Study on current practice of proper Donning and Doffing during the Corona virus Pandemic

By

Vaishnavi Gupta

Dissertation submitted in partial fulfillment of the

requirements of the degree

MBA Hospital and Health Management

Academic year, 2019-

2021

Dr. Veena Nair Sarkar

The IIHMR University, Jaipur

1, Prabhu Dayal Marg, Sanganer, Airport
Jaipur 302029, Rajasthan
Ph: 0141 3924700, Fax: 3924738
Website: **www.iihmr.edu.in**

Study on the current practices of proper Donning and Doffing during Coronavirus Pandemic

By

Vaishnavi Gupta

Dissertation submitted in partial fulfillment of

award of MBA Hospital and Health Management

Academic year, 2019-2021

Mahatma Gandhi University of Medical Sciences and Technology, Jaipur

The IIHMR University, Jaipur

1, Prabhu Dayal Marg, Sanganer, Airport
Jaipur 302029, Rajasthan
Ph: 0141 3924700, Fax: 392473
Website: **www.iihmr.edu.in**

TO WHOMSOEVER MAY CONCERN

This is to certify that Vaishnavi Gupta, student of MBA Hospital and Health Management from The IIHMR University, Jaipur has completed the internship training at Mahatma Gandhi University of Medical Sciences and Technology, Jaipur from 03/02/2020 to 29/05/2020.

The Candidate has successfully carried out the study designated to her during internship training and his approach to the study has been sincere, scientific, and analytical.

The Internship is in fulfillment of the course requirements.

I wish her all success in all her future endeavors.

Dean, Academics and Student Affairs
The IIHMR University, Jaipur
Professor
The IIHMR University, Jaipur

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled "Study on the current practices of proper Donning and Doffing during Coronavirus Corona -virus Pandemic" and submitted by Vaishnavi Gupta, Enrollment No: 1033, under the supervision of Dr. Veena Nair Sarkar for award of MBA in Hospital and Health Management of the University carried out during the period from 01/04/2021 to 01/07/2021 embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.

Vaishnavi Gupta
Signature

Acknowledgement

I would like to take this opportunity to express my gratitude to my guide, Dr. Veena Nair Sarkar who supported me from the beginning of my dissertation to the end.

I would also like to thank my team at Mahatma Gandhi University of Medical Sciences and Technology who constantly made it possible for me to devote time to completing my dissertation.

My parents and friends showed immense levels of support during this time, especially considering the ongoing pandemic.

TABLE OF CONTENTS

Study on the current practices of proper Donning and Doffing during Coronavirus Pandemic

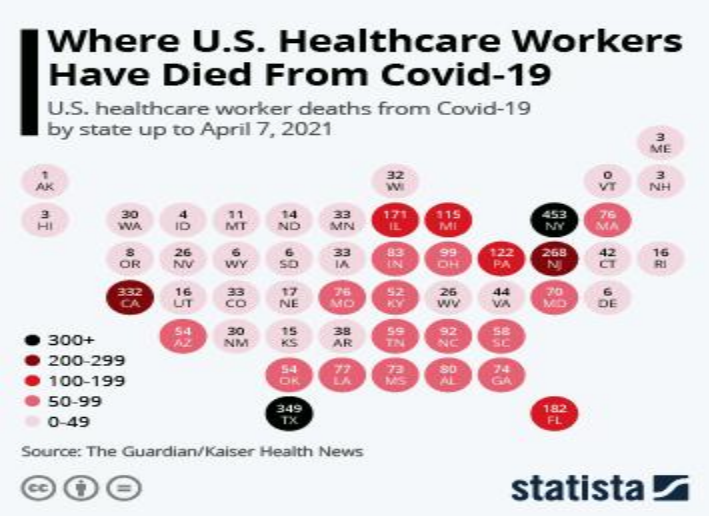
INTRODUCTION

The sudden surge in rise of coronavirus diseases and cases thereof caused by (2019-nCoV), has become a global threat. Coronavirus pandemic is the most crucial event in today's day and age and so it requires a lot of attention and care. Coronavirus Pandemic has proven itself to be one of the most lethal pandemics that history has ever seen spreading itself in six continents causing more than 3.8 million deaths worldwide Patients suffering with coronavirus are in many cases getting very critically ill, developing severe complications and at times getting to the final step that is death, way before the normal time. Intensive Care Unit care is henceforth, extremely important and so is the ICU staff including doctors, nurses, paramedics and others.

Covid 19 infection can be easily identified by symptoms such as cough, high grade temperature, muscle pain, joint soreness, fatigue and not feeling energetic enough to carry out basic day to day chores. Covid in many cases has caused severe illness in patients and unimaginable physical and mental trauma, patients are developing respiratory failure, organ failure, sepsis, etc and hence, are requiring mechanical intervention such as ventilation for prolonged periods of time (McLaren G, *et al,2020).* Critically ill patients with COVID-19 are extremely susceptible to a plethora of severities such as progressing rapidly into severe complications such as acute respiratory distress syndrome (ARDS), septic shock, metabolic acidosis, coagulation disorders and multiple organ failure and finally death and hence, they have to be transferred to the critical care units in time and for that a high level of care from doctors, nurses, dieticians, psychologists, paramedical staff and other ICU staff is of paramount importance. For all this care, a specialised team of doctors, nurses, other hospital staff to be present at all times is of paramount importance. Owing to such great complications due to the virus, patients are very commonly facing conditions that include, delusions, hallucinations, extreme stress, depression, anxiety attacks, panic attacks, even seizures in certain cases, creating a direct link to post-critical care psychological morbidity such as post-traumatic stress disorder (PTSD), depression and anxiety (Richards-Belle A, Mouncey PR, Wade D, *et al*,2020).
The Frontline as well as healthcare workers are fighting tirelessly to stop the spread of this virus along with curing patients suffering from and its aftereffects. Hence, Ways to avoid the spread of this dangerous virus among healthcare workers is also of utmost importance. Due to shortage of information available and not many intervention studies in infection control and transmission in healthcare settings Health care personnel (HCP) are at heightened risk of acquiring COVID-19 infection (Scheuer T, *etal*,2020). Since, the frontline healthcare workers are fighting day and night for those infected, they are at a very high risk of developing some of these physical and mental complications as well but, being they cannot stop providing services and treating the patients hence, there has to be a particular way to avoid the contamination of this virus.

