

# Stress, Fatigue, and Workload in Intensive Care Nursing: A Scoping Literature Review

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Stress and fatigue are being interchangeably used in the nursing literature resulting in operationalization and measurement issues. A scoping review was conducted to identify different definitions and operationalization of these constructs. Findings can be used to develop tools to measure stress and fatigue as different constructs to aid nursing administrators to gain a new perspective into nursing schedule, workload, morale and well-being of nurses. The findings show that there is a research gap in measurement of acute stress in nursing, physiological measures are currently not used for continuous assessment of stress or fatigue for nurses, and lack of stress and fatigue definitions in terms of physiological measures for assessment purposes. Continuous monitoring and physiological measures such as heart rate can be used to measure and differentiate between the constructs of stress and fatigue

## INTRODUCTION

Preventable medical errors are pervasive and their life and monetary costs are the subject of ongoing discussion. According to Institute of Medicine (Donaldson et al., 2000), in United States, preventable medical errors account for about 400,000 deaths per year. This staggering number is costing the United States economy around \$765 billion dollars; 30% of the total healthcare costs (Szczerba, 2013).

The effects of stress and fatigue on preventable errors have been well documented. While there are several definitions in the literature, stress is commonly defined in terms of a response to an unexpected stressor and fatigue is defined as a negative effect of an activity that is carried forward due to lack of rest between two tasks. In recent years, research studies have focused on isolating factors that cause stress and fatigue in hospital environments for nurses. However, the stress and fatigue constructs are not well defined in the literature to develop tools to measure these constructs in isolation.

This scoping review is part of a research study that will focus on building knowledge in the field of Intensive care unit (ICU) nursing related to stress and fatigue to aid nurse administrators in monitoring overall stress and fatigue levels of their unit. ICU was chosen as a focus of this review as studies show that approximately 1.7 errors per patient per day occur in all ICUs in the United States (Donchin et al., 1995; Wu et al., 2002). Medical errors most likely occur in ICUs due to the complexity of care and environment. It is difficult to detect medical errors in ICUs as deteriorating health can be attributed to the patient's underlying medical condition as opposed to physician or nurses' error. Since, this is a front-end analysis for a study that involves operationalizing and monitoring stress and fatigue in the ICU the focus was restricted to ICU nursing to explore previous work in this specific environment. This review sheds light on the difficulties and opportunities to improve monitoring and measurement of stress and fatigue in error prone and difficult to intervene ICU environments to implement interventions that are effective and minimally intrusive to critical tasks performed by nurses in the ICU. In addition, the construct of 'workload' in nursing is often used as a performance and resource planning metric. It seems that

workload is influenced by both stress and fatigue and could act as a stressor or a contributor to fatigue, therefore this construct was also studied as part of the review.

## METHOD

A scoping literature review was conducted in order to gather relevant literature on nursing stress, fatigue and workload with focus on operationalization and measurement of these constructs. Compendex and PubMed databases along with Google Scholar were searched using a combination of keywords including: "stress", "fatigue", "workload", "nursing", "nursing stress", "nursing fatigue", "measurement of fatigue", "measurement of stress." Only peer-reviewed publications written in English were considered. Papers not related to ICU nursing were excluded. Initial search resulted in 893 abstracts. Additional resources were identified through citation tracing (forward and backward). After removing the redundant papers and applying the exclusion criteria, 75 papers were included and reviewed.

## RESULTS

### Nursing Stress

The first definition for stress roots back to 1956. Selye (1956) in his book, 'The stress of life' has described stress as a body response to external or internal demands. Since then, stress has been generally defined in terms of a set of stressors such as unnecessary prolongation of life, conflict with physicians and unrealistic expectations from colleagues, self, and patient families. Sawatzky's (1996) study of ICU nurses showed that unnecessary prolongation of life stress and trajectory of illness results in highest frequency and intensity of stress and was more stressful than death of the patient itself. Another stressor was over-involvement with patients and their family and unrealistic expectations from one's self (Mallett, 1991).

Anderson et al. (1988) used 'Nursing Stress Project Questionnaire,' while looking at changes in management stressors on ICU nurses and found that interpersonal relationships or conflict with physicians was more stressful than managing the

unit which was believed to be the principal stressor previously. Guerrer and Bianchi (2011) surveyed 19 nurses in an ICU and identified important variables that contribute to stress in ICUs including excessively dry environment, sealed, artificially lit surroundings, uninterrupted internal noise in the environment, a similar steady relationship amongst the team members that remain constant through the shift, excessive responsibility towards the demands of the suffering patients, and experiencing pain and death daily. The study also found that 57.1% of nurses considered the ICU a stressful environment. In addition, 23.8% of nurses had a high score on the Inventory of Nurse Stress (INS test) indicating the presence of stress.

