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Perspectives of Frontline Nurses Working in South Korea during the COVID-19 Pandemic: A Combined Method of Text Network Analysis and Summative Content Analysis

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Purpose: This study aimed to explore the perspectives of frontline nurses working during the novel coronavirus disease 2019 (COVID-19) pandemic. **Methods:** An online qualitative study was conducted using a pragmatic approach. The data were collected in August 2021. Registered Korean nurses who provided direct nursing care to patients with confirmed COVID-19 were eligible for this study. An online survey was used to gather free-text data, which were then analyzed using machine-based network analysis and summative content analysis. **Results:** The analysis examined the responses of 126 participants and led to the identification of six prominent themes. These themes were further classified into three distinct levels: personal, task, and organizational. The identified themes are as follows: "collapse of personal life," "being overwhelmed by the numerous roles required," "personal protective equipment was sufficiently provided, but that is not enough," "changes in interprofessional collaboration," "inappropriate workforce management," and "diverted allocation of healthcare services and resources." **Conclusion:** Our findings highlight areas for improvement in resources, systems, and policies to enhance preparedness for future pandemics.

Key words: Nurses; Nursing Care; COVID-19; Pandemics; Qualitative Research

INTRODUCTION

Since late 2019, the novel coronavirus disease 2019 (COVID-19) has remained a global threat, with a continuous surge in the number of new infections, fatalities, and the emergence of new variants. As of July 2023, approximately 767.6 million individuals worldwide have contracted COVID-19, with 6.9 million deaths reported, and these figures continue to increase [1]. Similar to other countries, South Korea (hereafter referred to as Korea) has suffered substantial human loss and socioeconomic burdens from the pandemic, with 35,000 deaths attributed to COVID-19 [2]. Moreover, since 2019, COVID-19 has posed a formidable challenge to the healthcare workforce in Korea, as they have been working diligently to prevent the spread of the virus and to care for patients with confirmed or suspected infections. Korean healthcare professionals (HCPs) have been appreciated for their professional efforts and dedication in combatting the infection, with the public referring to them as heroes and angels through the "Thank You Challenge" [3]. Despite this recognition, Korean HCPs still faced diverse hardships that cannot be easily alleviated by expressing gratitude and encouragement from the public.

Among the various HCPs, nurses have been at the frontline in providing direct care to patients during the pandemic. Consequently, they have suffered from physical and psycho-

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logical symptoms, including posttraumatic stress disorder, depression, physical fatigue, and skin problems [4-6], resulting from constant and close contact with infected patients. Moreover, nurses encountered various difficulties, including increased workloads due to caring for high-acuity patients, job-related stress resulting from inadequate education and staffing for patient care, and insufficient provision of personal protective equipment (PPE) by institutions [4,5,7]. These issues can lead to decreased coping abilities and job satisfaction and increased turnover rates among nurses [8]. Consequently, this scenario presents a significant concern for the nursing workforce and public health.

Globally, an increasing number of studies have examined the impact of the COVID-19 pandemic on the nursing workforce. During the initial phase of the pandemic, most studies focused primarily on the physical and psychological health of nurses, their workload, infection risks, and control measures [9-12]. Subsequently, researchers explored how the pandemic affected nurses' roles, their interactions with other healthcare professionals, and operations and support within healthcare organizations [13-15]. However, most studies have been conducted within a single country, and evidence comparing nurses' experiences and the corresponding changes in organizational operations and professional roles across different countries is limited. Given Korea's renowned reputation for well-established preparedness and management protocols [16,17], exploring the perspectives of Korean nurses regarding work during the pandemic is particularly relevant.