The Guardian and Kaiser Health News, laid down an analysis which suggested the death of over

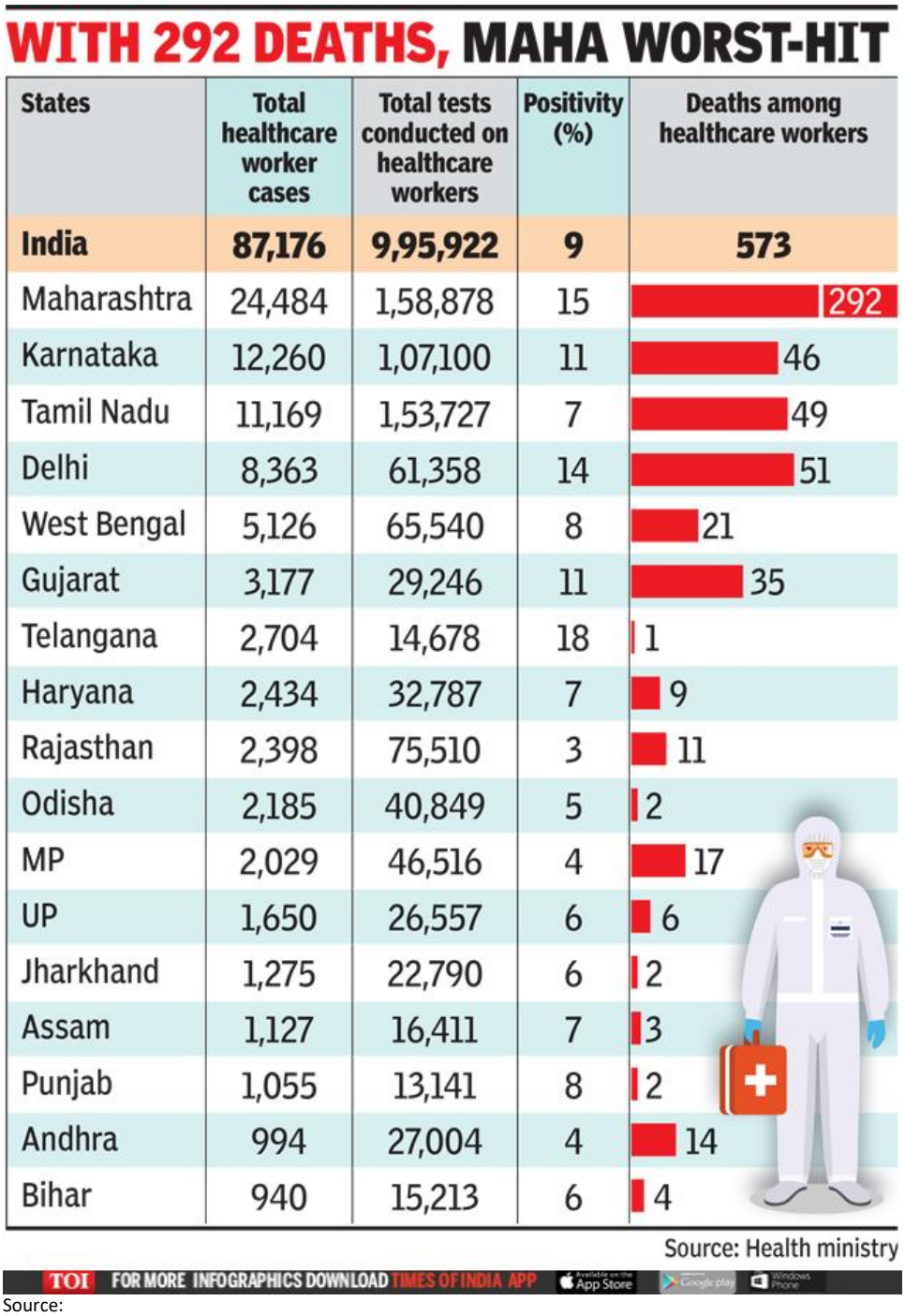
3,600 U.S. healthcare workers have died due to Covid-19 so far (2020). Although, this looks like a lot less than the actual mortalities and official figures reported by the Centres for Disease Control and Prevention.



Source: https://www.statista.com/chart/23882/healthcare-worker-deaths-by-state/

Certain well designed and early studies from the Peoples Republic of China (PRC) demonstrate that Healthcare workers such as doctors, nurses, paramedics and other hospital staff are more susceptible to COVID-19 than common people who are not very much in contact with the hospitals. Studies amongst Health Care Workers in People's Republic of China showcased that COVID-19 risk was linked with working in high-risk department such as infectious disease and pulmonology (RR = 2.13, 95% CI 1.45–3.95), diagnosed family member (RR = 2.76, 95% CI 2.02–3.77), inadequate hand hygiene (RR = 2.64, 95% CI 1.04–6.71), suboptimal hand hygiene before and after contact with patients (RR = 2.43, 95% CI 1.34–4.39), improper PPE (RR = 2.82, 95% CI 1.11–7.18), close contact with patients (12 times/day), long daily contact hours (≥ 15 h), and unprotected exposure. Common symptoms that were observed were fever (85%), cough (80%), weakness (70%), chest distress (7%), hemoptysis (7%), headache (7%), and diarrhoea (7%) (Li Ran, *et al,* 2020). Even though not many intervention studies exist, going by early data

suggestions, there should be implementation strategies to reduce the chances of infections, proper donning and doffing of PPE kits, designing of a more comfortable PPE Kit, shorter shift lengths, and mechanisms for mental health like frequent counselling support could reduce the morbidity and mortality amongst Health Care Workers (Shaukat N., *et al,* 2020).



WITH 292 DEATHS, MAHA WORST-HIT

States	Total healthcare worker cases	Total tests conducted on healthcare workers	Positivity (%)	Deaths among healthcare workers
India	**87,176**	**9,95,922**	**9**	**573**
Maharashtra	24,484	1,58,878	15	292
Karnataka	12,260	1,07,100	11	46
Tamil Nadu	11,169	1,53,727	7	49
Delhi	8,363	61,358	14	51
West Bengal	5,126	65,540	8	21
Gujarat	3,177	29,246	11	35
Telangana	2,704	14,678	18	1
Haryana	2,434	32,787	7	9
Rajasthan	2,398	75,510	3	11
Odisha	2,185	40,849	5	2
MP	2,029	46,516	4	17
UP	1,650	26,557	6	6
Jharkhand	1,275	22,790	6	2
Assam	1,127	16,411	7	3
Punjab	1,055	13,141	8	2
Andhra	994	27,004	4	14
Bihar	940	15,213	6	4

Source: Health ministry

Source:
https://www.google.com/search?q=healthcare+workers+deaths+due+to+covid+19,+2021&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjttuzZ0ILxAhVv6nMBHS42BksQ_AUoAnoECAEQBA&biw=1366&bih=657#imgrc=OVx7vQEivsr8CM

Healthcare workers are advised to wear PPE kits in a properly defined way laid down by various supreme healthcare organizations and governing bodies in the world so as to avoid any infection pertaining to Covid 19 which, many times, they do not adhere to. **Healthcare personnel** should adhere to Standard and Transmission-based Precautions laid down by several national and international healthcare bodies in and around the world when caring for patients with coronavirus infection. The correct way to use a PPE is well provided in the the Infection Control Guidance (Center for Disease Control and Prevention).

