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RESILIENT PERFORMANCE IN HEALTH: A SOCIOERGONOMIC PERSPECTIVE

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Abstract

Ergonomics can be investigated for a wide variety of interests, including physiological, psychological, and sociological factors. The latter can be verified in terms of social support among colleagues and supervisors. Perceived social support among coworkers increases the level of satisfaction with performance and buffers work-related stressors, in addition to the fact that people cope 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 supporters for various work issues in 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 profile of greater centrality of those workers with mobility between shifts, long experience, and who work the morning shift. Workers with higher hierarchical positions provide a greater contribution to the resilient performance of the radiology service, as do informal leaders. It was concluded that the analysis of social networks allows us to understand how the flow of resources between workers correlates with their behaviors and individual characteristics. Finally, it is emphasized that adequate 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 to support the improvement of the organizational climate.

Keywords: socioergonomics; social network analysis; resilience; radiology.

1. INTRODUCTION

The study of social interactions at work through the prism 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, broadening the horizons for the study of the interactions between human and human (WELFORD, 1979). Social interaction is essentially a feedback process: for example, friendship can be thought of as a relationship in which each party encourages communication from the other and thus produces positive feedback; while hostility is typically a relationship where each party tries to prevent the other's communication – a negative feedback situation. In the same terms, loneliness

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can be considered as a result when feedback is sought, but none, positive or negative, occurs (WELFORD, 1976).

Many studies implicitly or explicitly subscribe to a model of social support as coping assistance (THOITS, 1986). Goldsmith (2004) points out 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 collaborate for organizational resilience. Furthermore, Goldsmith (2004) concluded that the dampening of stress due to social support is the predominant property among the findings on 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). In addition, social support among health workers mediates the negative effects of the Burnout Syndrome that 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 helps in the socioergonomic diagnosis and, in view of this, in the Organization of Work. The objective of this study was to identify the most central actors of a multidisciplinary team in a socio-technical system, in addition to measuring the individual contribution to organizational resilient performance.

2. THEORETICAL REVIEW

Several studies draw attention to the human aspect in organizations, linking the quality of life at work with social support networks. Perceived social support among co-workers increases the level of satisfaction with performance and cushions harm and job stressors (HALBESLEBEN, 2006). Social support was also associated with safety culture, shown by indicators on discussing and encouraging communication about safety were correlated with workers' perception of the emphasis on 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 their treatment safely (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 relationships.

2.2. Social metrics of centrality

Freeman (1978) established the foundations of centrality in networks through the lens of human communication and emphasized that structurally, a network in the shape of a star or wheel has the most visually easy to find central point. This position has the highest *degree* of connections; it is the greatest *geodesically intermediation* (shortest path between two points) of the network; and it is located at a minimum distance from all other points, so it is the position that has the greatest *proximity* of all (FREEMAN, 1978). In quantitative terms, these three metrics are obtained by ARS, where: *degree* is the sum of the nearest neighbors; *intermediation* 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 health performance

A commonly adopted analytical framework for investigating resilient health care involves the four potentials of systems with resilient performance, namely: monitor, anticipate, respond, and learn, available in Chart 1 (HOLLNAGEL, 2017):

Chart 1 – Potentials of organizational resilient performance

Monitoring – implies knowing what to look for, focusing on what is critical or may become a threat in the short term.	Anticipating – 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 conditions, attending ward rounds, and during shift handovers (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 SRA aimed at distinguishing different support contemplating 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 Chart 2. The second questionnaire deals with sociodemographic issues (e.g., gender, shift, length of professional experience). These questionnaires were applied in a large and highly complex hospital, specifically in the radiology service, characterized in Chart 3 according to the four subsystems of sociotechnical systems proposed by Hendrick and Kleiner (2001).

Chart 2 – ARS Questionnaire

Question 1. Interactions	From the following list of colleagues, select the ones you interact with most often.	(Q1) List of names
Question 2. Monitor	How often do you interact with this person to know what's going on or what happened in real time at your job?	(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 – from 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-term work-related trends?	
Question 4. Answer	How often do you interact with this person to take action 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 that person likely to provide accurate information or assistance?	
Question 8. Name	From the list of names below, select your name.	(Q8) Name

Chart 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).	TÉCNICO: 170,000 exams/year; Exams such as X-rays, mammograms, CT scans, magnetic resonance imaging, ultrasounds and biopsy procedures are performed; fixed and mobile diagnostic imaging equipment. Use of dosimeter. Main elevators of the building one hundred meters from the radiology entrance, located in the second floor.

	WORK ORGANIZATION: Nursing performs shift changes and has a fixed shift and weekly station rotation. Radiology technicians and technologists have fixed shifts and in some workstations they have weekly rotation. Administrative assistants have the highest daily working hours. Doctors have shift mobility. Resident Physicians have a residency program in three annual phases.	EXTERNAL ENVIRONMENT: Varied profile of patients (inpatients and outpatients; 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 purpose with the use of a survey, executed through two questionnaires. Data collection took place from October to December 2020. Data analysis was performed using the ARS method and correlational statistics. The analysis of the ARS questionnaire was performed using Excel® and NICUNET® software. In addition, for reasons of confidentiality and ethics, the names of the respondents in the data analysis were transformed into alphanumeric codes, which are: A (Administrative Assistant); E (Nurse); M (Physician); R (Resident); TE (Nursing Technician); and TR (Radiology Technician or Technologist). Soon after data treatment, the two formulas of Bertoni et al. (2022) were applied, 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 the participants.

