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Relationships between disaster nursing competence, anticipatory disaster stress and motivation for disaster engagement

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1. Introduction

Natural and man-made disasters are increasing in frequency and severity worldwide over the past decade. Examples of major disasters in Taiwan include the severe acute respiratory syndrome (SARS) outbreak in 2003, the Kaohsiung massive gas explosions in 2014, and the Taiwan Water Park Blast in 2015. These disasters have resulted in many injuries and fatalities, as well as economic losses, serious environmental disruption, and lasting psychological trauma among survivors [1,2]. According to the 2018 World Disasters Report [3], there were 3751 recorded disasters from 2008 to 2017, and 79.8% of these reported disasters occurred in Asian countries. Asians accounted for the largest number of people affected by these disasters. In fact, the percentage of disasters occurring in Asia was 37% in the 1998–2007 decade [3]. Likewise, the frequency and intensity of disaster events in Taiwan have noticeably increased in recent years. In 2016, the Center for Research on the Epidemiology of Disasters reported that Taiwan was one of the top 10 countries in terms of disaster mortality that year [4]. These statistics amplify the importance of sound disaster training and preparation so that nurses can respond effectively and appropriately during a disaster event in Taiwan.

In Taiwan, during disaster incidents, nurses are expected, with limited resources, to attend and work in chaotic disaster sites to quickly provide nursing care to a growing number of survivors. In light of this, issues about the current level of competence, skills, and experience in disaster preparedness and response among nurses have been valued and emphasized [5,6]. Studies focused on disaster nursing in Taiwan and other countries revealed that existing preparedness for and competence in disaster response among hospital personnel including nurses is less than optimal [7–9] and is often fragmented, or not available at all [5]. Moreover, they may not be ready to face future disasters because of an inadequate disaster competence such as a lack of awareness of the roles and skills needed when encountering disaster events [10–15].

High levels of psychological and emotional stress are frequently reported in emergency or disaster responders [16,17]. Studies found that nurses felt psychologically unprepared when asked to engage in disaster...
events [18,19] because the events might exceed their capacity to function well, or they worried about their personal loss or their families’ welfare during disaster relief [17,20]. Additionally, nurses had less desire to report to work during an emergency or disaster event, although most strongly believed that they are responsible for working during such situations [13,21]. Moreover, few nurses were motivated to engage in practical preparation and obtain the experience required to deploy in response to a disaster event [6,10]. In one study, some nurses openly commented that they were frustrated and were not motivated to engage in disaster trainings because of their heavy workloads and lack of time for attending educational programs [20]. Yet, other surveys reported that many hospitals or service organizations do not frequently conduct exercises to determine their level of preparedness for disaster management, which may be due to the economic burden of undergoing training exercises [22]. Therefore, it is critical to understand how to help disaster nurses overcome personal stress and assist others, such as colleagues and survivors, to effectively cope with stress as well [16].

Nurses are the largest group among the healthcare provider workforce and play an important role during the emergent phase of a disaster and throughout the phases of disaster preparedness and recovery [23]. Therefore, disaster competence and preparedness among nurses is necessary to effectively manage unpredictable events. However, the exploration of nurses’ perspectives on disaster nursing remains limited in Taiwan. Therefore, the purposes of the study were to determine the level of and relationships between Taiwanese nurses’ disaster competence, anticipatory disaster stress, and motivation for disaster engagement.

2. Methods

2.1. Study framework

The motivation for engagement in disaster events can be explained by the Self-Determination Theory developed by Deci and Ryan [24]. The theory suggests that people are often moved to act by two types of motivation: intrinsic or extrinsic. The theory also proposes that three basic psychological needs—competence, autonomy, and relatedness—are important for self-growth and must be met for healthy functioning, promoting intrinsic motivation, engagement behavior, and maintaining motivation over a period of time [24,25]. Competence refers to the mastery of experiences in the practical world. An individual’s perceived competence can enhance their motivation for an action only when it is accompanied by a sense of autonomy and relatedness within an organization [26].

In addition to the psychological needs that influence motivation, personnel involved in disaster events are prone to experiencing psychological problems and distress [16]. For nurses, psychological distress may affect their commitment to attend or remain at a disaster situation site [17,27,28]. Therefore, we proposed that anticipatory disaster stress and disaster competence are factors in nurses’ motivation to engage in disaster events.

