

# Study on the incidence of adverse events during intra-hospital transfer of critical care patients from emergency department

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## ABSTRACT

**Introduction:** Emergency department (ED) plays a main role in the initial management of patients who are critically ill. These patients require intra-hospital transfer for continuation of care. Adverse events can occur during this short duration and the distance of intra-hospital transfer. The aims of this study were to determine the incidence of adverse events during intra-hospital transfer from ED and to determine the factors associated.

**Methodology:** This was a cross-sectional observational study done from November 2017 until December 2017 at ED Hospital Sultan Abdul Halim (HSAH), a 650-bedded tertiary hospital in the state of Kedah. All patients that were triaged to red zone, age 18 years and above, and involved in intra-hospital transfer to critical coronary unit, intensive care unit and wards were included. All cases were documented in proforma by the accompanying staff.

**Results:** Among the 170 critically ill patients, only 29 patients (17.1%) experienced adverse events during intra-hospital transfer. The adverse events seen were hypotension (12.4%), desaturation (3.5%) and dislodged peripheral line (2.4%). Cardiorespiratory related diagnosis was the commonest presentation. Intra-hospital transfer during morning shift and evening shift has 79.5% ( $b=-1.59$ ,  $OR=0.21$ , 95% CI: 0.06, 0.69,  $p=0.011$ ) and 75.6% ( $b=-1.41$ ,  $OR=0.24$ , 95% CI: 0.08, 0.73,  $p=0.012$ ) lesser odds of experiencing adverse events compare to night shift. Patients with vasopressor/inotropes had 9 times higher odds of experiencing adverse events during transportation, compared to patients with no vasopressor/inotropes ( $b=2.27$ ,  $OR=9.70$ , 95% CI: 3.39, 27.72,  $p<0.001$ ).

**Conclusions:** Critical care patients who are involved in intra-hospital transfer were at risk of adverse events such as hypotension, desaturation and dislodge peripheral line. Risk identification and maintaining level of care is important to minimize the adverse events during transfer. Patients had higher rates of adverse events if they were transferred during night shifts and on inotropic/vasopressor support.

## KEY WORDS:

*Intra-hospital transfer, emergency department, adverse events, critical care patient*

## INTRODUCTION

Emergency department (ED) receives patients with many types of problems, ranging from simple ailments such as upper respiratory tract infection to those critically ill.<sup>1</sup> Patients are subsequently triaged and managed accordingly. The disposition of patients is equally important in managing these patients. They are either received as outpatients or inpatients (to be admitted) and given treatment that they require. Patients are transferred either via wheelchair or patient transport trolley, and even though the duration and distance may be short in comparison to inter-hospital transfer, adverse events can still occur. Critically ill patients who are involved in intra-hospital transfer are at risk of adverse events such as hypotension, desaturation and dislodge peripheral lines. Risk identification and maintaining a good level of care is important to minimize any adverse events during such transfer. Patients have higher rate of adverse events if they were transferred during night shifts and on inotropic/vasopressor support.<sup>2</sup>

Transfer of patient (or intra-hospital) is the movement of a patient from one physical location within the hospital. Such transfers may be temporary (e.g., to obtain diagnostic imaging) or for a longer term (e.g., transfer from ED to an intensive care unit (ICU)). These are critical transitions in which adverse events and death may occur.<sup>3</sup>

The reported incidents of adverse events during intra-hospital transfer range from 6% to as high as 70%.<sup>4</sup> These adverse events may be minor events such as intravenous line displacement or nasogastric tube displacement, to life threatening major events like cardiac arrest or death. Successful intra-hospital transfer invariably depends on the planning and organisation of a multidisciplinary team as well as appropriate monitoring and intervention during a transfer.<sup>5</sup> It is potentially hazardous and associated with poor outcome.<sup>6</sup> The standard is generally poor when the most junior staff performs the intra-hospital transfer without adequate monitoring.<sup>7</sup>