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

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

Onde: ER_{ij} = *Escore de Resiliência para o ator i e rede j*, GE_{ij} = *Grau de entrada*, INT_{ij} = *Intermediação*, PR_{ij} = *Proximidade*, D_i = *Disponibilidade*, C_i= *Confiabilidade*, *i = ator avaliado e j = rede do potencial avaliado.*

4. RESULTS AND DISCUSSIONS

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

Table 1 – Sample response rate by groups

Team	Respondents (*n* = 148)	% of sample	Population (*N* = 221)	% group representation	Population in %
Radiology Technicians and Technologists (RT)	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 shows one of the Top10 analyses of resilience potentials, i.e., the most central actors, where eight of these actors (TR37, TR65, E3, A18, E5, A13, TR10, M44) appear among the Top10 in the four potential networks. 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 head.

Table 2 – Top10 actors: Learn

Actor	Diff. Tur.	Sex	Shift	Entry Degree	Intermediation	Closeness	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	No	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

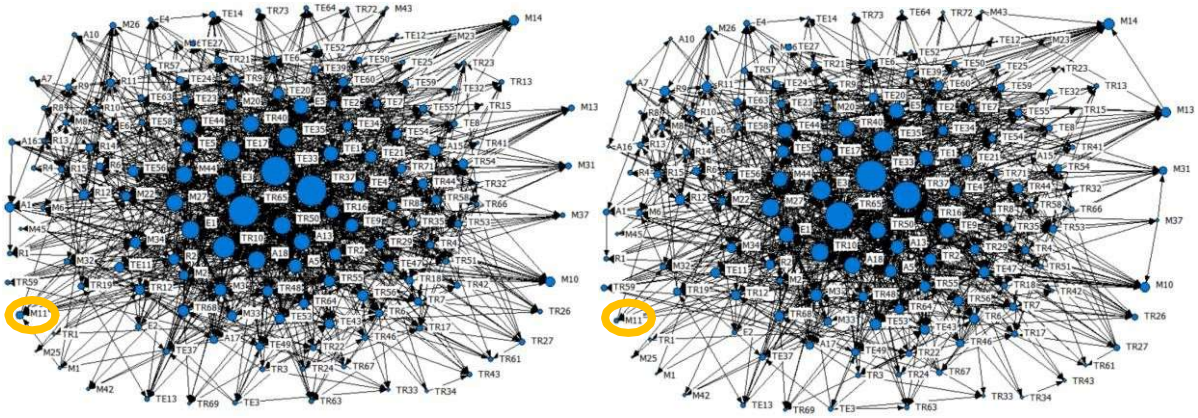
Where: *Diff. Tur. = working different shifts, as opposed to working steady in one shift. M = male; F = female. 1 = morning; 2 = afternoon; 3 = night. * = management position.*

Of these 13 different actors that appear in the four networks of resilient potentials, 38% are radiology technicians, 23% nurses, 23% administrative assistants, 13% physicians, and 0% nursing technicians and residents. Also, 62% are female and 38% male. This distribution is close to that of the sample, which is composed of 59% female participants and 41% male participants. Only one works in a fixed shift, the RT50. This makes sense considering that working in different shifts tends to widen the circle of social interactions. Regarding the shift, the majority (84%) work predominantly in the morning shift and only one (8%) in the afternoon and one (8%) in the evening. This is disproportionate to the sample, in which 48% are in the morning and 14% in the evening. Thus, interactions in the afternoon shift, 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%), which are the actors RT37 and RT10. On average, the actors in the Top10 of resilience networks have been working in radiology for 17 years, ranging from 5 to 34 years. The majority of respondents (69%) answered 'always' to 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 most contribute to organizational resilience, according to the Top10 rankings, is as follows: morning shift, works only in this company, long experience in the service, and takes the initiative to offer help to colleagues.

The results regarding the correlations by Spearman's coefficient, with a confidence interval at the level of 10%, showed only two significant variables, which involved the period in which the professionals are available at work). Professionals who work in more than one shift, i.e., mobility between shifts, showed a positive correlation with the potentials 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 possibly 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. In addition, the morning shift was correlated with the four potentials, anticipate (r=0.183; p=0.026), learn (r=0.177; p=0.031), monitor (r=0.163; p=0.047) and respond (r=0.143; p=0.083), which demonstrates that actors who work in 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 the 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 learning network (the quantitative indicators of density of each network are, respectively, 6% and 5.2%); (ii) the imbalance of the 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 size of the node, the greater the centrality). The presentation of these sociograms in the feedback meeting to the participants had an impact on them, who associated more central actors with the role of informal leaders, as well as considered that the complexity of social interactions was well illustrated. It is worth remembering that informal leaders are also known for being agents influencing 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 organizational resilient 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 which factors such as working hours or hierarchical position provide greater centrality. Therefore, professionals with mobility between shifts, long experience, morning shift 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 to provide adequate social support and improve organizational performance.

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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.