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Interhospital Transfer Versus other Modes of Admission of Patients with Covid-19 at the University Hospital Andohatapenaka: A Retrospective Cohort Study

Josoa Rakotoarisoa Andrianiaina[1]*, Falihery Albertin Rakotomavo[2], Andoniaina Rakotonaivo[1], Nirina Andrianome Raharimahenina[3], Francklin Rabenjarison[1] and Nasolotsiry Enintsoa Raveloson[2]

[1]*University Hospital of Andohatapenaka, Antananarivo, Madagascar*

[2]*University Hospital of Befelatanana, Antananario, Madagascar*

[3]*Institut National de Santé Publique et Communautaire (INSPC), Antananarivo, Madagascar*

***Corresponding Author:** Josoa Rakotoarisoa Andrianiaina, University Hospital of Andohatapenaka, Antananarivo, Madagascar.

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Abstract

Background: The COVID-19 pandemic did not spare Madagascar, and we observed that a significant number of inpatients who were transferred passed away. The aim of this study was to investigate how admission by transfer influences the outcome of COVID-19 patients and to identify factors associated with mortality in patients admitted through interhospital transfer.

Methods: This is a retrospective cohort study conducted at the Andohatapenaka University Hospital over a three-month period from December 2021 to February 2022. The first group included in the study population was composed of patients from interhospital transfers (n=54). The second group consisted of patients admitted by other admission methods (n=127). The chi-square test was used to check the validity of the relative risk (RR), and the significance threshold was set by a p value < 0.05.

Results: After analysis, it was found that the mode of admission interhospital transfer was associated with patient mortality (RR=1.47 [1.06-2.04]). Additionally, we identified several factors associated with mortality in COVID-19 patients, including a history of diabetes (RR=1.58[1.02-2.43]), a respiratory rate of more than 30 cycles/min (RR=1.58[1.02-2.45]), SpO_2 less than or equal to 88% (RR=2.45[1.21-4.92]), Glasgow score between 9 and 12 (RR=2.09[1.55-2.83]), critical form (RR=2.41 [1.68-3.47]), lung involvement greater than 50% (RR=1.99 [1.05-3.74]), presence of complications (RR=1.90 [1.24-2.93]), complications by myocardial infarction (RR=2.00 [1.50-2.65]), and use of noninvasive ventilation (RR=2.00 [1.50-2.65]). Therefore, admission through interhospital transfer influenced the unfavorable patient outcome.

Conclusion: Our study shows that admission by transfer is associated with mortality in COVID-19 patients. We recommend that healthcare professionals exercise vigilance in managing these patients to improve outcomes.

Keywords: admission; COVID-19; mortality; transfer

Abbreviations

BHC: Basic Hospital Centers.
CI: Confidence Interval.
COVID-19: Coronavirus Disease 2019.
CRP: C-Reactive Protein.

CT: Computed Tomography.
GCS: Glasgow Coma Scale.
ICU: Intensive Care Unit.
MI: Myocardial Infarction.
NIV: Non-Invasive Ventilation.
NS: Not Significant.
OR: Odds Ratio.
PCR: Polymerase Chain Reaction.
RDT: Rapid Diagnostic Test.
RR: Relative Risk.
SpO_2: peripheral capillary oxygen saturation.

Background

Introduction

The COVID-19 (Coronavirus Disease 2019) pandemic is one of the most difficult global health crises to manage. If it emerged in Wuhan, China, in December 2019, globally, from the start of the pandemic to March 2022, the number of people infected with COVID-19 is approximately 530,254,424, with 6,173,184 deaths [1]. Hospital capacities have been strained during the waves of COVID-19, leading to the necessity of transfers for certain patients to other hospitals with greater availabilities. Interhospital transfers were made by various countries to address hospital overcrowding and the need for resuscitation beds [2-3]. Many patients with COVID-19 have benefited from interhospital transfer in Madagascar. At the University Hospital Andohatapenaka Antananarivo, several of our patients from interhospital transfer died. This motivated us to carry out this study, the objective of which was to verify first that the mode of admission by interhospital transfer of patients with COVID-19 influences their outcomes. Second, we aimed to identify factors associated with mortality in patients from interhospital transfers.

