

Multicenter cross sectional study involving health care workers of different specialties from the first wave to third wave of COVID-19 pandemic in western India.

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Aims & objective: To study the impact of COVID-19 among healthcare workers in western India and their involvement during COVID-19 pandemic.

Covid-19, SARS Cov-2, Pandemic, Social distancing, PPE, RT-PCR test, HCW.

Introduction:

COVID-19 has impacted the life of healthcare workers and general public alike. Lockdowns, infection to self, family, friends (healthcare workers in general) have been facing challenges in COVID-19 pandemic. The first and second wave have been worst in terms of lockdown, supply of essentials goods, more patient load (extended working hours), etc. The third wave has been manageable in terms of workload due to lessons learnt during first and second wave.

The whole world has experienced COVID-19 without sparing any continent. SARS CoV-2 virus infected poor and rich alike.¹ Both the first wave and second wave have been toughest for the mankind. The third wave has been much better than first two waves as mortality rate remained lower than the first two waves. It has been mentioned that good vaccination has been the reason for this²

The aim of the present study is to understand the impact of COVID-19 among healthcare workers in western India and their involvement during COVID-19 pandemic. In this study basic questions were asked about volunteering for the COVID-19 pandemic, area of their work, duration of the work, vaccination status, chances of cross infection during work, knowledge of the source of infection, symptoms experienced during infection (from mild to severe), prevention and treatment modalities, any post illness weakness faced, presence of family pressure to work or not to work during pandemic, infection to self, to their colleagues, friends, use of PPEs and the number of times they got tested during the pandemic. The students were asked about online lectures and their preference with regards to classroom/ offline teaching. Questions on social media /App /web based telemedicine /consultation, their preference over clinic visit and the financial implications were asked. Steps taken by the local and central governments to prevent and manage the COVID-19 pandemic in an effective manner and any other issues that they faced during pandemic were also asked.

These were the times of stress to all human beings, locally and globally too. Work from home was done for most possible job profiles like IT/ITES, Bankers and teachers (theory) but only healthcare workers and frontline workers could not do that and had to face the challenge.

In these testing times all healthcare workers joined hands to fight the COVID-19 pandemic and students of health care industry. Volunteers from different colleges, scouts and guides, NCC,

NSS, NGOs, whole of government machinery joined hands in mass testing. Also help was sought to follow the COVID-19 protocols like social distancing, wearing of mask, encouraging vaccinations and the distribution of the food/staples to the needy. All the towns, cities and villages learnt to wear and dispose mask, follow social distancing, learnt to be at home/work from home even though there were issues regarding salaries, financial losses and other new problems springing up due to lockdown and other pandemic related issues. Humanitarian support was provided by good Samaritans including film actors and care givers /donors and most importantly by front line workers too.

On January 30, 2020 the World Health Organization declared the outbreak as a Public Health Emergency of International Concern as SARS CoV -2 was spreading rampantly all over the world³. The virus spread extensively in the Wuhan region of China and has gained entry to over 210 countries and territories and some countries may not have been counted . Bats have been known to harbor Corona viruses for quite some time now all over the world⁴. Just as in the case of avian flu, SARS, MERS, and possibly even HIV, it was hard for scientists in the world to speculate the source and its disease progress as a pandemic.

India with the guidance and approvals from Ministry of health and family welfare and ICMR and other ministries and research Institutions, opened RTPCR testing lab and also opened genome sequencing labs all over India (NIV Pune and INSACOG was instrumental in genome sequencing partnerships with regional and national labs) . RTPCR testing was considered one of the gold standard tests. ecological pressure due to human activities, the virus made the jump from animal to mankind.

Even though substantial progress in clinical research has led to a better understanding of SARS-CoV-2 and the management of COVID-19, containing the spread of this virus and its variants has become increasing concern⁵, as SARS-CoV-2 continues to wreak havoc across the world, with many countries enduring a second or third wave of outbreaks of this viral illness attributed mainly due to the emergence of mutant variants of the virus.

