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Pneumonia-Associated Emergency Transfers, Functional Decline, and Mortality in Nursing Home Residents

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A B S T R A C T

Objective: To describe nursing home residents (NHRs) transferred to the emergency department (ED) with pneumonia, and investigate the association of pneumonia with functional ability and mortality.
Design: Case-control observational multicenter study.
Setting and participants: Participants of the FINE study, including 1037 NHRs presenting to 17 EDs in France over 4 nonconsecutive weeks (1 per season) in 2016, mean age 87.2 years ± 7.1, 68.4% women.
Methods: Activities of daily living (ADL) performance evolution between (1) 15 days before transfer and (2) within 7 days after discharge back to the nursing home was compared in NHRs with or without pneumonia. The association of pneumonia with functional evolution was investigated by a mixed-effect linear regression of ADL and mortality was compared by a χ^2 test.
Results: NHRs with pneumonia (n = 232; 22.4%) were more likely to have a lower ADL performance than NHRs without pneumonia (n = 805, 77.6%). They presented with a more severe clinical condition, were more likely to be hospitalized after ED and to stay longer in ED and in hospital. They showed a 0.5 decline in median ADL performance after transfer and a significantly higher mortality than NHRs without pneumonia (24.1% and 8.7%, respectively). Post-ED functional evolution did not differ significantly between NHRs with or without pneumonia.
Conclusions and implications: Pneumonia-associated ED transfers resulted in longer care pathways and higher mortality, but no significant difference in functional decline. This study identified a suggestive course of symptoms that could facilitate early identification of NHRs developing pneumonia and early management to prevent ED transfer.

Respiratory conditions in nursing home residents (NHRs) are among the leading causes of transfers to emergency departments (EDs), ranging from 12% to 37% of all transfers[1] and hospitalizations, often resulting in functional decline,[2,3] death,[4,5] or poor symptom control.[6,7] Pneumonia is considered an ambulatory care sensitive condition,[8] meaning an NHR's hospitalization for pneumonia could be prevented by primary care interventions, for which several risk factors in NHRs have been identified.[9-12]

Understanding health outcomes after pneumonia-associated ED transfers is essential to estimate the complete burden of this condition.[13] NHRs may not only encounter pneumonia as a life-threatening acute condition, but also as a trigger to functional decline as suggested by previous works on the FINE study participants.[4] Care pathway after ED transfers may also influence health outcomes, as hospital length of

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stay was found to be associated with NHRs' activities of daily living (ADL) performance and their evolution.[14]

This study aimed to determine the prevalence of pneumonia-associated ED transfers among NHRs, describe NHRs' care pathway, and investigate functional outcomes and mortality after a pneumonia-associated ED transfer.

Methods

Design and Study Population

This work is a secondary analysis of the FINE study, an observational multicenter study in 17 EDs (clinicaltrials.gov, NCT02677272). Methods and procedures were fully described in a previous publication.[15] FINE included 1037 NHRs presenting to the ED over 4 nonconsecutive weeks in 2016 (1 week per season) in the Midi-Pyrénées region, Southwestern France. Participating EDs represented 65.0% of all ED activity in the region in 2016 (531,326 patients over 818,020), and 64.3% of geriatric emergency activity (patients aged 75 or older) in the region in 2016.[16] All NHRs presenting to participating EDs during the inclusion periods were included in the study if they did not oppose inclusion after being informed by the emergency physician. All participants were NHRs who were transferred to the ED.

The FINE study was granted ethics committee approval by the Committee for the Protection of Persons Sud Ouest and Outre-Mer III (CPP SOOM III). Written informed consent was not required as FINE was an observational study of usual care.

Data Collection

Prospective data on ED stay and NHR condition after discharge back to the NH were collected respectively by ED staff and NH staff. Retrospective data on NHR characteristics before transfer were collected by NH staff. Additional prospective data on hospitalization were collected by hospital staff.

Outcome Measures

Pneumonia was computed as a binary variable whether NHRs were diagnosed with pneumonia or not, either in the ED or during hospitalization. Data on diagnoses were collected as open text and International Classification of Diseases, 10th Revision codes[17(p10)] in the ED and during hospitalization. A physician investigator classified NHRs in the pneumonia variable according to a comprehensive understanding of all clinical data available, including discharge diagnoses at each transition of care, presence of febrile dyspnea at any time during follow-up, and analysis of potential differential diagnoses when fever or dyspnea was present. No biological or radiological data were available.

