Mansoura Nursing Journal (MNJ) Vol. 9. No. 2 – 2022
Print ISSN: 2735 – 4121 Online ISSN : 2735 – 413X

Original Article

Intrahospital Transport of Critically Ill Patients: Current Evidenc

Eman Ahmed Abdullah Mansour 1 Marwa Fathallah Mostafa 2 Nahla Shaaban Khalil 3
1 Specialist Nurse, Oncology Center, Mansoura University, Egypt.
2 Assistant Professor of Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University, Egypt.
3 Professor of Critical Care and Emergency Nursing, Faculty of Nursing, Cairo University, Egypt.
Corresponding author : mercy_angel1908@gmail.com

1.ABSTRACT

One of the major activities in the health care process is the transport of patients. Much needed attention has been directed to the transfer of those suffering from actual or potentially life-threatening problems. Adverse events during transportation are still common, and they might pose a serious risk to the patient. The transport process requires a lot of assessment and preparation of the patient, staff, and equipment that should be made prior, during, and after transport. Intrahospital transportation is a continual process of care and monitoring, rather than just a simple transportation procedure. Critically sick patients are frequently transported throughout the hospital without previous planning. This lack of planning may impair the preparation of the team, materials, and equipment and may facilitate the occurrence of adverse events. This literature highlights the most common complications that might face the patient during intrahospital transport and its related risk factors so that health care providers can avoid or reduce the occurrence of it later on.

Keywords: *Intrahospital Transport, Critically Ill Patient, Transportation*

2. Literature Searching Strategy:

To find appropriate relevant literature on this subject, the authors searched electronic medical and health care databases such as Google Scholar, Ovid, Science Direct, PubMed, Cochrane Library, Pro-Quest, and Medline. As keywords, the following search phrases were used: *"intrahospital transportation", "risk/benefit assessment", "patient assessment and preparation", "equipment, devices, and medications for transport", "transportation team", "transportation process", "risk factors", "complications before during and after transport".*

3.Literature Review

The purpose of this review is to *discuss* the current evidence related to risk factors and complications of intrahospital transportation of critically ill patients. The discussion covers three main sections as follows:

Section I: Overview of critically ill patients' transport.

Section II: Risk factors and complications of intrahospital transport.

Section III: Critical care nurses' role before, during, and after intrahospital transport.

Section I: Overview of critically ill patients transport

Intensive care units (ICUs) are designed to look after severely sick patients who require continual monitoring, attention, and specialized care. **(Vincent and Creteur, 2015).** Patients in ICU are on continuous monitoring of vital signs, where they *should* be attached to the cardiac monitor for the reading of blood pressure, oxygen saturation, heart, and respiratory rate **(Drews and Doig, 2014).**

Prehospital transport, interhospital transfer, and intrahospital transport (IHT) are various situations in which severely sick patients may require transportation ***(*Kaljević et al., 2019*)***. The IHT is the process of transporting patients from one section of the hospital to another for diagnostic or therapeutic reasons **(Bergman et al., 2017)**. IHT could be divided into three phases. *Pre-transport phase*; in which the patient's preparation for transfer should take place, while The transport phase includes the time spent transitioning from the ICU to another department and vice versa, as well as the time spent undergoing diagnostic or therapeutic procedures. When the patient was returned to the ICU, In which ICU monitoring and previous ICU therapies had to be reinstalled in the post-transport period***(Brunsveld-Reinders et al. 2015*).**

Unfortunately, while the patients in the ICU transferred, they could be exposed to significantly higher risks and adverse events. Therefore, the transfer decision must not be taken lightly since it could expose the patient and the team to additional risk**(Parmentier-Decrucq et al., 2013).** The

determination to transport the critically ill patient is based on evaluating the advantages and disadvantages. It is critical to understand the frequency of adverse events and risk factors during IHT in order to schedule safe ICU patient transport **(Alizadeh Sharafi et al., 2020)**.

