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RESEARCH PAPER

Mobile emergency department care to nursing home residents: a novel outreach service

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Abstract

Background: Every month, 6% of Danish nursing home residents are admitted to hospital. However, these admissions might have limited benefits and are associated with an increased risk of complications. We initiated a new mobile service comprising consultants performing emergency care in nursing homes.
Objective: Describe the new service, the recipients of this service, hospital admission patterns and 90-day mortality.
Design: A descriptive observational study.
Model: When an ambulance is requested to a nursing home, the emergency medical dispatch centre simultaneously dispatches a consultant from the emergency department who will provide an emergency evaluation and decisions regarding treatment at the scene in collaboration with municipal acute care nurses.
Method: We describe the characteristics of all nursing home contacts from 1st November 2020 to 31st December 2021. The outcome measures were hospital admissions and 90-day mortality. Data were extracted from the patients' electronic hospital records and prospectively registered data.
Results: We identified 638 contacts (495 individuals). The new service had a median of two (interquartile range: 2–3) new contacts per day. The most frequent diagnoses were related to infections, unspecific symptoms, falls, trauma and neurologic disease. Seven out of eight residents remained at home following treatment, 20% had an unplanned hospital admission within 30 days and 90-day mortality was 36.4%.
Conclusion: Transitioning emergency care from hospitals to nursing homes could present an opportunity for providing optimised care to a vulnerable population and limiting unnecessary transfers and admissions to hospitals.

Keywords: acute care, emergency medicine, emergency care, nursing home residents, nursing homes, aged care facilities, outreach service, older people

Key Points

- Advancing emergency care from the hospital to the nursing homes makes it possible for the residents to receive specialised care and stay at home instead of being transported to hospital.
- Seven out of eight residents could remain in nursing homes after being assessed and treated by emergency department (ED) consultants.

- Many residents required end-of-life care, which was possible for emergency department (ED) consultants, municipal acute care nurses and nursing home staff to manage in nursing homes.

Introduction

The prevention of unnecessary acute hospital admissions and hospital contacts among older people is a major focus in healthcare planning [1–4]. However, nursing home residents are often admitted to hospitals [5–7], with 6% of Danish nursing home residents admitted every month [6]. These admissions from nursing homes are primarily caused by infections, falls, dehydration, respiratory diseases and circulatory diseases [5, 6, 8]. Unfortunately, hospital admissions within this vulnerable population are associated with an increased risk of delirium, hospital-acquired infections, functional disability and mortality [7, 9–11]. Given these potential complications, hospital admissions might not represent the optimum solution when this population needs emergency care. One study revealed that ambulance transfers from nursing homes are up to four times more common compared with an age- and gender-matched cohort living elsewhere in the community [12]. Accordingly, it is possible that nursing home residents could benefit from alternative solutions to hospital admissions, which would reduce unnecessary admissions to hospitals [11, 13]. Moreover, the advancement of emergency care in nursing homes with the aim of delivering on-site evaluations and treatment would provide residents with the possibility of staying at home.

In this paper, we present a new service model for providing mobile emergency department (ED) care to nursing home residents as an alternative to transferring them to an ED. This mobile ED-based service is manned by consultants from an ED, and the service provides on-site emergency care in nursing homes in collaboration with acute care nurses from the local municipality, the emergency medical dispatch centre (EMDS) and the nursing home staff. We also describe the treated nursing home residents and information registered on-site in the nursing homes, in addition to reporting unplanned hospital admissions and 90-day mortality.

Method

System setting

The Danish healthcare system is tax-based and consists of both primary and secondary/tertiary healthcare sectors [14]. The primary healthcare service is provided by the municipalities (which are responsible for home care and nursing homes) and general practitioners (GPs), who are the patients' primary contact points with the healthcare services [14]. In cases of lesser urgency occurring outside the usual service hours, an out-of-hours system based on GPs is provided [15]. The secondary/tertiary healthcare services are provided by hospitals, which are responsible for specialised healthcare services [14]. A three-tiered prehospital system provides immediate prehospital emergency care, which comprises emergency medical technicians, paramedics and prehospital anaesthesiologists [16].