Materials and Methods

Study design

This study is a retrospective cohort study of all patients hospitalized for COVID-19 in the multipurpose intensive care unit and medical polyclinic of the Andohatapenaka Antananarivo University Hospital. The study was conducted from December 2021 to February 2022.

The study population included all patients hospitalized for COVID-19 at the polyvalent resuscitation and medical polyclinic service of the Andohatapenaka University hospital. All patients hospitalized with confirmed COVID positive (PCR(Polymerase chain reaction) positive and/or RDT(Rapid Diagnostic Test) positive and/or CT (Computed Tomography) indicative of COVID-19 pneumopathy and/or genexpert positive) in the following departments were included: the first group was composed of patients transferred from COVID-19 treatment centers , other university hospital centers, regional hospital centers or private clinics. The second group consisted of patients admitted by other admission means, such as self-referral by a free doctor or a basic health center (BHC). Incomplete medical records were excluded from this study. Exhaustive sampling was applied for patients meeting the inclusion criteria. The sample consisted of 181 patients, of which 54 were transferred patients and 127 were admitted by other means.

Data collection procedure

Data were collected from the records of patients admitted to the two wards from December 2021 to the end of February 2022. The data were collected on a collection grid specific to each individual.

Study variables

The variables studied were patient outcomes (deceased, other outcomes), social factors (age, sex, place of residence, vaccination status for COVID-19), mode of admission (transferred, self-referred, referred), medical history (such as hypertension, diabetes, etc.), admission parameters, clinical signs at admission (such as Glasgow, dyspnea, etc.), the presence of complications, and the presence of a medical condition.), the presence of complications during hospitalization, the treatment received (oxygen therapy), and the paraclinical tests.

Statistical analysis

The data collected were entered into Microsoft Office Excel 2010 and analyzed using Epi Info software version 3.5.4. The relative risk [RR] was calculated with its 95% confidence interval [RR 95% CI]. The chi-square test was used to check the validity of the RR, and the significance threshold was set by a p value < 0.05. For the mean, Student's t test was used.

The study was conducted while ensuring confidentiality and professional secrecy, with strict adherence to file anonymity.

Results

The age of the patients included in the present study ranged from 29 to 91 years. The study population was predominantly male, with a sex ratio of 1.13. For patients with a medical history, 73.08% passed away. In terms of vaccination, only 14.10% of the deceased patients were vaccinated against COVID-19 (Table 1).

Patient characteristics	*Died*		*Other outcomes*			
	(n=78)	*%*	*(n=103)*	*%*	*N*	*%*
Age						
> 64 years	48	61.54	43	41.75	91	50.28
≤ 64 years	30	38.46	60	58.25	90	49.72
Gender						
Male	44	56.41	52	50.49	96	53.04
Female	34	43.59	51	49.51	85	46.96
Comorbidity						
With comorbidity	57	73.08	68	66.02	125	69.06
No comorbidity	21	26.92	35	33.98	56	30.94
Vaccine against covid-19						
Vaccinated	11	14.10	12	11.76	23	12.71
Not vaccinated	67	85.90	91	88.24	158	87.29

Table 1: General patient characteristics.

Of the transferred patients, 55.56% died compared to 37.80% of those admitted by other admission methods. The mode of admission by transfer is a risk factor for the occurrence of mortality (Table 2).

Mode of admission	*Died (n=78)*	*Other outcomes (n=103)*	*RR with 95% CI*	*p*
Transfer	30	24	1.47[1.06-2,04]	0.027
Other modes of admission	48	79	1	

Table 2: Distribution of patients by mode of admission and outcomes.

There was no significant difference in the mean age of deceased patients, irrespective of the mode of admission. Age > 64 years is a risk factor for the occurrence of mortality for the other modes of admission. Regardless of the mode of admission of patients, sex was not significantly associated with mortality. There was no significant association between the mode of admission, place of residence, and the occurrence of patient mortality (Table 3). History The presence of a history of diabetes was a risk factor for the occurrence of death in patients admitted by transfer. The association was statistically significant. The association between the mode of admission, vaccination status, and outcome was not significant (Table 3).

