



Intra-hospital transport of critically ill adult patients: complications related to staff, equipment and physiological factors*

Transporte intra-hospitalar de pacientes adultos em estado crítico: complicações relacionadas à equipe, equipamentos e fatores fisiológicos

Transporte intrahospitalario de pacientes adultos en estado crítico: complicaciones relacionadas al equipo, equipamientos y factores fisiológicos

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ABSTRACT

Objective: To identify in the literature the complications related to physiological changes of the patient, the multidisciplinary team and the use of equipment during the intrahospital transport of critically ill patients. **Methods:** Integrative review of literature, through a search in the databases of PubMed, MEDLINE, and LILACS. **Results:** We encountered 20 articles, all written in the English language. Studies have shown that changes in arterial pressure and heart rate are most common during transport. Of the adverse events related to problems with the team, the lack of knowledge of the professional and failure of communication stood out, apart from those derived from equipment used. **Conclusion:** Transporting the critically ill patient safely requires improving communication between teams, standardizing the actions and equipment used by means of protocols, and identifying opportunities to obtain excellence in service during transport.

Keywords: Transportation of patients; Patient transfer; Critical care; Inpatient; Clinical symptoms

RESUMO

Objetivo: Identificar na literatura as complicações relacionadas às alterações fisiológicas do paciente, à equipe multidisciplinar e ao uso de equipamentos durante o transporte intra-hospitalar de pacientes críticos. **Métodos:** Revisão integrativa da literatura, com busca nas bases de dados PUBMED, MEDLINE, e LILACS. **Resultados:** Foram encontrados 20 artigos, todos escritos na língua inglesa. Os estudos mostraram que as alterações na pressão arterial e na frequência cardíaca são as mais comuns durante o transporte. Dos eventos adversos relacionados a problemas com a equipe, destacaram-se, a falta de conhecimento do profissional e a falha de comunicação, além dos provenientes dos equipamentos utilizados. **Conclusão:** Transportar o paciente crítico de maneira segura significa melhorar a comunicação entre as equipes, padronizar as ações e equipamentos utilizados por meio de protocolos e identificar intercorrências para obter excelência no atendimento durante o transporte.

Descritores: Transporte de pacientes; Transferência de pacientes; Cuidados críticos; Pacientes internados; Sintomas clínicos

RESUMEN

Objetivo: Identificar en la literatura las complicaciones relacionadas a las alteraciones fisiológicas del paciente, al equipo multidisciplinario y al uso de equipamientos durante el transporte intrahospitalario de pacientes críticos. **Métodos:** Revisión integrativa de la literatura, con búsqueda en las bases de datos PUBMED, MEDLINE, y LILACS. **Resultados:** Fueron encontrados 20 artículos, todos escritos en el idioma inglés. Los estudios mostraron que las alteraciones en la presión arterial y en la frecuencia cardíaca son las más comunes durante el transporte. De los eventos adversos relacionados a problemas con el equipo, se destacaron, la falta de conocimiento del profesional y la falla en la comunicación, además de los provenientes de los equipamientos utilizados. **Conclusión:** Transportar al paciente crítico de manera segura significa mejorar la comunicación entre los equipos, patronizar las acciones y equipamientos utilizados por medio de protocolos e identificar complicaciones para obtener excelencia en la atención durante el transporte.

Descriptores: Transporte de pacientes; Transferencia de pacientes; Cuidados críticos; Pacientes internos; Síntomas clínicos

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INTRODUCTION

Intensive Care Units (ICUs) are complex areas in the hospital for the care of severely ill patients who require specific physical spaces, specialized human resources, and advanced technology and/or equipment⁽¹⁾. Despite all the sophistication observed in ICUs, not all exams or care required by these patients can be offered at the bedside⁽²⁾, and patients frequently need to be transported within the hospital. Intrahospital transport is the temporary or permanent forwarding of critical patients within the hospital environment, whether with diagnostic or therapeutic purposes⁽³⁻⁴⁾. It is a time of potential complications because the patient is out of the intensive care environment, vulnerable to factors that may culminate in rapid, progressive and avoidable hemodynamic alterations⁽⁵⁻⁶⁾. The decision to transport a critical patient is based on the evaluation of the potential benefits of such transport⁽⁴⁾.

