



## REVIEW ARTICLE

# Intrahospital transport policies: The contribution of the nurse

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## Abstract

**Background:** Although intrahospital transports are performed daily in hospitals, they pose various risks to patients, which could lead to life-threatening complications. Nursing care, significantly, contribute to achieve the above, although the role of the nurse has never been studied, separately. The aim of this study was to analyze the risk factors for complications that usually occur during intrahospital transports and describe the role of nursing in intrahospital transport policies.

**Method and Material:** We searched electronic databases Medline, Cinahl, Cochrane Library and Scirus, for the period 1980-2013, on both original articles and reviews, selecting and analyzing the articles related to the issue.

**Results:** The risk factors for complications during intrahospital transport are related to patient's illness severity, handling during transport, inadequate equipment, lack of highly trained staff, inadequate monitoring and ineffective communication among staff during transport. Nurses have an active involvement in intrahospital transport procedures, as personnel of the sending and receiving departments or as members of the intrahospital transport team, following or upgrading current policy. Nurses can create an intrahospital transport protocol, based on

published guidelines, train the staff on it, assess and stabilize patient's health condition prior to transport and improve the overall quality of care for transported patients.

**Conclusion:** The risks posed by intrahospital transports for critically ill patients can be minimized or even prevented by a well-designed transport protocol with the effective participation of the nurse.

**Keywords:** Critically ill patients, health care, intrahospital transport, literature review, nursing care

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## Introduction

The need for numerous diagnostic or interventional tests in hospitalized patients requires, even today, where technological development is rapid, and their transport into or outside the hospital.

Intrahospital transport is called the transfer of patients in the hospital for diagnostic or therapeutic purposes or their transfer to specialized units of the hospital.<sup>1</sup> This usually involves moving the patient from an area of the hospital such as the intensive care unit (ICU), the emergency department (ED), the operating theatre department to areas that patients may not receive the same intensive care. The reduction or change of care and the movement itself can become, for the critically ill patients, the cause for serious complications and put their health at risk.

In recent years, intrahospital transports have been extensively studied and described in literature as risky procedures, especially for critically ill patients.<sup>2</sup> They are associated with increased incidence of life-threatening complications, morbidity and mortality,<sup>3</sup>



particularly for patients transported outside the ICU.

The interest of researchers in the last 20 years has focused on adverse events occurring during intrahospital transport of critically ill patients,<sup>4,5</sup> the equipment that should accompany the critically ill during transport,<sup>6</sup> and on the prevention and management of these complications.

Several professional organizations, including the Society of Critical Care Medicine (SCCM), the American Association of Respiratory Care, the European Society of Intensive Care Medicine (ESICM), the Study Group for Safety in Anesthesia and Intensive Care (SIAARTI), the Australasian College for Emergency Medicine and very recently the Société de Réanimation de Langue Française (SRLF), the Société Française d'Anesthésie et de Réanimation (SFAR), and the Société Française de Médecine d'Urgence (SFMU) have published guidelines for the performance of intrahospital transports.<sup>7</sup> Hospitals all over the world developed intrahospital transport policies, based on the above. However, not every hospital in all countries does follow these guidelines, due to lack of resources or highly trained personnel.

Transporting a critically ill patient within the hospital creates a challenging and highly stressful work environment, even for experienced physicians and nurses.<sup>8</sup> Nurses, in every day clinical practice, deal with critically ill transported patients, who need holistic nursing care and their role can be multifunctional, since they participate in almost every part of patients' care having different and complex responsibilities.

For example, a nurse providing care in the Radiology Department must facilitate the required diagnostic testing and simultaneously provide the surveillance necessary to detect physiological changes signaling the need for intervention, like activation of a Medical Emergency Team.<sup>9</sup> Nurses, working in ICU, must provide high-quality nursing

care, constant monitoring and prepare the critically ill patient for transport outside of the secure environment. Nurses working as members of the intrahospital transport team should provide qualitative, continuing health care and vigilance for the occurrence of complications during transport. In addition, as members of clinical departments in the hospital, they are also responsible for preparing and stabilizing patient before sending for transport and after admitting patient to destination department. Therefore, the assumption of these responsibilities should be undertaken by appropriately trained nurses and other personnel, because as Fanara<sup>10</sup> poses in a study, the critically ill patients, prepared and accompanied by inappropriate personnel are a dangerous combination.

