

THEORETICAL ARTICLE/ESSAY

Pre-Hospital Care for Trauma Victims Based on Kolcaba's Theory of Comfort

Assistência Pré-Hospitalar à Pessoa Vítima de Trauma Alicercada na Teoria de Conforto de Kolcaba

Asistencia Prehospitalaria a Victimas de Traumatismos Basada en la Teoría del Confort de Kolcaba

Filipe Melo^{1, 2, 3}

 <https://orcid.org/0000-0001-7713-4371>

Margarida Reis Santos^{6, 3, 1}

 <https://orcid.org/0000-0002-7948-9317>

Miguel Castelo Branco^{7, 8}

 <https://orcid.org/0000-0002-6191-5912>

Mauro Mota^{4, 3, 5}

 <https://orcid.org/0000-0001-8188-6533>

¹ University of Porto, School of Medicine and Biomedical Sciences (ICBAS), Porto, Portugal

² Active Aging Competence Center, Loulé, Portugal

³ University of Porto, Center for Health Technology and Services Research (CINTESIS), Porto, Portugal

⁴ Polytechnic Institute of Viseu, School of Health, Viseu, Portugal

⁵ Nursing School of Coimbra (ESENFC), Health Sciences Research Unit: Nursing (UICISA: E), Coimbra, Portugal

⁶ Nursing School of Porto, Porto, Portugal

⁷ University of Beira Interior, Faculty of Health Sciences, Covilhã, Portugal

⁸ Centro Académico Clínico das Beiras, Covilhã, Portugal

Corresponding author

Filipe Correia de Melo

E-mail: fil_cm@hotmail.com

Received: 14.08.24

Accepted: 06.01.25

Abstract

Background: The physical, emotional, and psychological discomfort of pre-hospital trauma victims is often neglected by focusing only on the ABCDE approach and acute pain. A more comprehensive approach to discomfort is essential for humanizing the care of trauma victims in pre-hospital settings.

Objective: To critically analyze Kolcaba's theory of comfort in the management of discomfort in the pre-hospital care of trauma victims.

Discussion: Kolcaba's theory of comfort is valuable for pre-hospital care, covering physical, emotional, and spiritual comfort. Based on the types of comfort - relief, ease, and transcendence - the theory suggests holistic assessment, empathic communication, psychological support, spiritual respect, a comfortable environment, and continuity of care. This allows for comprehensive, person-centered care that promotes humanized recovery in pre-hospital emergencies.

Conclusion: Kolcaba's theory of comfort guides healthcare professionals in improving the physical, emotional, and spiritual recovery of trauma victims by providing a humanized and comprehensive approach to pre-hospital emergencies.

Keywords: nursing theory; models, nursing; nursing; prehospital care; patient comfort; trauma

Resumo

Enquadramento: Os desconfortos físico, emocional e psicológico das vítimas de trauma no pré-hospitalar são frequentemente negligenciados, com foco apenas no ABCDE e na dor aguda. Uma abordagem mais abrangente ao desconforto é essencial para um cuidado humanizado às vítimas de trauma em contexto pré-hospitalar.

Objetivo: Analisar criticamente a Teoria do Conforto de Kolcaba na gestão do desconforto durante o socorro pré-hospitalar a vítimas de trauma.

Discussão: A Teoria do Conforto de Kolcaba é valiosa para os cuidados de enfermagem no pré-hospitalar, abrangendo conforto físico, emocional e espiritual. Baseada nos tipos de conforto — alívio, tranquilidade e transcendência — a teoria propõe avaliação holística, comunicação empática, apoio psicológico, respeito espiritual, ambiente confortável e continuidade do cuidado. Isso permite cuidados abrangentes e centrados na pessoa, promovendo recuperação humanizada em emergências pré-hospitalares.

Conclusão: A Teoria do Conforto de Kolcaba orienta profissionais de saúde na melhoria da recuperação física, emocional e espiritual das vítimas de trauma, proporcionando uma abordagem humanizada e completa em emergências extra-hospitalares.

Palavras-chave: teoria de enfermagem; modelos de enfermagem; enfermagem; assistência pré-hospitalar; conforto do paciente; trauma

Resumen

Marco contextual: El malestar físico, emocional y psicológico de las víctimas de traumatismos en el entorno prehospitalario suele descuidarse y se centra únicamente en el ABCDE y el dolor agudo. Es esencial adoptar un enfoque más integral del malestar para ofrecer una atención humanizada a las víctimas de traumatismos en el entorno prehospitalario.

