

# A matrix for the evaluation of COVID-19 contact risk in healthcare workers: Technical note

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## Research Article

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# Abstract

Detecting risky contacts and early isolation of healthcare workers who have been in contact with COVID-19 cases will increase the likelihood of limiting the spread of the infection. The aim of this technical note is to propose a reliable, fast-adaptable and easy-to-use matrix that accurately classifies risk for contact tracing of healthcare workers with COVID-19 patients. The researchers have created a matrix with the support of the literature and their experience within the university hospital surveillance team. This matrix enables a detailed High / Medium / Low Risk classification of contacts of healthcare workers with COVID-19 cases, covering many different contact situations encountered in a university hospital. The distinction between different contact risk categories implies different preventive measures: High-risk contacts are isolated at home for 7 days and return to work if they test PCR-negative on day 7; while medium and low risk contacts continue to work using masks, with medium-risk contacts tested on day 7, so it is important to standardize the classification among different interviewers. Three main headings have come to the fore in health worker contact risk classification: 1. Differences caused by the ventilation of the environment: Indoors, well ventilated indoors, outdoors. 2. Direct contact or material sharing. 3. Aerosol generating procedure (AGP). The matrix has been used effectively in 1169 risky contact interviews over a two-month period (24 August - 23 October 2020). It has been evaluated by two groups: the surveillance team using it routinely for contact tracing and by experts. The matrix is quickly adapted by new surveillance team members and is easy to use.

## Introduction

It is accepted that the transmission of coronavirus disease 2019 (COVID-19) from person to person occurs through direct contact or droplets [1]. This type of spread puts healthcare workers (HCWs), who are crucial for the functioning of health systems, at great risk [2]. Although a systematic report on COVID-19 infections among HCWs around the world has not been submitted, the World Health Organization (WHO) reported that one in 10 HCWs were infected in some countries [3].

To control the spread of COVID-19, it is necessary to ensure that the number of new cases arising from each confirmed case remains below 1 [4]. Management strategies for identifying risky contacts of healthcare workers who have been in contact with a COVID-19 case and their early isolation will increase the likelihood of controlling the spread of the infection [5]. WHO recommends questioning for contact detection of COVID-19 from 1-3 days before the occurrence of the symptoms of the case to 14 days later [1]. Histories of contact with a patient with COVID-19 disease such as being within one meter from the case for more than 15 minutes, direct contact, use of common materials without the use of appropriate personal protective equipment (PPE) are defined as different contact risk groups, taking also into account the characteristics of the environment [6]. It is also important for HCWs to use appropriate PPE in aerosol generating procedures [7].

The first case of COVID-19 was seen in Turkey on March 11, 2020 and on the same day the World Health Organization (WHO) has declared the pandemic [8]. Then, the Ministry of Health published the COVID-19 Guideline, and the definitions of contact and close contact were used in the guide. Those who had unprotected direct contact with the COVID-19 patient or their secretions and those who stayed in the same indoor environment for more than 15 minutes at a distance of less than 1 meter with the COVID-19 patient were considered as close contacts [9]. On April 5, the guide “Contact Tracing in Health Care Workers” was published, which categorized healthcare workers according to the actions and the precautions they had taken. The contact risk of healthcare workers who did not use a medical mask or N95 in aerosol-forming procedures listed was deemed high in this guide. Moderate and low-risk contacts were defined by matching the choice of mask use with the use of PPE by the healthcare provider [10]. However, these options focusing on aerosol-generating procedures remained limited compared to many different instances of contact encountered in the hospital setting, and professionals who made contact tracing have faced many contact histories that did not fit these options, thus had to make subjective evaluations, taking also into account the “close contact” (requiring isolation) and “contact” (no isolation) definitions for the general public

In the advanced stages of the pandemic, the risky contacts of healthcare workers began to be concentrated in the COVID-19 areas, as well as in recreational areas, social areas or home environments with their colleagues. This situation started to cause problems in terms of continuity of health service delivery [3].

Hospital surveillance teams are often composed of HCWs and may face contact risks faced by HCWs. In cases where the continuity of the surveillance service is at risk or when it is necessary to increase the workforce that performs contact assessment due to the increase in the number of contacts, it is necessary to add new employees to the team. It is also vital that new members of the team quickly adapt to how they will carry out the contact assessment.

The aim of this technical note is to propose a reliable, fast-adaptable and easy-to-use matrix that accurately classifies the risk of contacts of healthcare workers with COVID-19 patients.

