 in the places/regions they planned to visit. Regarding the CF Care, in regions that are extremely affected by COVID-19, CF care centers are offering telehealth visits for routine care, connecting by phone or video consultation to avoid unnecessary risk of exposure and pressure on their patients, families, medical staff and health care institutions. Various centers may take different approaches, but in the early stages of reopening, most care teams will work with the patients to help them determine if an in-person visit is recommended for the patients. Care teams will also implement the proper process and procedures that will protect and reduce the risk

of exposure to COVID-19 for CF patients. Hospitals are using strict infection control practices during the pandemic. Beyond regular precautions, such as wearing a mask and practicing handwashing, the care team is the best source to inform about the proper and the right safety precautions that should the patients follow when visiting the hospital during COVID-19 to reduce the risk of exposure to the virus. In some circumstances, CF patients may be able to attend appointments virtually; and many labs have implemented strategies to reduce the risk of exposure to COVID-19, like allowing patients to stay outside the lab until they receive a text message on their mobile phones that notifies them when it is time for their test [20].

### **2.7. Infection control strategies for CF patients**

- Auditing of IPC (Infection Prevention and Control) practices in the hospital and clinic by the office of environmental health and safety (HSE)/ quality & patient safety: CF care groups should participate with their IPC teams to develop protocols, checklists and audits to standardize implementation of practices- policies & Procedures- for cleaning and disinfecting the multiuse items and surfaces in the health care environment; putting patients with CF immediately into the examination room, using a system that will alert patient with CF that the exam room is available [10].
- According to SA (South Australia) Health the infection control principles for CF patients are adhering to hand hygiene, source to the containment of respiratory secretions, appropriate use of personal protective equipment, environmental cleaning, and sterilization of reusable medical instrument. All healthcare facilities must develop a comprehensive risk-based, institution-specific, infection, infection management plan to reveal, limit, and control infection and/or colonization risks for CF patients [21].
- According to CF care, during COVID-19 CF care centers are providing telehealth visits for patients, and they are connecting with patients by phone or video to check their health and if they are feeling well or not, so CF care does not recommend CF patients to come to the clinic for their routine appointments, to not take the infection of COVID-19 from the hospital [19].

## **3. Methodology**

This study utilizes a collection of one type of methodology which is qualitative data collection. Qualitative research was used through a structured interview with a case (Ms.S.F). Who is a CF patient Moreover, a survey was conducted with a sample of 50 people including physicians and EHS (Environmental Health & Safety) specialists The survey was uploaded to an online survey website for an accurate statistical and numerical analysis as its easier and a faster way to collect responses.

### **3.1. The Interview**

In this research, an interview was used as the primary source of information. The interview was conducted with Ms. S.F; a CF patient living in the United States. Ms. S.F is a 22 years old female who was diagnosed in 1998 when she was 8 months old. The interview results are summarized and discussed in the results and discussion. section.

### **3.2. The survey**

The survey was composed of 50 physicians from different hospitals, and Environmental Health & Safety Specialists from different sectors. The specialists were chosen based on their experience, knowledge, and background related to safety precautions.

The survey results were summarized and discussed in the following section

## **4. Results and Discussions**

### **4.1. The Interview**

- **Implementation of safety precautions based on the need of CF patients at the hospital**

In the United States, there are appropriate precautions that are well documented in CF hospitals and clinics and recommended by CF Foundation., Ms. S.F stated. For example, wearing masks when accessing an IV, hand sanitizer at every door for both staff and patients to use, and wearing protective gowns. Of course, how thoroughly those precautions are followed depends on each individual, hospital, staff and the experience overall has been positive. Ms. S.F estimated that proper safety practices are followed by about 95% of the time. Studies showed that the infection control strategies for CF patients are Wearing Personal Protective Equipment (PPE), such as gloves, gowns, and by both patients and healthcare workers. Wearing these PPE will protect the patients from infections [8].

- **PPE (Personal Protective Equipment) instructions for CF patients**

Ms. S.F stated that since the CF world is so connected, the patients are aware of the PPE guidelines and most hospitals assume that the typical patient is aware of the guidelines. However, there are posters in waiting rooms with proper safety techniques listed as a reminder for those who may not be familiar. The CF hospitals, clinics, and CF patients, their families, and the CF caregivers are following the PPE instructions and safety precautions from CF Foundation as Ms. S.F stated. According to BC women's hospital & health center, BC children hospital, & BC Mental Health & Addiction Health, the use of PPE for people with CF adapted from the Infection Prevention and Control Guideline for Cystic fibrosis, such as gowns for CF patients are not recommended, and they can perform hand hygiene instead. Surgical masks are recommended when the patients are in common areas in healthcare settings (E.g., corridors, waiting areas, radiology). Also, it is not recommended to wear the surgical mask in exam rooms, in hospital rooms, or when performing pulmonary function tests [22].

