



UNIVERSITY OF LEEDS

This is a repository copy of *A Daily Diary Approach to the Examination of Chronic Stress, Daily Hassles and Safety Perceptions in Hospital Nursing*.

White Rose Research Online URL for this paper:  
<http://eprints.whiterose.ac.uk/116850/>

Version: Accepted Version

---

**Article:**

Louch, G, O'Hara, J [orcid.org/0000-0001-5551-9975](https://orcid.org/0000-0001-5551-9975), Gardner, P  
[orcid.org/0000-0002-8799-0443](https://orcid.org/0000-0002-8799-0443) et al. (1 more author) (2017) A Daily Diary Approach to the Examination of Chronic Stress, Daily Hassles and Safety Perceptions in Hospital Nursing. *International Journal of Behavioral Medicine*, 24 (6). pp. 946-956. ISSN 1070-5503

<https://doi.org/10.1007/s12529-017-9655-2>

---

© International Society of Behavioral Medicine 2017. This is an author produced version of a paper published in *International Journal of Behavioral Medicine*. The final publication is available at Springer via <https://doi.org/10.1007/s12529-017-9655-2>. Uploaded in accordance with the publisher's self-archiving policy.

**Reuse**

Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

**Takedown**

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing [eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk) including the URL of the record and the reason for the withdrawal request.



[eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk)  
<https://eprints.whiterose.ac.uk/>

**A daily diary approach to the examination of chronic stress, daily hassles and safety  
perceptions in hospital nursing**

**In press**

***International Journal of Behavioral Medicine***

Gemma Louch<sup>1</sup>, Jane O'Hara<sup>1,2</sup>, Peter Gardner<sup>3</sup>, Daryl B. O'Connor<sup>3</sup>

<sup>1</sup> *Bradford Institute for Health Research, Bradford Royal Infirmary, Bradford, BD9 6RJ, UK*

<sup>2</sup> *Leeds Institute of Medical Education, University of Leeds, Leeds, LS2 9JT, UK*

<sup>3</sup> *School of Psychology, University of Leeds, Leeds, LS2 9JT, UK*

Accepted 25/05/17

\*Correspondence to: Gemma Louch, Bradford Institute for Health Research, Bradford Royal Infirmary, Duckworth Lane, Bradford, BD9 6RJ, UK; [Gemma.Louch@bthft.nhs.uk](mailto:Gemma.Louch@bthft.nhs.uk)

**ABSTRACT**

**Purpose**

Stress is a significant concern for individuals and organisations. Few studies have explored stress, burnout and patient safety in hospital nursing on a daily basis at the individual level. This study aimed to examine the effects of chronic stress and daily hassles on safety perceptions, the effect of chronic stress on daily hassles experienced, and chronic stress as a potential moderator.

## **Methods**

Utilising a daily diary design, 83 UK hospital nurses completed three end of shift diaries, yielding 324 person days. Hassles, safety perceptions and workplace cognitive failure were measured daily, and a baseline questionnaire included a measure of chronic stress. Hierarchical multivariate linear modelling was used to analyse the data.

## **Results**

Higher chronic stress was associated with more daily hassles, poorer perceptions of safety, being less able to practise safely, but not more workplace cognitive failure. Reporting more daily hassles was associated with poorer perceptions of safety, being less able to practise safely and more workplace cognitive failure. Chronic stress did not moderate daily associations. The hassles reported illustrate the wide-ranging hassles nurses experienced.

## **Conclusion**

The findings demonstrate in addition to chronic stress, the importance of daily hassles for nurses' perceptions of safety, and the hassles experienced by hospital nurses on a daily basis. Nurses' perceive chronic stress and daily hassles to contribute to their perceptions of safety. Measuring the number of daily hassles experienced could proactively highlight when patient safety threats may arise, and as a result interventions could usefully focus on the management of daily hassles.

**Keywords:** Nursing; chronic stress; patient safety; daily hassles; diary methods

## **INTRODUCTION**

### **Consequences of stress in nursing**

Within nursing, the consequences of stress are a significant concern for the individual and the organisation [1, 2]. The workload and demands placed on nurses are ever increasing [3, 4] and healthcare organisations are under rising pressure [5, 6]. High workloads and inadequate staffing are challenges for hospital nursing workforces internationally [7-9], with these issues recognised as important job related stressors within hospital nursing [10-12].

Research has extensively documented associations between stress and poorer physical and psychological health in nurses [13-15], and stress in nursing has been shown to impact on healthcare organisations in terms of sickness absence [16, 17], intention to leave and turnover rates [18-21]. Added to this, associations between nurse stress and job performance [22-24], quality of care [25, 26] and patient safety [27, 28] have been established. Yet despite this evidence base, it is recognised that further work is needed to improve our understanding of the effects of stress (and burnout) on patient safety in nursing [29, 30].

### **Contribution of the research**

Much of the research exploring stress, burnout and patient safety in hospital nursing has used cross-sectional methods, often examining between-person relationships [e.g., 31-33], so there is little evidence in terms of how these relationships play out on a daily basis for individual nurses. Nonetheless, a small number of studies have utilised a within-person approach, for example, one such study found work stressors (e.g., time pressure) which were observer-rated, to predict safety-related event characteristics [34].

One of the main contributions of our research is the novel within-person approach in the form of an online daily diary design. The advantages of this approach include reduced bias as a result of retrospective recall [35-37] and the associated data analyses—multi-level modelling, which allow phenomena to be explored at different levels of analysis simultaneously [38]. This is important, as we know that concentrating on differences at the average group level might not reflect the direction and nature of individual level associations [35].

People may appraise and perceive stress differently, and respond to the demands of stress in different ways. Therefore, by taking a daily diary approach to assess 'perceptions' of daily hassles, we are attempting to capture these differences at the individual level, albeit via self-report. We utilised self-report measures of safety as associations between measures of 'perceptions' of safety (i.e., safety culture) and more objective indicators of safety have been established previously [39-41].

