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Drivers and mediators of healthcare workers' anxiety in one of the most affected hospitals by COVID-19: a qualitative analysis.

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Abstract

Objectives: To report healthcare workers' anxiety and explore relates drive and mediate factors during COVID-19 pandemics.

Design: Semistructured interview study

Setting: The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China.

Participants: 53 healthcare workers who were or were not diagnosed as COVID-19.

Results: During COVID-19 epidemics, healthcare workers did not have sufficient psychological preparation initially, and then suffered from severe anxiety and apprehension in the peak stage, no matter whether infected by SARS-CoV-2. These negative emotions were exacerbated by four drivers, including infection risk, supplies, isolations, and media. As the epidemic was gradually under control, healthcare workers experienced less anxiety from the factors above but became concerned about low financial status. In order to reduce anxiety, healthcare workers distracted attention from dangers through personal entertainment and religious belief and concentrated on treatments for patients. Furthermore, assistance from other people, including colleagues, families, friends, patients, and society, defended healthcare workers from anxiety.

Conclusions: Personal and social supports can relieve healthcare workers' anxiety to some extent during different stages of epidemics. Both protective equipment and financial allowance benefit healthcare workers to focus on patients' care, although the latter matters most as the epidemic is under control.

Strengths and limitations of this study

- To our knowledge, this study is the first qualitative study to examine healthcare workers' mental health, also the first studies focusing on drivers and mediators of healthcare workers' anxiety during COVID-19 epidemics to date.
- This research population came from a particular hospital, where the COVID-19 epidemics firstly broke out, and six healthcare workers here passed away due to infection by COVID-19. The staff here underwent tremendous pressure from multiple factors, so they represent most healthcare workers worldwide who are under severe psychological stress during epidemics.
- All participants were voluntary to take part in the research. Although we randomly sampled healthcare workers and successfully invited most of them to interview, some personnel suffered severely would be less inclined to participate.
- Due to social distance and city lockdown, many participants could not be directly interviewed through a face-to-face way, which is less convenient to convey emotions. To catch participants' faces and actions, video calls and online conference app were recommended if permitted by interviewees.

Introduction

The coronavirus disease 2019 (COVID-19) epidemic is a global health threat and is by far the most massive pandemic since the severe acute respiratory syndrome (SARS) in 2003. The outbreak was first identified in Wuhan, China, in December 2019, with early cases reported here [1]. Until August 2020, the total number of cases exceeded 20 million, and the number of deaths exceeded 800 thousand in the world [2].

Central Hospital in Wuhan (CHW) played a significant role in defending the Wuhan people from the COVID-19 invasion and sacrificed tremendously during the epidemic's outbreak (Figure 1). Cases in the initial cluster were associated with a seafood market in Wuhan and received treatment in the houhu district of the Central Hospital in Wuhan (CHW) nearby [3]. Before the new coronavirus was discovered, healthcare workers in CHW were fully exposed to infected patients without enough cognition and sufficient personal protective equipment (PPE). On 30th Dec 2019, a patient's test report, which showed a high confidence level for SARS coronavirus infection, was spread to the public by Dr. A in CHW, who was called a "whistleblower". Unfortunately, Dr. A was diagnosed as COVID-19 infection later and passed away after five days. Similar to Dr. A, another five doctors in CHW passed away because of COVID-19 associated complications until now, and they are all honored as heroes in China.

Since December 2019, healthcare workers in Wuhan, China, worked with an increased workload and at risk of infection to treat patients with COVID-19 infection. SARS-CoV-2 has a strong transmission ability in Wuhan before travel restrictions when the virus median daily reproduction number (Rt) was estimated as 2.35 [4]. In a Wuhan hospital case series, a super-spreader was confirmed to transmit SARS-CoV-2 to more than 10 physicians and nurses in the department [5]. As epidemics progressed and cases increased, healthcare workers were recognized as a group with high infection risk. Until 8th Mar 2020, 1496 health care workers were diagnosed with laboratory-confirmed COVID-19 in Wuhan, China, a large part of whom worked in CHW [3]. Healthcare workers have shown professionalism and care, but healthcare workers' physical and psychological health is under pressure when working with high infection risk.

Multiple studies have searched for the mental health of hospital staff through the method of questionnaires. It was reported that more than half of health care workers experienced depression and distress symptoms [6]. Nurses, women, frontline staff had worse mental health than others [6, 7]. Social support could help healthcare workers with decreased anxiety and stress and improved sleep quality [8]. In quantitative research using questionnaires above, the respondents are only allowed to answer predefined questions. For individual participants, questions not covered by the questionnaire might be highly relevant and therefore missed. Moreover, questionnaires do not allow personalized thoughts and feelings about topics [9, 10].

Therefore, qualitative research constitutes a feasible complement to exploring a phenomenon in depth.

No research articles are exploring the innermost thoughts of healthcare workers during COVID-19 epidemics with interviews until now. This study aimed to make an in-depth exploration of (a) describe the mental status of healthcare workers during COVID-19; (b) identify main factors upsetting healthcare workers; (c) characterize how the medical staff is relieved from pressure.

Method

Design and patients

A qualitative survey was conducted on workers at the Central Hospital of Wuhan (CHW) between 16th May, and 1st Jul 2020. Study participants were eligible if they worked in the CHW during the epidemic. All kinds of workers in the CHW, including doctors, nurses, administrative and support staff, were sampled for the study.

Participants were selected through purposeful maximum variation sampling regarding age, sex, occupation, and working position for patients to accomplish full coverage. The number of participants was determined based on ‘‘saturation'', a sense of closure that occurs when data collection ceases to provide important new information and when patterns in the data become evident. During the study, saturation was achieved after 38 interviews. To accomplish maximum variation, interviews continue with further participants to ensure that no new aspects emerged. In total, 53 healthcare workers completed the full survey, with a participation rate of 53/76 (69.7%) based on the total number of individuals whom we invited to interview. All participants who accepted our invitation finished the full interview.

This study was conducted in accordance with the Declaration of Helsinki. All of the participants agreed to participate. The Central Hospital of Wuhan Ethics Committee approved the study procedures. Verbal informed consent was obtained both before and after the interviews.

Data collection

Data were gathered by semistructured interviews mostly through phone or internet communication tools such as Wechat and QQ due to social distancing. All interview audio was recorded and transcribed verbatim with participants' permission, after which interview transcripts were sent to participants via email for comments or corrections. Demographic data included age, gender, departments, professional titles, educational background, marriage status, occupation, occupation, working life, and COVID-19 infection history were collected.

The interview guide included questions regarding the experience of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to

interviewers with associated experience (Supplementary file 1). Examples of initial questions were: "What did you experience during the epidemic?", "How did you feel when you heard of your colleagues' death?", "Has something changed after epidemic?". When needed, follow-up questions were posed. The interviews were carried out by at least one interviewers and lasted for 10–60 minutes. Six interviews were repeated for more than one time to clarify critical questions.

Data analysis

The date was analyzed by a team of three trained qualitative researchers based on a qualitative content analysis method [11]. This approach is designed to interpret meaning from the content of interview data and, hence, adhere to the naturalistic paradigm. First, the interviews were read through several times in order to become acquainted with the content. They were then reread systematically to identify meaning units, such as words or text segments and patterns of meaning, which were also marked with a preliminary code. The team developed a structured codebook that included inductively derived codes that represented ideas that emerged from the data as well as deductively selected categories to organize the dataset. Second, the investigators conducted multiple rounds of codebook revision and interrater reliability testing until a minimum pooled kappa value greater than 0.8 was achieved by all coders to ensure the clarity of coding definitions. Periodic discussions among the investigators ensured consistency of coding and helped us reach agreement on codebooks. Third, those segments marked with similar codes were brought together and formed meaningful clusters, as far as possible the actual words expressed by the informants were used. Next, each cluster's statements were scrutinized and compared to find the central component and then fused into categories. The final categories were then compared to avoid obvious overlapping, and in the last step, the categories were compared and analyzed to reveal possible relationships or hierarchies between them.

In addition, all excerpts from interviews in this paper were translated from Chinese by investigators and native English speakers cooperatively to convey the interviewees' semantics completely. This study is reported in accordance to the Consolidated criteria for reporting qualitative research (COREQ) checklist [12].

Result

Altogether, 53 healthcare workers were interviewed. Their ages ranged from 23 to 63 years (Mage = 39 years), and 32 (60.4%) participants were women. 18 healthcare workers were infected by COVID-19, and 40 participants treated COVID-19 patients in the frontline. All the participants were working in the Central Hospital of Wuhan during epidemics (Table 1).

The issues and connections are extracted from all interview data and summarized in the conceptual model, which was composed of healthcare workers' anxiety during different stages of

epidemics and related drivers and mediators (Figure 2).

Healthcare workers' anxiety during different stages of epidemics

Healthcare workers experienced a process of dynamic changes in emotions during the whole pandemic, which was divided into three stages.

In the initial stage of the epidemics, most participants experienced few intrusive and frightening thoughts about their clinical work because they did not understand the severity of COVID-19. The Wuhan government released that “No clear evidence of human-to-human transmission was found. Therefore, this epidemic is preventable and controllable” in January 2020, which made some participants lose their vigilance. However, participants from departments such as respiratory, infection, and emergency departments were more likely to be exposed to pneumonia patients and noticed a new kind of emerging respiratory disease. Therefore they were more vigilant and worried ahead of other healthcare workers.

“At the beginning of the outbreak, I felt nothing because it had not happened besides before. I was not scared until people around me were infected” -26

“In the early stage of the epidemic, the emergency department staff was all transferred from other departments. The team leader was isolated because of the abnormal CT examination results, and she only taught me one day. Other nurses without enough professional skills often sat beside the consultation desk outside, and only I worked in the rescue room. Everyone was lazy and didn't want to do anything.” -29

“Hmmm... In December, patients with similar symptoms(to COVID-19) appeared in our department. At that time, we were quite anxious. Although the number of cases increased in January, people from other departments came to support us, and more protective equipment was provided to us, so the situation is much better. By this time, we became accustomed to this state.” -31 (Nurse, Respiratory department)

As the epidemic progresses to its highest peak, almost all general practitioners in the hospital experienced infection or death around, including patients, colleagues, and even themselves. They began to realize the seriousness and severity of the epidemic. Most of our interviewees overflowed intense negative emotions such as ”desperation”, “depression”, “fear” and "anxiety” after they heard or witnessed their colleague tortured by COVID-19 and worried about their health.