- **The challenges CF patients are facing during their visit to hospitals, and being inpatient**

The challenges that patients are facing during their clinic visit come from catching germs from hospital environments, lack of a system that sterilizes nebulizer cups. 15 years ago; Ms. S.F said that she has been infected with two species of bacteria from the hospital. Ms. S.F explained that this was because of a lack of



following proper precautions by one of the inpatient staff. However, Ms. S.F believes that nowadays the hospitals have very strict policies regarding safety precautions compared to 15 years ago. There are numerous reports of HCWCF confirmed that CF patients can get the pathogens from the hospital's environments. Examples are *Mycobacterium tuberculosis*, rhinovirus and parainfluenza, *Burkholderia cepacia* complex, and *staphylococcus aureus*. Patients could get the infection by direct or indirect contact, or it can be inhaled from the air [12]. According to (2013) Infection Prevention and Control, (IP&C) Guideline for Cystic Fibrosis commissioned by the CF Foundation recommended that to use the single-use disposable nebulizers during hospital admission that, after each use, should be rinsed with sterile water to remove residual volume, the mask/mouthpiece wiped with an alcohol pad and the nebulizers discarded every 24 h [23].

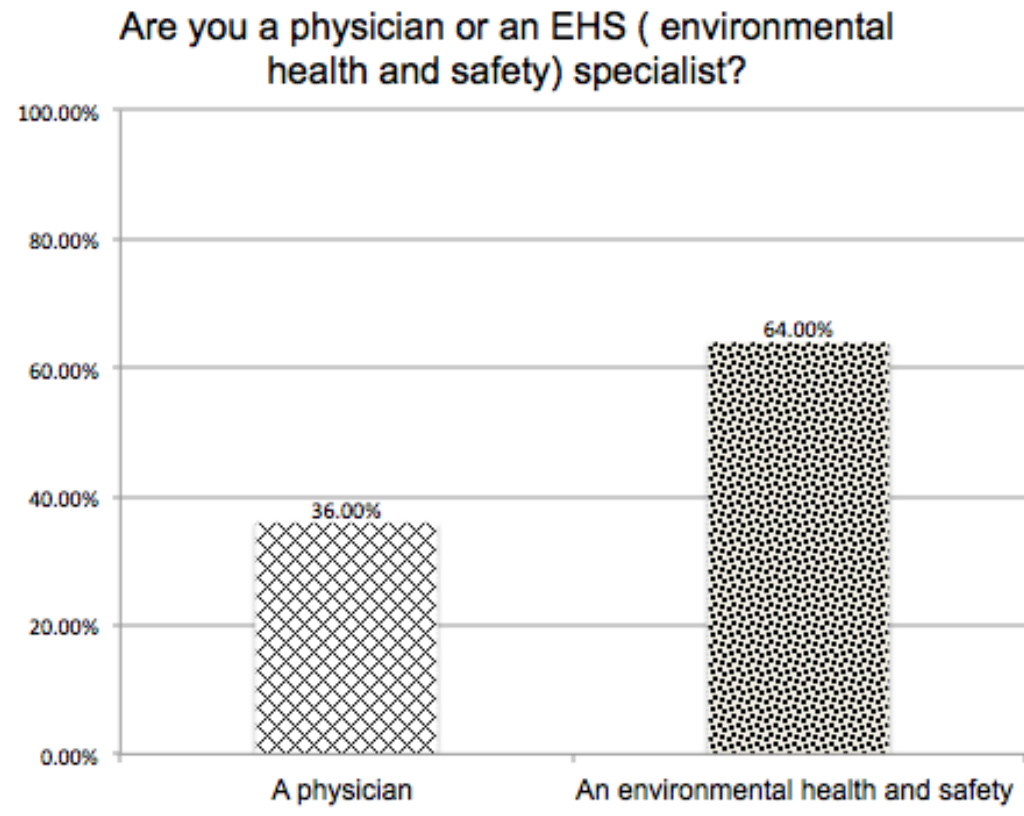
- **Safety precautions for CF inpatient**