Korea has a universal health coverage system and is a high-income country [18]. Compared with other Organisation for Economic Co-operation and Development countries, Korea has exhibited a significantly lower number of COVID-19-related deaths without stringent lockdown policies [17]. Previous qualitative studies have described the perspectives of Korean nurses working during the pandemic, encompassing various clinical settings including hospitals temporarily closed due to the pandemic [19], screening clinics [20,21], emergency rooms [22], and long-term care hospital [23]. However, most of these studies were conducted in a single hospital or a few hospitals, which limits the generalizability of the findings. Moreover, the sample sizes in previous studies were small, ranging from 8 to 21 participants [4,21]. In addition, limited aspects of nurses' work experiences have been identified. For instance, while prior studies have mentioned the discomfort of wearing PPE and the excessive workload [6,24,25], little attention has been paid to nurses' interactions with other professionals and operational and structural changes within their organizations during the pandemic. Thus, there is a need for scientific evidence of how organizations have adapted their operations and how nurses' roles have evolved in response to these changes within Korea's universal healthcare system.

This study was designed to capture the perspectives of nurses working at hospitals in Korea during the pandemic. This study was part of an international study that sought to capture nurses' perspectives on their workplace and clinical practices across the world. The international comparative research to which this study belongs was initiated by the New York University (NYU) College of Nursing [26]. Researchers worldwide joined this research consortium, and this is the only study that represents a Korean sample. A comprehensive exploration of nurses' perspectives on various aspects, from a personal to the organizational level, will help us assess the changes implemented and identify persisting problems. Such an understanding will aid in better preparedness for future pandemics. Lessons learned from the perspectives of Korean nurses during the pandemic may also prove to be beneficial for other countries.

METHODS

1. Design

An online qualitative study was conducted using a pragmatic approach that proved effective in practically and promptly investigating data and translating the findings into practice [27]. During the pandemic, when various restrictions were placed on academic and clinical settings, a pragmatic approach facilitated the collection and analysis of data from frontline nurses working at hospitals. This online data collection method enabled to recruit more nurses nationwide, thus overcoming the inability to meet them face-to-face during the pandemic [28,29]. Moreover, this approach en-

sured privacy and encouraged more truthful and less socially desirable answers, particularly when addressing socially sensitive questions related to the pandemic [30,31].

2. Translation and pre-testing of the qualitative survey instrument

The NYU nursing research team developed an English version of the qualitative survey instrument by asking nurses their perspectives on working during the pandemic in the United States (US) [26]. The survey instrument included items that collected nurses' demographic information and open-ended questions that explored nurses' perspectives on several topics. These topics encompassed resources and training, utilization and availability of PPE, nursing roles, organizational operations, interprofessional collaboration, and primary sources of stress in work and personal lives. The details of the original instrument have been published previously [26]. To use the survey instrument with a Korean population, a Korean research team translated it into the Korean language. Guided by the World Health Organization [32] and the Agency for Healthcare Research and Quality [33], a translation team consisting of five people (three translators and two translation reviewers) performed a five-stage translation process: forward translation, review of translation, back translation, pre-testing, and finalization. All translation team members were bilingual and familiar with the clinical settings in Korea and the US. The three translators included a Korean-American nurse working at a Korean hospital, a Korean nurse working at a Korean hospital, and a Korean nursing PhD student studying at a university in the US. The two translation reviewers were professors of nursing in Korea. First, the two Korean translators independently translated the instrument from English to Korean. The translation reviewers reviewed the two forward translations, reconciled any discrepancies, and provided the Korean version. After the forward translation, the Korean-American translator back-translated the Korean version into English without seeing the original English version. The translation reviewers compared the English-translated version with the Korean version, discussed and reconciled any ambiguities and discrepancies between them, and agreed to the revised Korean version. Finally, the revised Korean version was pretested on three nurses purposefully chosen based on their age, work unit, and hospital. After the pre-tests, the Korean version of the instrument was finalized.

3. Sample

The inclusion criteria were Korean registered nurses who provided direct nursing care to patients with confirmed COVID-19 infection at hospitals during the pandemic. Nurses who did not care for inpatients with confirmed COVID-19 infection were excluded from the study. Participation in the study was voluntary.