In practice, ***Kue et al., 2016*** noted that the IHT of critically ill patients is frequently performed automatically and without previous planning. This lack of planning may impede the team's, materials, and equipment preparation, as well as facilitate the occurrence of bad events.

The global prevalence of adverse events (whether severe or not) has been recorded to reach 68%, while the incidence of serious adverse events requiring therapeutic intervention varies between 4.2% to 8.9%. Furthermore, cardiac arrest during IHT varies between 0.34% to 1.6%**(Papson et al., 2007; Koyfman et al., 2021).** The specific incidence of adverse events linked to a clinical decline varies between 17 and 33 percent. Hypotension, arrhythmia, hypoxia due to ventilator desynchronization or otherwise, and elevated intracranial pressure are all symptoms of this condition. According to a previous study by **Shirley and Stott (2011)**, the specific incidence of equipment and organization-related adverse events is between 10.4% and almost 72%**.**

Conquering the relation between COVID-19 and IHT, Authorities used several travel modalities to move critically sick ventilated patients to less congested units due to the COVID-19 epidemic. In a cohort of COVID-19 ventilated ICU patients from three French university hospitals, inter-hospital evacuation did not appear to increase death, as a result, it may be used to manage ICU surges in the future. **(Painvin et al., 2021**).

Reasons for patients' IHT

There are two main reasons for IHT. Transport for diagnostic reasons comprises radiological examinations, as well as hemodynamic and diagnostic endoscopic operations performed in the endoscopic chamber. In comparison, therapeutic reasons include surgical procedures in the operating room, endovascular procedures in the laboratory or cardiology department, and endoscopic procedures in the endoscopic room **(Gimenez et al., 2017).**

According to the findings of the study by **Kue et al.,2016** computed tomography imaging is the most prevalent reason for IHT (86.2 %), followed by ultrasonography (4.1 %), radiations (1.8 %), MRI (1.6 %), endoscopy (0.9 %), and finally angiography (0.9 %).

Modes of transportation

During an IHT, the patient must leave the ICU and be moved to different parts of the hospital through corridors and elevators. As a result, IHT is a potentially risky procedure **(Bergman et al., 2017)**. The safest and most efficient approach to the procedural area should be determined before the patient leaves the ICU. It's a good idea to think about flooring inclines and a sharp narrow turn scan. Elevators should be the largest and most "secured" available **(Bergman et al., 2020).** If necessary, especially with patients in unstable conditions. Another factor to consider while deciding on the best route is the availability of emergency assistance along the way. The availability of a code cart within 4 minutes at any location along the route is recommended**(Löw & Jaschinski, 2009).**

Patient transportation team

According to published international guidelines, the IHT team should consist of a minimum of 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 **(Australasian College for Emergency Medicine et al., 2003b; Alamanou and Brokalaki, 2014).** If the patient is attached with mechanical ventilation, it is recommended to be accompanied by a 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. A nurse, an emergency room technician and an intensivist (or anesthetist) are needed for hemodynamically unstable patients who may require immediate intervention ***(Williams et al., 2020)*.**

Minimally, the patient must be cared for according to ICU guidelines. According to **Droogh et al. (2015)**, equipment should be appropriately fixed before transfer. Trolleys should carry all the equipment, and the equipment should be checked for safety, and their efficiency must be determined**.** ***Figure 1*** shows the equipment organized by the ABCs (airway, breathing, and circulation).