Studies have documented adverse events related to variables such as the multidisciplinary team, equipment, and physiological alterations inherent to the patient him or herself. In this sense, the safety of patients during transport has been facilitated by the development of appropriate equipment, trained staff, and the development of specific protocols, since this is a population exposed to potential complications and instability that is inherent to the primary disease⁽⁷⁻⁹⁾.

Successful intrahospital transportation directly depends on the planning and work organization of the multidisciplinary team, as well as the use of appropriate equipment⁽⁶⁻⁷⁾. In this context, an important aspect in the transportation of patients is the prior communication of information between the staff transporting the patient and the staff receiving the patient so that the safety and continuity of health care is reinforced⁽¹⁰⁾.

In this context, the following question emerged: what are the complications experienced by critically ill patients during intrahospital transportation? We believe that the identification of these complications can support the development of intrahospital transport protocols for critically ill patients, as well as reduce the exposure of patients to intrinsic and extrinsic risks inherent to the procedure, thus improving safety. Based on this question, the objective of this study was to identify, in the literature, complications related to the patient's physiological changes, to the use of equipment, to the multidisciplinary team, and to inter-team communication during the intrahospital transport of critically ill patients.

METHOD

An integrative literature review was performed. The stages followed during this review included⁽¹¹⁾:

identification of a topic and selection of the study question; establishment of inclusion and exclusion criteria; definition of information to be extracted from papers; evaluation of selected papers; interpretation of results; and presentation of a synthesis of results.

The search for papers was performed covering the span from August to November 2010 in the LILACS, MEDLINE and PUBMED databases and the following descriptors recommended for health sciences were used: Patient Transfer, Transportation of Patients, Critical Care, Inpatients, and Clinical Symptoms. Descriptors were also searched in Portuguese, Spanish and English. Inclusion criteria were papers published between 1998 and 2010, written in Portuguese, Spanish or English. Exclusion criteria were papers addressing the transportation of non-critical patients and/or inter-hospital transportation.

An instrument to store data was developed with the following items: title of the paper, database, author(s), year of publication, language, country of origin, results, and conclusion.

RESULTS

A total of 20 papers addressing the theme were identified based on the inclusion criteria. All the papers were written in English: eight were identified in MEDLINE, seven in PUBMED, and the other five papers were found in more than one database (PUBMED/MEDLINE) or (PUBMED/LILACS).

In relation to year of publication, a larger number of publications (four) was found in 2004, followed by 1998 and 2009 (three papers each). No papers were found in 2000, 2003, 2008, or 2010.

Most papers (11) were published in periodicals in the United States, followed by England with three studies, Brazil and Australia with two papers each, and Austria and China with one paper each.

The rate adverse events observed during transportation ranged from 30% to 70% of all cases of intrahospital transportation^(7,12-13). The most frequently observed events included: patients' physiological alterations, problems in the multidisciplinary team involved in the transport, inter-staff communication, and equipment failure.

Physiological alterations in the critically ill patient being transported

The studies, in general, report a series of physiological alterations patients may experience during intrahospital transport, among them, increased heart rate^(4,7,12), altered blood pressure^(4,7,12), increased intracranial pressure⁽¹²⁾, arrhythmias^(4,7,12), heart attacks⁽¹²⁾, altered respiratory rate^(4,12), decreased oxygen satura-

tion^(4,7), increase in airway pressure⁽⁷⁾, airway obstruction by secretion⁽⁷⁾, excessive coughing⁽⁷⁾, agitation⁽⁷⁾, bleeding⁽⁷⁾, hypo/hypercapnia⁽¹²⁾, hypoxemia^(7,12) and cardiac arrest^(7,14). Change in blood pressure and cardiac rate are the most frequently found.

