COVID-19 Isolation Tents: Risk Assessment of Standard Safety Protocols in Assembling Tents Outside of Hospitals in the Philippines

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Abstract

This paper focuses on the risk assessments of the COVID-19 isolation tents, whether they follow the standard safety protocols and guidelines set by the World Health Organization (W.H.O.) and the Department of Health of the Philippines (D.O.H.) to cater severe COVID-19 cases in the most hit areas. Through conducting a survey and review of related literatures and studies, the researchers found out that in terms of application of: 1-hygiene, 2-personal protective equipment, 3-visitor guidelines, 4-decontamination, disinfection and sterilization, and 5-isolation tent precautions, standard safety protocols in the isolation tents are poorly practiced and will highly need an innovation. With this, the researchers did a risk assessment with the help of Ishikawa Diagram, to lay down all the underlying problems in tent that makes it inefficient and ineffective. Aside from that, the researchers adopted the service quality manufacturing-based approach, whereas in following this approach, it means that conformance to the design or specifications are important, and that noncompliance means error. Finally, the researchers led to the solution of improving the isolation tents through its design, to make it more efficient and cost-effective.

Keywords
Risk Assessment, Isolation Tents, Standard Safety Protocols, Innovation, Design

1. Introduction

During a pandemic especially in the case of a novel virus like COVID-19, the health sector of a country if unprepared, suffers a fatal blow. It is the novel virus that wreak havoc to every place in the world and paralyze the economy of every country, especially here in the Philippines. The Filipinos were unprepared for this kind of phenomena and that's why it is important to gather every help, and focus on establishing strong connections with every department of the government and its citizens. Due to this lack of foresight, our country today reports thousands of COVID-19 cases each day, which in turn supplies hospitals with immense number of patients that overwhelmed our health care system. To help ease the congestion of severe cases of COVID-19 in hospitals, Local Government Units (LGUs) in partnership with private sectors, came up with an alternative solution which is the COVID-19 tents. With this, the researchers want to help with risk assessment management of the overflow in COVID-19 tents, that is an innovative solution to the surge of patients in every hospital. This study will specifically answer these questions:

1. Do hospitals have or implement standard safety protocols in managing the said tents in terms of:

- Hygiene
- Personal Protective Equipment
- Visitor Guidelines
- Decontamination, Disinfection and Sterilization
- Isolation Tents Precautions

2. Is the overflow in COVID-19 tent made it inefficient?
3. Does it provide the health care that every patient needs?
4. What changes could be made to make the tents better and help patients to recover faster?

1.1 Objectives

General Objective:

- To assess the risk management of assembling facilities like the said COVID-19 tents, and to know if they are implementing the standard safety protocols that are set forth by the Department of Health of the Philippines.

Specific Objectives:

- To provide better space for the patients that cannot be accommodated inside the main facilities of the hospitals.
- To determine what more could be changed in the management of the said tents to make it more efficient.
- To make the tents more effective in treating the patients allowing them to recover faster.
- To arrive at a solution that is cost effective.
- For the researchers to be able to help in their little way, and practice their expertise even they are still studying.

1.2 Scope and Delimitation of the Study

The study is only limited at the tent facilities that are here in Manila which is one of the highest cities with confirmed cases of COVID-19 in the Philippines. The basis of the survey population comes from the people who reside in Sampaloc, Sta. Cruz, and Tondo, which places who have the highest confirmed cases of COVID-19 in Manila, who have seen the inside and outside of tent, and those who have experienced using it. The researchers used the survey population as basis and nonetheless, the study is still applicable to every tent facility in Manila. Then the number is used in Slovin's formula to arrive at the sample size, which is needed to determine how many respondents should be enough for the study. With the time constraint, the researchers only used 5% margin of error. The study of risk assessment management is only limited to the tents and doesn't include the main facilities inside the hospitals. The researchers decided to focus on the tent more to know whether it is efficient and effective in treating patients or whether it's just making the situation worse than it already is. This study is only limited to the facilities and risk management of the tents when it comes hygiene, personal protective equipment, visitor guidelines, decontamination, disinfection and sterilization, and isolation tent precautions; tents that serve as isolation tents for low-risk and high-risk patients and doesn't include the treatment process that they do to the other patients. More on how the facilities and the management and the guidelines inside the tents affect the recovery of the patients.

1.3 Significance of the Study

The researchers would like to present the topic as a significant issue and that this study will address the current situation of the country. With the aim of assessing the risks in assembling tents/facilities for the COVID-19 outside of the hospitals in the Philippines, and also to check if there is a standard safety protocols in place. This study will be beneficial to the following:

To the Government

This study will help our government to have better ideas when it comes to assembling the isolation tents in a cost-efficient manner and at the same time follows standard safety protocols set by the DOH.

To the Society

This study will help the society be aware of the dangers and the things to consider when visiting hospitals and isolation tents. Most importantly, it will help the society to recover faster from the damage and loss that this pandemic incurred to everyone.