Objetivo: Analizar críticamente la teoría del confort de Kolcaba en la gestión del malestar durante la atención prehospitalaria a víctimas de traumatismos.

Discusión: La teoría del confort de Kolcaba es valiosa para los cuidados de enfermería prehospitalarios, ya que abarca el confort físico, emocional y espiritual. Basada en los tipos de confort —alivio, tranquilidad y transcendencia—, la teoría propone la evaluación holística, la comunicación empática, el apoyo psicológico, el respeto espiritual, el entorno confortable y la continuidad de los cuidados. Esto permite una atención integral y centrada en la persona, que promueve una recuperación humanizada en las urgencias prehospitalarias.

Conclusión: La teoría del confort de Kolcaba guía a los profesionales sanitarios en la mejora de la recuperación física, emocional y espiritual de las víctimas de traumatismos y proporciona un enfoque humanizado y completo en las urgencias extrahospitalarias.

Palabras clave: teoría de enfermería; modelos de enfermería; enfermería; atención prehospitalaria; comodidad del paciente; trauma



Escola Superior de
Enfermagem de Coimbra

fct

Fundação
para a Ciência
e a Tecnologia

How to cite this article: Melo, F., Mota, M., Santos, M. R., & Branco, M. C. (2025). Pre-hospital care for trauma victims based on Kolcaba's theory of comfort. *Revista de Enfermagem Referência*, 6(4), e37070. <https://doi.org/10.12707/RV124.85.37070>



Introduction

Pre-hospital trauma victims often report different types of discomfort that can be physical, emotional, and psychological. Diagnosing them and defining specific intervention plans for each is essential for effective care (Mota, Santos et al., 2022). The scientific and clinical community is increasingly pointing to other areas of suffering besides acute pain, which until recently was the main nosological entity causing discomfort in trauma victims (Mota et al., 2024).

Pain is a subjective, complex concept with several dimensions and is defined as an unpleasant sensory experience associated with actual or potential tissue damage (Yam et al., 2018). More than 70% of pre-hospital trauma victims report acute pain, and approximately half describe pain intensity as 7 or greater on a scale of 0 to 10 (Mota, Cunha et al., 2022). In addition to pain, pre-hospital trauma victims may experience other discomforts, such as cold, discomfort associated with immobilization, and psychological distress, including fear, anxiety, and grief (Mota et al., 2023). Recent studies examining the relationship between acute pain in trauma and other types of discomfort concluded that immobilized victims and victims with discomfort from cold, grief, or fear tend to have higher levels of pain (Mota et al., 2023).

The pre-hospital care of trauma victims is a complex challenge that goes beyond the management of an ABCDE approach; it must take into account the management of pain, discomfort caused by cold and immobilization, fear, anxiety, and other entities that often affect the comfort of the trauma victim rescued in pre-hospital settings (Mota et al., 2023). Therefore, it is crucial to operationalize a theoretical nursing model that provides tools to increase the effectiveness of comfort management in trauma victims. The theoretical nursing models that have been operationalized for the clinical practice of pre-hospital nurses in the care of trauma victims have essentially focused on the management of hemodynamic instability and hemorrhage control (Mota et al., 2019). The theory of comfort developed by Katharine Kolcaba is a conceptual framework aimed at improving the quality of nursing care, where comfort is the central theoretical concept in the satisfaction (active, passive, or cooperative) of basic human needs, based on three types of comfort: relief, ease, and transcendence (Kolcaba, 1994). This conceptual model has been adapted to different clinical frameworks (Lin et al., 2023), but we believe that using it to define a model of care for trauma victims in pre-hospital care could be an important tool for improving the quality of care. Therefore, this research aimed to critically analyze Kolcaba's theory of comfort in the management of discomfort during pre-hospital care for trauma victims.

Development

The reflective analysis of Kolcaba's theory of comfort, in the context of discomfort management in trauma care, was supported by the critical analysis method of Chinn

et al. (2022), first with a description of the theory, taking into account the object for which it is operationalized, concepts, definitions, relationships, structure and assumptions, and second with a critical reflection, taking into account the *importance* and *generalizability* components of the model, so that the theory is linked to clinical importance and application in professional practice.