Recognising that work life is not independent of lives outside of work, the approach taken in this study was to consider stress in a more global sense focusing on chronic stress and daily hassle experiences as opposed to work specific/occupational stress. Chronic stress has been described as the result of an imbalance with respect to personal traits, resources and the demands on a person by occupational and social situations [42]. Increasingly attempts to understand the influence of psychosocial stressors have examined the experience of minor events or daily hassles [e.g., 43-45]. Furthermore, a study conducted outside of a healthcare context focussing on psychological distress found measures of chronic stressors to be associated with more daily hassle reports [46]. The authors of this study however, suggested that although they share a common context, daily hassles and chronic stressors have a different aetiology, and their findings supported the rationale for measuring chronic stressors as distinct from daily hassles. Therefore, in addition to assessing levels of chronic stress, the current study aims to make a novel contribution to the literature by including a measure of daily stress together with a measure of chronic stress.

Moreover, in addition to an over reliance on cross-sectional methods, research is lacking which examines the effects of stress on patient safety in a UK context. The UK healthcare economy context is different to other post-industrialized countries in that the National Health Service (NHS) in the UK is free at the point of use. This differs to other countries such as the USA where a considerable amount of the previous research on stress and patient safety in hospital nursing has been conducted. Therefore, we sought to add to the literature in a number of ways by exploring associations between stress and patient

safety outcomes in a UK sample, taking a within-person approach in the form of an online daily diary design.

### **Theoretical framework**

Although we were not aiming to examine specific theory constructs, the study was underpinned by Reason's systems approach [47]. The systems approach postulates that error occurs due to an interaction between system-based organisational weaknesses (referred to as latent conditions e.g., staffing management) and the unsafe acts by individuals who have contact directly with the system or patient (referred to as active failures e.g., slips, lapses, mistakes). There are many reasons why we might expect nurses reporting higher levels of chronic stress and nurses who report more daily hassle experiences, to also perceive patient safety less favourably. For one, stress can affect cognitive performance [48], working memory task performance and cognitive flexibility [49] and decision-making [50]. As a result, when experiencing stress, nurses may not be able to perform as effectively, due to a diminished cognitive capacity. Workplace cognitive failure refers to motor function, memory and perception failures [51], and there is evidence of an association between patient safety incidents and workplace cognitive failure in nursing [52]. Therefore, in this study we also measured workplace cognitive failure as a daily level outcome. For nurses who report higher levels of chronic stress and/or report more daily hassle experiences the incidence of unsafe acts occurring as a result of poor local conditions (e.g., high workload) may be exacerbated due to impaired cognitive performance, potentially leading to patient safety threats arising.

### **Research questions**

To summarise, taking an end of shift diary approach, this study aimed to examine the effects of chronic stress and daily hassle experiences on safety perceptions and the effect of chronic stress on daily hassles experiences. We were also interested in whether there is an increased vulnerability to experience more daily hassles when chronic stress is high; and if so, does this increased vulnerability impact on the daily associations between hassle

experiences and perceptions of safety. Therefore, the potential moderating effects of chronic stress on hassle–safety perception relationships were examined.

Specifically, we addressed the following research questions:

- 1) Are higher ratings of chronic stress related to nurses' daily safety perceptions (poorer perceptions of safety at the level of the individual and work area/unit, and increased workplace cognitive failure)?
- 2) Are more daily hassle experiences related to nurses' daily safety perceptions (poorer perceptions of safety at the level of the individual and work area/unit, and increased workplace cognitive failure)?
- 3) Do nurses who report higher ratings of chronic stress, also report more daily hassle experiences?
- 4) Does chronic stress moderate associations between hassle experiences and the safety perceptions of nurses at the daily level (i.e., are these relationships more pronounced in nurses who report higher ratings of chronic stress)?

## **METHODS AND MATERIALS**

This paper draws on data from a wider study that measured other variables not reported here. Fuller details of the study method including more information pertaining to participants, design, procedure and analysis have been published previously [53].

### **Participants**

We recruited UK hospital nurses from three NHS Trusts (n=95) to complete pre-diary surveys between March and July 2013. Following this, 77 nurses returned a minimum of three end of shift diary entries, 83 returned two diaries and 89 returned one diary. The baseline sample had a mean age of 36.74 years, 91% of the participants were female and the mean length of time qualified was 11.72 years. In terms of clinical areas, surgery (22.1%), medicine (22.1%), paediatrics (12.6%), intensive care (9.5%) and emergency department (8.4%) were most common.

## Design

Participants completed an online pre-diary survey and a series of online end of shift diaries (interval-contingent approach). NHS governance approvals were obtained, and ethical approval was granted by the University of Leeds, School of Psychology Ethics Committee (ref 13-0029).

## Procedure

The study information including the web address to sign up to take part was circulated to ward areas and distributed via email. At the study sign up stage participants completed the online pre-diary survey and indicated for the following two-week period the dates, start and finish times for when they would complete the end of shift diaries, participants were asked to complete a minimum of three (consecutive) diary entries. It is possible that some nurses had more complicated shift patterns which although were consecutive shifts, were not on consecutive days<sup>1</sup>. Participants received automatic emails (and text messages if desired) at the end of the shifts with the web-link to complete the diary entries. The time stamps for each entry were checked to ensure they were completed within an acceptable time frame after a shift ended (four hours). To encourage participation a £10 shopping voucher was offered.

## Measures

### *Pre-diary survey*

The survey collected information about: gender, length of time as a fully qualified nurse and age. *Chronic stress* was measured using the 12-item screening scale from the Trier Inventory for Chronic Stress [54]. This questionnaire assesses chronic stress non-specifically and globally and has previously demonstrated favourable psychometric properties [55, 56]. The scale contains items pertaining to five different types of stress: chronic anxiety; work-related and social overload; overextension and lack of social recognition. Participants indicated how often a series of descriptions of situations and

---

<sup>1</sup> 39.8% of participants completed five diaries, 18.1% completed four diaries, 34.9% completed three diaries, and 7.2% completed two diaries; 83.6% of the diaries were completed on weekday.

experiences had happened to them on a 5-point scale (ranging from 0 = never to 4 = very often) over the previous six months. Higher ratings indicated that a participant was more chronically stressed ( $\alpha = .92$ )<sup>2</sup>.