Covid-19 is a potential zoonotic disease with low to moderate mortality rate (3-5%). Person to person transmission may occur through droplet or contact transmission and if there is a lack of stringent infection control or if no proper personal protective equipment donned, it may infect the first line healthcare workers⁶.

Symptoms and disease pattern was based on clinical observations of COVID-19 cases to ascertain the most likely order of discernible symptoms (i.e., fever, cough, nausea/vomiting, and diarrhea) in COVID-19 patients. Comparison with COVID-19 to other respiratory diseases, such as influenza, SARS, and MERS, to observe if the diseases present differently. Markov model predicts that influenza initiates with cough, whereas COVID-19 like other coronavirus-related diseases initiates with fever⁷. However, COVID-19 differs from SARS and MERS in the order of gastrointestinal symptoms.

Mutations:

Based on the recent epidemiological update by the WHO, as of December 11, 2021, six SARS-CoV-2 VOCs have been identified since the beginning of the pandemic:

- Alpha (B.1.1.7): first variant of concern described in the United Kingdom (UK) in late December 2020

- Beta (B.1.351): first reported in South Africa in December 2020
- Gamma(P.1): first reported in Brazil in early January 2021
- Delta (B.1.617.2): first reported in India in December 2020
- Omicron (B.1.1.529): first reported in South Africa in November 2021
- BA 2.75 and its sublineages
- BFF-7
- BA 2.86
- XBB 1.5(Pango lineage), XBB 1.16
- JN.1
- KP.2 (FLiRT) strain

The FDA has currently granted emergency use authorization (EUA) for clinical use of casirivimab plus imdevimab, bamlanivimab plus etesevimab, both as combination therapy, or sotrovimab as monotherapy in patients with mild to moderate COVID-19 who are at high risk of developing severe illness⁸. And WHO is strongly recommending nirmretelvir, ritonavir. Remdesivir Mornupiravir and others also were recommended .

COVID-19 is now recognized as a multi-organ disease with a broad spectrum of manifestations. Similarly, there are increasing reports of persistent and prolonged effects after acute COVID-19⁹. “Long Covid” is the name used by patients to describe symptoms of Covid-19 that persist beyond the acute illness . Working definitions of ‘post-acute’ (symptoms beyond 3–4 weeks) and ‘chronic’ (symptoms beyond 12 weeks) Covid-19 are yet to be formally confirmed¹⁰.

The covid-19 pandemic has heavily burdened healthcare systems throughout the world. There seems to be a mismatch between risk factors for adverse mental health outcomes among HCWs. This was given least importance by authorities in the current pandemic, their needs and preferences, and the individual psychopathology focus of current interventions¹¹.

In modern diagnostics, psychiatric symptoms coexisting with severe infections are diagnosed as ‘mental disorders due to a general medical condition’¹². Infections can cause a broad spectrum of psychiatric symptoms, e.g. delirium, psychotic disorder or mood disorder which were the main complaints by HCWs.

In developing countries , risk of reporting a positive test for COVID-19 was increased among front-line health-care workers. Health-care systems should ensure adequate availability of PPE and develop additional strategies to protect health-care workers from COVID-19, particularly those from Black, Asian, and minority ethnic backgrounds. Additional follow-up of these observational findings is needed¹³.

Health workers should continue to enjoy their right to decent, healthy and safe working conditions in the context of COVID-19¹⁴ . But its was not easy to get their work recognized or right to decent was not taken into consideration due to high need for HCWs.

The available literature has emerged from only a few of the affected countries, and may not reflect the experience of persons living in other parts of the world. It concludes that, subsyndromal mental health problems are a common response to the COVID-19 pandemic¹⁵. Although, primary route for the spread of COVID-19 is thought to be through aerosolized droplets that are expelled during coughing, sneezing, or breathing, but there also are concerns about possible airborne transmission¹⁶. In the situation its described that, 85% of health care workers were exposed during an aerosol-generating procedures exposed while wearing a surgical mask, and the remainder were wearing N95 masks.