DONNING and DOFFING of PPE Kits-

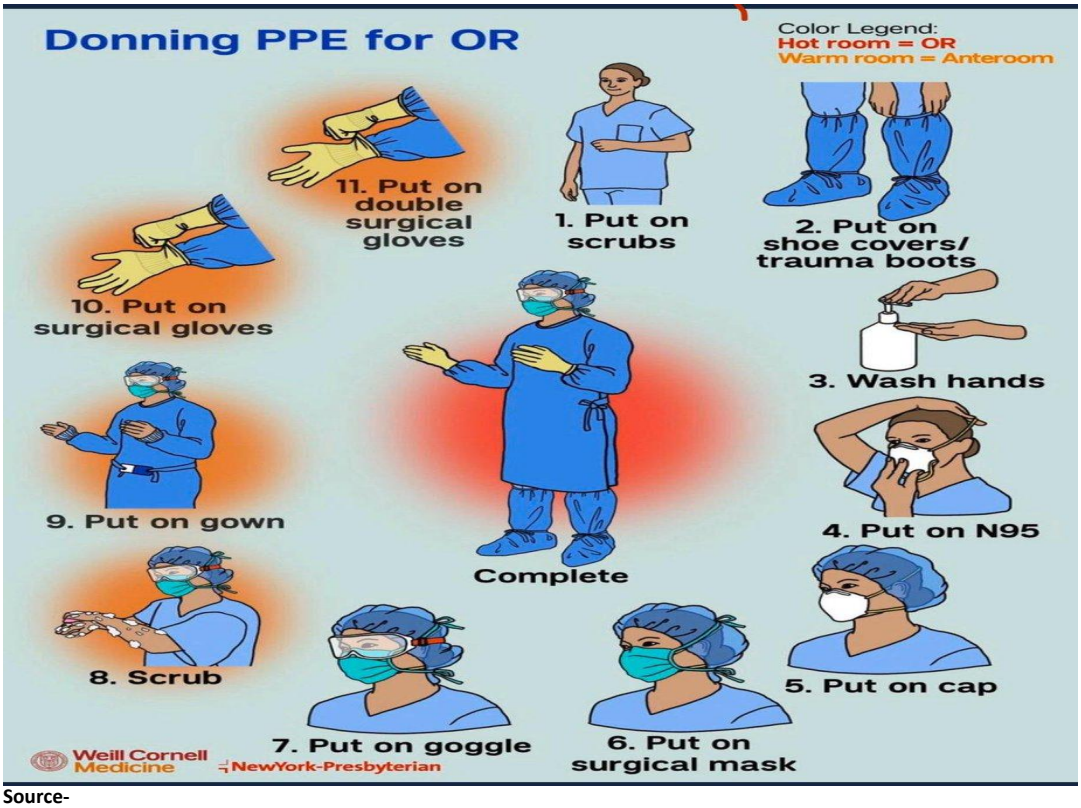
The novel coronavirus mainly spreads through the following channels: - the respiratory droplet, aerosol exposure, person to person contact (Rohan HA, *et al,*2020). Using Personal Protective Equipment Kit is of utmost importance. Nurses and other hospital staff should wear(donning) PPE (Personal Protective Equipment) before going in to treat, meet and check any infected person.

Certain fundamental ways of Donning and Doffing of PPE kits is suggested by various national and international bodies under their standard protocols for the treatment of Covid 19 patients. One of the several ways is listed as below.

The correct way to **DON (Wear)** a PPE kit (According to CDC Guidelines) is-
Among the several methods laid down, anyone donning method may be acceptable. Below is one specified way of donning.

1. Identification and gathering the proper PPE to don**.** Ensure choice of gown size is correct (based on training). It refers to finding the correct fit of the kit so as to avoid any glitches in between the work like constant touching and adjusting.
2. Perform proper hand hygiene using a good, bacteria disinfecting hand wash or hand sanitizer.
3. Put on a fitted isolation gown**.** Tie all of the ties on the gown. Assistance may be needed by other healthcare personnel.
4. Put on N95 filtering face piece respirator or higher (use a facemask if a respirator is not available)**.** The nosepiece should tightly cover the nose and should not be loose Respirator/facemask should be placed in such a way that it covers the nose, mouth and chin. In no way should it hang below the chin, below the nose, or above anywhere.
    - The first respirator strap should be placed on the crown portion of the of head and the second strap should be on the base of neck.
    - Facemask: Mask ties should be secured on crown of head (top tie) and base of neck (bottom tie). If mask has loops, hook them appropriately around your ears.

5. Put on face shield or goggles**.** When one is wearing an N95 respirator, one should also focus on finding a good eye cover so as to protect the openings in the eye also. The eye protection should be such which does not hinder with the view and is comfortable. Here is where goggles come into picture. Face shields provide full face coverage. The only downside of goggles is that they cause fogging although, they are excellent eye protection providers.
6. Put on clean and fitted gloves**.**
7. Healthcare personnel is ready to enter the patient area.



Source-
https://www.google.com/search?q=doffing+of+ppe+kits&source=lnms&tbm=isch&sa=X&ved=2ahUKEwigx7nf94LxAhU_8XMBHeHJB1IQ_AUoAXoECAEQAw&biw=1366&bih=657#imgrc=rDRIEJO_-paMDM

How to Take Off (Doff) PPE Gear

More than one doffing method may be acceptable.

. Below is one example of doffing.

1. Removal of gloves consists of techniques like bird beak or glove in glove which makes sure that hands do not get contaminated or infected.
2. Removal of the gown should be done in a gentle way to avoid breaking or tearing. Certain gown ties are not very thick and can easily be broken but that has to be done in

a gentle fashion avoiding any forceful movements. Another good approach can be rolling the gown down in a careful soft way.

3. Healthcare personnel is ready to go out of the infected area.
4. Removing face shield and goggles and then Performing proper hand hygiene like washing of Hands for a minimum of 20 seconds with a good disinfecting soap and water.
5. Remove and discard respirator (or facemask if used instead of respirator)**.** Do not touch the front of the respirator or facemask.
    - Remove the bottom strap carefully by bringing it over your head and then slightly rolling it off similarly, clasp the first strap and roll it over your head afterwhich, the respirator is removed without touching the skin of the face
    - Carefully the mask straps are pulled away from the face without touching the nose or mouth.
6. Perform hand hygiene after removing the respirator/facemask and before putting it on again if your workplace is practicing reuse. Ideally, it is advised to not reuse the respirator.