4. Recruitment

The study participants were recruited using convenience sampling. According to Salmons [34], more than 50 participants were required to reach data saturation in this online qualitative study. The research team selected five major COVID-19-dedicated hospitals nationwide and contacted them to obtain their permission to conduct the study. After obtaining permission, on behalf of the research team, the hospitals disseminated an online study flyer that included a link to the online questionnaire through their online bulletin boards and nurses' emails. The flyer was also distributed through the research team's personal and professional networks. With multiple recruitment efforts, 146 nurses participated in the study, and data saturation was assumed to be achieved.

5. Data collection

Following the data collection methods employed by the NYU research team [26], this study used Qualtrics XM (Qualtrics Co., Seattle, WA, USA), an online survey platform, for data collection. The data were collected in August 2021. Nurses who agreed to participate were asked to click on an online link embedded in the study flyer. Clicking on the link directed participants to a screening page to determine their eligibility to participate in the study. If deemed eligible, participants were required to complete a demographic profile before providing free-text responses to the open-ended questions. Each question was presented on a separate page

and had an adjustable large text box to accommodate participants' desired response lengths.

6. Data analysis

We used a combination of machine-based network analysis and summative content analysis to analyze the free-text data [26]. Network analysis of the free-text data was performed using the natural language processing function of NetMiner version 4.0 (Cyram Inc., Seongnam, Korea), a software specialized in network analysis. As a quantitative content analysis method, network analysis extracts meaningful words (keywords) from text data and offers central keywords, connections among the central keywords, and a network illustrating the relations, thus enabling a deeper understanding of context-based meanings [35,36]. In addition, a summative content analysis was conducted that involved calculating word counts and interpreting the underlying meaning in a specific context to understand the use of words and content [37]. The research team started the data analysis after being familiarized with the data by repeatedly reading all the participants' responses.

Machine-based network analysis was conducted using NetMiner software (Cyram Inc.). Only nouns were extracted as keywords from the text data using the software. Many Korean studies employing text network analysis have used nouns as units of analysis [38,39]. Further, the frequency of each keyword was calculated for comparison. The frequency list of keywords was used to perform a co-occurrence analysis, focusing on each sentence that contained the keywords [39,40]. Consequently, a network showing the significance of the keywords and the connections among them was generated using word co-occurrence analysis. Summative content analysis was performed through repetitive discussions among the research team members. The research team reviewed the keyword list, in addition to the frequencies generated by NetMiner (Cyram Inc.), to identify the most common words used by the study participants and compare them. In addition, the team traced the original sentences using keywords and the respondents of the sentences to find any links among the respondents' characteristics and to understand the contexts they described. This allowed the team to explore the use and meaning of words [37]. Further, a computer-generated network was analyzed to determine whether it appropriately reflected the data. The major codes and themes in the data were identified through multiple readings and discussions of the data and network. After reaching a consensus, themes that best described the perspectives of frontline nurses during the pandemic were finalized.

Iterations were required at all stages, until the research team reached a full consensus regarding the themes extracted. In this study, the combination of traditional and machine-based analyses enhanced the trustworthiness of the data [41] and allowed a better understanding of nurses' work during the pandemic.

7. Ethical considerations

This study was approved by the Institutional Review Board of the Yonsei University Medical Center (IRB No. 4-2021-0400). All human approaches were performed after obtaining ethical approval. All the respondents provided informed consent online before starting the survey. No identifiable data were requested for this study and no questions were mandatory.

RESULTS

A total of 145 responses were collected. However, 19 incomplete responses (only the screening questions were completed) and three duplicate responses were noted. The final sample size for the analysis comprised 126 participants. More than 80% of the participants (n = 104) were aged 20~39 years. Most participants were female (n = 111) and had a bachelor's degree (n = 102). Forty-one participants had nursing experience of 0~3 years (32.5%). Most nurses provided direct care to adult patients in specialized units, including intensive care units, emergency departments, and operating rooms. Table 1 summarizes the participants' characteristics.