The **purpose** of this review was to analyze the risk factors for complications and highlight the contribution of the nurse in intrahospital transport policies, followed to prevent these complications.

Searches of four large electronic databases, Medline, Cinahl, Cochrane Library and Scirus, were conducted for data collection, on both original articles and reviews. The search was limited to articles published between the years 1980 and 2013. The articles related to our interest, were selected and analyzed, founding that very few data exist on the role of the nurse in intrahospital transport policies, all of which are mainly reference points in studies of relevant issues.

### **Risk factors for complications during intrahospital transports**

Intrahospital transport complications were recorded for the first time in the early '70s, where a study by Taylor<sup>11</sup> found that 84% of patients with severe heart problems, who were transported, had arrhythmias and more than half of them required immediate intervention.

The process of intrahospital transport is considered to adversely affect the patient's condition, whose body has reduced physiological reserves to counteract the alterations induced by the environmental changes.<sup>12</sup> The frequency of complications could reach 76.1%<sup>13</sup> and they could be short or long term or even require immediate intervention.

The complications that occur during intrahospital transport of critically ill patients, as shown in Table 1,<sup>12</sup> are usually from circulatory and respiratory systems, or from other systems and complications derived from the intrahospital transport equipment. The risk factors for these complications are complex and related to patients and severity of their illness, equipment and malfunction of the devices, poor communication between staff that prepare and accompany the patient, inadequate monitoring of patient during transport and insufficient documentation of intrahospital transport procedure.<sup>14</sup>

Therefore, the existence of an intrahospital transport protocol or plan is, obviously, not just useful, but important. Especially, when critically ill patients are transported, a standard and well known healthcare policy is required.

Nurses should be aware of the risk factors for complications and act accordingly to transport policies to avoid the occurrence of unexpected outcomes.

Specifically, changes in the condition of the patient may occur due to preexisting health conditions, changes of environmental conditions, or may follow the course of the severe illness from which the patient suffers. The process of intrahospital transport may cause minor complications such as a harmless hemodynamic instability, or critical incidents that may put patient's life at risk. Interruption of vasopressor drugs infusion, pain, inadequate oxygenation, reduced dose of sedative drugs, changes in the distribution of body fluids due to movement,

stress and anxiety are common causes of hemodynamic instability. In a study, investigating the effects on circulatory and respiratory systems of oxygen's therapy discontinuation during intrahospital transports was found an important decrease in partial pressure of oxygen in blood (PaO<sub>2</sub>) and in saturation of oxygen in blood (SaO<sub>2</sub>), increased heart rhythm and arrhythmia.<sup>15</sup> Thus, the nurses that prepare critically ill patients for transport should consider the continuation of intravenous therapy and oxygen administration during transport, at the same levels, as if patient was in the ICU, as an extremely important matter.

Regarding the process of intrahospital transport, patient's health condition may be adversely affected by various external factors when moving from the bed. The changes in patient's position can cause alterations in flow of liquids and medicines, disconnection of intravenous catheters, extubation or deregulation of the portable ventilator, causing respiratory distress. In addition, changes in location can result in pain and movement or removal of drainage tubes. Therefore, nurses and paramedical personnel that are responsible for moving patients on stretcher for transport should be trained in the proper movement of critically ill patients, who are under mechanical ventilation and have intravenous and other catheters, in order to avoid previous complications.

Inappropriate handling of the vehicle with which the patient is transported is another influencing factor. Sudden speed changes and sudden changes in the direction of stretcher may result in increased intracranial pressure or cause pulmonary edema, due to movement of blood to the head and chest, or cause reduction of blood supply to vital organs and cerebral ischemia, by suddenly moving blood to the abdomen and legs. Finally, any shock and vibration can cause patient pain, tissue damage, and hemodynamic disturbances. Careful and soft handling is needed to avoid the above complications.