Nursing stress can be split up into two aspects: the stress related to organization and stress related to patient care. Bahadori et al. (2014) looked at factors that result in workload stress from two different aspects, the management component and the process component of the nursing job. According to this research, organizational stressors include lack of clear responsibilities and authorities, performing unnecessary tasks, and lack of a trained team for transferring patients to other hospitals. Stressors related to process component aspect of the job include the difference in capacity of wards and number of patients, as well as training students and new staff to get up to speed. Espinosa et al. (2010) investigated the experiences of ICU nurses in terminal care and identified lack of involvement in the patient care planning, different practice models for physicians and nurses, perception of unnecessary treatment to prolong life, family expectations that are unrealistic, lack of training, experience, and education for nurses as barriers for care affecting nursing stress.

The effects of these stressors on a frequent basis leads to burnout among nurses that in turn results in higher turnover in the nursing profession. Maslach and Jackson (1981) identified three main components of burnout: emotional exhaustion, depersonalization, and diminished personal accomplishment. Burnout can also lead to lower morale, reduced job performance, higher tardiness, absenteeism, high turnover rate, and alcohol and drug abuse (Chiriboga and Bailey, 1986; Duquette et al., 1994; Eastburg et al., 1994, in Hillhouse et al., 1997). Mallett et al. (1991) found that occupational stress and death anxiety had a positive correlation with nurse burnout.

Moral distress is another major stressor for nurses due to the unique nature of the nursing profession. For example, family's expectation of prolongation of life by subjecting the patient to unnecessary procedures can cause moral dilemma in nurses. Nurses in these situations know about the appropriate course of action but cannot act in that manner because of various constraints which results in stress (Ganz, 2012). Frequency of perceived futile or non-beneficial situations for patients resulting in moral dilemma and distress results in emotional exhaustion associated with burnout for nurses (Meltzer and Huckabay, 2004). Bahadori et al. (2014) recommend that the important aspects researchers need to look at in order to reduce stress due to workload are controlling environmental disturbances, adopting new technologies, and redefining the role of nurses to better suit the demands of the job. In general, most research in ICU stress is closely linked to nursing workload.

## Nursing Workload

Morris et al. (2007) referred to the term *nursing work* as the amount of work performance required to carry out nursing work in a specified time. Lundgrén-Laine and Suominen (2007) argued that the classification of patients and nursing staff numbers as well as the structure of the nursing staff play an important role in nursing workload and nursing intensity. Mion and Frengley (1988) found clinical severity values at patient admission to be a predictor of daily workload.

Nursing workload can generally be categorized into low, medium and heavy workload based on the level of patient care needed. Usually mid-clinical severity patients have longer hospital stays and are observed to have high scores on nursing workload measurement systems (Higgins et al., 2003). Padilha et al. (2008) argue that adding variables such as severity of illness, therapeutic interventions, and mortality rates to workload measurement can be used to improve nursing resources forecasting to reduce ICU costs as well as to improve patient care.

According to Duffield et al. (2006), excessive workload has been identified as a cause of stress and dissatisfaction among nurses (Aiken et al., 2001; Fagin 2001, in Duffield et al., 2006). A survey in Scotland found that 53.7% of 1200 nurses felt the workload was too heavy and 49.7% reported the work pressure was too much (Royal College of Nursing, 2002 in Duffield et al., 2006). Increased workload has a direct effect on nurse retention as nurses feel they are unable to provide the quality of care that their patients require and this increases turnover rate. Cost of staff turnover has been estimated at US\$62,100 to \$67,100 per registered nurse (Jones, 2004).

Although methods to measure nursing workload in ICU have been discussed, there is a consensus in the literature that such measurement is challenging. De Cordova et al. (2010) stated that nurses' workload does not only depend upon a specific package of guidance but also on cognitive factors and complexity of the work environment. Two major factors were identified as barriers to measure workload: nurses' interaction with patients and excessive qualitative indicators in patient care (Bahadori et al., 2014)

Workload is usually measured using physiological, psychological and procedural techniques (Weinger et al., 2004). Individual's well-being and curtailed work performance may occur when workload moves beyond an acceptable level resulting in physiological strain such as heart rate elevation and behavior changes such as reduced work pace (Chen et al., 2011). A definition of acceptable workload was given by Wu and Wang (2001) as "a level that an individual is able to sustain for a given work shift in a physiologically steady state without fatigue or discomfort."