These complications may lead to consequences in the medium and/or long term, are verified up to four hours after transport⁽¹²⁾, and are most frequently observed in patients intubated with mechanical ventilation having Positive End-Expiratory Pressure (PEEP), and the use of continuous vasoactive drugs⁽¹³⁾.

Among trauma patients on mechanical ventilation, a study reported that 604 unexpected events occurred in 230 transports and 30 different types of physiological alterations were listed, such as severe hypotension, reduced intracranial pressure, cardiopulmonary arrest, pneumothorax, bronco aspiration, and chest pain, among others⁽¹⁴⁾.

Another adverse event frequently observed during transport is change in arterial blood gasometry. A study reported that about 17% of the transported patients experienced variations in pH > 0.07, while respiratory alkalosis was the most frequently observed. This fact is probably due to a prior increase of the fraction of inspired oxygen (FiO₂) from the ventilator in an attempt to minimize reduced oxygenation of the patient during the transport⁽⁹⁾.

Contrary to the other studies previously described, one review paper indicated that of the 245 critical patients transported with a large variety of diagnoses, no adverse event or significant therapeutic intervention was observed and the most common indication in most transfers was diagnostic investigation⁽¹⁵⁾.

Multidisciplinary team involved in the transport/inter-team communication

The transport is performed by various health workers, though the most frequent participants are nurse technicians⁽¹⁶⁾. Some authors recommend at least two trained people to accompany the patient to ensure successful transportation^(9,17). Studies indicate that the rate of adverse events during the transport of patients is lower when physicians with more experience transport critically ill patients, when compared to less experienced physicians⁽⁹⁾.

The importance of the transport to be performed by qualified individuals was described in another study⁽¹⁸⁾ reporting a rate of 15.5% of adverse events in transports performed by a specialized team; when the transport is performed by non-qualified individuals, the incidence of adverse events is above 75%.

The presence of the nursing staff is essential during the transportation of patients because it reduces the incidence of adverse events. The analysis of professionals involved in the occurrence of events during transport shows that the incidence of events triggered

by the nursing staff was smaller when compared to the medical team (22% and 26% respectively) and similar to that found among other health workers (22%). Additionally, the incidents that did occur were primarily detected by nursing professionals (82%)⁽⁷⁾.

Among the adverse events that occur during transportation due to problems within the staff, we highlight a lack of knowledge and communication failure. Human factors contributing to incidents add up to 54% of the total and are related to errors due to a lack of knowledge (22%), nature of routines (18%), inexperience (8%), and technical problems (6%). Among the factors related to lack of knowledge are errors of judgment, recognition of problems, haste, and lack of attention, failure in following protocol, and inappropriate preparation of equipment and/or patients⁽⁷⁾.

Other authors go deeper in the estimation of occurrences due to failure in communication between the teams, especially when the patient's destination is an ICU⁽¹⁹⁾. The transportation of critical patients requires a careful strategy, especially in relation to inter-staff communication, in order to identify basic information related to the patient such as age, weight, diagnosis, destination and procedure, hemodynamic stability, respiratory pattern, venous access/administration of medication, and transmission of such information to the team receiving the patient^(5,10,17).

One of the great obstacles indicated by the nursing team is a communication barrier. There would be fewer difficulties if the teams interacted in a calm environment⁽¹⁰⁾. We highlight that important information may be lost if the professionals involved in the transfer of patients do not use the time required to obtain information when nursing shifts change or when they do not know the patients' real clinical conditions⁽²⁰⁾.

Two studies are in agreement when they report that the supply of patient information via telephone before the patient is transferred reduces difficulties upon admission at the receiving unit, in addition to alleviating the professionals' anxiety and stress and facilitating the continuity of patient care^(10,17).

The protocol "Ticket to ride" was implemented in the United of States to improve communication during the transportation of patients. In the form of a checklist, this system focuses on the standardization of information concerning the patient's clinical condition and strengthens interactions between the team and patient during transportation⁽²⁰⁾. The purpose of the study was to establish a protocol to ensure the safety of patients.