Theory description

The concept of comfort brings together different perspectives in the light of different nursing theories, but we believe it is most robust in the theories of Leininger, Watson, Morse, and Kolcaba. For Watson and Leininger, caring is central and comfort is one of its components, whereas, for Morse, caring is a construct of comfort that requires nurses to act. However, the evaluation of these outcomes has not been explored in light of this theory. Kolcaba, on the other hand, argues that the process of comfort should be studied with the evaluation of outcomes, based on its conceptualization and operationalization (Apóstolo, 2009).

Kolcaba's theory of comfort proposes a holistic and multidimensional approach to understanding and promoting patient well-being (Castro et al., 2021). It defines comfort as a state in which the needs for relief, ease, and transcendence are met in the physical, psychospiritual, social, and environmental contexts (Kolcaba, 2003). Kolcaba created a conceptual framework to show how her theory fits into the flow of care in the context of practice and describes it as a product of holistic nursing practice (Kolcaba, 2003). The theory conceptualizes comfort as a complex state that includes physical, psychospiritual, social, and environmental dimensions (Kolcaba, 1994). It identifies three types of comfort: relief, which refers to the reduction or elimination of physical discomfort; ease, which aims to promote an environment that provides calm and psychological well-being; and transcendence, which promotes meaning and spiritual peace (Kolcaba, 2003). It is also based on four fundamental dimensions, (1) the physical, in the basic relief of the body; (2) the psychospiritual, for mental and emotional balance, in the search for purpose and meaning in life; (3) the social, evident in interpersonal relationships and social support; and finally, (4) the environmental (Gaibor et al., 2021). Physical comfort is related to physiological factors, such as rest and relaxation, responses to illness, nutrition and homeostasis, or even pain itself, which is one of the main factors affecting physical comfort (Kolcaba, 1994). Psychospiritual comfort includes the mental and spiritual aspects, the emotions that define the individual's sense of life, such as self-esteem, self-concept, and self-awareness (Kolcaba, 2003). Social comfort is related to the person's social and cultural environment, with respect for the traditions, customs, and religious beliefs of the person and family, and ranges from the provision of financial support services to discharge planning and/or preparation for home care (Kolcaba, 1994, 2003). Finally, environmental comfort refers to the person's external environment, such as light, noise, temperature, or the safety of the environment (Kolcaba, 2001).

The impact of Kolcaba's theory of comfort has been significant in nursing practice, influencing the way nurses approach person-centered care. It has therefore been instrumental in promoting a holistic and compassionate approach to care, emphasizing the importance of considering not only the physical dimension, but also the emotional, social, and spiritual needs of people during the care process (Bice & Bramlett, 2019). This model of care has been applied in different clinical contexts and to different types of patients, from pediatric oncology (Ebrahimipour & Hoseini, 2018) to gynecology and assisted reproductive technologies (Schoener & Krysa, 1996) to geriatrics (Oliveira et al., 2020).

The definition of comfort is complex and difficult to conceptualize, but it has long been the most fundamental goal of health care, understood as the antithesis of nosological entities such as pain or other sources of discomfort (Gonzalez-Baz, et al., 2023). Comfort, as the antithesis of discomfort listed in the four independent but complementary frameworks, is the goal of nursing care in all clinical contexts and, as such, also in the care of trauma victims in pre-hospital emergency settings.

Critical reflection

The provision of pre-hospital care to trauma victims must consider not only an ABCDE approach, usually focused on hemodynamic stability and hemorrhage control, which are critical to the person's survival, but also, and because health is more than the absence of disease, the alleviation of suffering, regardless of its origin, whether it is acute pain, discomfort caused by cold or immobilization, anxiety, or grief (Mota et al., 2023).

The application of Kolcaba's theory of comfort to trauma victims in pre-hospital settings should involve the integration of strategies and approaches that cover the three types of comfort: relief, ease, and transcendence (Kolcaba, 2003).

Relief comfort in trauma victims, which is experienced when a specific state of discomfort is alleviated, can be achieved through the administration of various measures, such as pharmacological and non-pharmacological analgesics, which reduce acute physical pain; reduction, stabilization, and immobilization of fractured limbs, which minimize physical discomfort (Mota et al., 2024); or active and passive warming systems for people suffering from hypothermia, which reduce the discomfort caused by cold (Mota et al., 2021).