A basic physiological indicator to assess workload as used by many studies is expenditure of energy. Irimagawa and Imamiya (1993) investigated the effects of nursing physical activities on heart rate and energy expenditure in ICU and found that ICU energy expenditure per day was 3,064 kcal (1,744 kcal during the day shift and 1,645 kcal for the evening shift and 1,839 kcal during the night shift). The highest energy expenditure for a particular activity for ICU was assisting

with medical examination and treatment. In terms of physical exertion during the shift, Welton et al. (2006) found that usually for a 12-hour shift nurses walk 4-5 miles which corresponds to 1/3-1/2 mile per hour of nursing work. There was a strong relationship between time pressure and the number of steps taken.

Heart rate is another physiological measure that can be used to measure workload. Wierwille and Eggemeier (1993) showed that heart rate can be used as a measure for arousal or physical effort that accompanies increased workload as heart rate is found to increase with increase in work demand. Roscoe (1982) recommended heart rate monitoring along with a rating scale for workload as good practice for nursing workload assessment. The author stated that although the science behind the neurophysiological mechanism involved in elevation of heart rate is not known, a reasonable hypothesis can be constructed using arousal for elevation in heart rate and its association with workload. In one study, 96.9 beats per minute (bpm) was the average HR for a 12-hour nursing shift and about 36% nurses experienced an average heart rate above 100 bpm (Chen et al., 2011). For different nursing activities among hospital nurses, heart rate range was reported to be from 79 to 129 bpm (Hui et al., 2001; Nuikka et al., 2001). However, physiological effects such as elevation in heart rate are influenced by various sources such as biological, environmental, and behavioral factors at different levels of intensity. It is recommended that future studies should evaluate wide range of sources in a hospital for heart rate changes (Chen et al., 2011). Morrison et al. (2003) study found that noise, caffeine intake, work experience and shift schedule are factors that can influence heart rate in nurses.

Along with physical workload, nursing tasks are also associated with high cognitive or mental workload. Apart from high level nursing tasks such as medication administration, there are additional sub-tasks such as preparation of multiple intravenous (IV) infusions, checking drug libraries and dose error reduction systems (DERS) and titration of doses (Giuliano, 2015). These additional subtasks are associated with more rule- and knowledge-based decisions, and additional subtasks lead to increased mental demand (Umansky, 2015).

Workload in ICU nursing is closely related to fatigue as nurses normally work 12-hour shifts in addition to the critical nature of the work. The nursing tasks also involve vigilance tasks which results in visual fatigue in nursing. Future research should also focus on factors such as patient acuity and turnover, quality of leadership and management, and patient outcomes to assess the relationship between nursing workload and nurse staffing to improve public health policy and well-being (Duffield et al., 2006).

## Nursing Fatigue

There are several definitions of fatigue in variety of different domains. Fatigue can be defined as *“a general psychophysiological phenomenon that diminishes the ability of the individual to perform a particular task by altering alertness and vigilance, together with the motivational and subjective states that occur during this transition.”* (Thiffault and Ber-

geron, 2003, pp. 160-161, in De Vries et al., 2003). A common theme in fatigue definitions across domains is the notion of *“an inhibitory effect of an activity that is carried forward”* (Ugrovics and Wright, 1990, pp. 64A).

Fatigue can be further classified into different aspects such as acute or chronic, mental or cognitive fatigue or physical fatigue. Winwood et al. (2006b) in (Barker and Nussbaum, 2011) found that acute fatigue levels for nurses are higher than chronic fatigue levels. Nurses also perceived total fatigue to be higher than either mental or physical fatigue. Bertram et al., (1990) argue that for nursing mental workload and fatigue is directly proportional to number of patients that are under the nurse's care. In addition, mental fatigue tends to be higher than physical fatigue for nurses as measured by both Swedish Occupational Fatigue Inventory (SOFI) and Fatigue Related Symptoms Questionnaire (F-RSQ) (Barker and Nussbaum, 2011). According to Barker and Nussbaum (2011) important variables that affect perceived levels of fatigues in registered nurses are demographics and work environment factors such as shift length, number of hours of sleep per night and years of experience in a particular work setting.

According to De Vries et al.'s (2003) study on comparison of six fatigue measurement scales, Fatigue Assessment test (FAS) was found to have better validity for measuring fatigue. The findings suggest that fatigue should be studied as a unidimensional phenomenon for the working population. However, fatigue may be multidimensional for patients and non-patient groups.

Physiological measures such as VO<sub>2</sub> max (maximal oxygen uptake) can also be used to measure fatigue. Barnekow-Bergkvist et al. (2004) study found that VO<sub>2</sub> max and isometric back endurance are important predictors of developed fatigue for both females and males. For females, one-leg rising, and shoulder extension strength were also important predictors for fatigue.