Patients may experience hypothermia during transport. The main factors for the occurrence of hypothermia is exposure to areas with low temperature, interruption of heating of infusive fluids, lack of insulation blankets and absence of heated humidifiers of ventilators. Patients' temperature should be measured before transport and cautions must be taken, such as extra blankets and continuous heating therapy. Noises, to which patients are exposed during transport, being outside of the safe environment of clinic, may disturb their orientation and cause confusion, anxiety, fear or even convulsions. For this reason, patients that are awake and able to understand us should be informed for their transport and the possibility of noises appearance during its performance. In any other circumstances, ear shields could be used if not contraindicated.

Equipment used during transport is the most common risk factor for complications. A study observing the most frequent adverse events during intrahospital transports showed that 45.9% of them were related to equipment, 26.2% to the patient's condition, 25.8% to lines and 2.2% to other factors.<sup>15</sup> Moreover, a study conducted in Brazil to assess complications during intrahospital transport of patients on mechanical ventilation showed that 7.1% of complications were related to equipment, 7.1% to personnel of the transport team and 85.8 % to patient and the severity of his condition.<sup>16</sup> Therefore, additional attention must be paid regarding the equipment. Firstly, when placing the equipment on stretcher, before transport, make sure that is secure and stable. Secondly, during transport, try not to make sudden movements that can throw the equipment on patient, causing injuries. After transport, before putting patient back to bed, beware for the patient's tangling with the equipment which could lead to disconnection of lines and tubes or injuries.

Regarding the personnel involved in patient's transport, the creation of an intrahospital transport team is necessary for safe transfers in hospitals. However, this team is insufficient if it does not consist of properly trained and qualified personnel. All staff involved in intrahospital transports need to know how to use the equipment accompanying the patient, be able to intervene directly in acute events and properly interpret the monitoring data. A relevant study concluded that the use of a specially trained transport team can reduce the rate of adverse events during intrahospital transports.<sup>17</sup>

Inadequate monitoring of a patient during transport is also a major risk factor. Significant deficiencies in special equipment may increase the likelihood of complications. The critically ill patient should receive the same level of monitoring as if was in the ICU. Thus, any unexpected hemodynamic changes will be properly and quickly identified and managed.

In addition, lack of communication between staff of the sending and receiving departments of transport may cause delays in the procedure, leaving the patient outside of a safe environment for longer than necessary. Direct communication of nurses and physicians of sending and receiving departments prior to transport about the critically ill will reduce time delays. Also, the transport team should contact the receiving department prior to leaving the ICU and then inform the ICU of the expected time of return.

Finally, lack of documentation of all transactions carried out during transport is an obstacle to the effective evaluation of the outcome, since it does not reflect the actual implementation of the process. Specifically, everyday transports documentation should be kept and evaluated in order to identify possible mistakes and correct transport tactics.

### **Nurse's contribution in intrahospital transport procedures**



Intrahospital transport guidelines published, worldwide, include information about decision making prior to transport, the personnel involved in transports, the equipment used in preparation and stabilization of patient, monitoring during transport and evaluation of the outcome.

Health care policies for transported patients, used in any hospital, should include all the above information, depending on the particularities of each country or health formation. Moreover, the role of each specialty involved, as well as the role of the nurse, should be also described, in all parts of the existing protocol.

Nurses have an important role in each and every part of intrahospital transports, since they daily ensure the continuous and holistic provision of care to all patients.

Although international guidelines for intrahospital transport are known for almost two decades, there are many hospitals where guidelines are not used in every day practice and transport policies are not developed. However, since the decision for transport is taken, an organized and detailed plan for intrahospital transport procedure should be available to run.

#### *Decision making*

The first and most important step in preventing intrahospital transport complications is the decision whether the transport should be done or not. The risk – benefit consideration of its outcome and the search for alternative solutions to avoid transport should be the first thought of health care professionals. According to the findings of an old study, when technology was not as developed as today, the outcome of diagnostic tests, in 76%, does not lead to a change in therapy within the first 48 hours, which makes us wonder whether those tests that require transport should be carried out.<sup>18</sup>

The anxiety of health professionals, related to increased responsibility for the transported

patient and awareness of transport complications, led to studies calculating the risk in relation to benefit through specially designed cards and charts.<sup>19</sup> Their goal was the decision for intrahospital transport to be based on a complete evaluation of patient's health condition, in order to be done with maximum safety.

