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RESILIENT PERFORMANCE IN HEALTHCARE: A SOCIOERGONOMIC PERSPECTIVE

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Summary: Ergonomics can be investigated by a wide variety of interests that include physiological, psychological and sociological factors. The latter can be checked for social support between colleagues and supervisors. Perceived social support among co-workers increases the level of satisfaction with performance and buffers work-related stressors, in addition to the fact that people deal better with the work environment when they feel actively involved and well-informed. In this sense, this research aimed to identify the most central actors considered supportive for various issues in the work of a multidisciplinary health team. For this purpose, the social network analysis method was used, in addition to correlational statistics. This analysis was carried out in a hospital radiology service, resulting in the most central profile being those workers with mobility between shifts, long experience and morning shifts. Workers with a higher hierarchical position provide a greater contribution to the resilient performance of the radiology service, just as informal leaders also contribute. It was concluded that the analysis of social networks allows us to understand how the flow of resources between workers correlates with behaviors and their individual characteristics. Finally, it is emphasized that proper training in counseling for the most central actors would be of great value for the organization to improve its assistance and provide adequate social support, as well as supporting the improvement of the organizational climate.

Keywords: socio-ergonomics; social network analysis; resilience; radiology.

1. Introduction

The study of social interactions at work through the lens of Ergonomics is not new. Since the formalization of Ergonomics in the 1940s, what has come to be known as the

information processing approach to human performance has been studied (WELFORD, 1979). This approach leveraged the studies of the interaction between man and machine, expanding the horizons for the study of interactions between human and human (WELFORD, 1979). Social interaction is essentially a feedback process: for example, friendship can be considered as a relationship in which each party encourages the other's communication and thus produces positive feedback; whereas hostility is typically a relationship in which each party tries to prevent the other from communicating – a negative feedback situation. In the same terms, loneliness can be considered as a result when feedback is sought, but none, positive or negative, occur (WELFORD, 1976).

Many studies implicitly or explicitly subscribe to a model of social support as coping assistance (THOITS, 1986). Goldsmith (2004) highlights that there are ways of conceptualizing social support that do not presuppose a conversation about a problem and there are ways of modeling the positive effects of social support that do not have to do with coping and stress, the author cites the work of Cohen, Gottlieb and Underwood (2000), which reviews the effects of social support on physical health. As well as the work of Bertoni, Saurin and Fogliatto (2022) demonstrated that social counseling networks among workers in a hospital intensive care unit contribute to organizational resilience. Furthermore, Goldsmith (2004) concluded that the buffering of stress due to social support is the predominant property among the findings about involvement in personal relationships, and improves individual and community well-being.

In the Health sector, social support helps to preserve the mental health of health workers and contributes beneficially to the perception of self-efficacy (LABRAGUE, 2021). Furthermore, social support among healthcare workers mediates the negative effects of Burnout Syndrome, which is prevalent in these professionals (RUISOTO et al., 2021). Therefore, social relationships interfere with health and quality of life at work, and therefore, Social Network Analysis (SNA) can be a tool that assists in socio-ergonomic diagnosis and, in view of this, in Work Organization. The present work aimed to identify the most central actors of a multidisciplinary team in a socio-technical system, in addition to measuring the individual contribution to resilient organizational performance.

2. Theoretical review

Several studies draw attention to the human aspect in organizations, linking quality of life at work with social support networks. Perceived social support among co-workers increases the level of satisfaction with performance and buffers the damage caused by work

stressors (HALBESLEBEN, 2006). Social support was also associated with safety culture, shown by indicators about discussing and encouraging communication about safety being correlated with workers' perception of the tone of social support (TUCKER et al., 2008). From the point of view of patient safety it is no different, it is proven that communication between co-workers plays an essential role in the quality of patient care, ensuring safe treatment (FUCHSHUBER; GREIF, 2022).

2.1 Social network analysis concept

According to Wasserman and Faust (1994), a social network consists of actors, which can be people, organizations, among others, who have some form of connection, such as a common interest. ARS is an interdisciplinary behavioral science. She considers that the interdependence and connections between social actors have important consequences for each actor. For example, the flow of materials and information between actors affects their influence and power (FREEMAN, 1978). According to Freeman (1978), the origins of this science date back to the 1930s and are associated with social psychologist Hellen Hall Jennings and psychiatrist Jacob Levy Moreno, who created sociometry as a means of quantifying social relations.

