Queueing Models and
Service Management
Vol. 8, No. 2, page 17-34, 2025

QMSM

Managerial Implications of the Perception Difference in Frontline Workers in Healthcare Service Systems During the COVID-19 Pandemic

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(*Received May 2024; accepted November 2024*)

Abstract: COVID-19 pandemic had significant psychological impact to frontline healthcare workers (HCW). Variations in job positions have resulted in differing perceptions of adverse psychological effects, which in turn can impair organizational performance and the quality of patient care. We conducted cross-sectional study to survey the psychological impact on healthcare workers during the COVID-19 pandemic. The study included frontline physicians, nurses, and specialized nurses such as physician assistants (PAs) and respiratory therapists (RTs) from a regional teaching hospital, achieving a final valid response rate of 87.92%. For statistical analysis, we employed descriptive statistics, Pearson correlation, and one-way analysis of variance. The analysis revealed that among different groups of HCWs, nurses reported higher levels of insomnia, poorer social support, insufficient personal protective equipment (PPE) support, lower satisfaction with workplace relationships, increased social pressure, and less family support compared to physicians. PAs and RTs also reported poorer social and family support than physicians. These findings highlight the hierarchical differences in the perception of negative psychological impacts and the extrinsic factors influencing them. The psychological well-being of HCWs is crucial for organizational performance, patient care quality, and safety. From a managerial perspective, this study identified that hierarchical differences have negative implications for the psychological health of HCWs, particularly during the pandemic. We propose flattening organizational hierarchies to foster an atmosphere of equity and enhancing employer support, especially for nurses and PAs/RTs, as strategic measures to mitigate the negative psychological impacts on vulnerable groups of HCWs.

Keywords: COVID-19, healthcare workers, job position differences, psychological impact.

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1. Introduction

COVID-19 pandemic due to SARS-CoV-2 virus had been a major global public health threat. From 2020 to 2023, it affected to more than 676 million people in the world, causing nearly seven million deaths worldwide. This scale is unprecedented. Healthcare worker (HCW) such as nurses, physician assistants (PAs) and respiratory therapists (RTs) and physicians, particularly those specialized in internal medicine and emergency medicine are in the frontline to care and treat infected patients, either in the ward, intensive care units (ICU), or emergency room (ER). Numerous studies had revealed that they are psychologically the most impacted professionals in the hospital.

Physically and mentally exhausted HCW would impair the care of patients. Previous researches had demonstrated that negative psychological impact on HCW decreases professional performance, consequently impairing quality-of-care and patient's safety, decreases efficacy and performances of the organization (See Hall et al. [15], Montgomery et al. [29]).

Numerous papers studied the negative psychological impact of the pandemic on HCW (e.g, Cabarkapa et al. [4], Chigwedere et al. [7], Kisely et al. [20], Stuijfzand et al. [42], Sung et al. [43]). They proved that multiple influencing factors, either intrinsic to HCW per se, or extrinsic to HCW, had impacted on HCW. By 2021, during the COVID-19 pandemic in Taiwan, a study based on questionnaires through e-mail and social medias, revealed that 40.1 % of HCWs felt exhausted, 78.1% had significant anxiety, and 45.5% were affected by depression, particularly those HCWs working in critical care units, ICU, and ER (Sung et al. [43]). A cross-sectional study in 2020 among 1,421 healthcare workers in Spain showed that 83% had potential or significant mental problems, 53% of the respondents felt lonely or insufficient support compared to about 30% of the general population, and these medical workers were more likely to have mental problems (Cabello et al. [5]).

From the daily feedback of the HCW in our institution, we observed that there were some unanswered questions: Is there any difference on the negative psychological effect between different job positions of HCW during the pandemic? How different influencing factors were perceived between different groups? Some pre-pandemic studies suggested that different job positions and occupation's hierarchy effect in the organizational culture within the hospital has negative psychological effect (Kim and Choi [19], Omura et al. [32]). Studies about this issue are lacking during the COVID-19 pandemic.

With this paper we intent to explore differences of psychological impacts between physicians, nurses, and specialized nurses such as PAs/RTs of internal medicine and emergency room during the pandemic, and to analyze differences of perception on extrinsic influential factors between different groups of HCW. Based on our findings, we intent to propose strategies to ameliorate and attenuate these negative psychological impacts.