Six themes related to nurses' perspectives on work during the pandemic were identified and organized at the personal, task, and organizational levels (Figure 1). In this study, the personal level involved the personal lives of nurses, including

Table 1. Characteristics of Participants (*N* = 126)

Characteristics		n (%)/M ± SD
Age (yr)		32.4 ± 7.6 (24~57)
Gender	Woman	111 (88.1%)
	Man	15 (11.9%)
Years of experience in nursing	0~3 years	41 (32.5%)
	4~6 years	30 (23.8%)
	7~10 years	18 (14.3%)
	≥ 11 years	37 (29.4%)
Population served†	Mothers/children ≤ 5 years	24
	Children aged 6~18 years	31
	Adults aged 19~64 years	122
	Older adults aged ≥ 65 years	95
Place of work	ICU/ER/OR	76 (60.3%)
	General wards	31 (24.6%)
	Infection/isolation/ COVID-19 units	19 (15.1%)
Education level	Associates degree	10 (7.9%)
	Bachelor's degree	102 (81.0%)
	Master's degree or higher	13 (10.3%)
	Missing	1 (0.8%)
Period of working with COVID-19 patients	≤ 4 weeks	15 (11.9%)
	≥ 5 weeks	105 (83.3%)
	Not sure	6 (4.8%)
Number of COVID-19 patients cared for in workplace	≤ 15	23 (18.3%)
	≥ 16	92 (73.0%)
	Not sure	11 (8.7%)

M = Mean; SD = Standard deviation; ICU = Intensive care unit; ER = Emergency room; OR = Operating room; COVID-19 = Novel coronavirus disease 2019.
†Multiple choice.

their relationships with family, friends, and others. Meanwhile, the task level was related to their work, and the organizational level involved where they worked, including their organization's structures and operational procedures.

1. Personal level: collapse of personal life

Most participants mentioned that their employers restricted them from engaging in outside activities to prevent infection, resulting in feelings of isolation and a sense of deprivation of their freedom. Normal activities before the pandemic, such as meetings and meals with family, were hardly allowed. Moreover, they had to be highly responsive to the slightest signs of illness, even if they did not qualify as clinical symptoms of COVID-19, because of concern for the health of their loved ones and acquaintances. Furthermore, owing to infection risks, participants' personal lives tended to be considerably limited and isolated amid significant worry for their loved ones.

"Full restrictions on outside activities, feelings of freedom, living only in the house, restrictions on meeting people, and feeling socially isolated." (ID#39)

"Worried that people close to me will become ill, or that others will become ill if I am caught." (ID#14)

2. Task level

1) Being overwhelmed by the numerous roles required

During the pandemic, the participants reported being significantly overwhelmed due to the multiple roles they were expected to fulfill, ranging from non-patient-related tasks to clinically advanced responsibilities. Non-patient-related responsibilities included cleaning rooms and toilets, providing meal assistance, conducting exposure investigations, and dealing with patients' families. Furthermore, nurses who were originally assigned to general wards were expected to care for critically ill patients requiring intensive care, leaving those with limited knowledge and experience in this area feeling anxious and overwhelmed.

"Tasks that the general ward nurses were not in charge of, such as cleaning rooms, cleaning toilets, collecting medical waste, dressing pressure ulcers, and taking pictures of pressure ulcers, were given to nurses." (ID#106)

"Because of the change from being a ward to an intensive care unit nurse, the severity of the patients increased so much that there were many times when I felt burdened." (ID#58)

"Nurses working in clinical settings have to participate in the tracking of movement routes, exposure investigations, and hospital cleaning practices in the event of a confirmed case. It is very stressful." (ID#4)