The principle of intra-hospital transfer is to maintain the optimal medical quality of care from the referral department to the receiving department or unit. Lack of understanding of this principle can significantly contribute to morbidity and mortality.<sup>8</sup> In one study, among the most frequent adverse events encountered

during the were physiological alterations, followed by equipment and team failures.<sup>9</sup>

There is a lack of research and data concerning adverse events amongst patients from the ED. Previous studies concentrated more on patients in ICU involved in intra-hospital transfers.<sup>10</sup> Patients from the ICU are mainly transferred to the radiological department for imaging and are at risk for adverse events.<sup>11</sup> A study done in Turkey in 2015 involving patients from the ED showed low incidence of adverse events. Out of 1000 patients involved in intra-hospital transfer, only 38 had adverse events with intravenous catheter displacement being the most common adverse event. This study included all patients that was involved in transfer, and not limited to critical ill patients only. A quarter of the patients were accompanied by a doctor during transfer, thus resulting in lower incidence of adverse events. To date, there is limited data available in this country regarding intra-hospital transfer, especially involving the ED. The aims of this study are to determine the incidence of adverse events during intra-hospital transfer from ED and to determine the associated factors that contribute to the events so that appropriate measures can be introduced.

## MATERIALS AND METHODS

This was a cross-sectional observational study with the duration beginning from 1st November 2017 until 31st December 2017 and conducted at ED, Hospital Sultan Abdul Halim (HSAH) Sungai Petani, Kedah. This is a tertiary hospital receiving up to 120,000 patients through ED annually.

The reference population in this study was patients that seek treatment at the ED. Patients that were triaged to red zone, aged 18 years old and above and involved in intra-hospital transfer were included. Intra-hospital transfer is defined as transfer of patients from ED to the ICU, coronary care unit and clinical wards.

Data collection was done using a proforma form. The form was filled up by a staff who accompanied the patient during transfer. Data of patients that include age, gender, registration number, race, diagnosis and vital signs were recorded. Any adverse event that occurred during transportation of patients was documented. We define here adverse events as any untoward medical occurrence and event that affected the stability of a patient. The adverse events that were included here was based on previously published studies in which similar outcomes were assessed for patients undergoing intra-hospital transport. The adverse events during transport were classified as cardiac arrest, hypotension, desaturation, dislodged airway device, Ryles tube, arterial line, peripheral line, central line, continuous bladder drainage (CBD) and equipment failure. Any other additional adverse event or intervention done to patients during transport are to be specified also. Vital signs of patients were recorded at the time of initial transfer, and once again when arrived at the respective wards. This form was subsequently returned to the ED at the end of transfer.

Details in proforma form was counter checked by the investigator and compared with data that was keyed in the hospital computed

information system. This form was kept in a file in the ED. Filling up of this form was integrated as part of the ED protocol. Hence, no consent was required from patients. Furthermore, the nature of the study was observational. The safety of patients was never compromised throughout this study, as any adverse events that occurred during transfer were managed according to standard care.

Data recorded from the proforma form was compiled and analysed using Statistical Package for Social Sciences (SPSS) software version 22.0. Factors associated with adverse events experienced among patients during intra-hospital transfer from ED was analysed by using multiple logistic regression. Results were reported as odds ratio (OR) and statistical significance was ascertained by the 95% confidence interval.

This study was approved by the Human Research Ethics Committee USM (USM/JEPeM/17030150) on 27th April 2017 and by the National Medical Research and Ethics Committee (NMRR-17-611-34171) on 20th June 2017.

## RESULTS

A total of 170 critically ill patients from the red zone were involved in the intra-hospital transfer to the wards, CCU and ICU. Table I shows the sociodemographic characteristics of all the patients. Most patients were males (60.6%), Malays (78.2%) and the mean age was 51.9 years (SD±16.7). Most of the intra-hospital transfer occurred in the evening shifts (37.1%) and patients were sent to the wards (75.3%). All patients were on cardiac monitors and accompanied by one paramedic and one attendant. Table II shows the clinical situation of patients in ED.