2. Methods

After obtaining approval from the Institutional Review Board, this cross-sectional study was conducted from November 1st 2021 to February 28th 2022. 207 paper

questionnaires were issued to frontline physicians, nurses, and PAs/RTs of department of internal medicine and emergency medicine were included, who were involved in caring and treatment to suspected or infected SARS-CoV-2 patients in the ward, ICU and ER. 182 HCWs had returned questionnaires with complete response (87.92% of response rate).

The questionnaire was divided in following three parts: First, Socio-demographic characteristics related to age, gender, professional and educational backgrounds, family status, past professional experiences in pandemics/epidemics, and personal health status and habit.

The second part of questionnaire evaluated psychological impacts, using three well known scales: Hospital Anxiety and Depression Scale (HADS) (Spinhoven et al. [40]), Insomnia Severity Index (ISI) (Bastien et al. [2]), and the Oslo social support scale (OSSS–3) (Kocalevent et al. [21]). These are Likert scale based questionnaires. The level of internal consistency for these three evaluation tools in this study were within acceptable level, the Cronbach's alpha coefficient was 0.90 for anxiety evaluation and 0.84 for depression in HADS. the Cronbach's alpha coefficient for ISI was 0.91, and for OSSS-3 was 0.77.

We designed the third part of questionnaire, which were Likert scale based, with intention to evaluate responder's perception on influencing extrinsic factors during the pandemic (Appendix 1). As influential factors were numerous, after reviewing the most cited review articles related to negative effects of the pandemics to healthcare workers worldwide (Chigwedere et al. [7], Kisely et al. [20], Stuijfzand et al. [42], Sung et al. [43]), we extracted seven extrinsic factors that we considered the most influential to be included to our study. These seven selected factors were critical in different levels from familial, institutional, governmental, social, to administrative level. These were changes of workload and schedules, sufficiency of personal protection equipment (PPE) and medical supply, concerns over the risk of infection, working place relationships, social pressure, family support, and public health policy and information accuracy and transparency. The questionnaire for extrinsic factors was tested by Barlett's test of sphericity, this demonstrated that there was correlation between these extrinsic factors ($X^2 = 4361.11$, $df = 351$, $p < .001$). The level of internal consistencies was within acceptable level, the Cronbach's alpha coefficient ranged from 0.83 to 0.92.

For statistical analysis, we used descriptive statistics for the baseline socio-demographic characteristics and proportions of psychological impacts. Then, we analyzed the relation of extrinsic factors to psychological effects with the Pearson correlation test; later, one-way analysis of variance (ANOVA) for evaluation of differences of perception on influential extrinsic factors between nurses, PAs/RTs and physicians. We used IBM SPSS Statistics version 26 as analysis tool. Statistical significance was defined with a two-tailed p value of <0.05.

3. Results

182 of 207 frontline physicians, nurses, and PAs/RTs of department of internal medicine and emergency medicine involved in caring and treatment to suspected or confirmed SARS-CoV-2 infected patients in the ward, ICU and ER had responded with complete answer. The response rate was 87.92%.

The demographic characteristics are presented in Table 1. The mean age of the responders was 34.8 years (SD = 9.41). The professionals involved in our study have mean clinical professional experience of 11.08 years (SD = 8.18). 76.9% were female (n = 140). Most have university degree (65.5%, n = 121). 70.3% of our responders were nurse (n=128). 45.1% were frontline clinical professionals in ward (n=82), 34.6% were ICU staffs (n=63), and 20.3% were HCW of ER (n=37). 51.1% of participants in this study were single (n = 93). The majority live with family members (73.6%, n = 134).

Table 1. Respondents socio-demographic characteristics.

