Interhospital transport of the critically ill patient
Droogh, Joep

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Chapter 2

Transferring the critically ill patient, are we there yet?

Joep M. Droogh, Marije Smit, Jack J.M. Ligtenberg, Jan G. Zijlstra

Submitted
**Abstract**

Over the last forty years the quality of transferring the critically ill patient has improved, although its effectiveness has not been confirmed by randomized control trials. Nowadays, it is generally accepted that these patients should be transferred by specialized retrieval teams. However, how these teams are composed, trained and assessed is still a matter of debate. Furthermore, since it is likely that these kind of transfers will increase in the near future, both intensivists and intensive care societies should take their responsibility and further professionalize the transfer process.
Introduction

The purpose of this review is to establish where we stand today regarding the transfer of the critically ill patient. In order to evaluate this, it is important to understand more about the background of the transfer process.

Background

History

Already some 20 years ago, over 11000 patients per annum required secondary transfers in the United Kingdom[1]. Nowadays, in the United States, nearly 1 in 20 ICU patients will be transferred to another hospital’s ICU[2, 3]. Moreover, in eight large states in the USA, it is estimated that every year 4,000 mechanically ventilated patients die who might have been saved had they been in another, better qualified, hospital[4]. This illustrates that interhospital transfer of critically ill patients has been necessary for decades and still is of major importance for the quality of the public health system today.

When, how and where to transfer a patient has been subject of research since the late seventies. Waddel was one of the first, in 1975, to report on patient transport. His conclusions: earlier transfer, resuscitation before transfer, continuing medical care during the journey, and hence a slower and smoother journey still stand today.[5]. Also, Ehrenwerth et al, in 1978 concluded that with a specialized transport team and appropriate hemodynamic stabilization and monitoring severely ill patients can be transported safely[6]. From then on, the equipment improved, trolleys were modified and the first mobile intensive care unit appeared[7-9].

Effect of transport

The effect of transport was studied as well. Kanter concluded that the incidence of physiologic deterioration during transport was found to be significantly greater with greater pre-transport severity of illness or injury.[10]. Others found that both system-level and patient-level characteristics influenced mortality after transfer[11]. Wallen et al. tested the hypothesis that adverse events occurring during intra-hospital transport are due to the transport process itself; his conclusions were that severity of illness and the duration of transport are associated with the occurrence of adverse events during transport[12]. It also appeared that all inadequately transferred patients already had acutely threatened vital functions prior to transfer[13]. In 1994, an observational study found a disturbing 75% of adverse clinical events during transport. Furthermore, many of the medical escorts were inexperienced in the care of the critically ill and incapable of performing necessary basic resuscitative measures.[14]
Most respondents to a survey in the United Kingdom believed that existing arrangements for transfer were unsatisfactory[15]. Therefore, it was argued that dedicated transfer teams should be created[10, 12, 16, 17].

Guidelines
Although guidelines appeared during the nineties[18, 19], Waydhas still found in his review in 1999 adverse events in up to 70% of transports. To prevent these adverse effects he suggested existing guidelines concerning the organization of transports, the personnel, equipment and monitoring should be followed[20]. So even in the nineties, we already knew how to transfer the critical ill patient, the guidelines were there, so was the expert opinion. And although even newer guidelines appeared[21-23], high, quite often preventable, incident rates, inadequate accompaniment, and thus inadequate transfers remain daily practice.[24-30]

In an editorial in 2005, Haji-Michael discussed the reasons why, despite the existence of guidelines, interhospital transfer of the critically ill patient is still associated with preventable mishaps. In his opinion there were two reasons. The first reason is sponsorship: those with responsibility and authority simply do not do transfers. A second reason is a lack of a tension for change. We have always somehow managed[31]. In this regard it is interesting to see that referring specialists consider escorting personnel and transport facilities as most important for a safe transport. When these factors are optimal, even severely critically ill patients are considered able to undergo a safe transport[32]. Interhospital transfer may even become of greater importance since regionalization and centralization is thought to be a way of improving public health. For this, not only must some centers be identifiably better at providing care and must patients be moved to these centers, transport in between centers must be safe and timely as well[2]. However, the transfer process may often be cumbersome and is still not always directed to the local hospitals with lowest 30-day mortality.[33, 34]

Pediatric transportation
In pediatric intensive care centralization of critically ill patients and bed shortage made the transport of critically ill patient’s necessary a long time ago. Pediatric transportation systems are therefore better established, so those involved in transferring the critically ill adult rely on their experience in development and research.