Effects of fatigue appear to be highest during the closing period of the first 12-hour shift of an individual's new workweek (Scott et al., 2007). Scott et al.'s study found that 12-hour shift increased the risk of drowsy driving and had the potential for a Multi Vehicle Collision (MVC) or a near MVC. These are similar to the findings of (Barger et al., 2006, in Witkoski and Dickson, 2010) where they identified a link between extended work hours and fatigue-related incidents while driving. Dorrian et al.'s (2008) study states that 25.9% of days, participating nurses in the study did not have a sound sleep at night. Rather than acute sleep loss prior to a particular shift, consistent sleep loss over time contributes to sleepiness and errors. The same study states that on 14.8% of occasions work-related concerns were responsible for sleep disruptions. 27% of shifts had moderate to high levels of stress, 42% of shifts experience physical exhaustion and 39% of the shifts experience mental exhaustion. 32% of the shifts also experience a struggle to stay awake during the shift. Dorrian et al.'s (2008) findings indicate that sleep deprivation or sleep debt increases likelihood of committing an error and decreasing chances of catching someone else's error. This characteristic is of particular importance to nurses who are responsible for intercepting other's errors (Leape et al., 1995, in Dorrian et al.,

2008). In the absence of quality sleep nurses also fail to intercept errors made by other nurses or physicians (Dorrian et al., 2006).

## DISCUSSION

In this paper, a brief overview of the constructs of stress, fatigue, and workload as experienced by ICU nurses is documented. Overall, this review demonstrates that the terms “workload” and “fatigue” are used interchangeably to refer to the same phenomenon. While there is evidence that shows these constructs overlap, the literature review indicated that these constructs are very nuanced. Characteristics associated with nursing stress, workload and fatigue show a significant overlap amongst these concepts which makes differentiation difficult. Research studies in recent past, have recognized stressors that contribute to high stress levels for nurses. Fatigue and workload have been commonly listed as a stressor. Based on the literature, sustained stress is associated with a response to stimuli that is usually unfavorable to the individual. Fatigue is defined as a response to a multidimensional and multicausal environment that affects physiological functions, mental functionality and alters behaviors. Fatigue is also associated with recovery period where lack of recovery increases fatigue. These definitions correlate stress and fatigue and distinguishing unique factors associated with stress or fatigue is deemed to be challenging.

The two constructs influence nursing workload in ICUs and lead to degraded performance in the long run. These effects may include medical errors, high turnover and burnout rates, unnecessary costs, and lost work hours.

The measurement techniques used to evaluate stress and fatigue in ICU also overlap significantly. Elevation of heart rate or autonomous nervous system activation can be a measure of acute or chronic stress but also fatigue. Physiological measurements such as maximal oxygen uptake (VO<sub>2</sub> max), skin conductance, heart rate variability, energy expenditure can be used to measure either stress or fatigue.

While chronic stress and fatigue have been well-documented, there is a research gap in identification of acute stress and fatigue thresholds above which there is a risk associated with the individual nurse’s well-being. This risk can manifest into chronic diseases associated with elevated stress or fatigue or contribute to medical errors such as medication administration errors as a result of increased slips and lapses or incidents of drowsy driving.

While physiological measures such as heart rate, VO<sub>2</sub> max, skin conductance, number of steps during the day have been used along with a workload assessment tool, intervention methods are not studied in detail. Continuous monitoring of nurses using physiological measures can be used to detect periods of high-stress or high-fatigue and stress-inducing events specially during safety-critical tasks such as medication administration, scheduling, or physician-nurse communications should be identified and mitigated.

Future studies focused at reducing degraded performance of ICU nurses may benefit from combining the constructs of stress and fatigue into one entity known as ‘psychophysical

health deterioration’ for the purpose of operationalizing the overall degraded performance in an ICU. If the research question does not proclaim separation of these two construct, it will be easier to combine them to study the effects in conjunction as opposed to performing separate studies. While we acknowledge that in certain cases it might not be appropriate to combine the two constructs, investigating a single construct without due consideration to the other highly-interrelated and possibly confounding construct might underestimate key details regarding combined effects for measuring or operationalizing degraded performance due to the constructs of stress and fatigue. Future studies should investigate unique responses and interlinkage between responses due to stress, fatigue, and workload in order to better operationalize and measure these constructs in nursing.

## CONCLUSIONS

Despite the extensive previous research on stress, fatigue, and workload in healthcare, these constructs lack a clear distinction and have been used interchangeably in the literature to refer to the same phenomenon resulting in issues in operationalization, knowledge accumulation, and measurement. This paper provided a scoping review of work done to define and measure these constructs in complex ICU environments. It seems that reducing the effects of stress and fatigue in the workplace environment requires a context-dependent investigation of these constructs in isolation. However, the combined effects of these constructs as ‘psychophysical health deterioration’ could be used for future efforts in improving nursing performance in ICU.

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