Mean Age (years) (SD)	34.80 (9.41)	**Professional Experience (in years) (SD)**	11.08 (8.18)
	N (%)		**N (%)**
Gender		**Marital status**	
Male	42 (23.1)	Single	93 (51.1)
Female	140 (76.9)	Married	86 (47.3)
Education level		Divorced or separated	3 (1.6)
Technical school	51 (28)	**Underage children**	
University	121 (65.5)	Yes	73 (40.1)
Post–graduate	10 (5.5)	No	109 (59.9)
Occupation		**Living status**	
Nurse	128 (70.3)	Living alone	48 (26.4)
Pas/RTs	31 (17)	Living with family	134 (73.6)
Physician	23 (12.6)	**Personal habits**	
		Smoking	4 (2.2)
Service setting		Alcohol	9 (4.9)
Ward	82 (45.1)	No	169 (92.9)
Intensive care unit	63 (34.6)	**Chronic disease**	
Emergency room	37 (20.3)	Yes	24 (13.2)
		No	158 (86.8)
Previous professional experience in pandemic/epidemics		**Pre-pandemic psychiatric illness**	
Yes	86 (47.3)	Yes	7 (3.8)
No	96 (52.7)	No	175 (96.2)

SD = standard deviation. N=number.

As shown in the Table 2, by the end of our research, which was near the end of second wave of the pandemic in the country, 26% and 47% of our HCW had borderline and abnormal level of anxiety respectively. 29% of HCW had borderline depression, 33% had abnormal level of depression. Regarding to insomnia, 44 % had sub-threshold level, 10% had clinically moderate level and 4% had severe level of insomnia. 32% felt poor level of social support.

Table 2. The impact of negative psychological effects.

Anxiety	**N (%)**	**Depression**	**N (%)**
No	49(27%)	No	70(38%)
Borderline	47(26%)	Borderline	52(29%)
Abnormal	86(47%)	Abnormal	60 (33%)
Insomnia	**N (%)**	**Social support**	**N (%)**
No	76(42%)	Poor support	58 (32%)
Subthreshold	81(44%)	Moderate support	76 (42%)
Clinically moderate	18(10%)	Strong support	48 (26%)
Clinically severe	7(4%)		

N=number.

Pearson correlation analysis between extrinsic factors and negatives psychological effects with their respective correlation coefficient (*r*) and *p* value as showed in the Table 3.

Table 3. Correlations among extrinsic factors, anxiety, depression, insomnia and social support.

	1	**2**	**3**	**4**	**5**
1. Changes of workload and schedules	(.86)				
2. Sufficiency of PPE and medical supplies	-.289**	(.90)			
3. Concerns over risk of infection	.500**	-.231**	(.92)		
4. Working place relationships	-.351**	.506**	-.096	(.89)	
5. Social pressure	.370**	-.315**	.423**	-.140	(.89)
6. Family support	-.172*	.171*	.096	.313**	.010
7. Public health policy and information accuracy and transparency	-.347**	.664**	-.151*	.548**	-.222**
8. anxiety	.489**	-.285**	.538**	-.254**	.390**
9. depression	.425**	-.255**	.460**	-.357**	.251**
10. insomnia	.447**	-.229**	.359**	-.313**	.302**
11. social support	-.128	.255**	-.092	.351**	-.121
Mean	1.29	1.48	1.61	2.00	1.67
SD	.69	.67	.78	.57	.75

(Continued)

	6	7	8	9	10	11
1. Changes of workload and schedules						
2. Sufficiency of PPE and medical supplies						
3. Concerns over risk of infection						
4. Working place relationships						
5. Social pressure						
6. Family support	(.83)					
7. Public health policy and information accuracy and transparency	.249**	(.87)				
8. anxiety	-.128	-.303**	(.90)			
9. depression	-.244**	-.293**	.598**	(.84)		
10. insomnia	-.188*	-.226**	.515**	.519**	(.91)	
11. social support	.394**	.260**	-.169*	-.225**	-.254**	(.77)
Mean	2.20	1.79	10.71	8.65	8.70	9.81
SD	.74	.45	4.95	4.23	5.93	2.53

SD= standard deviation. On the diagonal line are the values of Chronbach's α coefficient.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The extrinsic factors that related positively in common to anxiety and depression were changes of workload and schedules, concerns over risk of infection and social pressure.

The shared extrinsic factors that related negatively to anxiety and depression were sufficiency of PPE and medical supplies, working place relationship, and public health policy and information accuracy and transparency. In addition, family support, as extrinsic factor, had negative relation to depression.

