Which Factors of Digitisation Bias the Work-Related Stress of Healthcare Employees? A Systematic Review

Cristina VIRONEa,1, Lisanne KREMERa and Bernhard BREILa
a Faculty of Health Care, Niederrhein University of Applied Sciences, Germany

Abstract. Background: Digitisation affects our working environment. It demands new cognitive and digital skills of healthcare employees. Technostress and burnout are more likely to occur due to the additional workload. Aim: Objective is the identification of determinants affecting work related technostress. Methodology: We carried out a systematic review according to the PRISMA statement. For the identification of the digital factors, we applied an inductive content analysis based on Mayring’s theory. Results: Included studies showed the following factors to be relevant for coping with technostress: autonomy, competence, understanding of roles, time pressure, attitude, security and ergonomics. The emerging factors serve the regulation of stress in the healthcare system and contribute to better healthcare and higher occupational safety.

Keywords. technostress, healthcare workers, computerization, occupational stress, digitisation

1. Introduction

Healthcare workers are exposed to many different demands, including everchanging digital technologies, especially since the onset of the Covid 19 pandemic. Digital systems and technological equipment in intensive care units require health workers to adjust to a work-place with an increased level of digitisation [1]. Technostress, as described by the psychologist Brod in 1982 is the inability to maintain a healthy approach to technology [2]. Technostress marks the beginning of a long cascade of psychological problems and health complaints, which are emotional, physical or cognitive stress resulting in concentration problems, frustration, exhaustion and nervousness [3]. An approach to technostress in health care is particularly useful since the rapid rise of device usage has not been accompanied by a growth in related research.

The objective of this paper is to describe the current state of scientific knowledge about it. By conducting a systematic review, we would also like to specify factors that influence the emergence of technostress in the workplace of health facilities.

---

1 Corresponding Author, Lisanne Kremer Faculty of Health Care, Hochschule Niederrhein, Germany; E-mail: lisanne.kremer@hs-niederrhein.de.
2. Methods

A systematic search of published literature dating from 1990 until 2020 was conducted. The initial search built on the specified key words. After reconciliation of the key concepts with the Medical Subject Headings (MeSH) [4] thesaurus from the National Library of Medicine, search terms were phrased. Only articles written in english or german were considered. We did not limit the selection of papers in terms of study design and study type due to the low number of search results. Articles discussing stress referring to the usage of health information systems or medical technology were included. Burnout as an effect of prolonged Technostress was included. External validity was rated higher for studies with big study samples and sufficient randomization. Studies with a higher reduction of interference factors and therefore reduction of systematic bias were associated with better internal validity. Also standardised test situations were assessed more positively. Instruments with a Cronbach’s alpha value higher than 0.7 passed as reliable. The methodical procedure for the literature review was carried out according to the PRISMA statement [5]. For the identification of factors each included scientific article was summarized followed by word processing according to Mayring [6]. In this way seven categories emerge as research results, which are presented in the further course.

3. Results

A total of 925 articles were identified. The majority of studies can be searched through the user interface of PubMed (n=915), the remaining articles derived from reference lists and other databases (n=10). The duplicates amounted to 356 articles, which were removed, resulting in 569 remaining articles for the first review. The abstract screening resulted in 29 articles, that were eligible for the full text analysis. The final selection of included articles is n=22. Table 1 summarizes the most important features and aspects of the selected literature. The majority of the selected studies are based on a quantitative research design (n=13). Furthermore we identified n=7 studies that applied qualitative research designs and two studies with qualitative and quantitative elements. Two sources were only included to a limited extent because they are based on recommendations and comments [7,8]. Cross-sectional studies and panel studies combined with personal interviews were determined as particularly advantageous study designs. The assessment of the methodological quality proved to be a difficult process, as the requirements of the Cochrane Collaboration were partially fulfilled. Quantitative studies are assessed on their quality based on validity, reliability and objectivity [6]. Criteria for evaluating qualitative studies are transparency, coverage and intersubjectivity [9]. Seven Factors could be extracted as regulators of technostress. Time pressure is the strongest predictor for technostress. The added number of technological tasks in the same amount of work time causes the need for faster processing and often overstrains health employees in their usage of new technologies. Technostress is more likely to decrease if technologies are operated by skilled personnel, because workers themselves are empowered to solve their problems [10,11,12,13].
Table 1. Included Studies and characteristics

