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Joana de Oliveira Côrte-Real Lucena

NURSES' STRATEGIES TO PREVENT OR DECREASE
WORK-RELATED TECHNOSTRESS: A SCOPING REVIEW

Dissertação no âmbito do Mestrado Integrado em Psicologia, área de especialização em Psicologia das Organizações e do Trabalho, orientada pela Professora Doutora Carla Maria Santos de Carvalho e apresentada à Faculdade de Psicologia e Ciências da Educação da Universidade de Coimbra.

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ABSTRACT

Background: Technostress appears as an emerging psychosocial work risk resulting from the individual's inability to deal with technologies in a psychologically healthy way. This risk can originate consequences in professionals' mental and physical health, especially concerning healthcare workplaces, which are already characterized as high-stress environments. Nurses, in their turn, are one of the professionals that exhibit higher stress levels, since the development of healthcare delivery depends on the use of complex and intricate technological tools and medical devices. Although there is evidence of the impact of technostress regarding the physical and psychological well-being of professionals, there are no previous studies that highlight the strategies reported by nurses to prevent or decrease Technostress.

Objective: To map and identify what strategies do nurses adopt to prevent or decrease work-related Technostress.

Review method: This review will follow the methodology proposed by the Joanna Briggs Institute for scoping reviews.

Conclusion: After analyzing all articles selected for full-text reading, we concluded that none of the studies focused on the strategies adopted by nurses to prevent or reduce work-related Technostress. This result can be explained by the fact that it is a very comprehensive concept, thus becoming difficult to operationalize; by the lack of research on this topic in the particular context of health organizations; or by the existence of other variables from nurses' work setting environment that generates such high stress that they end up overlapping Technostress effects itself, in such a way that the nurses' strategies to decrease this risk, remain an understudied subject.

Keywords: Technostress, nurses, strategies, technologies, scoping review.

Resumo

Enquadramento: O Tecnostress surge como um risco psicossocial emergente resultante da incapacidade do indivíduo para lidar com as tecnologias de uma forma psicologicamente saudável. Este risco pode originar consequências na saúde mental e física dos profissionais, principalmente no que diz respeito às organizações de saúde, que já são caracterizadas como ambientes de trabalho particularmente stressantes. Os enfermeiros, por sua vez, são um dos profissionais que apresentam níveis de stresse mais elevados, uma vez que o todo o processo de prestação de serviços de saúde depende da utilização de ferramentas tecnológicas e dispositivos médicos de grande complexidade. Embora existam evidências sobre o impacto do Tecnostress em algumas dimensões do bem-estar físico e psicológico destes profissionais, não existem trabalhos conhecidos que ressaltem as estratégias utilizadas pelos enfermeiros para prevenir ou diminuir o Tecnostress relacionado com o seu trabalho.

Objetivo: Mapear e identificar quais são as estratégias que os enfermeiros adotam para prevenir ou diminuir o Technostress relacionado com o seu trabalho.

Metodologia: Esta revisão seguirá a metodologia proposta pelo Instituto Joanna Briggs para *scoping reviews*.

Conclusão: Após a análise de todos os artigos selecionados para leitura de texto integral, concluímos, que nenhum dos estudos se centrou nas estratégias adotadas pelos enfermeiros para prevenir ou diminuir o Tecnostress. Este resultado poderá ser explicado pela abrangência do conceito e a dificuldade em operacionalizá-lo; por falta de pesquisa sobre este tema no contexto particular das organizações de saúde; ou, pela existência de outras variáveis presentes no contexto de trabalho dos enfermeiros que são geradoras de um stress tão elevado, que acabam por se sobrepor aos próprios efeitos do Tecnostress, permanecendo estratégias adotadas pelos enfermeiros para diminuir este risco, um assunto por estudar.

Palavras-chave: Tecnostress, enfermeiros, estratégias, tecnologias, revisão.

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Nota Introdutória

A presente dissertação foi redigida integralmente na língua inglesa, tendo sido elaborada e estruturada de acordo com as normas para publicação de artigo científico de revisão sistemática da *Revista de Enfermagem Referência,* com o objetivo de posterior publicação na mesma.

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LIST OF ACRONYMS

EHR - Electronic Health Record

HIT - Healthcare Information Technology

ICT - Information Communication Technology

ICU - Intensive Care Unit

JBI - Joanna Briggs Institute

MEMR - Mobile Electronic Medical Record

MeSH - Medical Subject Headings

PCC - Population, Concept, and Context

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

"Questions you cannot answer are usually far better for you than answers you cannot question" (Yuval Noah Harari).

INTRODUCTION

Technological evolution has brought countless contributions to the development of humankind in many social and labor contexts, with information and communication technologies (ICTs) progressively guiding personal and professional life. Transcending all professions, technology has improved the overall performance of professionals, as well as allowing faster and more accessible knowledge for all. However, despite its positive effect, the technological revolution was also attended by new problems, exposing professionals to new risks and weaknesses arising from the use of technology (Camelo & Angerami, 2008; La Torre, Esposito, Sciarra, & Chiappetta, 2018).

