


# Feasibility of using risk reminders to prevent falls, dehydration and pulmonary aspiration in nursing homes

Raquel Bouça-Machado <sup>1,2,3</sup>, Márcia Duarte <sup>1</sup>, Joaquim J Ferreira <sup>1,2,3</sup>,  
on behalf of CNS risk reminders study group

<sup>1</sup> CNS - Campus Neurológico, Torres Vedras, Portugal

<sup>2</sup> Instituto de Medicina Molecular João Lobo Antunes, Lisbon, Portugal

<sup>3</sup> Laboratory of Clinical Pharmacology and Therapeutics, Faculdade de Medicina, Universidade de Lisboa, Lisbon, Portugal

✉ **Corresponding author:**

Joaquim J Ferreira

Laboratory of Clinical Pharmacology and Therapeutics, Faculdade de Medicina, Universidade de Lisboa

Av. Prof. Egas Moniz  
1649-028 Lisboa, Portugal  
Tel: + 351 21 7802120

E-mail: [joaquimjferreira@gmail.com](mailto:joaquimjferreira@gmail.com)



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**ABSTRACT:** **Background:** Previous research has indicated an increased risk of dehydration, falls, and pulmonary aspiration among older adults in nursing homes, negatively impacting independence and quality of life. To provide high-quality care and prevent risks, it is crucial to be aware of residents' difficulties, implement risk minimization strategies, and effectively communicate this information to all nursing home staff. This study aimed to evaluate the feasibility of using a set of risk reminders designed to caution against fall, dehydration, and pulmonary aspiration risks. **Methods:** All residents from CNS - Campus Neurológico were invited to participate if they met the eligibility criteria. At baseline, residents underwent a screening risk assessment, and corresponding risk reminders were assigned. The study included a daily record of falls, dehydration, and pulmonary aspiration events, as well as monthly interview assessments. Event data were compared with historical data extracted retrospectively from medical and nursing charts. **Results:** A total of 23 CNS residents participated in the study. Residents median satisfaction score on a 7-point Likert scale was  $3.4 \pm 0.2$  (quite satisfied). Healthcare professionals assessed satisfaction and usability mean scores were  $2.4 \pm 0.2$  (very satisfied) and  $2.2 \pm 0.1$ , respectively. The mean number of times per user that bracelets were removed was 1.78. The main reasons for removal included: lack of adjustability, forgetting the purpose of the bracelets, and a lack of habit. **Conclusion:** The results showed good adherence and acceptance of risk reminders by both residents and health professionals. Further studies are needed to investigate their efficacy in decreasing events in nursing homes.

**KEY WORDS:** Nursing home, falls, dysphasia, pulmonary aspiration, dehydration

## INTRODUCTION

Given the increased life expectancy, the number of older adults living in nursing homes is expected to considerably rise over the next few decades [2,3]. Nursing homes provide 24-hour nursing care to residents with varying degrees of functionality and a wide array of health-related problems [1]. The necessity for

strategies to minimize safety risks and to maintain the quality of life and autonomy of residents is now imperative [2,3].

Falls, choking, pulmonary aspiration, and dehydration pose significant challenges in nursing homes, contributing significantly to the deterioration of independence and residents' quality of life [4–9].

The incidence of falls and fall-related injuries among individuals in institutions has been reported in several studies, emerging as a major external cause of death in nursing homes [2,10,11]. Compared with elderly persons living in the community, the mean fall incidence is three times higher, with an average of falls per bed per year in nursing homes being 1.5. Moreover, the incidence of falls in demented patients is two to three times higher, with weakness and gait problems being the most common causes [10,11].

Aspiration pneumonia is another major problem. It is particularly challenging to diagnose since the moment of aspiration is usually not observed. According to an Australian study on external-cause deaths of nursing home residents [2], choking was the most common external cause of death in residents younger than 65 years. Important risk factors for aspiration pneumonia include dysphagia, old age, male gender, lung diseases, diabetes mellitus, poor oral health, severe dementia, Parkinson's disease, malnutrition, and the use of antipsychotic drugs, proton pump inhibitors, and angiotensin-converting enzyme inhibitors [12].