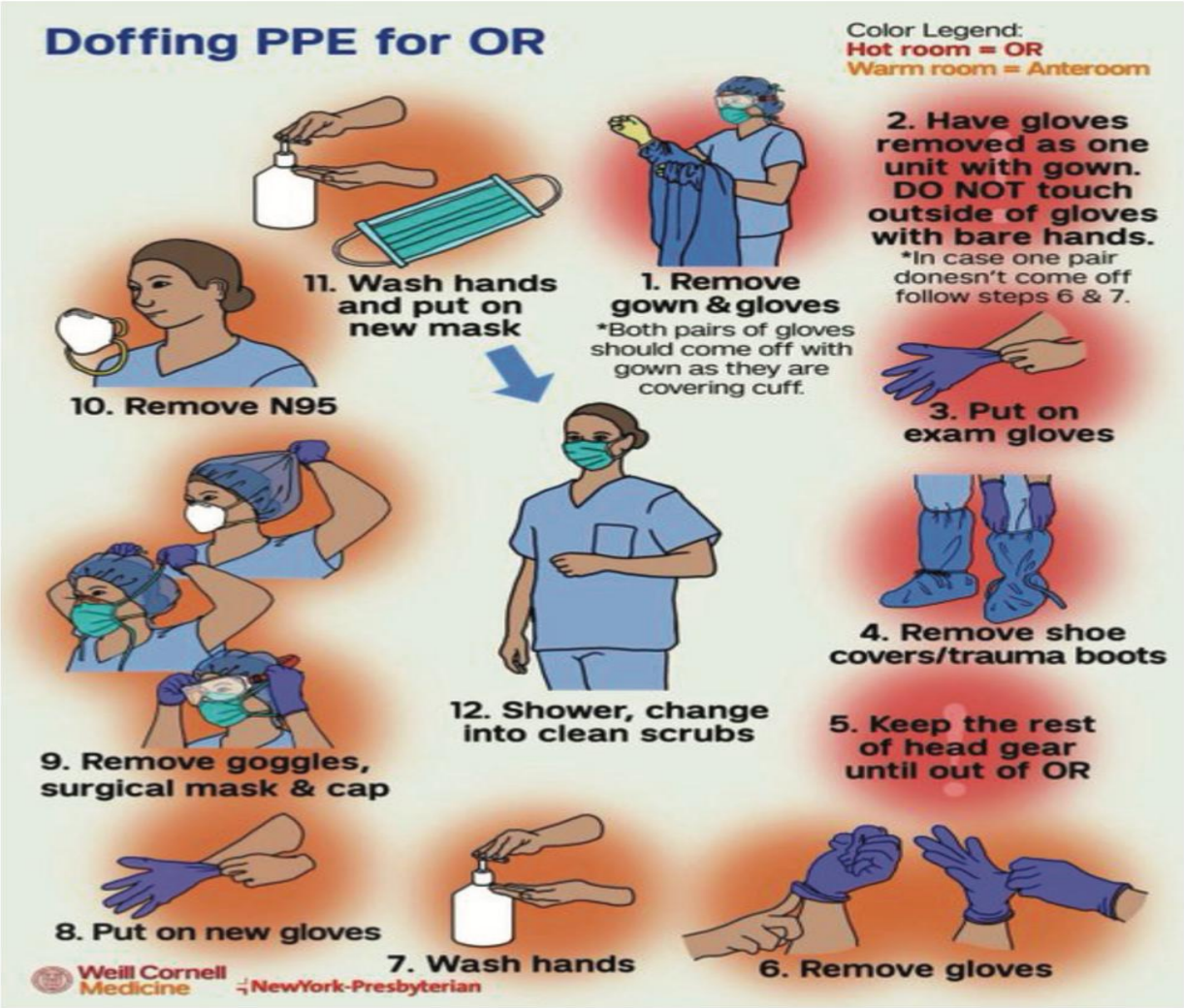


Figure 3. Illustrations of the steps for doffing PPE from Weil Cornell Medicine, Columbia Presbyterian Hospital, New York, New York.

Source-
https://www.google.com/search?q=doffing+of+ppe+kits&source=lnms&tbm=isch&sa=X&ved=2ahUKEwigx7nf94LxAhU_8XMBHeHJB1IQ_AUoAXoECAEQAw&biw=1366&bih=657#imgrc=h7yvkzpOe-loiM

General Guidelines for donning and doffing-

A general suggestion /advice is that the that ICU staff should ideally wear two layers of protective equipment like N95 mask and over that another surgical mask, two medical head covering caps, three layers of gloves, three special layers protective gowns, full coverage providing goggles, 2 layers of shoe cover, and a thick face shield so that all the potential openings in the body are sealed.

If, in case the ICU staff has to perform a patient check or a medical procedure or an examination that can potentially cause contamination by spreading sputum (Zhonghua Jie He He Hu Xi Za Zh, *et al,* 2020). The medical protective clothing is worn in between the two layers of gowns. The gown on the outer layer protects the healthcare personnel from getting infected by even the slightest contamination by the patient's bodily fluids and to keep the protective

effect. The gown clothing is worn to prevent the healthcare personnel from being exposed to the virus while taking off the protective clothing. COVID-19 ICU is divided into three separate areas: clean, buffer, and contaminated zones for the sake of stronger isolation and avoidance of any cross-contamination among healthcare workers, (Liu Qian, Wang Rongshuai, Qu Guoqiang, *et al,* 2020). Hand hygiene is another very important step that should be taken into a fair consideration, it points to washing hands with a good disinfectant and water for at least 20 seconds. All the doorknobs/handles should be disinfected by using a good alcohol-based sanitizer spray before and after touching it, all healthcare workers must put on PPE according to the protocol in the clean zone following these steps:

1. Proper hand washing and other hand hygiene practices like using a sanitizer spray.
2. Application of a medical cap to cover the head and hair properly
3. Using the 3M 1860/9132 medical mask or the N95
4. Application of another medical cap (for extra protection)
5. Putting the surgical mask over the N95 mask.
6. Wearing goggles for complete eye protection
7. Wearing the first layer of isolation gown
8. Wearing glove layer first to secure hands.
9. Wearing the first layer of shoe covers which are disposable
10. Wearing on the isolation protective coverall
11. Wearing the second layer of gloves over the first to firmly cover hands and fix the first layer.
12. Putting on another layer of gown
13. Wearing the third layer of gloves
14. Wearing the face shield.