It is in this context that makes sense to introduce the concept of Technostress, an emerging psychosocial risk, defined by Brod in 1984, as the incapability to face new technologies in a psychologically healthy way.

It is also important to mention the background of Technostress to understand the construct itself better. The antecedents can be defined as a presence of computerized technology (i.e., any machine that needs to be charged with electricity) in which a person should interact in order to achieve tasks. This interaction can be audiovisual or physical, or even being a part of the body such as having a robot hand or leg. In addition, it is relevant to know that the individuals who are in contact and control of those technological machines have different levels of ability and skill in the use of such technology, since there are other variables that affect their interaction, such as their experiences and age group, influencing the level of perceived technology-related stress (Abuatiq, 2015).

Technostress can, then, be defined as a modern disease of maladaptation, caused by the fear and the lack of ability to deal with new technologies. It shows similar symptoms to those of stress, such as fatigue, insomnia, headache, muscular tension and depression. Although, the most frequent symptom is the existence of frequent episodes of irritability or resistance to receiving instructions about the operation of any technological equipment or tool (Sagrera, 2008). In addition to this, Technostress can also be characterized by feelings of anxiety, confusion and being psychologically and physically uncomfortable when using technologies (Abuatiq, 2015).

Technostress can also be a continuum between two poles: technophobia and techno-addiction. Technophobia, in which the present paper will mainly focus, refers to a generally negative attitude on the part of the professional concerning any technological innovation, including even an explicit rejection in its use. It has a more frequent target of middle-aged or advanced workers and refers to a fear of technology, mainly due to the lack of training

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(joanacortereallucena@gmail.com)

of those professionals, especially those who do not use ICT in their daily life (Valenzuela, 2017). In its turn, Techno-addiction can be described as an addition to the new technologies caused by its use and abuse, especially in the workplace, generating a behavioral pattern of dependency, being the young professionals a more frequent target. Sometimes the compulsory use of ICTs is so high that it makes it difficult or even impossible to carry out work function that does not require the use of electronic devices (Valenzuela, 2017).

It is real the existence of damages inherent to technological changes with significant consequences in professionals' health. For instance, Technostress can cause several disorders, such as techno-anxiety, characterized by attitudes of distrust, skepticism, and thoughts of disability and technological incompetence; and techno-fatigue, described by feelings of fatigue and mental and cognitive exhaustion (Hernandez, 2017; Valenzuela, 2017), which can be manifested through attitudes of fear and distrust regarding the effectiveness of the use of technologies in the workplace (Valenzuela, 2017).

This psychosocial risk it is, then, characterized by the existence of an incongruity between the work demands and the resources associated to the use of ICT, leading to a high level of non-pleasurable psychophysiological activation and the growth of negative attitudes towards them (Carlotto & Câmara, 2010).

Technostress increases the more work setting requires the implementation and use of ICTs. Which is the case of health care workplaces that are already described as high-stress environments (Valenzuela, 2017), being nursing an intrinsically more stressful profession than others. The truth is that change regarding innovation technology is a constant in nurses' daily practice with the endless introduction and consequent adaptation to new technological equipment and medical devices (Morrison, Maded, & Lindberg, 2008). For instance, it is common to find nurses treating and caring for patients using complex electronic health record (EHR) software and other intricate tools such as infusion pumps, ultrasound light devices, cardiac monitors, all under severe flowcharts and bundles (Zhang, Barriball & While, 2014). This fact is crucial since technostressors include all innovations and developments related to technology (i.e., medical devices and technological tools), which leads to the increasing nurses' responsibility in work efficiently and in operate new devices that need to be integrated into care delivery systems. Besides, professionals have also the obligation to continuing to improve their competence regarding the use of this equipment to guarantee patient care and safety (Zhang et al., 2014).

As the use of medical devices proliferates, it becomes essential to manage the relationship between nurses and these technical equipments, since they are responsible for creating patterns of technological activity as well as changes in the nature of nursing practice itself, especially on workflow, in the way they manage all work and how they interact with patients (Sensmeier, 2012).

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Although there is a growing interest in the literature about the impact of Technostress on dimensions such as healthcare nurses' productivity, mental and physical exhaustion, and well-being (Burke, 2009; Koivunen, Kontio, Pitkanen, Katajisto & Valimaki, 2012; Morrison et al., 2008; Wallace, 2017), no scoping reviews (published or ongoing) has been found, in a preliminary search conducted in OVIDSP, EBSCOHost, and PubMed Databases, that maps the strategies that nurses use to prevent or decrease work-related Technostress. As a result, a scoping review of the literature was conducted based on the Joanna Briggs Institute (JBI) for Scoping Reviews methodology (Peters, Godfrey, Khalil, Mclnerney, Parker & Soares, 2015) with the intent of answer the following question: "*What strategies do nurses adopt to prevent or decrease work-related Technostress?*".

Systematic review method

According to JBI, the systematic review and the synthesis of evidence have to be in the core of evidence-based practice (Peters et al., 2015). In order to synthesize the research evidence more effectively and rigorously and map the existing literature, the development of new approaches, like scoping reviews, can be very helpful (Peters et al., 2015).