Dehydration, due to poor fluid intake or pathological loss of body fluids, was present in 0.8% to 1.4% of nursing home residents, with a 6-month incidence of dehydration of 1 in 3. It is associated with frailty, poor cognition, falls, delirium, disability, and mortality [13]. Additionally, dehydration is a major cause of decreased attention and fluctuating mental status, which are hallmarks of delirium [13].

These conditions are preventable. However, to provide high-quality care, nursing home staff needs to function as a coordinated team, possess an effective communication system, and better understand the needs of residents [1]. The aim of this study was to evaluate the feasibility of a set of risk reminders, as part of a risk prevention strategy, to communicate falls, dehydration, and pulmonary aspiration risks and to help formulate tailored interventions to manage these events in nursing homes.

## METHODS/DESIGN

### *Study design*

A national, single-centre, feasibility study with a duration per participant between 3 and 5 months was conducted.

### *Study participants*

Study participants were recruited from CNS - Campus Neurológico, a tertiary specialized neurological disorders center in Portugal, which includes a nursing home. All inpatients at CNS were invited to participate if they met the eligibility criteria. Patients were included if they resided at the CNS nursing home for long-term care, exhibited a risk of falling, dysphagia, and/or dehydration as determined by a brief screening assessment, and agreed to participate and comply with study requirements. Exclusion criteria involved the presence of significant active psychiatric problems (e.g., hallucinations, confusion, psychosis), which, based on the clinical judgment of the CNS multidisciplinary team, could be exacerbated by the use of risk reminders.

To prevent potential devaluation of risk reminders by nursing home staff, only residents with moderate to severe risk were considered candidates for the use of these reminders. This selection was based on the results of the screening assessment and on investigators best judgment. Those with significant active psychiatric problems (e.g., hallucinations, confusion, psychosis) that could potentially worsen with the use of risk reminders were excluded. Ethic committee of Centro Académico de Lisboa Norte (CAML) approved the study (Ref. 176/15). All participants gave their informed consent before any study-related proceedings or, if dementia was present, the caregiver.

### *Study materials*

Risk reminders were created by the CNS risk reminders study group and were used by study participants, once included in the study, in their daily routines at the CNS. They include the following standardized materials (Figs. 1 and 2):

- Small, lightweight rubber-coloured bracelets, for residents' use (on the wrist, visible), with phrases related to the different risks: "prevent to not fall", "contain to protect", "drink to hydrate", and "avoid choking".
- Small and coloured signposts next to the residents' headboard in their rooms



**Fig 1.** Coloured bracelets with slogans related with the different risks



**Fig 2.** Coloured signposts next to residents' headboard

### Study Procedures

Demographic information, clinical manifestations, and disease management data were gathered using a structured questionnaire. Additionally, a brief clinical assessment of the risk of falls, pulmonary aspiration, and dehydration was conducted.

At the end of each nursing shift, all events—falls, near falls, dehydration, and pulmonary aspiration—were documented using forms specifically created for this purpose by the CNS Risk Reminders Study Group.

At the end of each month, residents underwent an interview conducted by an investigator, and healthcare professionals completed a self-administered questionnaire. Both groups were queried about satisfaction and any encountered problems related to the use of risk reminders. Healthcare professionals were asked to evaluate usability in a 7-points Likert-scale. If dementia was present, only the occurrence of adverse events and the reason for not conducting the interview were recorded.

Furthermore, historical data regarding falls, de-

hydration, and pulmonary aspiration events for all CNS residents were collected retrospectively from medical and nursing charts within the study period and for the corresponding period the year before.

### Statistical Analysis

The statistical analysis was conducted using SPSS® version 21.0 by SPSS Inc., Chicago, IL. Data were described using descriptive statistics. Our primary outcome focused on measuring residents' adherence to risk reminders by recording the number of times and reasons they removed, refused, or withdrew from the study during the study period.

The secondary outcomes included:

1) Residents' satisfaction with the risk reminders, assessed on a 7-point Likert scale and through open-ended questions at the end of the study.

2) Healthcare professionals' satisfaction with the risk reminders, measured on a 7-point Likert scale, along with open-ended questions exploring the overall benefits of using the displays and their perception of the impact on decreasing risk, at the end of the study.