2.2. Study design, settings, and participants

This study used a cross-sectional design to understand factors related to nurses’ motivation to engage in disaster events. Using convenience sampling, nurses who: (a) had a registered nursing license; (b) were employed full-time by hospitals for more than one year; and (c) were willing to sign an agreement to complete questionnaires; were invited to participate in the study. Before data collection, the sample size was calculated using G*Power (version 3.0) with two-tailed, a level of 0.05, and an estimation that the effect size for correlation between measured variables was at least medium (r = .3). Eighty-eight participants were needed to achieve a power of .80. More nurses were invited to participate in the study because of possible incompletion rates. 102 nurses distributed over eight hospitals in southern Taiwan responded to our invitation to participate in the study. Ninety nurses returned completed questionnaires with an 88.24% response rate.

2.3. Data collection

The study was approved by the institutional review board (IRB 201509382B0) before recruitment began. A packet containing a cover letter, questionnaires, informed consent, and two addressed-and-stamped envelopes were mailed to nurses who were interested in participating in the study. The cover letter described the purposes of the study, the participants’ rights and confidentiality. They could complete the study surveys at any place they felt comfortable with. They could decline or stop participation in the study whenever they felt uncomfortable. Participants were asked to send back the signed informed consent and questionnaires separately by using the two addressed-and-stamped envelopes if they agreed to participate in the study. On average, surveys were completed in less than 20 min. Data were collected between August and December of 2017. There was no disaster in Taiwan or any neighboring countries that might have influenced the participants’ responses during the data collection period.

2.4. Study instruments

Demographic survey. We designed the participant information sheet based on the Self-Determination Theory that individual differences are important factors that may influence individuals’ motivation to engage in actions. In this study, individual differences are defined as a nurse’s personal characteristics that may influence their preparedness and motivation to engage in disaster events, such as gender, age, seniority in the hospital, educational level, hospital type, work unit, and job title.

The Disaster Nursing Competence Questionnaire (DNCQ). The DNCQ developed by the research team, based on a literature review, contains 37 items used to measure nurses’ perceived competence level when responding to disaster events. On a 5-point Likert scale ranging from 1 (not familiar) to 5 (very familiar), a higher score indicates a higher level of disaster nursing competence. In the study, Cronbach’s alpha for the DNCQ was 0.96. The principal component analysis for the validity showed that 78.19% of the variance of the disaster nursing competence could be explained by the DNCQ.

The Anticipatory Disaster Stress Questionnaire (ADSQ). The Anticipatory Disaster Stress Questionnaire was developed by the research team according to literature reviews and consists of 24 items used to measure nurses’ anticipation of stressors when encountering disaster events. Using a 5-point Likert scale scored from 1 (strongly disagree) to 5 (strongly agree), a higher score indicates greater perceived stress while facing disaster events. In the study, Cronbach’s alpha for the ADSQ was 0.75. The principal component analysis showed that 47.34% of the variance of the anticipatory disaster stress could be explained by the ADSQ.

The Motivation for Disaster Engagement Questionnaire (MDEQ). The MDEQ, developed by the research team, was used to measure nurses’ motivation to engage in disaster events or preparedness activities. With three items on a five-point Likert scale (ranging from 1 to 5), a higher score indicates a higher level of motivation to participate in disaster events. In this study, Cronbach’s alpha for the MDEQ was 0.85. Principal component analysis showed that 76.68% of the variance of the motivation in disaster engagement could be explained by the MDEQ.

2.5. Data analysis

Data were analyzed with the use of SPSS version 23.0. Demographic information, levels of disaster competence, anticipatory disaster stress, and motivation for engagement in a disaster event were analyzed with descriptive statistics such as frequency, mean, and standard deviation. Before inferential analyses of the data, the normality of all variables was examined using the Shapiro-Wilk test. Results showed that the DNCQ...
and ADSQ were normally distributed, whereas MDEQ was not normally distributed. Relationships between measured variables were examined using the Pearson correlation when the variables were normally distributed, and the Spearman correlation was used when variables were not normally distributed. The reliability of the scales was tested using Cronbach’s alpha coefficients, and the validity was tested with principal component analysis. Hierarchical regression was applied to understand the predicting relationship of individual differences, disaster competence, and anticipatory stress on motivation for engagement in disaster events.