Mode of admission		*Died (n=78)*	*Other outcomes (n=103)*	*RR with 95% CI*	*p*
	Age Mean(years)				
Transfer			65.40 [±15.72]	64.46 [±14.09]	NS
Other modes of admission			63.48 [±12.35]	59.30 [±11.50]	
	Age range (years)				
Transfer	> 64	21	13	1.37 [0.79-2.38]	NS
	≤ 64	9	11	1	
Other modes of admission	> 64	27	30	0.47 [0.36-0.62]	0.046*
	≤ 64	21	49	1	
	Gender				
Transfer	Female	13	10	1.03 [0.64-1.66]	NS
	Male	17	14	1	
Other modes of admission	Female	21	41	0.81 [0.52-1.28]	NS
	Male	27	38	1	
	Place of residence				
Transfer	Rural	11	10	0.91 [0.55-1.50]	NS
	Urban	19	14	1	
Other modes of admission	Rural	11	22	0.85 [0.49-1.46]	NS
	Urban	37	57	1	
	Arterial hypertension				
Transfer	Yes	16	12	1.06 [0.66-1.71]	NS
	No	14	12	1	
Other modes of admission	Oui	30	44	1.19 [0.75-1.90]	NS
	Non	18	35	1	
	Diabetes				
Transfer	Oui	10	3	1.58 [1.02-2.43]	0.043*
	Non	20	21	1	
Other modes of admission	Oui	15	19	1.24 [0.78-1.98]	NS
	Non	33	60	1	
	Vaccination status				
Transfer	vaccinated	5	4	1.08 [0.57-2.07]	NS
	not vaccinated	25	24	1	

Other modes of admission	Vaccinated	6	8	1.1[0.58-2.12]	NS
	not vaccinated	42	67	1	

NS: Not significant.

*: Statistically significant.

Table 3: Distribution of patients according to their mode of admission, sociodemographic characteristics, and outcomes.

As a result of our study, we found that regardless of the mode of patient admission, a respiratory rate (RR) > 30 cycles per minute at entry was a risk factor for patient mortality, and the association was significant. Regardless of the mode of patient admission, SpO_2 (Peripheral Capillary Oxygen Saturation) ≤ 88% at patient entry is a risk factor for the occurrence of mortality. The association between mode of admission by transfer, SPO_2 ≤ 88% at entry, and the occurrence of death was significant. Regardless of the mode of admission of patients, at entry, GCS (Glasgow Coma Scale) score, presence of dyspnea, and "critical" form of COVID-19 were risk factors for mortality. Among patients admitted by transfer, a GCS score between 9 and 12 is significantly associated with mortality. Patients admitted by other modes with dyspnea at entry had twice the risk of mortality, and the association was significant. The critical form in patients admitted after transfer is significantly associated with mortality. The risk is lower in patients admitted by transfer than in those admitted by other modes (Table 4).

Mode of admission		***Died (n=73)***	***Other outcomes (n=97)***	***RR with 95% CI***	***p***
	Respiratory rate (breaths per minute)				
Transfer	> 30	12	4	1.58 [1.02-2.45]	0.035*
	≤ 30	18	20	1	
Other modes of admission	> 30	18	26	1.13 [0.72-1.78]	NS
	≤ 30	30	53	1	
	SpO_2 (%)				
Transfer	≤ 88	17	5	2.45 [1.21-4.92]	0.005*
	89-92	7	6	1.70 [0.74-3.92]	NS
	≥ 92	6	13	1	
Other modes of admission	≤ 88	32	23	2.71 [1.46-5.05]	< 0.001*
	89-92	7	23	1,09 [0.46-2.60]	NS
	≥ 92	9	33	1	
	Glasgow				
Transfer	3-8	2	0	2.09 [1.54-2.83]	0.244
	9-12	6	0	2.09 [1.55-2.83]	0.018*
	> 12	22	24	1	
Other modes of admission	3-8	3	1	2.12 [1.15-3.93]	0,138
	9-12	3	1	2.12 [1.15-3.93]	0,138
	> 12	42	77	1	
	Dyspnea at entry				
Transfer	Yes	22	14	1.37 [0.77-2.45]	NS
	No	8	10	1	

Other modes of admission	Yes	41	53	2.06 [1.02-4.13]	0,017 *
	No	7	26	1	
	The clinical form of Covid				
Transfer	Critical	13	0	2.41 [1.67-3.47]	<0.001*
	Moderate and severe	17	24	1	
Other modes of admission	Critical	25	5	3.51 [2.38-5.20]	<0.001*
	Moderate and severe	23	74	1	

NS: Not significant.