The use of criteria to identify safety is essential, such as: resources needed by each patient during transportation; check whether the patient is the correct patient to be transported; ensure that information concerning the patient is transmitted in a standardized manner among

the unit of origin, transport team, and unit of destination; continuous maintenance of care during the entire process of transportation and while the patient is out of his/her unit of origin; and an evaluation of the real need to transport the patient⁽¹⁸⁾.

Some authors are emphatic when they state that an absence of coordination, lack of focus on the patient's real needs, and non-adherence to procedures increase the number of adverse events during transportation⁽¹⁰⁾.

A study conducted in Australia observed 101 inpatient transfers and recorded 420 errors with an average of four errors per transportation. The most frequent error was inappropriate delegation of transport (43.1%), followed by problems in the identification of patients (41.9%), inappropriate preparation of patients for transport (7.4%), inappropriate control of infection, and non-adherence to specific precautions during transport (2.9%), inappropriate preparation of the transport team (2.1%), the use of an inappropriate vehicle for transportation (2.1%), and equipment failure (0.2%)⁽²¹⁾.

Therefore, we suggest that the coordination of transportation be organized by a nurse, who should give priority to performance measures to ensure appropriate monitoring and to optimize the satisfaction and comfort of patients^(4,8).

Failure in equipment used in the transportation

In relation to equipment failure, one study reported that 45% of the events occurring in the transportation were related to the equipment used and were divided into four groups: 1. Ventilation equipment (disconnection, empty oxygen cylinders, perforated bags/improper sealing); 2. Infusion equipment (battery died, end of medication without the possibility of immediate replacement); 3. Monitoring equipment (malfunction, battery died, interference, malfunctioning of arterial line, unsuitable screen display); 4. Intravenous access (disconnection, difficulty reaching lines, filing/inappropriate size of lines, difficulty in administering fluids during transport)⁽¹⁹⁾.

Other studies indicate similar data concerning problems with equipment, such as accidental extubation, failure in continuous infusion pumps – interruption of the infusion of vasoactive drugs, disconnection of electrodes, cardioscope, unloading monitors, loss of venous access and/or disconnection of the mechanical lung ventilator. These authors assert that complications due to equipment were errors committed by the staff and were often avoidable^(4,5,7-9).

Another problem identified during transportation was the possibility of the oxygen in the cylinders running out because patients mechanically ventilated require sources of oxygen sufficient for the transportation to be concluded without incidents. One study

described the duration of oxygen cylinders, including base and size, fraction of inspired oxygen (FiO₂) and minutes of ventilation. The results showed that the real duration of the cylinder is, on average, 12% longer the cylinder's estimated duration⁽²²⁾.

A hospital in the United States created a spreadsheet containing all the adverse events that jeopardize the safety of patients during transport. Among such events were included problems related to oxygen, especially empty cylinders or oxygen flow below the patient's need, delay in treating intercurrents, wrong destination and/or patient, in addition to issues related to the monitoring and satisfaction of patients⁽²⁰⁾. Therefore, it is extremely important to verify the technical condition of the equipment to be used during transportation prior to use⁽⁹⁾.

For each preventive action performed before transportation, there is a level of recommendation and a degree of evidence, as described in Table 1⁽³⁾.

Table 1. Recommendations and degree of evidence of preventive actions performed before the transport of critical patients

Recommendations	RL/DE
1. Monitoring of hemodynamic and respiratory conditions	1A
2. Knowledge concerning the patient's clinical condition	1B
3. Evaluation of risk/benefit of transport	2A
4. Training and improvement of professionals	1A
5. Precautions concerning physiological complications and equipment failure	1A
6. Organization and division of tasks by the transport staff	2B
7. Composition of the transport staff:	
Physician and Nurse	1A
Physician, Nurse and Physical Therapist	2A
Physician, Nurse and Nursing Auxiliary	2C
Physician and Nursing Auxiliary	2C
8. The use of a gurney during transport	1A
9. The use of infusion pumps and portable respirators	1A
10. The use of a monitor/defibrillator and pulse oxymeter	1A
11. Presence of briefcase drugs box during transport	1B
12. Check the briefcase drug box and intubation material before the procedure	1B
13. Check the gas levels of cylinders	2A
14. Use of conventional gurneys and infusion pumps.	2B
15. Use of manual ventilation and capnography	2B
16. Periodical maintenance of material	2C

*RL- Recommended levels/DE- degrees of evidence

DISCUSSION

This study's results show that actions are not always performed with caution and individuals do not always follow the plan. The goal of minimizing risks patients are exposed to during transportation is not being achieved.