3. Results

3.1. Descriptive results

The mean age of the nurses was 31.46 (SD = 7.19) years. On average, they worked 114.44 months (9.54 years, SD = 86.54) as a nurse and 93.49 months (7.79 years, SD = 80.41) in their current hospital. Most participants were females (85.6%). While 28.9% of them had an associate’s degree, 68.9% had a bachelor’s degree (25.6% were in the four-year bachelor program and 43.3% were in the two-year RN-BSN program), and 2.2% had a master’s degree. Seventy-eight nurses worked as registered nurses (77.8%) or nurse specialists (12.2%), and 85.6% worked in the emergency room (ER) or intensive care unit (ICU) in non-medical centers or regional hospitals (82.2%). Over the past 3 years, more than half of nurses attended either in-service education or conferences about disaster nursing (61.1%) and attended disaster practices held by their hospital (82.2%). Most hospitals where the participants worked held massive disaster courses (87.8%) and practices (90.0%) every year. Only 26.7% of the participants had attended a disaster field rescue; 48.9% had attended disaster management at their hospital; and only 5.6% had attended care management of disaster afterhours. More than half of the participants agreed (38.9%) or strongly agreed (14.4%) to join a hospital disaster rescue if they were asked, while 37.8% disagreed and 7.8% strongly disagreed to join a disaster rescue.

3.2. Relationships between measured variables and differences in measured variables by demographic variables

The levels of disaster nursing competence, anticipatory disaster stress, and motivation of disaster engagement among participants were presented in Table 1. The MDEQ, DNCQ, and ADSQ were significantly inter-correlated (r ranged from 0.31 to 0.34). The DNCQ was correlated with a greater number of times attending onsite practices, number of times attending in-service education or conferences about disaster nursing, number of times participating in care management of disaster afterhours and stress of managing a disaster in hospital. The ADSQ was correlated with the number of times attaining onsite practices held by hospital in the past 3 years, number of times attending in-service education or conferences about disaster nursing and the stress caused by managing a disaster in hospital. The MDEQ was correlated with the number of times attending in-service education or conferences about disaster nursing and the stress caused by managing a disaster in hospital. However, effect sizes of all these correlations were low to moderate.

Most of the demographic variables had no statistically significant impact on nurses’ disaster competence, anticipatory disaster stress, or their motivation for disaster engagement. As shown in Table 2, participants who attended the in-service education or conferences about disaster nursing in the past 3 years had higher scores on the DNCQ. Participants who completed graduate school had lower scores on the ADSQ compared to those with an associate’s or bachelor’s degree. Those who were more willing to join hospital disaster rescues had higher levels of ADSQ and MDEQ than those who were less willing to participate. Those who had never attended care management of disaster afterhours had higher scores on the MDEQ.

3.3. Predictive relationship of the DNCQ and ADSQ with MDEQ

Because the number of times attending in-service education/conferences and stress caused by managing a disaster in hospital were correlated with the MDEQ, and the MDEQ differed by whether nurses attended care management of disaster afterhours beforehand and their willingness to join hospital disaster rescues, these four variables were entered in the first set of regression analysis. As shown in Table 3, regression analysis showed that attendance of disaster aftercare management was included in the model and 35% of the variance of the MDEQ could be explained ($F = 4.38$, $p < .001$).

4. Discussion

This study aimed to explore the relationships between disaster competence, anticipatory disaster stress, and motivation for disaster engagement among hospital nurses in Taiwan. In addition, the factors associated with the motivation for engagement in disaster events among nurses were identified.

We found that hospital nurses’ level of disaster competence was not high. Our findings were similar to previous studies that reported a low level of self-reported familiarity with preparedness among nurses for large-scale emergency or disaster events [12,29,30]. This finding implies that most hospital nurses may not be ready or confident in their abilities to respond to disaster events. Contrary to prior studies which revealed that work unit or specialty, work experiences, educational level, and gender were associated with disaster competence [31,32], our analysis did not support such findings. Rather, we found that nurses who exhibited higher competence had attended in-service education or conferences about disaster nursing. Interestingly, most hospitals held massive disaster courses or practices every year; however, nurses’ attendance rates to these educational offerings were not high. In addition, although the participation rates of field drills were high, nurses did not perceive that they were competent in disaster management. This situation is similar to Williams et al.’s article which reviewed 258 studies and found that the effects of disaster training on health care workers’ knowledge and skills in disaster response were inconclusive. The authors suggested that hospitals should urgently examine and find the most appropriate methods for disaster preparedness practices for nurses in order to augment the authentic efficiency of the training [2].

