

## Conference Paper

# KOPIDShield: Safety Partitions as a Novel Approach for Health-Worker's Protection during the Covid-19 Pandemic

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## Abstract.

Several tests have been developed for Covid-19 diagnosis. One of these tests is a PCR examination with a swab sample. The infection transmission risk to health workers during swab sampling is very high so an adequate protection standard is paramount. A special PPE for Covid-19 specimens' collection that is safer and can be used for a long time needs to be developed. The study aims to develop a prototype safe facility for collecting Covid-19 specimens with a high level of biosafety standard to prevent infection transmission, ergonomic, and can be used for an extended time. Applied research methods were used to produce a safety partition for Covid-19 specimen collection. The result was a safety partition prototype named KOPIDShield. It is completely impermeable to prevent the transmission of infectious agents from patients to health workers. It is equipped with supporting equipment that allows accurate specimen collection.

**Keywords:** biosafety, Covid-19, health\_ worker\_protection, personal\_protection\_equipment, transmission\_prevention

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**Published** 27 December 2022

**Publishing services provided by**  
**Knowledge E**

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Selection and Peer-review under the responsibility of the SIRES Conference Committee.

## 1. INTRODUCTION

Severe acute respiratory syndrome coronavirus (SARS-CoV)-2, a novel coronavirus from the same family as SARS-CoV and Middle East respiratory syndrome coronavirus, has spread worldwide leading the World Health Organization to declare a pandemic [1]. Covid-19 virus is transmitted between people through close contact and droplets. Healthcare workers are at significant risk of acquiring the infection; therefore, they are required to protect themselves and prevent transmission in the healthcare setting. Precautions to be implemented by healthcare workers caring for patients with Covid-19 include using appropriate personal protective equipment (PPE). The World Health

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Organization (WHO) and other national and international public health authorities recommend implementing safety protocols for healthcare workers. However, basic protective equipment and safety protocols are not always available in many medical institutions dealing with Covid-19 patients. Many medical institutions around the world do not have access to an appropriate number of human resources and diagnostic/therapeutic protocols to care for admitted and ambulatory patients suffering from Covid-19 [2,3]. The Covid-19 pandemic has strained health care system resources and reduced the availability of life-sustaining and medical-grade PPE through the combination of increased demand and disrupted manufacturing supply chains. One strategy to reduce the risk of infection and preserve existing equipment is the implementation of secondary barrier devices placed directly over patients or providers [4-6].

Several countries managed to control the spread of Covid-19 very well were; Mainland China as the earliest country to get these cases managed to control the situation after 30 days after 100 confirmed cases first happened. South Korea was brought under control within 20 days of its first 100 cases. Countries known for their great health systems are also helpless against Covid-19. This includes the United States, Germany, England, Denmark, Italy, and a series of other countries that we call developed countries [7-9].

Most people infected with the Covid-19 virus will experience mild to moderate respiratory disease and recover without requiring special treatment. Older people and those with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness [1,10-12]. To understand the unprecedented challenges posed by Covid-19, it is not enough to rely solely on confirmed cases and their geospatial spread. This information is very valuable, but also insufficient, to report statistical status in the mild, severe, and critical groups [13-16]. Worldometer reported high morbidity and mortality with a high new case growth rate per day [8,17,18]. At the same time, Indonesia has reported high accelerated new cases with high mortality [19]. With this increase in extraordinary cases, the government has issued various programs to prevent more widespread transmission. One of them is through a rapid test for initial screening and PCR examination for diagnosis [20,21].

Coronavirus is a very infectious virus that requires special handling and preparation. To carry out this rapid test, special facilities were needed that could protect health workers, especially those responsible for Covid-19 specimen collection. The required swab specimens are taken from the patient's nasopharynx and oropharynx. Currently, the rapid development of tests for screening methods is being promoted. This method requires that the Gold standard specimen of the throat is a viral culture, but this method is expensive and difficult and takes a long time. At this time, for specimen collection,

what is available is a special room with health workers who ideally wear high grade PPE. No facility separates patients from health workers [1,22–24].

Health professionals are at high risk of infection transmission during outbreaks of new diseases, especially before the dynamics of transmission are fully known. Many cases have been reported of SARS-CoV-2 transmission to health personnel in various parts of the world and more cases have been identified. Reports from various countries have described groups of healthcare workers exposed to patients with Covid-19; Most of the exposures to health personnel in these cases occurred in these patients through contact, droplet, or exposure to air [13,16,18,25].

