Chapter 7

Adverse Events during Intrahospital Transfers: Focus on Patient Safety

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Abstract

Intrahospital transport of patients constitutes an integral part of care delivery in the complex environment of modern hospitals. In general, the more complicated and acute the patient's condition is, the more likely he or she will require both scheduled and unscheduled trips. The purpose of this chapter is to highlight the potential adverse events associated with intrahospital transfers (IHTs), to discuss the interdepartmental handoff process when patients travel within the walls of a single institution, and finally to provide strategies to prevent adverse events from occurring during the IHT process. A comprehensive literature review, covering some of the most recent developments in this area, has been included in this manuscript. Aspects unique to this presentation include sections dedicated to risk assessment, commonly seen patterns of transfers and complications, as well as the inclusion of family communication as a core component of the process. The overall goal of providers and patient safety champions should be the achievement of "zero incidence" rate of IHT-related events. We hope that this chapter provides a small, but significant, step in the right direction.

Keywords: patient safety, intrahospital transfers, transport checklist, critical illness

1. Introduction

Intrahospital transfers, especially those involving high-acuity patients, are inherently complex processes, with levels of direct and indirect risk inextricably tied to a multitude of difficult-to-control factors [1]. Although many diagnostic and treatment modalities are being increasingly "brought closer" to the intensive care unit (ICU) bedside, sporadic IHTs are still necessary throughout each ICU patient's typical stay [2–4]. In addition, non-ICU patients also require complex, highly coordinated, movement to multiple departments and locations. Interestingly, the non-ICU patient group has been found to constitute the majority of medical emergency calls in a recent study [1].

From the time of initial admission to hospital discharge, a complex meshwork of diagnostic testing in departments separated by considerable distance, and often with multistage trips required to provide life-saving surgical and nonsurgical therapies, combine to create a significant amount patient risk. Frequently this is both poorly appreciated and difficult to manage [5, 6]. Due to this elevated potential for complications, the need for IHTs is frequently questioned due to valid concerns regarding patient safety (PS). Over the past two decades, multiple safety issues surrounding the transfer of patients between different units within hospitals have been identified, described, and investigated [1, 5–7]. Following an introductory clinical vignette, this chapter summarizes key aspects of PS in the context of IHT, focusing on minimizing the risk associated with medically necessary transfers and appropriately managing the risk of unplanned intrahospital transfers. Although our focus will be primarily on the critically ill patient population, most concepts discussed herein apply across all hospital and healthcare settings.

2. Clinical vignette

A 41-year-old female was admitted to the ICU for severe acute pancreatitis secondary to alcohol abuse. During the initial 72 hours, she underwent massive (>12 liters) crystalloid fluid resuscitation. Due to the development of concurrent acute respiratory failure, she required endotracheal intubation on the third hospital day. Portable chest radiograph showed increasing bilateral infiltrates. Overnight, the patient was noted to have increasing oxygen requirements, necessitating a transition to a more advanced mode of ventilatory support. She also experienced worsening agitation, fevers, and progressively decreasing urine outputs. The ICU team suspected that the patient developed necrotizing pancreatitis, and it was decided to obtain a computed tomography (CT) scan of the chest, abdomen, and pelvis. After meticulous planning, the patient and her bedside care team, including primary nurse, ICU resident, and respiratory therapist, proceed downstairs to the CT imaging suite. The brief elevator trip was largely uneventful, with only a self-limited, brief period of tachycardia and hypertension. While in the Radiology Department, the patient became increasingly agitated and difficult to ventilate, necessitating ventilation by bagging. After obtaining non-contrast CT images of the abdomen and pelvis, it was decided that further imaging would carry too much risk. After aborting any further CT studies, the patient was transferred back to the ICU, where she subsequently declined clinically to the point of requiring pharmacological paralysis for worsening respiratory failure over the next 24 hours. The patient eventually recovered but was unable to be discharged to home and required a combined 6-month inpatient and outpatient rehabilitation course before returning to work. Following this incident, important questions arose: Was the respiratory worsening in the CT suite preventable? What measures could have been taken by the team to safely obtain required images without putting the patient's well-being at risk? Were there any warning signs that could have prompted the team to either postpone the CT study or to proceed with more caution?