Research and quality management
“If anything can go wrong, it will” (Murphy’s Law). This definitely has been proven for transport of the critically ill patient. Over the years several articles have been published concerning
the adverse events occurring during transfer. Adverse events rates reported varied from 3 to 75% [14, 35]. This large variation instantly highlights the problem with incident monitoring. The exact definition of incidents is different in different studies. For example in the study of Philpot et al. unplanned events are defined as unintended extubations, difficult intubations, intravenous access loss, medication errors, pneumothorax and bag-valve ventilation required on arrival, whereas others also consider blown fuses of equipment used or transport delays to be incidents[36, 37]. These different definitions, make it very difficult to compare published incident numbers.

Furthermore it is sometimes difficult to relate adverse events to the transport process itself due to poorly documented pre-transport variables. Moreover, many studies only examined short-term adverse events, although it cannot be ruled out that adverse events occur later on.[38] Nonetheless, incidents do occur and since neither assistance nor backup equipment is readily available, it is essential to learn from each others’ mishaps. Therefore incident reports with standardized definitions are of major importance for quality management as well as for research purposes.

Incident prevention

By definition, critically ill patients are prone to changes in their condition even without being transported. The goal during every transport should be the continuation of high quality ICU care, while preventing deteriorations or incidents. However, incidents occur often.

Incidents may be divided into medical and technical incidents (table 1). Medical adverse events are most often cardiovascular or respiratory events. The most common cardiovascular events are hyper- and hypotension, brady- and tachycardias and arrhythmias with a reported incidence varying from 6% to 24%. Respiratory events are most often inadequate ventilation or oxygen desaturation with incidences ranging from 0 to 15%. [12, 28, 37, 39, 40] Equipment failure or technical problems are common and may account for 46% of all incidents[41-43]. Incidences vary from 9% to 36%.[36, 37, 40, 44] Transfer by specialized retrieval teams seems to lower the incidence of technical problems[44] emphasizing the need for training and technical understanding of equipment used[36] and the need for standardized transfer equipment[31]. Of all incidents, up to 31% are classified as significant[10, 41] and up to 79% require an intervention[43].

Strikingly, most incidents seem to be preventable, reported numbers range from 52 to even 91%.[28, 42, 45] Minimizing factors are good crew skills/teamwork (42%), checking equipment (17%) and patient (8%), patient monitors (15%) and good interpersonal communication (4%). [42]. By implementing a nurse driven grid in order to identify risks for incidents prior the transport Berube already achieved an absolute 20% decrease in incidents[46]
Table 1. Incidents

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<thead>
<tr>
<th>Types</th>
<th>Medical</th>
<th>Technical</th>
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<tr>
<td>Incidence</td>
<td>Cardiovascular</td>
<td>Respiratory</td>
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<tr>
<td>6 - 24%</td>
<td>0 - 15%</td>
<td>9 - 36%</td>
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<tr>
<td>Common events</td>
<td>hypo- / hypertension</td>
<td>inadequate ventilation</td>
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<td></td>
<td>brady- / tachycardias</td>
<td>oxygen desaturation</td>
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Specialized retrieval teams versus standard transportation

Is the use of specialized retrieval teams warranted? Back in the eighties it was already shown that how sicker the patient was prior transfer, the more likely it was deterioration would occur during transfer.[10] Adverse events, sometimes thought to be preventable, like inadequate circulatory and ventilatory support, inadequate monitoring, equipment failures, or drug errors have often been described with study recommendations for establishing specialized transfer teams.[13, 14, 26, 28, 41, 47] Studies comparing specialized with non-specialized retrieval teams have shown lower incident rates, less deterioration or less morbidity.[28, 40, 47-49] Moreover, Bellingan did show a reduction in acute physiology and a reduced mortality in critically ill patients transferred by a specialized retrieval team[50] and, in 2010, Ramnarayan found a reduced risk-adjusted mortality.[51] However, a review published in 2006 concluded insufficient data existed to determine whether the use of specialist transport personnel improves patient outcome. In this review 39 publications were evaluated, of which 33 were excluded because of a lack of or unsuitable control groups. In only one of the remaining 6 publications, intervention and controls were matched. No prospective randomized control studies were found.[52].