“So desperate, there was definitely a desperate mood, most desperate in 6th Feb (when Dr. A passed away)... it's not suitable for elaboration... such famous ones are not cured. If me...” -41

“At first I didn’t know it was COVID-19, so I wasn’t afraid. Later, after a large number of patient cases were reported on the internet, I began to get scared.” -50

“When I heard that the doctor in our hospital died, I was scared and wanted to cry. (silence). I don’t know how to describe it.” -13

“Very unreal feeling, kind of unbelievable, after all, they (doctors who died of COVID-19) were working with me before. I can't believe this news is true!” -15

“My family members were very worried about me and called me every day. Although I worried

about myself, I was more scared about whether my family members would be infected." -36

As time went by, people might gradually recover to calmness and pursue the tranquillity of post-virus life. Most frontline workers have gradually adapted to this state of work, with increasing cases being cured, and good news reported by the media. However, after the ending of Wuhan lockdown and the opening of outpatient service, the number of patients has dropped sharply than those before the epidemics, so healthcare workers' wages also decreased, which stressed participants who need to repay the loans. However, some participants were unwilling to mention what happened during COVID-19 epidemics and commit to new careers to minimize anxiety and pretend fearlessness.

"I'm very sorry. (silence) My comrades fighting side by side are gone forever. Strongly grieved for their families! I wanted to do something for them, so I participated in donations and contacted related foundations." -4

"About the occupation, the COVID-19, others' death... I didn't think deeply. Not dare to. I just wanted to have a good day every day." -16

Nevertheless, several interviewees didn't seem to experience any emotional fluctuations from beginning to end, probably due to personal temperament and working experience.

"When doctors in our hospital passed away, I'm not afraid at all. I only had two choices, either survive or die. I don't care." -42 (Infected doctor)

"I experienced many ups and downs in my whole life. This epidemic is only one of the difficulties. I was not afraid, because I participated in the fight for SARS in Guangzhou in 2003" -17 (Second-line doctor)

Drivers of healthcare workers' anxiety

This category was developed to capture the underlying causes of participants' anxiety during different epidemics stages in around five themes.

Infection Risk-SARS-CoV-2 is spread mainly by aerosolized droplets expelled during coughing, sneezing, or breathing with a robust transmission ability [4]. Healthcare workers have been particularly hard hit by SARS-CoV-2, with high reported infection rates from Italian data. Even a high percentage of asymptomatic healthcare workers were reported to test positive for SARS-CoV-2 according to PCR results [13]. Their anxiety was related to, and triggered by, examinations and treatments to confirmed and suspected patients, as there was always a potential infection risk. After getting off work and staying away from patients, the anxiety level temporarily decreased, but it increased again close to the next day at the hospital. Participants' anxiety for infection risk mainly occurred during the epidemic's peak and gradually disappeared as the epidemic was controlled.

"At that time, I was crying with my roommate at home every day. In fact, I got only an ordinary lung infection." -19

"Everyone could be infected, and I was no exception" -25

"Scared! I was really terrified! I was really afraid of getting infected. The isolation wards were full of COVID-19 confirmed patients" -3

Supplies-After the outbreak of COVID-19, the government imposed a strict lockdown in Wuhan, and many living supplies were difficult to obtain. Furthermore, the healthcare workforce's need for personal protective equipment (PPE) such as surgical masks and isolation gowns outpaced the supply in the early onset of COVID-19. Adequate supplies of PPE were identified as an effective protective strategy for the psychological distress by emerging virus outbreak on healthcare workers [14]. Participants without enough PPE worried about high infection risk for themselves and their families. Therefore, communities and governments provided adequate supplies to alleviate the shortage to minimize clinical staff burden.

"After job transfer from respiratory medicine to CCU, no one cared about me. Totally helplessness. I couldn't get living supplies such as rice and noodles and buy food (because of lockdown in Wuhan)" -51

"Living and protective supplies are sufficient. When everyone in the hospital was scrambling for supplies, a friend knew my situation and sent me two food boxes with bread and milk. I thought Wuhan was quite lovely at that time." -34

"Because of fundraising from all over the country and even around the world, healthcare workers including me were not short of living supplies, but my family still lacked supplies. During this period, I was more worried about my family than myself" -15

Isolation-WHO recommended that healthcare workers with suspected COVID-19 who present with mild or moderate symptoms should be encouraged to stay home and away from the workplace during illness[15]. It was reported that individuals, including healthcare workers who self-isolated at home, suffered from increased anxiety and stress [16]. Participants felt "so lonely as if abandoned by the world" and "be seemingly treated like a criminal" during the quarantine. In contrast to depression brought about by isolation, some participants prefer to confront the patients and continue the clinical work despite the high risk of infection.

"At the beginning of the epidemic, I was under a lot of psychological pressure. There was something wrong with the CT examination of the roommate's lungs, so I was also isolated at home"-49

"I'm afraid of isolation. No matter how good the environment is, I can't accept isolation. I am willing to work in the hospital rather than being isolated. In order not to be isolated, it is necessary to rest well and boost immunity." -22

Media-Although WHO has produced guidance for opinion-makers and the media on how to describe the outbreak, few local and social media strictly obeyed them in the initial stage of the epidemics yet, which stressed healthcare workers deeply [17]. For example, some media presumed the possibility of healthcare workers having or spreading COVID-19 rather than highlighting the effectiveness of preventive measures, and therefore some people worried about

contact with their neighbors who worked in the hospital.

In addition, many Healthcare staff learned about the infection or death of their colleagues through social media, which made them mourn for the loss and also scared of being infected. An interviewee quoted a Chinese colloquialism to express her sorrow: *The fox mourns over the hare's death*.

> "During the epidemic, I lived in a hotel close to the hospital rather than at home. The management company in my community was not willing to allow me to enter it after hearing that many doctors in our hospital were infected." -37
>
> "When I was treated for COVID-19, all kinds of bad news appeared, especially which doctors in our hospital passed away. (Appeared surprised) I tried not to watch bad news, but It is impossible to block social media from all my friends. After reading them, I was afraid that I would not be cured. Therefore, when the doctor told me to use the immunity-enhancing drugs at my own expense, and I said:'use them, no matter how much they cost.'" -53

Financial Status-During the peak of epidemics, healthcare workers received an allowance from the government for treating COVID-19 patients. The government reimbursed people infected by COVID-19 in China for all treatment costs, and infected healthcare staff can also claim workers' compensation insurance. Therefore, few healthcare workers were anxious about their financial status during the peak of epidemics. However, after the ending of Wuhan lockdown and the opening of outpatient service, participants complained that salaries were not satisfied after the epidemic was under control because the government canceled allowance and patients unwill to visit the hospital for fear of infection risk, which decreased hospital profits. Some interviewees also felt that their efforts and sacrifice had not been reasonably compensated and eager to obtain adequate financial rewards.

> "Will my salary be raised in the future? It is too low to support myself now" -30
>
> "But I think we are really the cheapest labor force because I met my classmates on Sunday, they worked in Didi (a taxi company) and drove medically equipped vehicles during the epidemic? They earned more than 100,000 yuan ($14,000) in a single week! They really made more than 100,000 yuan! But how much for us? really cheap labor!" -21

Self mediators of healthcare workers' anxiety

In the face of high occupational risk, healthcare workers developed their own way to defend themselves from anxiety and depression.

Occupational attitude-Most healthcare staff decided to take up medicine as a career tended to endorse altruistic reasons (working with people, helping others) rather than the possibility to achieve high social status and financial stability [18]. Under the threat of COVID-19, participants identified the desire to rescue patients as a motivation for themselves.

> "The doctors' duty is to heal the wounded and rescue the dying" -41
>
> "I never thought of resignation, and still have full-hearted enthusiasm. Many colleagues returned

to work immediately after recovery from COVID-19" -33

"Everyone has their own responsibilities in their positions. I have a clear conscience only if I do my best"-17

Fitness-A high level of cardiorespiratory fitness caused by prior exercise training reduces all-cause mortality and may confer some protection against COVID-19 [19]. Two infected participants kept in satisfactory physical condition before and had a strong belief in being cured of COVID-19. In addition, patients with younger age were identified with a good prognosis, which boosted some young participants [19].

"There is no special medicine for COVID-19. It's totally dependent on your immunity. I always exercised before, so I wasn't injected with immunoglobulin while being infected." -28

"I limited energy intake to lose weight before. However, my workload suddenly increased, and I need to maintain a proper diet to supplement nutrition after COVID-19 epidemics."-52

Entertainment-Entertainment such as videos, computer games, and other personal hobbies at home has considerable potential for relieving healthcare workers from reality pressure. Several interviewees were addicted to personal hobbies to escape from the disturbance of work fatigue and anxiety for relatives' health.

"My boyfriend gifted me a microphone, and I sang at home. Later, I felt that I couldn't stand it and applied for a photography class at home. There is always something to do, in case I thought so much."-14

"Eat, drink, and sleep when I should. Watch TV drama or play video games when I'm free."-11

"When I was hospitalized, I played 'Honor of Kings' (a mobile MOBA game) every day."-32

Religion-Only one participant sought help from religion to stay away from negative moods under the pressure of frequent infections of companions. During the pandemic, places of worship such as temples, churches, synagogues, and mosques were also closed in Wuhan, which interrupted most of the religious activities. Therefore, she sought spiritual peace by "copying the Buddhist sutras at home".

"After I got off work, I copied the Buddhist sutras at home, The power of religious belief has always supported me"-29

Interpersonal mediators of healthcare workers' anxiety

Confronting patients and colleagues' successive deaths, many participants experienced heavy psychological pressure and sought help from other people, including colleagues, families, friends, patients, and society (Table 2).

During working hours, colleagues companion played a significant role in relieving loneliness and horror. Participants "rushed to the front" similar to soldiers and treated their colleagues as comrades-in-arms. Some infected interviewees experienced a dramatic change of identity from doctors/nurses to patients and desired more psychological support from their health carers also

colleagues. In addition, patients also expressed their gratitude to some participants for their dedication. After getting off work, Most of the participants felt less anxious and depressed by communicating with their families and friends, who always encouraged them to hold on. Participants' family relived them of the negative emotional state by encouragement, care, and comfort. Sometimes, participants were unwilling to share their anxiety with their families "because the family would be more worried and sleepless". Furthermore, the government and hospital provided living and protective materials "as much as possible", which were indispensable for living during epidemics and lockdown in Wuhan.

Discussion

Our findings suggest that healthcare workers experienced a process of dynamic changes in emotions during different stages of COVID-19 epidemics. While these emotions may be mitigated or exacerbated by the working experience, environment, and health status, participants' reports suggest these experiences are pervasive. Our conceptual model illustrates the role of infection risk, isolation, media, supplies, and financial status in triggering emotional responses. Besides, our data suggest multiple ways healthcare workers recover from affliction, not only by themselves but also by other people, including colleagues, families, friends, patients, and society.

In this study, a significant proportion of participants experienced anxiety and depression symptoms during epidemics[21]. Although our participants were from the Central Hospital of Wuhan (CHW), the highlighted mental problems of medical staffs are not unique to the single hospital: a cross-sectional comparison of 34 hospitals found that health care workers experienced symptoms of depression, anxiety, insomnia, and distress during COVID-19 epidemics [6]. It was reported that high-risk groups of mental health symptoms were nurses, women, frontline health care workers, and those working in Wuhan, China, who accounted for 35% of interviewees in this study [6].

Our research population came from a particular hospital in Wuhan, where the COVID-19 epidemics firstly broke out, and more medical workers here passed away due to infection than all other hospitals. Chinese and even the world media focused on the status of workers in this hospital during the epidemic. Due to tremendous pressure from multiple factors, healthcare workers might undergo more serious anxiety than those of other hospitals. Thereby, they represent the majority of healthcare workers worldwide who are under severe psychological stress during epidemics.

Our findings extend research on mental health in the medical workplace during a public crisis and provide a view of death anxiety directly from the perspective of those who experience it. It was reported that physicians' death anxiety for patients did not relate to decision making during clinical treatment but guilt or doubt after a patient's death[22]. However, few studies focused on

physicians' death anxiety for their colleagues, and participants in our study revealed significantly declined working enthusiasm and efficiency due to high stress. In fact, the local government and hospitals had predicted high mental pressure among healthcare workers in advance and offered professional psychological counseling and related questionnaires to them [23]. Nevertheless, none participants expressed their benefits from these measures, indicating these psychological intervenes were invalid and insufficient to alleviate the psychological issues.

Strengths and limitations

This study is the first qualitative study to examine healthcare workers' mental health, also the first studies focusing on drivers and mediators of healthcare workers' anxiety during COVID-19 epidemics to date.

A few limitations need to be considered when interpreting our findings. First, the timing of administering the interviews might affect the results. The participants likely had less anxiety because they were just assured that they would not be infected with COVID19 after the well-controlled epidemic in Wuhan. Second, all participants were voluntary to take part in the research. Although we randomly sampled healthcare workers and successfully invited most of them to interview, some personnel suffered severely would be less inclined to participate. Finally, due to social distance and city lockdown, many participants could not be directly interviewed through a face-to-face way, which is less convenient to convey emotions. In order to catch participants' faces and actions, video calls and online conference app were recommended if permitted by interviewees.

Conclusion

Our research provides new insights into the cause and regulation of anxiety during epidemics of highly transmissible disease on healthcare workers and raises problems about the protective measure for psychology and physiology. Although the government and society provide materials and spirit supports as much as possible, most of the healthcare workers still felt neglected and anxious for infection risk and income levels. Special mental interventions and protective equipment to healthcare workers need to be immediately carried out, especially in the districts and hospitals affected seriously by COVID-19. Healthcare workers in the epidemic-controlled district have less infection risk but also lower-income, so they benefited more from financial compensation.

MLF, BX and TT contributed equally to this work.

Author Contributions: MLF and ZHW conceived of the study and analysis plan. MLF, BX, TT and YH collected data. MLF and ZHW analyzed the data. ZHW drafted the conceptual model. MLF and ZHW wrote the first draft of the manuscript. All authors contributed to the interpretation of the data, edited the manuscript, and approved of the final manuscript. ZHW had full access to all the data in the study and had final responsibility for the decision to submit for publication.

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The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Figure Captions

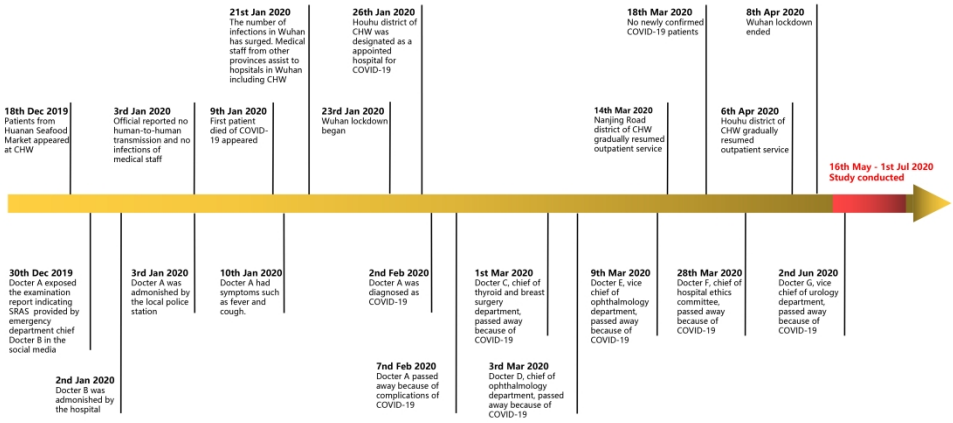
Figure 1: Milestone events in the Central Hospital of Wuhan during the epidemic of COVID-19.

Figure 2: Conceptual model of themes and relationships derived from healthcare workers' anxiety during different stages of epidemics.

Table1: Demographic and Occupational Characteristics of interviewees.

		Number
No. of interviewees		53
Gender	Male	21
	Female	32
Mean age, years	(range), years	23-63
Infection by COVID-19	Yes	18
	No	35
Working position	Front-line	40
	Second-line	13
Working life	(range), years	1-32
Occupation	Physician	18
	Nurse	24
	Others in hospital	11
Marriage status	Unmarried	33
	Married	20
Education background	≤Undergraduate	36
	≥Postgraduate	17

Table 2. Interpersonal mediators of healthcare workers' anxiety	
Theme	Exemplary quotes
Colleagues	"Many colleagues are rushing to the front, so I have no reason to back down." -36 "None in my family was infected, because a teacher in our department is very cautious. Before the New Year, when the epidemic was not exposed to the public, she already told me some precautions, such as keeping social distance and dining with public chopsticks." -48 "When I was diagnosed as COVID-19 and hospitalized, there were still very few beds. The chief nurse reported my situation to the public health department and arranged a bed for me. Doctors and nurses were very kind, maybe because we worked together" -44
Family	"Daily video with my family. I told them I am much better now and what medicine I used today. When I was dining outside the ward, I took down my mask and showed them that I was okay. In the later period, when I was about to be discharged from the hospital, they were completely relieved." -6 "My deepest thought (when I was infected and hospitalized)? I have my wife and my family. I must live a very healthy life. I still look forward to living in this world." -7
Friends	"I once collapsed. There were only three or five COVID-19 confirmed patients every day before. However, the number increased by tens of thousands those days, and I couldn't bear it. But I couldn't tell my mother because she would be more worried and sleepless. So I talked with my friends, which made me feel better." -3 "When I was upset, I talked to my good friend and complained about something." -37
Patients	"The lady who lived beside my bed was kind to me. She was always comforting me. She said: 'Although I had a basic illness like diabetes, I am much better now. The effusion of my lungs is almost absorbed.' Her words made me feel much better. I was so lucky that she was always encouraging me and chatting with me." -41
Society	"I was isolated at home for two months. The government sent us supplies and relief" -29 "The hospital helped us solve life problems as much as possible and gave us masks when we came to work every day. But few financial support." -32



Milestone events in the Central Hospital of Wuhan during the epidemic of COVID-19.

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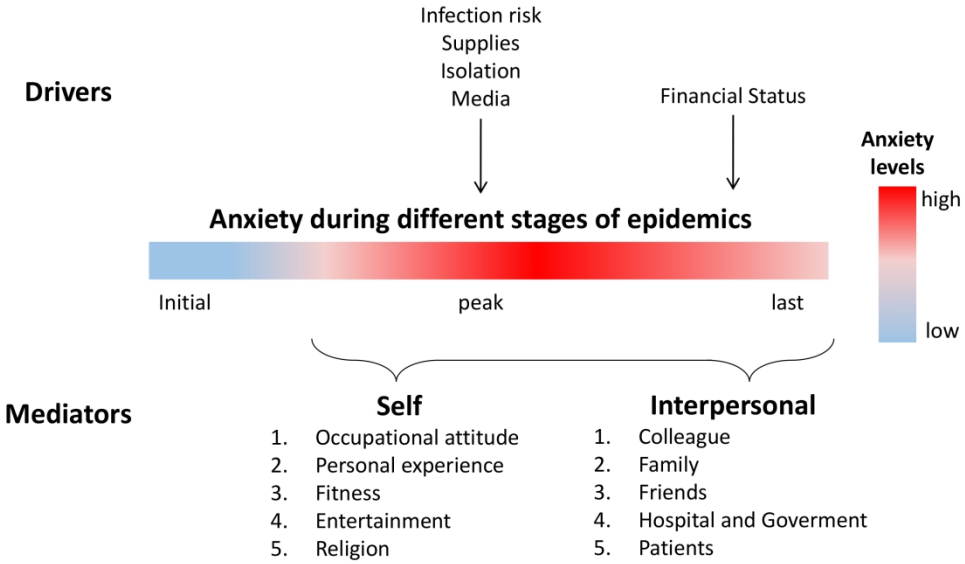

Conceptual model of themes and relationships derived from healthcare workers' anxiety during different stages of epidemics.

Interview Guideline

Basic information:

Age, Gender, Marriage status, Education level, Department, Working life, Occupation, Education background, COVID-19 infection history, Working position during epidemics

Key points at the beginning of the interview:

1. Thank you for participating in this research

2. This interview will be recorded and transcribed verbatim

3. Personal information will be kept confidential, and part of the interview will be used to publish.

The main content of the interview (for non-infected participants):

1. How did you feel at the beginning of the epidemic? When did you begin to realize the severity of the epidemic? How did you understand these? Could you talk about your inner thoughts when you heard that other colleagues in our hospital were infected? Why did you have these feelings?

2. (for front-line participants) When were you transferred to another department (for treating COVID-19 patients)? How long? Working position? Emotional reaction when you heard this news for the first time? Emotion change during this period? Why was there such a change? What were your more impressive experiences?

3. (for second-line participants) What were your main tasks during the epidemic? Emotion change during this period? Why was there such a change? What were your more impressive experiences?

4. Were you afraid during the epidemic? Why? Did you have depression or insomnia during this period? If so, to what extent? What supports you until now? How did you adjust yourselves? What intervention measures did the hospital provide correspondingly (such as classes, supplies, etc.)?

5. Were you worried about your family during this period? How to balance work and family? What troubles has this epidemic brought to your family and life, and how did you deal with

it?

6. How did you feel when you heard the sad news of the death of several doctors in our hospital? Will there be self-doubt or even questioning this job? why?

7. Now that the epidemic has been controlled effectively, how do you feel? why? Have there been any changes in life attitudes after experiencing the epidemic? New understanding of this job? Have you ever thought of resigning? Why? If so, is there still such an idea now? What made you change your mind/what idea made you choose to persist?

8. Do you have anything else to say? Regarding this epidemic, can you share with some suggestions based on your own experience?

9. What are your expectations for the future?

The main content of the interview (for infected participants):

1. How did you feel at the beginning of the epidemic? When did you begin to realize the severity of the epidemic? How did you understand these?

2. When did the symptoms appear? What was your inner thought at the time? When were you diagnosed with COVID-19? Feelings after the diagnosis? What is the inner change from symptom to diagnosis?

3. How did you feel during the treatment? Did you have depression or insomnia during this period? If so, to what extent? What supports you until now? How did you adjust yourselves? What intervention measures did the hospital provide correspondingly?

4. Had your family been infected? If so, what is their situation? How did you maintain contact during this time? They must be very worried about you, how did you deal with it?

5. How did you feel when you heard the sad news of the death of several doctors in our hospital? Will there be self-doubt or even questioning this job? why?

6. You have recovered, resumed work, and returned to your position now. Have there been any changes in life attitudes after experiencing the epidemic? New understanding of this job? Have you ever thought of resigning? Why? If so, is there still such an idea now? What made you change your mind/what idea made you choose to persist?

7. Do you have anything else to say? Regarding this epidemic, can you share with some suggestions based on your own experience?

8. What are your expectations for the future?

Interview requirements:

1. In-depth and sincere conversations. No simple questions and answers, but the interviewer actively grasps the true psychological feelings of the interviewee, and specifically understands his/her situation during COVID-19 epidemics, such as anxiety, fear, doubt, or luck, pride, and excitement. Talk like an old friend and increase the closeness of the interviewee.

2. Participants are not necessarily willing to admit true feelings. They may not be embarrassed to say that they are particularly scared during the epidemic, but the interviewer can slowly get in touch with their true thoughts through many indirect questions: "What did you think when *** were diagnosed with COVID-19?" "Have you ever suspected that you have been infected with SARS-COV-19?". As the interview proceeds, it is normal for the interviewee to have inconsistent remarks.

3. This interview is semi-structured, which means that the main content must be covered, but the way of asking can not be restricted to a fixed format

4. Mainly focus on personal inner emotional experience, do not involve some politically sensitive topics.

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
Domain 1: Research team and reflexivity				
Personal Characteristics				
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	12	MLF, BX, TT and YH collected data.
2.	Credentials	What were the researcher's credentials? *E.g. PhD, MD*	1	
3.	Occupation	What was their occupation at the time of the study?	1	
4.	Gender	Was the researcher male or female?	1	
5.	Experience and	What experience or training did the	4,5	The date was analyzed by a team of three trained qualitative

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
	training	researcher have?		researchers based on a qualitative content analysis method. In addition, all excerpts from interviews in this paper were translated from Chinese by investigators and native English speakers cooperatively to convey the interviewees' semantics completely. The interview guide included questions regarding the experience of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience
Relationship with participants				
6.	Relationship established	Was a relationship established prior to study commencement?	4	No relationship
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.*g. personal goals, reasons for doing the research*	4	Nothing
8.	Interviewer	What characteristics were reported	4	The interview guide included questions regarding the experience

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
	characteristics	about the interviewer/facilitator? e.g. *Bias, assumptions, reasons and interests in the research topic*		of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience
Domain 2: study design				
Theoretical framework				
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? *e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	4	The date was analyzed by a team of three trained qualitative researchers based on a qualitative content analysis method
Participant selection				
10.	Sampling	How were participants selected? *e.g. purposive, convenience, consecutive, snowball*	4	articipants were selected through purposeful maximum variation sampling regarding age, sex, occupation, and working position for patients to accomplish full coverage. The number of participants

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
				was determined based on ‘‘saturation'', a sense of closure that occurs when data collection ceases to provide important new information and when patterns in the data become evident.
11.	Method of approach	How were participants approached? e.*g. face-to-face, telephone, mail, email*	4	Data were gathered by semistructured interviews mostly through phone or internet communication tools such as Wechat and QQ due to social distancing.
12.	Sample size	How many participants were in the study?	5	Altogether, 53 healthcare workers were interviewed.
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	4	In total, 53 healthcare workers completed the full survey, with a participation rate of 53/76 (69.7%) based on the total number of individuals whom we invited to interview. All participants who accepted our invitation finished the full interview.
Setting				
14.	Setting of data collection	Where was the data collected? e.*g. home, clinic, workplace*	4	Data were gathered by semistructured interviews mostly through phone or internet communication tools such as Wechat and QQ due to social distancing.

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	4	none
16.	Description of sample	What are the important characteristics of the sample? *e.g. demographic data, date*	4	Demographic data included age, gender, departments, professional titles, educational background, marriage status, occupation, occupation, working life, and COVID-19 infection history were collected.
Data collection				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	4	The interview guide included questions regarding the experience of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience (Supplementary file 1). Examples of initial questions were: "What did you experience during the epidemic?", "How did you feel when you heard of your colleagues' death?", "Has something changed after epidemic?". When needed, follow-up questions were posed.
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	4	Six interviews were repeated for more than one time to clarify critical questions.

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	4	All interview audio was recorded and transcribed verbatim with participants' permission, after which interview transcripts were sent to participants via email for comments or corrections
20.	Field notes	Were field notes made during and/or after the interview or focus group?	4	No
21.	Duration	What was the duration of the interviews or focus group?	4	The interviews were carried out by at least one interviewers and lasted for 10–60 minutes.
22.	Data saturation	Was data saturation discussed?	4	During the study, saturation was achieved after 38 interviews. To accomplish maximum variation, interviews continue with further patients to ensure that no new aspects emerged.
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	4	All interview audio was recorded and transcribed verbatim with participants' permission, after which interview transcripts were sent to participants via email for comments or corrections.
Domain 3: analysis and findingsz				

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
Data analysis				
24.	Number of data coders	How many data coders coded the data?	4	The date was analyzed by a team of three trained qualitative researchers based on a qualitative content analysis method
25.	Description of the coding tree	Did authors provide a description of the coding tree?	4	The team developed a structured codebook that included inductively derived codes that represented ideas that emerged from the data as well as deductively selected categories to organize the dataset.
26.	Derivation of themes	Were themes identified in advance or derived from the data?	5	No. each cluster's statements were scrutinized and compared to find the central component and then fused into categories (theme).
27.	Software	What software, if applicable, was used to manage the data?	4	No
28.	Participant checking	Did participants provide feedback on the findings?	5	Yes
Reporting				

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.*g. participant number*	5-10	"Results" section
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	5-10	"Results" section
31.	Clarity of major themes	Were major themes clearly presented in the findings?	5	The issues and connections are extracted from all interview data and summarized in the conceptual model, which was composed of healthcare workers' anxiety during different stages of epidemics and related drivers and mediators (Figure 2).
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	5-10	"Results" section

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Drivers and mediators of healthcare workers' anxiety in one of the most affected hospitals by COVID-19: a qualitative analysis.

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Drivers and mediators of healthcare workers' anxiety in one of the most affected hospitals by COVID-19: a qualitative analysis.

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Word count: 3739

Abstract

Objectives: To report driving and mediating factors of healthcare workers' anxiety during the COVID-19 pandemic.

Design: Qualitative in-depth interview study

Setting: The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China.

Participants: 53 healthcare workers who were or were not diagnosed with COVID-19 infection.

Results: During the COVID-19 pandemic, healthcare workers did not have sufficient psychological preparation initially and then suffered from severe anxiety and apprehension in the peak stage, no matter whether infected by SARS-CoV-2. These negative emotions were exacerbated by four drivers, including infection risk, supplies, isolations, and media. As the epidemic was gradually under control, healthcare workers experienced less anxiety from the factors above but became concerned about low financial status. In order to reduce anxiety, healthcare workers distracted attention from dangers through personal entertainment and religious belief, and concentrated on treatments for patients. Furthermore, assistance from other people, including colleagues, families, friends, patients, and society, defended healthcare workers from anxiety.

Conclusions: Personal and social supports can relieve healthcare workers' anxiety to some extent during different stages of the epidemic. Both protective equipment and financial allowance benefit healthcare workers to focus on patients' care, although the latter matters most as the epidemic is under control.

Strengths and limitations of this study

- The study captured the mental health of healthcare workers during the different stages of from COVID-19 epidemic in Wuhan to the global pandemic.
- All participants worked in the Central Hospital in Wuhan (CHW), where six healthcare workers passed away due to the COVID-19 infection.
- This study included participants with multiple occupations, including doctors, nurses, administrative and support staff, some of whom had COVID-19 infection history, thus fully representing healthcare workers' views.
- Although we randomly sampled healthcare workers and successfully invited most of them for interviews, some personnel refused to participate.
- Due to social distancing and city lockdown, many participants could not be directly interviewed through a face-to-face way, which is less convenient to convey emotions.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic is a global health threat and is the most massive pandemic since the severe acute respiratory syndrome (SARS) in 2003. The outbreak was first identified in Wuhan, China, in December 2019, with early cases reported here [1]. Until August 2020, the total number of cases exceeded 20 million, and the number of deaths exceeded 800 thousand in the world [2].

Central Hospital in Wuhan (CHW) played a significant role in defending the Wuhan people from the COVID-19 invasion and sacrificed tremendously during the epidemic outbreak (Figure 1). Cases in the initial cluster were associated with a seafood market in Wuhan and received treatment in the nearby houhu district of the Central Hospital in Wuhan (CHW) [3]. Before the new coronavirus was discovered, healthcare workers in CHW were fully exposed to infected patients without enough cognition and sufficient personal protective equipment (PPE). On 30th Dec 2019, a patient's test report, which showed a high confidence level for SARS coronavirus infection, was spread to the public by Dr. A in CHW, who thus was called a "whistleblower". Unfortunately, Dr. A was diagnosed with COVID-19 infection later and passed away after five days. Similar to Dr. A, another five doctors in CHW passed away because of COVID-19 associated complications until now, and they are all honored as heroes in China.

Since December 2019, healthcare workers in Wuhan, China, had to treat patients with COVID-19 infection with increased workload and infection risk. SARS-CoV-2 has a strong transmission ability in Wuhan before travel restrictions when the virus median daily reproduction number (Rt) was estimated to be 2.35 [4]. In a Wuhan hospital case series, a super-spreader was confirmed to transmit SARS-CoV-2 to more than 10 physicians and nurses in the department [5]. As the epidemic progressed and cases increased, healthcare workers were recognized as a group with high infection risk. Until 8th Mar 2020, 1496 health care workers were diagnosed with laboratory-confirmed COVID-19 infection in Wuhan, China, a large part of whom worked in CHW [3]. Healthcare workers had shown professionalism and care, but their physical and psychological health was under pressure when working with high infection risk.

Multiple studies have searched for the mental health of hospital staff through the method of questionnaires. It was reported that more than half of health care workers experienced depression and distress symptoms [6]. Nurses, women, frontline staff had worse mental health than others [6, 7]. Social support could help healthcare workers with decreased anxiety and stress and improved sleep quality [8]. In the above quantitative research using questionnaires, the respondents are only allowed to answer predefined questions. For individual participants, questions not covered by the questionnaire might be highly relevant and therefore missed. Moreover, questionnaires do not allow personalized thoughts and feelings on the subject [9, 10]. Therefore, qualitative research constitutes a feasible complement to the in-depth exploration of

the phenomenon.

To understand the obstacles that healthcare workers encounter when performing epidemic control tasks, we conducted in-depth interviews using qualitative design. This study aimed to make an in-depth exploration of (a) describe the mental status of healthcare workers during COVID-19; (b) identify main factors upsetting healthcare workers; (c) characterize how the medical staff is relieved from pressure.

Method

Design and patients

Qualitative research was conducted on workers at the Central Hospital of Wuhan (CHW) between 16th May, and 1st Jul 2020. Study participants were eligible if they worked in the CHW during the epidemic. All kinds of workers in the CHW, including doctors, nurses, administrative and support staff, were sampled for the study. By using these separate groups, we aimed to improve the trustworthiness of the data.

Participants were selected through purposeful maximum variation sampling regarding age, sex, occupation, and working position for patients to accomplish full coverage. The number of participants was determined based on “saturation”, a sense of closure that occurs when data collection ceases to provide important new information and patterns in the data become evident. During the study, saturation was achieved after 38 interviews. To accomplish maximum variation, interviews continue with further participants to ensure that no new aspects emerged. In total, 53 healthcare workers completed the full research, with a participation rate of 53/76 (69.7%) based on the total number of individuals whom we invited to interview. All participants who accepted our invitation finished the full interview. To fully inform participants of all relevant information and risks of this research, formal informed consent was provided to all participants before the interview. At the beginning of the interview, all participants acknowledged that they had read this informed consent and fully understood this research.

This study was conducted in accordance with the Declaration of Helsinki. All of the participants agreed to participate. The Central Hospital of Wuhan Ethics Committee approved the study procedures.

Data collection

All researchers participated in the interview. Researchers possessed experience in qualitative interviews and underwent training by tutors with psychological consultant certificates issued by the Ministry of Human Resources and Social Security of China. They also worked in the frontline during the COVID-19 pandemic and empathized with other healthcare workers. Therefore, the researcher was able to carry out interviews independently. Data were gathered by semistructured interviews mostly through phone or internet communication tools such as

Wechat and QQ due to social distancing. All interview audio was recorded and transcribed verbatim with participants' permission. Demographic data included age, gender, departments, professional titles, educational background, marriage status, occupation, occupation, working life, and COVID-19 infection history were collected.

The interview guide included questions regarding the experience of living and working during the pandemic was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience (Supplementary file 1). Examples of initial questions were: "What did you experience during the epidemic?", "How did you feel when you heard of your colleagues' death?", "Has something changed after epidemic?". When needed, follow-up questions were posed. The interviews were carried out by at least one interviewer and lasted for 10–60 minutes. Six interviews were repeated for more than one time to clarify critical questions.

Data analysis

The data was analyzed by a team of three trained qualitative researchers based on Hsieh's conventional content analysis method [11]. Hsieh's approach is generally used with a study design to describe a phenomenon, healthcare workers' emotional reactions during COVID-19 pandemic in this case. The advantage of Hsieh's approach is gaining direct information from study participants without imposing preconceived categories or theoretical perspectives. Researchers immerse themselves in interview data content to allow new insights to emerge [11]. First, the interviews were read through several times in order to become acquainted with the content. They were then reread systematically to identify meaning units, such as words or text segments and patterns of meaning, which were also marked with a preliminary code. The team developed a structured codebook that included inductively derived codes that represented ideas that emerged from the data as well as deductively selected categories to organize the dataset. Second, the investigators conducted multiple rounds of codebook revision and interrater reliability testing until a minimum pooled kappa value greater than 0.8 was achieved by all coders to ensure the clarity of coding definitions. Periodic discussions among the investigators ensured consistency of coding and helped us reach an agreement on codebooks. Third, those segments marked with similar codes were brought together and formed meaningful clusters, as far as possible the actual words expressed by the informants were used. Next, each cluster's statements were scrutinized and compared to find the central component and then fused into categories. The final categories were then compared to avoid obvious overlapping, and in the last step, the categories were compared and analyzed to reveal possible relationships or hierarchies between them.

In addition, all participants are native Chinese speakers, so all interviews are conducted in Chinese. To cite the interviewees' words in this paper and completely convey their semantics, investigators and native English speakers cooperatively translated these excerpts to English. This study is reported in accordance with the Consolidated criteria for reporting qualitative research

(COREQ) checklist [12].

Trustworthiness

Trustworthiness is the standard that constitutes the rigor of qualitative research [13]. During the interviews, similar questions were put in different ways to ensure that the informant's view was correctly captured. Then, coauthors reviewed and commented on relevant interview transcripts separately and discussed their findings through continuous communications. To promote reflexivity during analysis meetings, team members discussed their insights, perceptions, and potential biases to make sure they were accounted for in data interpretation [13]. Then interpreted results were sent to participants via email for comments or corrections to ensure that participants' opinions were accurately reflected in the data and to check the consistency between the results of the researchers and the actual intentions of the participants [14]. Dependability is achieved through accurate records and in-depth descriptions of the methods used in the research. In terms of transferability, we used a detailed description method to ensure sufficient and accurate contextual information. The findings and conclusions can be transferred to other studies with similar situations. The quotes from the interviews are also provided as examples to clarify the explicated meanings and establish validity.

Patient and public involvement

No patients were involved in this study. Summary results were sent to participants via email before publication for feedback and comment.

Result

Altogether, 53 healthcare workers were interviewed. Their ages ranged from 23 to 63 years (Mage = 39 years), and 32 (60.4%) participants were women. 18 healthcare workers were infected by COVID-19, and 40 participants treated COVID-19 patients in the frontline. All the participants were working in the Central Hospital of Wuhan during the pandemic (Table 1).

The issues and connections were extracted from all interview data and summarized in the conceptual model, which was composed of healthcare workers' anxiety during different stages of pandemic and related drivers and mediators (Figure 2).

Healthcare workers' anxiety during different stages of the epidemic

Healthcare workers experienced a process of dynamic changes in emotions during the whole epidemic, which was divided into three stages.

In the initial stage of the epidemic, most participants experienced few intrusive and frightening thoughts about their clinical work because they did not understand the severity of COVID-19. The Wuhan government released that "No clear evidence of human-to-human transmission was found. Therefore, this epidemic is preventable and controllable" in January

2020, which made some participants lose their vigilance. However, participants from departments such as respiratory, infection, and emergency departments were more likely to be exposed to pneumonia patients and noticed a new kind of emerging respiratory disease. Therefore they were more vigilant and worried ahead of other healthcare workers.

"At the beginning of the outbreak, I felt nothing because it had not happened besides before. I was not scared until people around me were infected" -26

"In the early stage of the epidemic, the emergency department staff was all transferred from other departments. The team leader was isolated because of the abnormal CT examination results, and she only taught me one day. Other nurses without enough professional skills often sat beside the consultation desk outside, and only I worked in the rescue room. Everyone was lazy and didn't want to do anything." -29

"Hmmm... In December, patients with similar symptoms (to COVID-19) appeared in our department. At that time, we were quite anxious. Although the number of cases increased in January, people from other departments came to support us, and more protective equipment was provided to us, so the situation is much better. By this time, we became accustomed to this state." -31 (Nurse, Respiratory department)

As the epidemic progresses to its highest peak, almost all general practitioners in the hospital experienced infection or death around, including patients, colleagues, and even themselves. They began to realize the seriousness and severity of the epidemic. Most of our interviewees overflowed intense negative emotions such as "desperation", "depression", "fear" and "anxiety" after they heard or witnessed their colleague hurt by COVID-19 and worried about their health.

"So desperate, there was definitely a desperate mood, most desperate in 6th Feb (when Dr. A passed away)... it's not suitable for elaboration... such famous ones are not cured. If me..." -41

"At first, I didn't know it was COVID-19, so I wasn't afraid. Later, after a large number of patient cases were reported on the internet, I began to get scared." -50

"When I heard that the doctor in our hospital died, I was scared and wanted to cry. (silence). I don't know how to describe it." -13

"Very unreal feeling, kind of unbelievable, after all, they (doctors who died of COVID-19) were working with me before. I can't believe this news is true!" -15

"My family members were very worried about me and called me every day. Although I worried about myself, I was more scared about whether my family members would be infected." -36

As time went by, people gradually recovered to calmness and pursued the tranquillity of post-virus life. Most frontline workers had gradually adapted to this state of work, with increasing cases being cured, and good news reported by the media. However, after the ending of the Wuhan lockdown and the opening of outpatient service, the number of patients had dropped sharply than those before the epidemic, so healthcare workers' wages also decreased, which stressed participants who need to repay the loans. However, some participants were unwilling to mention what happened during the COVID-19 epidemic and committed to new careers to minimize anxiety and pretend fearlessness.