2.2 Social centrality metrics

Freeman (1978) established the foundations of centrality in networks from the perspective of human communication and emphasized that structurally, a network in the shape of a star or wheel has the most central point that is visually easy to find. This position has the highest degree of connections; it is the largest geodesically intermediate (shortest path between two points) of the network; and is located at a minimum distance from all other points, therefore it is the position that is closest to all (FREEMAN, 1978). In quantitative terms, these three metrics are obtained by ARS, where: degree is the sum of the nearest neighbors; betweenness is the frequency that the actor is in the path between two other actors; and proximity is the total distance from the actor to everyone else in the network.

2.3 Resilient healthcare performance

An analytical framework commonly adopted to investigate resilient healthcare involves the four potentials of systems with resilient performance, namely: monitor, anticipate, respond and learn, available in Table 1 (HOLLNAGEL, 2017):

Table 1 – Potentials of organizational resilient performance

Monitoring – involves knowing what to look for, focusing on what is critical or could become a threat in the short term.	Anticipate – implies knowing what to expect, anticipating threats, opportunities, changes, interruptions, pressures and their consequences.

Responding – implies knowing what to do, dealing with regular and irregular opportunities and threats, implementing a set of pre-prepared responses or adapting the normal functioning of the system.	Learning – implies learning from failures and successes, learning the right lessons from relevant experiences.

These potentials are implicitly developed through daily social interactions in the workplace, such as requesting information about the patient's condition, attending ward rounds and during shift changes (WACHS et al., 2016).

3. Method

To identify the social support provided by co-workers in a multidisciplinary team, a survey was carried out, in which two types of questionnaires were applied. The first is a questionnaire for ARS aiming to distinguish different support considering the four potentials (monitor, anticipate, respond and learn) proposed by Hollnagel (2017) for the resilient performance of an organization. This first questionnaire contains eight questions, as shown in Table 2. The second questionnaire deals with sociodemographic issues (e.g., gender, shift, length of professional experience). Such questionnaires were applied in a large and highly complex hospital, specifically in the radiology service, characterized in Table 3 according to the four subsystems of sociotechnical systems proposed by Hendrick and Kleiner (2001).

Table 2 – ARS Questionnaire

Question 1. Interactions	From the list of colleagues below, select those with whom you interact most frequently.	(Q1) List of names
Question 2. Monitor	How often do you interact with this person to find out what is happening or what happened in real time at work?	(Q2, Q3, Q4 and Q5) Names selected in Q1 1 – never 2 – less than once a month 3 – one to three times a month 4 – one to three times a week 5 – daily
Question 3. Anticipate	How often do you interact with this person to anticipate short, medium, and long terms work-related trends?	
Question 4. Answer	How often do you interact with this person to act or react to expected or unexpected situations at work?	
Question 5. Learn	How often do you interact with this person to learn about positive and negative situations at work?	
Question 6. Availability	How often is this person likely to be available when you reach out to them?	(Q6 and Q7) Names selected in Q1 1 – never; 2 – rarely; 3 – sometimes; 4 – frequently; 5 – always
Question 7. Reliability	How often is this person likely to provide accurate information or assistance?	
Question 8. Name	From the list of names below, select your name.	(Q8) Name

Table 3 – Description of the subsystems of the radiology service studied

SUBSYSTEMS	SOCIAL: The service has 221 employees, including administrative assistants (N=19), nurses (N=6), radiologists (N=45), resident radiologists (N=14), nursing technicians (N=64) and radiology technicians (N=73).	TECHNICAL: 170,000 exams/year; Exams such as x-rays, mammograms, computed tomography scans, magnetic resonance imaging, ultrasounds and biopsy procedures are performed; fixed and mobile diagnostic imaging equipment. Use of dosimeter. The building's main elevators are one hundred meters from the radiology entrance, located on the second floor.
	WORK ORGANIZATION: Nursing carries out shift changes and has a fixed shift and weekly position rotation. Radiology technicians and technologists have fixed shifts and in some workstations they rotate weekly. Administrative assistants have the longest daily working hours. Doctors have shift mobility. Resident Doctors have a residency program in three annual phases.	EXTERNAL ENVIRONMENT: Varied patient profile (inpatient and outpatient; neonatal to geriatric). Three buildings, the main one (A) has 13 floors and annexes (B) 8 floors and (C) 6 floors.