*: Statistically significant.

Table 4: Distribution of patients by mode of admission, clinical characteristics, and outcomes.

Regardless of the mode of admission, lung involvement is a risk factor for death in patients. The association between mode of admission by transfer, lung involvement greater than 50%, and death was significant (Table 5). A CRP (C-Reactive Protein) level of more than 60 mg/ml is a risk factor for death in patients admitted by other modes. The association was statistically significant (Table 5).

Regardless of the mode of admission of patients, the presence of complications during hospitalization is a risk factor for the occurrence of mortality. The association between the mode of admission by transfer, complications by MI (Myocardial Infarction) during hospitalization, and death was significant. For the other modes of admission, the occurrence of septic shock during admission was associated with mortality (Table 6).

Mode of admission	*Lung damage by CT scan Done*	*Died (n=41)*	*Other outcomes (n=60)*	*RR with 95% CI*	*p*
Transfer	> 50%	9	2	1,99 [1.05-3.74]	0.039*
	≤ 50%	7	10		
Other modes of admission	> 50%	11	17	1.26 [0.67-2.38]	NS
	≤ 50%	14	31		
		Died (n=78)	**Other outcomes (n=103)**		
	D-Dimer (ng/ml)				
Transfer	> 1000	11	10	0.91 [0.55-1.50]	NS
	≤ 1000 and not made	19	14		
Other modes of admission	> 1000	25	31	1.38 [0.88-2.15]	NS
	≤ 1000 and not made	23	48		
	c-reactive protein (mg/ml)				
Transfer	> 60	7	9	0.72 [0.39-1.33]	NS
	≤ 60 and not made	23	15		
Other modes of admission	> 60	24	22	1.76 [1.13-2.72]	0.010*
	≤ 60 and not made	24	57		

	Leucocytes (mg/ml)				
Transfer	> 10	4	6	0.68 [0.30-1.50]	NS
	≤ 10 and not made	26	18		
Other modes of admission	> 10	25	34	1.25 [0.80-1.96]	NS
	≤ 10 and not made	23	45		

NS: Not significant.

*: Statistically significant.

Table 5: Distribution of patients by mode of admission, paraclinical characteristics, and outcomes.

Mode of admission		***Died (n=78)***	***Other outcomes (n=103)***	***RR with 95% CI***	***p***
	Complication				
Transfer	Yes	14	3	1.90 [1.24-2.93]	0.007*
	No	16	21		
Other modes of admission	Yes	21	11	2.31 [1.54-3.47]	<0.001*
	No	27	68		
	Myocardial infarcts				
Transfer	Yes	6	0	2.00 [1.50-2.65]	0.023*
	No	24	24		
Other modes of admission	Yes	6	5	1.50 [0.83-2.72]	NS
	No	42	74		
	Septic shock				
Transfer	Yes	4	0	1.92 [1.47-2.51]	0.087
	No	26	24		
Other modes of admission	Yes	8	2	2.34 [1.57-3.49]	0.006*
	No	40	77		

NS: Not significant.

*: Statistically significant.

Table 6: Distribution of patients by mode of admission, complications during hospitalization, and outcomes.

The use of noninvasive ventilation in patients was a risk factor for the occurrence of mortality regardless of the mode of admission.

Among patients admitted by other modes, a length of hospital stay of 10-19 days was significantly associated with the occurrence of death.

The factors significantly influencing mortality related to the mode of admission by transfer in our study were the presence of a history of diabetes, a respiratory rate greater than 30 breaths per minute at admission, SpO_2 less than or equal to 88% at admission, Glasgow score between 9 and 12, clinical form in critical condition, pulmonary damage greater than 50%, presence of complications, a complication such as myocardial infarction and use of noninvasive ventilation.