“Sometimes it can be a little safety precarious, in waiting rooms at the clinic, but when I’m in my private room, I always feel like the proper precautions are applying correctly. At my clinic, CF patients are mandated to have their room with an attached restroom and if they are on isolation, everyone that enters has to wear masks, gloves, and a disposable gown in addition to the typical hand washing routine” Ms. SF stated. According to the Newcastle upon Tyne Hospitals NHS (National Health Service) Foundation Trust healthcare staff should risk assessing the procedure being undertaken and the patient’s infective status, and PPE by trust policy and all patients should be isolated in single rooms with bathrooms not shared by other CF patients [24].

#### **4.2. The Survey**

- **The composition of the Sample**

The majority (64%) of the respondents were Environmental Health & Safety specialists (Fig.1) which shows that most respondents in the study have knowledge and background in safety precautions.

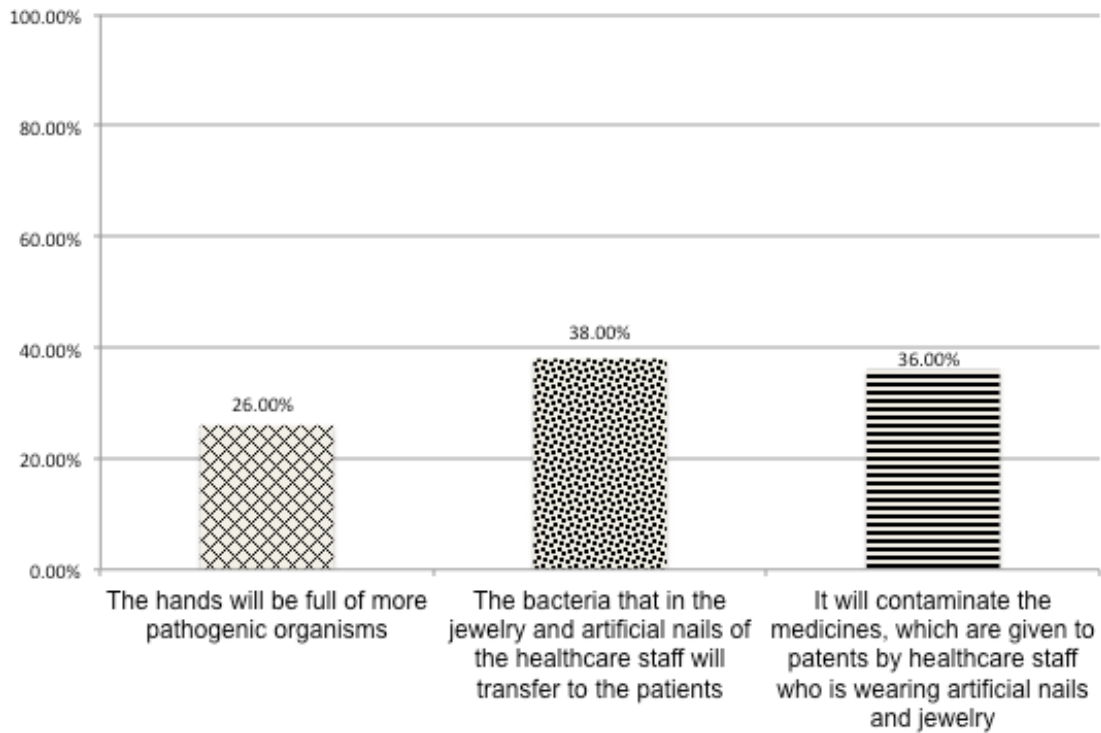


**Figure 1:** Are you a physician or an EHS (environmental health and safety) specialist?

- **Wearing artificial and jewelry by healthcare workers in CF clinics**

38% of respondents selected the option that the bacteria in the jewelry and artificial nails of the healthcare staff will transfer more pathogenic organisms to the patients (Fig.2). According to Public Health Ontario, artificial nails harbor more microorganisms and are more difficult to clean than natural nails. The artificial nails and nail enhancement, like gel nails and nail wraps, have been embroiled in the transfer of microorganisms such as pseudomonas species, klebsiella pneumonia, and yeast, also the nail enhancement and artificial nail are linked with poor hand hygiene practices and lead to additional tears to gloves. As mentioned above, wearing artificial nails and nail enhancement are not to be worn by those having direct contact with patients. When the hand and/or arm jewelry present they can affect the effectiveness of hand hygiene. It is suggested that rings and bracelets not be worn by those with direct contact with patients. The impediments to effective hand hygiene, such as Jewelry that is very hard to clean hides pathogen and viruses from the action of the hand hygiene agent [25].