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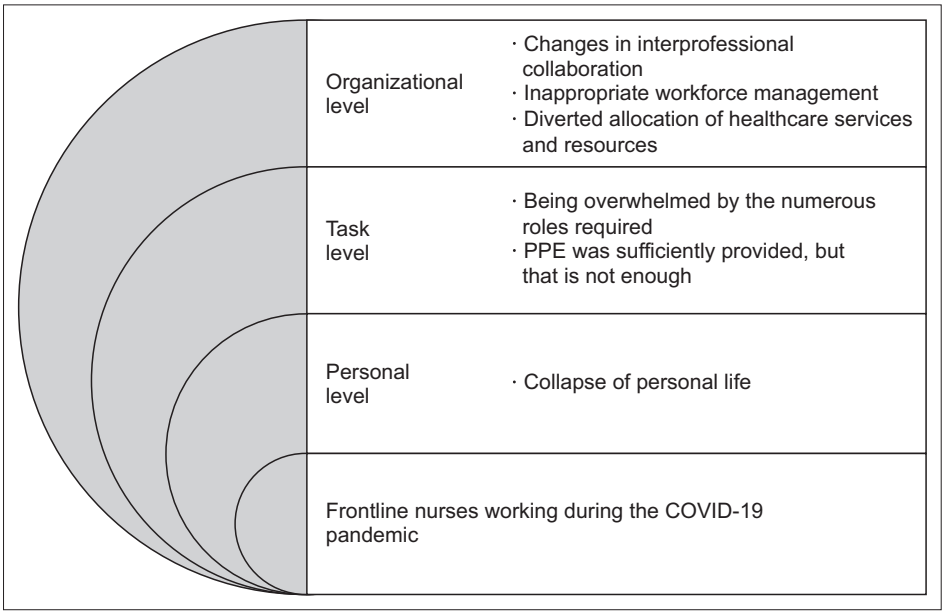

PPE = Personal protective equipment; COVID-19 = Novel coronavirus disease 2019.

Figure 1. Perspectives of frontline nurses working during the COVID-19 pandemic.

2) Personal protective equipment was sufficiently provided, but that is not enough

PPE was an important necessity for working during the pandemic. Based on the results of this study, the provision of PPE was not the only issue for participants working on the frontline. The participants stated that PPE was inadequately provided at the beginning of the pandemic, but became sufficient afterward. However, the quality of PPE and the requirement to wear it for extended periods significantly affected nurses' work. Participants' anxiety about infection risks was heightened while working owing to differences in the quality of PPE, as some products were oversized and easily torn. Most participants experienced discomfort due to the chemical smell, heavy weight, and heat provided by the PPE. This discomfort led to headaches, skin abrasions, pain, and dermatitis, especially when wearing sanitary pads. Moreover, the participants had difficulties assessing and caring for patients and could not accurately perform procedures (e.g., injections) because of wearing multiple layers of gloves and the presence of moisture in their goggles.

"Due to the huge difference in the quality of the personal protective equipment provided, I felt generally anxious that I might get infected while wearing low-quality equipment. The floor was too slippery to work when wearing overshoes, and the protective clothing was too thin which tore easily." (ID#57)

"I had to perform all procedures and treatments with numb hands with many gloves on. While wearing protective equipment, I used to sweat a lot and required twice the amount of energy." (ID#66)

"I always applied tape on my forehead and cheeks before wearing protective equipment because of the discomfort and severe pain it causes throughout the workday. I have experienced a lot of headaches when I wore goggles." (ID#92)

3. Organizational level

1) Changes in interprofessional collaboration

This theme exhibited conflicting responses among the participants, with 40% and 60% expressing positive and negative opinions on changes in interprofessional collaboration, respectively. For instance, some participants stated that their organizations adopted a collaborative system involving all workers. Various workers collaborated to plan patients' procedures and ensure timely completion. In addition, inter-

professional communication was encouraged for effective patient care. Physicians increased their frequency of patient visits, thereby reducing the nurses' workload and the need for phone notifications. Despite the challenges in patient care, all workers strived to maintain a professional and understandable approach and engaged in constructive discussions.

In contrast to the positive responses, some participants observed a decline in collaboration among professionals compared with the pre-pandemic period. For instance, to minimize direct contact and reduce the risk of infection, physicians often disregarded nurses' calls or relied on surveillance cameras and call bells to attend to patients. Furthermore, the participants frequently encountered conflicts with other professionals who were hesitant to visit the units and interact with patients because of concerns about infection.