As an exploratory outcome, we characterized the events that occurred in the nursing home for all CNS inpatients based on electronic clinical records during the 5-month study.

## RESULTS

Between October 2016 and February 2017, there were 104 inpatient subjects at CNS, with a median hospitalization duration of 29 days [4–151 days]. Of these, a total of 23 CNS residents met the eligibility criteria and were included in the study. The participants' mean age was  $80.1 \pm 8.6$ , and 56.5% ( $n=13$ ) were female. The most common diagnoses were Alzheimer's disease (30.4%,  $n=7$ ), Parkinson's disease (17.4%,  $n=4$ ), and stroke (13.0%,  $n=3$ ). Cognitive impairment was present in 52.2% ( $n=12$ ) of the participants. Following the screening assessment and multidisciplinary team discussion, all residents were identified as having a risk of falls and dehydration, 65.2% ( $n=15$ ) of pulmonary aspiration, and 39.1% ( $n=9$ ) as requiring restraint (Table 1).

### Residents' adherence

No residents refused the use of risk reminders during the study period. According to residents' interviews, the mean number of times per user that bracelets were removed was 0.4, while health professionals'

**TABLE 1.** Demographic and clinical characteristics of residents participating in the study

Residents' demographic data (n=23)	
Age (Mean, SD)	80.1 ±8.6
Gender (% Female)	56.5% (13)
Residents' clinical data (n=23)	
<b>Diagnosis (% , n)</b>	
Alzheimer's disease	30.4% (7)
Parkinson's disease	17.4% (4)
Stroke	13.0% (3)
Frontotemporal dementia	8.7% (2)
Lewy body dementia	8.7% (2)
Bipolar disorder	8.7% (2)
Multiple system atrophy	4.3% (1)
Progressive Supranuclear Palsy	4.3% (1)
Corticobasal degeneration	4.3% (1)
<b>Cognition</b>	
MMSE (n=18, Mean, SD)	19.4 ±7.8
<b>Falls</b>	
History of falling (% , n Yes)	13% (3)
Morse Scale (% , n High risk)	47.8% (11)
Time Up and Go	
Mean time (n=3, Mean, SD)	17.7 ±10.
Not applicable (bedbound, walking aids)	487% (20)
<b>Pulmonary aspiration</b>	
Presence of history of Pulmonary aspiration (% , n)	30.4% (5)
Presence of severe dysphasia (% , n)	8.7% (2)
Presence of impulse behavior disorder (% , n)	17.4% (4)
Swallowing Disturbance Questionnaire (n=21, Median, range)	4 [0,20]
<b>Dehydration</b>	
Presence of history of dehydration (% , n)	0%, 0
<b>GULP assessment</b>	
Low risk (% , n)	17.4% (4)
Medium risk (% , n)	78.3% (18)
High risk (% , n)	4.3% (1)

records indicated 1.8 removals. Since risk reminders included signposts next to residents' bed headboard, participants were allowed to remove bracelets overnight, and these removals were not considered in the adherence analysis.

The most common reasons for removing the bracelets during the day were their lack of adjustability, forgetting the purpose of the bracelets, and a lack of habit.

Five residents dropped out during the study: one due to a psychotic break, one passed away, and three were discharged from CNS (Table 2).

**TABLE 2.** Feasibility and safety data

Adherence	
<b>Bracelets removal</b> (mean n° of times the bracelet was removed/user)	
Based on residents' interview	0.4
Based on healthcare professional questionnaire	1.8
<b>Dropouts</b>	
Delirium (not related with the intervention, n)	1
Discharge from CNS (n)	3
Died (not related with the intervention, n)	1
Satisfaction	
Residents (Mean, SD)	3.4 ± 0.2
Healthcare professionals (Mean, SD)	2.4 ± 0.2
Usability	
Healthcare professionals (Mean, SD of 7-points Likert scale)	2.2 ±0.1
<b>Problems reported by residents</b>	
Fall off (n)	1
Hinder the movements (n)	1
Discomfort during the night (n)	1
Safety	
<b>Reported events of interest</b>	
Falls (n   n/participants)	20   0.9
Choking (n   n/participants)	14   0.6
Dehydration (n   n/participants)	0   0.0
<b>Reported adverse events</b>	
Hand edema (n)	1
Skin rash (n)	1

### Residents and health professionals' satisfaction and usability

Residents' mean satisfaction with the risk reminders was 3.4 ± 0.2 (quite satisfied).