The psychospiritual dimension also requires a multidisciplinary approach. Given that the clinical context in which trauma victims find themselves can be very hostile (Mota et al., 2019), more specific interventions are required, aimed at managing anxiety and fear (Mota et al., 2023). This can be achieved with appropriate communication techniques, based, for example, on clear and understandable information about the person's health situation, with the aim of providing psychospiritual relief (Eadie et al., 2013).

The environmental dimension can be ensured by promoting a calm and comfortable environment, where the room temperature can be controlled (e.g. ambulance),

reducing unnecessary noise and providing relief from the threat of the environment (Pécule-Carrasco et al., 2020). Respecting the victim's values, cultural issues, and social status is essential to create a trusting and safe environment between nurses and trauma victims, allowing, among other things, the social dimension to be respected (Bergstrom et al., 2018).

Ease comfort is based on a sense of calm and contentment, and in its physical dimension, positioning techniques can be implemented to avoid additional discomfort, providing postural support and physical comfort during transport and/or immobilization (Mota et al., 2019; Mota, Cunha et al., 2022). With regard to the psychospiritual dimension of ease comfort, empathy, and active listening are tools that allow the person to express their concerns and discomfort, while facilitating communication between the person and their family is essential to guarantee the necessary social support and promote their social dimension (Müller et al., 2023). The creation of a peaceful and welcoming environment, with soft lighting and control of external stimuli, allowing the person to feel more relaxed and comfortable during the provision of pre-hospital care, makes it possible to control the environmental dimension (Pécule-Carrasco et al., 2020).

Transcendence comfort, which is the ability to overcome problems or pain, also requires a multidisciplinary approach capable of being representative, which responds to the physical dimension, with specific techniques to control breathing and muscle relaxation (Miri et al., 2023). In the psychospiritual dimension, a safe and appropriate space should be created for moments of reflection and search for meaning (Goldin et al., 2023). In the environmental dimension, social support and interaction with family and friends should be promoted and a peaceful and serene environment should be created, with natural and welcoming elements to help the person make the transition to their current situation and find comfort and hope (Nascimento et al., 2023).

By addressing the comfort needs of trauma victims in pre-hospital care based on Kolcaba's theory of comfort, it will be possible to improve the person's experience and promote not only their physical recovery, but also their emotional and spiritual well-being. This will contribute to a more comprehensive and humanized approach to the care of trauma victims in pre-hospital emergencies (Goldin et al., 2023). By integrating these strategies, pre-hospital nurses can provide more comprehensive, person-centered care consistent with the principles of Kolcaba's theory of comfort. Adopting the theory's guiding principles aims not only to treat physical injuries, but also to address the emotional, psychological, and spiritual needs of trauma victims, contributing to a holistic approach and a more complete and humanized recovery.

Conclusion

Given the complex challenges of caring for trauma victims in pre-hospital settings, the approach needs to strengthen the emotional and psychological variables responsible for

discomfort, in addition to the more easily measurable physical variables. In this context, Kolcaba's theory of comfort emerges as a valuable conceptual framework that identifies comfort as the fundamental and desirable outcome of the response to different nosological entities. The theory, based on the principles of relief, ease, and transcendence, can be used as a valuable framework to guide the clinical practice of nurses in the care of trauma victims. Its application in pre-hospital care can be an asset to physical recovery and to the emotional and spiritual well-being of people. The practical integration of the theory involves the adoption of specific strategies, from holistic assessment to the development of new diagnostic tools to the creation of a welcoming environment to the promotion of continuity of care. These practices, aligned with the principles of Kolcaba's theory of comfort, can enable pre-hospital nurses to provide person-centered care by recognizing and responding to the physical, emotional, and spiritual needs of trauma victims. In doing so, a more complete and humanized recovery can be promoted, creating a new paradigm in extra-hospital emergency care.

Author Contributions

Conceptualization: Melo, F., Mota, M., Santos, M. R., Branco, M. C.

Data curation: Melo, F., Mota, M.

Formal analysis: Melo, F., Mota, M., Santos, M. R.

Investigation: Melo, F., Mota, M., Santos, M. R., Branco, M. C.

Methodology: Melo, F., Mota, M., Santos, M. R.

Project administration: Santos, M. R., Branco, M. C.

Resources: Melo, F., Mota, M.

Software: Melo, F., Mota, M.