Nurses participate in making the decision to transport, along with medical and paramedical personnel. They evaluate the health condition of the patient, who should be haemodynamically stable in order to cope with the difficulties of transport and suggest possible alternative ways for patient to have the diagnostic test, for example chest x-ray in the bedside of patient, avoiding the necessity for transport.

#### *Intrahospital transport policy*

In such cases, where there are no transport plans available, highly trained nurses contribute by building a basic policy for intrahospital transport performance. They know the allocated equipment and the equipment deficiencies of the nursing departments, the personnel and it's training, the way transports conduct in everyday clinical practice, in the facility of their employment and the correct actions for a successful transport. Nurses have the necessary clinical skills to create a detailed protocol (plan), consistent with the conditions of the hospital, and also based on the international guidelines, regarding the personnel involved in transports, the appropriate equipment, the preparation procedures and the evaluation of the outcome.

#### *Personnel*

Transporting a patient into a hospital, usually, includes passing through hallways, elevators and other areas that are unpleasant environments for an ill person, because of temperature alterations, noises, and many people, visitors, or hospital employees passing near the patient. It is, therefore, important, even for non-ICU patients, to be transported by well-trained personnel, who





would know how to move without delays, protect patients from harm and inconvenience that could lead to complications and maintain patients' dignity and respect through the crowded areas during transport.

Regarding the critically ill, apart from the above, it is also important for the transport team to care for the continuation of the provided treatment, detect possible physiological changes and be ready to intervene if needed.

According to published international guidelines, the intrahospital transport team should consist of minimum two persons, the nurse who has the responsibility of the patient or a nurse specialized in intensive care, trained in CPR, and a trained bearer. When the patient is under mechanical ventilation is recommended to be accompanied by pulmonologist trained in cardiopulmonary resuscitation. Patients who are intubated and have many intravenous or arterial catheters and drains should be accompanied by two or three additional people,<sup>20</sup> an nurse, an emergency room technician and an intensivist (or anesthetist) for patients who are haemodynamically unstable and may require immediate intervention.

Trained nurses not only participate in intrahospital transport team, but also educate unqualified personnel in managing emergent situations and crises during intrahospital transports. In particular, the nurse presents the protocol to personnel, explain why it is important to implement the plan in every transport and help staff understand the plan by answering their questions. The nurse, also, trains the intrahospital transport team in equipment use, maintenance and control of devices, performs regular exercises to improve practice and rewards the zeal and dedication of personnel, in order to feel allies in the completion of safe transports and not just executive bodies. Moreover, regular updates and reassessments would be important for personnel that do not involve in transports very often.

Nurses should also promote the training of the new staff by having them accompany the transport team to learn about the issues surrounding the process and the care that is required to maintain the safety of the patient and the holistic nature of the transport.

The greatest benefit of using this team is patient's safety during transport and reduction of complications appearance frequency. A relevant study showed that patients who were accompanied by a specialized transport team had 15.5% rate of complications compared with the overall rate which touched 75%.<sup>17</sup>

### *Equipment*

Table 2 shows a list of necessary equipment for the transport of critically ill adults suggested by the published international guidelines.

The devices, which are used in intrahospital transports, should have specific characteristics. It is important the equipment to meet the criteria for a safe transport. The devices that are usually needed for the transport of a critically ill patient, like monitors, oxygen cylinders or material trolleys are bid, heavy, not easy to carry, always connected with power source in the ICU or other departments, and they are rarely moved from their position. It is not possible the same devices to be used for a transport, where they should be on patient's stretcher, in motion. For example, devices without a broad base are unbalanced and they can easily fall on stretcher when moved, or devices that are not resistant to hardship can be disabled due to an unexpected striking on a wall during transport. The characteristics that the intrahospital transport's equipment should have are shown in table 3.

In addition, the necessary technical equipment should be entirely dedicated to intrahospital transport procedures.<sup>21</sup> According to Warren<sup>3</sup> they should definitely include a recording of vital signs (blood pressure, pulses, temperature, breath



rate) and an ECG monitor, a pulse oximeter and a defibrillator, in order all hemodynamic changes to be accurately and quickly detected and managed.