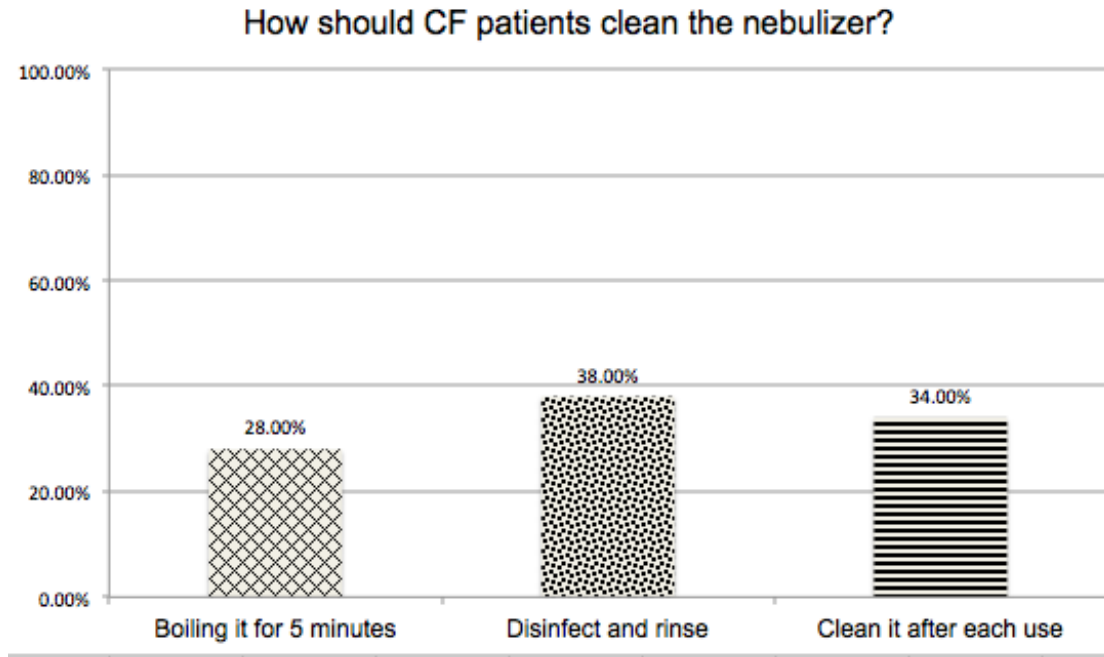
How does the artificial nails and jewelry worn by healthcare staff who are working in the CF clinics and deal with the patients transfer for them more pathogenic organisms ?



**Figure 2:** In which way the artificial and jewelry worn by healthcare staff who are working in the CF clinics will make patients sick more.