3. The importance of team communication

As discussed in other volumes and chapters of *The Vignettes in Patient Safety*, the importance of team communication is critical to ensuring the focus on safety throughout the entire healthcare experience of each and every patient [8, 9]. Because IHTs involve high-risk care transitions with complex handoffs between providers, clinical units, and different departments, it is essential that meticulous attention to every single aspect of the overall process is given in order to deliver optimal and safe care [10, 11]. When categorizing various safety occurrences during IHTs of nearly 600 patients involving more than 900 transfers, it was noted that patient care issues contributed to about 45% of total events, followed by poor documentation (32%) and finally various process-related findings (23%) [12].

According to Warren et al. [13], pre-transport coordination and communication are critical to the overall success of the IHT process, including the confirmation of readiness by the receiving department. Whenever care transitions occur, the responsibility for the patient's care shifts to the team that will temporarily assume direct bedside decision-making capacity. In the context of high-acuity ICU patients, such transitions require both physician-to-physician and nurse-to-nurse communication, including detailed review of the patient's most current condition and the associated treatment plan(s) every time patient care responsibilities are transferred [13]. As always, interdisciplinary dialogue and collaboration are critical to successful, complication-free patient outcomes [14, 15]. In this overall context, it is important to remember that significant proportion of IHT-related adverse events may be preventable [16] and that all too often medical emergency responses during IHTs are associated with preexisting "warning signs" of supplemental oxygen use, tachypnea, and tachycardia [1]. The movement of critically ill or injured patients, even in the most complex and austere environments, has been consistently performed by the US Air Force Critical Care Air Transport Teams (CCATTs). Over the preceding 10 years, an en route mortality of less than 1% was achieved only with rigorous training, preparation, and attention to real time and potential obstacles. Following this established model can greatly reduce IHT-related complications [17]. Even with such advanced level of preparation, a 10% incidence of transport-related events did occur and included oxygen desaturations, hypotension, worsening of neurologic status, and declining urine output. However, during 656 patient moves, there was no dislodgement of airway or chest tubes [18].

4. The impact of IHT-related complications: focus on common themes

The cumulative incidence of complications associated with IHT ranges from 22 to 67%, depending on patient characteristics and clinical acuity level [19–24]. Among all occurrences, more severe "critical" incidents take place during 2.4–7.8% of IHTs, depending on the urgency of the transport [25]. Of interest, one study reported that most emergency medical responses in the medical imaging department involved noncritical patients, with 43% occurring during the first day of hospitalization [1]. In critically ill patient population, the most commonly occurring events during IHTs for therapeutic or diagnostic procedures were oxygen desaturation, patient agitation, and perhaps most concerning, unplanned extubation and hemodynamic instability

[21, 23]. Specific risk factors associated with adverse events during IHT include emergent/urgent indications for the trip, the presence of mechanical ventilation, transport for diagnostic procedures, number of infusion pumps, duration of the overall process, and sedation requirement [21–23]. When transported patients require mechanical ventilation, the need for positive end-expiratory pressure (PEEP) ≥6 cm H_2O was associated with increased incidence of adverse events [21, 23, 26].

Unanticipated loss of airway can be catastrophic in the setting of respiratory failure [5]. In addition to the direct threat to the patient's life, hypoxic events pose the risk of exacerbating other critical conditions such as traumatic brain injury or cerebral infarction [27, 28]. Multiple factors can lead to loss of airway, including mechanical dislodgement or kinking of tracheal tubes, oversedation in non-intubated patient, under-sedation in intubated patient, malfunction of medication delivery infusion pumps, among many other possibilities and combinations thereof [29–33].

In a single-institution prospective observational study of 184 patients undergoing 262 IHTs, major complications were noted among critically ill patients undergoing CT scans, including both patient-related and equipment-related incidences [22]. The most common patient-related events included oxygen desaturation, unplanned extubation, unanticipated central line removal, and episodes of hemodynamic instability with increased vasopressor requirement. Equipment-related events included ventilator malfunctions, oxygen supply problems, and battery charge problems involving monitors or infusion pumps [22]. It is important to mention that among major events occurring during IHTs, approximately 40% are cardiac, 30% respiratory, and approximately 25% neurologic in nature [1].