Pearl stated in 1987 that the critical ill transport team is incomplete without a transport physician, just as an intensive care unit would be incomplete without an intensivist.[17] Since we want to treat our critically ill patients on at least an equivalent level of care during transfer, it seems reasonable that a physician should accompany the transfer. Is there any evidence to support this? So far, no prospective randomized study comparing a physician staffed transport team with a non-physician staffed team has been published. However, there is some circumstantial evidence. In a study comparing 130 pediatric transports, 8% of all problems occurred with
specialized physician staffed transport team, 20% occurred with a non-physician staffed specialized team and 72% occurred with escorts without transport training.[49] Another study comparing transport by air and ground found a significant better protocol adherence when patients were transferred by air. It was proposed to reflect the attending flight physician and advanced trauma training of the air transport crew as opposed to the ground transport teams, who often had only basic life support (BLS) training.[53]

Besides being more familiar with transport specific procedures and equipment, several other advantages of retrieval teams have been proposed. Britto et al. suggested that retrieval teams do a better job in stabilizing the patient prior to the transfer, which was concluded from the difference between risk of mortality scores before and after retrieval.[54]. Iwashyna argued that also front-end discontinuity would be better addressed by an expert transport team.[55, 56] Vos found a high incidence of dissatisfaction and stress among non-trained specialists.[26]

Also logistic problems could be better served by a retrieval team. In the nineties, it was recognized that trauma patients with major injuries were best treated in trauma centers with their concentration of expertise. The development of these trauma centers would increase the number of interhospital transfers. This could be handled by installing a transfer team at each hospital or by establishing centrally located retrieval teams. Even then, the latter was thought to be the best option.[57] Nowadays we see a shift from the traditional model of a “team” from the referring hospital accompanying the patient to the use of retrieval teams. Furthermore, patients from remote and rural areas will first arrive at health facilities with no capacity to provide critical care or a safe transfer. In such cases, deploying “retrieval” personnel with critical care skills to resuscitate, stabilize, and transfer the patient, is appropriate.[58, 59]

This illustrates that although firm evidence is not available (yet), expert opinion is clear: critically ill patients are preferably transferred by a specialized retrieval team. Also, in a survey among intensivists, escorting personnel and transport facilities were rated as most important factors in considering if a transfer would be feasible.[32] It is therefore no surprise that most intensive care societies recommend the use of specialized retrieval teams[29, 60, 61] or at least the use of specific trained personnel[22, 23]

**Training**

Crew resource management training teaches behavioral strategies to countermeasure errors by avoiding the error, trapping errors committed and mitigating the consequences of errors.[62] Simulation-based training in medicine reduces medical error, enhances clinical outcomes, and reduces the cost of clinical care.[63] Although evaluative and validation studies
of simulation-based education are sparse[64, 65], simulation training in medicine is being used more and more. These trainings are often used for relatively simple procedures like central line placement or intubations[66, 67], but also for more complex situations like pre-hospital trauma care[68].

It has been recognized that transfer teams should be trained before taking responsibility[36, 69] and that one of the most significant determinants of quality of care during transport is the training of the attendant[70]. However, surveys continue to demonstrate a lack of formal transfer training[71, 72] and although local training initiatives have been described[71, 73, 74], intensive care societies have still failed to do so. These societies all agree on the importance of specific transfer training for the transport team[22, 23, 60, 61, 75, 76] and some even provide competencies, but none have provided an extensive training program. Moreover, only one detailed crew resource management simulation training has been published so far[74].

No studies have compared the effect of specific transfer training on outcome. However, evidence shows that training relatively simple procedures leads to quality improvement[66, 67], even though there is no evidence to support this yet, it seems logical that this applies to more complex procedures, like transferring the critically ill patient, too. For our intensive care societies setting-up transfer training programs might be a great opportunity to support quality improvement.