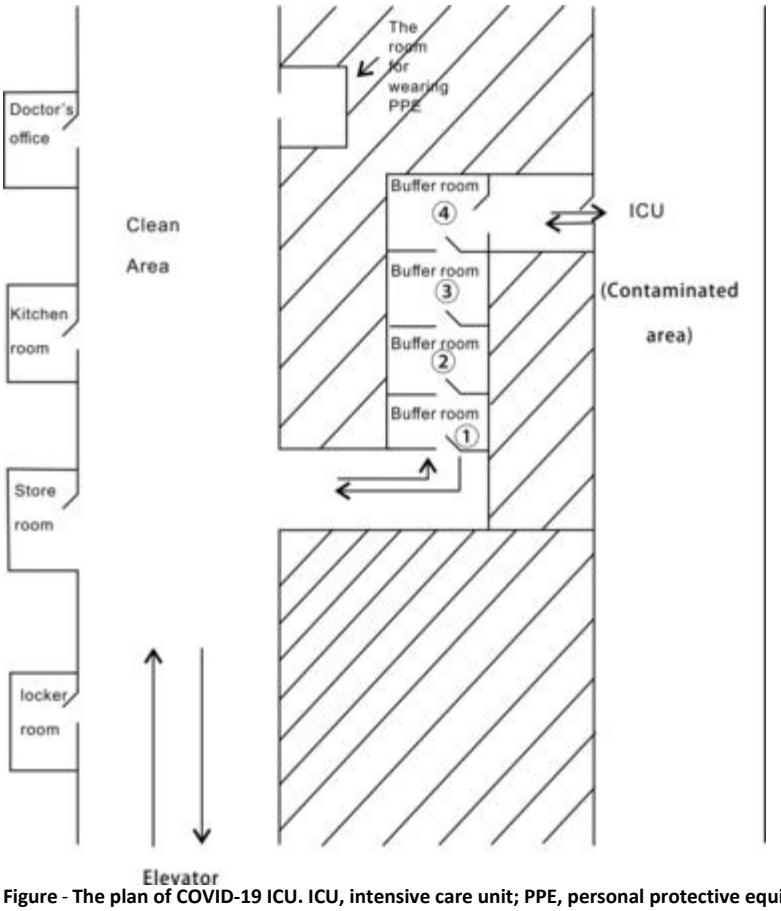


Figure - The plan of COVID-19 ICU. ICU, intensive care unit; PPE, personal protective equipment.
Source- https://svn.bmj.com/content/5/3/302#ref-12

After coming out of the infected persons vicinity, PPE must be removed in the beginning at a separate place called as the contaminated zone and four buffer zones step by step. The steps involve-

1. Through washing of hands with a good disinfectant and water
2. taking off the covering face shield
3. Removing the first layer of shoe covers and outermost layer of gloves and washing hands
4. Removing the gown which is on the outermost side alongside the protective coverall including goggles
5. Disinfecting the hands
6. Removing the second medical cap, surgical cap and performing hygiene
7. Entering the third buffer room after disinfecting the doorknobs.
8. Washing hands and removing the first shoe covers followed by the second layer of gloves and gown
9. Entering the second buffer room to follow certain steps like removing the 3M 1860/9132 medical mask and the last medical cap.
10. Lastly, entering the first buffer room immediately after disinfecting everything that was touched in the process including the door handle and other equipment.

11.In the first buffer room, a fresh new surgical mask is donned along with a fresh new medical cap along with.
The process of putting on as well as putting away of the PPE to go into the isolation room and come out of it would require a e about 30 minutes each.

LITERATURE REVIEW-

Authors (year)	Study location	Sample size	Sampling techniques	Salient features
McLaren G, *et al,2020*	USA	NA	NA	Covid 19 infected patients can easily be identified with the following symptoms, muscle soreness, pain in the body, severe cough, high body temperature, fatigue, and inability to perform basic chores. Patient with COVID-19 go in a critical state very quickly and frequently and can be identified if they have the following- respiratory troubles, organ failure, inability to act or respond to normal circumstances, sepsis, and severe seizures also at times.
Richards-Belle A, Mouncey P R, Wade D, *et al*,2020	USA	24 NHS adult, general, critical care units.	cluster-randomised clinical trial (cluster-RCT)	Observations such as depression, anxiety, stress, panic attacks, hallucinations, and delusions, are very common in critical care patients who are strict observation. There is also a very common link between these patients and psychological morbidity as it becomes progressively difficult for these infected persons to stay positive given the extreme situations and

				they tend to give up. Many also develop Post traumatic stress disorder.
Scheuer T, *et al*,2020	NA	2299	Clustered Sampling	Since not too much data and many intervention studies exist about infection in healthcare settings, Health care personnel (HCP) are at heightened risk of acquiring COVID-19 infection as many of them do not even have the knowledge about protective equipment and their usage.
The Guardian and Kaiser Health News	**USA**	**NA**	NA	More than 3,600 U.S. healthcare workers have died due to Covid-19 so far, which is substantially far more than the official figures reported by the Centres for Disease Control and Prevention. Due to certain reasons, the official reports are not releasing the correct data.
Shaukat N., *et al,* 2020	Karachi	NA	Systematic Literature Review	Early data suggest a proper implementation in strategies which lead to reduction in the chances of infections like proper donning and doffing of PPE kits, designing of a more comfortable protective equipment, shorter shift lengths, availability of a counsellor to take up mental and emotional issues, and mechanisms for mental health support could reduce the morbidity and mortality amongst HCWs
Cdc.gov.in	Atlanta	NA	NA	Donning and Doffing of PPE Kits in a proper and hygienic way is of utmost importance. There are certain ways that

				are prescribed by several national and international organizations and hence no one way is right. There are various steps though, that need to be followed while proper Donning and Doffing of PPE Kits.
Rothan HA, *et al,*2020	USA	NA	NA	Special attention is necessary to protect or reduce transmission in children, health care providers, and elderly people as they are very much prone to acquire infections. Especially healthcare workers as they are the ones who are in close proximity to the infected.
https://www.cdc.gov/coronavirus/2019-ncov/hcp/using-ppe.html	Atlanta	NA	NA	Procedure to carry out donning and doffing involves a lot of steps. Not one step should be missed. Carrying out hand hygiene is of paramount importance before starting Donning and after finishing Doffing.
Zhonghua Jie He He Hu Xi Za Zh, *et al,* 2020	China	NA	Simple Random Sampling	The most identifiable source of transmission of COVID-19 is from infected patients saliva, excreta, discards, and the main routes of transmission are following- respiratory droplets of the infected person and in person contact transmission. High-concentration aerosol exposure in a closed environment may also cause transmission. Standard precautions Should be routinely used, checked, and maintained in all areas of the hospital and patients should be isolated from contact and droplets.

https://svn.bmj.com/content/5/3/302#ref-12	NA	NA	Secondary Literature Review	Planning of Covid 19 ICU should be done in a proper way beforehand. For better isolation and contamination avoidance, the Covid ICU is divided into the following areas: clean, buffer, and contaminated zones.
Jennie H. Kwon, *et al.,* 2018	Washington	36	Prospective pilot study.	Deviations in certain protocols are PPE doffing and donning by the healthcare personnel because of certain factors such as lack of knowledge, careless attitude, strain due to long hours of duty in PPE Suits. Self-contamination was common. PPE donning/doffing are complex and deserve additional study.
Kamakshi Garg, *et al.,* 2020	India	155	Cross sectional	Health-care workers though are very much aware of the importance and criticality of donning and doffing procedure, but they lack the knowledge about spread of virus as 62% people who were given a certain questionnaire responded that virus dispersion occurs more during donning than doffing. Gaps were found in attitude of respondents as 51% of HCWs found it is difficult, inconvenient and time consuming to don PPE and that they sometimes think of compromising their own safety. Healthcare workers are hesitant in donning. Nearly 33.5% of HCWs move out of the doffing area without removing gloves and N-95, which is serious error and need correction in their practice and can cause severe infections.
https://nypos	New	NA	NA	Lack of proper PPE Kit Donning and