| Study | n    | Findings                                                                 | Study design                      |
|-------|------|---------------------------------------------------------------------------|-----------------------------------|
| [11]  | 20   | Technologies cause stress and increase time pressure. Training is helpful. | qualitative, descriptive Study    |
|       |      | Personal characteristics play a role in the development of technostress.   |                                   |
| [12]  | 22   | Acquisition of competence reduces technostress                           | Phenomenology                      |
| [19]  | 379  | Devices with basic functions reduce technostress                          | Cross-sectional study             |
| [20]  | 402  | Insecurity and work overload promote technostress                         | Cross-sectional study             |
| [7]   | -    | Technology promotes work overload and thus time pressure                   | Whitepaper                         |
| [21]  | 317  | Technostress promotes frustration, time pressure and burnout              | Cross-sectional study             |
| [22]  | 1095 | Time pressure is associated with a higher stress level. More complex     | Trend study                        |
|       |      | technologies promote stress                                               |                                   |
| [23]  | 1109 | Time pressure promotes technostress                                       | Trend study                        |
| [14]  | 35/16| Automation reduces the perception of work control. Technological          | Panel study                        |
|       |      | malfunctions increase technostress                                        |                                   |
| [16]  | 118  | Increased strain and limitation through technology                        | qualitative cross-sectional study  |
|       |      |                                                                            |                                   |
| [24]  | 146  | A positive attitude reduces stress and increases job satisfaction          | Cross-sectional study             |
| [25]  | 40   | Technologies increase time pressure and thus stress. Poor software       | Cross-sectional study             |
|       |      | design increases technostress                                             |                                   |
| [26]  | 665  | Training, optimism and the ability to innovate reduce technostress        | Cross-sectional study             |
| [27]  | 150  | Technologies are a risk factor for burnout                                | Secondary analysis                 |
| [28]  | 158  | Technostress relates to technological complexity and competence           | Cross-sectional study             |
| [15]  | 10   | Competencies reduce technostress                                          | qualitative, descriptive Study     |
| [8]   | -    | Introduction of technologies causes a change in work roles and workload   | Article                            |
| [29]  | 313  | Technologies contribute to work overload                                   | Cross-sectional study             |
| [30]  | 6375 | Technostress varies according to the medical specialisation of the doctors | Cross-sectional study             |
| [10]  | 3607 | Lack of competence and safety promotes time pressure and thus              | Cross-sectional study             |
|       |      | technostress                                                               |                                   |
| [31]  | 1860 | Lack of safety, poor ergonomics and negative mindset promote technostress | Cross-sectional study             |
| [17]  | 30   | Technologies promote time pressure and reduce autonomy                     | Systematic review                  |

Moreover, optimism and innovativeness promote openmindedness towards technologies and encourage their utilization [13]. To prevent higher level of technostress it is useful to allow more options in decision-making. Especially in health care professions, feelings of work control and safety are important factors for stress reduction [14]. Technostress of employees is significantly related to the technological design [7,10,13,15,16,17]. Technologies with a low number of functions are perceived as more uncomplicated and therefore believed to be more user-friendly and trustworthy.
4. Discussion

The studies show an increased risk for the prevalence of technostress due to the negative change in identified factors: autonomy, competence, mentality, time pressure, understanding of roles, safety and ergonomics. Changes in these aspects can whether have a positive or a negative influence on the perceived technostress at work. The influences of a digitalised working environment on health care workers have not yet been researched sufficiently. In total, 22 studies are included in the literature research. No randomised control trials or meta-analyses have been carried out. Although the total amount of articles is quite low, all articles state that digitization in health care causes increased technostress of health personnel. In comparison to other countries the national implementation of digital applications in Germany is low. Therefore it is difficult to find research results for such specific scientific problems [18]. The search in only one database (PubMed) may also be a reason for the low study count. It would be important to extend the search for articles to further databases for a bigger hit ratio. Surveys should take place in a more controlled setting and participants should be questioned about their general psychological health status to avoid the confusion between work stress and technostress.

5. Conclusion

Although the quality of the studies were insufficient concerning the evidence level all studies state that digitisation in health care causes increased technostress of health personnel. Research on Technostress is mainly in need of further development.