Several factors had positive relation to insomnia on our frontline HCW, namely changes of workload and schedules, concerns over risk of infection, and social pressure. Extrinsic factors that negatively related to insomnia were sufficiency on PPE and medical supplies, working place relationships, family support, and accuracy and transparency on public health policy and information.

Perception on social support was positively affected by extrinsic factors such as sufficiency of PPE and medical supplies, working place relationships, family support, and accuracy and transparency on public health policy and information.

We compared the impact of negative psychological impact between physicians, PAs/RTs and nurses in this paper using one way ANOVA with Tukey Post Hoc analysis (Table 4).

Table 4. Perception differences on negative psychological impacts and extrinsic factors between different occupations of HCW.

Negative psychological impact	Occupation (n)	Mean	SD	F	η^2	Turkey HSD Post Hoc
Insomnia	Nurse (128)	9.41	5.606	3.551*	.038	Nurses>PA/RT, Nurses>Physicians
	PA/RT (31)	7.55	5.966			
	Physicians (23)	6.26	6.975			
Social support	Nurse (128)	9.34	2.508	8.952***	.091	Nurses<PA/RT, Nurses<Physicians
	PA/RT (31)	10.55	2.278			PA/RT<Physicians
	Physicians (23)	11.43	2.128			
Extrinsic factors						
Sufficiency of PPE and medical supplies	Nurse (128)	1.41	.61	4.769**	.051	Nurses<Physicians
	PA/RT (31)	1.43	.67			PA/RT<Physicians
	Physicians (23)	1.86	.85			
Working place relationship	Nurse (128)	1.94	.55	4.920**	.052	Nurses<Physicians
	PA/RT (31)	1.98	.56			
	Physicians (23)	2.34	.60			
Social pressure	Nurse (128)	1.77	.70	4.888**	.052	Nurses>Physicians
	PA/RT (31)	1.53	.75			
	Physicians (23)	1.30	.92			
Family support	Nurse (128)	2.14	.72	5.872**	.062	Nurses<Physicians
	PA/RT (31)	2.08	.88			PA/RT<Physicians
	Physicians (23)	2.67	.42			

SD = standard deviation. *$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The result showed that there were no major differences between groups on anxiety and depression.

The major difference was on the perception on severity of insomnia. It differs between different group of professionals ($F(2, 179) = 3.511$, $p = .03$, the effect size calculated as eta squared (η^2), was .038). Tukey Post Hoc analysis revealed nurses ($M = 9.41$, $SD = 5.61$) were more affected by insomnia than physicians ($M = 6.26$, $SD = 6.98$) or PAs/RTs

(M = 7.55, SD = 5.97). Also, differences on social support was observed (F (2, 179) =8.952 , $p < .001$, η^2=.091). Tukey Post Hoc analysis revealed nurses (M = 9.34, SD = 2.51) feels less social support than PAs/RTs (M = 10.55, SD = 2.28) and physicians (M = 11.43, SD = 2.13), and PAs/RTs feels less social support than physicians.

Differences on perception of certain extrinsic factors were noted between different occupations of HCW: about sufficiency of PPE and medical supplies (F (2, 179) =4.769, $p < .01$, η^2= .051), both nurses (M = 1.41, SD = .61) and PAs/RTs (M = 1.44, SD = .67) felt less supported by PPE and medical supplies than physicians (M = 1.87, SD = .85). Working place relationship was also perceived differently (F (2, 179) = 4.92, $p < .01$, η^2= .052), nurses (M = 1.94, SD = .55) perceived more negative working place relationship than physicians (M = 2.34, SD = .60), but there's no significant differences between physicians and PAs/RTs (M = 1.98, SD = .56) . Social pressure (F (2, 179) = 4.888, $p < .01$, η^2= .052) also impacted differently to our HCW, nurses perceived significantly more social pressure (M = 1.77, SD = .70) than physicians (M = 1.29, SD = 0.92), there was no significant difference between PA/RT (M = 1.53, SD = .75) and physicians. Differences on feeling of family support was observed(F (2, 179) = 5.872, $p < .01$, η^2= .062), our nurses (M = 2.14, SD = .72) and PAs/RTs (M = 2.08, SD = .88) significantly felt less support from their family than physicians (M = 2.67, SD = .42).