Deterioration of respiratory function during and after IHTs is a known and serious issue that eludes satisfactory solutions [34]. Multiple potential causes include recumbent position for transport, the lack of PEEP valve use during transport "bagging," and inadequate ventilator support with "transport" ventilators. In one report, nearly 84% of post-IHT patients were noted to have a decreased PaO_2/FiO_2 ratio, with the worsening lasting >24 hours in 20% of cases [34]. There is conflicting evidence regarding the association between ventilator-associated pneumonia and IHTs. Although no significant relationship has been demonstrated in one study [22], another report comparing 118 mechanically ventilated patients undergoing IHT with 118 ventilated patients who did not undergo IHT showed that intrahospital transfers were independently associated with ventilator-associated pneumonia [35]. This is certainly very concerning given the potential harm to the patients and the increasingly severe penalties for hospitals reporting healthcare-associated infections [36].

In our review of current literature, few deaths are directly attributed to complications that occur during IHT; however, there continue to be a plethora of potential risks related to the totality of all adverse events associated with IHTs [26, 37]. For example, it has been noted that even the simple act of transferring a patient from their hospital bed to another resting surface (e.g., bed or stretcher) was associated with significant harm, including falls with injuries [38]. Patients requiring medical emergency response during the IHT have been noted to require higher level of care in 70% of cases [1]. Moreover, a correlation may exist between IHTs and longer ICU stays [39], although this requires independent confirmation. Excluding patient

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transfers involving escalation of the level of care [40], the best estimate of direct and indirect mortality attributable to IHTs, based on the totality of the reviewed literature, appears to be anywhere between 0 and 3% [1, 6, 16, 41].

5. Team planning and preparation

The success of the intrahospital transport of a critically ill patient depends on the ability of the clinical team to plan the transfer, monitor, and provide any necessary intervention [37]. The degree of collective experience and skill that a transfer team possesses can directly affect patient outcomes. Consequently, the involvement of appropriately trained and experienced medical personnel during patient transfers, especially those involving ICU level of care, is vital to promoting patient safety [22, 42]. The transport team for a critically ill patient should consist of three providers, all possessing critical care experience and training specific to patient transport [22]. It is recommended that this team include a physician with experience in airway management, critical care nurse, and respiratory professional familiar with mechanical ventilation equipment [13, 22, 43]. Collectively, such multidisciplinary team can effectively anticipate potential problems during transport [42, 44]. All members of the transport team should have appropriate training in patient transport and either direct experience or documented observation of patient transport teams [5, 13]. Finally, specialized/dedicated transport teams allow the primary ICU personnel to remain with other patients during time-consuming IHTs while ensuring the availability of expertise required for safe and effective transfer process [42].

When planning an IHT originating from the ICU, the patient's nurse and physician should communicate with the transport team about the patient's condition, known/possible risks, and/or specific needs during the transfer [43]. If the patient has an orthopedic or neurological injury, then a specialist from that field may need to be consulted to prevent the exacerbation of the injury during transfer (e.g., by ensuring that traction or fixation devices are properly operated and configured) [5]. Team planning should include the estimation of total transfer time, preparation for administering any dose- or time-sensitive treatments such as scheduled medications and continuous drips, and ensuring that any drains or wound dressings are functioning properly throughout the entire process [44]. The team should plan the route that will be taken through the hospital and ensure that it will be clear/passable at the time of transfer. The route and time of the transfer should be communicated to the necessary hospital personnel, such as security or respiratory professionals, so that necessary support can be provided to the transfer team [13]. Checklists for pre-, intra-, and post-transfer phases of IHT should be utilized assuring the presence of key patient safety aspects, including medication and equipment availability and functionality [45].