To the Students

This study will help students as it will give them prior information about researches in the field of Industrial Engineering, specifically Ergonomics 1: Physical & Cognitive Ergonomics. Aside from this, it will help them to be more aware of the current issues that the country is experiencing and ignite that burning passion in their hearts to take initiative and help their country.

To the Future Researchers

This study will also help the future researchers in knowing what the situation was at the time of COVID-19 pandemic here in the Philippines, and what area or aspect they should focus on that may pose high-risk for everyone. They can provide short and long-term solutions for all the risks that can be identified. The study will also be an eye-opener for everyone to know what is happening to those tents assembled outside the hospitals. This will allow researchers to study aspects that are not involve in this study, that will further the knowledge about this novel virus.

2. Literature Review

World Health Organization (2019) stated that it is important to ensure adequate supplies of alcohol-based hand rub (ABHR) (containing at least 60% alcohol) and availability of soap, clean water and tissue. Place them at all entrances, exits and points of care. Ensure that there's an appropriate waste disposal (bin with a lid). In 2020, W.H.O. said that all health-care facilities should have regular programs aimed at promoting best hand hygiene practices. All health-care facilities should establish hand hygiene programs. And People with suspected or confirmed SARS-CoV-2 infection should be provided with their own toilet (either a flush or dry toilet). Different toilets in every ward, sharing is not possible as patients don't have the same level of risks. Each toilet cubicle should have a door that closes and flush toilets should operate properly and have functioning drain traps. The toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds.

As discussed in "Putting on and Removing Personal Protective Equipment" (Ortega, et al., 2015), removal of PPE should take place in an anteroom or doffing area that is separate from the patient's room. These areas are considered to be contaminated and are separate from the clean area used for donning PPE. The PPE-removal area should not be used for any other purpose. According to World Health Organization (2020), PPE should be used based on the risk of exposure (e.g., type of activity) and the transmission dynamics of the pathogen (e.g., contact, droplet or aerosol). Health care workers involved in the direct care of patients should use the following PPE: gowns, gloves, medical mask, and eye protection (goggles or face shield). Specifically, for aerosol-generating procedures (e.g., tracheal intubation, non-invasive ventilation, tracheostomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy). In addition to using the impermeable PPE, frequent hand hygiene and respiratory hygiene should always be performed. PPE should be discarded in an appropriate waste container after use, and hand hygiene should be performed before putting on and after taking off PPE.

As one saying goes, prevention is most certainly better than cure. LGU's and establishments that opted to using sanitation tents as a measure for decontamination commonly use diluted household bleach while others suggest using isopropyl alcohol or diluted povidone iodine to decontaminate individuals in the tent. However, spraying individuals with disinfectant chemicals is strongly discouraged by various health authorities around the globe because of their propensity for eye and skin irritation, bronchospasm following inhalation, and gastrointestinal effects such as nausea and vomiting (Mallhi, Khan, Alotaibi, & Alzarea, 2020). In addition, the Centers for Disease Control and

Prevention noted that as most of the environmental protection agency-registered household disinfectants are effective against COVID-19, they are only approved to be used on surfaces and not on humans (Tan-Lim & Melendres, 2020).

Due to the rapid spread of the virus and the high-volume increase of cases recorded each day, and the whole world on high demand for them, supplies have become difficult to come by. As a result of this shortage, many shifted into disinfecting and sterilization of disposable masks for reuse, and going on non-certified manufacturing of protective equipment. It is concluded in the survey and research that disposable surgical masks are less effective than PPEs, while home-made or non-certified masks have very low effectiveness (Rubio-Romero, Ferreira, Garcia, & Castro, 2020). Due to the high influx of patients contracting this highly infectious disease in hospitals, it is expected that it will generate huge number of pollutants resulted from diagnostic, laboratory, research activities, and medical excretions by patients, which are bio-hazard wastes. Hospital discharge of hazardous wastes and wastewater, especially when untreated appropriately, would expose the public to danger of infections. The study conducted by Wang, et al. in China, provides scientific advice on the management, technology selection and operation of hospital waste and wastewater disinfection in China, which is of great importance for the development of the National Disinfection Strategy for Hospital Waste and Wastewater during the COVID-19 pandemic (Wang J, Shen J, Ye D, et al., 2020).

The Philippines' Department of Health, Office of Undersecretary, released a department memorandum no. 2020-0123, with a subject "Interim Guidelines on the Management of Surge Capacity through the Conversion of Public Spaces to Operate as Temporary Treatment and Monitoring Facilities for the Management of Persons Under Investigation and Mild Cases of Coronavirus Disease 2019 (COVID-19)". It stated guidelines and protocols that must be strictly followed when it comes to converting open spaces as a facility or accommodation for the surge of patients. In the implementation of this memorandum, it is expected to alleviate the continuously growing number of patients in the hospitals that cannot be admitted anymore because there is no available bed space for them. It also included the features that it should at least have, to protect the patients and health care workers, and to have an efficient system for faster recovery of everyone. According to Wu X, et al (2020) in China, triage tents or station was required to be located outside of outpatients' hall because it is a better idea, open space means less contact with each other and more space to accommodate patients. The queue or tent for febrile is different from the non-febrile patients. Aside from that, there's a QR code available for the patients to fill out as a registration form to avoid unnecessary interaction but there's also manual registration of forms for those who cannot access the QR code. Sanitizers are also available everywhere. Hospitals and old buildings were also remodeled and quickly set up temporary tents which are divided into three sections, cleaning, contaminated and buffer area.