This research operationalizes a case study as a procedure, in which the chosen approach is quantitative with descriptive purposes using a survey, carried out through two questionnaires. Data collection took place from October to December 2020. Data analysis was carried out using the ARS method and correlational statistics. The analysis of the ARS questionnaire was carried out using Excel® and UCINET® software. Furthermore, for reasons of confidentiality and ethics, the names of respondents in the data analysis were transformed into alphanumeric codes, namely: A (Administrative Assistant); E (Nurse); M (Doctor); R (Resident); TE (Nursing Technician); and TR (Radiology Technician or Technologist). Immediately after data processing, the two formulas by Bertoni et al. (2022), where the global resilience score and the score for each of the four potentials are calculated for each actor, according to equations (1) and (2). After data analysis, a feedback meeting was held for participants.

$$ER_{ij} = \left[GE_{ij} \times INT_{ij} \times PR_{ij}\right] \times D_i \times C_i \quad \text{Equation (1)}$$

$$ER_i = \left[\sum_{j=1}^{4} GE_{ij} \times INT_{ij} \times PR_{ij}\right] \times D_i \times C_i \quad \text{Equation (2)}$$

Where: ER_{ij} *Resilience Score for actor i and network j,* GE_{ij} = *Degree of entry,* INT_{ij} = *Intermediation,* PR_{ij} = *Proximity,* D_i = *Availability,,* C_i = *Reliability, i = valuated actor and j = evaluated potential network.*

4. Results and discussions

Table 1 illustrates the distribution of the sample, indicating the preponderance of radiology technicians and technologists (37% of respondents), as well as nursing technicians (28% of respondents). However, in terms of response rate considering the total population of each category, nurses and residents stood out, with respectively 100% and 86% participation of professionals belonging to the category.

Table 1 – Sample response rate by groups

Team	Respondents (n = 148)	% Sample	Population (N = 221)	% group representation	Population in %
Radiology Technicians and Technologists (TR)	55	37%	73	75%	33%
Nursing technicians (TE)	41	28%	64	64%	29%
Radiologists (M)	25	17%	45	51%	20%
Residents (R)	12	8%	14	86%	6%
Administrative Assistants (A)	9	6%	19	47%	9%
Nurses (E)	6	4%	6	100%	3%

Table 2 demonstrates one of the Top10 analyzes of resilience potentials, that is, the most central actors, where eight of these actors (TR37, TR65, E3, A18, E5, A13, TR10, M44) appear among the Top10 in the four networks of potentials. The actor E1 appears in three of the four networks, A5 appears in two and M3, TR50 and TR48 appear in only one of them. The categories of Nursing Technicians and Residents do not appear in the Top10. As for

doctors, only two appear among the Top10 networks (M44 and M3), with M44 being a manager.

Table 2 – Top10 actors: Learn

Actor	Diff. Tur.	Gender	Shift	Entry Degree	Intermediation	Proximity	Availability	Reliability	Resilience Score
TR37*	Yes	M	1	5,0	2,0	5,0	4,3	4,6	1008,0
TR65*	Yes	M	2	2,9	5,0	3,6	3,8	4,0	801,6
E3*	Yes	F	1	3,3	2,2	4,7	3,9	4,1	530,6
TR50	Yes	M	1	3,1	2,1	4,4	4,2	4,1	503,4
E5	Yes	F	1	2,6	1,8	3,6	4,6	4,6	363,2
M44*	Yes	M	1	2,5	1,8	4,3	4,3	4,5	357,9
A13*	Yes	F	1	2,6	1,3	4,4	4,5	4,6	300,0
TR10	Yes	M	1	2,1	2,5	3,1	4,1	4,3	285,8
A18	Yes	F	1	2,1	2,3	3,7	3,8	4,2	285,4
M3	Yes	F	1	2,5	1,5	3,9	4,2	4,3	253,7

Where: Diff. Tur. = working in different shifts, as opposed to working in one shift. M = male; F = feminine. 1 = morning; 2 = late; 3 = night. * = leadership position.