4. Discussion

The COVID-19 pandemic caused negative psychological impacts to our physicians, nurses and PAs/RTs working in internal medicine department and emergency service: 47% of responders had borderline to abnormal levels of anxiety, 33% had significant depression, 14% had moderate to severe insomnia, with 32% felt loneliness reflected by poor social support. All seven proposed extrinsic factors proved to have relationship with negative psychological effects during the pandemic.

Our analysis revealed that nurses felt more affected by insomnia, poorer social support, not fully supported by enough PPE, less satisfaction on working place relationship, higher level of social pressure and less family support than physicians, and PAs/RTs felt poorer social and family support than physicians. Our results had revealed hierarchy differences on perception of negative psychological impact and on extrinsic factors that influenced on them.

As mentioned previously, our nurses felt more affected by insomnia. Insomnia can be multi-factorial in scenario of pandemic. From managerial perspective, working overtimes and frequent or unexpected work shift changes are confirmed causes of shift work sleep disorder (Boudreau et al. [3]). During the pandemic, symptoms of the insomnia was exacerbated due to overwhelming workload, overtimes and work shift changes, consequently, worsening the negative psychological impact to frontline HCWs. Nurses are the most affected group (Sampaio et al. [37]).

Nurses and PAs/RTs involved in this survey seemed to feel less supported by sufficiency of PPE/ medical supplies than physicians. The possible reason of sense of shortage might be as both nurses and PAs/RTs are in frequent and close contact with infected/isolated patients, needing to change their PPE much more frequently than physicians, so, there was more chance to encounter the shortage during their job, and this

was more notable during initial stages of the pandemic. Previous studies proved that shortage of PPE were detrimental to HCWs not only physically but also mentally (Chigwedere et al. [7], Kim and Choi [19], Kisely et al. [20], Morawa et al. [30], Stuijfzand et al. [42], 2020; Sung et al. [43]). Sufficiency of PPE/medical supplies is an essential factor in reducing psychological stress of HCWs during pandemics (Wu et al. [47]). As a result of the sharp surge in demand during the pandemic, market instability ensued, leading to panic and a breakdown in supply chains, which in turn caused failure in maintaining and distributing domestic inventories of PPE in governmental level. Dysfunctional hospital budgeting models further discouraged the maintenance of adequate PPE stockpiles (Cohen and van der Meulen Rodgers [8]). The effort should prioritize achieving a balance between supply and demand. To minimize shortages and enable a rapid response, managers should focus on solutions that involve adapting, blending, and repurposing existing products, processes, technologies, and infrastructures. Extracting real-time data from public health authorities and internal systems is crucial for accurately predicting demand. The formation of expert teams, comprising representatives from infectious disease and critical care specialties, medical device technicians, infection control, software engineering, and the procurement department, has been proposed to enhance coordination of supplies. Additionally, the development of software or apps to aid in supply management has been suggested to further optimize resource allocation (Rowan and Laffey [36]).

Our study identified four social-interpersonal factors with significant differences between groups: perceptions of social support, workplace relationships, social pressure, and family support tended to be more negative among nurses and PAs/RTs. This finding suggests that these social-interpersonal factors are influenced by occupational and hierarchical status, both within the hospital structure and society in general.

Sense of social support differs from different job positions within healthcare organizations. Most of the healthcare system had traditionally organized on hierarchy structure, either within disciplines or among disciplines, and within clinical units or hospital system structure (Edmondson et al. [10]), and most of time, it is centered on physicians. Physicians used to be in leading role within a healthcare system, receiving more assistance in their daily medical activity, this would translates into better sense of being supported in their professional practice than other HCWs (see Omura et al. [32], Que et al. [33], Zelek and Phillips [49]). A study in South Korea, Kim et al. [18] showed that the sense of social support is negatively affected by culture of hierarchy within health care organization. During the pandemic, Wanigasooriya et al. [46] observed that well-being support and exposure to moral dilemmas at work were linked to mental health symptoms in hospital HCWs. Shechter et al. [39], in their New York-based study during the pandemic, found that HCWs other than physicians within the healthcare system often perceived lower levels of social support. This indicates that the negative effects of hierarchical culture within healthcare organizations require special consideration when providing support to frontline HCWs. Additionally, Tuckett et al. [44], in an e-cohort study, observed that a lack of managerial support and unsupportive relationships within work groups were significant factors contributing to nurses leaving their profession.