In addition, according to Hiroshi N, et al (2019) closed spaces are also related to the secondary transmission of COVID-19 and promote superspreading events. Closed environments are consistent with the large-scale transmission of the virus and it shows significance when the government of China, implements the distancing policies and prohibited social gathering and going to places without proper authority pass. It greatly reduced the number of cases in China. Reduction of unnecessary contact in closed environment will greatly help to reduce the frequency and intensity of transmission.

Overall, this presents all related studies and literatures to this study, COVID-19 Isolation Tents: Risk Assessment of Standard Safety Protocols in Assembling Tents Outside of Hospitals in the Philippines. It is concluded that other studies also suggested that hand hygiene and just hygiene in general, is really important to stop the transmission of virus and to prevent other contamination. Along with that is separate toilets for every ward and for patients that are high-risks or low-risks, especially those that are positive to the virus. It also talks about how important

is personal protective equipment not just to the health care workers but also for the patients. It prevents patients from acquiring any other virus to worsen their case. With that, decontamination, disinfection and sterilization are vital to maintain cleanliness of the facilities and to prevent the transmission of disease all over the place, given that it is bad for the visitors if not thoroughly cleansed. Lastly, it is mentioned that because of the high influx of patients, asymptomatic or symptomatic, it is clearly evident that the supplies are running out which forces medical facilities to reuse disposable PPEs which are very dangerous.

3. Methods

3.1 Research Design

The researchers utilize both quantitative and qualitative research design. Answers given by 99 people (computed using Slovin's Formula) from the survey roll-out will be used to collect data for quantitative analysis. Moreover, from in-depth review of related literatures and studies, the researchers shall propose improved safety protocols, risk assessments of guidelines on the operation of isolation tents as qualitative research.

3.2 Respondents of the Study

The researchers decided to have the people who have seen the inside and outside of the tents and those who have experienced using it, who are located in Sampaloc, Sta. Cruz, and Tondo, which are places within Manila who have the highest confirmed COVID-19 cases, as a basis for the possible relevant respondents for the study. It consists of 264 confirmed cases as of April 2020, and basing on the applicable proportion to be used in Slovin's Formula (Tejada & Punzalan, 2012), at least 132 will be the population size needed. It could be any gender, any race, as long as it is within the Manila, Philippines. Using the Slovin's Formula, it is found out that at 95% confidence level, the appropriate sample size for the survey will be at least 99 individuals.

3.3 Sampling Technique

The researchers used probability sampling method of simple random sample. The respondents have equal chances to be selected. Along with this, the researchers used Slovin's Formula to compute for the sampling size. Given the equation: $n = N / (1+Ne^2)$

n = sample size
N = population size
e = margin of error

The margin of error used is 5% and population size of 132 people. With that, the computed sample size is at least 99 individuals.

3.4 Research Tools/Techniques

- **Ishikawa Diagram** – also called as fish bone diagram that shows causal factors. The researchers used this to show what is the underlying problem with the COVID-19 isolation tents outside of the hospitals here in the Philippines.
- **Manufacturing-based Approach** – this approach is under the service quality, that states non-compliance to the design and specifications means error while compliance means excellence and quality.
- **Conceptual Framework** – using the input, process, and output format, the researchers used this to present steps they have taken to complete this study starting with the input, where it is the collected materials, and in process, how they used these inputs to answer the problems and what are the ways, then in output, is of course the result of the whole study.

3.5 Data Gathering Procedure

In data gathering procedure, the researchers did statistical analysis of other surveys from different studies and most especially with the data gathered from their own survey. In addition, content analysis of other qualitative data from different sources and interpreted the graphs in the study using words. The study also used these kinds or types of data:

- ***Primary Data*** - the researchers used statistical analysis through conducting survey questionnaire to collect original information that might or will support the statement of the problem.
- ***Secondary Data*** - the researchers maximized the use of electronic resources. The internet used to gather articles and journals to support the primary data in terms of COVID-19 Isolation Tents.