Model

The new service model was established on 1st November 2020 at the ED of the Odense University Hospital (OUH), Denmark, in collaboration with Odense Municipality and the EMDC. This new service is activated if a nursing home calls the EMDC for emergency assistance. Based on the perceived urgency of the task, the EMDC dispatches either the ED consultant alone or in conjunction with an ambulance or anaesthesiologist-manned mobile emergency care unit that is already operating in the area [17, 18]. At the nursing home, the ED consultant provides on-site emergency evaluation and treatment using point-of-care blood testing and ultrasonographic examinations. This treatment includes intravenous fluids, antibiotics and relevant medications. Furthermore, the ED consultant assists in drawing up future treatment plans, including the issue of do-not-resuscitate orders. Following the initial treatment offered by the ED-based service, the residents can either remain in the nursing home or be transported to a hospital depending on what is most applicable to the residents' goals of care. At the nursing homes, the ED consultants collaborate with municipal acute care nurses (who are specialised in delivering acute nursing services at home) [17–19], the nursing home staff, the residents and their relatives.

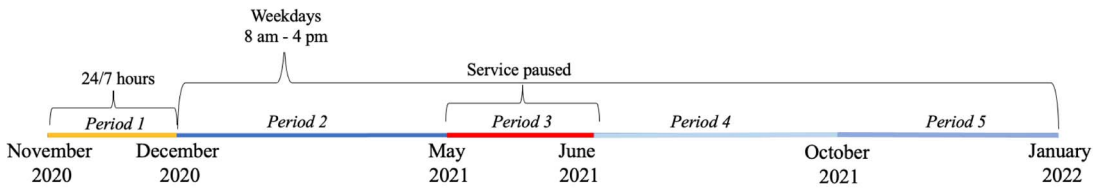
In the first month, the service operated 24/7 as an initial test run. Since then, the service was restricted to weekdays between 8 am and 4 pm (Figure 1). The municipal acute care nurses were referred to all tasks in the first month of implementation. However, after 6 months, they were only requested if specifically required, such as if the resident required intravenous (IV) treatment. The changes in the complex trans-sectorial model were based on organisational possibilities, including the access to resources and they were influenced by changes in regional guidelines. In the two last time periods, the care had to be initiated and finished during one visit by the ED consultants unless otherwise agreed with the municipal acute care nurses.

Study design

The study is a descriptive observational study.

Study population

The population comprised all nursing home residents in Odense Municipality who received nursing home care by the mobile ED-based service between 1st November 2020 and 31st December 2021. Based on information from the Odense Municipality on 1st November 2020, there were 30 nursing homes with a total of 1,176 residents, 59.8% of



Period	*Date*	*Hours*	*ED consultant and vehicle with equipment*	*Municipal acute care nurses*	*Intravenous treatment*
1	11/01/20-11/30/20	24/7 hours	Full access	Full access	Local agreement about IV treatment between OUH and Odense Municipality[1]
2	12/01/20-04/30/21	Weekdays 8 am to 4 pm	Full access	Full access	Local agreement about IV treatment between OUH and Odense Municipality[1]
3	05/01/21-06/07/21	The service was paused			
4	06/07/21-09/30/21	Weekdays 8 am to 4 pm	Full access	Requested if necessary and available	Local agreement about IV treatment between OUH and Odense Municipality[1]
5	10/01/21-12/31/21	Weekdays 8 am to 4 pm	Full access	Requested if necessary and available	Implementation of a new regional regulation concerning IV treatment between all hospitals and municipalities in the Region of Southern Denmark[2]

1: Intravenous treatment (fluid and antibiotic) can be given at the nursing homes without admission to hospital
2: The first two doses of intravenous antibiotics must be given at the hospital, which means that the residents must be admitted to the hospital before they can receive intravenous antibiotics at the nursing homes

Figure 1. Timeline of the new service model.

whom were female. The median age was 83 years (interquartile range (IQR): 74–90).

Data sources

The population comprised all activations between 1st November 2020 and 31st December 2021. All contacts were prospectively registered in the patient administrative system at OUH with a procedure code and a conclusive International classification of Diseases (ICD-10) diagnosis. Information regarding person identifiers, age, sex, dates and times of visits, final diagnoses and hospital admissions were extracted based on specific procedure codes. For the OUH registered data, we recorded the dates and times (index), hospital admissions, all acute hospital contacts within the past 2 years before the index visits and related discharge diagnoses until 30 days following the visits. The data were merged on an individual level and stored, prepared and assigned on a secure encrypted and logged server via OPEN Analyse, which is a secure analysis environment in the Region of Southern Denmark [20].