#### *End of shift daily measures*

Participants were asked to report at the end of each shift any hassles they experienced in an open response format [44]. *Daily hassles* were defined as ‘events, thoughts or situations which, when they occur, produce negative feelings such as annoyance, irritation, worry or frustration and/or make you aware that your goals and plans will be more difficult to achieve’. The time of each hassle was recorded together with its perceived intensity on a scale ranging from ‘not stressful’ (0) to ‘very stressful’ (4). Nurses from a range of clinical areas and levels of seniority who attended a feasibility focus group to discuss the study measures highlighted that hassles occurring out of work could still affect performance on a shift. Therefore, the measure was amended to capture not only hassles that *occurred* on a shift, but also hassles that *affected* participants on a shift. The results for ‘total number’ and the ‘total intensity’ of hassles were very similar, for that reason, only the results for the total number of hassles are reported. Hassles reports were categorised by one researcher (GL), and for reliability purposes 10% of the reports were coded by a second researcher (JOH) demonstrating strong agreement between the researchers (percentage agreement ranged from 85.7-100%)<sup>3</sup>.

*Perceptions of patient safety* were measured in relation to ‘this shift’ using four-items the Hospital Survey on Patient Safety Culture (HSOPC) [57], which has shown favourable psychometric properties in previous studies [58, 59]. Participants were asked to respond to statements on a 5-point scale (ranging from 1 = strongly disagree to 5 = strongly agree), and a higher score on this outcome represented a more favourable perception ( $\alpha = .83$ ).

*Workplace cognitive failure* was measured in relation to ‘this shift’ using an amended version of the Workplace Cognitive Failure Scale (WCFS) [60], which has previously

---

<sup>2</sup> The Cronbach’s alphas ( $\alpha$ ) we report are from our analyses.

<sup>3</sup> Hassle categories were not mutually exclusive.

demonstrated favourable psychometric properties [52, 61]. Participants were required to respond to 15-items on a 5-point scale (ranging from 0 = never to 4 = very often), and a higher score on this outcome represented more workplace cognitive failure experienced ( $\alpha = .90$ ).

To assess whether nurses perceived they were able to practise safety, referred to as *safe practitioner measure* [53], taking the conditions on shift into account—participants were asked to respond to one statement on a 5-point scale (ranging from 1 = strongly disagree to 5 = strongly agree). A higher score on this outcome represented a more favourable perception.

## **Data analysis**

There was no pattern in terms of missing data and no outliers were identified. The data were analysed using hierarchical linear modelling (HLM) and HLM6 [62], and was structured in two levels. Level 1 represented the within-person variation (safety perceptions and daily hassles), and level 2 represented the between-person variation (chronic stress and demographic characteristics)<sup>4</sup>. In terms of centering, the within-person data was group mean centered, the between-person data was grand mean centered and gender was uncentered [38, 63, 64]. In all analyses, length of time qualified, age and gender were controlled for. We examined the level 1 slope (models) to test the association between safety perceptions and total hassles, the cross-level influence of chronic stress (a level 2 variable) on both total hassles and safety perception relationships (level 1), and whether the level 1 total hassles and safety perception relationships were moderated by chronic stress (a level 2 variable). The equations and general form of the models for each research question are presented in Appendix 1.

## **RESULTS**

### **Descriptive statistics**

---

<sup>4</sup> Intra-class correlation coefficients (ICC) for outcome variables: perceptions of patient safety .42; safe practitioner measure .23; workplace cognitive failure .66.

Descriptive statistics are presented in Table 1. Eighty-three participants completed a total of 324 diary entries (mean entries completed = 3.9).

INSERT TABLE 1 HERE

### **Daily hassles**

The emergent hassle categories illustrated the wide-ranging hassles experienced including hassles relating to work and home life (see Appendix 2: Table 2). The top five types of hassle categories in terms of frequency were coded as negative mood (59), staffing issues (59), workload/demands (50), problems associated with relations between staff (45), and problems associated with staff communication (38).

#### *Are higher ratings of chronic stress related to nurses' daily safety perceptions?*

The findings demonstrated significant associations between chronic stress and two of the daily safety perception outcomes ( $\beta_{04}$ ). Participants who reported higher levels of chronic stress also reported less favourable patient safety perceptions at the work area/unit level, as well as reporting less favourable perceptions of being able to practise safely when taking shift conditions into account. However, the association between chronic stress and workplace cognitive failure was not significant (see Table 3).

INSERT TABLE 3 HERE

#### *Are more daily hassle experiences related to nurses' daily safety perceptions?*

The findings demonstrated significant associations between total hassle experiences and safety perceptions ( $\beta_{10}$ ). On shifts when participants experienced more hassles they reported less favourable patient safety perceptions at the work area/unit level, as well as reporting less favourable perceptions of being able to practise safely when taking shift conditions into account, and experienced a higher level of workplace cognitive failure (see Table 4).

INSERT TABLE 4

#### *Do nurses who report higher ratings of chronic stress, also report more daily hassle experiences?*

The findings demonstrated a significant association between chronic stress and daily total hassle experiences ( $\beta_{04}$ ). Participants who reported higher levels of chronic stress also reported experiencing more hassles for the study period (see Table 5).

INSERT TABLE 5

*Does chronic stress moderate associations between hassle experiences and the safety perceptions of nurses at the daily level?*

The analyses demonstrated that chronic stress did not moderate any of the relationships between total hassle experiences and safety perception outcomes (see Table 6).

INSERT TABLE 6

## **DISCUSSION**

The primary aim of this study was to take a within-person approach to examine the relationships between chronic stress, hassle experiences and safety perceptions in UK hospital nursing. In addition, we were also interested in the relationship between chronic stress and hassles experiences, and the potential moderating role of chronic stress on daily associations between hassle experiences and safety perceptions. The findings highlight an association between nurse perceptions of chronic stress and daily safety perceptions, and on days when more hassles were experienced, nurses also reported less favourable safety perceptions. Additionally, by introducing a novel measure of daily hassles in this context we were able to illustrate the wide-ranging hassles experienced by nurses on a daily basis. Nurses reporting higher levels of chronic stress also reported experiencing more daily hassles over the study period, but of particular note was the lack of moderating effect of chronic stress on daily hassles and safety perception associations. Each of these findings will be discussed in turn.