Study points were important in an in-depth understanding of the cultural and sociopolitical considerations around the personal and social meaning of mask wearing in different contexts as a necessary prerequisite for the assessment of the effectiveness of face masks as a public health measure¹⁷.

No information was available on extended use or reuse of N95 respirators in the websites of 17 countries (63%). Some countries recommended specific methods for N95 respirators decontamination, and others mentioned several options, leaving the decision to health services managers (Table 1). The following decontamination methods were mentioned: dry heat in a drying cabinet at 65–70°C; vaporous hydrogen peroxide ultraviolet germicidal irradiation and moist heat The maximum duration of extended used ranged from 4 hours (France, New Zealand, and Sweden) to 40 hours, and the maximum number of cycles of decontamination ranged from 2 to 5.¹⁸ These studies were conducted mostly in developed countries.

Material and methods:

As the study was started after third wave of COVID-19 subsided, the preferred way to get the best information from participants was online mode. Google sheet questionnaires were prepared and sent across western part of India, different healthcare workers involved in medical, nursing and dental colleges and hospitals and few of the private practitioners of different specialities' consented to participate in the study. Broad specialities are considered for the study to have a better picture of involvement of healthcare workers during different waves of the pandemic. Consent for the participation was taken prior to filling the google forms. Personal communications were done in case answers were not clear/unanswered.

Google sheets and personal answers were analyzed on MS excel sheet to segregate the answers/responses.

Statistical analysis was done by SPSS software, and frequency of distribution.

Results:

The table 1 indicates a frequency of distribution of study participants according to the profession, their work during the COVID-19 pandemic and whether they got paid for work during the pandemic. Majority of the study participants were MBBS students and Medical college faculty.

Table 1. Distribution of study participants

Profession	Frequency	Percent
MBBS students	123	34.5%
Faculty	83	23.2%
BDS students	66	18.5%

Interns	24	6.7%
Paramedical students	18	5.0%
Post graduate students	14	3.9%
Homeopathy	11	3.1%
Nursing students	9	2.5%
Unani	5	1.4%
Ayurveda	1	0.3%
Dentistry	1	0.3%
Pathologist	1	0.3%
Post Intern	1	0.3%

Financial emoluments during the pandemic varied as all the strata of healthcare workers got different payment/salaries. Some of the frontline workers got extra payments to appreciate the hard work done. Participants in the study also mentioned many of the state governments have hired the different COVID 19 staff for specific work. (OPD, Lab, IPD, ICU, ILI Ward...etc). Many of the different organizations like scouts & guides, NCC, NSS, RSS have volunteered to help the states to collect samples ,do the mass testing for the public, drivers , shop keepers, vegetable vendors, essential goods carriers were tested several times whenever they entered different state or Union territories.

Table 2 explains if the participants were working for COVID 19, if they were volunteers, if they got paid for their services or it was volunteering without payment. Only 17.4% of the volunteers got paid during the pandemic. 35.3% did not get any pay may be it was purely volunteering basis.

Table 2. Working for COVID 19 & if they were volunteers

	Frequency	Percent	Z-stat	p-value
Did you work/ volunteer in COVID-19 pandemic in hospital setting?				
Yes	149	41.7%	-3.136	<.001**
No	208	58.3%		
Did you get paid for this?				
Yes	62	17.4%	-4.6701	<.001**
No	126	35.3%		
No response	169	47.3%		

Many of the state government have honored the HCW like Consultants, Microbiologists, nurses, lab workers, frontline workers like police personnel, and many with cash awards and other means too for their exemplary work during COVID-19 pandemic.

All the healthcare workers /frontline and caregivers were given preference by government and even among them there was vaccine hesitancy, Reason of vaccine hesitancy being not sure of immunogenicity of the vaccine since most vaccines were told to be for emergency use. The vaccine trials were not as per the general protocols.

Table 3. Vaccines status, Covid-19 infection, source of infection, symptoms, treatment and post COVID 19 weakness.