"The system changed to a system that collaborated with all occupations, including all nurses, clinical pathologists, and radiologists." (ID#5)

"The number of doctors visiting patients increased, notifications to confirm doctors' prescriptions decreased, and the patient care process was facilitated through efficient communication." (ID#61)

"Rather than collaboration, concerns about infection resulted in more friction and difficulties with others." (ID#126)

2) Inappropriate workforce management

Participants expressed dissatisfaction with how their employers managed the nursing workforce during the pandemic, particularly mentioning the severe shortage of nurses trained to care for COVID-19 patients. Consequently, some hospitals abruptly dispatched nurses to COVID-19 units without providing training, only to return them to their original units. This management approach was not helpful for nurses as they had to train newly dispatched nurses in caring for COVID-19 patients. In addition, participants reported that owing to the fluctuating daily number of confirmed COVID-19 cases, their shifts changed frequently, leaving them with only one day off per week. This inadequate workforce management led to physical and psychological exhaustion of the participants as the pandemic persisted.

"Lack of trained nursing staff. While a certain period of training was needed, nurses were dispatched for a short period of time, so once they got to adapt, they went back, and a new nurse was dispatched again." (ID#70)

"If the number of COVID-19 patients decreased, nurses were sent to another sector…. If the number increased, the general ward was closed again, beds were set up, and increased number of COVID-19 patients were admitted without securing the workforce." (ID#65)

"I only had one day off in a week… the hardest." (ID#69)

3) Diverted allocation of healthcare services and resources

As COVID-19 cases surged, hospitals redirected most of their resources and services toward treating COVID-19 patients. New facilities such as negative-pressure units, designated zones for symptomatic patients, and screening stations were established to accommodate the influx of cases. Additionally, existing facilities were repurposed. The participants reported that most of the resources and financial assistance were allocated for the screening and treatment of COVID-19.

"Construction of a general isolation room as a negative pressure isolation room… began receiving patients in negative pressure isolation rooms who had severe symptoms and required ventilator care." (ID#131)

"Expansion of negative pressure tents inside and outside of emergency rooms… screening clinics." (ID#126)

DISCUSSION

This study explored the perspectives of Korean frontline nurses during the pandemic using a combination of machine-based network analysis and summative content analysis. A comprehensive understanding of the nurses' perspectives was obtained by exploring their personal lives, roles, responsibilities, organizational structures, and workplace operations. This information can be used to develop a more supportive work environment for nurses during future pan-

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demics.

The personal-level theme was consistent with previous literature, indicating that the pandemic posed a risk to nurses' personal lives as it restricted their daily activities and heightened their concerns about infecting their families [21,22,42,43]. The impact of the pandemic on their personal lives has led some nurses to experience anxiety and depression [19,21,42]. Despite numerous domestic and global reports on the personal challenges faced by nurses, there is a paucity of research examining their coping mechanisms and how the pandemic has affected their families. Therefore, further exploration of these topics in future research is warranted.

Our findings indicate that at the task level, nurses encountered challenges due to the inadequate quality of PPE provided by their organizations and the overwhelming number of responsibilities they were expected to fulfill. Despite the crucial role of PPE in protecting nurses and patients, our findings revealed that the quality of PPE provided to frontline workers was inadequate. Similar findings have been reported in other studies [22,44], indicating that concerns about PPE extend beyond its mere provision to include its quality; it is crucial to improve the quality of PPE to ensure a safer working environment. Nurses reported an increase in their roles and responsibilities during the pandemic, which aligns with previous studies [5,6]. Our findings indicate that nurses were tasked with new responsibilities such as medical waste management, formal caregiving, nurse aiding, and supply management, which are not traditionally considered professional nursing roles [5,6]. Moreover, hospitals worldwide implemented restrictions on visitors [45], leading to additional responsibilities for nurses such as providing meal assistance, making continuous calls to family members, educating families, and providing emotional support to patients. Although these restrictions effectively prevented transmission and infection, they heavily burdened the nurses [5,6,19,45]. Thus, organizational support is necessary to enable nurses to care for patients while minimizing the risk of infection. In addition, nurses dispatched to COVID-19 units had to acquire new knowledge and skills to effectively care for patients with varying conditions, irrespective of their previous work experience. The expanded and challenging roles observed among Korean nurses were consistent with reports from other countries, including China, Singapore, and the US [26,46,47]. Our study suggests that COVID-19 units should consider the nature of nurses' roles when assigning duties and provide adequate training and support to help nurses adapt to their new responsibilities.