There were 29 patients (17.1%) who experienced adverse event while 141 patients (82.9%) did not experience any adverse event during the intrahospital transfer. Thus, the proportion of patients who experienced adverse events were 17.1% (95%CI: 11.3, 22.8). The most frequently reported adverse events were physiological alteration which were hypotension (12.4%) and desaturation (3.5%). Dislodged peripheral line occurred in 2.4% of the cases. No patient experienced any cardiac arrest, equipment failure and dislodgement of endotracheal tube, Ryles tube, central line or Foley catheter.

The factors associated with adverse events experienced among patients during intra-hospital transfer were analysed by using multiple logistic regression. From simple logistic regression, three unadjusted significant factors with p-value <0.25 were identified to be included in variable selection (Table IV). The factors were shift during transportation, patients with the Foley catheter and vasopressor/inotropes. Variables with p-value less than 0.25 but its 95% confidence interval included 1.00 were not considered as significant. These were patients who were equipped with supplemental oxygen, intravenous drip and central line.

**Table I: Demographic and clinical characteristics of patients involved in intra-hospital transfer (n=170)**

Variables	Emergency Department patients n (%)
Gender	
Male	103 (60.6)
Female	67 (39.4)
Age (years)	51.9 (16.7) <sup>a</sup>
Age group	
18-50	66 (38.8)
>50	104 (61.2)
Ethnicity	
Malays	133 (78.2)
Chinese	16 (9.4)
Indians	20 (11.8)
Others	1 (0.6)
Diagnosis	
Cardiovascular related disease	49 (28.8)
Respiratory related disease	44 (25.9)
Trauma	17 (10.0)
Gastrointestinal related disease	14 (8.2)
Endocrinology related disease	11 (6.5)
Neurology related disease	9 (5.3)
Others	26 (15.3)

<sup>a</sup>mean (SD)

**Table III: Adverse events experienced during intra-hospital transfer (n=170)**

Variables	Emergency Department patients n (%)
Cardiac arrest	
Yes	0 (0.0)
No	170 (100.0)
Hypotension	
Yes	21 (12.4)
No	149 (87.6)
Desaturation	
Yes	6 (3.5)
No	164 (96.5)
Dislodge endotracheal tube	
Yes	0 (0.0)
No	170 (100.0)
Dislodge Ryles tube	
Yes	0 (0.0)
No	170 (100.0)
Dislodge peripheral line	
Yes	4 (2.4)
No	166 (97.6)
Dislodge central line	
Yes	0 (0.0)
No	170 (100.0)
Dislodge Foley catheter	
Yes	0 (0.0)
No	170 (100.0)
Equipment failure	
Yes	0 (0.0)
No	170 (100.0)
Arrhythmias	
Yes	0 (0.0)
No	170 (100.0)
Seizures	
Yes	0 (0.0)
No	170 (100.0)

**Table II: Clinical details of patients involved in intra-hospital transfer (n=170)**

Variables	Emergency Department patients n (%)
<b>Location</b>	
Ward	128 (75.3)
CCU	25 (14.7)
ICU	17 (10.0)
<b>Shift</b>	
Morning	50 (29.4)
Evening	63 (37.1)
Night	57 (33.5)
<b>Equipments</b>	
Cardiac monitor	
Yes	170 (100.0)
No	0 (0.0)
Ventilator	
Yes	34 (20.0)
No	136 (80.0)
Supplemental oxygen	
Yes	86 (50.6)
No	84 (49.4)
Intravenous drips	
Yes	127 (74.7)
No	43 (25.3)
Central line	
Yes	4 (2.4)
No	166 (97.6)
Ryles tube	
Yes	41 (24.1)
No	129 (75.9)
Foley catheter	
Yes	118 (69.4)
No	52 (30.6)
Vasopressor inotropes	
Yes	32 (18.8)
No	138 (81.2)
<b>Staff</b>	
Doctor	
Yes	0 (0.0)
No	170 (100.0)
Paramedic	
Yes	170 (100.0)
No	0 (0.0)
Staff Nurse	
Yes	0 (0.0)
No	170 (100.0)
Attendant	
Yes	170 (100.0)
No	0 (0.0)