As the length/duration of IHT has been shown to impact patient outcomes, the transport team should be in contact with the receiving department to confirm readiness for immediate testing or procedure upon patient arrival to reduce or eliminate any unnecessary delays at the destination [13, 22, 43]. Not only are such delays problematic from the PS standpoint, they also preclude transporting personnel from effectively tending to other patients. If the intended diagnostic or therapeutic procedure is lengthy and the receiving team has the personnel and resources to adequately care for the patient, then care can be transferred via direct personnel communication and written documentation of the patient's condition, treatments, and transfer details [13, 44]. If the approximate time spent at the destination is short or that particular department does not have the staff or resources needed to adequately care for the patient, then the transfer team should remain with the patient for the entire duration of the procedure and transport back to the point of origin (e.g., ICU) [43].

Effective navigation of the physical landscape of the hospital, including hallways, building connectors, and elevators requires careful planning and attention to detail. Excellent knowledge of the facility, including any potential construction or maintenance activities, is needed to avoid unexpected delays and/or dangerous backtracking. For example, some multibuilding medical centers feature connecting bridges only on certain floors, and travel on the incorrect level may result in unnecessary delays. It has indeed been noted that a small, but by no means trivial, number of IHTs were complicated by the team becoming either "lost" en route to their destination or unexpectedly "trapped" in an enclosed space, such as an elevator [24]. This is especially important when using battery-operated equipment that provides vital support to the patient. Communication regarding the overall status of the process is also crucial to the safe transport of patients [6, 46]. Finally, providers must be cognizant that while substantial proportion of adverse events involving IHTs occurs in radiology departments, the most susceptible type of diagnostic test appears to be computed tomography (CT, 42% of occurrences) [1].

6. Overview of IHT complication types

At this juncture, we will highlight specific IHT complication groups and types. Because the overall topic is quite vast, we will only "scratch the surface" of the different categories of patient safety events that can occur during intrahospital transfers. Rich referencing will be provided so that the reader can consult with source studies and manuscripts. To further compensate for lack of granularity, we will encourage our readers to think more broadly and to instead apply the principles learned throughout this and the other chapters of the *Vignettes in Patient Safety* cycle.

7. Cardiac and pulmonary complications

As discussed earlier in this chapter, cardiac and pulmonary complications are among the most serious and clinically impactful events during IHTs. This group of heterogeneous occurrences can take multiple manifestations, from acute respiratory failure to permanent cardiac or pulmonary impairment (e.g., pulmonary embolism and its sequelae). It is now well established that IHTs are associated with significant risk of healthcare-associated pneumonia [35]. In fact, the odds of this serious complication increase 3.1-fold among ventilated patients undergoing IHTs during their ICU stay [35]. Moreover, IHTs were associated with increased risk of

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thromboembolic phenomena, thus predisposing affected patients to a broad range of both acute and more chronic cardiovascular and pulmonary complications [39]. Cardiac arrests and severe dysrhythmias during IHTs have been reported, and despite their usually grave nature, attributable deaths have fortunately been uncommon [19, 24].

8. Hemodynamic parameter excursions

An extension of the preceding paragraph on cardiopulmonary complications, this section will briefly discuss the potential occurrence of unplanned blood pressure and heart rate gyrations during IHTs. The importance of hemodynamic parameter excursions is highlighted by the fact that approximately one in six patients who experienced adverse events during IHTs had a cardiovascular diagnosis and that nearly 40% of reported events were cardiac in nature [1]. Both high and low blood pressures can have deleterious effects on the patient's clinical condition, and both extremes can be attributable to common factors. For example, elevations of blood pressure can be due to intravenous pump malfunction resulting in interruption of analgesic infusion, yet the same patient during the continuation of the same scenario can then become profoundly hypotensive as multiple doses of analgesic medication are given to compensate for the severe pain that initially led to hypertension. If not promptly treated, severe hypertension can be associated with end-organ damage [47, 48], highlighting the need for immediate recognition and management of unplanned blood pressure elevations during IHTs.