In this study, changes in the structures and operations of organizations in response to the pandemic were identified within the organizational-level themes. One interesting, the theme of interprofessional collaboration yielded inconsistent statements among the participants. While some reported positive experiences of constructive communication and effective teamwork with other professionals, others encountered conflicts, primarily due to concerns about infection. This inconsistency in nurses' statements regarding interprofessional collaboration aligns with the findings of other studies conducted in Korea and the US [21,26,42,14]. Given the critical importance of interdisciplinary collaboration in the functioning of healthcare facilities, further investigation into organizational changes related to interprofessional collaboration is warranted.

This study highlights the importance of effective workforce management in response to the pandemic. The theme of workforce management has revealed systemic issues in the current healthcare system in Korea, including a shortage of nurses trained to care for COVID-19 patients, sudden deployment of nurses, and frequent shift changes with short notice periods. These factors can contribute to stress and a sense of helplessness among nurses, ultimately leading to lower quality of care due to inadequate preparation time [26]. While it may be challenging to anticipate every situation during a pandemic [48], it is crucial to recognize that nurses' unpreparedness can significantly impact patient outcomes. Therefore, it is essential to develop flexible and situational strategies for workforce management, including the recruitment, arrangement, and retention of workers, while allowing sufficient preparation time.

As reported by our study participants, hospitals implemented new facilities exclusively for COVID-19 patients and established dedicated COVID-19 isolation units. However, the

sudden or rapid redirection of health services and resources to control and manage COVID-19 has presented challenges for nurses, as they had to adapt to these changes quickly. Abrupt diversions, without timely and appropriate notice, can impose significant burdens on nurses as they strive to adjust while providing patient care [49]. Additionally, units unrelated to COVID-19 may encounter difficulties in supplies and staffing provisions due to the establishment of new facilities [49]. Therefore, it is crucial to strike a balance between establishing new healthcare facilities and maintaining the existing ones. Further investigations are warranted to develop flexible and situational strategies to promote this balance. Furthermore, the themes related to organizational change emphasize that structural and operational improvements should be developed to prepare for future public health emergencies [6,19,48].

As previously mentioned, multiple countries participated in this international comparative study and conducted their own studies using the same research tools as this study [26]. Currently, only data from the US have been published [26], enabling a comparison with data obtained from Korea. Discussing perspectives on the changes in nursing roles, redeployment, and interprofessional collaboration in these two countries is relevant. In both countries, staff nurses were required to perform a wide range of work tasks, including cleaning, waste management, laboratory work, and assuming the roles of nursing assistants and clerical staff. This was observed in general wards and intensive care units. One difference between the two countries was the role of advanced practice nurses. In the US, advanced practice nurses were able to work more efficiently because of the lifting of restrictions on their scope of practice during the pandemic, driven by workforce shortages [26]. However, as Korea does not have an officially legalized advanced practice nurse system, changes in the role of advanced practice nurses could not be identified.