	Frequency	Percentage		
Did you get vaccinated for COVID-19?				
Both doses	301	84.3%		
Single dose	24	6.7%	15.509	<.001**
None	32	9.0%		
Did you have COVID -19 infection?				
Yes	80	22.4%		
Maybe	44	12.3%	-5.7689	<.001
No	233	65.3%		
Possible cause of infection?				
Patients	59	16.5%		
Community	59	16.5%	-0.5389	0.295
Not known	80	22.4%		
What were the symptoms when you had infection?				
Fever	104	29.1%		
Myalgia	64	17.9%		
Loss of taste/smell	72	20.2%	7.5432	<.001**
Thoracic Pain	21	5.9%		
Asymptomatic	32	9.0%		
Severe Symptoms	11	3.1%		
What treatment/ antiviral did you take?				
AZITHROMYCIN	82	23.0%		
FABIFLU	38	10.6%	3.5901	<.001**
REMDESIVIR	19	5.3%		
TETRACYCLINE	15	4.2%		
Do you feel weakness even now? (Post infection)				
Yes	41	11.5%	-5.463	<.001**
No	120	33.6%		

>84% of the healthcare workers got vaccinated by 2/3 doses, this could be the reason that < 23% got infected /re-infected even though they were involved in frontline activity. Possibility is that, they might have suffered asymptomatic infection. (RRR- as per WHO >80% have suffered asymptomatic infection.

For many of them, possible cause of infection is known but as they are healthcare workers, it must have been a contact / cross infection by infected individuals/symptomatic or asymptomatic patients in healthcare settings.

Majority of the patients showed similar symptoms like fever, sore throat, myalgia, loss of taste/smell (in milder variant), lung infection, severe Covid-19 infection including some percentage of fungal infection (Black fungus /Zygomycosis) during post Covid -19 complications. Majority must have suffered from asymptomatic infection (> 80%). Some studies revealed that 85% healthcare workers showed COVID 19 IgM antibodies . Different types of antibodies were tested all over India .(Covid Kavach/ neutralizing antibodies).

Most of the trial drugs/antibiotics were taken by all healthcare workers including Azithromycin (23%), Fabiflu, Remdesivir, tetracycline etc.

Some of the healthcare workers feel that they have had long Covid19, so they suffered weakness even after long period of time (months together). Psychological issues were addressed as per the need which was important part of the treatment as many of them were isolated and felt loneliness during pandemic. Many psychiatrists/counselors were trained to speak the patients by phone/call centres , during pandemic to solve such issues. Even telemedicine was used to communicate to distant places with the help of internet. Number of call centers were established for such activities including transportation to hospital to and fro. Ambulances were deployed at connecting cities /villages to hospitals. Entry points, major junctions were used for taking entry in the register, taking COVID-19 samples, sending them to quarantine centers, hospitals if needed.

Table 4. Different areas of work of Health care workers .

	Frequency	Percent	Z-stat	p-value
Area of work in the COVID-19 Pandemic				
OPD	78	21.8%		
Lab	26	7.3%		
Community	58	16.2%	-5,9056	<.001**
IPD	52	14.6%		
ICU	17	4.8%		
Did your family pressurize you not to work in COVID-19 patient care?				
Yes	47	13.2%		
No	186	52.1%	-10.854	<.001**
Any of the health workers known to you suffered from COVID - 19 infection?				
Admitted to ward	248	69.5%		
ICU	61	17.1%	7.3575	<.001**
Death	48	13.4%		

Frequency of distribution of work areas during COVID 19 pandemic among HCW is as follows. 21.8% worked in OPD , in lab 7.3% participants worked ,who were handling preanalytical, analytical and post analytical areas of COVID 19 labs.Majority.16.2% people worked in community ,14.6% participants were contributing in (14.6%) in IPD areas (ILI ward) and 4.8% were part of the ICU workforce .

52.1% families did not pressurize HCW to work during Covid 19 even though there was always a risk involved. Among Patients known to HCW, 69.5% were admitted to ward, 17.1% were admitted to ICU and 13.4% died during COVID 19 pandemic of first and second wave.

Table 5. Use of PPEs and knowledge of discarding in a right BMW bin .