The psychosocial problems faced by nurses involved in disaster events are of much concern. Researchers indicated that nurses may be unprepared educationally and psychologically for disaster relief [33]. One study that was conducted to determine the international research priorities for disaster nursing found that psychosocial aspects ranked the highest [34]. However, in our study, the level of anticipatory disaster stress was not high. This finding is different from prior concerns that

Table 1
Levels of measured variables and their correlations with demographic variables.

|              | DNCQ   | ADSQ   | MDEQ   |
|--------------|--------|--------|--------|
| DNCQ         | 1.00   |        |        |
| ADSQ         | .31*   | 1.00   |        |
| MDEQ         | .33*   | .34*   | 1.00   |
| Times attending onsite practice | .31*   | .11    | .06    |
| Times attending onsite practice held by hospital in 3 years | .05    | .22*   | .04    |
| Times attending in-service education/conference | .35*   | .24*   | .25*   |
| Times of providing care management of disaster aftermath | .22*   | .09    | .03    |
| Stress of managing a disaster in hospital | .29*   | .38**  | .21*   |
| M±SD         | 119.92± | 78.42± | 11.48± |

The MDEQ was used to measure motivation of disaster engagement, ADSQ was for anticipatory disaster stress, and DNCQ was for disaster nursing competence. *p < .05, **p < .001 (two-tailed).
nurses often reported that disaster events exceeded their ability to function and caused imbalances between professional duties and personal stress, such as their families’ safety and personal loss [17,20,35]. Since most nurses in our study did not have any experience in disaster field rescue and also did not attend disaster management at their hospital, it may be hard for them to imagine how stressful it would be to participate in a real disaster management situation. This may be the reason for the finding of a low level of anticipatory disaster stress. Additionally, although the level of anticipatory disaster stress was not high, only 53.3% of nurses agreed or strongly agreed to join the hospital’s disaster rescue when they were asked to do so. Further analysis found that the participants who strongly agreed to join a hospital disaster rescue had significantly higher stress levels than nurses who did not agree to participate in a disaster relief. Somehow, anticipatory disaster stress existed, but only for nurses who have motivation to attend disaster events in the future.

In the study, the degree of nurses’ motivation for disaster engagement was not high. The results correspond to the earlier studies, which

Table 2 (continued)

| Gender | M ± SD | t or F/p | M ± SD | t or F/p | M ± SD | t or F/p |
|--------|--------|----------|--------|----------|--------|----------|
| Female | 120.60 | ± 19.93  | 78.65  | ± 5.74  | 11.38  | ± 1.80  |
| Male   | 115.92 | ± 20.84  | 77.08  | ± 8.94  | 12.08  | ± 1.94  |

| Educational level | M ± SD | t or F/p | M ± SD | t or F/p | M ± SD | t or F/p |
|-------------------|--------|----------|--------|----------|--------|----------|
| 1. Associate   | 117.31 | ± 22.33  | 77.19  | ± 5.56  | 1.59   | ± 1.23  |
| 2. Four Year    | 125.57 | ± 18.73  | 80.70  | ± 6.16  | 1.90   | ± 1.76  |
| 3. Two Year     | 119.59 | ± 18.73  | 78.59  | ± 6.16  | 1.90   | ± 1.76  |
| (bachelor)      |        |          |        |          |        |          |
| 4. Graduate     | 118.50 | ± 2.12   | 65.00  | ± 3.41  | 12.50  | ± 3.54  |