**Preparation**

The key to successful transport of the critically ill patient is stabilization before the transport is attempted.[17] Since up to 91% of incidents are thought to be preventable[25, 28, 42, 45], often by better transport preparation, it is not a surprise that the importance of assessing, resuscitating and stabilizing a patient before transport is still advocated today.[22, 75-77] Minor interventions like the development of transport tools or transport score cards lead to a better transport preparation of the patient and team[78, 79]. For example, a blood gas obtained immediately before transport resulted in adjustments to mechanical ventilation or treatment modifications in 30% of transferred patients[80] and implementing a preventive program even resulted in a reduction of incidents by 20%.[46]

Of course, these interventions take time, but it has been shown that time spent undertaking intensive care interventions at the referring hospital does not worsen patient outcome[81] and in some studies is even associated with a shorter length of hospital stay.[82] Intensive care does not start at the receiving hospital, but should start before transfer.
Equipment

Over the years, multiple minimum recommended transfer equipment suggestions have been made. These focus not only on the continuation of normal critical care (like monitoring, ventilation, administering medication), but also on transfer specific items (gas supply, batteries) and incident management (for example defibrillator, chest tubes). In general, an ICU monitor able to display EKG readings, several pressure curves, capnography and saturation; a ventilator, preferably an ICU ventilator; airway management tools; arterial lines; central venous lines and all sorts of medication are advised.

Equipment should be properly mounted, governed by CEN (Comité Européan de Normalisation) regulations. Transfer trolleys should carry all the equipment, like monitor, syringe pumps, ventilators, suction devices, defibrillator and gas cylinders. For safety reasons, this equipment should be mounted below the level of the patient. Battery life of all electronic devices should be at least several hours and battery life-expectancy should be properly displayed. Of course all equipment must be light weighted and suitable for transfer conditions.

These kind of transfer trolleys might outsize a standard ambulance stretcher and during transfer, the critically ill patient must be accessible from all sides. Therefore, it is quite common that transfers of these patients are done by oversized ambulances, sometimes especially designed for the transfers of critically ill patients.

Organizational and legal aspects

The decision to transfer a patient to another hospital must be made by the responsible consultant, in conjunction with consultant colleagues from relevant specialties in both the referring and receiving hospitals. Ideally, after consulting both the most appropriate receiving hospital and the patient or relatives, all agree on the transfer. Unfortunately, this is not always the case. Firstly, stakeholders do not always agree on the reasons for critical care transfers and secondly, the most appropriate receiving hospital is not always chosen as the destination.

In the United Kingdom critical care networks have been established to facilitate and organise transfers. Each network has a lead clinician and manager whose responsibilities include the development of referral pathways and transfer protocols. On top of this, all acute hospitals must have systems and resources in place to resuscitate, stabilise and transport critically ill patients when required. Therefore, they should have nominated a lead consultant for critical care transfers with responsibility for guidelines training and equipment provision. The situation in the Netherlands is similar to the United Kingdom. All hospitals are expected to be able to transfer a high urgency critically ill patient themselves. However if time is not a critical factor, ICU patients have to be transferred by a specialized retrieval team.
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Who is responsible for patient care during transport? In our opinion, it is the accompanying intensivist. Therefore, in theory, although referring and receiving staff may agree on the transfer, the accompanying physician makes the final decision whether the patient is transferrable or not and which treatment is given during the transport.

Furthermore, it has to be clear to all, at what exact moment responsibility transfers from one team to another. This has to be stated in a regional or national transport protocol. This formal handover from referring doctor to retrieval doctor and from the latter to the receiving hospital doctor is essential. One could imagine a situation in which a transported patient is already transferred off the trolley on the hospital bed and placed on the local equipment, but of course, before the formal handover took place. In case of a deterioration it is essential that all involved know who is responsible, the transport team who knows the patient, or the receiving team who knows the equipment? In our opinion, it should be the transport team.