The following detailed information was registered on-site in the nursing homes for two time periods by the ED consultant: level of acuity of the dispatched ambulance and the ED-based acute care service (response levels: high acuity, moderate acuity, low acuity and very low acuity); information regarding the dispatch of ambulances; IV fluid therapy; procedures performed (point-of-care analyses and ultrasonography); medical treatment initiated; and any ensuing treatment at the nursing home prescribed by the ED consultant. The medical treatments initiated included intravenous antibiotics, analgesics, sedatives, diuretics and other medical treatments.

Analysis

The descriptive characteristics of the population are presented as numbers and percentages, whereas data stratified into the different periods shown in Figure 1 can be found in Appendix 1. Stratification was further performed with regards to the Charlson comorbidity index score (0, 1, 2 and 3+), patient age (≤65, 66–75, 76–89 and ≥ 90 years of age) and the number of hospital admissions in the past 180 days (0, 1, 2, 3 and 4+), respectively. All data are presented as medians and IQRs. The Charlson comorbidity index score [21] was calculated using hospital discharge diagnoses from

the OUH within the past 2 years before the index visits. The final diagnoses assigned to the patients at the nursing homes were categorised using aetiological diagnosis groups (see Appendices) [22]. Hospital admissions within 4 h of the visit by the ED consultant were categorised as immediate hospital admissions.

The nursing home residents were followed for 90 days after their first contact with the service. Ninety-day mortality and admission to hospital within 30 days (including immediately admitted residents) were described using the person's first contact with the ED-based service as the index date. We described the 90-day mortality and hospital admissions within 30 days after the index date using Kaplan–Meier survival curves. Finally, all calculations were performed using Stata 17.0 (StataCorp, College Station, TX, USA), and the results are presented according to the STROBE checklist [9].

Ethics

Access to patient files and data storage was approved by the Region of Southern Denmark's record of data-processing activities (no. 21/69601). According to Danish law, studies based on registry data do not require approval from an ethical review board [23].

Results

We included 638 contacts with the mobile ED-based acute care service, consisting of 495 individuals. The median number of new contacts was 2 (IQR: 2–3) per day (excluding days when the service was not in operation). In the initial test period with 24/7 covering, 50 of the 84 contacts (59.5%) occurred between 8 am and 4 pm, with 63 (75.0%) occurring on weekdays. Characteristics of the two patient groups did not differ (Supplementary Table S1).

Almost 60% of the contacts were female, and the median age was 82 years (Table 1 and Appendix 1). In total, 80% of the contacts had at least one hospital admission during the past 180 days before they received treatment by mobile ED consultants. The most frequent diagnoses were related to infections (23.2%), unspecific symptoms (18.3%), trauma (13.3%) and neurologic diseases (10.7%) (Appendix 2).

The detailed information registered on-site in the nursing homes is described in Table 2 (N = 450 registrations). In 47.7% of the contacts, an ambulance was dispatched in conjunction with the ED consultants. The ED consultants performed point-of-care blood analyses and ultrasonographic examinations in 47.8 and 63.2% of the contacts, respectively, whereas intravenous fluid therapy was initiated in 22.0% of the contacts. Other medical treatments were initiated in 48.3% of the contacts, and 33.3% of the contacts received subsequent treatment by municipal acute care nurses.

In total, 180 (36.4%) of the 495 residents died within 90 days of initial contact with the ED consultants (Figure 2). Among these 495 residents, 62 (12.5%) were admitted to hospital by the ED consultants on the first visit. The ED consultants admitted 77 (12.1%) of the residents directly to the hospital, whereas 96 (19.4%) had unplanned admission to hospital within 30 days (Figure 3).

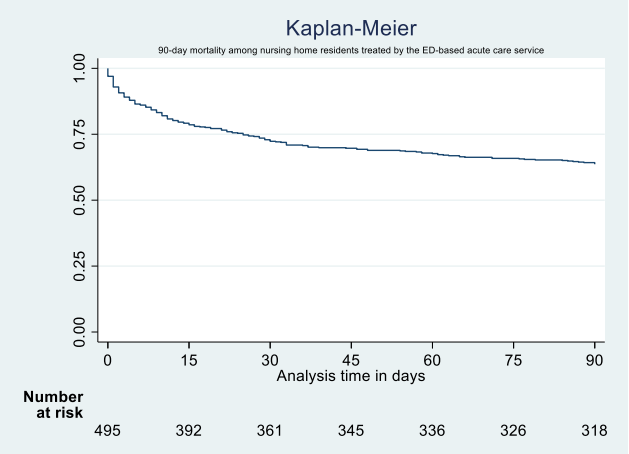


Figure 2. Kaplan–Meier: 90-day mortality among nursing home residents treated by the ED-based acute care service.