	Frequency	Percent	Z-stat	p-value
Do you use N-95 mask on regular basis?				
Yes	278	77.9%	10.5318	<.001**
No	79	22.1%		
Did you wear PPE any time during the Pandemic?				
Yes	175	49.0%	-0.3703	0.3556
No	182	51.0%		
What were the PPEs used by you during the Pandemic?				
3 PLY MASK	59	16.5%	-7.0401	<.001
N-95 Mask	112	31.4%		
FACESHIELD	57	16.0%		
PPE FULL DRESS	11	3.1%		
SURGICAL SCRUB/GOWN	27	7.6%		
None of the above	48	13.4%		
In which color coded bag did you dispose-off the used PPEs?				
Black	23	6.4%	3.0331	<.01**
Red	56	15.7%		
Yellow	122	34.2%		
Did not use PPE	156	43.7%		

77.9% used N-95 mask during COVID 19 work and for general use also 31.4% of healthcare workers uses N-95 masks. 42% donned PPE during pandemic. All healthcare workers were trained in donning and doffing of the PPEs and how reuse (N-95 masks) and where to discard was also been taught during training. Different color coded bags were used for discarding the doffed PPEs or into biomedical waste bins. All the training were given to HCWs by master trainers after training of the trainers were conducted including Covid appropriate behavior.

Table 6. Testing frequency

	Frequency	Percent	Z-stat	p-value
How many times have you tested yourself for COVID-19 virus?				
0	42	11.8%	5.9173	<.001**
1	81	22.7%		

2	87	24.4%		
3	51	14.3%		
4	12	3.4%		
>4	42	11.8%		
Do you prefer online lectures or offline lectures?				
Online	105	29.4%		
Offline	163	45.7%	-3.5426	<.001**
Any	89	24.9%		
In your opinion, is telemedicine/ teleconsultation a better option than personal visit to consultant?				
Yes	96	26.9%		
No	261	73.1%	-7.5664	<.001**
Do you feel that the steps taken by the Government is appropriate during the Pandemic?				
Yes	255	71.4%		
No	102	28.6%	8.0982	<.001**

11.8% HCWs not tested or tested atleast once and more than 22% HCWs tested 2-4 times during the Covid 19. Frequency of testing was depending on fear of positive results, availability and cost of the test. 24.9% HCWs were fine with any mode of teaching, 29.4% were preferring online mode of teaching but 45.7% of HCWs preferred offline teaching methods only. During Covid video conferencing, online lectures and other web based learning became a norm including work from home among IT/ITES and all other workers except HCWs and all other frontline workers.

As online consultation, telemedicine, teleconsultation, whatsapp consultations were practiced to avoid travel/contact, only 26.9% opted for this. 73.1% opted for physical consultations whenever they needed to visit doctors/healthcare workers.

Majority of the HCWs feel that steps taken by Government during pandemic, how they handled the situation was appreciated by majority of them (71.4%). This included lockdowns, containment zones, supply of groceries & medicines by online shopping & by home delivery, isolation, identification and treatment of suspected cases, and many more. Although 28.6% were not feeling that better steps could have taken by government due to poor supplies, sudden lockdowns, transportation issues to name a few.

Table 7. Distribution of study participants according to the common issues faced by them during the pandemic.

	Frequency	Percent
Most common issue faced by you during the Pandemic?		
STRESS AND ANXIETY	66	18.5%
OVERALL NOT HAPPY	60	16.8%
LONELINESS/ISOLATION	41	11.5%
FINANCIAL LOSS	38	10.6%

FAMILY ISSUES	33	9.2%
SADNESS DUE TO HEALTH CONDITION	27	7.6%

Stress and anxiety were the major issues HCWs faced including loneliness, long working hours (increased work pressure) overall not feeling happy or good and normal life was disrupted during COVID-19 times.

Discussion:

Vaccines have been a boon to control COVID-19 pandemic. Whichever the country got into vaccine trial mode early (US, India, UK, Russia, China), could control the pandemic in a quick time than expected. Different vaccines were approved in different countries which were made of various techniques of vaccine. WHO permitted these vaccines for emergency use only. Ethical clearances were taken in a fast track mode as it was a health emergency in most of the countries.