Supervision: Santos, M. R., Branco, M. C.

Validation: Santos, M. R., Branco, M. C.

Visualization: Santos, M. R., Branco, M. C.

Writing – original draft: Melo, F., Santos, M. R., Branco, M. C.

Writing – review & editing: Melo, F., Santos, M. R., Branco, M. C.

References

- Apóstolo, J. L. (2009). O conforto nas teorias de enfermagem—análise do conceito e significados teóricos. *Revista de Enfermagem Referência*, 2(9), 61-67. https://rr.esenfc.pt/rr/index.php?module=rr&target=publicationDetails&pesquisa=&id_artigo=2133&id_revisita=4&id_edicao=26
- Bergstrom, A., Hakansson, A., Stomberg, M. W., & Bjersa, K. (2018). Comfort theory in practice—nurse anesthetists' comfort measures and interventions in a preoperative context. *Journal of Perianesthesia Nursing*, 33(2), 162-171. <https://doi.org/10.1016/j.jopan.2016.07.004>
- Bice, A. A., & Bramlett, T. (2019). Teaching nurses from a holistic comfort perspective. *Holistic Nursing Practice*, 33(3), 141-145. <https://doi.org/10.1097/HNP.0000000000000325>
- Castro, M., Fuly, P., Santos, M., & Chagas, M. C. (2021). Total pain and comfort theory: Implications in the care to patients in oncology palliative care. *Revista Gaúcha de Enfermagem*, 42, e20200311. <https://doi.org/10.1590/1983-1447.2021.20200311>
- Chinn, P. L., Kramer, M. K., & Sitzman, K. (2022). *Knowledge development in nursing: Theory and process* (11th ed.). Elsevier.
- Eadie, K., Carlyon, M. J., Stephens, J., & Wilson, M. D. (2013). Communicating in the pre-hospital emergency environment. *Australian Health Review*, 37(2), 140-146. <https://doi.org/10.1071/AH12155>
- Ebrahimpour, F., & Hoseini, A. S. (2018). Suggesting a practical theory to oncology nurses: Case report of a child in discomfort. *Journal of Palliative Care*, 33(4), 194-196. <https://doi.org/10.1177/0825859718763645>
- Gaibor, D. M., Auquilla, J. Y., Sinche, N. P., & Paredes, N. V. (2021). Stories of the elderly in relation to Katharine Kolcaba's theory (Chillanes-Ecuador). *Journal of Advanced Pharmacy Education & Research*, 11(1), 48-52. <https://doi.org/10.51847/r1a44hm>
- Goldin, D., Maltseva, T., Scaccianoe, M., & Brenes, F. (2023). Holistic psychosocial approaches in the care of hispanic victims of trauma: An overview. *Journal of Holistic Nursing*, 41(1), 7-16. <https://doi.org/10.1177/08980101221083162>
- Gonzalez-Baz, M. D., Pacheco del Cerro, E., Ferrer-Ferrándiz, E., Araque-Criado, I., Merchán-Arjona, R., Rubia Gonzalez, T., & Moro Tejedor, M. N. (2023). Psychometric validation of the Kolcaba general comfort questionnaire in critically ill patients. *Australian Critical Care*, 36(6), 1025-1034. <https://doi.org/10.1016/j.aucc.2022.12.013>
- Kolcaba, K. (2001). Evolution of the mid range theory of comfort for outcomes research. *Nursing Outlook*, 49(2), 86-92. <https://doi.org/10.1067/mno.2001.110268>
- Kolcaba, K. (2003). *Comfort theory and practice: A vision for holistic health care and research*. Springer Publishing Company.
- Kolcaba, K. Y. (1994). A theory of holistic comfort for nursing. *Journal of Advanced Nursing*, 19(6), 1178-1184. <https://doi.org/10.1111/j.1365-2648.1994.tb01202.x>
- Lin, Y., Zhou, Y., & Chen, C. (2023). Interventions and practices using comfort theory of Kolcaba to promote adults' comfort: An evidence and gap map protocol of international effectiveness studies. *Systematic Reviews*, 12(33), 1-10. <https://doi.org/10.1186/s13643-023-02202-8>
- Miri, S., Hosseini, S. J., Vajargah, P. G., Firooz, M., Takasi, P., Mollaei, A., Ramezani, S., Tolouei, M., Zeydi, A. E., Osuji, J., Farzan, R., & Karkhah, S. (2023). Effects of massage therapy on pain and anxiety intensity in patients with burns: A systematic review and meta-analysis. *International Wound Journal*, 20(6), 2440-2458. <https://doi.org/10.1111/iwj.14089>
- Mota, M., Cunha, M., Santos, E., Abrantes, T., Melo, F., Monteiro, M., & Santos, M. R. (2022). Prehospital interventions to reduce discomfort caused by immobilization in adult trauma victims: A scoping review protocol. *JBI Evidence Synthesis*, 20(11), 2743-2750. <https://doi.org/10.11124/JBIES-22-00021>
- Mota, M., Cunha, M., Santos, M. R., Silva, D., & Santos, E. (2019). Non-pharmacological interventions for pain management in adult victims of trauma: A scoping review protocol. *JBI Database of Systematic Reviews and Implementation Reports*, 17(12), 2483-2490. <https://doi.org/10.11124/JBISIR-2017-004036>
- Mota, M., Melo, F., Castelo-Branco, M., Campos, R., Cunha, M., & Santos, M. R. (2024). Construction of the discomfort assessment scale for immobilized trauma victims (DASITV). *International Emergency Nursing*, 76(101501), 1-9. <https://doi.org/10.1016/j.ienj.2024.101501>