A cause for great concern in the critically ill patient, hypotension is an all-too-common complication during IHTs. This adverse event can occur as a result of multiple inciting events, including malfunctioning infusion pumps (e.g., during active infusion of vasopressor), airway dislodgment (e.g., the presence of acute hypoxia), impromptu medication boluses (e.g., beta blocker or calcium channel blocker administration for atrial fibrillation), worsening sepsis (e.g., immediately following deep abscess drainage), cardiopulmonary factors (e.g., hemodynamic device disconnection), and many other potential causes [49]. It has been noted that hypotension is among key secondary insults that affect outcomes in patients with traumatic brain injury [7]. In addition, episodic hypotension results in intermittent hypoperfusion of vital organs, including but not limited to the heart, kidneys, bowel, and liver [50, 51].

Episodic heart rate gyrations, especially those outside of the generally accepted normal range, can be associated with systemic hypoperfusion [52–54]. These potentially dangerous occurrences can be due to intrinsic cardiac causes (e.g., aberrant conduction pathways) or a plethora of extrinsic factors (e.g., tachycardia secondary to vasoactive medication infusion or uncontrolled pain, bradycardia associated with beta adrenergic blockade or acute vasovagal response). Various commonly used vasoactive infusions and intermittent medications have the potential to contribute to both heart rate and blood pressure gyrations, leading to potentially harmful hemodynamic manifestations [55–57]. In addition, pre-IHT abnormalities in blood pressure or heart rate may be a harbinger of adverse events during the trip. Thus, personnel accompanying the patient during IHTs should conduct close monitoring of vital signs, medication infusion rates, and the functional status of infusion pumps [58–60].

9. Elevation of intracranial pressures

Among patients with traumatic brain injury, IHTs have been associated with significant elevations in both intracranial pressures (ICP) and reductions in cerebral perfusion pressures [61]. As alluded previously in this manuscript, this may be related to contributions from singular or combined factors, including primary hypotension, inadequate analgo-sedation, and unfavorable patient positioning changes during image acquisition (e.g., supine positioning for magnetic resonance imaging [MRI] or CT scan) [7, 61]. When ordering any diagnostic tests that may put patients with traumatic brain injury at risk, providers must always be aware of the potential for unexpected ICP elevations. A common source of technical complications for the patient being transported is the intracranial pressure monitor, usually an external ventricular drain (EVD) [62, 63]. Studies have shown that the EVD catheter may be subject to displacement, removal, or accidental blockage during patient transfer, particularly if the catheter contains a strain gauge rather than fiber optic sensor. The overall rate of catheter disturbance is estimated to be 5%, although these can be replaced or flushed as necessary [62, 63]. Further, all team members must be comfortable with basic therapeutic maneuvers for ICP normalization, including administration of analgo-sedation, mannitol, hypertonic saline, vasopressors, transient hyperventilation, and positional changes (e.g., head-of-bed elevation to at least 30°) [64].

10. Equipment-related events

This heterogeneous group of IHT-related complications spans an entire spectrum from catheter dislodgements and/or kinking to failures of negative pressure wound dressings [5]. In a report of IHTs involving more than 250 critically ill patients, it was noted that a large proportion of unexpected occurrences were associated with some form of "equipment malfunction" [37]. In our review of the literature, common types of equipment failures included "oxygen probe displacement" [37], "physiologic and equipment alarm issues" [5, 22], "tube/drain dislodgement" [6], "loss of intravenous access" [65], "wound dressing integrity issues" [5], "battery-related problems" [22], and "loss of suction" [26]. Because some types of equipment malfunction can result in fatal outcome, appropriate provider/team training and careful planning prior to IHT are mandatory to avoid preventable complications [66–68], especially in patients whose management may be challenging to begin with [69]. Positioning changes can be especially risky for patients with multiple catheters or tubes, where each additional device adds an extra layer of complexity.

11. Risk assessment procedures and protocols

The need for major corrective steps has been reported in over one-third of all IHTs [70]. Coupled with the fact that adverse events of differing magnitude may occur in as many as 70% of IHTs [71], increasingly vocal calls are being made for improving PS during intrahospital trips. Beginning with team debriefing and equipment checks, the entire process should be conducted with utmost attention to the smallest detail. As outlined throughout the *Vignettes in Patient Safety* book cycle, strict adherence to established PS protocols helps reduce the incidence of adverse events and improves a broad range of associated clinical outcomes [8, 72].