Discussion

The present study was carried out at the polyvalent resuscitation and medical polyclinic departments of the Andohatapenaka University Hospital. A total of 181 hospitalized patients with COVID-19 were selected. According to our results, the mortality rate during hospitalization was 43.09% for all modes of admission combined. For transfer patients, mortality was 55.56% compared to 37.80% for

patients admitted by other modes. The association between the mode of admission by interhospital transfer and mortality was significant, with RR = 1.47 [1.06-2.04] and p = 0.021. A study by Wortel et al in New Zealand showed that the 180-day mortality rate did not differ significantly between transferred and nontransferred patients from an intensive care unit [3]. Parenmark et al, in Sweden, found that the mortality rate of patients from inter-ICU transfers was high except for those from repatriations [4]. The latter article has been criticized for being too hasty in its conclusions [5]. According to some studies, even though the transfer is a risk, patients from transfer would have a similar mortality to other types of admission if the rules of transfer were respected [6]. According to a study by Sanchez et al., based on a large French database, transferring selected patients with severe COVID-19 from overcrowded areas to areas with higher capacity would decrease the mortality rate of these patients [7]. According to Hug et al in a United Kingdom's study, COVID-19 patients undergoing mechanical lung ventilation may show short-term physiological deterioration when transferred between neighboring hospitals, but this resolves within 24 hours [8]. Explanations for this mortality of interhospital transfers in our study could be related to the status of University Hospital Andohatapenaka during COVID waves in the national policy for the management of COVID-19 infection waves in Madagascar. In Antananarivo, the capital of Madagascar, our hospital in Andohatapenaka was among the hospitals that were dedicated only to the management of severe forms of COVID-19. The most severe patients from COVID-19 treatment centers, private clinics with no resuscitation service, and some public hospitals were then transferred to hospitals such as ours for better care. In our context, the transfers were motivated mainly by the absence of suitable infrastructure in the hospital of departure (clinical transfer). Therefore, the transfers were performed urgently so that the patient could receive appropriate care as quickly as possible, even though some of them were very serious. It should also be noted that as our country is a developing country, the equipment necessary for an adapted transfer of a critical patient was not available, taking, for example, transport ventilators and outflows. In Parenmark's studies, the transfers studied were capacity transfers, so serious patients, not the most serious ones, were transferred to relieve the sending hospital to a less overburdened hospital.

In the present study, a history of diabetes, a GCS of 9-12, a respiratory rate of more than 30 breaths per minute, a critical condition on admission, a chest CT (Computed Tomography) score of more than 50%, the presence of complications at the time of hospitalization, the occurrence of MI during hospitalization and treatment with NIV (Non-Invasive Ventilation) were the factors associated with mortality in patients transferred. The mortality factors for the other types of admission were age over 64 years, oxygen saturation less than 88%, dyspnea and critical illness on admission, presence of complications on admission, occurrence of septic shock on admission, NIV treatment and CRP greater than 60 mg/ml, and length of stay between 12 and 19 days.

Factors specifically associated with mortality in patients admitted by interhospital transfer were the presence of diabetes in the past, Glasgow score of 9 and 12, a respiratory rate greater than 30, CT scan damage greater than 50%, and the presence of MI complications. In a Dutch study, we compared the patient characteristics and long-term mortality of transferred and nontransferred COVID-19 patients in intensive care units. Transferred patients were more often mechanically ventilated but less severely ill than nontransferred patients [3]. The difference between this study and ours may be related to the type of transfer (clinical, capacity, repatriation) and the national crisis management policy of the 2 countries during COVID. In the studies performed in developed countries, the transfers were mainly capacity transfers to avoid overloading the sending hospital.

We will discuss one by one the mortality factors specific to interhospital transfer according to our study.