Health worker's protection is very important because the medical personnel death rate due to Covid-19 in Indonesia was very high. One possible cause of the high mortality rate for health workers in Indonesia was the lack of safety protection for medical personnel. The need for personal protective equipment is the main thing to prepare. Currently, the need for PPE with its availability is not yet adequate, and if it is available, the price is very expensive. To be able to carry out their duties safely and comfortably, a safety protection facility that can be used safely, comfortably, and more economically was needed. This safety protection facility can prevent the spread of droplets from patients to laboratory personnel who carry out swab samples from the nasopharynx and oropharynx. This study aimed to design and develop a prototype safety protection facility for collecting Covid-19 specimens with a high level of biological safety standard to prevent infection transmission, ergonomic and can be used for an extended time.

## 2. METHODS

This research is applied research to develop a prototype of the most appropriate safe space to prevent infection transmission. The first step was to identify the problems faced by Al Islam Bandung Hospital as a useful partner. Identification is carried out through a discussion with hospital management and health workers involved in handling the Covid-19 case and adjusting to the situation and conditions of the Covid-19 handling flow at Al Islam Bandung Hospital. Then it was determined material requirements that were under the biosafety standards of the swab sampling facility, including the special needs for the specimen collecting officer. The next step was creating designs and infrastructure of the prototype followed by prototype development based on the design. Prototype development includes the mockup process, Factory Acceptance Test (FAT), and Site Acceptance Test (SAT). After prototype installation and testing, the health

personnel who will use this facility have tested the prototype and the expert evaluated the functions and safety standards of the prototype.

### 3. RESULTS AND DISCUSSION

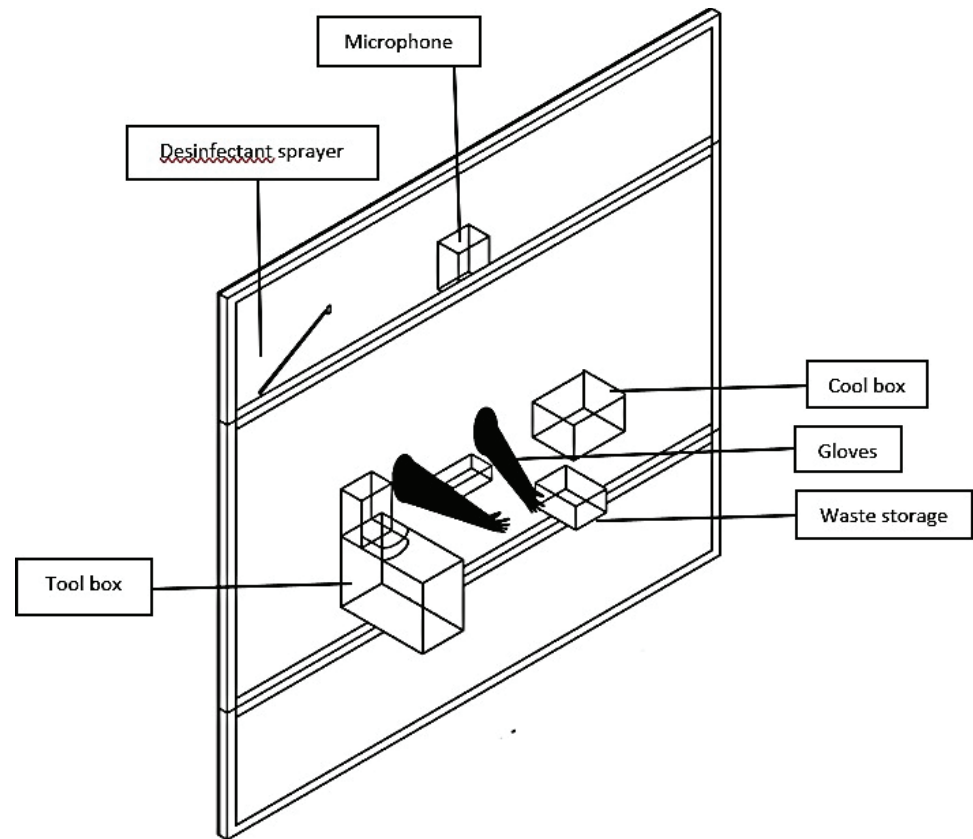
Based on the location and flow of Covid-19 handling at Al Islam Bandung Hospital, it appears that the location for taking the swab specimen was carried out in a room where the area is located between the red zone and the yellow zone. After observation of the room conditions and adjusting to the treatment flow, it was concluded that what was

needed was a partition-shaped protective installation that would separate the patient zone in the red zone from the health workers in the yellow zone. The protective partition was in accordance with the biosafety standards, which must be able to seal the room perfectly tightly so that there is no mixing of air, between the patient zone and the zone of health workers, to prevent infectious agents transmission from patients to health workers.