By demonstrating associations between nurse perceptions of chronic stress, daily hassles and safety perceptions, our findings support previous research reporting

relationships between stress and error, and quality and safety issues within hospital nursing [e.g., 28, 31, 34]. However, much of the previous research which has examined associations between stress (and burnout) and patient safety, has adopted a between-person approach, so we know little about these relationships at the individual level. By taking a within-person approach, and utilising a daily diary methodology, our findings add to the existing literature by establishing an association between chronic stress in nurses and perceived safety at the daily level. This is the first study to examine and find support for an association between *daily* hassles and daily safety perceptions. This is particularly important, as we have shown that in addition to chronic stress, daily perceptions of hassles are also predictive of safety perceptions.

There are a number of explanations as to why nurses who reported higher levels of chronic stress and more daily hassles also perceived safety less favourably. Stress can affect cognitive performance [48], working memory task performance and cognitive flexibility [49], and decision making [50]. As a result, when experiencing stress (either chronic or more acute) nurses may not be able to perform as effectively, due to diminished cognitive capacity, which may have consequences for patient safety. Moreover, the prolonged exposure to a stressful working environment poses not only threats to patient safety, but is also linked to the well-being of, and health outcomes for nurses [13-15]. Thus, work related stressors are of significant concern to individuals and organisations.

The second main contribution of the study is a descriptive one. Increasingly attempts to understand the influence of psychosocial stressors have focused on the role of minor events or daily hassles [e.g., 43, 44], hence in this study we focussed on daily hassle experiences in addition to chronic stress. By introducing a novel measure in this context, we have begun to unpick the types of hassles nurses experience on a daily basis. The majority of hassles experienced were work related, linked specifically to work environment factors. Therefore, we can say with a certain level of confidence that on the whole, job related hassles were associated with poorer safety perceptions in this study.

We also found evidence of an association between chronic stress and daily hassles, whereby nurses reporting higher levels of chronic stress reported experiencing more daily hassles over the study period. This suggests that nurses with higher levels of chronic stress may have increased vulnerability to experience more daily hassles, and our findings highlight the dual effects of stress on safety perceptions and being able to act as a safe practitioner. Indeed, more broadly, a recent review in healthcare staff demonstrated that burnout and poor wellbeing were associated with poorer patient safety [65].

Interestingly, chronic stress was not established as a moderator of the relationship between nurses' daily hassle experiences and daily safety perceptions. Intuitively, we expected higher levels of chronic stress to exacerbate the effects of daily hassle on safety perceptions, but our findings did not support this. It is possible that the study period was not long enough to pick up between-person effects on the within-person relationships. Additionally, the broad measure of chronic stress combined with the diversity in type of hassles experienced may account for the lack of moderating effects.

Chronic stress and burnout have consequences for patient safety within hospital nursing [31-33]. However, due to an over reliance on cross-sectional methods, we know much less around how associations between stress and patient safety play out on a daily basis for individual nurses. This is important as the nature and direction of between-person relationships may be different from those evident at a within-person level [35]. The current research suggests that both chronic stress and daily hassle experiences are important in terms of nurses' safety perceptions over a longer period. Utilising measures of daily hassles in this context may be a useful proactive approach to highlight when patient safety threats may arise and as a result interventions could usefully focus on the management of daily hassles. One final finding of note is that daily hassles impacted on perceptions of external (perceptions of patient safety and safe practitioner measures) and internal factors (workplace cognitive failure), whilst chronic stress only impacted on perceptions of external factors. One possible explanation for this is that daily hassles (more so than chronic stress)

may be disruptive to an individual's ability to function. It is possible that nurses adapt to chronic stress by learning to function despite the existence of on-going, chronic stressors.

### **Strengths and limitations**

A key strength of the study is the methodological design that enabled the data to be explored at different levels of analysis simultaneously [66, 67]. Limitations of the study include the time period over which daily assessments were made, and the total number of participants recruited. Ideally a longer study period and additional participants would have increased the power of the study, and would have allowed us to explore lagged effects. It is possible that some nurses with more complicated shift patterns had weekend or weekday days off within a consecutive shift pattern. In terms of the influence of having a weekend off in between the shift pattern, we expect this was minimal as 83.6% of the entries were completed on weekdays. Therefore a further potential limitation is that we did not control for the influence of shift type/pattern as our focus was not on shift type/pattern specifically and we believe the varied shift patterns of the sample as representative of the wider hospital nursing population. Also, we acknowledge that we were unable to calculate a response rate as participants were recruited opportunistically.

### **Implications for future research**

In terms of research implications, we advocate future research explores these relationships utilising a within-person day approach, but over a longer period of time. This would be hugely advantageous as lagged effects and how relationships are associated with what might be conceptualised as more 'objective' indicators of safety could be explored. Furthermore, now the utility of the daily hassles measure has been established in this context, within a longer study design the specific types of daily hassles in relation to perceived safety at the daily level could be examined. Finally, we also suggest future research utilises a more expansive measure of chronic stress, for instance the long version of the Trier Inventory for Chronic Stress [54], as this would allow for a more robust examination of potential moderating effects.

## **Conclusion**

The findings improve our understanding of the relationships between stress and patient safety consequences in hospital nursing. Higher levels of chronic stress, and experiencing more daily hassles were associated with less favourable safety perceptions at the daily level. Therefore the findings revealed, in addition to chronic stress, the importance of daily hassles in terms of nurses' perceptions of safety. By measuring daily hassles in this context, we also highlighted the types of hassles experienced by hospital nurses on a daily basis.

## **Acknowledgements**

We would like to thank the nurses who completed the questionnaires and made this study possible. The study was funded by the University of Leeds and Bradford Institute for Health Research (PhD Studentship).

## **Compliance with Ethical Standards**

All authors declare that they have no competing interests. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the University of Leeds School of Psychology Ethics Committee in February 2013. Informed consent was obtained from all individual participants included in the study.