The scoping review approach was selected since it is an advantageous type of review for when a body of literature has not yet been broader reviewed. Also, the scoping review aims to map the key concepts that underpin a research area (Arksey & O'Malley, 2005), like identify gaps in the existing evidence, and suggest directions for future research (Peters et al., 2015). Also, this methodology has the particularity of not pretending to find the best scientific evidence or analyze the methodological quality of included studies, but merely determine what range of evidence (quantitative or qualitative) is available on a topic (Peters et al., 2015).

It was used the PCC (Population, Concept, and Context) strategy for the research question formulation. So, this scoping review intended to include studies focused on: a) nurses in contact with ICTs or other technological innovations during the treatment or care of patients, as participants; b) nurses implicit and explicit strategies used for the prevention or decrease of work-related Technostress, a concept; and, c) all clinical settings and geographical regions, as context. Primary qualitative and quantitative studies were included.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Search strategy

The search strategy included published and unpublished studies and was composed by an initial limited search on PsycARTICLES, PsycBOOKS, and PsycINFO (via OvidSP), CINAHL (via EBSCOHost), and MEDLINE (via PubMed) databases, followed by an analysis of the text words in the title and abstract, and of the index and medical subject headings (MeSH) terms used to describe the article. Following, a second search was performed using all the keywords, index terms and MeSH terms identified in the included databases (see table 1 in Annexes), all combined through the Boolean Operations "OR" and "AND", using the tool "*" to include all variations of the same word, and thus, expanding the search. All the references of all articles found in the search were analyzed in order to identify additional studies. All studies conducted until November 2018, written in English, Portuguese, French or Spanish were considered for inclusion in this review.

Two independent reviewers examined the relevance of the articles to be included in the review, based on the information provided by the title and abstract. The full-text version of all the studies that met the criteria for inclusion in the review was obtained. Whenever the reviewers had doubts about the relevance of a study, the full-text version was acquired and analyzed by the two independent reviewers to check if they met the inclusion criteria. Any disagreements between the reviewers were solved through discussion or by a third reviewer.

Data extraction

Data were extracted by two independent reviewers, using an extraction tool developed by the researchers consistent with the scoping review objective and question. This process was accomplished through consensus between two reviewers, and any disagreement was resolved with a third reviewer. Whenever necessary, the authors of primary studies were contacted in order to obtain more information or clarify data.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Presentation of results

It was utilized the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model for the study selection process and data organization. So, as shown in Figure 1, a total of 880 sources were retrieved from the databases searched, as potentially relevant studies. Of these, 126 studies were excluded for being duplicates; of the remaining 754 studies, 748 were excluded after title and abstract screening; after a full-text analysis of the remaining 6 articles, all of them were excluded because they did not meet all the inclusion criteria, more specifically, none of the studies really focused on the strategies used by nurses to prevent or decrease work-related Technostress.
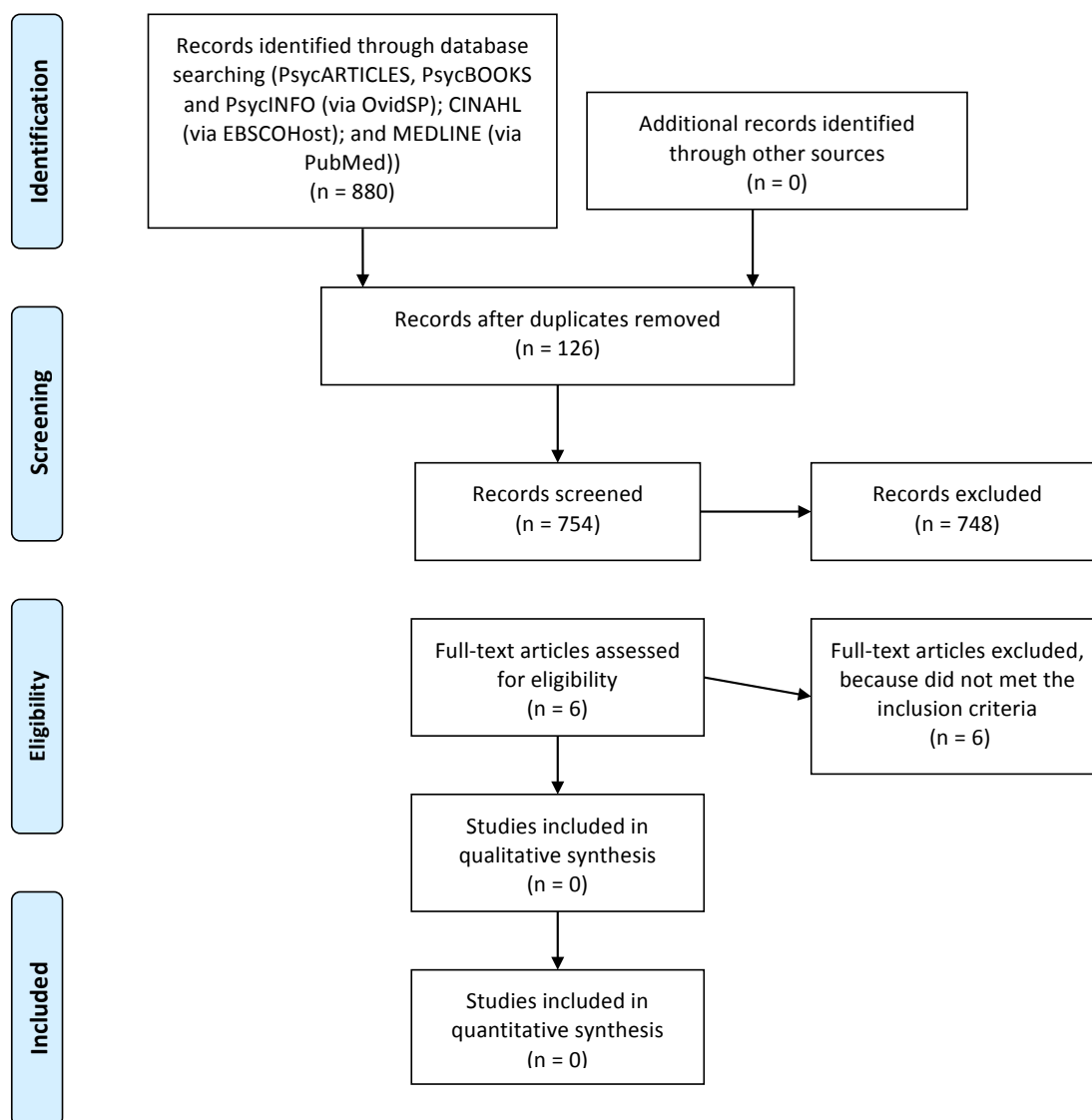
Figure 1
PRISMA Flow diagram (adapted) of the study selection process