Residents' complaints about the use of bracelets included one complaint about bracelets falling off the arm frequently, one stating that it hinders movements, and one expressing discomfort during the night. Regarding the open questions at the end of the study ("what do you like most?" and "what you like least?"), all

but one respondent stated that they had nothing to say. One participant mentioned that the colour was what they liked most, and what they liked least was its lack of adjustability, causing it to fall off.

Health professionals' mean satisfaction with the risk reminders was  $2.4 \pm 0.2$  (very satisfied) and the mean usability score of  $2.2 \pm 0.1$  (very useful). The most valued aspects of risk reminders in their opinion were providing a better and easy way to alert for residents' risks, assisting in improving personalized integrated care. They also valued the colours and messages. The least appreciated aspects were the ease of hiding under clothing, lack of adjustability, and hindrance during bathing, dressing, and transitions. The most frequent suggestions from both groups were to have a bracelet that symbolizes all risks, to change the type of material, make it adjustable, and ensure visibility regardless of the residents' clothing (Tables 2 and 3).

**TABLE 3.** Healthcare professionals' comments on risk reminders

What do you like least?	
Visibility issues (due to clothing, n)	16
Lack of adjustability (n)	10
Challenges with bathing/dressing (n)	9
Challenges with transitions (n)	3
The material causes discomfort for patients (n)	2
Bracelets can be easily removed by patients (n)	2
What do you like most?	
Better and easy way to alert for the patients' risks (n)	56
Optimizes personalized integrated care (n)	10
The colors and phases (n)	8
Improves communication (n)	5
Potentiates multidisciplinary intervention (n)	4
Suggestions for improvement	
A bracelet that symbolizes all risks (n)	8
Change the type of material (n)	3
Being adjustable (n)	3
Ensure visibility regardless of patient's clothing (n)	3

### Adverse events

Hands oedema (n=1), unrelated to the use of bracelets according to the clinical team, and a mild skin rash in the wrist area (n=1) were the only adverse events reported during the study (Table 2).

### Characterization of events based on electronic clinical records

During the 5-months of the study period, the frequency of events/occupied beds (n=104) was 0.41, with 78.5% (n=84) of the residents without having any event, 15.4% (n=16) with one or more falls and 9.6% (n=10) having one pulmonary aspiration event.

In this 5 months, 25 falls events occurred, of which 6 were near falls. The most common periods were until 11:00 and from 2:00pm to 8:00pm. Bathroom (28%, n=7), followed by living room (20%, n=5) and dining room (12%, n=3) were the places in which the events more frequently occur. Thirty-two percent (n=8) had no consequences and 16% (n=4) caused soft-tissue injuries. In relation to pulmonary aspiration events (n=18), 61.1% (n=11) occur during the meals, 66.7% (n=12) with fluids. None of them have consequences (Table 4).

There were no dehydration events. Five residents removed the restrains, two of them more than one time.

## DISCUSSION

A total of 23 residents and 131 answers from health professionals were included in this 5-months study. The mean age for study participants was 80 years old. All residents had some neurological disorder, the most common diagnoses were Alzheimer's disease (30.4%, n=7), Parkinson's disease (17.4%, n=4) and stroke (13%, n=3). Twelve (52.2%) participants had cognitive impairment, limiting the ability to collaborate in the monthly interviews.

### Feasibility of risk reminders

Regarding adherence, the frequency of residents that remove the bracelets, during the day, was low (mean number of times per user that bracelets were removed was 1.78).

Residents and health professional were quite or very satisfied with the risk reminders, respectively. Both agree bracelets need to be adjustable and to create a new one that symbolizes all risks. Visibility issues

**TABLE 4.** Characterization of events in the nursing home

Demographic data (n=104)	
<b>Age</b> (Average, SD)	75.8 ± 10.7
<b>Gender</b> (% Female)	51% (53)
<b>Number of hospitalization days</b> (Median, