Complex interactive multimodal intervention to improve personalized stress management among healthcare workers in China: A knowledge translation protocol

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Abstract

Objectives: Numerous stress management interventions have been implemented in the workplace, but few are adapted to the healthcare setting. Due to the nature of their jobs, healthcare workers (HCWs) may find it difficult to adopt recommended stress management strategies. We present the protocol for a 12-week personalized stress management intervention among HCWs to change their behavior as well as improve physiological/psychological outcomes.

Methods: It is a pragmatic quasi-experimental study involving stressed HCWs from two general hospitals in Wuhan, China. The intervention group will receive a complex interactive multimodal intervention, including advanced education via mobile connection, participation in a web-based social network, tailored feedback, and the support of a nurse coach, while the control group will engage in self-guided stress management.

Results: The primary outcome is centered on behavioral measures, namely improvements in stress management practice frequency after a 12-week intervention. The secondary outcomes are the changes in stress-related physiological indices (i.e. high frequency variability and normalized unit assessed by Holter) and psychological indicators (scores on the Perceived Stress Scale and Depression, Anxiety, Stress Scale) following 12 weeks of treatment.

Conclusion: The knowledge translation intervention builds on a body of work defining the role of individualized instruction and feedback intervention, as well as group intervention through WeChat social network and personalized coaching. We believe this novel intervention will help HCWs promote their stress management awareness and skills, and ultimately benefit their long-term health.

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Contributions to the literature

- Numerous stress management interventions have been implemented in the workplace, but few are adapted to the healthcare setting.
- Despite well-established evidence for the efficacy of the aforementioned management techniques in reducing stress symptoms, healthcare workers (HCWs) may find it challenging to implement the recommended techniques due to their job characteristics.
- This study employs a quasi-experimental design to test the effectiveness of a complex interactive multimodal intervention to enhance the practice of stress management strategies in daily life and improve stress outcomes in 12 weeks' time among HCWs.
- The Complex Interactive Multimodal Intervention builds on a body of work defining the role of web-based social interactions, mobile stress management education, tailored feedback, as well as social support intervention.
- Our protocol design may provide a basis for optimizing current stress management interventions and fill the gap between knowledge and practice of stress management among HCWs.

Background

Work stress is considered as one of the major occupational risk factors in the modern industrial society. Work stress can result in an enormous adverse effect on one's physical and psychological health, with possible costs ranging from $17.79 to $1211.84.[1] Due to the characteristics of healthcare context, healthcare workers (HCWs) are frequently exposed to stressors at work, including excessive workload, unscheduled work shifts, and long working hours.[2,3] Although healthcare stressors are somewhat inevitable, appropriate stress coping strategies may help prevent the negative impacts of chronic stress on individuals. Several stress management strategies such as physical exercise, deep breathing practice, and mindfulness have been used in stress management interventions.[4–7] Previous studies have found that those stress management strategies are beneficial for promoting mental health, well-being, and sleep quality,[8] as well as changing physiological indices of stress, such as heart rate variability (HRV),[9,10] and improving total cholesterol/high-density lipoprotein systolic blood pressure.[11]

Despite well-established evidence for the efficacy of the aforementioned management techniques in reducing stress symptoms, HCWs may find it challenging to implement the recommended techniques due to their job characteristics. In reality, the implementation of stress management strategies among HCWs was even less successful than that of the general population. According to a recent mixed-methods study, even though being fully aware of the presence and potential detrimental effects of work stress, approximately half of HCWs failed to implement stress management behaviors because multiple stressors, such as overwhelming workload and emotional burdens, made it difficult for the HCWs to change their current status on their own.[12] Previous research has also discovered that long-term stress symptoms may undermine a person's sense of self-efficacy and social support, deterring them from benefiting from stress management.[13,14] There appears to be a vicious circle of "stress-distress" preventing HCWs from implementing stress management strategies derived from scientific research. Only by narrowing the "knowledge-doing" gap can we ensure that they will receive the greatest benefit from stress management interventions and experience fewer stress symptoms.

Knowledge translation (KT) is defined as a process that occurs through social and environmental interactions, and underlines that knowledge exchange must happen in an interacting social situation.[15] Among different theoretical frameworks that support the implementation of KT projects, the most popular makes reference to social learning theory (SLT).[16] SLT emphasizes three main factors associated with human behaviors: environmental factors (influence of others), personal factors (knowledge and attitudes about implementing skills), and behavioral factors (education and practical skills, and self-efficacy feelings).[17] Similarly, SLT also proposes that only when environmental and individual factors interact synergically toward sustainability, knowledge can translate to the desired behavioral changes.[16,18–20] Inspired by this information, which supports the need for complex interventions, we decide to create a highly interactive and dynamic environment in which HCWs can gain new awareness, knowledge, and stress management skills while also receiving strong support from multiple sources during their stress management strategy practices.

Emerging mobile applications may offer the possibility for more direct and timely interactions with individuals, as well as the opportunity for individualized stress management interventions. According to the latest official report, the internet penetration rate in China has reached 73.0%, and there are more than 1.32 billion netizens in China, 99.7% of whom access internet by smartphones.[21] The high number of mobile applications logically suggests their potential use among working populations to promote behavioral changes. Actually, mobile treatments have been shown to be equally effective in workplace-based stress management interventions as traditional face-to-face training in terms of enhancing stress management skills and knowledge.[22,23] Hence, mobile stress management intervention may represent an efficient and inexpensive alternative to the traditional in-person onsite stress management training, especially in low-middle income countries where the number of mental health experts is insufficient; further, mobile apps

have the advantage to offer convenience of use, at time where the individual and more time or specific needs.[24]

In our protocol design, we aim to develop a mobile stress management intervention that will specifically address the environmental and personal factors that hinder the practice of stress management strategies among HCWs. This complex interactive multimodal intervention (CIMI) includes: (1) mobile stress management education, (2) involvement in a social interactive environment via WeChat group (web-based social network), (3) offering individualized stress practice feedback generated by HUAWEI portable device, and also from a weekly questionnaires, and (4) providing personalized support and guidance by a nurse-coach (Figure 1).[25,26]

Objectives

Primary objective

Our primary objective is to determine whether CIMI is more effective than the control group to increase practice frequencies of stress management strategies via a 12-week intervention.

Secondary objectives

Our secondary objective is to assess whether CIMI is more effective on improving stress-related physiological and psychological outcomes as compared to the control group, after 12 weeks intervention.

Methods

Study design

This is a theory-driven, pragmatic, quasi-experimental study conducted in two hospitals of Wuhan, China among HCWs working night shifts and experiencing psychological signs of stress. All hospital-A participants will get the CIMI intervention, whereas hospital-B participants will just receive an instruction brochure detailing stress management strategies (Supplemental file 1). Both physiological and psychological stress outcomes will be assessed at baseline and during the course of the study, with primary endpoint recorded 12 weeks after enrollment. This study is reported according to the Template for Intervention Description and Replication (TIDieR) Checklist (Supplemental file 2).

Participants eligibility

HCWs will be eligible to participate if they (1) are working night shift in hospital-A (intervention) or hospital-B (control), (2) do not have any plan to leave their current position within 6 months, (3) do not have serious medical conditions that affect the level of stress or the follow-up quality, (4) have at least one sign of distress using the Depression Anxiety
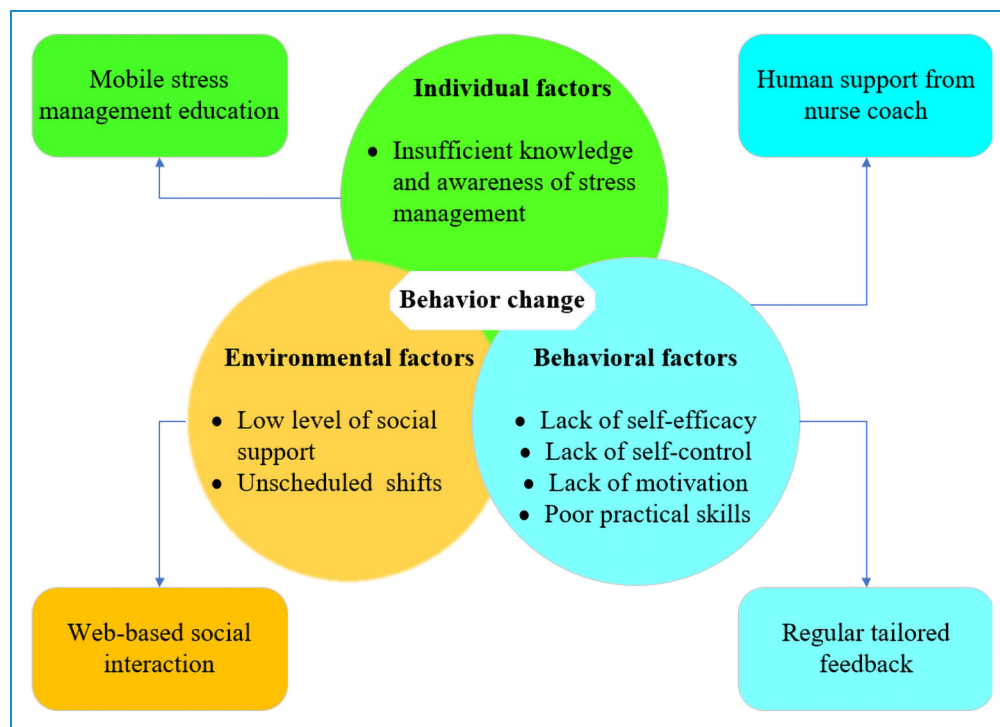

Figure 1. Conceptual framework that supports the protocol design. The intervention protocol integrates several factors that may determine changes in human behavior, including environmental, individual, and behavioral factors, as proposed by Bandura's social learning theory.

Stress scale (DASS-21): depression subscale score of 10 or higher, anxiety subscale score of 7 or higher, or stress subscale score of 11 or higher,[27] and (5) are willing to participate in this study and sign the consent form. HCWs will be excluded if they are (1) planning to leave the hospital or the units for any reason, (2) not in a good medical condition or context for reliable follow-up, (3) unwilling to complete the 12-week follow-up or sign consent.

Recruitment and allocation

Recruitment of HCWs is planned for the period autumn-winter 2021. Before recruitment, all potential participants will be informed about this study through staff meetings and flyers. At recruitment visit, all participants will undergo a personal interview with a physician and provide information regarding demographic characteristics, health status, work and life stressors, and personal lifestyle. The participants will then be asked to take the DASS-21screening performed by two trained-nurses. Participants who qualify will be required to wear a 24-h Holter device to assess the physiological indicators of stress indexed by HRV. The day of recording will be selected to be at least 48 h after a night shift to ensure enough rest prior recording. Finally, participants will be instructed about the usage of sport wristbands to record their exercise data. After enrollment, participating HCWs of hospital-A will be exposed to the different components of the CIMI intervention, while participants from hospital-B will be in the control group, to receive the sport wristbands and simple written instructions (Figure 2).

Intervention components

Participants in the CIMI intervention group will receive a 12-week online intervention with the following four components: mobile stress management education, weekly participation in web-based WeChat social network, tailored stress management feedback with a weekly summary, and personal nurse-coaching as needed.

Mobile stress management education

Immediately after enrollment, each HCW will be invited to join a Wechat group anonymously. The nurse coach will deliver the evidence-based instruction through WeChat group every weekend during the whole study period, following the logic model presented in Table 1. The lectures will first introduce some basic information regarding stress, including its common symptoms and long-term impacts. This approach is used to ensure that participants perceive their own susceptibility to stress and the severity of stress, so that they could realize the importance of stress management. The presentation will then describe the practice of three evidence-based interventions

recognized for their efficacy to reduce stress: physical activity,[28] deep breath,[29] and mindfulness.[9] The nurse will recommend HCWs to select one or more recommended stress management strategies based on their needs, interest, and capacity, so they won't feel excessive pressure for daily practice. To ensure HCWs practice those stress management strategies appropriately, each participant will obtain an internet link to access a package of instructional videos that will guide them through the procedures of the practices (Supplemental file 3). These videos will be accessed through private and secure personalized access to prevent the diffusion to other HCWs, especially from hospital-B.

Participation in weekly web-based WeChat social network

Each weekend, the nurse educator or a physician will hold an online discussion for about 30 min. During the discussion, HCWs will be invited to discuss several issues about stress management, in particular the solutions they find to practice stress management in context of busy life and work. They will be encouraged to share their photos or videos which record their stress management strategies practice over the past week. All this information will be kept anonymously as participants are registered with a personal ID number of their choice. To motivate HCWs participate in the WeChat social interaction, a random selection of participants will receive each week a small gift as incentive (Table 2).

Receiving tailored feedback regarding stress management strategies practice performance

Another component of CIMI is regular personalized feedback for HCWs, which is targeted at monitoring and promoting their practice during the intervention. Every weekend, HCWs will receive feedback messages about their performance on stress management strategies practice from the nurse coach. Furthermore, the nurse coach will present each participant several bar charts each month that illustrate if their stress symptoms and sleep condition have improved over the previous month. Performance information will come from two sources of information: (i) from a weekly questionnaire completed on-line through REDCap, and (ii) from the wristband data that are summarized every week.

- The weekly questionnaire contains four sections to assess, daily life stressors, stress management practice, psychological symptoms, and sleep (duration and quality). The first section records information regarding daily life stressors, including the shift work schedules and unexpected stressors in the past week. The second section records stress management practice by asking HCWs their practice frequency, perceived barriers and
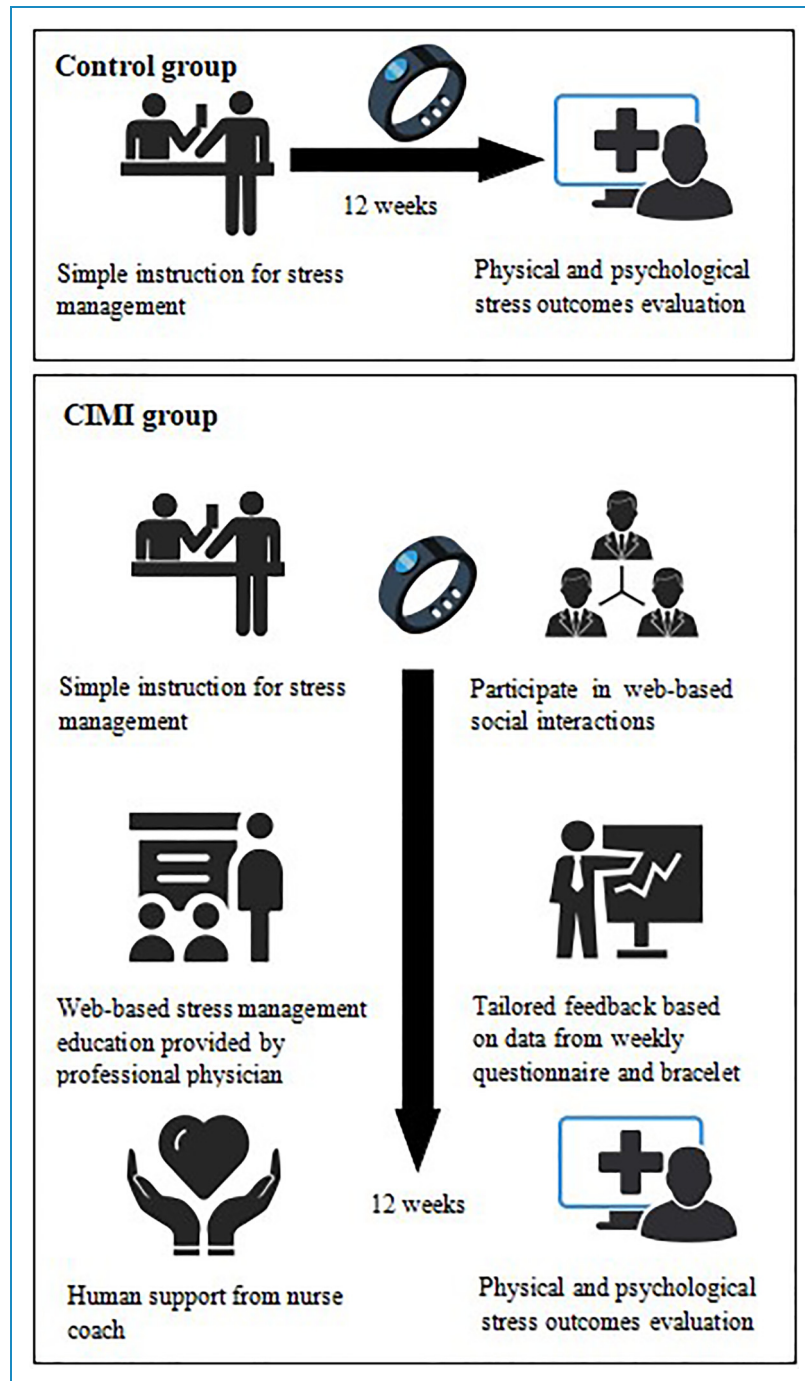
Figure 2. Procedures for implementation as usual treatment versus CIMI.
CIMI: complex interactive multimodal intervention.

benefits of practicing stress management strategies. The third section consists of five items related to stress symptoms, including fatigue, happiness, anxiety, depression, and strain, and each of the items are scored from 0 to 10, which means "not at all" to "extremely." Finally, the fourth part reviews sleep status, including sleep duration, problems (difficulty in falling asleep/getting up, awakenings at night), and use of sleep pills.

- Participants will also upload their exercise data from their wristbands to a research applications (app) on a daily basis. The research app records wristbands information related to exercise such as daily exercise time, consumed calorie, step counts, and also the wearing

Table 1. Online series of courses.

Time	Themes	Content
Week 1	Introduction	(1) Objectives of this program, (2) brief introduction of the constructive courses.
Week 2	Do you know about stress?	(1) Good stress and bad stress, (2) good way and bad way to cope with stress.
Week 3	Being aware of daily stress	(1) Common stress symptoms, (2) the potential mechanism of stress outcomes.
Week 4	Do you sleep well?	(1) The relationship between stress and sleep, (2) some tips about good sleep.
Week 5	Learn some stress management skills	(1) Physical exercise, deep breath practicing, mindfulness meditation, (2) regular exercise is important.
Week 6	Take a deep breath	(1) Why is deep breathing useful for controlling stress? (2) the right way to take deep breath.
Week 7	Practice mindfulness	(1) Why is mindfulness useful for controlling stress? (2) the right way to practice mindfulness.
Week 8	Do some physical activity	(1) Why is physical activity useful for controlling stress? (2) the right way to do exercise.
Week 9	Relax with a massage	(1) Why is massage useful for controlling stress? (2) differences between machine massage and manual massage.
Week 10	Nice music	(1) Why is music useful for controlling stress? (2) listen to music with mindfulness.
Week 11	Warm pets	(1) Why are pets useful for controlling stress? (2) try to treat yourself warmly just as the way you love pets.
Week 12	Speak out	(1) Why is sharing important for controlling stress? (2) try to speak out your challenges.

time. Each week, data from the wristbands and online questionnaires will be analyzed and then aggregated into a document for tailored feedback and possible individual coaching.

Personal contact with nurse coach

Besides sending tailored feedback messages, the nurse coach will also contact HCWs on a weekly basis to (1) ensure their proper use of portable device and continuous participation in the program; (2) discuss some issues regarding the stress management strategies practice performance and identify possible challenges and further give specific instructions; (3) support HCWs and encourage them to practice stress management strategies regularly during the intervention.

Control group

After enrollment, participants in the control group will receive an instructional brochure regarding stress and the three types of stress management strategies. They will also receive a wristband minimal instruction to ensure that they can use it correctly. After that, participants in

the control group will also be asked to fill out a brief online questionnaire every two weeks and upload their exercise data from the wristbands every week, aiming to monitor their practice progress. During this process, the control group will not receive any feedback or have any interaction with research team members. They will not be involved in any WeChat group to share their experience.

Outcomes

Primary outcomes

The primary outcome is an increase in the frequency of practice of recommended stress management strategies over the course of the 12-week intervention period. The practice will be assessed at baseline and every two weeks during the project. At each data collection point, participants will report the practice frequency for physical activities, deep breathing, and mindfulness meditation during the past two weeks. Success will be defined as the increase in practice frequency of the stress management strategies by at least 20% over 12 weeks, taking into account the three types of intervention combined. This percentage will be computed from questionnaire's responses in the last two

Table 2. Data collection protocols.

Time point	Allocation	Post-allocation			Check-out
	Baseline	Month 1	Month 2	Month 3	
Enrollment					
Demographic and medical information	x				
Participation administration form	x				
Eligibility screen	x				
Informed consent	x				
Allocation	x				
Interventions					
CIMI group					
Control group		←—————————→			
Assessment					
Stress management practice frequency[a]	x	x	x	x	x
Heart rate variability[b]	x				x
Perceived stress[b]	x				x
Mental distress[b]	x				x

Note: "x" refers to what is done in this period; CIMI: complex interactive multimodal intervention.
[a]Primary outcomes.
[b]Secondary outcomes.

weeks before the end of the study. For instance, if the HCW practices physical activity only, three times a week (six times over two weeks) at baseline; success will be considered if this person practice physical activity seven to eight times over two weeks at the end of the study, or if he/she starts a new practice of mindfulness or deep breathing one to two times per week, because the total number of practices will be three to four times a week (all stress management strategies combined). We expect the increase in stress management strategies practice in hospital-A HCWs to be at least 20% on average, and to be no more than 5% on average among hospital-B HCW.

Secondary outcomes

The secondary outcomes reflect the effectiveness of the intervention on stress outcomes by comparing changes in physical and psychological indicators between baseline and 12 weeks after enrollment.

- The psychological stress measures will be assessed by comparing changes of perceived stress scale (PSS) and DASS scores between baseline and 12-week after enrollment. The PSS is a widely used self-reported scale which consists of 14 items and two subscales: feelings of tension and perceived lack of control.[30] The PSS uses a 5-point Likert scale, and each item is scored from 0 to 4. The total score ranges from 0 to 56, with higher total scores indicating a higher level of stress. The DASS is a widely used instrument to assess the negative emotions of individuals during the past week, which includes 21 items and three subscales for depression, anxiety, and stress, and each item is rated on a 4-point Likert scale.[31] The sum score for each subscale is multiplied by 2 and ranges from 0 to 42, with a higher score representing greater emotional distress. We expect the stress scores on the different scales decreasing by 20% among hospital-A HCWs and no more than 5% on average among hospital-B HCWs.

- The physiological stress measures will be assessed by calculating changes of HRV parameters at the recruitment and the last day of 12-week intervention, with special focus on high frequency (HF) variability and normalized unit (HFnu) that represent the parasympathetic function. We expect HFnu value increasing by 20% on average among HCWs of hospital-A and no change among HCWs from hospital-B.

Sample size and power

Our study was designed as a 1:1 parallel controlled trial. We used an alpha of 0.05 and power $(1-\beta)$ of 0.80. For both the primary outcomes and the secondary outcomes, we expected the differences of changes between two groups would be 15%, therefore, we aim to include 98 participants in each hospital to produce a statistically relevant difference, with the effect size $d = 0.30$. Because group WeChat and interactions between HCWs in one hospital is part of the intervention, we did not adjust the sample size for hospital-clustering effects. Considering that approximately 50% of individuals can be included in the clinical trial following screening, approximately 392 individuals will need to be screened.

Statistical analysis

Baseline sample characteristics between the intervention group and the control group will be compared using the independent *t*-test for normally distributed continuous variables, Mann–Whitney *U*-test for non-normally distributed variables, and Chi-quest test for categorical variables.

The main analysis examining the changes in primary (practice frequency of stress management strategies) and secondary outcomes (HRV, PSS, and DASS scores) will be intention to treat using multilevel regression model (linear or Poisson regression, as appropriate), with time-point and intervention status as fixed effects. Covariates will include the stratification factors, which are stress levels, stress management behaviors, and locations. The logistic regression analysis will be used to identify factors associated with the success or failure of the interventions.

Discussion

Numerous stress management interventions have been implemented in different occupational populations. Most studies have emphasized the role of delivering knowledge and skills in stress management interventions, however, little research has focused on psychosocial factors associated with stress management strategies practice among participants.[32] As described by KT and SLT framework, human behavior depends not only on knowledge and skills, but also on the interaction between the individuals and the environment, and the support they receive, especially if it is personalized. Hence, we designed the CIMI to create a mutually interactive context that also offers constant support to HCWs during the course of the study, and further improve their awareness, knowledge, and skills of stress management; with an expected in-result to promote their stress management behaviors and improve their stress outcomes ultimately.

Because knowledge of stress management is important for behavior change, we will conduct stress management education through modern mobile technology to make it more convenient and flexible. The "education component" of CIMI will provide multiple opportunities to help HCWs gain knowledge and improve their stress management awareness. Material regarding stress and stress management will be available online, which means HCW can learn and practice stress management strategies anytime, anywhere, and further promote their awareness of stress management in daily life. In addition, constructive lectures by the professional physician will help HCWs gain a comprehensive understanding of the potential mechanistress management strategies of stress management to improve personal health, further enhancing their knowledge of stress management. In a word, we expect the mobile education will help persuade HCWs to adopt stress management strategies by increasing their personal awareness and knowledge of stress management.[33]

Besides, as mentioned in the KT and SLT frameworks, creating a supportive environment is critical to help individuals adopt the desired behaviors.[15,16] Previous studies have found that, by participating in web-based social networks, individuals can connect with group members and benefit more from the social support, social influence, and social comparison in the network.[31,34] Inspired by these findings, the study participants will be involved in weekly WeChat group discussions where they will have more chance to interact with other community members in a network of mutual influence. This community of practice model will enable observing and sharing learning experience, and also providing mutual support to enhance stress management skills.[35]

Furthermore, receiving personalized feed-back from the weekly questionnaires and also the sport wristband is another important element to motivate participation. The portable device will track the intervention change over time and boost participants' motivations and belief in growth.[36] Simultaneously, the nurse coach will also help sustain the positive attitude of stress management by boosting participants' self-efficacy and self-management skills.[37] By that way, we expect to promote HCWs' capacities and confidence to implement stress management strategies, and finally help them build stress management behaviors to cope with daily stress.

Despite the potential that these perspectives illustrate, the challenges faced by CIMI are substantial. Recruiting HCWs during a pandemic may be challenging, especially

in general hospitals where HCWs are exhausted by their heavy workload. We anticipate that our collaboration with employees' unions and the use of multiple recruiting strategies will facilitate on-site recruitment. Moreover, previous programs aimed at changing health behaviors report low adherence among stressed participants.[38] Our project may also experience a low engagement and a high risk of attrition unless we can find effective ways to incentivize participants to complete project follow-up. Last but not least, we recognize the possibility of communication between HCWs from the two hospitals. If it happens, it will only be verbal discussion as all educative material remains central, with protected access.

Even with above challenges, the CIMI still offers important contributions to both research and practice related to the stress management issues of HCWs. To the best of our knowledge, this is the first study that comprehensively considers the environmental, personal, and behavioral factors in stress management interventions. The CIMI builds on a body of work defining the role of web-based social interactions, mobile stress management education, tailored feedback, as well as social support intervention. Furthermore, the design of our protocol is based on KT and SLT frameworks, which will illustrate the mechanism of an interactive intervention with multiple components. In short, our protocol design may provide a basis for optimizing current stress management interventions and fill the gap between knowledge and practice of stress management among HCWs.

The present study has several limitations that need to be noted. Due to the fact that our study was quasi-experimental instead of a randomized controlled trial, our study result could be affected by selection bias and confounding variables. However, quasi-experimental study designs could be more practical, flexible, and realistic, especially in aim of exploring the efficacy of a novel intervention approach. Although we evaluate the outcomes before and after the 12-week intervention period, the current study lacks the long-term follow-up. It would be of worthy to perform post-intervention evaluations if CIMI is proven to be efficient, which requires additional designs. In the meanwhile, this current protocol was designed specifically for HCWs, it might to some extent limit the generalizability of the proposed interventions in other populations. However, we propose the protocol of CIMI could be applicable for stress management in other occupational populations with proper modifications.

Conclusion

Despite the fact that numerous interventions for stress management have been implemented in the workplace, few of them have been adapted for the healthcare setting. Our prior research uncovered a "knowledge-doing" gap among HCWs that prevented them from implementing

stress management strategies to combat daily stress. Consequently, by integrating the KT and SLT frameworks, we constructed an interactive context with multiple intervention components to improve HCWs' stress management behaviors and reduce their stress symptoms. The solid theoretical foundation and interactive intervention design will build on previous research delineating the role of individualized instruction and feedback intervention, as well as group intervention through the WeChat social network and personalized coaching. We believe that this innovative intervention will assist HCWs in enhancing their stress management awareness and abilities, thereby improving their long-term health.

Abbreviations

KT: knowledge translation; SLT: social learning theory; CIMI: complex interactive multimodal intervention; HCWs: healthcare workers; HRV: heart rate variability; PSS: Perceived Stress Scale; DASS: Depression, Axiety, and Stress Scale.

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