Airway	Oral/nasal airways, Soft wrist restraints, Sedation, Intubation tray with various sizes of endotracheal tubes, Complete suction setup with adequate tubing length.
Breathing	Oxygen saturation pulse oximetry, Oxygen delivery devices: nasal cannula, Venturi high-flow mask, nonrebreather mask, Bag-valve-mask (anesthesia bag/self-inflating bag). Fitted with positive end-expiratory pressure valve, Full oxygen tank with enough supply for flow requirements plus 30 min, Oxygen wall source at destination with flowmeter and adequate tubing length, Ventilator capable of matching intensive care unit's ventilator settings**.**
Circulation	Cardiac monitor, Defibrillator with pacing capacity and defibrillator/pacing pads (must be taken on route for known unstable rhythm/history of ventricular fibrillation, new myocardial infarction), Blood pressure cuff of the proper size; stethoscope, Supplies to establish intravenous access, Isotonic crystalloid intravenous fluid with big-bore tubing to establish "code line," Standard resuscitation drugs: epinephrine, atropine, amiodarone with adequate filter supply of vasoactive medications, analgesia, to meet patient's anticipated needs (with orders/protocols to cover administration), Temperature probe or thermometer.

Figure 1.Equipment for intrahospital transport **Adopted from** "Intrahospital transport policies: The contribution of the nurse " by Alamanou, D. G., and Brokalaki, H. (2014). Health Science Journal, 8(2), 166.

Section II: Risk factors and complications of IHT.

Risk factors that occur during IHT are categorized as the system and patient-based factors(**Figures2)**. The system factors are separated into two categories: equipment-related and human-related. Both are frequently the result of a lack of pre-planning and preparedness **(Knight et al., 2015)**. Physiological decline associated with critical illness is referred to as patient-related factors. These factors contribute to unique and challenging predictability adverse events and impact the patient's health **(Ringdal et al., 2016*)***. A study by **Reinders et al. (2015*)*** mentioned that IHT incidents were mostly related to equipment failure than physical deterioration of the patient.

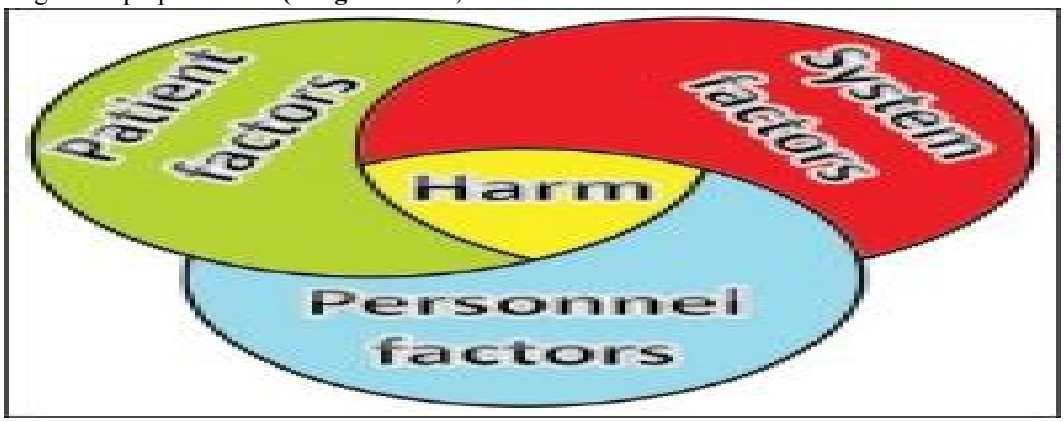

Figure 2. **Factors associated with patient harm during intrahospital transfers Adopted from** "Adverse events experienced with intrahospital transfer of critically ill patients: A national survey" by *Temsah, M.-H., Al-Sohime, F., Alhaboob, A., et al. (2021) Medicine, 100(18).*

Risk/ benefit assessment

A risk/benefit analysis of It must be done ahead of time. The possible benefit for the patient vs the possible risks for the patient is the first consideration for IHT **(Comeau et al., 2015**). "Benefit" refers to a diagnostic test that leads to a change in management or a treatment therapy that improves the outcome. "Risk" refers to the patient's potential for harm, which is directly proportional to his or her level of stability **(Tabah et al., 2020)**.