Nurses, experienced in intensive care, suggest the use of specific equipment in intrahospital transports of critically ill patients. They train the new staff or the intrahospital transport team in their proper use and ensure the equipment's services and replacement when needed.

#### *Preparation and intrahospital transport's procedures*

Preparation for intrahospital transport includes specific necessary procedures that should be completed before, during and after transport.<sup>12</sup> Nurses have an active involvement in every part of this process. Table 4 summarizes the most important of these procedures that nurses achieve for a safe transport.

As personnel of the sending department nurses take the decision for transport along with the medical team, prepare patients appropriately for transport, maintaining the provided treatment, as oxygen therapy and intravenous solutions, prepare the documentation of patients, which should accompany them and correctly update the transport team for patients' condition, destination department and type of the required examinations. They communicate with the receiving department, informing them for the expected time of the arrival. They, also, call additional staff for transport team, when necessary, due to patients' health condition and receive patients after transport, ensuring continuity of care and stabilization of their condition. Nurses, on this position, are also responsible for the daily charging of the equipment and checking it for proper operation and dysfunctions. This action has to be done after the end of every transport as well, to ensure that damage has not occurred, as this could compromise the next transport. In addition,

batteries should be checked for charge status prior to their use in a transport.

During transport, nurses as members of the intrahospital transport team, secure the equipment on stretcher and provide holistic and continuing care to the patients during their stay outside the secure environment. They vigilante for unexpected complications, such as disconnections of lines and pathophysiological changes in their health condition, through monitoring and ensure the availability and renewal of materials in stretchers transporting patients. After transport, nurses record encountered events and interventions needed.

After the completion of the transport, nurses, as personnel of the destination department, receive patients from transport team, continuing the provided care, get updated on their health condition and any adverse events encountered during transport and deliver patients to the team after the intervention-test, safely.

#### *Evaluation*

The completion of the intrahospital transport, when performed according to an existing protocol, should be evaluated. The purpose of the evaluation is to identify problems within the system, deficiencies in training, human errors, and unpredictable risk factors of transport, to discuss unique events where unexpected outcomes occurred and consider what could have been avoided.

After the evaluation, improvement recommendations and further implementation of them to the protocol are expected. Therefore the level of the provided care will be continuously upgraded for critically ill patients in intrahospital transports.

Nurses, who participated in the creation and implementation of the transport's protocol, evaluate the intrahospital transport's outcome. Specifically, they, carefully, watch the progress of



the process, recording complications that occurred during transport. They communicate with the personnel on the causes of complications and propose ways to address them in the future. They remodel the existing protocol and recommend improvements by monitoring international developments and studies.

### Conclusions

Intrahospital transports research, internationally, improved the way they are conducted in hospitals and reduced the unexpected complications. However, research and efforts for increased compliance should continue as Winter's<sup>22</sup> study, recently conducted in Australia, showed that despite the implementation of guidelines, in 44% of transports adverse events did occur, the majority of which could be prevented with careful planning and better communication between the personnel.

The participation of qualified, trained nurses along with the existence of a specific policy in intrahospital transports, suitable education, clinical experience in intensive care and development of communication tools-technics are the foundation for safe intrahospital transports.

Nurses' role is particularly crucial in intrahospital transports. They assess the health status of the patient prior to transport, provide holistic and continuing health care, stabilize and prepare patient properly and maintain dignity and respect of patient during transport. In addition, they ensure compliance with the existing policy and vigilante for the appearance of unexpected adverse events during transport and their effective management. However, this very important issue has not been purely and extensively studied by the international scientific nursing community. Therefore, further investigation is considered necessary.

With the above in force as Löw and Jaschinski<sup>23</sup> very characteristic wrote a "non-transportable" patient, even if in crucial health condition, is just as unlikely as a "non-anesthetizable" patient.