4. Data Collection

With the result of the survey, it is concluded that in every category, the majority of the 99 respondents gave a score level of 1 which means poor, in the implementation of standard safety rules in the isolation tents. And in this Pareto chart (figure 1), it shows which category should be prioritized first. It shows that the isolation tent precautions should be the 1st priority, it includes design and systems of the said isolation tent. It is important because it mostly revolves around the safety feature that is vital when it comes to facilities for virus outbreak; Having proper spacing and barriers among the patients. The 2nd priority is the decontamination, disinfection and sterilization, category. This includes sanitation rules and processes of the tents, such as using hospital-grade germicide along with using the appropriate PPEs while cleaning the contaminated area. At 3rd priority are the hygiene and personal protective equipment. In both hygiene and PPE, it just promotes the practice of hygiene such as having alcohol-based hand sanitizers and having separate lavatories for men and women that are stocked with paper towels and soap at least. In addition, the availability of the PPEs and its appropriate usage. And finally, at the 4th priority is the visitor guidelines. As it was already discussed that most of the hospitals already have this, it just needs a bit of improvement for further efficiency. (Note that the rating scale and categories are explained in the survey given to the respondents.)

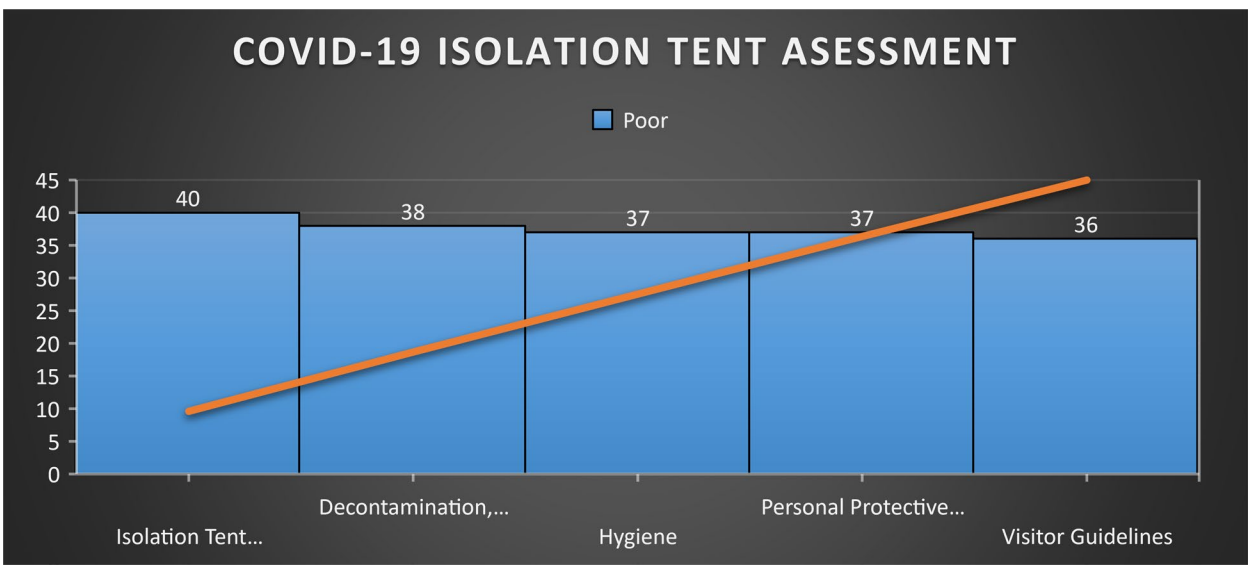

Figure 1. Pareto Diagram

5. Results and Discussion

5.1 Ishikawa Diagram

With the Ishikawa Diagram or fish bone diagram, the researchers want to show how they came up with the idea of improving the COVID-19 isolation tents and why. Ishikawa Diagram is best to show causal factors of why

there is an existing problem. With this, it could also help the researchers to look at the problem closely and get to the bottom of everything and see what might be, or what are the best possible solutions to solve the problem. You could see in figure 2 that the main problem is inefficient and ineffective COVID-19 isolation tents. The question is why do we care about this problem? Well, first of all, the COVID-19 cases are already high but it is still increasing day by day. The hospitals cannot handle the surge of patients anymore because the bed capacity is low, it cannot accommodate everyone that is why the government decided to build facilities and turn big spaces such as basketball court, gymnasium, and hotel, as an isolation facility and also to cater individuals that don't have home and live in the street that also need protection from the virus. Others also adopted this idea and built isolation tents outside of the hospitals. The thing is, with the survey that the researchers conducted, it is safe to say that it is inefficient and ineffective. The reason why it is important to solve this is to help the society restore its order and to cope up with the damages and losses that this pandemic brought. The more it is left unsolved the more lives will be taken.