**Table IV: Factors associated with adverse events experienced during intra-hospital transfer (n=170)**

Variables	Regression coefficient (b)	Crude Odd Ratio (95% CI)	Wald Statistics	p value
<b>Demographic</b>				
Gender				
Male	0	1		
Female	-0.44	0.64 (0.27, 1.52)	1.02	0.313
Age	0.01	1.01 (0.99, 1.04)	0.59	0.442
Age group				
18-50	0	1		
>50	0.05	1.05 (0.46, 2.38)	0.01	0.914
Ethnicity				
Malays	0	1		
Chinese	0.15	1.16 (0.31, 4.43)	0.05	0.823
Indians	0.23	1.26 (0.39, 4.14)	0.15	0.701
Other	-19.58	0.00 (0.00)	0.000	1.000
<b>Diagnosis</b>				
Cardiovascular related disease	-0.64	0.53 (0.17, 1.67)	1.17	0.279
Respiratory related disease	-0.51	0.60 (0.19, 1.92)	0.73	0.392
Trauma	-0.18	0.84 (0.20, 3.44)	0.06	0.803
Gastrointestinal related disease	-20.20	0.00 (0.00)	0.00	>0.950
Endocrinology related disease	-0.51	0.60 (0.10, 3.51)	0.32	0.574
Neurology related disease	-20.20	0.00 (0.00)	0.00	>0.950
<b>Location</b>				
Ward	0	1		
CCU	0.30	1.35 (0.45, 4.02)	0.29	0.589
ICU	0.51	1.66 (0.49, 5.62)	0.67	0.414
<b>Shift</b>				
Morning	-1.34	0.26 (0.09, 0.77)	5.88	0.015
Evening	-1.22	0.29 (0.11, 0.78)	6.12	0.013
Night	0	1		
<b>Equipments</b>				
<b>Ventilator</b>				
Yes	0.52	1.69 (0.67, 4.22)	1.24	0.266
No	0	1		
<b>Supplemental oxygen</b>				
Yes	0.74	2.10 (0.91, 4.83)	3.03	0.082
No	0	1		
<b>Intravenous drip</b>				
Yes	0.87	2.39 (0.78, 7.31)	2.33	0.127
No	0	1		
<b>Central line</b>				
Yes	1.64	5.15 (0.70, 38.15)	2.57	0.109
No	0	1		
<b>Ryles tube</b>				
Yes	0.001	1.001 (0.39, 2.55)	0.00	>0.950
No	0	1		
<b>CBD</b>				
Yes	1.17	3.23 (1.06, 9.80)	4.27	0.039
No	0	1		
<b>Vasopressor inotropes</b>				
Yes	2.26	9.62 (3.92, 23.60)	24.40	<0.001
No	0	1		

**Table V: Associated risk factors of adverse events during intra-hospital transfer of critical care patients (n=170)**

Variables	Regression coefficient (b)	Adjusted Odd Ratio (95% CI)	Wald Statistics	p value
<b>Shift</b>				
Morning	-1.59	0.21 (0.06, 0.69)	6.49	0.011
Evening	-1.41	0.24 (0.08, 0.73)	6.31	0.012
Night	0	1		
<b>Vasopressor/inotropes</b>				
Yes	2.27	<b>9.70 (3.39, 27.72)</b>	<b>17.98</b>	<b>&lt;0.001</b>
No	0	1		

Multiple Logistic Regression model was applied

Table V, shows that a patient transferred during the morning shift have 79.5% lesser odds of experiencing adverse events during transportation, compared to transportation during the night shifts (b=-1.59, OR=0.21, 95% CI: 0.06, 0.69, p=0.011). Similarly, patients transferred during the evening shifts have 75.6% lesser odds of experiencing adverse events during transportation, compared to transportation in night shift (b=-1.41, OR=0.24, 95% CI: 0.08, 0.73, p=0.012).