"I'm very sorry. (silence) My comrades fighting side by side are gone forever. Strongly grieved for their families! I wanted to do something for them, so I participated in donations and contacted related foundations." -4

"About the occupation, the COVID-19, others' death... I didn't think deeply. Not dare to. I just wanted to have a good day every day." -16

Nevertheless, several interviewees didn't seem to experience any emotional fluctuations from beginning to end, probably due to personal temperament and working experience.

"When doctors in our hospital passed away, I was not afraid at all. I only had two choices, either survive or die. I didn't care." -42 (Infected doctor)

"I experienced many ups and downs in my whole life. This epidemic was only one of the difficulties. I was not afraid, because I participated in the fight for SARS in Guangzhou in 2003" -17 (Second-line doctor)

Drivers of healthcare workers' anxiety

This category was developed to capture the underlying causes of participants' anxiety during different epidemic stages in around five themes.

Infection Risk-SARS-CoV-2 is spread mainly by aerosolized droplets expelled during coughing, sneezing, or breathing with a robust transmission ability [4]. Healthcare workers have been particularly hard hit by SARS-CoV-2, with high reported infection rates from Italian data. Even a high percentage of asymptomatic healthcare workers were reported to test positive for SARS-CoV-2 according to PCR results [15]. Their anxiety was related to, and triggered by, examinations and treatments to confirmed and suspected patients, as there was always a potential infection risk. After getting off work and staying away from patients, the anxiety level temporarily decreased, but it increased again close to the next day at the hospital. Participants' anxiety for infection risk mainly occurred at the peak of the epidemic and gradually disappeared as the epidemic was controlled.

"At that time, I was crying with my roommate at home every day. In fact, I got only an ordinary lung infection." -19

"Everyone could be infected, and I was no exception" -25

"Scared! I was really terrified! I was really afraid of getting infected. The isolation wards were full of COVID-19 confirmed patients" -3

Supplies-After the outbreak of COVID-19, the government imposed a strict lockdown in Wuhan, and many living supplies were difficult to obtain. Furthermore, the healthcare workforce's need for personal protective equipment (PPE) such as surgical masks and isolation gowns outpaced the supply in the early onset of COVID-19. Adequate supplies of PPE were identified as an effective protective strategy for the psychological distress by emerging virus outbreak on healthcare workers [16]. Participants without enough PPE worried about high infection risk for themselves and their families. Therefore, communities and governments

provided adequate supplies to alleviate the shortage to minimize clinical staff burden.

"After job transfer from respiratory medicine to CCU, no one cared about me. Totally helplessness. I couldn't get living supplies such as rice and noodles and buy food (because of lockdown in Wuhan)" -51

"Living and protective supplies are sufficient. When everyone in the hospital was scrambling for supplies, a friend knew my situation and sent me two food boxes with bread and milk. I thought Wuhan was quite lovely at that time." -34

"Because of fundraising from all over the country and even around the world, healthcare workers including me were not short of living supplies, but my family still lacked supplies. During this period, I was more worried about my family than myself" -15

Isolation-WHO recommended that healthcare workers with suspected COVID-19 who present with mild or moderate symptoms should be encouraged to stay home and away from the workplace during illness [17]. It was reported that individuals, including healthcare workers who self-isolated at home, suffered from increased anxiety and stress [18]. Participants felt "so lonely as if abandoned by the world" and "be seemingly treated like a criminal" during the quarantine. In contrast to depression brought about by isolation, some participants prefer to confront the patients and continue the clinical work despite the high risk of infection.

"At the beginning of the epidemic, I was under a lot of psychological pressure. There was something wrong with the CT examination of the roommate's lungs, so I was also isolated at home"-49

"I'm afraid of isolation. No matter how good the environment is, I can't accept isolation. I am willing to work in the hospital rather than being isolated. In order not to be isolated, it is necessary to rest well and boost immunity." -22

Media-Although WHO has produced guidance for opinion-makers and the media on how to describe the outbreak, few local and social media strictly obeyed them in the initial stage of the epidemic yet, which stressed healthcare workers deeply [19]. For example, some media presumed the possibility of healthcare workers having or spreading COVID-19 rather than highlighting the effectiveness of preventive measures, and therefore some people worried about contact with their neighbors who worked in the hospital.

In addition, many healthcare staff learned about the infection or death of their colleagues through social media, which made them mourn for the loss and also scared of being infected. An interviewee quoted a Chinese colloquialism to express her sorrow: *The fox mourns over the hare's death*.

"During the epidemic, I lived in a hotel close to the hospital rather than at home. The management company in my community was not willing to allow me to enter it after hearing that many doctors in our hospital were infected." -37

"When I was treated for COVID-19, all kinds of bad news appeared, especially which doctors in our hospital passed away. (Appeared surprised) I tried not to watch bad news, but It was

impossible to block social media from all my friends. After reading them, I was afraid that I would not be cured. Therefore, when the doctor told me to use the immunity-enhancing drugs at my own expense, and I said:'use them, no matter how much they cost.'" -53

Financial Status-During the peak of the epidemic, healthcare workers received an allowance from the government for treating COVID-19 patients. The government reimbursed people infected by COVID-19 in China for all treatment costs, and infected healthcare staff can also claim workers' compensation insurance. Therefore, few healthcare workers were anxious about their financial status during the epidemic's peak. However, after the ending of the Wuhan lockdown and the opening of outpatient service, participants complained that salaries were not satisfied after the epidemic was under control because the government canceled allowance and patients unwill to visit the hospital for fear of infection risk, which decreased hospital profits. Some interviewees also felt that their efforts and sacrifice had not been reasonably compensated and eager to obtain adequate financial rewards.

"Will my salary be raised in the future? It is too low to support myself now" -30

"But I think we are really the cheapest labor force because I met my classmates on Sunday, they worked in Didi (a taxi company) and drove medically equipped vehicles during the epidemic? They earned more than 100,000 yuan ($14,000) in a single week! They really made more than 100,000 yuan! But how much for us? really cheap labor!" -21

Self mediators of healthcare workers' anxiety

In the face of high occupational risk, healthcare workers developed their own way to defend themselves from anxiety and depression.

Occupational attitude-Most healthcare staff decided to take up medicine as a career tended to endorse altruistic reasons (working with people, helping others) rather than the possibility to achieve high social status and financial stability [20]. Under the threat of COVID-19, participants identified the desire to rescue patients as a motivation for themselves.

"The doctors' duty is to heal the wounded and rescue the dying" -41

"I never thought of resignation and still have full-hearted enthusiasm. Many colleagues returned to work immediately after recovery from COVID-19" -33

"Everyone has their own responsibilities in their positions. I have a clear conscience only if I do my best"-17

Fitness-A high level of cardiorespiratory fitness caused by prior exercise training reduces all-cause mortality and may confer some protection against COVID-19 [19]. Two infected participants kept in satisfactory physical condition before and had a strong belief in being cured of COVID-19. In addition, patients with younger age were identified with a good prognosis, which boosted some young participants [21].

"There is no special medicine for COVID-19. It's totally dependent on your immunity. I always

exercised before, so I wasn't injected with immunoglobulin while being infected." -28

"I limited energy intake to lose weight before. However, my workload suddenly increased, and I need to maintain a proper diet to supplement nutrition after the COVID-19 epidemic."-52

Entertainment-Entertainment such as videos, computer games, and other personal hobbies at home has considerable potential for relieving healthcare workers from reality pressure. Several interviewees were addicted to personal hobbies to escape from the disturbance of work fatigue and anxiety for relatives' health.

"My boyfriend gifted me a microphone, and I sang at home. Later, I felt that I couldn't stand it and applied for a photography class at home. There is always something to do, in case I thought so much."-14

"Eat, drink, and sleep when I should. Watch TV drama or play video games when I'm free."-11

"When I was hospitalized, I played 'Honor of Kings' (a mobile MOBA game) every day."-32

Religion-Only one participant sought help from religion to stay away from negative moods under the pressure of frequent infections of companions. During the pandemic, places of worship such as temples, churches, synagogues, and mosques were also closed in Wuhan, which interrupted most of the religious activities. Therefore, she sought spiritual peace by "copying the Buddhist sutras at home".

"After I got off work, I copied the Buddhist sutras at home. The power of religious belief has always supported me"-29

Interpersonal mediators of healthcare workers' anxiety

Confronting patients' and colleagues' successive deaths, many participants experienced heavy psychological pressure and sought help from other people, including colleagues, families, friends, patients, and society (Table 2).

During working hours, colleagues companions played a significant role in relieving loneliness and horror. Participants "rushed to the front" similar to soldiers and treated their colleagues as comrades-in-arms. Some infected interviewees experienced a dramatic change of identity from doctors/nurses to patients and desired more psychological support from their health carers also colleagues. In addition, patients also expressed their gratitude to some participants for their dedication. After getting off work, most participants felt less anxious and depressed by communicating with their families and friends, who always encouraged them to hold on. Participants' families relieved them of the negative emotional state by encouragement, care, and comfort. Sometimes, participants were unwilling to share their anxiety with their families "because the family would be more worried and sleepless". Furthermore, the government and hospital provided living and protective materials "as much as possible", which were indispensable for living during epidemic and lockdown in Wuhan.

Discussion

Our research divided the COVID-19 epidemic-pandemic experienced by healthcare workers into three stages and tracked the dynamic changes of their mental state. While these emotions may be mitigated or exacerbated by the working experience, environment, and health status, participants' reports suggest these experiences are pervasive. Ardebili et al. also showed how emotions and feelings were highly conditioned by the time of evolution of the pandemic [22]. These authors developed a three-level model: early exposure, with high levels of fear, anxiety, and loss of control; crisis peak, featured by feelings of helplessness, hopelessness, and depression; and long-term effects, with symptoms of post-traumatic stress disorder (PTSD) and reappearance of fears. Compared to Ardebili's model, we found that in the early exposure most participants had no sense about the COVID-19 epidemic, and thus experienced few negative emotions. However, they suffered tremendously psychological pain in the crisis peak as the massive infections and deaths of patients and colleagues. A faster emotional shift was observed in our research than in other reports.