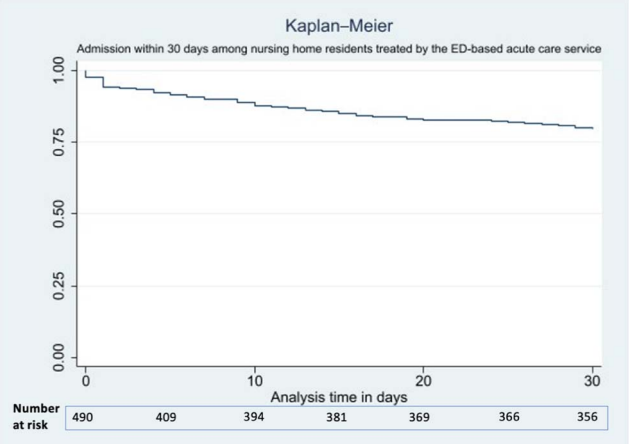


Figure 3. Kaplan–Meier: unplanned hospital admissions within 30 days among nursing home residents treated by the ED-based acute care service.

Discussion

In this study, we describe a new model for the management of emergency care at nursing homes, whereby mobile ED consultants are summoned from hospitals and dispatched to nursing homes. The ED consultants collaborate with municipal acute care nurses, the nursing home staff and the EMDC, rendering it possible to provide specialised emergency care in nursing homes as an alternative to hospital admissions. This new service was only activated when unplanned ambulances were requested, not for the management of planned hospital visits and chronic diseases. The service provided emergency care 638 times in 14 months, and the ED consultants admitted 12.1% of the residents directly to hospital. Thus, seven out of eight residents were evaluated

Table 1. Characteristics of the population

	Total (%)
	638 (100)
Sex	
Female	364 (57.1)
Male	274 (42.9)
Age	
Median (IQR)	82 (76–89)
≤ 65 years	56 (8.8)
66–75 years	102 (16.0)
76–89 years	328 (51.4)
≥ 90 years	152 (23.8)
Charlson comorbidity index score	
Median (IQR)	1 (0–2)
0	299 (46.9)
1	58 (9.1)
2	165 (25.9)
3+	116 (18.1)
Number of hospital admissions in the last 180 days before the index visit	
Median (IQR)	2 (1–5)
0	141 (22.1)
1	119 (18.6)
2	81 (12.7)
3	70 (11.0)
4+	227 (35.6)
Diagnosis assigned in the nursing home	
Cardiac diseases	62 (9.4)
Endocrine diseases	17 (2.7)
Hypovolemic diseases	47 (7.4)
Infection diseases	149 (23.2)
Intestinal diseases	25 (3.9)
Neurologic diseases	67 (10.5)
Respiratory diseases	32 (5.0)
Trauma	85 (13.3)
Unspecific symptoms	117 (18.3)
Other	37 (5.8)

and treated in the nursing homes and remained there instead of being transported to hospital. This new service should be perceived as an alternative to hospital admissions, as residents were not excluded from being transferred to hospital if they required (or preferred) hospital care. Furthermore, the level of care was always planned in collaboration with the residents—if possible as involvement of demented residents can be challenging in emergency care—alternatively with their relatives.

The residents had a median age of 82 years, and 80% had at least one hospital admission during the previous 180 days. This underscores that nursing home residents represent a frail and vulnerable population that requires health care targeted to their needs. Nursing home residents across Europe are considered comparable populations [24], and several studies from different countries have questioned whether hospital admissions represent the optimal solution when acute health issues occur in this population [5, 6, 11–13, 25, 26]. A British retrospective study concluded that hospital admissions might be an inappropriate response to frailty, especially when continued care cannot be established due to the nonexistence of post-acute healthcare services [25]. Moreover, a Norwegian study concluded that emergency hospital admissions from nursing homes were frequent and that there should be more focus on supplying emergency and palliative care in nursing homes [5]. In a third study that presented a systematic review of outcomes of nursing home residents following emergency transfers to hospitals, it was concluded that 19–38% of the admitted residents experienced in-hospital complications (such as pressure ulcers and delirium) [11], whereas up to 80% experienced invasive interventions [11]. Some of these complications and unnecessary invasive interventions could probably have been avoided by a service that enabled the resident to remain in the nursing home following acute treatment. Another systematic review concluded that 4–55% of hospital admissions among nursing home residents were classified as inappropriate and could have been avoided [13]. Several studies have also concluded that many hospital admissions are related to pneumonia, diagnoses related to injury, respiratory diseases and circulatory diseases [5, 6, 11, 26]. These diagnoses are consistent with our findings. In our study, some of the residents were diagnosed with neurologic diseases, such as delirium. This is a frequent