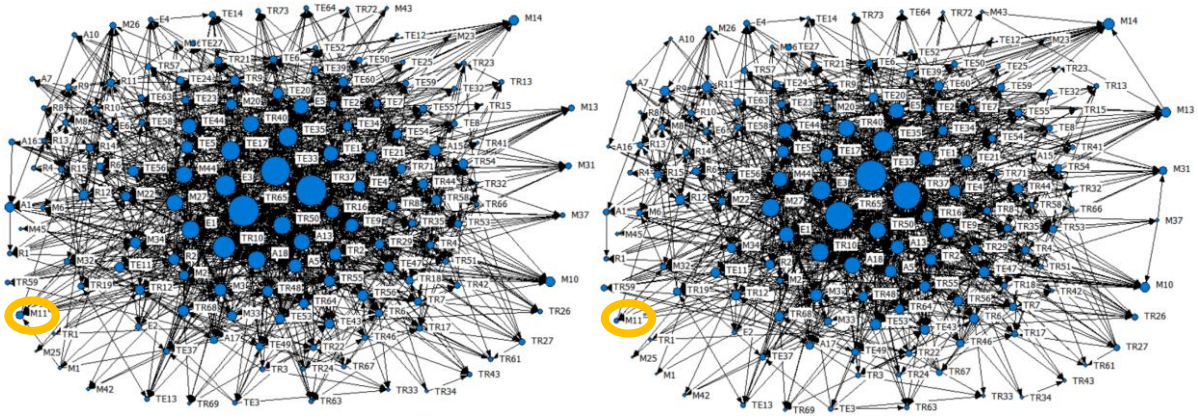
Of these 13 different actors that appear in the four resilient potential networks, 38% are radiology technicians, 23% nurses, 23% administrative assistants, 13% doctors and 0% nursing technicians and residents. Furthermore, 62% are female and 38% male. This distribution is close to that of the sample, composed of 59% female participants and 41% male participants. Only one works a fixed shift, RT50. This makes sense considering that working in different shifts tends to expand the circle of social interactions. With regard to the shift, the majority (84%) work predominantly in the morning shift and only one (8%) in the afternoon and one (8%) in the night. This is disproportionate to the sample, where 48% are in the morning and 14% in the evening. Thus, interactions in the afternoon, followed by the night, contribute less to the resilience of the system. The majority (85%) do not work in another company, only two who do (15%), namely the actors RT37 and RT10. On average, the actors in the Top10 resilience networks have worked in radiology for 17 years, ranging from 5 to 34 years. The majority of respondents (69%) said they 'always' take the initiative to offer help and information to colleagues, 15% 'often', 8% 'rarely' and 8% 'sometimes'. Thus, in general, the profile of the actors who contribute most to organizational resilience, according to the Top10 rankings, is the following: morning shift, works only in this company, long experience in the service, and takes the initiative to offer assistance to colleagues.

The results regarding Spearman coefficient correlations, with a confidence interval at the 10% level, demonstrated only two significant variables, these involving the period in which professionals are available at work). Professionals who work more than one shift, that is, mobility between shifts, showed a positive correlation with the potential to respond ($r=0.172$; $p=0.037$), anticipate ($r=0.137$; $p=0.096$) and monitor ($r= 0.145$; $p=0.079$), showing that the most central actors will likely be those who work in different shifts, as well as the most central actors related to the potential to learn do not necessarily work in more than one

shift. Furthermore, the morning shift showed a correlation with the four potentials, anticipating (r=0.183; p=0.026), learning (r=0.177; p=0.031), monitoring (r=0.163; p=0.047) and responding (r= 0.143; p=0.083), this demonstrates that actors who work the morning shift tend to be more central. According to participants' reports, the main decision-making takes place in the morning shift, increasing the likelihood that workers on this shift will obtain first-hand information, thus being more influential in social circles.

The sociograms in Figure 1a)b) graphically represent social interactions in the monitor and learn networks, which are presented with the purpose of exemplifying the conclusions that can be obtained from these representations: (i) the density of the monitor network is greater than the learn network (the quantitative density indicators of each network are 6% and 5.2% respectively); (ii) the imbalance of scores in each actor, such as M11 (21st, 81st, 128th and 43rd position in the monitor, anticipate, respond and learn networks, respectively); and (iii) the existence of central and peripheral actors (the larger the node size, the greater the centrality). The presentation of these sociograms at the feedback meeting to participants caused an impact among them, who associated more central actors with the role of informal leaders, as well as considering that the complexity of social interactions was well illustrated. It is worth remembering that informal leaders are also known for being agents that influence new behaviors or changes.