## References

- 1 Milliken TF, Clements PT, Tillman HJ. The impact of stress management on nurse productivity and retention. *Nurs Econ*. 2007;25(4):203–210.
- 2 Moustaka Å, Constantinidis TC. Sources and effects of Work-related stress in nursing. *Health Sci J*. 2010;4:210–216.
- 3 Carayon P, AP Gurses. Nursing Workload and Patient Safety—A Human Factors Engineering Perspective. In R. Hughes (Ed.) *Patient safety and quality: An evidence-based handbook for nurses* [internet]. Rockville, MD: Agency for Healthcare Research and Quality; 2008 [cited 2016 January 10]. Available from [http://archive.ahrq.gov/professionals/clinicians-providers/resources/nursing/resources/nursesfdbk/CarayonP\\_NWPS.pdf](http://archive.ahrq.gov/professionals/clinicians-providers/resources/nursing/resources/nursesfdbk/CarayonP_NWPS.pdf).
- 4 Gifford BD, Zammuto RF, Goodman EA, Hill KS. The relationship between hospital unit culture and nurses' quality of work life/Practitioner application. *J Healthc Manag*. 2002;47(1):13–25.
- 5 Ball JE, Murrells T, Rafferty AM, Morrow E, Griffiths P. 'Care left undone' during nursing shifts: associations with workload and perceived quality of care. *BMJ Qual Saf*. 2013;23(2):116–125.
- 6 Wray J. The impact of the financial crisis on nurses and nursing. *J Adv Nurs*. 2013;69(3):497–499.
- 7 Royal College of Nursing, 2010. Guidance on Nurse Staffing Levels in the UK. RCN, London.
- 8 Royal College of Nursing, 2012. Mandatory Nurse Staffing Levels. RCN, London.
- 9 Spetz J, Given R. The future of the nurse shortage: Will wage increases close the gap?. *Health Affair*. 2003;22(6):199–206.
- 10 Greenglass ER, Burke RJ, Fiksenbaum L. Workload and burnout in nurses. *J Community Appl Soc*. 2001;11(3):211–215.
- 11 Purcell SR, Kutash M, Cobb S. The relationship between nurses' stress and nurse staffing factors in a hospital setting. *J Nurs Manag*. 2011;19(6):714–720.
- 12 Sharma P, Davey A, Davey S, Shukla A, Shrivastava K, Bansal R. Occupational stress among staff nurses: Controlling the risk to health. *Indian J Occup Environ Med*. 2014;18(2):52.
- 13 Chang EM, Daly JW, Hancock KM, Bidewell J, Johnson A, Lambert VA. et al. The relationships among workplace stressors, coping methods, demographic characteristics, and health in Australian nurses. *J Prof Nurs*. 2006;22(1):30–38.
- 14 Letvak S. We Cannot Ignore Nurses' Health Anymore: A Synthesis of the Literature on Evidence-Based Strategies to Improve Nurse Health. *Nurs Adm Q*. 2013;37(4):295–308.
- 15 Tucker SJ, Weymiller AJ, Cutshall SM, Rhudy LM, Lohse CM. Stress ratings and health promotion practices among RNs: a case for action. *J Nurs Adm*. 2012;42(5): 282–292.
- 16 Ida H, Miura M, Komoda M, Yakura N, Mano T, Hamaguchi T, Yamauchi K. Relationship between stress and performance in a Japanese nursing organization. *Int J Health Care Qual Assur*. 2009;22(6):642–657.
- 17 Parker PA, Kulik JA. (1995). Burnout, self-and supervisor-rated job performance, and absenteeism among nurses. *J Behav Med*. 1995;18(6):581–599.
- 18 Carter MR, Tourangeau AE. Staying in nursing: what factors determine whether nurses intend to remain employed?. *J Adv Nurs*. 2012;68(7):1589–1600.
- 19 Heinen MM, van Achterberg T, Schwendimann R, Zander B, Matthews A, Kózka M. et al. Nurses' intention to leave their profession: a cross sectional observational study in 10 European countries. *Int J Nurs Stud*. 2013;50(2):174–184.
- 20 Mosadeghrad AM. Occupational stress and turnover intention: Implications for nursing management. *Int J Health Policy Manag*. 2013;1(2):169–176.
- 21 Wu TY, Fox DP, Stokes C, Adam C. Work-related stress and intention to quit in newly graduated nurses. *Nurse Educ Today*. 2012;32(6):669–674.