Table 2. Detailed information registered on-site in the nursing homes by the ED consultants in two time periods

	Time period: 01 December 2020–30 April 2021 *n* = 273 (60.7%)	Time period: 01 June 2021–18 December 2021 *n* = 177 (39.3%)	*n* = 450 (100%)
Urgency of the requested ambulance and the ED-based acute care service			
High-acuity responses (Immediate response with lights and sirens)	85 (31.5)	53 (29.9)	139 (30.9)
Medium-acuity responses (Immediate response without lights and sirens)	50 (18.5)	39 (22.0)	89 (19.8)
Low-acuity responses (Response within 30 min, no lights or sirens)	124 (45.9)	72 (40.7)	196 (43.6)
Very low-acuity responses (Planned transport without need for treatment)	11 (4.1)	13 (7.4)	26 (5.7)
Total	270[a] (100)	177 (100)	450 (100)
Concomitantly dispatched ambulances			
Yes	132 (50.4)	79 (45.1)	211 (47.7)
No	135 (50.6)	96 (54.9)	231 (52.3)
Total	267[a] (100)	175[a] (100)	442 (100)
Point-of-care analyses			
Yes	181 (67.0)	32 (18.2)	213 (47.8)
No	89 (33.0)	144 (81.8)	233 (52.2)
Total	272[a] (100)	176[a] (100)	446 (100)
Intravenous fluid therapy			
Yes	61 (22.4)	37 (21.4)	98 (22.0)
No	211 (77.6)	136 (78.6)	347 (78.0)
Total	272[a] (100)	173[a] (100)	445 (100)
Ultrasonographic examinations			
Yes	185 (68.3)	102 (57.9)	287 (64.2)
No	86 (31.7)	74 (42.1)	160 (35.8)
Total	271[a] (100)	176[a] (100)	447 (100)
Medical treatment initiated			
Yes	155 (57.0)	62 (35.0)	217 (48.3)
No	117 (43.0)	115 (65.0)	232 (51.7)
Total	272[a] (100)	177 (100)	449 (100)
Prescribed treatment in the nursing home the following days after initial contact conducted by the municipal acute care nurses			
Yes	112 (41.0)	37 (21.1)	149 (33.3)
No	161 (59.0)	138 (78.9)	299 (66.7)
Total	273 (100)	175[a] (100)	448 (100)

[a]Contains missing data.

complication of dementia, cognitive impairment, infection and hospital admission and is associated with an increased mortality rate [11, 27]. Given that many nursing home residents have dementia or cognitive impairment [6, 28], this factor should be considered when targeting emergency care services for this population. A Swedish study found that in-hospital deaths among demented nursing home residents were associated with poorer quality of end-of-life care [28]. Concerning this aspect, we revealed a 90-day mortality rate of 36.4%. One systematic review reported that 30-day in-hospital mortality was up to 34%, whereas another systematic review revealed that the median in-hospital 30-day mortality was 22.6% [11, 29]. This highlights that many residents who otherwise would have been transferred to the ED mostly required end-of-life care. The proportion of nursing home residents being admitted to hospital in the last month of their lives ranged from 25.5 to 69.7% [29], suggesting that hospital admissions are a common response to end-of-life care [29]. These particular tasks could be solved by ED consultants in nursing homes. Knowledge of supporting nursing functions, and particularly the lack of time constraints, provided ED consultants with in-depth possibilities for discussing end-of-life care with nursing home residents and their families.