Prevalence of pneumonia was determined as the number of NHRs with pneumonia over the total number of transferred NHRs during the 4-week inclusion period.

Functional capacity was measured on the Katz ADL scale, ranging from 0 to 6 (higher is better), and measuring the full (1 point), partial (half point), or absent (0 point) ability to bathe, transfer, dress, be continent, go to toilet, and feed.[18] ADLs were evaluated retrospectively 15 days before transfer and prospectively within 7 days after discharge.

Death was assumed when the NHRs died during transfer, in the ED, during their hospitalization, or within 7 days after their return to the NH.

Statistical Analyses

Dichotomous and categorical variables were described by proportion and compared between NHRs with or without pneumonia by χ^2 tests. Continuous variables were described by median, interquartile range, mean and SD, and compared between NHRs with or without pneumonia by Wilcoxon rank tests.

Functional evolution in NHRs transferred to the ED according to pneumonia status was investigated by a univariable mixed-effects linear regression on ADL change, with random effects on NHRs and on NHs, the former being nested in the latter.

Mortality in NHRs with or without pneumonia was compared by a χ^2 test.

Exploratory analyses were performed in the subgroup of NHRs with pneumonia, to compare functional evolution and mortality between NHRs who were hospitalized after the ED and NHRs who were discharged back to NH after the ED. Functional evolution was compared using a univariable mixed-effects linear regression on ADL change and mortality was compared using a χ^2 test.

Analyses were performed by Stata, version 17.0 (StataCorp). Statistical significance was assumed when $P < .05$.

Results

Pneumonia was diagnosed in 232 NHRs (22.4%) who were transferred to EDs over the 28 days of FINE inclusion.

Characteristics of NHRs, NHs, and care pathway in NHRs transferred with or without pneumonia are presented in Table 1. NHRs with pneumonia were more likely to have a lower baseline ADL performance than NHRs without pneumonia, a higher comorbidity and a history of chronic pulmonary conditions, renal failure, and peripheral vascular diseases. In terms of care pathway, NHRs with pneumonia were more likely to show a 1-week history of dyspnea, fever, anorexia, fatigue, or drowsiness before their transfer. These symptoms, except anorexia, remained more prevalent in NHRs with pneumonia during their transfer than in other NHRs. Once in the ED, NHRs with pneumonia presented with a more severe clinical condition, were more likely to stay longer in the ED, to be hospitalized, and to stay longer in the hospital. Among NHRs with pneumonia, 1.8% died in the ED, 81.8% were hospitalized (average length of stay 8.1 days ± 10.6), and 16.4% returned directly to the NH after ED.

Functional Evolution

Median ADLs in NHRs with pneumonia declined from 2.0 (1.0–3.5) to 1.5 (0.5–3.0), whereas median ADLs in NHRs without pneumonia remained stable from 2.0 (1.0–3.5) to 2.0 (1.0–3.0). Yet, no significant difference in functional evolution between both groups was found, as indicated by the pneumonia-by-time interaction (β-coefficient −0.07; 95% CI −0.25 to 0.10; $P = .414$). Mixed-effects regression table is shown in Table 2.

Mortality

Death occurred in 56 NHRs with pneumonia (24.1% of 232 NHRs with pneumonia) and 70 NHRs without pneumonia (8.7% of 805 NHRs without pneumonia), the difference being statistically significant ($P < .001$).

Exploratory Analyses

Median ADL in hospitalized NHRs with pneumonia declined from 2.0 (1.0 − 3.5) to 1.5 (0.5 − 2.5), whereas median ADL in nonhospitalized NHRs with pneumonia declined from 2.0 (1.0 − 3.25) to 1.75 (0.0 − 3.0). Yet, no significant difference in functional evolution