Since a transfer is a continuation of a patient’s treatment and since it is also a situation prone for incidents it is of the utmost importance to document the transfer process. Therefore, the clinical record should document the patient’s clinical status before, during and after transport, relevant medical conditions, environmental factors and therapy given.\[60, 75\] Moreover, organisations involved in medical transport should have an effective quality management system which can monitor and audit performance and make recommendations for appropriate improvements. \[23, 60\]

**Risk scores and interhospital transfers**

Risk scores are being used for determining severity of illness or expected mortality or for benchmarking ICU’s. The problem with most scores is that they are calculated over the first 12-24 hours after ICU admission and thus, in case of a transfer, do not take into account the effect of treatment given at the referral ICU.\[86, 87\] Furthermore, the transfer process itself may influence the severity score. Especially in pediatric literature, there is evidence of normalization of severity scores after stabilization and transfer by specialized retrieval teams. \[54, 88\] Although some scores, like APACHE III and ICNARC, adjust for admission source\[89, 90\], lead time bias as well as other undefined influences are still thought to explain differences in severity scores after transfer.\[86, 91\] Therefore, by using our present mortality scores, it is almost impossible to make a realistic comparison between transferred and non-transferred patients. By doing so, one could easily draw premature conclusions.\[92, 93\]
Another aspect of severity scores is the ability to differentiate between high risk and low risk transports, i.e. what kind of transfer team should accompany a patient? In adult transfer medicine, only one such a score has been investigated in two, rather small, studies. [94, 95] Although this score seemed very useful in discriminating between high risk and low risk patients, since only a few of the low risk patients were actually admitted to the ICU, it does not seem reasonable to use this score for the critically ill. Moreover, since specialized retrieval teams seem to transfer sicker patients with less incidents[40] scoring systems may only be of value in predicting the risk of inexpert transfers.[70] However, there are guidelines regarding the accompaniment, although only based on expert opinion. For example, in the Netherlands, non-urgent ICU patient’s transfers have to be carried out by a retrieval team if they are on the ventilator with certain settings or when haemodynamically unstable. The Intensive Care Society in Great Britain uses the classification in certain levels of care to determine which accompaniment is sufficient.[23] One could argue that patients, ill enough to be admitted to the ICU, need to be cared for by an ICU team throughout their ICU stay, especially during a high risk procedure like transportation.

Influences on and of the health care system

There is no doubt that some patients have to be transferred to higher levels ICU’s for therapeutic or diagnostic procedures. It is also clear that high risk admissions increase the burden of these ICU’s, both in resource utilization and in bed occupancy.[86, 96] The demand for higher level ICU beds may even further increase since some volume-outcome relationship studies have been published showing a reduced mortality in high volume hospitals.[2, 97] These studies increase the debate whether ICU treatment should be centralized. There are some items to consider in this regard:

Firstly, it is still a matter of debate whether this volume-outcome relationship is caused by selective referral (patients are referred to high quality centers), increased experience in high volume centers or better organizational factors.[98] Only the first is a true reason for transferring the patients, i.e. also smaller hospitals have shown to overcome the volume-outcome relationship, possibly by implementing measures for quality improvements regarding experience and organizational factors.[99, 100]

Secondly, multiple studies have been published showing patients are quite often not transferred to the most appropriate hospital, leaving room for further improvement in the transfer process. [33, 34, 101]

Thirdly, centralization will not only increase the burden of the receiving ICU’s, but also of the transfer system. That is another reason for a further professionalization of the transfer teams.
Conclusion

Over the last forty years the quality of transferring the critically ill patient has improved. Nowadays, it is generally accepted that these patients should be transferred by specialized retrieval teams. However, how these teams are composed, trained or assessed is at most expert opinion. Furthermore, it is to be expected that these kind of transfers will increase in the near future. It is therefore necessary that both intensivists and intensive care societies take their responsibility and further professionalize the transfer process. (Table 2) It is like sailing the ocean; the focus should be on the journey, not only on the destination.

Table 2. Recommendations for the transfer of the critically ill

<table>
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<th>Recommendations</th>
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<tr>
<td>Critically ill patients should be transferred by a specialized retrieval team</td>
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<tr>
<td>This team should receive transfer training</td>
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<tr>
<td>This team should be staffed with a physician, preferably an intensivist</td>
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<tr>
<td>The accompanying physician makes the final decision whether the patient is</td>
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<td>transferrable or not and which treatment is given during the transport.</td>
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<td>Transfer organisations should have a quality management system</td>
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<tr>
<td>Incidents reports should be standardized and mandatory</td>
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<td>Equipment used should meet both ICU as well as transfer standards</td>
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