Critically ill patients who are transported within the hospital have a high risk of complications. ICU patients may experience up to 80% of adverse events during IHTs, (desaturation, agitation, hemodynamic instability, arrhythmia, hypothermia, and equipment-related issues) are just some of the issues that can occur, however, this rate varies with each study **(Kue et al., 2016; Schwebel et al., 2013; Parmentier-Decrucq et al., 2013)**. Also, complications occur as a result of the patient's movement during IHT which happens due to acceleration, deceleration, frequent posture adjustments, and surface changes **(Martin et al., 2017).**

Moreover, during IHT, patients are at risk for hemodynamic, respiratory, psychological, and neurological problems **(Kue et al., 2016)**. The

IHTs are also associated with longer ICU and hospital length of stay, and complications such as the increased risk of ventilator-associated pneumonia **(Schwebel et al., 2013)**.

Airway and pulmonary complications can occur during IHT, especially in the ICU, when a large percentage of patients require mechanical ventilation, the transfer process becomes more complicated ***(Knight et al., 2015).*** Symptomatic pneumothorax where the risk of pneumothorax is increased by more than a factor of two. Atelectasis is a condition in which the occurrence of atelectasis is roughly threefold higher in patients having IHT **(Veiga et al., 2019)**. Furthermore, individuals who are moved may be at a higher risk of getting deep vein thrombosis (odds ratio of 4.5), leading to an increased incidence of pulmonary embolism**(Sanchez-Pinto et al., 2013)**. Equipment-related concerns have been linked to pulmonary complications in IHT patients, and manual ventilation may be more dangerous than mechanical ventilation ***(Kleffmann et al., 2016).***

*Hemodynamic complications***.** A study featured 35 patients who were moved from an ICU and had their vital signs taken at nine different periods, with the majority of them(77%) being intubated. In 19 patients(54%), there was a *significant* reduction in blood pressure. Moreover, one patient suffered considerable hypotension (systolic blood pressure less than 90 mmHg) as a result of the procedure **(Nakayama et al., 2012).**

cardiac arrest remains a serious issue for critically ill patients undergoing IHT, this feared complication affects 0.34 percent to 1.6 percent of patients. This could be due to insufficient monitoring during transportation, *especially* when inexperienced or unprepared staff members are involved **(Parmentier-Decrucq et al., 2013).** A study by **Reinders et al. (2015)** mentioned that patients who are at high risk of cardiovascular events during transfer could be very liable to arrhythmia.

Nosocomial infections: IHT has been identified as a possible infection risk factor. Such a risk may exist for both the patient being transported and others who may be exposed to the patient being transported (e.g., in cases of highly contagious or resistant infectious agents) **(Kalra et al., 2014)**. Another matched-cohort study found that intra-hospital transport was linked to a more than three-fold increase in the risk of VAP **(Bercault et al., 2015).** Overall, the evidence suggests that IHT is a measurable risk factor for the development of VAP **(Schwebel et al., 2013)**.

Hypoglycemia and hyperglycemia: During IHT, disturbances in glucose homeostasis and their control can occur. Over 3,000 IHTs were examined for consequences, including adverse events such as glucose changes, in research. When compared to control individuals, hyperglycemia during IHT was about 2.3 times more common. Similarly, the chances of IHT leading to hypoglycemia were increased by a similar percentage **(Schwebel et al., 2013)**.

Acid/Base Disorders: During IHTs, changes in ventilator settings, intravenous fluid infusion adjustments, vasoactive medication administration interruptions, and changes in circulatory dynamics and end-organ perfusion can all cause changes in the systemic acid-base milieu. Acidosis can impact the efficiency of vasopressors and put patients at risk for arrhythmias **(Zuchelo & Chiavone, 2009)**.

An existing injury: the patient's movement from bed to stretcher and then to the procedures table, moving the patient through *the* hallway and elevators could not only cause patient discomfort but also can cause tissue damage**(Comeau et al., 2015)**. Minor patient manipulation without sufficient safeguards could result in a musculoskeletal injury. During IHT, all monitoring and stabilizing equipment must be correctly aligned and fastened **(Conrad et al., 2012)**.