| Hospital type | M ± SD | t or F/p | M ± SD | t or F/p | M ± SD | t or F/p |
|---------------|--------|----------|--------|----------|--------|----------|
| Non-medical   | 119.07 | ± 20.07  | 78.22  | ± 6.14  | 1.47   | ± 1.76  |
| center        |        |          |        |          |        |          |
| Medical       | 126.57 | ± 18.93  | 80.57  | ± 6.26  | 2.23   | ± 2.87  |
| center        |        |          |        |          |        |          |
| Job title     | 1.79/75| ± .003/21| 5.02/37| ± .40/64| 1.56/70| ± .21/45|
| Registered    | 118.50 | ± 20.01  | 78.10  | ± 5.26  | 1.28   | ± 1.78  |
| nurse         |        |          |        |          |        |          |
| Nursing       | 117.75 | ± 23.30  | 82.25  | ± 5.55  | 1.28   | ± 1.76  |
| administrator |        |          |        |          |        |          |
| Nurse         | 130.55 | ± 16.74  | 78.82  | ± 6.26  | 2.07   | ± 2.23  |
| specialist    |        |          |        |          |        |          |
| Work unit     | 17.89/49| ± .40/.05| 77.47/61| ± .09/34| 1.09/34| ± .34/10 |
| Medical       | 123.80 | ± 26.89  | 79.40  | ± 5.26  | 1.52   | ± 1.52  |
| surgical      |        |          |        |          |        |          |
| Emergency/    | 120.10 | ± 20.26  | 78.45  | ± 5.91  | 1.86   | ± 1.86  |
| Intensive     |        |          |        |          |        |          |
| Care          | 110.67 | ± 11.48  | 75.33  | ± 5.80  | 1.03   | ± 1.03  |
| Others        |        |          |        |          |        |          |
| Hospital held | -1.05/30| ± .29/10 | -1.65/60| ± .59/34| -1.65/60| ± .10/10 |
| massive       |        |          |        |          |        |          |
| disaster      |        |          |        |          |        |          |
| disaster      |        |          |        |          |        |          |
| rescue        |        |          |        |          |        |          |
| No            | 114.00 | ± 17.19  | 76.55  | ± 3.78  | 10.64  | ± 1.29  |
| Yes           | 120.75 | ± 20.33  | 78.68  | ± 6.51  | 11.59  | ± 1.86  |

| Hospital held | -1.42/16| ± .60/55 | -1.41/16| ± .60/55 | -1.41/16| ± .60/55 |
| massive       |        |          |        |          |        |          |
| disaster      |        |          |        |          |        |          |
| practice       |        |          |        |          |        |          |
| every year    |        |          |        |          |        |          |
| No            | 111.00 | ± 20.51  | 77.22  | ± 3.67  | 10.67  | ± 1.41  |
| Yes           | 120.91 | ± 19.84  | 78.56  | ± 6.49  | 11.57  | ± 1.85  |

| Attend in-service education/conferences in the past 3 years | M ± SD | t or F/p | M ± SD | t or F/p | M ± SD | t or F/p |
|------------------------------------------------------------|--------|----------|--------|----------|--------|----------|
| No             | 113.36 | ± 20.97  | 78.03  | ± 6.37  | 11.12  | ± 1.80  |
| Yes            |        |          |        |          |        |          |

DNCQ = Disaster Nursing Competence Questionnaire; ADSQ = Anticipatory Disaster Stress Questionnaire; MDEQ = Motivation for Disaster Engagement Questionnaire.

Brown Forsythe analysis was used.
indicated that few nurses intended to report for work during disasters [13,35,36]; moreover, few nurses have the motivation to engage in practical preparation and obtain experiences in response to a disaster event [6]. Specifically, we found that nurses who had attended care management of disaster aftermaths had lower motivation for disaster engagement. The fear of being incapable of managing disaster aftermaths and the worry that no one can take care of their family or children when they cannot get out of their duty might have made them reluctant to attend field rescue or care management of disaster aftermaths [17, 35]. Former surveys reported that nurses did not feel supported or motivated to engage in disaster preparedness because of their heavy workloads, and the hospitals in which they were employed did not regularly conduct exercises to prepare them for disaster management [8, 16,22]. Although hospitals in Taiwan held disaster education or practice every year, nurses reported being physically and mentally exhausted by their heavy daily workload on top of having difficulty in finding the time to participate in educational programs that were not directly work-related. Therefore, as shown by a previous study that showed a perceived well-ordered organizational climate can arouse individuals’ motivation and consequently cause emergent behaviors [37], a perception of being supported by the work environment is a meaningful motivational factor in healthcare workers’ decision to work during a disaster.