ICMR and most other government bodies worked 24/7 to set up labs for testing SARS CoV-2 by RTPCR which was considered a 'gold standard' test ((RR)). They guided all the labs to establish in a toughest situation as lockdown issues were prevailing, manufacturing of medical equipment, medicines, diagnostic kits(RTPCR,RAT.), transportation, training, whole of the processes were facing trouble. Entire world knew pandemic is on but did not know how to control. All doctors, other medical personals, central ministry, health authorities (central & state), scientists, all laboratories, did a commendable job to end the pandemic.

All frontline workers including healthcare workers from Asha workers to Medical superintendents of the hospitals, police, all medical colleges & hospital, (All Doctors/clinicians, Microbiology, Community medicine ,Laboratory Medicine specialists, Chest TB and all medical officers) everyone contributed in an extraordinary manner. Centre and states set up quarantine centres. Strategy by MoHFW & ICMR to test, isolate and treat COVID-19 was followed throughout to save lives. And it has served the purpose.

Healthcare workers, police, disinfection team, IDSP, sample collection, transportation , testing teams, contact tracing team, ambulance workers, COVID-19 helpline, hospital emergency area , triage area team, ILI wards, ICU and other critical care areas , all doctors and nurses , food supply department, oxygen plants (biomedical engineering department) , Collection, segregation and safe disposal of BMW was managed, infection control team was on their toes , every person contributed towards better facilities for the patients. Public sector and private sector worked hand in hand to manage the pandemic.

Conclusion:

Healthcare workers were facing a mammoth task ahead of them when Covid-19 struck. Healthcare in India was poorly managed earlier and pandemic became an eye opener as all public and private healthcare workers had to be on their toes and delivered what was not experienced before.

Healthcare workers had to work extra hours with all PPEs on, which was not experienced before especially with full PPEs (donning /doffing drills etc) with the risk of getting infected. Whole healthcare industry of the country woke up to the pandemic in a way as majority of the people never experienced a lockdown in their life, never thought only healthcare workers,

frontline workers will be working and rest of the world will work from home or will stay back home and watch them work from TV sets and /or all social media platforms.

Healthcare workers did have issues with pay packages, delayed payments, infections to self and close ones (more than once in different waves), relatives, friends and saw patients who came walking collapsed in ward/hospital premises in a few hours to days of admission. Had to rush to critical care areas/ICUs in but some could not help due the situation the patient brought in and the wards being full. At times they were just mute spectators and helpless.

All the new terms PPE, Pandemic, Plandemic, frontline workers, HCQ, Kada, COVID 19, SARS CoV 2, Remedesivir, Liquid oxygen, RTPCR, RAT, whole genome sequencing were used from the start of the pandemic and became a routine to use them.

ICMR supported all the COVID 19 labs by giving them needed support and supply to government labs (ICMR supported labs) when India needed many testing labs. MOHFW kept pushing healthcare facilities & workers to give their best to keep country safe from COVID-19 pandemic.

Healthcare workers have contributed more than expected, more than their capacity during COVID-19 pandemic in western part of India.

As per our study healthcare workers did face losses in finance, got infected during work, lost family members & friends.

In western part of the country as it included Mumbai, Thane, Navi Mumbai, where population is dense and in Silvassa, Daman where population is not as much as others areas of study.