There is a need to plan intrahospital transport and to pay greater attention to technical and human conditions concerning such transport, especially in relation to equipment batteries and the staff responsible for the transport.

One of the ideas extensively described in the analyzed papers addresses the benefits of care protocols that organize the procedure and avoid complications that may occur during the intrahospital transport. The protocols involve planning, and a trained and organized staff, as well as the use of appropriate equipment to ensure the success of the entire process⁽³⁾.

The development of care protocols is intended to standardize and systematize the conduct of the staff in order to reduce variation in medical practice, to improve care delivered to patients and reduce the request for exams and services that are sometimes unnecessary. The development of routines and protocols encourages the acquisition of knowledge by the team, improves its communication, favors the coordination of care and the monitoring of results^(2,3).

The Joint Commission on National Patient Safety Goals recommends that facilities establish protocols to improve the shift change between the units involved in transport, and the results are promising both in terms of safety and patient satisfaction⁽²⁰⁾.

One study evaluated efficiency in the transport of critically ill patients through four safety indicators: circulation, respiration, equipment, and duration of transport from the unit of origin to the destination unit and the patient's return to the hospitalization unit. After the implementation of continuing education actions, implementation of protocols, and inspection of equipment prior to transport, the results based on the four indicators showed that the

quality and safety of transport improved and a reduced number of events was observed in this procedure⁽²¹⁾.

However, the implementation of protocols requires professionals to be aware of the importance of institutional routines; otherwise, its applicability is nullified. That is, actions would be inefficient in the prevention of errors due to the professionals' low adherence. Thus, we defend increased adherence to the existing guidelines as a strategy to improve the procedure before resources are invested in new processes⁽²¹⁾.

CONCLUSION

The intrahospital transport of critically ill patients can generate considerable risks with immediate consequences, such as the patient's abrupt physiological deterioration, which often leads to a long and difficult recovery. These patients require appropriate technological support and trained staff capable of foreseeing risk situations, identifying conditions, and more importantly, of acting immediately.

Difficult interaction and poor communication between the origin and destination teams contributes to a significant increase of complications in the transport. Therefore, nurses play an essential role in transmitting information, and should be sensitive to their patients' real needs.

Constant training and improvement of the professionals involved in intrahospital transport, such as the standardization of actions and equipment required for the clinical monitoring of patients, should be available to prevent and minimize adverse events, in order to achieve excellence in patient care and safety.

Health facilities should standardize, through protocols, how patients are transported. The health workers involved in the transport of patients should be aware of information relevant for their clinical condition.

Finally, transport standardization means improved communication, appropriate equipment used in each case of transportation, professionals able to identify and resolve potential interferences, minimizing errors and increasing the safety and satisfaction of patients.

REFERENCES

1. Barreto SM, Vieira SR, Pinheiro CT. Rotinas em Terapia Intensiva. 3ª ed. Porto Alegre: Artes Médicas; 2001.
2. American Association for Respiratory Care (AARC). AARC Clinical Practice Guideline: in-hospital transport of the mechanically ventilated patient. *Respir Care*. 2002; 47(6):721-3.
3. Nogueira VO, Marin HF, Cunha ICKO. [Online information about intrahospital transport of adults patients critical]. *Acta Paul Enferm*. 2005; 18(4): 390-6. Portuguese.
4. Caruana M, Culp K. Intrahospital transport of the critically ill adult: a research review and implications. *Dimens Crit Care Nurs*. 1998; 17(3):146-56.
5. McLenon M. Use of a specialized transport team for intrahospital transport of critically ill patients. *Dimens Crit Care Nurs*. 2004; 23(5):225-9.
6. Shirley PJ, Bion JF. Intra-hospital transport of critically ill patients: minimizing risk. *Intensive Care Med*. 2004; 30(8):1508-10.
7. Beckmann U, Gillies DM, Berenholtz SM, Wu AW, Pronovost P. Incidents relating to the intrahospital transfer of critically ill patients: an analysis of the reports submitted to the