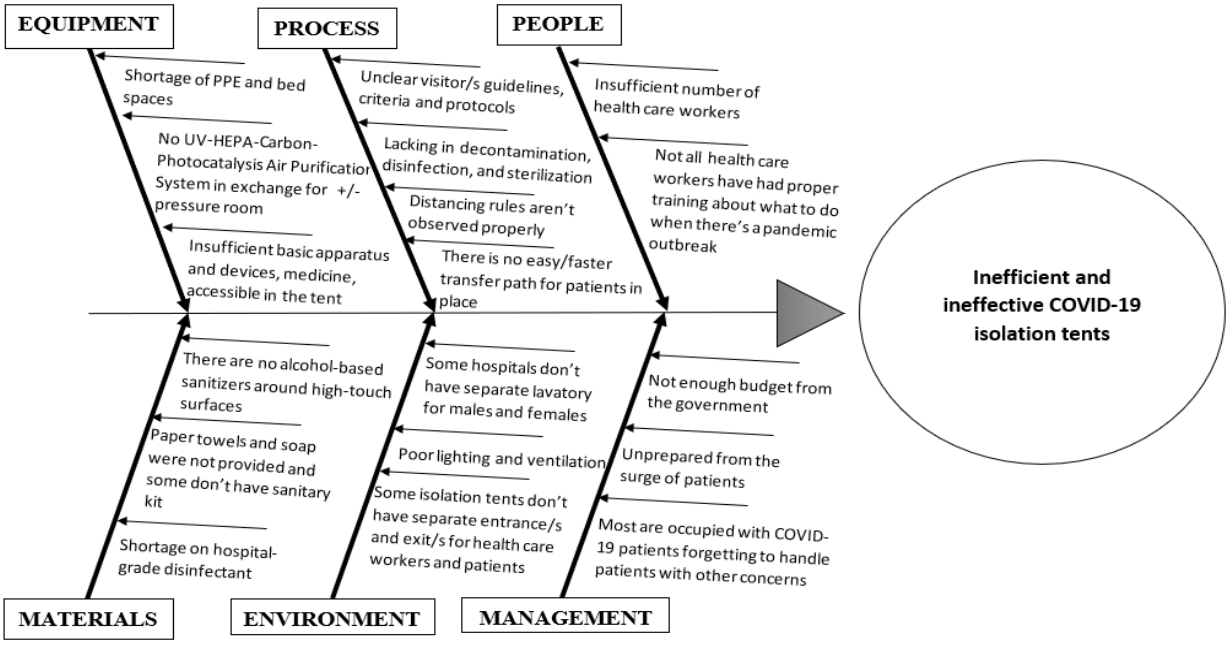

Figure 2. Ishikawa Diagram

5.2 Numerical Results

The summary of findings presents the summary of the research work undertaken. This paper focuses on the risk assessments of the said tents, whether they follow the standard safety protocols set by the W.H.O. and the D.O.H. to cater severe COVID-19 cases in the most hit areas. Parts of the study was done by statistical analysis and content analysis of other qualitative and quantitative data from different primary and secondary sources. The study of risk assessment management is only limited to the tents and doesn't include the main facilities inside the hospitals.

With the result of the survey conducted, it is concluded that in all 5 categories, the majority of the 99 people voted that the implementation of standard safety protocols in the isolation tents are Poor (rating scale 1-5, 1 being the lowest, means poor). Thus, resulting from the isolation tents being inefficient and ineffective when it comes to treating its patients. In regards to that, the researchers improved the isolation tents and applied all the guidelines and standard safety protocols that the W.H.O. and D.O.H. set for this COVID-19 Pandemic. The prominent findings of the study are as follows:

Rate or level of implementation of standard safety protocols (rating scale 1-5, 1 being the lowest, means poor) in managing the said tents in terms of: 1) Hygiene 2) Personal Protective Equipment 3) Visitor Guidelines 4) Decontamination, Disinfection and Sterilization 5) Isolation Tent Precautions