Patients with vasopressor/inotropes have 9 times higher odds of experiencing adverse event during transportation, compared to patients with no vasopressor and inotropes (b=2.27, OR=9.70, 95% CI: 3.39, 27.72, p<0.001).

## DISCUSSION

Intra-hospital transfer is part of continuation of medical care and must be taken seriously by healthcare providers. The level of care delivered during transfer and at the site of initial treatment should be good, adverse events should be anticipated and risk identification must always be practiced.<sup>3</sup>

The most common diagnosis of critically ill patients was cardiorespiratory related diseases of more than 50%. This finding is similar to another study in one of the ED in Denmark where they found more than 50% of their critically ill non-trauma patients were related to breathing and circulatory problems.<sup>12</sup> In our study even though the multivariate analysis is not statistically significant for both cardiovascular related diagnosis or respiratory related diagnosis in separation, in combination they account for higher proportion of adverse events. Thus, staff have to be more vigilant when accompanying this group of patients during intra-hospital transfer.

In this study, there were only 29 patients (17.1%) who experienced adverse events during the intra-hospital transfer. Other studies have reported that adverse events range from 6% to as high as 70%.<sup>4</sup> In a study conducted in France, almost half of the patients (45%) had adverse events.<sup>11</sup> However, the cohort for both these studies were among patients in ICU and not from the ED. Reported rates of adverse events vary among studies, not only because of difference of incidence but also because of different definitions were used.<sup>13</sup>

The most common adverse event that was observed was hypotension (12.4%), followed by desaturation (3.5%) and dislodged peripheral line (2.4%). This is contrast with a study in Turkey among 1000 patients from ED that reported dislodgement of peripheral lines as the most common complication.<sup>10</sup> However, our study includes patients that were not critically ill as well. A study using Multi-parameter Intelligent Monitoring in Intensive Care Unit Database had shown that hypotensive episodes are relatively high (63.3%) during the first 24 hours.<sup>14</sup> This study provides useful information about physiological instability in critically ill patients and may contribute to risk identification prior to intra-hospital transfer.

By using multivariable analysis, significant risk factors of adverse events experienced among patients undergoing intra-hospital transfer were identified. These included the shift in which patient was transferred and whether patients were on vasopressor/inotropes. There was almost equal number of patients being transferred during each shift (50 patients during morning, 63 in the evening and 57 at night). Patients transferred during night shift experienced higher rate of complications compared to

morning and evening shift despite involving similar number of patients. This could be related to reduced efficiency of staff during this period. Previous research had indicated that working during night shift leads to reduced performance. There is a decline in neurocognitive performance leading to higher risk of fatigue related errors.<sup>15</sup>

Patients who were on inotropic/vasopressor support also contributed to higher rate of adverse events that was mainly hypotension. They were already critically ill and already have profound haemodynamic impairment such that tissue blood flow is not sufficient to meet metabolic requirements.<sup>16</sup> This includes patients with severe heart failure, septic and cardiogenic shock.

There are some limitations in this study. This study was conducted in a single centre, and this probably limits the generalisability of the findings. Inclusion of more hospitals from other states will likely improve the type of clinical emergencies, hence providing a more accurate representation of our population. The duration of study and sample size may not have been adequately to represent the population in this busy centre, and hence influence the results of multiple logistic regression.

Only three types of adverse events were identified which includes hypotension, desaturation and dislodged peripheral lines. There could be different types of adverse events if more patients were included. There are many more detailed information to be explored and considered in adverse events on intra-hospital transport. It is definitely important as this will improve the service offered to patients and enhance the current patient safety.

## CONCLUSION

Critical care patients who are involved in intra-hospital transfer are at risk of adverse events such as hypotension, desaturation and dislodged peripheral line. Risk identification and maintaining level of care are important to minimize the adverse events during the transfer. Patients have higher rate of adverse events if they were transferred during night shifts and on inotropic/vasopressor support. The updating of existing protocol is one of the measures to improve the quality of care in the future.

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