t.com/2020/03/25/worker-at-nyc-hospital-where-nurses-wear-trash-bags-as-protection-dies-from-coronavirus/	York			availability lead to nurses wearing trash bags at a New York hospital. Some of the Healthcare workers died within days because of not Donning a PPE kit.
Rubin MA, *et al.,* 2021	USA	NA	Literature Review	Certain contact precautions in order to avoid the spread of infections are taken into consideration. There can be several types of it like- using hand gloves to protect the hands, wearing of layers of gowns to protect the body, wearing of head covering medical cap to protect hair and skin, wearing shoe covers to protect feet. These have been in use for quite some time now and these help in keeping pathogen transmission at bay that can be acquired from healthcare settings when caring for the sick patients. Despite all recommendations and guidelines regarding these, people do not adhere owing to preconceived notions and the need to stay away from burdensome and hectic procedures. Certain Observational studies also suggest that contact precautions give patients as well as healthcare providers anxiety and depression, are very

				expensive to get and significantly dip patient and healthcare providers interaction with each other thus patients also feel stressed and low.
Mona Hers, *et al.,* 2015	Canada	332	Rapid Review	PPE Kits should be worn adhering to some specifications, guidelines ad rules. Protective equipment causes a significant reduction in the chances that the infection would be spread to the person coming in contact with the infected person. Proper adherence to the guidelines also makes it easier and more comfortable for the healthcare personnel to stay in the kits for a longer period of time without feeling tired or worn out. It also keeps at bay all the heat and stress thereof.
Sara Geale, 2020	Australia	NA	Literature Review	The correct use of PPE by healthcare providers and other healthcare setting staff is necessary in COVID times as it is one very dangerous virus and can cause a lot of ailments. An article that came out in 2020, August 4th in Australia stated that as many as over 1100 healthcare providers got infected by this deadly virus and developed a lot of complications thereafter. Many of whom got infected because of lack of proper Donning and Doffing practices of PPE Kits.
Santosh	Gujarat	143	Web Based	Knowledge regarding PPE Kits is a topic

Ojha, *et al.,* 2021			Survey	of extreme concern as a study conducted in Gujarat proved that only 67.8 percent participants, all of which were health workers gave the correct response to information regarding the proper way to donning and doffing of participants gave the right response to the question regarding the sequence of donning and doffing of PPE. This proved that those who should be most aware about it, are untrained and lack knowledge. Hence, there is a need to provide in depth training and education to make these providers trained about the importance, effectiveness and correct sequence of protective equipment wearing and taking off.
Taghrir, *et al*., 2020	Iran	240	Cross Sectional	Only 43.3% Iranian medical students had received any kind of education about COVID-19. In a study, 85.5% of the participants responded the use of PPE such as face mask can help prevent the transmission of COVID-19 meaning only these many people knew about the use of PPE and 79.2% of the study population knew the use of N95 respirators with face shield during aerosols producing procedures.
Modi, *et al.,* 2020	Mumbai	1562	Convenience Sampling	In Mumbai, Among all the health-care students that were administered a questionnaire, only 45.4% of responders knew the correct way to donning and doffing of the PPE, others all were unaware and lacked knowledge.

Robert McCarthy, *et al.,*2020	NA	NA	Technical Report	Nosocomial spread of COVID-19 can be avoided by becoming efficient and proficient in donning doffing and doffing.
Wax RS, *et al.,*2020	Canada	NA	NA	Healthcare providers protect themselves by using gowns, head covers, shoe covers, gloves, N95 masks, a surgical mask, hair protection and a face shield along with hand washing to avoid the spread of virus and to block the entrance of the virus through mucous membranes. It is advised that if any close contact procedure such as endotracheal intubation is being performed, the nose and mouth portion should be tightly covered and concealed and respirators should be worn.
Sujan C Reddy, *et al.,* 2019	India	NA	Systematic Literature Review	The 2014–2016, when Ebola virus broke, there was a lot of gaps that were highlighted in terms of healthcare workers' usage of protective gear. It was seen that even the white coats that the healthcare personnel wear could serve as a source of contamination. The clothes that the healthcare professional was wearing were acting as a reservoir of virus causing a lot of infections in an otherwise healthy individual. Certain basic protocols such as proper hand washing and wearing PPE are the standards to avoid any sort of contamination that occur through infectious materials, bodily fluids or blood.

(Baloh J, *et al,* 2019), (Mana TSC, *et al.,* 2018), (Drews FA, *et al.,* 2019)	IOWA	30	Qualitative study, Randomized trial, Systematic Review	Since it is a well-known fact that wearing PPE Kits for a prolonged period of time causes heatstroke and burnout, certain prevention epicenter investigators after performing certain studies and trials suggested that there should be designs which allow for comfort and easy removal of the kits. There should be a proper system of colour coding to recognise easily the potentially contaminated zones.
Koh Okamoto, *et al.,* 2016	NA	125	Self-administered survey	Potentially modifiable risk factors associated with donning/doffing errors, including time since degree training and fatigue. In univariate analysis, HCWs who felt more tired were more likely to make multiple errors in donning gloves (RR 2.21, $P = .058$) or gowns (RR 1.17, $P = .073$). HCWs who received their professional degree ≥6 years ago were less likely to make multiple errors in donning gowns (RR 0.86, $P = .057$). The following factors were associated with multiple errors in doffing PPE: completing degree training ≥6 years ago (RR 1.54, $P = .061$), PPE training ≥5 years ago (RR 1.83, $P = .043$), being overweight (RR 1.56, $P = .057$), and having a stressful day (RR 2.39, $P = .054$). HCWs who completed their degree training ≥6 years ago were more likely to doff gloves first (RR 2.78, $P = .006$), which in other analyses was associated with self-contamination.

Kang, et al. (2017)	Pittsburg	50	Observational study (Video Taping of participants was done).	Healthcare personnel lack a lot of knowledge and hence they contaminated themselves more than 80 percent of the times because they lack in proper ways of using the protective gear. Hence, it is imperative to impart knowledge and protocols among the healthcare workers to ensure their safety while dealing with the infected.
Poller, *et al.* (2018)	UK	NA	NA	Healthcare workers can use certain examples/models to learn and adapt to proper ways of PPE Donning and Doffing by models such as VIOLET (Visualizing Infection with Optimized Light for Education and Training) which is basically a mannequin to showcase how PPE Kits are efficient in avoiding infections. The model showcases bodily fluids containing tracers which are ultraviolet.
https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/guidance.html	USA	NA	NA	PPE must be removed in a slow fashion, carefully, deliberately and in the correct sequence to bring down contamination levels. The purpose of a PPE Kit is to protect the person's entire body from head to toe so that all chances of the infection entering through any opening in the body are negligible.
Lin Cheng, *et al.,* 2020	China	NA	Observational.	Certain people find that the Steps of donning are complicated, yet donning is the procedure that all the staff members tend to focus on the most without much hassle. The difference between donning and doffing areas are also there like,

				donning areas are very clean whereas, the doffing areas are unkempt, messy and dirty due to a lot of stress, long hectic working hours of the healthcare workers and the physical exertion.

RESEARCH QUESTION-

How important is the practice of proper Donning and Doffing in healthcare settings, how useful it is to prevent infections during the Covid 19 Pandemic and what suggestions can we provide to better the use of PPE Kits?