## **Risk Assessment In Health Care Workers, Eumf Hospital Experience**

Hospital surveillance teams are often composed of healthcare professionals and may face contact risks experienced by healthcare professionals. In cases where the continuity of the surveillance service is at risk or when it is necessary to increase the workforce that performs contact assessment due to the increase in the number of contacts, it is necessary to add new employees to the team. It is also vital that new members of the team quickly adapt to how they will carry out the contact assessment.

The Employee Health and Safety Unit (EHSU) conducts COVID-19 contact-tracing among the healthcare workers of Ege University Medical Faculty (EUMF) Hospital. The first PCR positive case of the hospital was diagnosed on March 18, 2020, and from that day on, contact detection was made in accordance with the guidelines of the Ministry of Health and classification was carried out according to the algorithm [11].

From March 11 to September 10, 2020, 1742 patients were found to have positive COVID-19 PCR tests [11]. In the same period, 1759 risky contacts were identified by the surveillance team and 616 (35.0%) of these risky contacts were classified as high, 570 (32.4%) as medium, 573 (32.6%) as low risk group [11].

In the surveillance working group, in line with the Ministry of Health's (MoH) guidelines then in effect between March 18 - April 5, 2020, the contacts of health staff were classified as "Close-contact / Contact" and close contacts were isolated. Simultaneous with the updates of the MoH guidelines, contacts of HCWs were classified as "High / Medium / Low Risk" between April 6 and August 23, 2020. During the process, it has been realized that the coverage of the guidelines remained limited. After the new normalization process as of June 1, 2020, as the contact stories began to diversify, the surveillance group had difficulty in making evaluations according to the updated guidelines.

As the pandemic progressed, an increasing experience showed that risky contacts are not only of patient origin. Of the 94 employees diagnosed as COVID-19 with a known contact history, 32 had developed in contact with patients, 34 in contact with family or partner and 25 are in contact with a colleague [11]. The variety of the environment in terms of risky contacts in the workplace (open / well ventilated closed / closed / the environments where the aerosol-generating process is performed), the use of mask in the case and the healthcare worker, and the type of mask, together with the exposure time and distance (variety of distance), a need for a guide has arisen. While evaluating the diversity of the use of personal protective equipment by healthcare workers in the environment where aerosol-generating processes take place, the possibility of the presence of another healthcare worker in the same environment should not be ignored. In addition, it was necessary to evaluate the use of PPE and contact distance of the health worker together. When questioning direct contact with the cases or the use of common materials like computer keyboards, the need to question hand hygiene after contact was also required.

During the pandemic period, rapid adaptation of surveillance members to contact assessment was an important need. Surveillance members may also become isolated as SARS-CoV 2 patients or case contacts, or may be assigned to other work environments due to the pandemic. In this situation, rapid adaptation is critical. In addition, standardization has gained importance in the application of isolation to ensure consistency between practitioners. For this reason, a matrix based on the guidelines of the Ministry of Health was developed by the researchers with the support of the literature and started to be used as of August 17 (Figure 1,2,3). The High / Medium / Low Risk classification has been updated [6,7,12–14]. The first draft of the matrix, which was submitted for the approval of seven nurses, two occupational safety specialists and two medical doctors involved in contact determination studies, was updated in line with the recommendations and started to be implemented on August 24. At the end of the first month, the matrix was evaluated by the surveillance team and 7 experts (2 public health, 2 microbiology, 2 infectious diseases experts, 1 epidemiologist), and its application was continued following its approval.

## Evaluation Of The Matrix

The matrix was submitted to the surveillance team and expert evaluation at the end of the first month. With an online survey method, the question "How many of the ten contacts do you think each matrix classifies correctly?" was asked. The matrix received an average score of 8.6/10 (min: 8.2, max: 9.0) and was used in 1169 risky contact interviews in two months (24 August - 23 October 2020).

Three main headings came to the fore in health care workers contact risk classification.

### **1. Differences caused by the ventilation of the environment: Indoors, well ventilated indoors, outdoors (figure 1)**

Indoors are more risky areas where it is difficult to keep the distance between people wide [15]. Another possible situation that increases the risk is the longer stay together indoors [16]. Well ventilation, essential for a healthy indoor climate, helps limit the spread of the SARS-CoV-2 virus [17]. However, according to available data, the contamination potential is much lower outdoors than indoor environments, due to the turbulence levels found outdoors [16]. In evaluating the contact of HCWs with COVID-19 cases, it was necessary to categorize the contact environment as closed / well ventilated indoor / outdoor. However, in situations where the same environment is shared, the risk is associated with many factors including ventilation of the environment, use of masks, distance and exposure time [13].