Table 1
Characteristics of NHRs Transferred to the ED

		NHRs Without Pneumonia (%, n = 805)	NHRs With Pneumonia (%, n = 232)	Total (n = 1037)	*P**
NHR Characteristics					
Age					.181
Mean (SD)		87.9 (7.0)	87.0 (7.5)	87.7 (7.1)	
Median (IQR)		89.2 (8.3)	88.3 (8.9)	88.9 (8.3)	
Gender female		70.7	60.3	68.4	.003
Functional capacity at baseline (ADL/6)					.029
Mean (SD)		2.5 (1.7)	2.2 (1.6)	2.4 (1.7)	
Median (IQR)		2.0 (2.5)	2.0 (2.5)	2.0 (2.5)	
Functional capacity after transfer (ADL/6)					.003
Mean (SD)		2.1 (1.6)	1.7 (1.6)	2.0 (1.6)	
Median (IQR)		2.0 (2.0)	1.5 (2.5)	2.0 (2.5)	
Body mass index (kg/m^2)	<18.5	11.6	11.1	11.5	.116
	18.5–24.9	51.3	42.4	49.3	
	25.0–29.9	24.2	30.3	25.6	
	≥ 30	12.9	16.2	13.7	
Main comorbidities	Hypertension	60.4	58.0	59.9	.514
	Dementia, all stages	60.6	51.5	58.5	.014
	Advanced dementia	32.9	28.1	31.8	.168
	Arrythmia	37.1	39.0	37.5	.593
	Depression	30.1	34.9	31.2	.167
	Congestive heart failure	23.1	27.6	24.2	.164
	Moderate or severe liver disease	1.8	0.4	1.5	.140
	Fractures				
	Hip fracture	20.2	24.4	21.1	.177
	Vertebral fracture	4.6	7.5	5.3	.087
	Osteoporotic	11.6	10.6	11.3	.680
	Other location fracture	22.1	21.5	22.0	.842
	Moderate or severe renal disease	15.8	24.6	17.8	.002
	Dialysis	0.6	0.4	0.6	.734
	Diabetes, without end organ damage	18.1	14.7	17.3	.222
	Diabetes, with end organ damage	4.3	6.9	4.9	.099
	Peripheral vascular diseases	15.8	22.3	17.2	.022
	Cerebrovascular disease	16.7	14.7	16.2	.484
	Hemiplegia	7.1	7.8	7.3	.738
	Chronic pulmonary disease	12.0	30.0	16.0	<.001
	Cancer, non-metastatic	14.3	17.2	15.0	.266
	Cancer, metastatic	1.1	0.9	1.1	.737
	Lymphoma or myeloma	1.1	1.7	1.3	.460
	Leukemia	1.1	2.6	1.5	.102
	Acute confusion episode	11.7	12.2	11.8	.817
	Myocardial infarct	9.6	9.2	9.5	.836
	Psychosis	6.6	10.4	7.5	.052
	Bipolar disorder	3.6	5.2	4.0	.273
	Other psychiatric condition	6.7	4.9	6.3	.334
	Parkinson's disease	5.9	8.2	6.4	.194
	Epilepsy	6.1	6.5	6.2	.831
	Other neurologic condition	10.0	4.9	8.9	.018
Charlson comorbidity index					.036
Mean (SD)		2.6 (2.0)	2.8 (1.9)	2.7 (2.0)	
Median (IQR)		2.0 (3.0)	2.0 (2.0)	2.0 (3.0)	
Length of stay in NH before transfer (mo)					.595
Mean (SD)		42.0 (53.7)	40.2 (49.2)	41.6 (52.7)	
Median (IQR)		23.9 (48.2)	26.1 (41.7)	24.6 (47.3)	
No. of hospitalizations in the past month					.779
0		86.3	87.4	86.5	
1		11.7	11.2	11.6	
≥2		2.0	1.4	1.9	
No. of ED transfers in the past month					.754
0		89.8	91.4	90.2	
1		8.9	7.8	8.7	
≥2		1.2	0.9	1.2	
NH Characteristics					
No. of beds in NH					.966
Mean (SD)		88.8 (36.0)	87.8 (32.0)	88.6 (35.1)	
Median (IQR)		81.0 (31.0)	81.0 (22.0)	81.0 (26.0)	
Ownership†	Private for-profit	22.1	20.7	21.8	.287
	Private non-for-profit	28.7	34.5	30.0	
	Public (hospital)	24.8	20.3	23.8	
	Public (other)	24.4	24.6	24.4	
Night shift nurses†		12.6	14.7	13.0	.404