AIM:

This paper aims at understanding the importance of proper Donning and Doffing practices among healthcare workers and other frontline workers in order to keep Covid 19 infections and complications at bay.

OBJECTIVES:

- To collect, study and synthesize the information and data on the effects of improper donning and doffing practices and the importance of correct procedures to wear and dispose a PPE Kit, studied in the past 10 years.
- To suggest some ways to improve the donning and doffing practices undertaken by healthcare workers during the Covid 19 Pandemic.

6. RESEARCH METHODOLOGY

6.1. STUDY DESIGN: Integrative Literature Review

6.2. METHODOLOGICAL APPROACH: A detailed review study was conducted, and research papers and articles were taken into consideration which had been published and studied in the last 15 years. A total of 60 studies were approached thoroughly but only 30 were taken due to availability of to the point information and authenticity about the donning and doffing procedures during the outbreaks of several viruses that have happened in the past years.

6.3. SEARCH METHODS: Search terms identifying and emphasising the importance of Proper Donning and Doffing practices during Coronavirus Pandemic were trialled and the accompanying inquiry terms were found. Sources such as Google Scholar, PubMed, Lancet, WHO, CDC, abdc list of journals, etc were referred.

7. DISCUSSIONS

a. Importance of good knowledge and its implementation in proper Donning and Doffing practices

The Coronavirus pandemic being one of the deadliest pandemics of all times has forced people far and wide to take steps to maintain their and their family's health (McLaren G, *et al,202)*. Countries in the world are imposing Lockdown's time and again to curb the effects of this pandemic and to stop the rapid spread so as to safeguard its citizens. People all over the world are facing sever effects and aftereffects of this pandemic like breathing difficulties, heart problems, severe pain in the body, lung infections, organ failures and in some cases, deaths also (Richards-Belle A, Mouncey PR, Wade D, *et al*,2020). lockdowns being forced far and wide produce different difficulties for people in terms of reduced mobility disrupting economic, social and access to healthcare facilities. All this has led to people being fearful, anxious and

sometimes confused as to where and how to find medical treatments (Richards-Belle A, Mouncey PR, Wade D, *etal*,2020). For curbing this problem doctors as well as all other frontline healthcare workers must be constantly on the front. Healthcare workers who are responding to this global crisis are trying their level best to protect individuals, families, and communities with stretched resources. The Pandemic proved extremely fatal for immunocompromised, old people, pregnant women, and children but, most of all, the healthcare workers like doctors, nurses, paramedical staff, other hospital administration staff, etc. For safeguarding the healthcare workers and other frontline workers, there are some practices such as following proper Donning and Doffing techniques to avoid any infection (Kang*, et al., 2017)*. Donning refers to the wearing of personal protective equipment in a way that avoids the contracting of any disease while going near the infected person and Doffing refers to the correct way of removal of the personal protective equipment to avoid the spread of any infection whatsoever. There are various ways of Donning and Doffing of PPE kits prescribed by many national and international organisations and any of these can be followed (*cdc.gov*). Various studies have shown that many healthcare workers do not have proper knowledge about the Donning and Doffing of PPE Kits and a lot of them do not even believe in the efficacy of these kits. This perception has to change in order to protect the HCW's from the risk of contracting Covid 19 and facing severe complications thereafter (Koh Okamoto, *et al.,* 2016).

b. Suggestions to improve the proper practices of Donning and Doffing:

- As Healthcare workers and frontline workers are prone to contracting Covid 19 infection and developing multiple complications thereof, the leaders such as senior doctors, Nursing in charge, hospital administration staff must take appropriate actions to keep the proper practice of Donning and Doffing in check and to train and educate those who are unaware about the importance of these practices (Poller, *et al.* 2018).
- Third person such as Government should mandate training of HCW and other hospital staff regarding PPE Kit wearing and disposing. And impose fines on those hospitals which fail to meet the criteria (cdc.gov).

CONCLUSION-

From the above discussion, it can be stated that a situation of crisis such as Covid 19 pandemic has proven to be extremely fatal and lethal to people all over the world. Healthcare workers are the only weapon to fight off this deadly disease. Though, extreme numbers of infected as well as healthcare workers have died, and even more are still suffering from Covid 19 infections or post recovery complications. Hence, protecting the HCW's at all costs is very important. To fight this battle, it is important that these HCW's do not become the targets and hence they should always maintain all safety precautions like knowing, wearing, and disposing the PPE Kits in a proper and systematised manner. There so much misunderstanding and lack of knowledge among these workers regarding the importance of wearing protective kits and their disposal. Certain studies conducted in countries like Australia, China, India, Iran have showed that healthcare workers believe that donning of PPE Kits is cumbersome and expensive, which leads to them avoiding certain guidelines. This, in turn increases the chances of contamination. Governments, hospital administration and other regulatory bodies including the Doctors association, Nursing association, etc should assume responsibility of teaching and preaching the importance of proper Donning and Doffing of PPE kits and if not followed, then imposing heavy fines. Ways of Improving adherence to what is being suggested and recommended in the guidelines include providing a conducive environment that encourages the use of PPE, Healthcare personnel's education and training, showing them real life examples of how protection is important, competency demonstration, and monitoring. Health Care Workers should be educated about the importance of transmission in healthcare settings, the role of HCW contamination in transmission events, and methods for reducing that risk. Furthermore, educational institutions like nursing colleges, medical college should indulge in early career development, training, research and sessions for healthcare professionals regarding the importance of protective equipment' systematic usage to create a work environment that is safe and secure for them.

REFERENCES

1.Yuan L, Chen S, Xu Y
Donning and doffing of personal protective equipment protocol and key points of nursing care for patients with COVID-19 in ICU
Stroke and Vascular Neurology 2020;5 doi: 10.1136/svn-2020-000456
https://svn.bmj.com/content/5/3/302.citation-tools

2. Liew MF , Siow WT , MacLaren G , et al
. Preparing for COVID-19: early experience from an intensive care unit in Singapore. Crit Care 2020;24:83. doi:10.1186/s13054-020-2814-x pmid:http://www.ncbi.nlm.nih.gov/pubmed/32151274
Richards-Belle A, Mouncey PR, Wade D On behalf of the POPPI Trial Investigators, et al Psychological Outcomes following a nurse-led Preventative Psychological Intervention for critically ill patients (POPPI): protocol for a cluster-randomised clinical trial of a complex intervention
BMJ Open 2018;8:e020908. doi: 10.1136/bmjopen-2017-020908
https://bmjopen.bmj.com/content/8/2/e020908.citation-tools

3. Transmission of COVID-19 to Health Care Personnel During Exposures to a Hospitalized Patient - Solano County, California, February 2020. MMWR Morb Mortal Wkly Rep 2020;69:4726. doi:10.15585/mmwr.mm6915e5 pmid:http://www.ncbi.nlm.nih.gov/pubmed/32298249