SARS-CoV-2 spreads between people who are in close contact with each other. A distance of at least 1 meter is recommended for COVID-19 patients to reduce the risk of infection when talking or coughing [18]. However, there are also sources that suggest staying at least 2 meters away from other people even in open environments [15]. In contact risk assessment, it is important to take into account that a physical distance of at least 1 meter reduces the risk of SARS-CoV-2 transmission, but 2 meters may be more effective, and the greater the distance, the more likely to be protected [19].

The risk of SARS-CoV-2 spread is determined by how closely the interaction with the COVID-19 case takes places and how long this interaction lasts.. For healthcare workers, high-risk exposures are directly related to face-to-face contact lasting 15 minutes or longer [6,13]. Using the 15-minute contact time limit on the basis of evidence provides practicality in classification of contact risk [14]. It should also be taken into account that the cumulative exposure time in repeated contacts affects the risk of transmission [20].

The mask worn by the person acts as a simple barrier to help prevent respiratory droplets from getting into the air and other people. The use of masks is particularly important in environments where people are close to each other or where social distance is difficult to maintain [19]. Mask use details of both the HCW and the patient are important in determining the risk of COVID-19 exposure [21].

### **2. Direct contact or material sharing**

A high-risk contact occurs when healthcare workers care for COVID-19 patients without or with inappropriate PPE. If hand hygiene has not been achieved after direct contact with the patient, with the patient's body fluids, or with the patient's contaminated environment, it is also within the scope of high-risk contact [6]. This feature becomes more important when the case in contact is a colleague, so many

different items like pens and keyboards could be shared with the case in the two days before the symptoms or diagnosis.

### **3. Aerosol generating procedures (AGP)**

Situations such as exhaling, singing, coughing, and sneezing create high-momentum gas clouds containing respiratory droplets. This moves droplets faster than background ventilation streams and they can reach distances of more than 2 meters in a short time [13]. Some procedures performed on patients are more likely to generate higher concentrations of infectious respiratory aerosols than coughing, sneezing, talking or breathing [22]. Performing aerosol generation procedures in healthcare settings or potentially elsewhere in closed, crowded, poorly ventilated environments increases the risk of infection [1]. High risk contact can be considered when a healthcare worker is applying the procedure or is present in the environment without PPE or with inappropriate PPE during an AGP [6]. The Ministry of Health's Assessment of the Contact Status of the Health Care Worker with the COVID-19 patient recommends the use of N95 masks and face shields or eyeglasses together in aerosol-generating procedures, considering the use of a medical mask instead of N95 or not using a face shield/eyeglasses as medium risk [7].

However, there are difficulties in determining whether the reported transfers during AGPs are due to aerosols or other exposures [22]. Another issue is that currently there is insufficient evidence to support the effectiveness of face shields for resource control. Therefore, face shields are not currently recommended to replace masks [22].

## **Limitations**

Despite all this evidence, there are still situations where the matrix may be limited in its use. It should be noted that as the contact time increases in a poorly ventilated indoor, the importance of the distance and the protection of the mask decrease. Even if the contact time is short, how long the patient has been in the environment might be important and whether the patient is not wearing a mask as well. The total time of repeated exposure, whether it exceeds 15 minutes might be evaluated in detail by an experienced surveillance team. In addition, if there is more than one contact type, all of them should be evaluated separately and the HCWs followed-up according to the one with higher risk. It should not be forgotten that the evaluations rely on the self-reports of the person coming into contact with a COVID-19 case.

## **Conclusion**

The matrices that have been applied as of August 24, 2020 in the surveillance studies of the EUMF Hospital, classifying the risky contacts of healthcare workers with COVID-19 cases, which are found to be quickly adapted by surveillance teams and easy to use are recommended. These matrices, in their widespread use, will provide more protection for high-risk situations, while enabling the sustainability of healthcare delivery by detecting lower risk situations.

# Declarations

## Competing Interest

The authors declare that they have no competing interests.

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## Consent Statement

The surveillance team and the experts consented to participate in the evaluation of the contact risk classification matrices.

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# Figures

		PATIENT				DISTANCE	
		MASK USE		NO MASK			
		Medium	High	High	High		
INDOORS	HCW HAS A MASK	NO	Medium	High	High	High	<1 M
			Low	Medium	Medium	High	1-2 M
			No Risk	Low	Low	Medium	≥2 M
		YES	Low	Medium	Medium	High	<1 M
			No Risk	Low	Low	Medium	1-2 M
			No Risk	No Risk	No Risk	Low	≥2 M
WELL VENTILATED INDOORS	HCW HAS A MASK	NO	Low	Medium	Medium	High	<1 M
			Low	Medium	Medium	High	1-2 M
			No Risk	Low	Low	Medium	≥2 M
		YES	Low	Low	Low	Medium	<1 M
			No Risk	Low	Low	Low	1-2 M
			No Risk	No risk	No Risk	Low	≥2 M
OUTDOORS	HCW HAS A MASK	NO	Low	Medium	Medium	High	<1 M
			Low	Low	Low	Medium	1-2 M
			RD	RD	RD	RD	≥2 M
		YES	Low	Low	Low	Medium	<1 M
			No Risk	Low	Low	Low	1-2 M
			No Risk	No Risk	No Risk	No Risk	≥2 M
		<15 Min	≥15 Min	<15 Min	≥15 Min		
		TIME					