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(joanacortereallucena@gmail.com)

Since there are no studies that meet the criteria to answer our methodological question, we consider pertinent to show (see Table 2 in Annexes) the objectives, design and methods and the most relevant results of the studies included in full-text reading articles, making known the most significant literature topics in this area.

The studies used qualitative and mostly quantitative designs, were published between 2006 and 2015, and were written in English. Concerning the country of origin, the studies were conducted in Greece, Finland, Taiwan, United Kingdom, Netherlands and the United States of America. All the studies had, as participants, nurses in contact with ICTs or other technological innovations during the treatment or care of patient, and were all conducted in the hospital context.

Interpretation of the results

This scoping review intended to examine, synthesize and map studies that describe the implicit or explicit strategies used by nurses to decrease or abolish Technostress in their daily practice.

Since none of the studies was integrated into this review for failing to meet the inclusion criteria, it becomes necessary to understand why this occurred.

Dealing with technology is associated with both positive and negative issues. However, while the positive effects of the use of technology in workplaces are unquestionable, the negative ones have significant consequences, such as a new type of work stress, namely Technostress (Abuatiq, 2015).

The concept of Technostress dates back to the 1980s and has been conceptualized in literature as a problem of adaptation where individuals cannot cope with the changes of technology, being a specific kind of stress related to uncomfortable technology usage (Brod, 1984).

However, Technostress is a very comprehensive construct since it is considered as a psychosocial work risk that covers all types of organizations that have to deal with technologies in the course of their work, becoming difficult to operationalize and makes it the object of scientific research (Salanova, 2003).

While previous research has investigated and examined the impact of Technostress creators (i.e., stressful situations influenced by technology) and their negative consequences

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

(i.e., harmful stress, anxiety, and reduced work productivity) (Tarafdar, Tu, Ragu-Nathan & Ragu-Nathan, 2007), few research have been carried out on the influence of such negative stressors in healthcare context, being Technostress itself an emergent psychosocial risk, present in clinical contexts, that remains overlooked and understudied (Califf, Sarker, Sarker & Fitzgerald, 2015).

Technostress used to be directly associated with the negative psychosocial cognitions related to ICT use. However, recent research shows that the exposure to technology during daily work affects the professionals' well-being positively (i.e., enthusiasm and flow experiences) and not just in a negative way, emphasizing the ambiguous perceptions and thoughts nurses have towards technology (Salanova, 2003; McVicar, 2003; Califf, 2015).

This ambiguity comes together with other significant aspects, such as the way they perceived and psychologically responds to technology-induced situations (Califf et al., 2015), the beliefs in its own skills and capacities to deal with technological tools, the self-efficacy attitudes towards technology, and the values and characteristics of technology itself (Salanova, 2003). This highlights the complexity that seems to be the understanding and assessment of Technostress in healthcare workplaces since it is dependent on a wide range of effects and variables.