- Mota, M., Melo, F., Henriques, C., Matos, A., Castelo-Branco, M., Monteiro, M., Cunha, M., & Santos, M. R. (2023). The relationship between acute pain and other types of suffering in pre-hospital trauma victims: An observational study. *International Emergency Nursing*, 71(101375), 2-6. <https://doi.org/10.1016/j.ienj.2023.101375>
- Mota, M., Santos, M. R., Santos, E., Henriques, C., Matos, A., & Cunha, M. (2022). Tratamento pré-hospitalar da dor traumática aguda: Um estudo observacional. *Acta Paulista de Enfermagem*, 35, eAPE039001834. <https://doi.org/10.37689/acta-ape/2022AO001834>
- Mota, M., Santos, M. R., Santos, E., Henriques, C., Matos, A., & Cunha, M. (2021). Trauma prehospital hypothermia prevention and treatment: An observational study. *Journal of Trauma Nursing*, 28(3), 194-202. <https://doi.org/10.1097/JTN.0000000000000583>
- Müller, F., Schröder, D., & Noack, E. M. (2023). Overcoming language barriers in paramedic care with an app designed to improve communication with foreign-language patients: Nonrandomized controlled pilot study. *JMIR Formative Research*, 7, e43255. <https://doi.org/10.2196/43255>
- Nascimento, B. A., Lima, D. M., & Passos, S. G. (2023). Humanização da assistência de enfermagem na unidade de terapia intensiva. *Revista JRG de Estudos Acadêmicos*, 6(13), 2024-2032. <https://revistajrg.com/index.php/jrg/article/view/815>
- Oliveira, S. M., Costa, K. N., Santos, K. F., Oliveira, J. S., Pereira, M. A., & Fernandes, M. G. (2020). Comfort needs as perceived by hospitalized elders: An analysis under the light of Kolcaba's theory. *Revista Brasileira de Enfermagem*, 73(suppl 3), e20190501. <https://doi.org/10.1590/0034-7167-2019-0501>
- Péculo-Carrasco, J. -A., Sola, H., Casal-Sánchez, M. -M., Rodríguez-Bouza, M., Sánchez-Almagro, C. -P., & Failde, I. (2020). Feeling safe or unsafe in prehospital emergency care: A qualitative study of the experiences of patients, carers and healthcare professionals. *Journal of Clinical Nursing*, 29(23-24), 4720-4732. <https://doi.org/10.1111/jocn.15513>
- Schoener, C. J., & Krysa, L. W. (1996). The comfort and discomfort of infertility. *Journal of Obstetric Gynecologic & Neonatal Nursing*, 25(2), 167-172. <https://doi.org/10.1111/j.1552-6909.1996.tb02421.x>
- Yam, M. F., Loh, Y. C., Tan, C. S., Adam, S. K., Manan, N. A., & Basir, R. (2018). General pathways of pain sensation and the major neurotransmitters involved in pain regulation. *International Journal of Molecular Sciences*, 19(8), 2164. <https://doi.org/10.3390/ijms19082164>