In the battle against the pandemic, teamwork is essential. This is directly related to working place relationship. Trust issue, confidence and mutual support significantly affect psychologically during daily fight against this new emerging virus, not only between co-workers, but also how the leadership demonstrate the confidence, understanding and support to team members is essential (Lee et al. [23], Tuckett et al. [44], Turner and Marino [45]).

Social pressure positively increases psychological impact during the pandemic. In our survey, 68% of responders manifested that the public in general demands too much from their services, 55% felt discrimination because of their occupation in some point of the COVID-19 pandemic, 51% had experience of disrespect from people. During SARS pandemic, studies showed that because of the nature of their profession and duties, frontline healthcare professional's perception on stigmatization and social isolation was a significant risk factor for negative psychological outcome (Chen et al. [6]). Social rejection or isolation is associated with negative psychological effect during pandemic/ epidemics (Kim and Choi [19]).

Our study showed that family support is a negative factor to perceived severity of depression/ insomnia and a positive factor to perception of social support. This finding is in concordance with other studies (Cabarkapa et al. [4], Chigwedere et al. [7], Montgomery et al. [29], Sung et al. [43]). There are several substantial ways that family members can be supportive: understanding the nature and responsibility of professional duties of loved ones, being aware of trend of the pandemic, be vaccinated, actively taking protective measures, and sharing duties of daily life (Albott et al. [1], Turner and Marino [45]).

What are the managerial implications of our findings? In our opinion, leaders and managers in health care system should understand that the ultimate goal of the psychological health of HCWs is not only the organizational performance, furthermore the quality care and safety of the patients (Stock et al. [41]). To achieve these targets, the health of HCWs, both physically and mentally, is of a paramount importance, as HCWs are the foundation of all healthcare system.

Gergerich, Boland and Scott in their paper had explained that unresolved hierarchy conflict can be source of tension and conflict in health care system, and some members of the health care team may experience marginalization that impairs working as a team (Gergerich et al. [13]). A study published in 2022 by Zipf et al. [50], had observed that, during the pandemic, nurses felt that they are "dispensable" human resources, in comparison to other health professionals. We believe that leaders and managers in healthcare systems should pursue a organizational hierarchy flatteninng. Research has shown that reducing the hierarchical gap between medical and nursing staff improves communication and patient care (Rabøl et al. [34]). To achieve this, managers should cultivate a workplace environment that promotes positive feedback and encourages all team members to speak up, regardless of their role. Fostering a supportive culture where everyone feels safe to speak up is crucial for patient safety. NHS England had stated "Methods for communicating with staff to build healthy and supportive cultures where everyone feels safe to speak up should also be put in place." (NHS England [31]). In their 2023 review of studies on hierarchy in healthcare, Essex et al. [11] noted that

organizational hierarchy is dynamic and can modifiable over time with appropriate strategies. Green et al. [14] proposed practical strategies inspired by the aviation industry to support open communication and collaboration, thereby reducing hierarchy gradients. These include communicating in a non-confrontational, fact-based manner, using the "PACE" sequence (probe-alert-challenge-emergency) to address potential issues, and engaging in collaborative inquiry to enable self-correcting dialogue among professionals. Adopting effective strategies for flattening organizational structures can alleviate dissatisfaction and reduce negative psychological effects, leading to better communication, a stronger sense of inter-professional teamwork, increased job satisfaction, and, ultimately, resulting les medical errors and improved patient care (Green et al. [14], Liedtka et al. [26], Rabøl et al. [34], Zipf et al. [50]).