Patients with *neurosurgical and spinal injuries* are on the list, and they will require extra care during transit ***(Knight et al., 2015)***. Patients who are not properly stabilized risk secondary harm from distraction, misalignment, *neurovascular* damage, or other soft tissue injuries **(Bach et al., 2017)**. According to a study by **Picetti et al., 2013** on a brain-injured patient, complications such as intracranial hypertension, oxygen saturation below90%, bronchospasm, ventilator dyssynchrony, hypertension or hypotension, and arrhythmias were reported in 103/288(36%) of the patients.

Section III: Critical care nurses' role before, during, and after IHT

Nurses have an important role in each part of IHT since they daily ensure the continuous and holistic provision of care to all patients **(Alizadeh Sharafi et al., 2020; Sakshi & Vinay, 2021)**. IHT complications have been reduced over time as a result of evidence-based nursing **(Bergman et al., 2020; Branson & Rodriquez, 2020)**. Nurses' role is *particularly* crucial in IHT. They assess the health status of the patient before transport, provide holistically and continuing health care, stabilize

and prepare the patient properly and maintain dignity and respect of patient during transport**(Alamanou&Brokalaki, 2014)**. In addition, they ensure compliance with the existing policy and vigilante for the appearance of unexpected adverse events during Transport and their effective management **(Hu et al., 2021)**.

A study has done by**Kulshrestha and Singh (2016)** stressed that in the preparation phase for patient transfer, the airway, breathing, circulation, and disability, should be checked, and any associated preventable problems should be corrected. They also urged that the patient be resuscitated and stabilized to the greatest extent feasible without wasting time in order to prevent the patient's clinical condition from deteriorating.

In addition, nurses should be responsible for the daily charging of the equipment and check it for proper operation and dysfunction. This action had to be done after the end of each transfer as well, to ensure that damage did not occur as this could compromise the next transfer. Also, batteries should be checked for charge status before their use in a transfer **(Alamanou&Brokalaki, 2014)**.

Regarding IHT decision making. Nurses participate in deciding on patients' transport, along with medical and paramedical personnel. They evaluate the health condition of the patient, who should be hemodynamically stable to cope with the difficulties of Transport **(Backman,2019)**. Highly trained CCNs contribute to building a basic policy for IHT performance. They know the allocated equipment and the equipment deficiencies of the nursing departments, the personnel, and their training, the way transports are conducted in everyday clinical practice, and the correct actions for a successful transport **(Alizadeh Sharafi et al., 2020).**

Moreover, they 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**(Khan,2021)**. They 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 **(Nakayama et al., 2012**).

Trained nurses not only participate in IHT teams but also educate unqualified personnel in managing emergent situations and crises during IHT. They train the IHT team in equipment use, maintenance, and control of devices**(Alamanou and Brokalaki, 2014)**. 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 **(William, 2017)**.

As regards IHT procedures preparation. Nurses have an active involvement in every part of this process. They prepare patients appropriately for transport, maintain the provided treatment, like oxygen therapy and intravenous solutions, prepare the documentation of patients, which should accompany them, and correctly update the transport team for patients' conditions. **Figure 3** summarizes the most important of these procedures that nurses achieve for safe transport**(Alamanou, & Brokalaki, 2014)**.

Before Transport	• Stabilization of patient's condition • Collection and control of equipment used in Transport • Collect patient's data (medical record) • Connecting patient to monitoring equipment and control of recording parameters • Reassessment of patient's stability, vital signs, intravenous catheters, and drainage
During Transport	• Follow the easy and short route, planned. Elevators should be available and secured to avoid delays and crowds • Means of communication with the destination the department should be available • 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. • Immediate intervention when needed
After Transport	• Admission of a patient at destination department • Reassessment of patient's health condition and control of equipment's operation • After the completion of the transport, nurses, as personnel of the destination department, receive patients from the transport team, continue 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.