### References

1. Martin TE. Handbook of Patient Transportation. London, 2001.
2. Jarden RJ, Quirke S. Improving safety and documentation in intrahospital transport: development of an intrahospital transport tool for critically ill patients. *Intensive Crit Care Nurs* 2010; (2)26:101-7.
3. Warren J, Fromm EJr, Orr RA, Rotello LC, Horst HM. Guidelines for the inter- and intrahospital transport of critically ill patients. *Crit. Care Med* 2004; (1)32: 256-62.
4. Papon PNJ, Russell LK, Taylor D. Unexpected Events during the Intrahospital Transport of Critically ill Patients. *Academic Emergency Medicine* 2007; (6)14: 574-7.
5. Mazza BF, Amaral JLG, Rosseli H, Carvalho RB, Senna AP, Guimaraes HP, et al. Safety in intrahospital transportation: evaluation of respiratory and hemodynamic parameters. A prospective cohort study. *Sao Paulo Med J.* 2008; (6)126: 319-22.
6. Pope B.B. Provide safe passage for patients. *Nursing Management* 2003; 34(9): 41-46
7. Day D. Keeping patients safe during intrahospital transport. *Crit Care Nurse* 2010; (4)30: 18-32.
8. Kue R, Brown P, Ness C, Scheulen J. Adverse clinical events during intrahospital transport by a specialized team: A preliminary report. *Amer. J. Crit. C* 2011; (2)20:154-165.
9. Ott LL, Hoffman LA, Hravnak M. Intrahospital Transport to the Radiology Department: Risk for Adverse Events, Nursing Surveillance, Utilization of a MET and Practice Implications. *J Radiol Nurs* 2011; (2)30: 49-52.
10. Fanara B, Manzon C, Barbot O, Desmettre T, Capellier G. Recommendations for the intrahospital transport of critically ill patients. *Crit Care* 2010; (3)14: 87.
11. Taylor JO, Landers CF, Chulay JD, Hood WBJ, Abelman WH. Monitoring high – risk cardiac patients during transportation in hospital. *Lancet II* 1970; (7685)296: 1205-8.





12. Brokalaki H, Kostaki Z. Intrahospital transports. In: Baltopoulos GI Intensive Care and Emergency Medicine: Trauma. 1<sup>st</sup> edition. Athens, Medical Publications P.X. Pasxalidis 2005.
13. Wallen E, Vencataraman ST, Grosso MJ, Kiene K, Orr RA. Intrahospital transport of critically ill pediatric patients. Crit. Care Med 1995; (9)23: 1588-95.
14. Brokalaki H, Giakoumidakis K, Brokalaki E. Monitoring patient during intra and inter-hospital transport. In: Baltopoulos G,I, Gavala A.X, Tsigou E.V (sygr.) Intensive Care & Emergency Medicine: Monitoring, 1<sup>st</sup> edition. Athens, 2009.
15. Brokalaki HJ, Brokalakis JD, Digenis GE, Baltopoulos G, Anthopoulos L, Karvountzis G. Intrahospital transportation: monitoring and risks. Intensive Crit Care Nurs 1996; (3)12: 183-6.
16. Zuchelo LTS, Chiavone PA. Intrahospital transport of patients on invasive ventilation: cardiorespiratory repercussions and adverse events. J Bras. Pneumon 2009; (4)35: 367-74.
17. Stearly HE. Patients' outcomes: intrahospital transportation and monitoring of critically ill patients by a specially trained ICU nursing staff. Amer. J. Crit. C 1998; (4)7: 282-7.
18. Indeck M, Peterson S, Smith J, Brotman S. Risk, cost and benefit of transporting ICU patients for special studies. J Trauma 1988; (7)28: 1020-5.
19. Esmail R, Banack D, Cummings C, Duffett-Martin J, Rimmer K, Shultz J. et al. Is your patient ready for transport? Developing an ICU patient Transport Decision Scorecard. Health Care Quarterly 2006; 9(Sp): 80-6.
20. Australasian College for Emergency Medicine. Minimum standards for transport of critically ill patients. Emergency Medicine 2003; (2)15: 197-201.
21. Society of Critical Care Medicine1 Guidelines for the transfer of critically ill patients. Crit Care Med 1993; (6)21: 931-7.
22. Winter MW. Intrahospital transfer of critically ill patients; a prospective audit within Flinders Medical Centre. Anaesth Intensive Care. 2010; (3)38: 545-9.
23. Löw M, Jaschinski U. Intrahospital transport of critically ill patients. Anaesthesist 2009; (1)58:95-105.