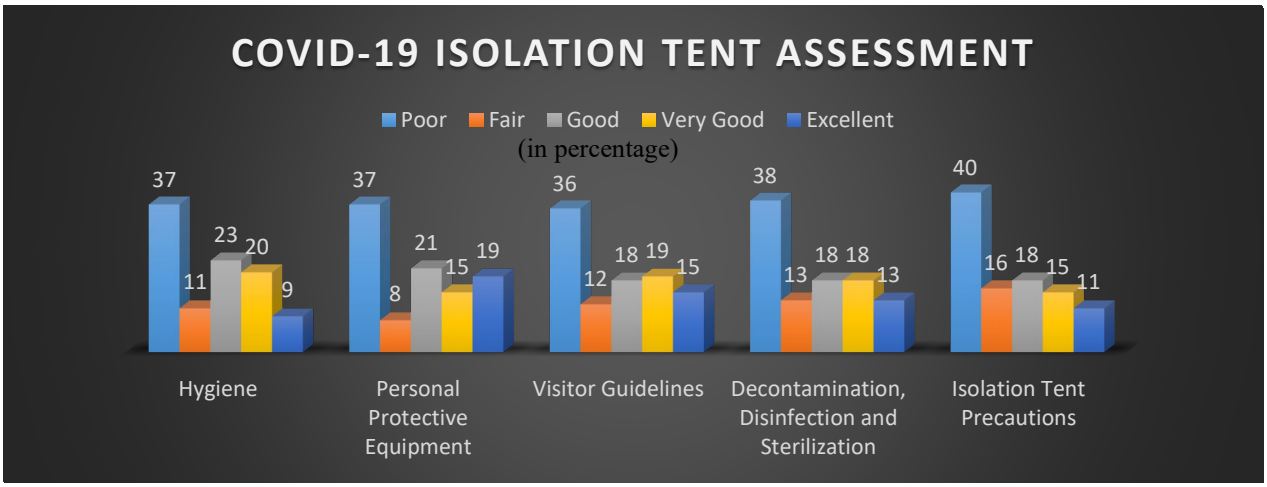

Figure 3. COVID-19 Isolation Tent Assessment

5.2 Graphical Results

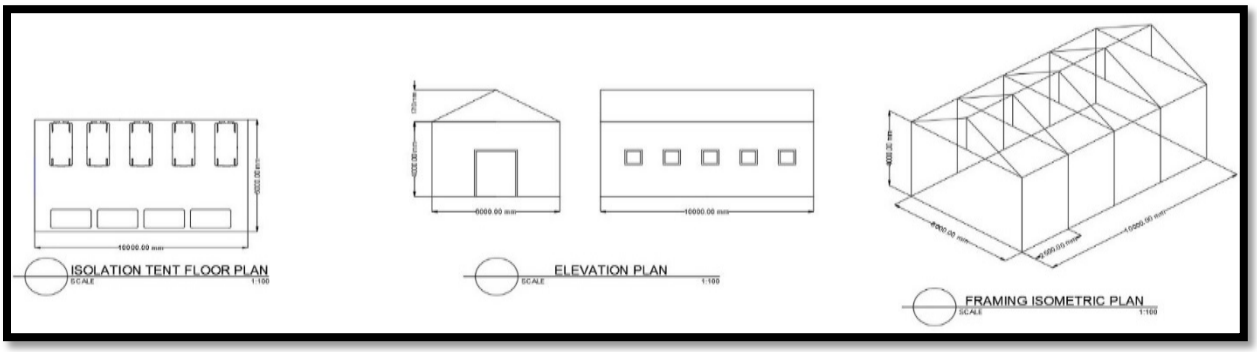

Figure 4. Existing Floor Plan of Isolation Tent

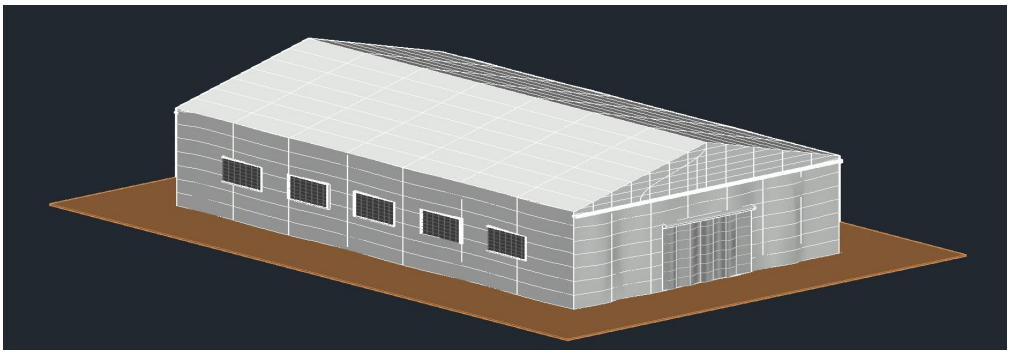

Figure 5. Existing Design of Isolation Tent

In the figures 4 and 5, it shows the design of the existing isolation tents within Manila. A lot of existing isolation tents might not look like this, but you have to consider the place where it is located. A lot of really efficient tents were located in different areas like basketball courts, stadium, parking lots, and just big spaces in general, was funded by their local government units with the help of some sponsorship. However, in this study, we focus on the isolation tents built outside of hospitals in Manila, which are mainly funded by the hospital itself. With the lack of money and time and preparation, it really looks just like the simple tent. It doesn't feel like anything's wrong with the figures but if you analyze it, there's not enough space for features such as visitor lane, doffing, and donning area. It doesn't comply with the needed features of the tents in the guidelines set by the W.H.O. and D.O.H.