(*continued on next page*)

Table 1 (*continued*)

		NHRs Without Pneumonia (%, n = 805)	NHRs With Pneumonia (%, n = 232)	Total (n = 1037)	*P*
Staff ratios (full-time equivalent per 100 beds)	Medical director				.718
	Mean (SD)	0.4 (0.2)	0.4 (0.2)	0.4 (0.2)	
	Median (IQR)	0.5 (0.3)	0.5 (0.3)	0.5 (0.3)	
	Nurse				.466
	Mean (SD)	6.8 (1.8)	6.6 (1.6)	6.7 (1.7)	
	Median (IQR)	6.5 (1.7)	6.5 (1.6)	6.5 (1.6)	
	Licensed nursing assistant				.402
	Mean (SD)	22.3 (5.8)	21.9 (5.2)	22.2 (5.6)	
	Median (IQR)	22.4 (6.1)	22.1 (4.5)	22.3 (6.1)	
	Unlicensed nursing assistant				.601
	Mean (SD)	5.1 (5.6)	5.2 (5.5)	5.1 (5.6)	
	Median (IQR)	3.5 (8.9)	3.5 (9.1)	3.5 (8.9)	
Transfer Characteristics					
Season	January to March	26.7	30.2	27.5	.158
	April to June	23.4	28.0	24.4	
	July to September	24.4	19.0	23.1	
	October to December	25.6	22.8	25.0	
Out-of-hours transfer		44.6	49.1	45.6	.221
Symptoms 1 wk before transfer	Confusion	12.9	13.1	12.9	.927
	Agitation	12.4	9.9	11.8	.319
	Pain	21.6	18.1	20.8	.259
	Dyspnea	5.9	30.5	11.4	<.001
	Fever	8.6	17.1	10.5	<.001
	Anorexia	10.7	17.6	12.2	.006
	Fatigue	23.7	37.4	26.7	<.001
	Drowsiness	12.6	19.4	14.1	.011
Symptoms during transfer	Confusion	25.6	21.9	24.8	.262
	Agitation	18.6	7.9	16.2	<.001
	Pain	56.2	27.1	49.7	<.001
	Dyspnea	13.4	66.8	25.4	<.001
	Fever	8.5	30.3	13.4	<.001
	Anorexia	9.0	12.6	9.8	.109
	Fatigue	24.9	51.1	30.8	<.001
	Drowsiness	18.4	37.4	22.7	<.001
No. of severity criteria					<.001
Mean (SD)		1.1 (0.7)	1.4 (0.8)	1.1 (0.7)	
Median (IQR)		1.0 (0.0)	1.0 (1.0)	1.0 (1.0)	
Length of ED stay (h)					.018
Mean (SD)		5.3 (3.9)	6.1 (4.7)	5.5 (4.1)	
Median (IQR)		4.6 (3.6)	5.0 (3.7)	4.7 (3.7)	
Disposition from ED (n = 226)	Direct return to nursing home	53.9	16.4	45.5	<.001
	Death	0.5	1.8	0.8	
	Admission to surgical service	10.6	2.2	8.7	
	Transfer to short-stay hospital unit	14.0	26.6	16.8	
	Admission to internal medicine service	12.2	28.8	15.9	
	Admission to geriatric medicine service	3.9	11.5	5.6	
	Admission to intensive care	2.3	4.4	2.8	
	Admission to psychiatry	1.1	3.5	1.7	
	Other	1.5	4.9	2.3	
Length of hospital stay (d)		n = 374	n = 191	n = 565	.017
Mean (SD)		8.6 (11.2)	9.7 (10.9)	9.0 (11.1)	
Median (IQR)		5.3 (8.3)	6.8 (10.0)	6.0 (8.8)	

*χ^2 tests for dichotomous and categorical variables, Wilcoxon rank tests for continuous variables.
†Number of NHRs in such nursing homes.

between both subgroups of NHRs with pneumonia was found, as indicated by the hospitalization-by-time interaction (β-coefficient −0.17; 95% CI −0.57 to 0.22; $P = .391$). Death occurred in 51 hospitalized NHRs with pneumonia (26.7% of 191 hospitalized NHRs with pneumonia) and 1 nonhospitalized NHR with pneumonia (2.7% of nonhospitalized NHRs with pneumonia), the difference being statistically significant ($P = .005$).