12. Special considerations

Transport of critically ill patients from the emergency department (ED) to the ICU is among the better researched areas within the broader domain of IHTs. The most common adverse events occurring during IHTs of critically ill patients from the ED to the ICU were equipment problems such as oxygen saturation probe failures, monitoring lead and intravenous line entanglements, hemodynamic parameter excursions, and problems related to analgesia, sedation, and paralytic medications [19, 24]. The most common serious adverse events requiring intervention included severe hypotension, declining level of consciousness requiring intubation, and increased intracranial pressure in brain-injured patients [24]. Of note, delays in transport from the ED to ICU can significantly impact patient outcomes, including both increased lengths of stay and hospital mortality [73]. The interdisciplinary nature of the process cannot be overemphasized, and all members of the team must respect each other's expertise and the ever-present potential for mishaps [14].

Another important, yet often overlooked type of intrahospital critical care transport involves patients on extracorporeal membrane oxygenation (ECMO) circuits [74]. While intrahospital transfers involving patients with acute respiratory distress syndrome (ARDS) can be challenging, the addition of an ECMO circuit adds an extra layer of complexity that requires significantly greater amount of team/provider expertise during IHTs [74]. Despite recent advances in device design, including miniaturization and simplification of the overall transport framework, extreme caution is required during any kind of "more-than-minimal" change in patient environs [75–77]. Consequently, providers caring for ECMO patients who require intrahospital transfers during their active therapy period must be able to handle not only the routine "sets of challenges" associated with transporting critically ill patients but must additionally be able to successfully tackle issues specific to ECMO. When examining interhospital ECMO transfers in terms of safety and efficacy, outcomes of patients transported by an experienced ECMO team appear to be comparable to outcomes for non-transported ECMO patients [78]. These data are likely translatable to intrahospital transfers.

13. Improving the safety of IHT

Good clinical practices and common sense provide a solid platform for making IHTs safer, as well as efficient. It is important to note that although our focus on preventing adverse events related to diagnostic and procedural patient trips is centered mainly on the ICU setting, it is well documented that significant proportion of unexpected occurrences may in fact be associated with IHTs involving non-ICU patients [1]. Several tools have been developed to address various safety issues associated with IHTs. Perhaps the most obvious and straightforward tool is the use of patient care checklists [12, 79]. Fanara et al. describe a comprehensive checklist that includes

Equipment and patient preparation
Patient labels
Preparation and equipment adapted to procedure
Sufficient medication, O_2, and electrical reserves
Breathing:
Intubation secured and position confirmed on CXR
Mechanical ventilation adapted to patient
Intubation equipment, bag + valve + mask, suction catheters, and monitors
Circulation:
Route for venous access isolated and secured
Medication and fluid loading solutions
Alarms adjusted and activated
Lines, cables, and drainage tubes
Transport team
Minimum of three escorts available including experienced doctor
Transport organization
Confirmation of timetable for procedure
Transport route clear, lifts, and emergency room available
Operational equipment for continuous treatment at sites of procedure
Clinical stability of patient
Preparation adapted to clinical status of each patient
Breathing (as above)
Circulation (as above)
Neurological status: GCS, pupils, and ICP
Sedation/analgesia
Breaks stabilized, burns, and wounds protected
Head raised if possible
Systematic check points following transport
A: airway = integrity of ventilation system
B: breathing = bilateral auscultation, insufflation pressure, spirometry, SpO_2, and $EtCO_2$
C: circulation = read monitor, check blood pressure, and isolate injection route
D: disconnect = plug O_2 and electrical supplies into wall socket
E: eyes = monitors are visible to transport team
F: fulcrum = check points of support

CXR = chest radiograph; $EtCO_2$ = end-tidal carbon dioxide; GCS = Glasgow Coma Scale; ICP = intracranial pressure; O_2 = Oxygen; SpO_2 = peripheral capillary oxygen saturation.

Table 1. Checklist for intrahospital transport of critically ill patients. Modified from Fanara et al. [79].

both patient and equipment assessment prior to transport, an evaluation of patient stability during transport, and a complete repeat assessment after the patient is moved (**Table 1**) [79].