Additionally, we believe that the level of technology-related stress felt by nurses is probably dependent on personality traits that make them more or less disposed to the use of technologies. For instance, a study conducted by Kuo, Liu, and Ma (2013), revealed that the personality traits influence nurses' acceptance of technologies as much as the level of stress perceived by them. So, nurses who are more optimistic have more positive attitudes and confidence towards technology and consequently less stress on new technology implementation process (Koivunen, et al., 2012; Kuo et al., 2013), as much as nurses who are used to deal with technological tools are more innovative and so, more eager to try new devices. On the other hand, nurses who are insecure and uncomfortable about technology are always concerned with the negative consequences of its use, showing lack of confidence in devices that they have to deal with, being everything that implies an adaptation to technological changes, an increase stress factor for them (Kuo, et al., 2013).

Moreover, Technostress can probably be felt in different ways depending on the hospital unit/service in which nurses' works. The way technology-related stress is perceived is also dependent on the relationship between the professional and the work setting environment in which professional cooperates (Walker & Avant, 2005; Califf et al., 2015). For instance, Mealer, Shelton, Berg, Rothbaum and Moss (2007) in their comparative study, reported evidence of post-traumatic stress disorder in Intensive Care Unit (ICU) nurses when compared with general nurses, mostly by dealing with dead bodies, caring for trauma victims and coping with psychological crises of patients' family. They consider that this scenario can

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(joanacortereallucena@gmail.com)

lead to a mental overload of ICU nurses (Burgess, Irvine & Wallymahmed, 2010), being the ICU environment perceived as a very demanding work setting that increases nurses anxiety and depression (Mealer et al., 2007). The same happens in the acute psychiatric unit, where nurses do their job in an unpredictable climate, having to deal, most of the time, with crisis management. This is also a challenging work environment, where nurses end up experiencing mentally strenuous work and occupational stress (Koivunen et al., 2012). Additionally, nurses who reported more positive experiences related to their work environment, generally have better capacities to cope in their own work, being also, more skilled in accepting new technology into their daily practice (Koivunen et al., 2012).

Despite this, Brod (1984) suggested that other several critical variables can affect the probability of developing Technostress, such as the age, the past experiences in contact with technology, the perceived control over new tasks, and the characteristics of the organizational climate and culture.

All of these factors, that being part of the nurses' work context, lead us to believe that probably Technostress can be perceived as a fragment of a professional context that generates more significant stress, overlapping its consequences. This may partly justify all the studies carried out around these variables and not about the strategies themselves to reduce it.

We can also approach Technostress concerns from the organizational level, which is where we suppose the central intervention takes place. The healthcare organizations can try to reduce Technostress effects from mechanisms that directly influence how nurses perceive the technology-induced stressful situations in order to make them adaptive responses (Ragu-Nathan, Tarafdar, Ragu-Nathan & Tu, 2008; Tarafdar, Tu, Ragu-Nathan & Ragu-Nathan, 2011).

According to Tarafdar et al. (2011), related to this topic, there are three organizational mechanisms, which seem to be essential to implementing. The first is the involvement facilitation mechanism that includes encouraging the professionals to use new technological equipment and implying them in preparation, elaboration, and implementation of technologies (Tarafdar et al., 2011). The second is the literacy facilitation mechanism, which provides the incitement of professionals to share expertise and knowledge between them, providing training and education (Ragu-Nathan et al., 2008). Finally, the third mechanism is the technical support system or team that needs to respond positively and quickly to professionals' requests and doubts related to any technological device. These mechanisms can increase job satisfaction, organizational commitment, continuance commitment, can reduce the impact of harmful stress derived by ICTs usage (Ragu-Nathan et al., 2008; Tarafdar et al., 2011), decrease patient risk due to human errors or mechanical faults (Kiekkas et al., 2006) and, in the long-term, they can relieve turnover and, consequently, improve the delivery of high-quality patient care (Califf, 2015).

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Finally, it seems crucial to highlight that clinical education should adjust in order to respond to the dramatic changes in technology (Linderman, 2000) since the adverse effects of technological equipment seem to be closely related to the lack of proper knowledge and training of nursing professionals (Kiekkas et al., 2006).

Lacking knowledge about technology devices increases nurses' fears, discomfort and lack of confidence in its use, being one of the key factors influencing nurses' attitudes towards technology (Zhang et al., 2014). Besides, an inadequate education can result in personnel errors, malfunction of equipment rising from poor maintenance, increasing stress and decreasing autonomy of nurses (Kiekkas et al., 2006; Zhang et al., 2014).

It would probably be significant to focus on the reliability of technological devices together with strategies to encourage nurses' knowledge and skills concerning to the use of devices, that have repercussions on positive attitudes and more natural adaptation to technological, medical equipment (Zhang et al., 2014).

Limitations of the scoping review

Only the mentioned databases were used for the research procedure. Other health-related databases could also have been useful to find further relevant studies to be included in the review. Besides, the title and abstract analysis may not be enough to effectively mirror what was done in the investigations, possibly eliminating some relevant articles. Additionally, using only healthcare professionals or physicians in addition to nurses as the research question population, could be less restrictor than use merely nurses.

Investigations may contemplate different concepts of Technostress, since it is a construct that is directly linked to the concept of stress and, therefore, can be understood in many different ways. Still, Technostress, as a psychosocial risk, is considered a very comprehensive construct, since that is present in almost all organizations that work with technologies, being difficult to operationalize.

Finally, Technostress can also be felt in different ways and degrees depending on the context, it means, the type of health organization in which it is being considered and on the type of hospital unit/service nurses works. Other contextual, individual and socio-demographic variables could be relevant to take into account in this scoping review.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Conclusion

The objective of this scoping review was to analyze and synthesize the research evidence in order to map studies that describe what strategies do nurses apply to prevent or decrease work-related Technostress, thus answering the proposed methodological question.

After an analysis of all full-text reading articles, it was concluded that none of the studies focused on the strategies adopted by nurses to prevent or decrease work-related Technostress.

We believe that this result can be explained by several factors that we have been trying to highlight throughout this paper.

Technostress appear in literature as a very general construct since it is considered as a psychosocial work risk that exists in almost all organizational contexts, becoming difficult to operationalize and to makes it the object of scientific research (Salanova, 2003).

The investigation has been very focused on examining the impact of technostress causes and consequences in organizational contexts in general. However, little research have been carried out in the particular context of health organizations, being Technostress as itself a subject that remains overlooked and understudied (Califf et al., 2015).

The understanding and assessment of Technostress in healthcare workplaces seems to be very complex, since it is dependent on a wide range of effects and variables, such as nurses' personal characteristics and personality traits that make them more or less disposed to the use of technology and their coping resources to deal with this (Kuo et al., 2013); their self-efficacy beliefs to deal with technology equipment; their past experiences with ICTs; and the technology values and characteristics itself (Salanova, 2003).

Lastly, Technostress can be felt in different ways depending on the context, it means, the hospital unit/service nurses' work. Besides, seems to exist other variables from nurses' work context, such as the extent of their demand (i.e. dealing with dead bodies, caring for trauma victims, and do their job in an unpredictable climate), and their work setting environment characteristics, that can be more or less challenging (Mealer et al., 2007; Koivunen et al., 2012), and can generate such high stress that they end up overlapping Technostress effects itself, remaining the nurses' strategies to decrease this risk, an undervalued subject.

It becomes essential to highlight that the intervention can be carried out through some organizational mechanisms that can be implemented in organizations, in order to reduce Technostress, such as the involvement facilitation, the literacy facilitation and the technical support (Califf, 2015; Califf et al., 2015). These mechanisms can also increase job

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(joanacortereallucena@gmail.com)

satisfaction and organizational commitment; reduce the impact of harmful stress derived by ICTs usage (Ragu-Nathan et al., 2008; Tarafdar et al., 2011), decrease patient risk due to human errors or mechanical faults (Kiekkas et al., 2006), and improve the delivery of high quality patient care (Califf, 2015).

Furthermore, there are some coping strategies that professionals can adopt to deal with work-related stress in general, which we believe that can be adapted to the specific case of Technostress and to nurses context. We refer to strategies like seeking for social, emotional and technical support, planning problem solving (Chan & Hoi, 1995), looking for positive feedback, adopting assertiveness techniques and communication skills, participate in training programs, and develop social support networks (Austin, Shah & Muncer, 2005).

Concerning to cognitive-behavioral methods there are techniques that includes changing negative responses to stressful-induced situations for new effective responses, giving the professional the chance to learn how to absorb positive and rational thoughts and how to use them on a daily basis (Austin, Shah & Muncer, 2005).

Other strategies can be found to be effective, such as relaxation techniques, the use of spirituality, meditation and transcendental meditation (Stein & Cutler, 2002), nutrition and physical exercise. Professionals can also adopt significant strategies like participate in posttraumatic debriefing sessions, talking about traumatic events and join to social support programs and health education interviews (Austin, Shah & Muncer, 2005). None of these strategies is the correct one to adopt since it is up to the professional to develop and to know how to choose the most effective strategy.

It is also relevant to emphasize the need of an adequate and continuing nursing education, which can provide proper technological knowledge, avoiding personnel errors, malfunction of equipment, that can decrease stress and increase nurses' autonomy (Kiekkas et al., 2006).

Finally, this lack of research specific to nurses strategies to eliminate Technostress makes it an important area for future investigations in which would be necessary to take into account another individual, contextual and socio-demographic variables in research.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Implications for future research

Literature has broadly presented the antecedents and the consequences of Technostress, as well as, shown several investigations about the impact of Technostress on dimensions such as nurses' productivity, job satisfaction, turnover intention, burnout, and well-being. Henceforth, more qualitative or quantitative studies must be conducted in order to deepen all these issues related to Technostress.

Future studies can investigating the Technostress issue starting by a qualitative survey to reach some understanding for how nurses perceive and felt Technostress, interviewing nurses from different hospital units/services and ask them about their own perception regarding if Technostress significantly impairs their clinical practice and if so, then how did they think they can reduce this stress, what strategies did they use to decrease it, or if they consider that this is a problem that should be controlled by the organizations, promoting some mechanisms that can help professionals to reduce it.

Future research is encouraged to include or relate other variables of nurses' professional context that were found to be probably significant to better understand the Technostress substance.

Finally, the study of this issue in the nursing field can help to show the impact that Technostress can have on nurses' clinical practice, alerting to its adverse effects on their physical and psychological health. Could be interesting to create psychosocial training and awareness programs next to health organizations and health professionals, both for the causes and consequences of Technostress, proposing strategies to manage this risk effectively in health workplaces.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

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Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

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Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

ANNEXES

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Table 1
Search strategy and search results per database

Database: MEDLINE (via PubMed)
Results: 586
Search strategy (21 november 2018)

Search (((((((((((((((((nurs*[Title/Abstract]) OR "Healthcare professionals"[Title/Abstract]) OR "health care professionals"[Title/Abstract]) OR "Health providers"[Title/Abstract]) OR "healthcare providers"[Title/Abstract]) OR "Health care providers"[Title/Abstract]) OR "health professionals"[Title/Abstract]) OR "Health personnel"[Title/Abstract]) OR "Healthcare personnel"[Title/Abstract]) OR "Health care personnel"[Title/Abstract]) OR "Primary care providers"[Title/Abstract]) OR "Health workers"[Title/Abstract]) OR "Healthcare workers"[Title/Abstract]) OR "Health care workers"[Title/Abstract]) OR "Health practitioners"[Title/Abstract]) OR "Healthcare practitioners"[Title/Abstract]) OR "Health care practitioners"[Title/Abstract])) AND ((((((((((((((technolog*[Title/Abstract]) OR innovat*[Title/Abstract]) OR telematics[Title/Abstract]) OR telecare[Title/Abstract]) OR telemedicine[Title/Abstract]) OR telenursing[Title/Abstract]) OR telehealth[Title/Abstract]) OR ICT*[Title/Abstract]) OR "mobile health"[Title/Abstract]) OR m-health[Title/Abstract]) OR e-health[Title/Abstract]) OR ehealth[Title/Abstract]) OR informatics[Title/Abstract])) AND stress[Title/Abstract])

Search (((((((((((((((((nurs*[Title/Abstract]) OR "Healthcare professionals"[Title/Abstract]) OR "health care professionals"[Title/Abstract]) OR "Health providers"[Title/Abstract]) OR "healthcare providers"[Title/Abstract]) OR "Health care providers"[Title/Abstract]) OR "health professionals"[Title/Abstract]) OR "Health personnel"[Title/Abstract]) OR "Healthcare personnel"[Title/Abstract]) OR "Health care personnel"[Title/Abstract]) OR "Primary care providers"[Title/Abstract]) OR "Health workers"[Title/Abstract]) OR "Healthcare workers"[Title/Abstract]) OR "Health care workers"[Title/Abstract]) OR "Health practitioners"[Title/Abstract]) OR "Healthcare practitioners"[Title/Abstract]) OR "Health care practitioners"[Title/Abstract])) AND (((((((((Technostress[Title/Abstract]) OR "Techno stress"[Title/Abstract]) OR "Techno-stress"[Title/Abstract]) OR "Techno-stressors"[Title/Abstract]) OR "Techno stressors"[Title/Abstract]) OR "Technology dependency"[Title/Abstract]) OR "Technological stress"[Title/Abstract]) OR "Technology-related-stress"[Title/Abstract])

Database: CINAHL (via EBSCOHost)
Results: 8
Search strategy (4 december 2018)

S45	(S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17) AND (S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38) AND (S39 AND S42)
S44	(S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17) AND (S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25)
S43	(TI stress AND AB stress) AND (S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38)

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

S42   (S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38)

S41   (S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25)

S40   (S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17)) AND (S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17)

S39   TI stress AND AB stress

S38   TI informatics AND AB informatics

S37   TI "ehealth" AND AB "ehealth"

S36   TI "e-health" AND AB "e-health"

S35   TI "m-health" AND AB "m-health"

S34   TI "mobile health" AND AB "mobile health"

S33   TI ICT* AND AB ICT*

S32   TI telehealth AND AB telehealth

S31   TI telenursing AND AB telenursing

S30   TI telemedicine AND AB telemedicine

S29   TI telecare AND AB telecare

S28   TI telematics AND AB telematics

S27   TI innovat* AND AB innovat*

S26   TI technolog* AND AB technolog*

S25   TI "technology-related-stress" AND AB "technology-related-stress"

S24   TI "technological stress" AND AB "technological stress"

S23   TI "technology dependency" AND AB "technology dependency"

S22   TI "techno stressors" AND AB "techno stressors"

S21   TI "techno-stressors" AND AU "techno-stressors"

S20   TI "techno-stress" AND AB "techno-stress"

S19   TI "techno stress" AND AB "techno stress"

S18   TI technostress AND AB technostress

S17   TI "health care practitioners" AND AB "health care practitioners"

S16   TI "healthcare practitioners" AND AB "healthcare practitioners"

S15   TI "health practitioners" AND AB "health practitioners"

S14   TI "health care workers" AND AB "health care workers"

S13   TI "healthcare workers" AND AB "healthcare workers"

S12   TI "health workers" AND AB "health workers"

S11   TI "primary care providers" AND AB "primary care providers"

S10   TI "health care personnel" AND AB "health care personnel"