- 22 AbuAlRub RF. Job stress, job performance, and social support among hospital nurses. *J Nurs Sch.* 2004;36(1):73–78.
- 23 Bakker AB, Heuven E. Emotional dissonance, burnout, and in-role performance among nurses and police officers. *Int J Stress Manag.* 2006;13(4):423.
- 24 Packard JS, Motowidlo SJ. Subjective stress, job satisfaction, and job performance of hospital nurses. *Res Nurs Health.* 1987;10(4):253–261.
- 25 Poghosyan L, Clarke SP, Finlayson M, Aiken LH. Nurse burnout and quality of care: Cross-national investigation in six countries. *Res Nurs Health.* 2010;33(4):288–298.
- 26 Vahey DC, Aiken LH, Sloane DM, Clarke, SP, Vargas D. Nurse burnout and patient satisfaction. *Med care.* 2004;42(2 Suppl):II57.
- 27 Dugan J, Lauer E, Bouquot Z, Dutro BK, Smith M, Widmeyer G. Stressful nurses: the effect on patient outcomes. *J Nurs Care Qual.* 1996;10(3):46–58.
- 28 Virtanen M, Kurvinen T, Terho K, Oksanen T, Peltonen R, Vahtera J. et al. Work hours, work stress, and collaboration among ward staff in relation to risk of hospital-associated infection among patients. *Med care.* 2009;47(3):310–318.
- 29 Halbesleben JR, Wakefield BJ, Wakefield DS, Cooper LB. Nurse burnout and patient safety outcomes nurse safety perception versus reporting behavior. *West J Nurs Res.* 2008;30(5):560–577.
- 30 Jennings B. Work stress and burnout among nurses: Role of the work environment and working conditions. In R. Hughes (Ed.) *Patient safety and quality: An evidence-based handbook for nurses* [internet]. Rockville, MD: Agency for Healthcare Research and Quality; 2008 [cited 2016 January 10]. Available from <http://www.ncbi.nlm.nih.gov/books/NBK2676/?report=reader>.
- 31 Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *JAMA.* 2002;288(16): 1987–1993.
- 32 Cimiotti JP, Aiken LH, Sloane DM, Wu ES. Nurse staffing, burnout, and health care-associated infection. *Am J Infect Control.* 2012;40(6):486–490.
- 33 Teng CI, Shyu YIL, Chiou WK, Fan HC, Lam SM. Interactive effects of nurse-experienced time pressure and burnout on patient safety: a cross-sectional survey. *Int J Nurs Stud.* 2010;47(11):1442–1450.
- 34 Elfering A, Semmer NK, Grebner S. Work stress and patient safety: observer-rated work stressors as predictors of characteristics of safety-related events reported by young nurses. *Ergonomics.* 2006;49(5-6):457–469.
- 35 Affleck G, Zautra A, Tennen H, Armeli S. Multilevel daily process designs for consulting and clinical psychology: a preface for the perplexed. *J Consult Clin Psychol.* 1999;67(5):746.
- 36 Ferguson E. The use of diary methods in clinical and health psychology. in: J Miles, P Gilbert (Eds.) *A Handbook of Research Methods in Clinical and Health Psychology.* Oxford University Press, Oxford; 2005.
- 37 O'Connor DB, Ferguson E. Stress and Stressors. In: Y Benyamini, M Johnston, EC Karademas (Eds.) *Assessment in health psychology* (pp. 104–118). Göttingen/Boston, Hogrefe; 2016.
- 38 Nezlek JB. Multilevel random coefficient analyses of event-and interval-contingent data in social and personality psychology research. *Pers Soc Psychol Bull.* 2001;27(7):771–785.
- 39 Hofmann DA, Mark B. An investigation of the relationship between safety climate and medication errors as well as other nurse and patient outcomes. *Pers Psychol.* 2006;59(4):847–869.
- 40 Huang DT, Clermont G, Kong L, Weissfeld LA, Sexton JB, Rowan KM. et al. Intensive care unit safety culture and outcomes: a US multicenter study. *Int J Qual Health Care.* 2010;22(3):151–161.
- 41 Mardon RE, Khanna K, Sorra J, Dyer N, Famolaro T. Exploring relationships between hospital patient safety culture and adverse events. *J Patient Saf.* 2010;6(4): 226–232.
- 42 Petrowski K, Paul S, Albani C, Brähler E. Factor structure and psychometric properties of the Trier Inventory for Chronic Stress (TICS) in a representative German sample. *BMC Med Res Methodol.* 2012;12(1):42.

- 43 Gartland N, O'Connor DB, Lawton R, Bristow M. Exploring day-to-day dynamics of daily stressor appraisals, physical symptoms and the cortisol awakening response. *Psychoneuroendocrinology*. 2014;50:130–138.
- 44 O'Connor DB, Jones F, Conner M, McMillan B, Ferguson E. Effects of daily hassles and eating style on eating behavior. *Health Psychol*. 2008;27(1S):S20.
- 45 Sliwinski MJ, Almeida DM, Smyth J, Stawski RS. Intraindividual change and variability in daily stress processes: findings from two measurement-burst diary studies. *Psychol Aging*. 2009;24(4):828.
- 46 Serido J, Almeida DM, Wethington E. Chronic stressors and daily hassles: Unique and interactive relationships with psychological distress. *J Health Soc Behav*. 2004; 45(1):17–33.
- 47 Reason J. Human error: models and management. *BMJ*. 2000;320(7237): 768–770.
- 48 Lupien SJ, Maheu F, Tu M, Fiocco A, Schramek TE. The effects of stress and stress hormones on human cognition: Implications for the field of brain and cognition. *Brain Cogn*. 2007;65(3):209–237.
- 49 Renner KH, Beversdorf DQ. Effects of naturalistic stressors on cognitive flexibility and working memory task performance. *Neurocase*. 2010;16(4):293–300.
- 50 Starcke K, Wolf OT, Markowitsch HJ, Brand M. Anticipatory stress influences decision making under explicit risk conditions. *Behav Neurosci*. 2008;122(6):1352.
- 51 Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The cognitive failures questionnaire (CFQ) and its correlates. *Br J Clin Psychol*. 1982;21(1):1–16.
- 52 Park YM, Kim SY. Impacts of job stress and cognitive failure on patient safety incidents among hospital nurses. *Saf Health Work*. 2013;4(4):210–215.
- 53 Louch G, O'Hara J, Gardner P, O'Connor DB. The daily relationships between staffing, safety perceptions and personality in hospital nursing: A longitudinal on-line diary study. *Int J Nurs Stud*. 2016; 59:27–37.
- 54 Schulz P, Schlotz W, Becker P. Trierer Inventar zum chronischen Stress (TICS) [Trierer Inventory of Chronic Stress]. Hogrefe; 2004.
- 55 Schulz P, Schlotz W. Trierer Inventar zur Erfassung von chronischem Sre (TICS): Skalenkonstruktion, teststatistische Überprüfung und Validierung der Skala Arbeitsüberlastung. *Diagnostica*. 1999.
- 56 Petrowski K, Paul S, Albani C, Brähler E. Factor structure and psychometric properties of the Trier Inventory for Chronic Stress (TICS) in a representative German sample. *BMC Med Res Methodol*. 2012; 12(1):42.
- 57 Sorra JS, Nieva VF. Hospital Survey on Patient Safety Culture. AHRQ Publication No. 04-0041. Rockville, MD: Agency for Healthcare Research and Quality, September 2004. (Available from: <http://www.ahrq.gov/qual/hospculture>; accessed January, 2016).
- 58 Blegen MA, Gearhart S, O'brien R, Sehgal NL, Alldredge BK. AHRQ's hospital survey on patient safety culture: psychometric analyses. *J Patient Saf*. 2009;5(3):139–144.
- 59 Sorra JS, Dyer N. Multilevel psychometric properties of the AHRQ hospital survey on patient safety culture. *BMC Health Serv Res*. 2010;10(1):199.
- 60 Wallace JC, Chen G. Development and validation of a work-specific measure of cognitive failure: Implications for occupational safety. *J Occup Organ Psychol*. 2005; 78(4):615–632.
- 61 Elfering A, Grebner S, Dudan A. Job characteristics in nursing and cognitive failure at work. *Saf Health Work*. 2011;2(2):194–200.
- 62 Raudenbush SW. HLM 6: Hierarchical linear and nonlinear modeling. Scientific Software International; 2004.
- 63 Bryk AS, Raudenbush SW. Hierarchical linear models. Sage, Newbury Park, CA; 1992.
- 64 Kreft IG, De Leeuw J, Aiken LS. The effect of different forms of centering in hierarchical linear models. *Multivariate Behav Res*. 1995;30(1):1–21.
- 65 Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare staff wellbeing, burnout, and patient safety: A systematic review. *PLoS One*. 2016;11(7):e0159015.
- 66 Griffin MA. Interaction between individuals and situations: Using HLM procedures to estimate reciprocal relationships. *J Manage*. 1997;23(6):759–773.
- 67 Hofmann DA. An overview of the logic and rationale of hierarchical linear models. *J Manage*. 1997;23(6):723–744.