Figure 3. Role of Nurse Before/During/After Transport Procedures **Adopted from"** Intrahospital transport policies: The contribution of the nurse" by Alamanou, D. G., and Brokalaki, H. (2014). Health Science Journal, 8(2), 166

Nurses, who participated in the creation and implementation of the transport protocol, evaluate the transport process outcome. They carefully watch the progress of the process, record complications that occurred during transport, communicate with the personnel on the causes of complications, and propose ways to address them in the future **(Zhang,2021)**. They remodel the existing protocol and recommend improvements by monitoring international developments and studies(**Alamanou&Brokalaki, H, 2014)**.

Finally, Health care brings benefits to patients in general, but at the same time, it can put patients at risk of adverse events. Thus, maintaining patients' safety is proposed as the main concern in providing health care. Most of the adverse events are caused by incomplete systems or processes. IHT is one of them **(Kleitsch et al., 2021)**. The participation of qualified, trained nurses along with the existence of a specific policy in IHT suitable education, clinical experience in intensive care, and development of communication tools-technics are the foundation for safe IHT **(Hu et al., 2021)**.

4 .References:

Alamanou, D. G., and Brokalaki, H. (2014). Intrahospital transport policies: The contribution of the nurse. *Health Science Journal, 8*(2), 166.

Alizadeh Sharafi, R., Ghahramanian, A., Sheikhalipour, Z., Ghafourifard, M., & Ghasempour, M. (2020). Improving the safety and quality of the intra□hospital transport of critically ill patients. Nursing in critical care, 26(4), 244-252.

Australasian College for Emergency Medicine, J. F. o. I. C. M., Australian, and Anaesthetists, N. Z. C. o. (2003b). Minimum standards for Transport of critically ill patients. Emergency Medicine, 15(2), 197-201.

Bach, J. A., Leskovan, J. J., Scharschmidt, T., et al. (2017). The right team at the right time–Multidisciplinary approach to multi-trauma patient with orthopedic injuries. International journal of critical illness and injury science, 7(1), 32.

Backman, T., Juuso, P., Borg, R., & Engström, Å. (2019). Ambulance nurses' experiences of deciding a patient does not require ambulance care. Nursing Open, 6(3), 783-789.

Bercault, N., Wolf, M., Runge, I., et al. (2015). Intrahospital Transport of critically ill ventilated patients: a risk factor for ventilator-associated pneumonia—a matched cohort study. Critical care medicine, 33(11), 2471-2478.

Bergman, L. M., Pettersson, M. E., Chaboyer, W. P., et al. (2017). Safety hazards during intrahospital Transport: a prospective observational study. *Critical care medicine, 45*(10), e1043-e1049.

Bergman, L., Pettersson, M., Chaboyer, W., et al. (2020). Improving quality and safety during intrahospital Transport of critically ill patients: a critical incident study. *Australian critical care, 33*(1), 12-19.

Branson, R. D., & Rodriquez, D. Jr (2020). Monitoring during transport. *Respiratory Care,*65(6), 882–893. https://doi.org/10.4187/respc are.07796

Brunsveld-Reinders, A. H., Arbous, M. S., Kuiper, S. G., et al. (2015). A comprehensive method to develop a checklist to increase safety of intra-hospital Transport of critically ill patients. *Critical Care, 19*(1), 1-10.

Comeau, O. Y., Armendariz-Batiste, J., and Woodby, S. A. (2015). Safety first! using a checklist for intrafacility Transport of adult intensive care patients. *Critical care nurse, 35*(5), 16-25.

Conrad, B. P., Del Rossi, G., Horodyski, M. B., et al. (2012)**.** Eliminating log rolling as a spine trauma order. *Surgical neurology international, 3*(Suppl 3), S188.