References

[1] Die Bundesregierung. Besprechung der Bundeskanzlerin mit den Regierungschefinnen und Regierungschefs der Länder am 12. Maerz 2020. https://www.bundesregierung.de/bregde/themen/coronavirus/beschluss-zu-corona-1730292.
[2] Brod C. Technostress: The Human Cost of the Computer Revolution. 1984. AddisonWesley Publishing Company, Reading.
[3] Ungvarsy J. Technostress. 2019. In: Salem Press Encyclopedia of Health.
[4] Bluemle A, Lagreze WA und E Motschall. Systematische Literaturrecherche in "PubMed": Juli 2018. In: Gefaesschirurgie 23.4, 264–275. ISSN: 1434-3932. DOI: 10.1007/s00772-018-0373-0
[5] Moher D, Liberati A, Tetzlaff J und D Altman. Preferred Reporting Items for Systematic Reviews and MetaAnalyses: The PRISMA Statement. 2009. In: PLoS Med 6.7.
[6] Mayring P. Qualitative Inhaltsanalyse: Grundlagen und Techniken. 2015. 12. überarbeitete Auflage. Weinheim: Beltz Verlagsgruppe. ISBN: 978-3-407-29393-0.
[7] Furlow B. Information overload and unsustainable workloads in the era of electronic health records. Mårz 2020.In: The Lancet Respiratory Medicine8.3. Publisher: Elsevier, 243 – 244.
[8] Morrison J und P Lindberg. When no one has time: measuring the impact of computerization on health care workers. Sep. 2008.In: AAOHN journal: official journal of the American Association of Occupational Health Nurses 56.9, S. 373 – 378. DOI: 10.3928/0891016220080901-06.
[9] Mey G, Vock R und S Ruppel. Gütekriterien qualitativer Forschung. 2020. https://studi-lektor.de/tipps/qualitative-forschung/guetekriterien-qualitativer-forschung.html.
[10] Vehko T, Hypponen H, Puttonen S, Kujala S, Ketola E, Tuukkanen J, Aalto A-M und T Heponiemi. Experienced time pressure and stress: electronic health records usability and information technology competence play a role. Aug. 2019. In: BMC Medical Informatics and Decision Making 19.1, 160.
Adaskin EJ, Hughes L, McMullan P, McLean M und D McMorris. The Impact of Computerization on Nursing: An Interview Study of Users and Facilitators. Computers in Nursing: administration, practice, research, education. 1994; 12(3): 141 – 148.

Alasad J. Managing technology in the intensive care unit: the nurses’ experience. International Journal of Nursing Studies. 2002; 39(4): 407 – 413.

Kuo K-M, et. al. An investigation of the effect of nurses’ technology readiness on the acceptance of mobile electronic medical record systems. BMC medical informatics and decision making. 2013; 13(88).

James KL, et. al. The impact of automation on pharmacy staff experience of workplace stressors. International Journal of Pharmacy Practice 2013; 21(2): 105 – 116.

McConnel EA. The impact of machines on the work of critical care nurses. Critical Care Nursing Quarterly 1990; 12(4): 45 – 52.

Kielkcas P, et al. Use of technological equipment in critical care units: nurses’ perceptions in Greece. Journal of Clinical Nursing. 2006; 15(2): 178 – 187. DOI: 10.1111/j.1365-2702.2006.01243.x.

Zhang W, Barriball KL While AE. Nurses’ attitudes towards medical devices in healthcare delivery: a systematic review. Journal of Clinical Nursing 2014; 23(20): S. 2725 – 2739.

Thiel R, et al. #SmartHealthSystems: Auszug Deutschland – Digitalisierungsstrategien im internationalen Vergleich. 2018. Hrsg. von Bertelsmann Stiftung. 1. Aufl. SPOTLIGHT Gesundheit. Gesundheitsinfos 2. Gutersloh.

Califf CB. Technostress in Healthcare: a multi-method investigation. Aug. 2015. Diss. Washington State University, Carson College of Business.

Harris DA, Haskell J, Cooper E, Crouse N, Gardner R. Estimating the association between burnout and electronic health record-related stress among advanced practice registered nurses. Applied Nursing Research. 2018; 43: 36 – 41.

Kuo K-M, Liu C-F, Ma C-C. An investigation of the effect of nurses technology readiness on the acceptance of mobile electronic medical record systems. BMC medical informatics and decision making 2013;13(88). DOI: 10.1186/1472-6947-13-88.

Lilly CM, Cucchi E, Marshall N, Katz A. Battling Intensivist Burnout: A Role for Workload Management. Nov. CHEST 2019;156(5): 1001 – 1007.

Liu C-F, Cheng T-J, Chen C-T. Exploring the factors that influence physician technostress from using mobile electronic medical records. Informatics for Health & Social Care 2019;44(1): 92 – 104. DOI: 10.1080/17538157.2017.1364250.

Sandoval-Reyes J, Acosta-Prado JC, Sanchus-Pedregosa C. Relationship Amongst Technology Use, Work Overload, and Psychological Detachment from Work. International Journal of Environmental Research and Public Health 2019;16(23). DOI: 10.3390/IJERPH16234602.

Shanafelt TD, Dyrbye LN, Sinsky C, Hasan O, Satele D, Sloan J, West CP. Relationship Between Clerical Burden and Characteristics of the Electronic Environment With Physician Burnout and Professional Satisfaction. Mayo Clinic Proceedings 2016;91(7): 836 – 848. DOI: 10.1016/j.mayocp.2016.05.007.

Vitari C, Olodjeau-Taddi R. The intention to use an electronic health record and its antecedents among three different categories of clinical staff. BMC Health Services Research 2018;18(1): 194. DOI: 10.1186/s12913-018-3022-0.