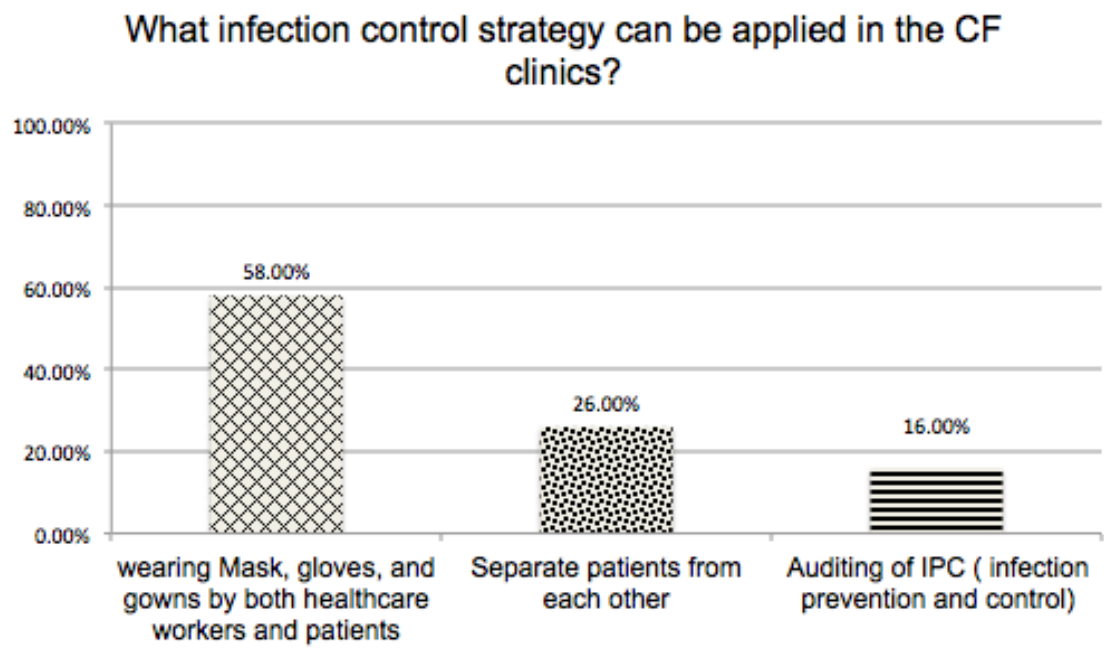
- **Methods of cleaning the nebulizer**

When participants were asked about cleaning nebulizers, 38% chosen that disinfect and rinse (Fig.3). According to the British Lung Foundation, nebulizers should be cleaned after each use by washing the nebulizer parts in warm soapy water, shaking off excess water and leaving the parts to air dry on a clean tissue or kitchen paper towel, and disinfect the nebulizer regularly [26].



**Figure 3:** The options of cleaning the nebulizers.

- **How to control the spread of infection?**



**Figure 4:** Infection control strategy at the CF clinics.

When asked about how to control the spread of infection, 58% of respondents answered that mask, gloves, and gowns by both health-care workers and patients (Fig.4). According to Cystic Fibrosis Center at Stanford to prevent the spread of infections gloves should be worn when the risk of direct or indirect contact, gowns to

prevent soiling of clothes with contact or droplets, and masks to limit contamination of mucous membranes (eyes, nose, mouth) with droplets [27].

## **5. Conclusion**

This research proved that safety precautions for cystic fibrosis patients at hospitals will protect them from many pathogens and diseases. CF patients do not only visit pulmonologist and gastrointestinal specialists, but they also visit many specialists, such as neurologist due to the airway clearance vest it's affecting their head and brain, orthopedist as CF patients are taking antibiotics, and it's affecting their bones, and ENT (ear, nose, and throat) specialists as the nose of CF patient could be clogged due to the sputum. The research concluded that there are many aspects of safety that might not be taken into consideration such as, wearing artificial nails and jewelry that have been shown to harbor more pathogenic organisms, particularly gram-negative bacilli and yeasts, in the subungual area than those with native nails. Applying the right strategy of washing hands will reduce the incidence of methicillin-resistant staphylococcus aureus (MRSA) bacteria, dangerous bacteria that can be colonized in the lungs, and cause multiple infections in the lungs [16]. Cystic Fibrosis patients should be provided with (PPE) personal protective equipment like masks, gloves, and gowns [8]. Clean and sanitize everything in the healthcare facilities and clinics, such as the tables, walls, surfaces, computers, and the laptop is a must. It is very important to not examining the patient after using computers, laptops, or mobile phones and to avoid using the same while examining the patients; as the computer, laptops, and phones as these are considered as sources of bacteria and pathogens.

## **6. Recommendations**

- Doctors should inform the CF patients to wear a facemask when they are coming to the hospital.
- Health care providers who are dealing with CF patients should not be wearing jewelry and/ or artificial nails.
- Doctors should not schedule CF patients on the same day, and if they are enforced to; they need to see them in shifts.
- HSE office (Health, safety, and environment office) should check if the patients and healthcare staff are applying the necessary safety precautions at the hospital, especially on the day of the CF patient's appointment.
- HSE office should monitor, audit, and take the corrective actions of the safety precautions for the CF patients and the healthcare providers.
- Health care providers should make it clear to every patient to wear a mask when entering the hospital
- Self-sterilization corridors are recommended.
- CF hospitals should have a system in each area of the CF clinics that will sterilize the air.
- In CF clinics for inpatient, the cafeteria should be designed in a way that each table is covering, and have a purifying air system, to purify the sitting after each patient, so by this strategy the hospital will limit the spread of germs and infections through CF patients at the cafeteria.

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