Rosentein et al. [35] in their survey had revealed that more than 90 percent of nurses had witnessed disruptive behaviors of physicians, and more than 30 percent of survey participants reported knowledge of a nurse leaving their job because of the same reason, revealing inequalities within healthcare system has serious consequences on human resources. Consequently, creating an atmosphere of equity within the framework of teamwork is an essential work for managers and leaders. While teamwork has been proven essential for delivering optimal patient care (LePine et al.[25]), historically medical professional formation often emphasizes individual skills, development, contribution, and accountability over team-based approaches (Leggat [24]). However, all healthcare team members, regardless of position, need a foundational understanding of teamwork. Team is a group of individuals who are interdependent in their tasks, they share responsibility for outcomes, perceived mutually as a cohesive social entity embedded within one or more larger social systems, and manage their relationships across organizational boundaries (Cohen and Bailey [9]). In healthcare system, cross-functional, inter-professional teams, in our case, comprised by physicians, nurses, PAs, and RTs, are crucial in this ecosystem, especially during the pandemic, where effective collaboration directly impacts service quality and reliability. Challenges in healthcare teamwork include psychological barriers (e.g., professional silos, hierarchies, power imbalances) and organizational barriers (e.g., distributed teams). Managers and leaders can plan strategies for optimizing workflows and reducing unnecessary stress such as proposed by Zajac et al.[48], these include clearly defining goals, roles, and responsibilities; establishing open communication channels with equal opportunities for input; fostering a collaborative environment; and recognizing each role's value. By implementing these strategies and supporting them with regular interdisciplinary team meetings, real-time communication tools, and shared decision-making platforms, seamless coordination is achievable. Additionally, timely rewarding collective achievements and providing positive feedback strengthen team relationships, create an atmosphere of equity, and break down inter-professional barriers, ultimately improving service reliability, enhancing patient care quality, and reducing medical errors (Edmondson et al. [10])

Social support proved to enhance the psychological resilience in organizational level during the pandemic (Labrague [22]). It is crucial employer and management leader's positive reinforcement, this would decrease sense of social isolation, increases sense of supportive climate, enhancing feeling of security (Häussl et al. [16]). Lack of positive

reinforcement from peers, leaders, and others within the profession, are major driving force for leaving profession (Gellasch [12]). At the institutional level, managers and leaders can actively modify, adapt, and enhance support systems for healthcare workers in practical ways. These strategies can be perceived by HCWs as positive reinforcement, serving not only as encouragement but also as a form of service recovery for these internal customers, ultimately aiding in staff retention. The workgroup at the University of California adopted the innovative three-tiered public mental health model for disaster intervention, as recommended by the U.S. National Academy of Medicine. This model is represented graphically as a pyramid with three tiers. The Tier 1 team provides broad-based practical, informational, and educational support to all HCWs involved, including childcare, lodging, training courses, and more. Tier 2 focuses primarily on screening and offering emotional support through trained faculty and staff mental health clinicians to HCWs in high-risk units or departments. Tier 3 offers direct mental health services to individual HCWs in need, as well as to their immediate family members (Miotto et al., [28]).

Considering healthcare workers as “internal customers” of the healthcare system, leaders and managers should develop concepts, plans, and strategies for service recovery to address HCW dissatisfaction. Schweikart et al. [38] proposed three timing approaches to service recovery: preventive, concurrent, and post-event. In our context, this could involve providing clear public health policy information to prepare HCWs for pandemic response, ensuring sufficient PPE while they care for patients, and scheduling breaks to alleviate fatigue. The same authors also suggested psychological and tangible service recovery methods. Taken our institution as example, we implemented psychological counseling programs and provided additional remuneration during the pandemic.

This study has the following limitations: the number of participants is limited, as the study was performed in a single regional healthcare system in a metropolitan area situated in the central region of the country. This might explain why the effect size calculated as eta squared (η^2) for insomnia was rather small to moderate (.038), and for four significant extrinsic factors (sufficiency of PPE and medical supplies, working place relationship, social pressure, and family support), the effect size was moderate (.051~.062). Larger scale of study involving multi-healthcare system, cross regional or even in national level, incorporating larger number of participants, would better reflect the phenomenon in panoramic view. Also, other than increasing sample size, incorporating other measurements tools for more detailed evaluation of the mentioned factors would resolve these limitations in future studies (Meyvis and Van Osselaer [27]).