## ANNEX

**Table 1.Complications of intrahospital transports**

<b>Cardiovascular System</b>	Changes in blood pressure (usually hypotension) Tachycardia Arrhythmia Cardiac arrest Pulmonary edema
<b>Respiratory System</b>	Changes in respiratory frequency Pneumonia, aspiration Airway obstruction Accidental displacement/Movement of endotracheal tube Respiratory arrest SaO <sub>2</sub> reduction Blood gas alterations Alterations of acid-base balance
<b>Complications from other systems</b>	Increase in intracranial pressure Pain Vomiting Hypothermia Bleeding
<b>Complications derived from equipment malfunction</b>	Disconnection/dysfunction of portable ventilator Removal/Disconnection of intravenous catheters or others Removal of feeding tubes Shutdown devices (mechanical failure, drop in power, battery) Interruption of oxygen supply Removal of intracranial pressure measuring devices Patients injury

**Table 2. Necessary equipment for the transport of critically ill adults**

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<b>Equipment</b>	
	<ul style="list-style-type: none"><li>▪ airway management equipment (in the appropriate size for each patient and a range of sizes, as airway trauma and swelling may require a smaller tube)</li><li>▪ oxygen cylinder (completely filled, so that there is enough oxygen for the entire duration of transport and 30 extra minutes in case of a delay)</li><li>▪ basic resuscitation medications (such as epinephrine and antiarrhythmic agents readily available for any heart attacks and arrhythmias)</li><li>▪ additional drugs such as tranquilizers and narcotic analgesics</li><li>▪ a large amount of intravenous solutions and drugs for continuous intravenous infusion</li><li>▪ pumps for liquids and medicines</li><li>▪ portable suction (for patients with reduced level of consciousness, a tracheostomy and/or on a ventilator)</li><li>▪ ventilator (which allows for the same ventilatory parameters as the ICU ventilator, including non-invasive ventilation modes, and the ability to switch immediately to manual ventilation through an endotracheal tube or mask) (Quenot, 2012)</li></ul>

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**Table 3. Transport's equipment characteristics**

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<b>Equipment Characteristics</b>	
	Suitable designed
	Portable
	Simple in use
	Resistant to hardship
	Small in size
	Function with (ac)power and batteries(dc)
	Broad base and low center of gravity
	Equipped with alarm systems (visual and acoustic)
	Placed on special shelf, not on stretcher
	Able to work in special areas such as MRI chamber
	Easy to control and watch from distance
	Ability to record, store and playback data

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**Table 4. Before/During/After Transport Procedures**

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<b>Before transport</b>	<ul style="list-style-type: none"><li>• All staff involved in transport is relieved of other obligations</li><li>• Stabilization of patient's condition</li><li>• Collection and control of equipment used in transport</li><li>• Collect patient's data (medical record)</li><li>• Connecting patient to monitoring equipment and control of recording parameters</li><li>• Reassessment of patient's stability, vital signs, intravenous and other catheters and drainage</li><li>• Safe transportation of patient on stretcher, in comfortable position</li><li>• Planning of the route to be followed</li><li>• Communication of the sending department with destination department to inform those responsible and to define the arrival time</li></ul>
<b>During transport</b>	<ul style="list-style-type: none"><li>• Follow the easy and short route, planned. Elevators should be available and secured to avoid delays and crowds</li><li>• Means of communication with the destination department should be available</li><li>• Continuously checking and recording patient's health condition and the parameters of the devices at regular intervals, especially if the duration of the transport is long, to address any complications.</li><li>• Immediate intervene when needed</li></ul>
<b>After transport</b>	<ul style="list-style-type: none"><li>• Admission of patient at destination department</li><li>• Reassessment of patient's health condition and control of equipment's operation</li><li>• Connect patient with the new recording equipment, if transfers from the stretcher</li><li>• Detailed update to the monitoring team. The transport team does not leave the area, if the other team is not fully prepared to take over</li><li>• Recording and documentation of all incidents on specific forms</li></ul>

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