To date, most reported qualitative researches focused on the emotional experiences of healthcare workers during the peak of the COVID-19 pandemic [23-25]. All these researches found that the pandemic outbreak led to a series of negative emotions, such as depression, anxiety, and fear [23-25]. However, these psychological symptoms were attributed to different driving factors in different studies. Some participants were plagued by job challenges, such as inappropriate clinical scheduling, inadequate capacities for difficult tasks, and insufficient cooperation with community workers [24, 25]. They also sympathized with the patients' suffering and felt upset for incapability to cure the dying patient [23, 25]. Zhang et al. [26] reported that nurses experienced negative emotional reactions in the initial period of home isolation. During social distancing and isolation, residents felt psychological and emotional loss, criticized government communication, adhered to social distancing guidelines, and uncertain about social reintegration and the future [27]. In addition, viral infection risk and shortage of protective devices distressed many healthcare workers [22, 23, 25]. Except for the above factors, our conceptual model also illustrates media's role in triggering emotional responses.

Few studies explored healthcare workers' emotional experiences in the late period of the epidemic. Notability, the anxiety level of participants didn' t significantly decrease with the complete control of the epidemic in Wuhan, which attributed to not only PTSD but also poor post-epidemic financial status. Most participants explicitly or impliedly expressed their concerns and dissatisfaction with incomes, which was never mentioned in other researches. Therefore, strategies to help healthcare workers overcome challenges and prevent the primary care system from being overwhelmed are continuously needed in the long fight against COVID-19. Health authorities and institutional leaders were expected to provide both mental and material support to healthcare workers.

It was reported that high-risk groups of mental health symptoms were nurses, women, frontline health care workers, and those working in Wuhan, China, who accounted for 35% of interviewees in this study [6]. Notably, most of our interviewees never worked in respiratory, infection, emergency, intense medicine, and other related departments before the COVID-19 pandemic. Therefore they experienced more perceived stress and less social support when treating COVID-19 patients [28]. In addition, our research population came from a particular hospital in Wuhan, where the COVID-19 epidemic first broke out, and more medical workers here passed away due to infection than all other hospitals. Chinese and even the world media focused on workers' status in this hospital during the epidemic. Due to tremendous pressure from multiple factors, healthcare workers might undergo more serious anxiety than those of other hospitals. Thereby, they represent the majority of healthcare workers worldwide who are under severe psychological stress during the pandemic.

Our findings extend research on mental health in the medical workplace during a public crisis and provide a view of death anxiety directly from the perspective of those who experience it. Death anxiety is a multidimensional construct involving cognitive, emotional, and experiential aspects [29]. It was reported that physicians' death anxiety for patients did not relate to decision making during clinical treatment but guilt or doubt after a patient's death [30]. However, few studies focused on physicians' death anxiety for their colleagues, which had a huge negative impact on health professionals. Participants in our study revealed significantly declined working enthusiasm and efficiency due to colleagues' infection and death. When healthcare workers saw their colleagues bearing the hardship, they were inspired to have greater solidarity and cohesion. As for some participants infected by COVID-19, they also reported concerns regarding their fear of dying alone and being separated from their loved ones, fear of infecting their families, friends, or colleagues, and fear of stigmatization [22].

Healthcare providers had multiple ways to recover from affliction, not only by self-management strategies but also by social support systems, including colleagues, families, friends, patients, and society. With logistical support from their hospital and encouragement among colleagues, they had a sense of safety and felt they were not alone [23]. In addition, the local government and hospitals had predicted high mental pressure among healthcare workers in advance and offered professional psychological counseling and related questionnaires to them [31]. Nevertheless, no participants expressed their benefits from these measures, indicating these psychological intervenes were invalid and insufficient to alleviate the psychological issues.

Some limitations need to be considered when interpreting our findings. First, the timing of administering the interviews might affect the results. The participants likely had less anxiety because they were just assured that they would not be infected with COVID19 after the well-controlled epidemic in Wuhan. Second, all participants were voluntary to take part in the research. Although we randomly sampled healthcare workers and successfully invited most of them to interview, some personnel who suffered severely would be less inclined to participate.

Finally, due to social distance and city lockdown, many participants could not be directly interviewed through a face-to-face way, which is less convenient to convey emotions. In order to catch participants' faces and actions, video calls and online conference app were recommended if permitted by interviewees.

Conclusion

Our research reports a comprehensive conceptual model to describe the cause and regulation of anxiety among healthcare workers at different stages of the pandemic and raises problems about the protective measure for psychology and physiology. Although the government and society provide materials and spirit support as much as possible, most healthcare workers still felt neglected and anxious about infection risk and income levels. Psychological intervention and personal protection for healthcare workers need to be immediately carried out, especially in the districts and hospitals affected seriously by COVID-19. Healthcare workers in the epidemic-controlled district have less infection risk but also lower-income, so they benefited more from financial compensation.

MLF, BX and TT contributed equally to this work.

Author Contributions: MLF and ZHW conceived of the study and analysis plan. MLF, BX, TT and YH collected data. MLF and ZHW analyzed the data. ZHW drafted the conceptual model. MLF and ZHW wrote the first draft of the manuscript. All authors contributed to the interpretation of the data, edited the manuscript, and approved of the final manuscript. ZHW had full access to all the data in the study and had final responsibility for the decision to submit for publication.

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Data sharing: Data are available upon reasonable request.

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Figure Captions

Figure 1: Milestone events in the Central Hospital of Wuhan during the pandemic of COVID-19.

Figure 2: Conceptual model of themes and relationships derived from healthcare workers' anxiety during different stages of the pandemic.

Table1: Demographic and Occupational Characteristics of interviewees.

		Number
No. of interviewees		53
Gender	Male	21
	Female	32
Mean age, years	(range), years	23-63
Infection by COVID-19	Yes	18
	No	35
Working position	Front-line	40
	Second-line	13
Working life	(range), years	1-32
Occupation	Physician	18
	Nurse	24
	Others in hospital	11
Marriage status	Unmarried	33
	Married	20
Education background	≤Undergraduate	36
	≥Postgraduate	17

Table 2. Interpersonal mediators of healthcare workers' anxiety	
Theme	Exemplary quotes
Colleagues	"Many colleagues are rushing to the front, so I have no reason to back down." -36 "None in my family was infected, because a teacher in our department is very cautious. Before the New Year, when the epidemic was not exposed to the public, she already told me some precautions, such as keeping social distance and dining with public chopsticks." -48 "When I was diagnosed as COVID-19 and hospitalized, there were still very few beds. The chief nurse reported my situation to the public health department and arranged a bed for me. Doctors and nurses were very kind, maybe because we worked together" -44
Family	"Daily video with my family. I told them I am much better now and what medicine I used today. When I was dining outside the ward, I took down my mask and showed them that I was okay. In the later period, when I was about to be discharged from the hospital, they were completely relieved." -6 "My deepest thought (when I was infected and hospitalized)? I have my wife and my family. I must live a very healthy life. I still look forward to living in this world." -7
Friends	"I once collapsed. There were only three or five COVID-19 confirmed patients every day before. However, the number increased by tens of thousands those days, and I couldn't bear it. But I couldn't tell my mother because she would be more worried and sleepless. So I talked with my friends, which made me feel better." -3 "When I was upset, I talked to my good friend and complained about something." -37
Patients	"The lady who lived beside my bed was kind to me. She was always comforting me. She said: 'Although I had a basic illness like diabetes, I am much better now. The effusion of my lungs is almost absorbed.' Her words made me feel much better. I was so lucky that she was always encouraging me and chatting with me." -41
Society	"I was isolated at home for two months. The government sent us supplies and relief" -29 "The hospital helped us solve life problems as much as possible and gave us masks when we came to work every day. But few financial support." -32

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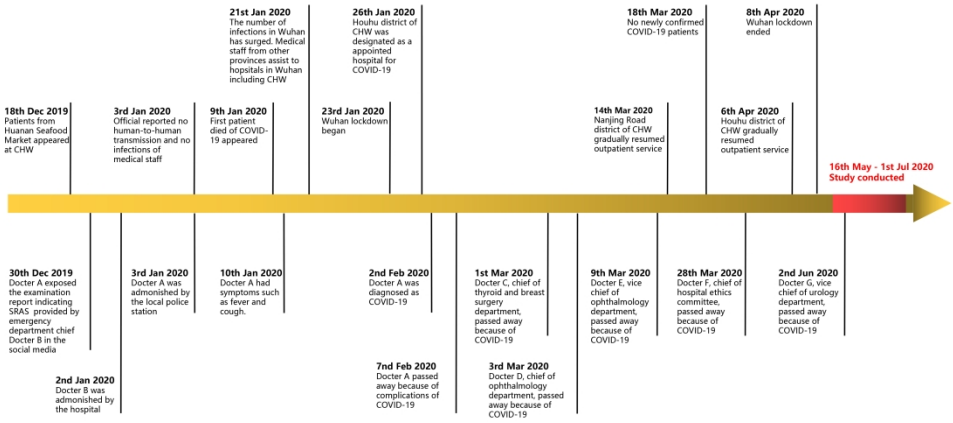

Milestone events in the Central Hospital of Wuhan during the epidemic of COVID-19.