Interestingly, the study found that nurses who were more competent in disaster nursing felt more stress. This situation might be because nurses may believe that they will never be competent enough when facing an unpredictable disaster. Additionally, disaster competence and anticipatory disaster stress were significantly and positively correlated with nurses’ motivation to engage in disaster events. However, both disaster competence and anticipatory disaster stress could not predict motivation to engage in disaster events. The Self-Determination Theory proposes that competence is one of the significant factors influencing individuals’ motivation in engagement behaviors [25]. And, other studies pointed out that individuals would move toward activities and take on responsibilities or challenges when they felt more confident in their disaster competence and knowledge [13,24,38,39]. In our study, nurses’ did not perceive high level of disaster competence and therefore might not be motivated to participate in disaster management.

5. Limitations

The sampling method in the study is convenience sampling. Participants were only invited from eight regional hospitals in southern Taiwan. These reasons may have caused a selection bias in sampling. In addition, 85.6% of our participants were emergency or intensive care nurses although they might be the first line nurses to manage disaster events. Therefore, the generalizability of the study findings to all Taiwanese nurses is limited. Because the study used a cross-sectional design, the findings cannot establish a causal relationship between variables.

6. Recommendations

The findings of this study contribute to the body of knowledge regarding motivation for disaster engagement among hospital nurses and furnish implications for nursing administration, practice, education and research. We have recommendations for policy, research, practice and education.

6.1. Implications for policy and research

The study indicated that the rates of attending in-service education, disaster field rescue, and care management of disaster aftermaths among hospital nurses were not high. Nurses’ disaster competence and motivation for disaster engagement were not high as well. These findings highlight the necessity of further research to explore nurses’ concerns and needs in-depth when they participate in disaster-related activities. The results of the further research can offer information for healthcare administrators to make more practical policies to enhance nurses’ disaster competence and further increase nurses’ motivation to participate in these activities.

6.2. Implications for nursing practice

The study found that even though hospitals held disaster courses and trainings every year, nurses had a worryingly low level of disaster competence, which correlated with their low motivation to participate in disaster rescue. Providing realistic disaster training using simulations, tabletop exercises [40,41], and virtual reality/augmented reality/mixed reality exercises may improve individuals’ interests and understanding about disaster situations and disaster knowledge and skills. This would further increase nurses’ confidence in disaster management.

6.3. Implications for nursing education

The insufficiency of disaster competence among nurses revealed in the study emphasizes the important role of nursing educators in preparing nursing students with the knowledge and skills for disaster management. Disaster nursing is a generally neglected topic in nursing education. In most nursing schools in Taiwan, disaster nursing is taught as one or two units in courses of Public Health Nursing (required course) or Emergency Nursing (elective course). It is urgent for nursing schools to develop a stand-alone disaster course for both undergraduate and graduate programs to increase nurses’ awareness of disaster and prepare

### Table 3

Predictive relationship of DNCQ and ADSQ with MDEQ.

| Step 1 | Step 2 |
|--------|--------|
|        |        |
| Constant |        |
| Times of attending in-service education/conferences |        |
| Stress of managing disaster in hospital |        |
| Attended care management of disaster aftermaths |        |
| Willingness to join hospital disaster rescue |        |
| DNCQ |        |
| ADSQ |        |
| \( R^2 \) | .30 |
| \( F \) | 5.62** |
| \( \Delta R^2 \) | .35 |
| \( \Delta F \) | 4.38** |
| \( \Delta F \) | .04 |
| \( \Delta F \) | .64 |

DNCQ = Disaster Nursing Competence Questionnaire; ADSQ = Anticipatory Disaster Stress Questionnaire; MDEQ = Motivation for Disaster Engagement Questionnaire.

\( * * p < .001 \) (two-tailed).
for future nurses who are competence in disaster management.

7. Conclusion

This study sheds some light to provide a better understanding that the degree of disaster competence may impact the motivation for disaster engagement among hospital nurses in Taiwan. It appears that disaster competence and stress play an important role for nurses when encountering disaster. This situation should alert hospital administrators to reexamine the appropriateness of their training programs and their nurses’ needs when it comes to training for disaster preparedness. Stress management and counseling programs also need to be provided. The best and suitable methods for disaster practice to augment the authentic efficiency of training and to promote nurses’ motivation for disaster engagement should be further explored and developed.

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Declaration of competing interest

No conflict of interest has been declared by the authors.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijidrr.2020.101545.

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