Furthermore, nurses in both countries expressed concerns about redeployment. Many nurses were reassigned to units with higher acuity, different patient populations, or different practice areas compared with their previous units, often working alongside dispatched nurses. They consistently reported that they were assigned without sufficient training or support. However, US nurses associated this issue with increased risks at work stemming from a lack of experience and compromised patient safety [26], while Korean nurses were more concerned about frequent changes in work shifts and a lack of day offs. This disparity may be attributed to the fact that the largest group (31.0%) of participants in the US study [26] consisted of highly experienced nurses with 11+ years of experience, whereas that in the Korean study consisted of nurses with less than three years of experience (32.5%). Moreover, the mean age of all Korean participants was 32.4 ± 7.6 years, representing a generation that values work-life balance. Further investigation is required to understand the divergent perceptions of redeployment. Moreover, nurses in both countries mentioned the positive and negative aspects of interprofessional collaboration. Positive aspects included increased respect, bonding, and improved patient care. Negative aspects included conflicts with physicians who were concerned about the risk of COVID-19 infection and were reluctant to visit patients in their rooms [26]. As physicians conducted assessments and provided care from outside the room, nurses in both countries were obligated to remain inside the room to provide the necessary direct care to patients, thereby making them more vulnerable to COVID-19 infection [26].

In this study, the combination of machine-based text network analysis and traditional content analysis provided several distinct advantages from a methodological standpoint, extending beyond the mere presentation of qualitative research in a more scientific manner. First, text network analysis allowed us to identify key concepts, themes, and their interconnections within nurses' descriptions, providing a visual representation of the complex network of perspectives expressed by the participants [35,36]. This approach helps uncover potential clusters or key concepts that may have been overlooked using traditional qualitative analysis alone. Traditional content analysis complements this analysis by including depth and granularity. This involves systematically categorizing and summarizing textual content in a context [37]. By organizing and condensing the data into meaningful categories, summary content analysis facilitates a more

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comprehensive understanding of the nurses' perspectives, ensuring that vital information is not overlooked.

Moreover, combining these two methods presents a powerful approach to data analysis in an international comparative research context. It enables cross-country comparisons and an in-depth exploration of each country's data. Text network analysis contributed to the identification of similarities and differences in emerging themes across countries, facilitating a broader understanding of the experiences of the global nursing workforce during the pandemic. Summative content analysis provides a comprehensive contextual understanding of the distinct aspects and variations within the data from each country. Additionally, it considers the cultural, societal, and contextual factors that may influence nurses' perspectives. Ultimately, this integrated methodological approach enhanced our understanding of the complex and multifaceted nature of nurses' experiences during the pandemic in an international comparative context.

This study has several limitations. First, the generalizability of this study's findings may be limited to nurses working in hospitals and may not extend to other healthcare settings, such as outpatient medical offices, community health centers, and residential treatment centers. Second, the cross-sectional data collection method used indicates that the timing of data collection may have influenced the findings. Finally, the use of network analysis and summative content analysis in this study may have overlooked less frequently mentioned opinions and may have been subject to the researchers' subjective judgment throughout the analysis process.

Nevertheless, this study provided valuable insights into the perspectives of frontline nurses regarding their work during the pandemic at the personal, task, and organizational levels. These findings can inform the development of comprehensive strategies to provide better working conditions for nurses. Methodologically, this study combined traditional and machine-based analyses, which are validated through an iterative process. Additionally, the study used an online survey for data collection and demonstrated the potential of this method for qualitative studies, despite the preference for face-to-face data collection.

CONCLUSION

Frontline nurses play a critical role in providing comprehensive care to isolated patients with COVID-19. This online qualitative study was conducted to explore the perspectives of frontline nurses working during the COVID-19 pandemic using a pragmatic approach that combined traditional and machine-based analyses. As a result, six themes emerged at the personal, task, and organizational levels: Nurses' personal lives have been negatively impacted, and they frequently face heavy workloads and stress primarily due to insufficient support. This study highlights the necessity of enhancing personal, professional, and institutional areas to effectively respond to the pandemic and guide improvements in resources, systems, and policies to prepare for future pandemic situations.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

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DATA SHARING STATEMENT

Please contact the corresponding author for data availability.

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Validation: Lee T & Lee SE.

Visualization: Lee SA.

Writing original draft or/and Review & Editing: Lee SA & Lee T & Lee SE.

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