*Table 1 Descriptive statistics for level 1 (end-of-shift) and level 2 (between-subject) variables across the study period*

	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
<b>Level 1 variables</b>				
Total hassles	1.37	1.81	0	8
Workplace cognitive failure	23.06	7.69	14	51
Safe practitioner	4.02	1.10	1	5
Perceptions of patient safety	16.31	3.22	7	20
<b>Level 2 variables</b>				
Age	36.74	10.52	21	59
Length of time qualified (months)	140.61	117.40	6	444
Chronic stress	33.91	8.73	14	56

*Note.* SD, standard deviation.

Appendix 2: Table 2 Hassle Categories, Frequencies and Descriptions

<b>Hassle Category (frequency)</b>	<b>Description</b>
Mood (59)	This code represents hassles associated with negative mood states of the member of staff e.g., annoyance and worry
Staffing (59)	This code represents hassles related to staffing issues. This includes hassles relating to levels of staff, skill mix, sickness absence, and temporary/new staff. An inability to find appropriate staff (e.g., doctors, pharmacists, ward clerk, porter, interpreter), and associated delays are also represented here
Workload/demands (50)	This code represents hassles related to excessive workload and demands e.g. feeling busy/pressured, paperwork issues, time management and delegation problems
Relations between staff (45)	This code represents hassles concerning the relationships between staff. This encompasses hassles associated with the relations between different professional groups e.g., between nurses and doctors, as well as within professional groups e.g. between nurses, and hassles concerning relations across departments and wards
Staff communication (38)	This code represents hassles related to staff communication of information both written and verbal e.g. problems with patient notes and handover issues. This code also includes hassles relating to communication between staff
Interruptions/distractions (29)	This code represents hassles related to being interrupted or distracted
Patient status (29)	This code represents hassles related to the status of a patient. This includes hassles relating to a deteriorating patient, a difficult patient condition to manage, a patient not complying or a key patient event occurring such as a cardiac arrest
External (28)	This code represents hassles associated with traffic, parking and the weather
Equipment /storage (27)	This code represents hassles related to equipment and storage e.g. delays, availability, design and maintenance
Physical (24)	This code represents hassles related to the physicality of the member of staff i.e. fatigue, lack of concentration, hunger and headaches
Patient factors (21)	This code represents hassles concerning patient issues such as a patient being aggressive or violent, this code also encompasses hassles related to communication issues with patients
Family/ home (21)	This code represents hassles associated with issues outside of work, such as interpersonal issues with family members
Bed management (19)	This code represents hassles associated with finding beds, allocating beds and moving patients
Other (19)	This code represents hassles that cannot be classified into the described hassle types

<b>Hassle Category (frequency)</b>	<b>Description</b>
Patient safety/quality (14)	This code represents hassles related to the occurrence of an adverse event or near miss, as well as patient complaints
Team factors (13)	This code represents hassles related to teamwork, hierarchy, and team dynamics
Discharge/admissions (13)	This code represents hassles related to the process of discharge and admissions
Support (9)	This code represents hassles related to a lack of support experienced, this includes both administrative, team and managerial support
Task factors (4)	This code represents hassles related to specific tasks i.e. tasks left undone, time taken to complete tasks, unable to carry out a particular task/fulfil duties

Table 3 Cross-level effects of chronic stress on safety perception outcomes

HLM Effect	Symbol	Coeff	SE	<i>p</i>
<b>Perceptions of patient safety</b>				
<i>Intercept</i>	$\beta_{00}$	15.113	1.276	<i>p</i> < .001
<i>Level 2 effect:</i>				
Chronic stress – PPS	$\beta_{04}$	-.069	.031	<i>p</i> = .030
<b>Safe practitioner</b>				
<i>Intercept</i>	$\beta_{00}$	4.083	.488	<i>p</i> < .001
<i>Level 2 effect:</i>				
Chronic stress – SP	$\beta_{04}$	-.023	.009	<i>p</i> = .017
<b>Workplace cognitive failure</b>				
<i>Intercept</i>	$\beta_{00}$	36.636	6.943	<i>p</i> < .001
<i>Level 2 effect:</i>				
Chronic stress – WCF	$\beta_{04}$	.127	.078	<i>p</i> = .109

*Note.* HLM, Hierarchical linear modelling; Symbol, Hierarchical linear modelling symbol; Coeff, unstandardized coefficient; SE, standard error; PPS, Perceptions of Patient Safety; SP, Safe Practitioner measure; WCF, Workplace Cognitive Failure.

Table 4 Within-subject relationships between daily hassle experiences and safety perception outcomes

HLM Effect	Symbol	Coeff	SE	<i>p</i>
<b>Perceptions of patient safety</b>				
<i>Intercept</i>	$\beta_{00}$	14.802	1.448	<b><i>p</i> &lt; .001</b>
<i>Level 1 slope: daily hassles — PPS</i>	$\beta_{10}$	-.403	.131	<b><i>p</i> = .003</b>
<b>Safe practitioner</b>				
<i>Intercept</i>	$\beta_{00}$	3.922	.538	<b><i>p</i> &lt; .001</b>
<i>Level 1 slope: daily hassles — SP</i>	$\beta_{10}$	-.147	.045	<b><i>p</i> = .002</b>
<b>Workplace cognitive failure</b>				
<i>Intercept</i>	$\beta_{00}$	37.119	6.944	<b><i>p</i> &lt; .001</b>
<i>Level 1 slope: daily hassles — WCF</i>	$\beta_{10}$	.547	.161	<b><i>p</i> &lt; .001</b>

Note. HLM, Hierarchical linear modelling; Symbol, Hierarchical linear modelling symbol; Coeff, unstandardized coefficient; SE, standard error; PPS, Perceptions of Patient Safety; SP, Safe Practitioner measure; WCF, Workplace Cognitive Failure.