References:

1. Machhi J, Herskovitz J, Senan AM, et al, The Natural History, Pathobiology, and Clinical Manifestations of SARS-CoV-2 Infections. *J Neuroimmune Pharmacol.* 2020 Sep;15(3):359-386. doi: 10.1007/s11481-020-09944-5. Epub 2020 Jul 21. PMID: 32696264; PMCID: PMC7373339.
2. Raquel Carbonell , Silvia Urgelés , Alejandro Rodríguez,et al, Mortality comparison between the first and second/third waves among 3,795 critical COVID-19 patients with pneumonia admitted to the ICU: A multicentre retrospective cohort study, *The Lancet Regional Health-Europe*, Volume 11, December 2021, 100243
3. Jacqui Wise, Covid-19: WHO declares end of global health emergency, *BMJ* 2023;381:p1041
4. Raghuvir keni, Anila Alexandar et, al.Covid-19: Emergence, Spread, Possible Treatments, and global burden; *Front. Public Health*, 28 May 2020 | <https://doi.org/10.3389/fpubh.2020.00216>.
5. Marco Cascella, Michael Rajnik et al. Features, Evaluation, and treatment of coronavirus (covid-19); *Statpearls publishing*; sept 2, 2021
6. Wu, Yi-Chi et, al; The outbreak of COVID-19: An overview; *Journal of the Chinese Medical Association*: March 2020 - Volume 83 - Issue 3 - p 217-220.
7. Joseph R. Larsen, Margaret R. Martin et,al.; Modeling the Onset of Symptoms of COVID-19; *Front. Public Health*, 13 August 2020 | <https://doi.org/10.3389/fpubh.2020.00473>

8. Abdul aleem Abdul Bari Akbar samad et, al; Emerging variants of SARS-Cov-2 and Novel Therapeutics against coronavirus (COVID-19); StatPearls Publishing; 2021 Jan.
9. FDA news release, Coronavirus (COVID-19) Update: FDA Authorizes Monoclonal Antibodies for Treatment of COVID-19, November 21, 2020
10. Ani Nalbandian, Kartik Sehgal et, al.; Post-acute COVID-19 syndrome; Nature medicine 27,601-615(2021).
11. Muller AE, Hafstad EV, Himmels JPW, et al. The mental health impact of the covid-19 pandemic on healthcare workers, and interventions to help them: A rapid systematic review. *Psychiatry Res.* 2020 Nov;293:113441. doi: 10.1016/j.psychres.2020.113441. Epub 2020 Sep 1. PMID: 32898840; PMCID: PMC7462563.
12. Sartorius N, Holt RIG, Maj M (eds): Comorbidity of Mental and Physical Disorders. *Key Issues Mental Health.* Basel, Karger, 2015, vol 179, pp 99–113 (DOI: 10.1159/000365542)
13. Nguyen LH, Drew DA, Joshi AD, et al, Risk of COVID-19 among frontline healthcare workers and the general community: a prospective cohort study. *medRxiv [Preprint].* 2020 May 25:2020.04.29.20084111. doi: 10.1101/2020.04.29.20084111. Update in: *Lancet Public Health.* 2020 Sep;5(9):e475-e483. PMID: 32511531; PMCID: PMC7273299.
14. Behera D, Praveen D, Behera MR. Protecting Indian health workforce during the COVID-19 pandemic. *J Family Med Prim Care.* 2020 Sep 30;9(9):4541-4546. doi: 10.4103/jfmprc.jfmprc_925_20. PMID: 33209760; PMCID: PMC7652162.
15. Ravi PhilipRajkumar; COVID-19 and mental health: A review of the existing literature; *Asian Journal of Psychiatry*; Volume 52, August 2020, 102066; <https://doi.org/10.1016/j.ajp.2020.102066>
16. Kangqi Ng, MBBS, Beng Hoong Poon, et al.; COVID-19 and the Risk to Health Care Workers: A Case Report; *Annals of internal Medicine*: 2 June 2020; <https://doi.org/10.7326/L20-0175>.
17. Lucia Martinelli, Vanja Kopilaš, et, al.; Face Masks During the COVID-19 Pandemic: A Simple Protection Tool With Many Meanings; *Front. Public Health*, 13 January 2021| <https://doi.org/10.3389/fpubh.2020.606635>.
18. Leticia Mitiko Kobayashi, Bianca Ramos Marins, et, al.; Extended use or reuse of N95 respirators during COVID-19 pandemic: An overview of national regulatory authority recommendations; *Infect Control Hosp Epidemiol.* 2020 Apr 22: 1–3.