- Australian incident monitoring study in intensive care. *Intensive Care Med.* 2004; 30(8):1579-85.
8. Wilson P. Safe patient transportation: nurses can make a difference. *Nurs Times.* 1998; 94(26):66-7.
 9. Zuchelo LT, Chiavone PA. Intrahospital transport of patients on invasive ventilation: cardiorespiratory repercussions and adverse events. *J Bras Pneumol.* 2009; 35(4):367-74.
 10. Boutilier S. Leaving critical care: facilitating a smooth transition. *Dimens Crit Care Nurs.* 2007; 26(4): 137-42; quiz 143-4.
 11. Mendes KD, Silveira RC, Galvão CM. [Integrative literature review: a research method to incorporate evidence in health care and nursing]. *Texto & Contexto Enferm.* 2008;17(4):758-64. Portuguese.
 12. Waydhas C. Intrahospital transport of critically ill patients. *Crit Care Med.* 1999; 3(5):83-9.
 13. Lahner D, Nikolic A, Marhofer P, Koinig H, Germann P, Weinstabl C, et al. Incidence of complications in intrahospital transport of critically ill patients – experience in an Austrian university hospital. *Wien Klin Wochenschr.* 2007; 119 (13-14):412-6.
 14. Papsen JP, Russell KL, Taylor DM. Unexpected events during the intrahospital transport of critically ill patients. *Acad Emerg Med.* 2007; 14(6):574-7.
 15. Fan E, MacDonald RD, Adhikari NK, Scales DC, Wax RS, Stewart TE, et al. Outcomes of interfacility critical care adult patient transport: a systematic review. *Crit Care.* 2006; 10(1):R6.
 16. Pereira Júnior GA, de Carvalho JB, Ponte Filho AD, Malzone DA, Pedersoli CE. [Intra-hospital transport of critical patients]. *Medicina (Ribeirão Preto).* 2007;40(4):500-8. Portuguese.
 17. Warren J, Fromm RE Jr, Orr RA, Rotello LC, Horst HM; American College of Critical Care Medicine. Guidelines for the inter- and intrahospital transport of critically ill patients. *Crit Care Med.* 2004; 32(1):256-62.
 18. Stearley HE. Patients' outcomes: intrahospital transportation and monitoring of critically ill patients by a specially trained ICU nursing staff. *Am J Crit Care.* 1998; 7(4): 282-7.
 19. Lovell MA, Mudaliar MY, Klineberg PL. Intrahospital transport of critically ill patients: complications and difficulties. *Anaesth Intensive Care.* 2001; 29(4):400-5.
 20. Pesanka DA, Greenhouse PK, Rack LL, Delucia GA, Perret RW, Scholle CC, et al. Ticket to ride reducing handoff risk during hospital patient transport. *J Nurs Care Qual.* 2009; 24(2):109–15.
 21. Ong MS, Coiera E. Safety through redundancy: a case study of in-hospital patient transfers. *Qual Saf Health Care.* 2010;19(5):e32.
 22. Blakeman TC, Rodriguez D, Branson RD. Accuracy of the oxygen cylinder duration calculator of the LTV-1000 portable ventilator. *Respir Care.* 2009; 54(9):1183-6.
 23. Laselva CR, Moura Junior DF, Splaore EH. Enfermagem em terapia Intensiva. Segurança do paciente em UTI: o enfermeiro e a prevenção de iatrogenias. São Paulo: Atheneu, 2006, p.59-66.