Table 2
Results of the Mixed-effects Regression of ADL

	Coefficient	95% CI		*P* Value
Pneumonia	−0.28	−0.52	−0.04	.021
Time	−0.45	−0.52	−0.37	<.001
Pneumonia-by-time interaction	−0.07	−0.25	0.10	.414

Note: 1908 ADL observations of 1020 NHRs in 306 NHs.

Discussion

Almost one-fourth of NHRs transferred to the ED developed pneumonia in this study, representing a large proportion of all ED transfers from NHs.

NHRs in the pneumonia group tended to have a lower premorbid functional capacity, which could relate to a higher risk of aspiration pneumonia. Assessing the risk of aspiration in NHRs with a more

severe functional impairment could inform on their risk to develop pneumonia during a future acute episode, and therefore help clinicians and NHRs in advance care planning.

Pneumonia-associated ED transfers resulted in longer durations of stay at every step of their care pathway. Such a longer care pathway may be related to a more severe clinical condition on ED admission and to comorbidities that may have increased the risk for in-hospital complications, like chronic pulmonary conditions, renal failure, vascular diseases, and overweight. A higher severity and some of these conditions were also associated with a higher risk of mortality[19-22] and functional decline[2,3] in previous studies on pneumonia or pneumonia-related hospitalization in NHRs. Other risk factors for pneumonia in NHRs or NHRs' hospitalization for pneumonia were previously identified, like male gender,[10,12] chronic pulmonary conditions,[9,12] chronic renal disease,[12] and lower functional ability.[9,10,12] In previous studies, clinical worsening, as indicated by higher respiratory rate, shortness of breath, and septic shock, was associated with a higher risk of hospitalization in NHRs with pneumonia.[9,23] This study identified a suggestive weeklong history of unusual symptoms that could facilitate the early identification of NHRs developing pneumonia. This early identification, based on both the recent course of suggestive symptoms (dyspnea, fever, anorexia, fatigue, and drowsiness) and risk factors analysis (comorbidities, swallowing disorders, pneumococcal and influenza vaccination[24,25]), would allow their early on-site management, potentially preventing further clinical worsening and the need for a transfer to the ED.

Our results suggest pneumonia may not be a significant driver of functional evolution after a transfer to the ED, especially when compared with stronger drivers. The heterogeneity in the onset of pneumonia in our study leads to interpreting functional decline not only in NHRs who were transferred because of pneumonia, but also in NHRs who were transferred because of potential stronger drivers of functional decline, like strokes or fractures,[4] and developed pneumonia as a subsequent complication during hospitalization. This might explain why pneumonia was not associated with a significantly different functional evolution.

On the other hand, considering all cases of pneumonia together allows estimating its total burden. Pneumonia can be a complication of many severe acute conditions that lead to immobility or swallowing disorders.[26] NHRs with pneumonia showed a higher mortality, either as a high case fatality condition itself or by severely complicating other conditions, particularly in hospitalized NHRs. Treatment withholding, including do-not-hospitalize orders, should be considered in these NHRs who may be eligible for on-site palliative care.

Restricting the scope of analysis to a dichotomous outcome (pneumonia: yes or no), instead of comparing pneumonia with other specific conditions individually, was the main limitation of this study. However, NHRs could have been diagnosed with several conditions after their transfer, especially NHRs with complex comorbidities,[4] and summarizing these complex situations as one specific condition would only be a virtual categorization. In addition, pneumonia may sometimes be only 1 of the potential diagnoses[27] when the clinical presentation is mild, and when acute heart failure is also likely. The use of broader clusters of conditions, like symptom-defined clusters, rather than conditions individually could be more appropriate for research purposes in these complex situations.

Prospective studies comparing on-site management of pneumonia and ED transfer, like the OPTIMISTIC study,[27-29] help to estimate benefits and risks of each option, on which clinicians could base their decisions.

Conclusions and Implications

Pneumonia-associated ED transfers resulted in longer care pathways and higher mortality, but no significant difference in functional decline. This study identified a suggestive course of symptoms that could facilitate early identification of NHRs developing pneumonia and early management to prevent ED transfer.

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