5. Conclusion

In summary, COVID-19 pandemic during 2020-2022 had affected negatively to our nurses, PAs/RTs and physicians of our internal medicine and emergency medicine department. Significant proportion of HCWs suffered from anxiety, depression and insomnia, as well insufficient social support. HCWs from different job positions had perceived these negative psychological effected on different ways, mainly, compared to physicians and PAs/RTs, nurses felt more affected by insomnia, poorer social support. They also felt not fully supported by enough PPE, less satisfaction on working place

relationship, higher level of social pressure and less family support. Our PAs/RTs felt relatively poorer social and family support than physicians, but seemed to be less affected than nurses. Organizational culture of hierarchy is evident. This should be overcome by organization hierarchical flattening, creation of an atmosphere of equity and positive reinforcement from the employers and management leaders, to reduce psychological impact in our HCWs, to improve organizational performance, and ultimately, to achieve quality of care and safety for patients during the pandemic.

Acknowledgements

This work was supported by the Cheng Ching Hospital Research Fund in Chung Kang branch, grant number CH11000266. We would like to thank to all healthcare workers involved in a very challenging daily work during the pandemic, as well our gratitude to anonymous reviewers and editors for their constructive comments and suggestions, which helped to improve this article significantly.

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Appendix

A. Extrinsic Factors Measures

1. *Changes of workload and schedules* *(Not at all = 0, sometimes = 1, often = 2, very frequently = 3).*

1.1 Do you feel that the frequency of overtime work had increased?
1.2 Do you feel that unexpected schedule changes are more frequent?
1.3 Do you feel unable to adapt the changes on the schedule of duty?
1.4 Do you find it more difficult to cope with work during the epidemic?
1.5 Do you feel like you have more emergencies at work?

2. *Sufficiency of PPE and medical supplies* *(Totally inadequate = 0, slightly insufficient = 1, adequate = 2, completely sufficient = 3).*

2.1 Do you think the hospital had provided enough personal protective equipment?
2.2 Do you think the hospitals had provided enough medical supplies?
2.3 Do you think the hospital has a clear intra-hospital traffic control plan?
2.4 Do you think the government has provided sufficient infection prevention resources to hospitals and staffs?

3. *Concerns over risk of infection* *(Not worried at all = 0, a little worried = 1, often worried = 2, very worried = 3).*

3.1 Are you worried about being infected with COVID-19 through medical work?
3.2 Are you worried that you would be infected by the virus through medical work and infect your family and friends?
3.3 Are you worried about the long-term consequences of post COVID-19 syndrome?
3.4 Are you worried that you will be seriously ill or die from COVID-19?

4. *Working place relationships* *(Not good at all = 0, insufficient = 1, adequate = 2, very good = 3).*

4.1 Do you feel you have good relationships with your colleagues and supervisors?
4.2 Do you feel that there are appropriate communication channels with your unit supervisor and colleagues?
4.3 Do you feel that your supervisor provides sufficient support and encouragement for your work?
4.4 Do you feel that your supervisor has taken the initiative to seek more resources and support for members in the unit?

5. *Social pressure* *(Not at all = 0, sometimes = 1, often = 2, very frequently = 3).*

5.1 Do you feel that the public's demands on medical staff are too high?
5.2 Do you feel that the public was discriminatory at health care workers during the Very frequently 3?
5.3 Do you feel that the public does not respect health care workers enough during the pandemic?

6. *Family support* *(Not at all = 0, sometimes = 1, mostly = 2, absolutely = 3).*

6.1 Does your family understand what is your work about during the pandemic?
6.2 Does your family support your medical practice during the pandemic?

7. *Public health policy and information accuracy and transparency* *(Not at all = 0, insufficient = 1, adequate = 2, very good = 3).*

7.1 Do you feel that the hospital or your supervisor has provided clear guidelines for your work during the pandemic?
7.2 Do you feel that the hospital or your supervisor clearly provides information on the pandemic in the hospital?
7.3 Do you feel that the hospital or unit supervisor provides adequate on-the-job training?
7.4 Do you feel that the government has provided clearly information about the progression of the pandemic?
7.5 Do you feel that the government has provided clearly information about the prevention and treatment for the pandemic?