\*No Risk: Cannot be considered risky

Figure 1

Contact risk assessment matrix for indoors, well ventilated indoors, and outdoor environments in the lack of an aerosol generating procedure

		PATIENT				DISTANCE	
		MASK USE		NO MASK			
INDOORS	HCW HAS A MASK	NO	Medium	High	High	High	<1 M
			Low	Medium	Medium	High	1-2 M
			No Risk	Low	Low	Medium	≥2 M
		YES	Low	Medium	Medium	High	<1 M
			No Risk	Low	Low	Medium	1-2 M
			No Risk	No Risk	No Risk	Low	≥2 M
WELL VENTILATED INDOORS	HCW HAS A MASK	NO	Low	Medium	Medium	High	<1 M
			Low	Medium	Medium	High	1-2 M
			No Risk	Low	Low	Medium	≥2 M
		YES	Low	Low	Low	Medium	<1 M
			No Risk	Low	Low	Low	1-2 M
			No Risk	No risk	No Risk	Low	≥2 M
OUTDOORS	HCW HAS A MASK	NO	Low	Medium	Medium	High	<1 M
			Low	Low	Low	Medium	1-2 M
			RD	RD	RD	RD	≥2 M
		YES	Low	Low	Low	Medium	<1 M
			No Risk	Low	Low	Low	1-2 M
			No Risk	No Risk	No Risk	No Risk	≥2 M
		<15 Min	≥15 Min	<15 Min	≥15 Min		
<b>TIME</b>							

\*No Risk: Cannot be considered risky

Figure 1

Contact risk assessment matrix for indoors, well ventilated indoors, and outdoor environments in the lack of an aerosol generating procedure

**DIRECT CONTACT**  
In case of medical  
necessity  
**USE OF GLOVES**

		YES	NO
HANDWASHING	NO	<b>MEDIUM</b>	<b>HIGH</b>
	YES	<b>LOW</b>	<b>MEDIUM</b>

Figure 2

Contact risk assessment matrix in direct contact or material sharing

**DIRECT CONTACT**  
In case of medical  
necessity  
**USE OF GLOVES**

		YES	NO
HANDWASHING	NO	<b>MEDIUM</b>	<b>HIGH</b>
	YES	<b>LOW</b>	<b>MEDIUM</b>

Figure 2

Contact risk assessment matrix in direct contact or material sharing

## AEROSOL GENERATING ENVIROMENT

		PATIENT				DISTANCE	
		MASK USE		NO MASK			
HEALTH CARE WORKERS	NO MASK	Medium	High	High	High	<1 M	
		Low	Medium	High	High	1-2 M	
		Low	Low	Medium	High	≥2 M	
	MASK USE	Low	Medium	Medium	High	<1 M	
		Low	Medium	Medium	High	1-2 M	
		No Risk	Low	Low	Medium	≥2 M	
	N95 USE	No Risk	Low	Low	Medium	<1 M	
		No Risk	Low	Low	Medium	1-2 M	
		No Risk	No Risk	No Risk	Low	≥2 M	
			YES	NO	YES	NO	
	FACE SHIELD						

No Risk: Cannot be considered risky

**Figure 3**

Contact risk assessment matrix for aerosol generating procedure (AGP) environments

## AEROSOL GENERATING ENVIROMENT

		PATIENT				DISTANCE	
		MASK USE		NO MASK			
HEALTH CARE WORKERS	NO MASK	Medium	High	High	High	<1 M	
		Low	Medium	High	High	1-2 M	
		Low	Low	Medium	High	≥2 M	
	MASK USE	Low	Medium	Medium	High	<1 M	
		Low	Medium	Medium	High	1-2 M	
		No Risk	Low	Low	Medium	≥2 M	
	N95 USE	No Risk	Low	Low	Medium	<1 M	
		No Risk	Low	Low	Medium	1-2 M	
		No Risk	No Risk	No Risk	Low	≥2 M	
			YES	NO	YES	NO	
	FACE SHIELD						

No Risk: Cannot be considered risky

**Figure 3**

Contact risk assessment matrix for aerosol generating procedure (AGP) environments