5.4 Proposed Improvements

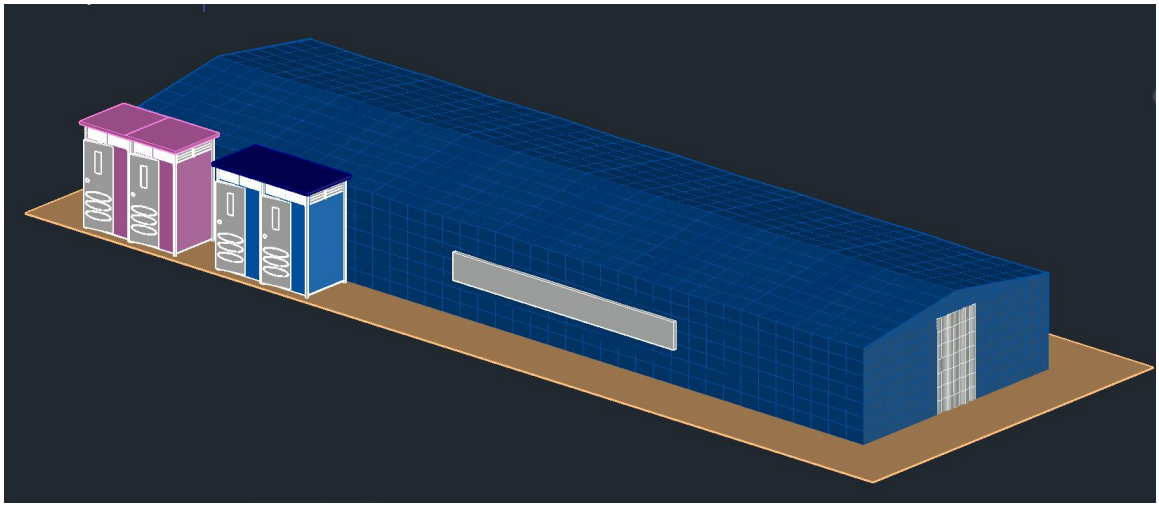

Figure 6. Improved Isolation Tent Exterior

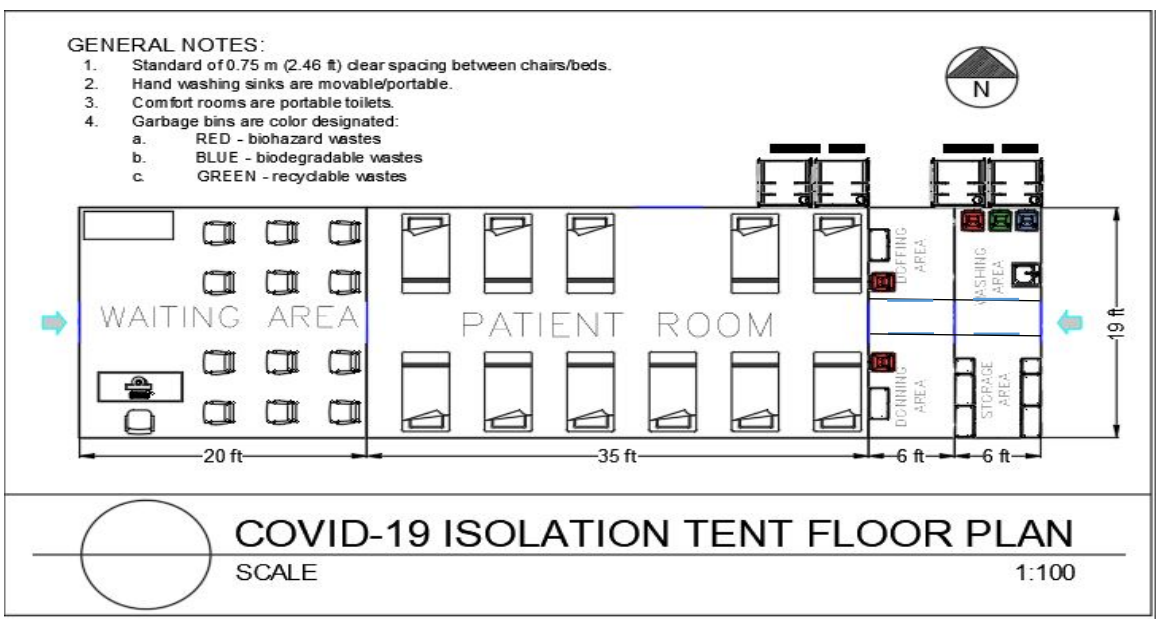

Figure 7. Improved Isolation Tent Floor Plan

Now, in figures 6 and 7, it presents proposed improved design of the isolation tents by the researchers. It strictly follows every instruction in the guidelines released by the D.O.H. (the said guideline is in the references), when it comes to building temporary medical facilities, to ease the congestion of COVID-19 patients in the hospitals. As you can see in the exterior, it is securely covered, so that contaminations will not leak inside or outside of the tent. It also has donning area which is meant for health care workers so that they could put on their PPE. Doffing area, to put off their PPE. Patient flow will be from left and straight ahead, while health care worker from right and ahead. It is important that it has different places to put on and off the PPE because used PPE shouldn't be mixed with the clean PPE for sanitation purposes. The improved design of the isolation tent also has small storage area, where can also hold off workers who will enter the tent, and in front of it is the washing area, so that workers can clean their hands before going to the donning area. The storage for some basic medicines, apparatus, and supplies for the tent. Separate lavatories for the patients and health care workers. The researchers also added a waiting area so that visitors of the patients have a place to stay in while waiting. The innovated tent also considers barriers of opaque and transparent plastic between patients, to provide privacy and of course, good lighting and proper ventilation.

5.5 Validation

Comparative Analysis

Table 1. Comparative Analysis

	Existing Isolation Tents	Improved Isolation Tents
Advantage/s	Cost is comparably lower than the improved isolation tents. (Ballpark figure: Php 210,000.00)	Efficient processes.
		Cost-effective isolation tents.
		The design is more appropriate and suitable.
		Help in faster recovery of the patients.
Disadvantage/s	Have inefficient processes.	The cost for redesigning the isolation tents. (Ballpark figure: Php 400,000.00)
	Risk exposure of everyone in the tents.	
	Ineffective in treating patients.	