Drews A, Doig A (2014). Evaluation of a configural vital sign display for intensive care unit nurses. *Human Factors.*56(3)569-580.

Droogh, J. M., Smit, M., Absalom, A. R., et al. (2015). Transferring the critically ill patient: are we there yet? *Critical Care, 19*(1), 1-7.

Gimenez, F. M. P., Camargo, W. H. B. d., Gomes, A. C. B., et al. (2017). Analysis of adverse events during intrahospital transportation of critically ill patients. *Critical care research and practice,* 2017: 6847124. DOI: 10.1155/2017/6847124

Hu, Y., Shi, D., You, L., et al. (2021). Intrahospital Transport of critically ill patients: A survey ofemergency nurses. Nursing in Critical Care, 26(5), 326-332.

Kaljević, G., Micić, D., Olujić, B., et al. (2019). inter-hospital transport of the critically ill and severe injured patient. *Medicinski Glasnik/Medical Gazette, 23*(72), 99-104

Kalra, S., Kelkar, D., Galwankar, S. C., et al. (2014). The emergence of Ebola as a global health security threat: From 'lessons learned to coordinated multilateral containment efforts. *Journal of global infectious diseases, 6*(4), 164.

Khan, S. M., Lance, M. D., & Elobied, M. A. K (2021). Transport of Critically Ill Patients-A Review of Early Interventions, Protocols, and Recommendations. *International Journal of Health Sciences and Research*,11(4)133-143.

Kleffmann, J., Pahl, R., Deinsberger, W., et al. (2016). Intracranial pressure changes during intrahospital transports of neurocritically ill patients. *Neurocritical care, 25*(3), 440-445.

Kleitsch, J., Nistal, D. A., Romano Spica, N., Alkayyali, M., Song, R., Chada, D., & Dangayach, N. S. (2021). Interhospital transfer of intracerebral hemorrhage patients undergoing minimally invasive surgery: the experience of a New York City Hospital System. World Neurosurgery, 148, e390–e395. Retrieved from https://doi.org/10.1016/j. wneu.2020.12.163

Knight, P. H., Maheshwari, N., Hussain, J., et al. (2015). Complications during intrahospital Transport of critically ill patients: Focus on risk identification and prevention. *International journal of critical illness and injury science, 5*(4), 256.

Koyfman, L., Simchon, O., Koyfman, A., et al. (2021). Clinical Outcomes of Critically Ill Patients Using Inhaled Nitric Oxide (iNO) during Intrahospital Transport. *Critical care research and practice,* 2021, 1-6.

Kue , L., Wang, H., Gao, Y., et al. (2016). High incidence of adverse events during intra-hospital Transport of critically ill patients and new related risk factors: a prospective, multicenter study in China. *Critical Care, 20*(1), 1-13.

Kulshrestha, A., and Singh, J. (2016). Inter-hospital and intra-hospital patient transfer: Recent concepts. *Indian journal of anaesthesia, 60*(7), 451.

Löw, M., and Jaschinski, U. (2009). Intrahospital Transport of critically ill patients. *Der Anaesthesist, 58*(1), 95-105.

Martin, M., Cook, F., Lobo, D., Vermersch, C., Attias, A., Ait-Mamar, B., Plaud, B., Mounier, R., Dhonneur, G., (2017). Secondary insults and adverse events during intrahospital transport of severe traumatic brain-injured patients. *Neurocrit. Care* 26, 87–95.

Nakayama, D. K., Lester, S. S., Rich, D. R., et al. (2012). Quality improvement and patient carechecklists in intrahospital transfers involving pediatric surgery patients. *Journal of pediatric surgery, 47*(1), 112-118.

Painvin, B., Messet, H., Rodriguez, M., et al. (2021). Inter-hospital Transport of critically ill

patients to manage the intensive care unit surge during the COVID-19 pandemic in France. *Annals of intensive care, 11*(1), 1-6.