Table 5 Cross-level effects of chronic stress on daily hassle experiences

HLM Effect	Symbol	Coeff	SE	<i>p</i>
<b>Daily hassles</b>				
<i>Intercept</i>	$\beta_{00}$	-.284	.661	<i>p</i> = .669
<i>Level 2 effect:</i>				
Chronic stress – daily hassles	$\beta_{04}$	.041	.017	<b><i>p</i> = .018</b>

Note. HLM, Hierarchical linear modelling; Symbol, Hierarchical linear modelling symbol; Coeff, unstandardized coefficient; SE, standard error.

Table 6 Chronic stress as a moderator of within-person relationships between daily hassle experiences and safety perception outcomes

HLM Effect	Symbol	Coeff	SE	<i>p</i>
<b>Perceptions of patient safety</b>				
<i>Intercept</i>	$\beta_{00}$	14.945	1.302	<i>p</i> < .001
<i>Cross-level interaction with chronic stress:</i>				
Chronic stress x daily hassles – PPS	$\beta_{11}$	-.003	.018	<i>p</i> = .854
<b>Safe practitioner</b>				
<i>Intercept</i>	$\beta_{00}$	3.972	.506	<i>p</i> < .001
<i>Cross-level interaction with chronic stress:</i>				
Chronic stress x daily hassles – SP	$\beta_{11}$	-.009	.006	<i>p</i> = .115
<b>Workplace cognitive failure</b>				
<i>Intercept</i>	$\beta_{00}$	36.854	6.873	<i>p</i> < .001
<i>Cross-level interaction with chronic stress:</i>				
Chronic stress x daily hassles – WCF	$\beta_{11}$	.024	.016	<i>p</i> = .133

Note. HLM, Hierarchical linear modelling; Symbol, Hierarchical linear modelling symbol; Coeff, unstandardized coefficient; SE, standard error; PPS, Perceptions of Patient Safety; SP, Safe Practitioner measure; WCF, Workplace Cognitive Failure.

**1) Are higher ratings of chronic stress related to nurses' daily safety perceptions?**

The general form of the model is expressed by the following equation:

$$\text{Outcome variable (e.g., safety perception)} = \beta_{00} + \beta_{01} (\text{gender}) + \beta_{02} (\text{age}) + \beta_{03} (\text{length of time qualified}) + \beta_{04} (\text{chronic stress}) + \varepsilon$$

$\beta_{00}$  = Mean level of outcome variable (e.g., safety perception)

$\beta_{01}$  = Indicates the extent to which this average is influenced by gender

$\beta_{02}$  = Indicates the extent to which this average is influenced by age

$\beta_{03}$  = Indicates the extent to which this average is influenced by length of time qualified

$\beta_{04}$  = Indicates the extent to which this average is influenced by level of chronic stress

$\varepsilon$  = Error term

**2) Are more daily hassle experiences related to nurses' daily safety perceptions?**

The general form of the model is expressed by the following equation:

$$\text{Outcome variable (e.g., safety perception)} = \beta_{00} + \beta_{01} (\text{gender}) + \beta_{02} (\text{age}) + \beta_{03} (\text{length of time qualified}) + \beta_{10} (\text{total hassle experience}) + \varepsilon$$

$\beta_{00}$  = Mean level of outcome variable (e.g., safety perception)

$\beta_{01}$  = Indicates the extent to which this average is influenced by gender

$\beta_{02}$  = Indicates the extent to which this average is influenced by age

$\beta_{03}$  = Indicates the extent to which this average is influenced by length of time qualified

$\beta_{10}$  = Indicates the extent to which this average is influenced by level of total hassle experience

$\varepsilon$  = Error term

### **3) Do nurses who report higher ratings of chronic stress, also report more daily hassle experiences?**

The general form of the model is expressed by the following equation:

$$\text{Outcome variable (total hassle experience)} = \beta_{00} + \beta_{01} (\text{gender}) + \beta_{02} (\text{age}) + \beta_{03} (\text{length of time qualified}) + \beta_{04} (\text{chronic stress}) + \varepsilon$$

$\beta_{00}$  = Mean level of outcome variable (total hassle experience)

$\beta_{01}$  = Indicates the extent to which this average is influenced by gender

$\beta_{02}$  = Indicates the extent to which this average is influenced by age

$\beta_{03}$  = Indicates the extent to which this average is influenced by length of time qualified

$\beta_{04}$  = Indicates the extent to which this average is influenced by level of chronic stress

$\varepsilon$  = Error term

### **4) Does chronic stress moderate the relationships between nurses' daily hassle experiences and daily safety perceptions?**

The general form of the model is expressed by the following equation:

$$\text{Outcome variable (e.g., safety perception)} = \beta_{00} + \beta_{01} (\text{gender}) + \beta_{02} (\text{age}) + \beta_{03} (\text{length of time qualified}) + \beta_{04} (\text{chronic stress}) + \beta_{10} (\text{total hassle experience}) + \beta_{11} (\text{chronic stress X total hassle experience}) + \varepsilon$$

$\beta_{00}$  = Mean level of outcome variable (e.g., safety perception)

$\beta_{01}$  = Indicates the extent to which this average is influenced by gender

$\beta_{02}$  = Indicates the extent to which this average is influenced by age

$\beta_{03}$  = Indicates the extent to which this average is influenced by length of time qualified

$\beta_{04}$  = Indicates the extent to which this average is influenced by level of chronic stress

$\beta_{10}$  = Indicates the extent to which this average is influenced by level of total hassle experience

$\beta_{11}$  = Indicates the extent to which this average is conditional on the level of chronic stress

$\varepsilon$  = Error term