Activity Relationship Diagram

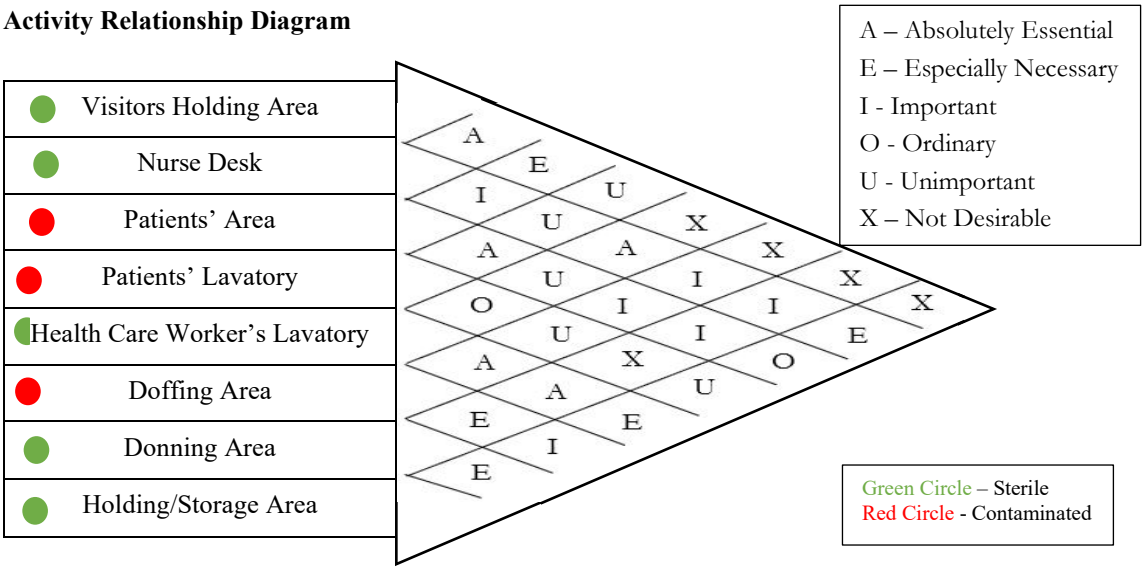

Figure 8. Activity Relationship Diagram

This activity relationship diagram shows the relationship of how important are these areas/facilities should be close to each other, or if it needs to be placed close to each other. Overall, patients' lavatory is undesirable to be

closed to the doffing and donning area, and holding/storage area. Of course, patients don't really need to be there because it is a restricted area for the health care workers only. While for the donning and doffing area, it is important to be close to the patients' area, of course you don't want the newly used PPE to be exposed to the other contaminant before seeing the patients. Also remember that this setup is also inspired to the guidelines released by the D.O.H.

6. Recommendations

Future researchers might want to research about sustainable materials that could be used in upgrading current PPEs, as well as creating an affordable Powered-Air Purifying Respirators (PAPR) that could increase the protection of healthcare workers and front liners, against viruses and other communicable diseases based on recent findings. The researchers recommend the study for affordable PAPR since current respirators on the market are expensive, making this preventive option not feasible to the Philippines due to the lack of monetary funds. In addition to this, the government should search and reserve spaces and areas allocated for emergency isolation facilities and tents, on condition that another virus outbreak might rise ahead. Moreover, they should ensure that these isolation facilities or portable and reusable tents are maintained and stored in safe space ready to be reused again efficiently if ever. Lastly, future researchers might also want to increase their population survey accordingly.

7. Conclusion

In conclusion, the risk assessment, survey, and other quantitative and qualitative research for COVID-19 isolation tents, believe that hygiene is poorly observed, especially in the close and limited spaces of the tent and respondents agrees that it should be a top priority as everyone is susceptible to the virus. With the sudden jolt of the pandemic, the standard safety protocols in wearing personal protective equipment (PPE) are not met along with the procurement of more supplies for that reason, everyone is trying to do their best to manage with whatever supplies are present at hand. In the result of the survey, there are still people who believe that isolation tents implement visitor guidelines that well, but the majority believe that yes there exist visitor guidelines but it didn't reach their expectations. To ensure a more efficient and safe operation of isolation tents, it is more of the process and design of the tents that are important. An isolation tent for this kind of highly contagious disease must have top quality of proper lighting and ventilation, electricity, help desk, I.T. access, separate entrance and/or exits, adequate spacing of accommodations. Additionally, the researchers believe that improving the isolation tents will definitely help in faster recovery of the patients, and having a more efficient process will make it easier for everyone. And with the faster recovery and efficiency of the system, hopefully that it will help the country to return to normal and cope up with the damages and loss that this pandemic has brought. At times like this, it is important that everyone is united towards one goal, and that is for everyone to rise stronger amidst this pandemic and support one another. One country and united citizens towards one goal.

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Biographies

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