Papson, J. P., Russell, K. L., and Taylor, D. M. (2007). Unexpected events during the intrahospital Transport of critically ill patients. *Academic Emergency Medicine, 14*(6), 574-577.

Parmentier-Decrucq, E., Poissy, J., Favory, R., et al. (2013). Adverse events during intrahospital Transport of critically ill patients: incidence and risk factors. *Annals of intensive care, 3*(1), 1-10.

Picetti, E., Antonini, M. V., Lucchetti, M. C., et al. (2013). Intra-hospital Transport of brain-injured patients: a prospective, observational study. *Neurocritical care, 18*(3), 298-304.

Ringdal, M., Chaboyer, W., and Warrén Stomberg, M. (2016). Intrahospital transports ofcritically ill patients: critical care nurses' perceptions. *Nursing in Critical Care, 21*(3), 178-184.

Sakshi, G., and Vinay, K. (2021). Effectiveness of Transport Guidelines on Intra Hospital Transport Practices of Nurses and Occurrence of Mishaps among Critically ill Patients. *Indian Journal of Forensic Medicine & Toxicology*, 15(1), 87-94.

Sanchez-Pinto, N., Giuliano, J. S., Schwartz, H. P., et al. (2013). The impact of postintubationchest radiograph during pediatric and neonatal critical care transport. *Pediatric Critical Care Medicine, 14*(5), e213-e217.

Schwebel, C., Clec'h, C., Magne, S., et al. (2013). Safety of intrahospital Transport in

ventilatedcritically ill patients: a multicenter cohort study. *Critical care medicine, 41*(8), 1919-1928.

Shirley, P., and Stott, S. (2011). Clinical and organizational problems in patients transferred

from the intensive care unit to other areas within the hospital for diagnostic procedures. Paper presented at the British Journal of anesthesia, 87(2),346 -347

Tabah, A., Bassetti, M., Kollef, M. H., et al. (2020). Antimicrobial de-escalation in critically ill patients: a position statement from a task force of the European Society of Intensive Care Medicine (ESICM) and European Society of Clinical Microbiology and Infectious Diseases (ESCMID) Critically Ill Patients Study Group (ESGCIP). *Intensive care medicine, 46*(2), 245-265.

Temsah, M.-H., Al-Sohime, F., Alhaboob, A., et al. (2021). Adverse events experienced with intrahospital transfer of critically ill patients: A national survey. *Medicine,* 100(18), e2581.

Veiga, V. C., Postalli, N. F., Alvarisa, T. K., et al. (2019). Adverse events during intrahospital Transport of critically ill patients in a large hospital. *Revista Brasileira de terapia intensiva, 31*, 15-20.

Vincent, J.-L., Creteur, J., (2015). Paradigm shifts in critical care medicine: the progresswe have made. Crit. Care 19, S10. Retrieved from https://doi.org/10.1186/cc14728

William, T. (2017). Care of critically ill patients during inter-hospital transportation: a descriptive study in Dar Es Salaam, Tanzania (Doctoral dissertation, Muhimbili University of Health and Allied Sciences).

Williams, P., Karuppiah, S., Greentree, K., et al. (2020). A checklist for intrahospital Transport of critically ill patients improves compliance with transportation safety guidelines. *Australian critical care, 33*(1), 20-24.

Zhang, W., Lv, J., Zhao, J., Ma, X., Li, X., Gu, H., Zhang, M., & Zhou, R. (2021). Proactive risk assessment of intrahospital transport of critically ill patients from emergency department to intensive care unit in a teaching hospital and its implications. Journal of Clinical Nursing, 00, 1–14. https://doi.org/10.1111/jocn.16072

Zuchelo, L. T. S., and Chiavone, P. A. (2009). Intrahospital transport of patients on invasive ventilation: cardiorespiratory repercussions and adverse events. *Jornal Brasileiro de Pneumologia, 35*(4), 367-374.