The present study shows that patients with diabetes admitted by transfer have a risk of death with RR [95% CI] = 1.58 [1.02-2.43] and p=0.043. According to a study by Yu C et al, in China in 2020, the presence of diabetes increased morbidity and mortality in COVID-19 patients with OR= 2.34 (95% CI: 1.45-3.76) across all admission modes [9]. Diabetes and hyperglycemia can impair innate and adaptive immunity [10]. Diabetic patients are at high risk of severe pneumonia and have a marked proinflammatory and prothrombotic state compared to nondiabetic infected patients.

According to the results, for transfer patients, there was a significant association between a Glasgow score of 9-12 at entry and the occurrence of mortality, with RR [95% CI] = 2.09 [1.55-2.83] and p=0.009. In a study by Vikas Verma and colleagues in India, a GCS

score of < 9 was significantly associated with patient transfers from peripheral hospitals (p=0.000). 3 [11]. A low GCS score indicates a major impairment of consciousness, reversible or not, requiring immediate management to minimize the risk of mortality.

According to our study, the presence of a frequency greater than 30 per minute at entry among those admitted by interhospital transfer was significantly associated with the occurrence of mortality with an RR of 1.58 [1.02-2.45]. According to a study in Algiers, dyspnea and respiratory distress are significantly greater in deceased patients compared to living patients regardless of their mode of admission [12]. A frequency greater than 30 per minute in patients from an interhospital transfer reflects hypoxemia that is not compensated by the available means of oxygenation. This indicates that these patients were very serious.

In the present study, for patients admitted by interhospital transfer, there was a significant association between the degree of lung involvement greater than 50% and the occurrence of mortality, with RR [95% CI] = 1.99 [1.05-3.74] and p=0.022. According to a study by Malécot et al., the extent of lesions greater than 50% on CT was correlated with the risk of mortality, and this risk was greater if the patient was over 75 years of age [13]. This relationship between lung involvement and mortality underlines the importance of chest CT in the management of COVID-19 infection.

In the present study, for patients from the interhospital transfer, the development of MI during hospitalization was significantly associated with mortality. A study of a very large number of patients strongly suggests that COVID-19 is a risk factor for MI and stroke and that these cardiovascular events are part of the clinical picture of COVID-19 [14]. According to Toscano et al., MI increases the risk of mortality in patients with COVID-19 [15].

Study limitations: The retrospective nature of the study does not allow for all the necessary data to be obtained for the present study. This exposes the risk of information bias that is difficult to recover and that can make it difficult to interpret the results. The results obtained in this research were specific and do not reflect the situation on the main island. This is the first comparison to look at the mode of admission of patients hospitalized for COVID-19 in Madagascar, hence the difficulty in discussing the results.

Conclusion

Madagascar has not been spared the waves of COVID-19 in recent years. During these periods, an interhospital transfer is mainly motivated by the referral of a patient to a hospital center adapted to his or her severity or the exceeding of the capacity of the efferent center. In the hospital, we found that many of our transferred patients died. We aim to demonstrate that the mode of admission by transfer influences patient outcomes and to identify factors associated with mortality in patients according to their mode of entry. In this study, poor outcome was shown to be associated with admission by interhospital transfer. We were also able to highlight the role of certain factors on the outcome of patients from a transfer, such as a history of diabetes, a respiratory rate greater than 30 breaths per minute at admission, SpO_2 less than or equal to 88% at admission, Glasgow score between 9 and 12, patients in critical condition, pulmonary damage greater than 50%, presence of complications, complications such as myocardial infarction, and use of noninvasive ventilation. Knowledge of these factors will allow adequate management of our patients. This study was limited by its retrospective and mono-centric nature, and the results obtained are dependent on the crisis context. Our data need to be compared with other prospective and multicentric studies to obtain national data and open the way for future research opportunities.

Supplementary information

- ***Ethical approval and consent to participate***: We declare that this study did not experiment on patients. It is a retrospective observational study in which data collection resulted from routine clinical practice at the hospital. The ethics committee of the Andohatapenaka University Hospital approved the study design. All methods were carried out by relevant guidelines and regulations. Confidentiality and professional secrecy were respected by applying anonymity to the files. The need for informed consent was waived by the Ethics committee of the Andohatapenaka University Hospital. The authors had all the necessary administrative authorizations to access the data.

- ***Consent to publication***: not applicable.
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