Several studies have addressed issues or targeted areas that might help avoid inappropriate admissions to hospitals from nursing homes. Some studies have suggested an increase in the role of GPs [13, 26], whereas others have called for

better training of nursing home staff [26] and increased inter-professional collaboration between EDs, nursing home staff and GPs [13]. To the best of our knowledge, evidence about emergency care performed in nursing homes by specially appointed ED consultants is limited. Within some areas, an American study described interventions that were comparable to the interventions that we reported [30]. In this study, the authors implemented a new service consisting of a multidisciplinary team of hospital consultants and specialised nurses who were trained in basic emergency care. The intervention was operational 24/7 and provided access to an ED consultant and a specialised nurse. The specialised nurse was initially contacted if a nursing home resident required emergency care, and care plans were developed in collaboration with the nursing home staff and an ED consultant. Our results indicated a 55% reduction in unplanned hospital admissions and a commensurate reduction in ancillary laboratory costs [30]. The economic benefits of providing emergency care in nursing homes have only been sparsely studied. However, a systematic review study revealed that the current model of in-hospital emergency care is associated with substantially increased healthcare costs compared with care managed in nursing homes [11]. These increased costs can arise from ambulance use and possibly from superfluous medical investigations. In our study, an ambulance was only dispatched initially in 47.7% of the contacts, and many of the ambulances were not used if the residents remained in nursing homes.

We found that 12.5% of nursing home residents were directly admitted to hospital by the ED consultants. Moreover, almost one resident in five experienced unplanned admissions to hospital within 30 days of the first contact with the ED consultants. Assuming that some of these unplanned admissions could have been avoided, our findings suggest that the need for emergency care solutions in nursing homes is not completely solved by implementing this model during the daytime on weekdays. As demonstrated in the first implementation period, emergency care is still required on evenings, nights and weekends, as 40% of the contacts occurred in evenings and nights, whereas 25% happened during the weekend. Moreover, changes in the collaboration model with municipal acute care nurses and the implementation of a new regional regulation concerning intravenous antibiotics could also have affected the possibility of avoiding hospital admissions. According to the regulations, the first two doses of any intravenous antibiotic must be administered at the hospital, which would reduce the number of residents eligible for treatment in nursing homes. We found support for that notion in the decreasing number of medical treatment regimens initiated by the ED consultants during our study period. Accordingly, local agreements and collaboration across sectors could have a crucial impact on the possibility of implementing new healthcare solutions.

Strengths and limitations

This is a prospective observational study of nursing home residents treated by an ED-based service. However, a control group was lacking, meaning we could not compare the results of this new acute care service with a comparable group of nursing home residents that were not offered a similar service. Interpretations of the results shall be performed with attention to the missing comparators. This also addresses the second limitation of the study being based on local data from one hospital between 08.00 and 16.00 in weekdays, which limited the level of information. In future research, it would be relevant to include data from national registries, which would facilitate the inclusion of other characteristics of the residents in addition to their medical history. Finally, other aspects to consider in future research about this new service model include economic costs, ethically aspects regarding treatment and user perspectives. Healthcare professionals' experiences have been investigated [19].

Implications for health policy and future research

This study contributes valuable information about the new service, as the results increase the amount of evidence about an alternative to hospital admissions from nursing homes. The study also underscores that it is possible to establish emergency care based on the special needs that residents in nursing homes might have at the end of their lives. We believe that the concept can be used as an inspiration for other countries that are trying to develop sustainable healthcare solutions. This is because avoiding inappropriate hospital admissions is an international policy issue due to demographic developments, increasing numbers of chronic diseases and the reducing capacity of hospital beds [31–33]. Moreover, evidence about new approaches is important to ensure dignity and improve the quality and effectiveness of care.

Conclusion

Advancing emergency care from the hospital to the nursing homes made it possible for the residents to stay at home instead of being transported to hospital. Our results indicated that seven out of eight residents could remain in nursing homes after being assessed by ED consultants. Moreover, the 90-day mortality rate was 36.4%. This underscores that many residents could require end-of-life care, which was possible for ED consultants, municipal acute care nurses and nursing home staff to manage in nursing homes.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Data Availability Statement: The Danish Data Protection Act prevents us from sharing data in a public dataset. All data relevant to the study are included in the article or uploaded as supplementary information.

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Declaration of Conflicts of Interest: The authors have no financial conflicts of interest, but some of the authors have organisational interests as they believe in the idea of providing emergency care in nursing homes. C.H.R. has initiated the intervention and is also one of the ED consultants who operate the ED-based acute care service. M.B. and A.L. are also employed at the ED at Odense University Hospital.

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