S9   TI "healthcare personnel" AND AB "healthcare personnel"

S8   TI "health personnel" AND AB "health personnel"

S7   TI "health professionals" AND AB "health professionals"

S6   TI "health care providers" AND AB "health care providers"

S5   TI "healthcare providers" AND AB "healthcare providers"

S4   TI "health providers" AND AB "health providers"

S3   TI "health care professionals" AND AB "health care professionals"

S2   TI "healthcare professionals" AND AB "healthcare professionals"

S1   TI nurs* AND AB nurs*

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Database: PsycARTICLES, PsycBOOKS and PsycINFO (via OvidSP)
Results: 288
Search strategy (25 november 2018)

1 nurs*.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
2 "healthcare professionals".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
3 "health care professionals".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
4 "health providers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
5 "healthcare providers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
6 "health care providers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
7 "health professionals".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
8 "health personnel".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
9 "healthcare personnel".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
10 "health care personnel".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
11 "primary care providers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
12 "health workers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
13 "healthcare workers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
14 "health care workers".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
15 "health practitioners".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
16 "healthcare practitioners".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
17 "health care practitioners".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
18 technostress.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
19 "techno stress".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
20 "techno-stress".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
21 "techno-stressors".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
22 "techno stressors".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
23 "technology dependency".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
24 "technological stress".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
25 "technology-related-stress".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
26 technolog*.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
27 innovat*.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
28 telematics.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
29 telecare.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
30 telemedicine.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
31 telenursing.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
32 telehealth.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
33 ICT*.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
34 "mobile health".mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
35 m-health.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
36 e-health.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
37 ehealth.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
38 informatics.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
39 stress.mp. [mp=ti, ab, tx, ct, hw, tc, id, ot, tm]
40 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
41 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
42 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38
43 39 and 42
44 40 and 41
45 39 and 40 and 42

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Objectives, design and methods, and results of the studies included in full-text reading articles

Study	Country	Objectives	Design and methods	Results
Kiekkas et al. (2006)	Greece	To determine the perceptions of nurses who work in critical care units about the positive and negative effects related to the use of technological equipment.	A 14-item questionnaire was administered to 122 nurses, followed by a personal interview.	The majority of nurses pointed the positive effects of equipment regarding patient care and clinical practice. Although, they also pointed the possibility of technological equipment to increase risk due to human errors or mechanical faults, as well as, increase stress and reduce nurses autonomy.
Koivunen et al. (2012)	Finland	To exam nurses' occupational stress with the implementation of information technology (IT) on acute psychiatric wards, analyzing nurse's common use and attitudes to IT.	A structured questionnaire was administered to 146 nurses.	The majority of participants reported that the process of a new internet-based system implementation was mentally strenuous, increasing the stress levels. Although, nurses with positive attitudes to Internet use reported less stress and more job satisfaction than nurses with neutral attitudes.
Kuo et al. (2013)	Taiwan	To investigate nurses' personality traits in regard to technology readiness toward Mobile Electronic Medical Record (MEMR) acceptance.	A self-administered questionnaire was used to collect 665 valid responses.	Of the four personality traits of technology readiness (i.e., optimism, innovativeness, insecurity, and discomfort), all proven to have a significant impact on the perceived ease of use of technology equipment in general.
Zhang et al. (2014)	UK	To describe nurses' attitudes towards medical devices and to understand what factors are influencing these attitudes.	A systematic review was conducted, including all study designs. A search of six databases was undertaken for publications written in English dating from June1985 to June 2013. The search yielded 30 studies.	While some nurses recognized the potential contribution of medical devices to better outcomes for patients and themselves, the use of medical devices was also associated with increased personal stress, decreased autonomy and increased nurses' administrative time. The design of the devices, knowledge and training relating to device management and use, were identified as key factors influencing nurses' attitudes.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)

Study	Country	Objectives	Design and methods	Results
Veer et al. (2011)	Netherlands	To gain a better understanding of the determinants influencing the success or failure of the innovation process of new technologies as perceived by nursing staff.	A questionnaire was used to collect 685 (67%) responses of a nationally representative sample of nursing staff.	Half of the respondents were confronted with the introduction of new technology in the last three years. Also, only half of these rated the introduction of the technology as positive. The factors most frequently mentioned as impeding actual use were related to the (kind of) technology itself, such as malfunctioning, ease of use, relevance for patients, and risks to patients. Furthermore, nurses stress the importance of an adequate innovation strategy.
Califf, C. (2015)	USA	To theorize how hospital-based nurses appraise and perceive the stress induced by Healthcare Information Technology (HIT).	A case study was conducted from April 2012 to March 2014, corroborated by interviews.	Several nurses experienced harmful stress feelings about their relationship with HIT. Although HIT was associated with psychological stress in nurses, they also pointed that this stress is not always negative. The study illustrates the technology's potential to be associated with positive and negative psychological cognitions, being part of a transactional process that emphasizes the individuals' relationship to the environment and what the environment offers to the individual.

Joana de Oliveira Côrte-Real Lucena
(joanacortereallucena@gmail.com)