For the accurate specimen collection procedure, the facilities are needed to reach the patient zone from the zone of health workers, so that a special pair of gloves is needed which allows the process of taking swab specimens freely and accurately while still under biosafety standards. Therefore, the required gloves were resistant to various possible stimuli such as mechanical trauma, chemicals, or harmful rays so that they can be used for a long time. Also, the glove material was impassable by microscopic agents including infectious agents such as Covid-19, and installed in such a way that it is completely insulated following biosafety standards [2,26].

The existence of this partition was also not causing the specimen collection procedure to be not optimal so that supporting equipment is needed in the patient zone to accommodate various needs according to the stages of the swab sample collection procedure. Containers for storage of equipment such as tubes containing Virus Transfer Media (VTM), swab sticks, disinfectant spray bottles, VTM tube racks, coolbox, and medical bins storage. The supporting equipment is placed in size and distance that meets ergonomic standards so that the procedure for collecting swab specimens remains accurate and flexible. The existence of a perfectly insulated partition between the patient zone and the health worker zone makes supporting equipment needed for communication so that microphones were placed in the patient zone and the health worker zone. To minimize the risk of infection transmission between patients it is necessary to do the patient zone disinfection at the time between the completion of the patient's swab specimen collection and the next patient. For this reason, a disinfectant sprayer was needed which

will spray disinfection liquid into the patient zone [27-30]. The safety partition prototype design that has been made can be seen in fig. 1.



**Figure 1:** Safety partition prototype design for swab specimen collection procedure.

The next stage is the mockup process to see a preview of a design concept so that the image looks like its actual form. The mockup will provide an overview of the design before it is applied to real objects. The mockup process for the development of this partition involves health workers who are users as well as related technical consultants. In the mockup process, adjustments to the ergonomic size and material used to realize the installation of this partition were carried out according to the design [5,15,31]. The mockup process was adjusted according to the sequence of swab specimen collection procedures.

The result of the mockup process is the measurements of the mainframe and supporting equipment and the distance between each tool. The material used for each piece of equipment is also determined based on the results of the material

test so that in accordance with biosafety standards. Furthermore, the partition installation prototype was made according to the results of the design and mockup process. Supporting equipment is positioned in such a way as to allow health workers to be able to collect specimens accurately and safely even using a protective partition. The next

step after the prototype is the FAT process which is carried out before delivery to the user at the hospital. FAT is carried out at industrial partners' premises by conducting tests on systems/equipment following the test plan/user specifications which aim that the system/equipment will be installed according to the time of the user. By doing the correct FAT, it will minimize the risk of errors when the equipment/system is installed in a place/room in the hospital. The safety partition installed at the hospital can be seen in fig. 2.



**Figure 2:** Safety partition for swab specimen collection procedure installed at the hospital.

After the FAT was carried out with good results, then a prototype partition was installed at the Hospital in an area that had been determined. At the same time, the prototype was named **KOPIDShield**. The installation is carried out with the result that it is a partition separates the patient zone from the zone of health workers in a perfectly impermeable manner to prevent the risk of transmission of infections including the Covid-19 from the patient to the health worker during the swab specimen collection procedure. This prototype is also equipped with supporting equipment that is positioned ergonomically so that the swab specimen collection procedure can be carried out accurately. The safety partition was then empowered at the Al Islam Bandung Hospital for handling the Covid-19 pandemic and also been registered at the Directorate General of Intellectual Property as Intellectual Property Rights in the Industrial Product Design category with registration number A00202001425.

We hoped that the development of the safety partition also has a positive impact in protecting health workers, accelerate the handling of the Covid-19 pandemic, and encourage the participation of the homeland industry, especially industries that are engaged in developing health devices that accordance with biosafety standards.

## 4. CONCLUSION

As a solution to the limitations of personal protective equipment in handling the current Covid-19 pandemic, a prototype of a safety partition facility has been developed for the swab specimen's collection procedure that accordance with biosafety standards. The safety partition separates the patient zone from the zone of health workers in a perfectly impermeable manner to prevent the infectious agents' transmission including the Covid-19 virus from patients to health workers. This safety partition prototype is also equipped with supporting equipment that is positioned ergonomically so that the swab specimen collection procedure can be carried out accurately, also equipped with safety facilities that minimize the risk of transmission between patients. The material used in the safety partition allows this protective facility to be used for a long-term use and can be adapted to the location and condition of any health facility.

## ACKNOWLEDGEMENT

We would like to express our gratitude to the Research and Community Service Institution of Universitas Islam Bandung for full financial support to this study through the research grant program (039/B.04/LPPM7IV/2020), AI Islam Bandung Hospital as user partner, Hikmat Alitamsar as an engineering consultant for fruitful discussions and

biosafety insight, and K. Ardiansah for excellent work as an industrial partner. This work is dedicated to every healthcare provider fighting this pandemic, and to our Covid-19 patients, their families, and loved ones. This study was carried out in memory of our colleagues who lost their lives due to Covid-19.

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