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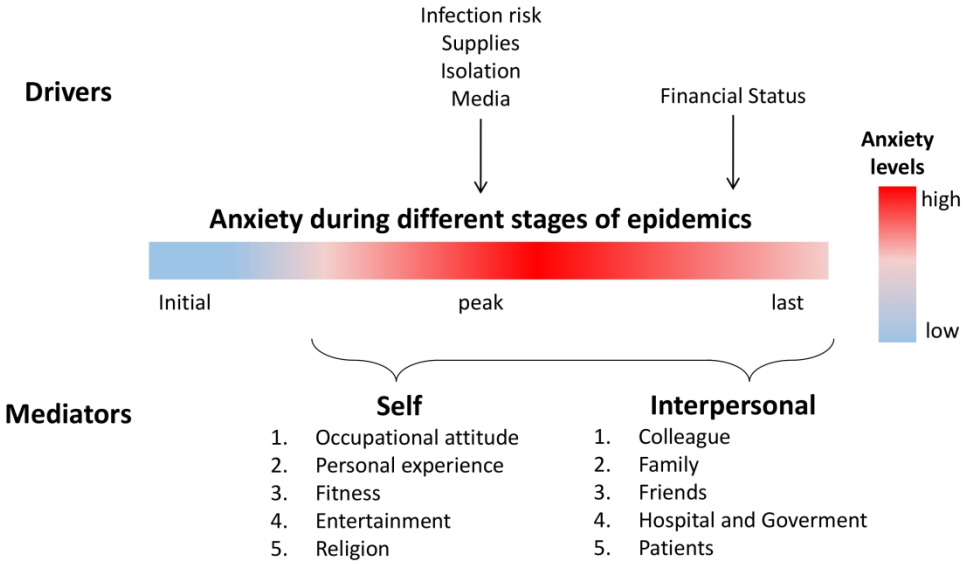

Conceptual model of themes and relationships derived from healthcare workers' anxiety during different stages of epidemics.

Interview Guideline

Basic information:

Age, Gender, Marriage status, Education level, Department, Working life, Occupation, Education background, COVID-19 infection history, Working position during epidemics

Key points at the beginning of the interview:

1. Thank you for participating in this research

2. This interview will be recorded and transcribed verbatim

3. Personal information will be kept confidential, and part of the interview will be used to publish.

The main content of the interview (for non-infected participants):

1. How did you feel at the beginning of the epidemic? When did you begin to realize the severity of the epidemic? How did you understand these? Could you talk about your inner thoughts when you heard that other colleagues in our hospital were infected? Why did you have these feelings?

2. (for front-line participants) When were you transferred to another department (for treating COVID-19 patients)? How long? Working position? Emotional reaction when you heard this news for the first time? Emotion change during this period? Why was there such a change? What were your more impressive experiences?

3. (for second-line participants) What were your main tasks during the epidemic? Emotion change during this period? Why was there such a change? What were your more impressive experiences?

4. Were you afraid during the epidemic? Why? Did you have depression or insomnia during this period? If so, to what extent? What supports you until now? How did you adjust yourselves? What intervention measures did the hospital provide correspondingly (such as classes, supplies, etc.)?

5. Were you worried about your family during this period? How to balance work and family? What troubles has this epidemic brought to your family and life, and how did you deal with

it?

6. How did you feel when you heard the sad news of the death of several doctors in our hospital? Will there be self-doubt or even questioning this job? why?

7. Now that the epidemic has been controlled effectively, how do you feel? why? Have there been any changes in life attitudes after experiencing the epidemic? New understanding of this job? Have you ever thought of resigning? Why? If so, is there still such an idea now? What made you change your mind/what idea made you choose to persist?

8. Do you have anything else to say? Regarding this epidemic, can you share with some suggestions based on your own experience?

9. What are your expectations for the future?

The main content of the interview (for infected participants):

1. How did you feel at the beginning of the epidemic? When did you begin to realize the severity of the epidemic? How did you understand these?

2. When did the symptoms appear? What was your inner thought at the time? When were you diagnosed with COVID-19? Feelings after the diagnosis? What is the inner change from symptom to diagnosis?

3. How did you feel during the treatment? Did you have depression or insomnia during this period? If so, to what extent? What supports you until now? How did you adjust yourselves? What intervention measures did the hospital provide correspondingly?

4. Had your family been infected? If so, what is their situation? How did you maintain contact during this time? They must be very worried about you, how did you deal with it?

5. How did you feel when you heard the sad news of the death of several doctors in our hospital? Will there be self-doubt or even questioning this job? why?

6. You have recovered, resumed work, and returned to your position now. Have there been any changes in life attitudes after experiencing the epidemic? New understanding of this job? Have you ever thought of resigning? Why? If so, is there still such an idea now? What made you change your mind/what idea made you choose to persist?

7. Do you have anything else to say? Regarding this epidemic, can you share with some suggestions based on your own experience?

8. What are your expectations for the future?

Interview requirements:

1. In-depth and sincere conversations. No simple questions and answers, but the interviewer actively grasps the true psychological feelings of the interviewee, and specifically understands his/her situation during COVID-19 epidemics, such as anxiety, fear, doubt, or luck, pride, and excitement. Talk like an old friend and increase the closeness of the interviewee.

2. Participants are not necessarily willing to admit true feelings. They may not be embarrassed to say that they are particularly scared during the epidemic, but the interviewer can slowly get in touch with their true thoughts through many indirect questions: "What did you think when *** were diagnosed with COVID-19?" "Have you ever suspected that you have been infected with SARS-COV-19?". As the interview proceeds, it is normal for the interviewee to have inconsistent remarks.

3. This interview is semi-structured, which means that the main content must be covered, but the way of asking can not be restricted to a fixed format

4. Mainly focus on personal inner emotional experience, do not involve some politically sensitive topics.

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
Domain 1: Research team and reflexivity				
Personal Characteristics				
1.	Interviewer/facilitator	Which author/s conducted the interview or focus group?	12	MLF, BX, TT and YH collected data.
2.	Credentials	What were the researcher's credentials? *E.g. PhD, MD*	1	
3.	Occupation	What was their occupation at the time of the study?	1	
4.	Gender	Was the researcher male or female?	1	
5.	Experience and	What experience or training did the	4,5	The date was analyzed by a team of three trained qualitative

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
	training	researcher have?		researchers based on a qualitative content analysis method. In addition, all excerpts from interviews in this paper were translated from Chinese by investigators and native English speakers cooperatively to convey the interviewees' semantics completely. The interview guide included questions regarding the experience of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience
Relationship with participants				
6.	Relationship established	Was a relationship established prior to study commencement?	4	No relationship
7.	Participant knowledge of the interviewer	What did the participants know about the researcher? e.*g. personal goals, reasons for doing the research*	4	Nothing
8.	Interviewer	What characteristics were reported	4	The interview guide included questions regarding the experience

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
	characteristics	about the interviewer/facilitator? e.g. *Bias, assumptions, reasons and interests in the research topic*		of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience
Domain 2: study design				
Theoretical framework				
9.	Methodological orientation and Theory	What methodological orientation was stated to underpin the study? *e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	4	The date was analyzed by a team of three trained qualitative researchers based on a qualitative content analysis method
Participant selection				
10.	Sampling	How were participants selected? *e.g. purposive, convenience, consecutive, snowball*	4	articipants were selected through purposeful maximum variation sampling regarding age, sex, occupation, and working position for patients to accomplish full coverage. The number of participants

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
				was determined based on ‘‘saturation'', a sense of closure that occurs when data collection ceases to provide important new information and when patterns in the data become evident.
11.	Method of approach	How were participants approached? e.*g. face-to-face, telephone, mail, email*	4	Data were gathered by semistructured interviews mostly through phone or internet communication tools such as Wechat and QQ due to social distancing.
12.	Sample size	How many participants were in the study?	5	Altogether, 53 healthcare workers were interviewed.
13.	Non-participation	How many people refused to participate or dropped out? Reasons?	4	In total, 53 healthcare workers completed the full survey, with a participation rate of 53/76 (69.7%) based on the total number of individuals whom we invited to interview. All participants who accepted our invitation finished the full interview.
Setting				
14.	Setting of data collection	Where was the data collected? e.*g. home, clinic, workplace*	4	Data were gathered by semistructured interviews mostly through phone or internet communication tools such as Wechat and QQ due to social distancing.

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
15.	Presence of non-participants	Was anyone else present besides the participants and researchers?	4	none
16.	Description of sample	What are the important characteristics of the sample? *e.g. demographic data, date*	4	Demographic data included age, gender, departments, professional titles, educational background, marriage status, occupation, occupation, working life, and COVID-19 infection history were collected.
Data collection				
17.	Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	4	The interview guide included questions regarding the experience of living and working during epidemics was designed with the help of professional qualitative researchers and distributed to interviewers with associated experience (Supplementary file 1). Examples of initial questions were: "What did you experience during the epidemic?", "How did you feel when you heard of your colleagues' death?", "Has something changed after epidemic?". When needed, follow-up questions were posed.
18.	Repeat interviews	Were repeat interviews carried out? If yes, how many?	4	Six interviews were repeated for more than one time to clarify critical questions.

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
19.	Audio/visual recording	Did the research use audio or visual recording to collect the data?	4	All interview audio was recorded and transcribed verbatim with participants' permission, after which interview transcripts were sent to participants via email for comments or corrections
20.	Field notes	Were field notes made during and/or after the interview or focus group?	4	No
21.	Duration	What was the duration of the interviews or focus group?	4	The interviews were carried out by at least one interviewers and lasted for 10–60 minutes.
22.	Data saturation	Was data saturation discussed?	4	During the study, saturation was achieved after 38 interviews. To accomplish maximum variation, interviews continue with further patients to ensure that no new aspects emerged.
23.	Transcripts returned	Were transcripts returned to participants for comment and/or correction?	4	All interview audio was recorded and transcribed verbatim with participants' permission, after which interview transcripts were sent to participants via email for comments or corrections.
Domain 3: analysis and findingsz				

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
Data analysis				
24.	Number of data coders	How many data coders coded the data?	4	The date was analyzed by a team of three trained qualitative researchers based on a qualitative content analysis method
25.	Description of the coding tree	Did authors provide a description of the coding tree?	4	The team developed a structured codebook that included inductively derived codes that represented ideas that emerged from the data as well as deductively selected categories to organize the dataset.
26.	Derivation of themes	Were themes identified in advance or derived from the data?	5	No. each cluster's statements were scrutinized and compared to find the central component and then fused into categories (theme).
27.	Software	What software, if applicable, was used to manage the data?	4	No
28.	Participant checking	Did participants provide feedback on the findings?	5	Yes
Reporting				

No	Item	Guide questions/description	Page No.	Relevant text from manuscript
29.	Quotations presented	Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.*g. participant number*	5-10	"Results" section
30.	Data and findings consistent	Was there consistency between the data presented and the findings?	5-10	"Results" section
31.	Clarity of major themes	Were major themes clearly presented in the findings?	5	The issues and connections are extracted from all interview data and summarized in the conceptual model, which was composed of healthcare workers' anxiety during different stages of epidemics and related drivers and mediators (Figure 2).
32.	Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	5-10	"Results" section