Figure 1 – Sociogram of the network a) monitor and b) learn



a) b)

5. Conclusion

The quality of the social environment at work influences subjective well-being. Social support can prevent stress at work or at least help workers cope more effectively. In the present study, the objective had been stated as follows: “to identify the most central actors of a multidisciplinary team in a socio-technical system, in addition to measuring the individual contribution to resilient organizational performance.” This objective was achieved through

quantitative techniques, which involved correlation analysis and social network analysis, which in turn requires the application of a specific ARS questionnaire, and this methodology can be replicated in other contexts. In this study, the profile of the most central actors was verified, and that factors such as working hours or hierarchical position provide greater centrality. Therefore, professionals with mobility between shifts, long experience, and morning shifts contribute more to the resilient performance of the radiology service. That said, proper training in counseling for the most central actors would be of great value to the organization in providing adequate social support and improving organizational performance.

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Bibliographic references

BERTONI, V. B.; SAURIN, T. A.; FOGLIATTO, F. S. How to identify key players that contribute to resilient performance: a social network analysis perspective. **Safety Science**, v. 148, 2022.

COHEN, S.; GOTTLIEB, B. H.; UNDERWOOD, L. G. Social relationships and health. *In*: COHEN, S.; UNDERWOOD, L. G.; GOTTLIEB, B. H. (eds.). **Social support measurement and intervention: a guide for health and social scientists**. Oxford: Oxford University Press, 2000.

FREEMAN, L. C. Centrality in social networks. **Social Networks**, v. 1, n. 3, p. 215–239, 1979.

FUCHSHUBER, P.; GREIF, W. Creating effective communication and teamwork for patient safety. *In*: ROMANELLI, J. R.; DORT J. M.; KOWALSKI, R. B.; SINHA, P. (EDS.). **The SAGES manual of quality, outcomes and patient safety**. Cham: Springer, 2022.

GOLDSMITH, D. J. **Communicating social support**. Cambridge: Cambridge University Press, 2004.

HALBESLEBEN, J. R. B. Sources of social support and burnout: a meta-analytic test of the conservation of resources model. **Journal of Applied Psychology**, v. 91, n. 5, p. 1134–1145, 2006.

HENDRICK, H. W.; KLEINER, B. M. **Macroergonomics: an introduction to work system design**. Santa Monica: Human Factors and Ergonomics Society, 2001.

HOLLNAGEL, E. The resilience potentials. *In*: **Safety-II in practice: developing the resilience potentials**. London: Routledge, p. 26–49, 2017.

LABRAGUE, L. J. Psychological resilience, coping behaviours and social support among health care workers during the COVID-19 pandemic: a systematic review of quantitative studies. **Journal of Nursing Management**, v. 29, n. 7, p. 1893–1905, 2021.

RUISOTO, P.; RAMÍREZ, M. R.; GARCÍA, P. A.; PALADINES-COSTA, B.; VACA, S. L.; CLEMENTE-SUÁREZ, V. J. Social support mediates the effect of burnout on health in health care professionals. **Frontiers in Psychology**, v. 11, January, p. 1–8, 2021.

THOITS, P. A. Social support as coping assistance. **Journal of Consulting and Clinical Psychology**, v. 54, n. 4, p. 416–423, 1986.

TUCKER, S.; CHMIEL, N.; TURNER, N.; HERSHCOVIS, M. S.; STRIDE C. B. Perceived organizational support for safety and employee safety voice: the mediating role of coworker support for safety. **Journal of Occupational Health Psychology**, v. 13, n. 4, p. 319–330, 2008.

WACHS, P.; SAURIN, T. A.; RIGHI, A. W.; WEARS, R. L. Resilience skills as emergent phenomena: a study of emergency departments in Brazil and the United States. **Applied Ergonomics**, v. 56, p. 227–237, 2016.

WASSERMAN, S.; FAUST, K. **Social Network Analysis: methods and applications**. Cambridge: Cambridge University Press, 1994.

WELFORD, A. T. Motivation, capacity, learning and age. **Int. J. Ageing & Hum. Develpt**, v. 7, p. 189–199, 1976.

WELFORD, A. T. The concept of skill and its application to social performance. *In*: Singleton, W. T.; Spurgeon, P.; Stammers, R. (Eds.). New York. **Proceedings of the Symposium on The Analysis of Social Skill**. Leuven, Belgium, June 5-9. New York: Plenum Press, 1979.