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Nurses play a critical role in ensuring patient safety during IHTs through both adequate communication and meticulous patient monitoring, as well as managing patient handover protocols [25, 80]. A potentially helpful clinical intrahospital transport tool was described by Brunsveld-Reinders et al. [45]. The tool utilizes a pre-transport, intra-transport, and post-transport checklist in order to ensure proper functioning of equipment; adequate supply of medications, fluids, and oxygen; and continuous patient monitoring [45]. Pre-IHT patient assessment deserves further mention, especially when one considers that among patients who required medical emergency response while in a diagnostic department, nearly 40% of patients arrived receiving supplemental oxygen administration, almost 30% had tachypnea, and approximately one-third had tachycardia [1].

Hemodynamic and other forms of patient monitoring during transport are becoming more advanced, and the availability of clinical data can be leveraged to improve the quality and safety of IHTs. For example, when transporting brain-injured patients, more frequent or continuous neuromonitoring by using intracranial pressure and end-tidal CO_2 determinations throughout the IHT duration has been proposed as a means to reduce both hemodynamic and neurological complications [81]. It has also been postulated that critically ill patients undergoing IHTs be accompanied by an intensivist or experienced attending physician in order to reduce adverse events [24, 37]. This particular aspect may be important for the most critically ill patients, where the impact of even the smallest errors, including omissions during the handover process, may result in major clinical setbacks [46].

Finally, ensuring operational readiness of medical equipment, particularly mechanical ventilators, is crucial during the IHT of critically ill patients [6, 23, 79]. It has been suggested that hospital transport stretchers/beds incorporate key functional components (e.g., high-capacity batteries, monitoring equipment core units, built-in suction pumps) and intelligent sensing instrumentation to prevent the snagging and tangling of leads and lines and discontinuation of critical functionalities [24, 78, 82].

14. Family communication

Transporting critically ill patients is inherently associated with adverse events that have the potential to change the patient's medical condition; thus it is reasonable to treat transports in a manner similar to that of any other medical treatment. In respect of the patient's right to privacy and autonomy as well as compliance with the Patient Self-Determination Act [83, 84], the patient's wishes regarding communicating medical information to family members, the patient's advanced directive, and proxy appointment(s) should be established as part of general consent to treatment. If the patient is not competent to make a determination, then the patient's appointed proxy or next of kin should be consulted to give informed consent for the transport and procedure on the patient's behalf. Majority of patients express wishes that their families be kept informed regarding their condition, and when this is the case, medical personnel have a responsibility to communicate clearly and efficiently with families so that good understanding of key diagnostic and therapeutic issues exists [85]. When a critically ill patient requires potentially risky IHT, families should be made aware of the patient's condition, reasons for transport, and the risks and risk–benefit consideration associated with both the transport and procedure [5].

Medical personnel should communicate with the family before the transport about the projected time, duration, destination, and expected benefit or outcome of the process. Thus, proper expectations can be met, and family members are provided with basic goals and parameters regarding the overall clinical context [86]. Prior to the transport, the patient's proxy or next of kin should be available, and their phone numbers should be obtained by the transport team in case of unexpected events, especially if the patient is not decisionally competent or becomes noncompetent during the transport or procedure. When the patient is stabilized at the destination or returned to the ICU, the patient's proxy and family members should be informed and updated on the patient's condition by a member of the transport team [86–88].

15. Conclusions

Intrahospital transfers are among some of the most dangerous, yet necessary endeavors that hospitalized patients require during the implementation of diagnostic and therapeutic plans. Although the overall risk profile of IHTs depends on patient acuity, other factors are important risk determinants as well, including location and distance between hospital departments, team member knowledge and communication, the complexity of medical management, and the equipment involved. Significant amount of provider/staff training is required to optimize the team performance and minimize the overall risk of an adverse event occurring during an IHT. Healthcare professionals are encouraged to strictly follow the fundamentals of patient safety, as outlined throughout the *Vignettes in Patient Safety* cycle, to help reduce complications and to propagate a culture of safety throughout their clinics and hospitals.

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