4. https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e5.htm?s_cid=mm6915e5_w
Ran L, Chen X, Wang Y, Wu W, Zhang L, Tan X. Risk factors of healthcare workers with corona virus disease 2019: A Retrospective Cohort Study in a Designated Hospital of Wuhan in China. Clin Infect Dis. 2020. https://doi.org/10.1093/cid/ciaa287.
https://academic.oup.com/cid/article/71/16/2218/5808788

5. https://www.statista.com/chart/23882/healthcare-worker-deaths-by-state/

6. Shaukat, N., Ali, D.M. & Razzak, J. Physical and mental health impacts of COVID-19 on healthcare workers: a scoping review. Int J Emerg Med 13, 40 (2020).
https://doi.org/10.1186/s12245-020-00299-5
https://intjem.biomedcentral.com/articles/10.1186/s12245-020-00299-5#citeas
https://www.cdc.gov/

7.The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun 2020;109:102433. doi:10.1016/j.jaut.2020.102433 pmid:http://www.ncbi.nlm.nih.gov/pubmed/32113704 https://www.sciencedirect.com/science/article/abs/pii/S0896841120300469?via%3Dihub
CrossRef PubMed Google Scholar

8.Respiratory care committee of Chinese Thoracic Society
. [Expert consensus on preventing nosocomial transmission during respiratory care for critically ill patients infected by 2019 novel coronavirus pneumonia]. Zhonghua Jie He He Hu Xi Za Zhi 2020;17:E020. doi:10.3760/cma.j.issn.1001-0939.2020.0020 pmid:http://www.ncbi.nlm.nih.gov/pubmed/32077661
http://rs.yiigle.com/yufabiao/1182334.htm

9.https://www.cdc.gov/coronavirus/2019-ncov/hcp/using-ppe.html

10.Liu Qian, Wang Rongshuai, Qu Guoqiang, et al. General Observation Report of Systemic Anatomy of New Coronavirus Pneumonia Dead Autopsy[J]. Journal of Forensic Medicine, 2020, 36(1): 21-23. http://www.fyxzz.cn/CN/10.12116/j.issn.1004-5619.2020.01.005

11.https://www.ijournalhs.org/article.asp?issn=2542-6214;year=2021;volume=14;issue=1;spage=53;epage=59;aulast=Mishra

12.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6263164/

13.https://www.aeronline.org/article.asp?issn=0259-1162;year=2020;volume=14;issue=3;spage=370;epage=375;aulast=Garg: Hersi M, Stevens A, Quach P, Hamel C, Thavorn K, Garritty C, et al. (2015) Effectiveness of Personal Protective Equipment for Healthcare Workers Caring for Patients with Filovirus Disease: A Rapid Review. PLoS ONE 10(10): e0140290. doi:10.1371/journal.pone.0140290

14.https://juniperpublishers.com/jojnhc/pdf/JOJNHC.MS.ID.555821.pdf

15.https://www.sciencedirect.com/science/article/pii/S1546084320302054
M.H. Taghrir, R. Borazjani, R. Shiraly

16.COVID-19 and Iranian Medical Students; A survey on their related-knowledge, preventive behaviors and risk perception
Archives of Iranian Medicine, 23 (4) (2020), pp. 249-254
https://www.cureus.com/articles/29822-covid-19-awareness-among-healthcare-students-and-professionals-in-mumbai-metropolitan-region-a-questionnaire-based-survey

17.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7805491/

18.Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients.
Wax RS, Christian MD
Can J Anaesth. 2020 May; 67(5):568-576.
[PubMed] [Ref list]

19.Sujan C Reddy, Amy L Valderrama, David T Kuhar, Improving the Use of Personal Protective Equipment: Applying Lessons Learned, Clinical Infectious Diseases, Volume 69, Issue Supplement_3, 1 October 2019, Pages S165–S170, https://doi.org/10.1093/cid/ciz619
23. Jure Baloh, Heather Schacht Reisinger, Kimberly Dukes, Jaqueline Pereira da Silva, Hugh P Salehi, Melissa Ward, Emily E Chasco, Priyadarshini R Pennathur, Loreen Herwaldt, Healthcare Workers' Strategies for Doffing Personal Protective Equipment, Clinical Infectious Diseases,

Volume 69, Issue Supplement_3, 1 October 2019, Pages S192–S198, https://doi.org/10.1093/cid/ciz613

20.Koh Okamoto, MD, Yoona Rhee, MD, ScM, Michael Schoeny, PhD, Jennifer Cheng, DO, Shivani Reddy, DO, Efrain Salazar, BS, George Warpinski, BA, Robert A. Weinstein, MD, FIDSA, FSHEA, Mary K. Hayden, MD, FIDSA, FSHEA, Kyle Popovich, MD, For the CDC Prevention Epicenters Program, Importance of Healthcare Worker Personal Protective Equipment in Reducing Doffing Errors—Correlation with HCW Characteristics and Perceptions, Open Forum Infectious Diseases, Volume 3, Issue suppl_1, December 2016, 1389, https://doi.org/10.1093/ofid/ofw172.1092

21.Kang J, O'Donnell JM, Colaianne B, Bircher N, Ren D, Smith KJ. Use of personal protective equipment among health care personnel: Results of clinical observations and simulations. Am J Infect Control. 2017 Jan 1;45(1):17-23. doi: 10.1016/j.ajic.2016.08.011. PMID: 28065328.

22. Poller B, Hall S, Bailey C, Gregory S, Clark R, Roberts P, Tunbridge A, PoranV, Crook B, Evans C, 'VIOLET' – a fluorescence-based simulation exercise for training healthcare workers in the use of personal protective equipment, Journal of Hospital Infection (2018), doi: 10.1016/j.jhin.2018.01.021

23.Centers for Disease Control and Prevention: Guidance on Personal Protective Equipment (PPE) To Be Used By Healthcare Workers during Management of Patients with Confirmed Ebola or Persons under Investigation (PUIs) for Ebola who are Clinically Unstable or Have Bleeding, Vomiting, or Diarrhea in U.S. Hospitals, Including Procedures for Donning and Doffing PPE. 2015. https://www.cdc.gov/vhf/ebola/healthcare-us/ppe/guidance.html.

24.Cheng, Lin, Chen, Lei, Xiao, Li, Zhang, Jianping, Cheng, Yilian, Zhou, Lian, Peng, Yu and Liu, Lei. "Problems and solutions of personal protective equipment doffing in COVID-19" Open Medicine, vol. 15, no. 1, 2020, pp. 605-612. https://doi.org/10.1515/med-2020-0172

25.https://www.degruyter.com/document/doi/10.1515/med-2020-0172/html

26.Rubin MA, Samore MH, Harris AD. The Importance of Contact Precautions for Endemic Methicillin-Resistant Staphylococcus aureus and Vancomycin-Resistant Enterococci. JAMA. 2018;319(9):863–864. doi:10.1001/jama.2017.21122

27. https://nypost.com/2020/03/25/worker-at-nyc-hospital-where-nurses-wear-trash-bags-as-protection-dies-from-coronavirus/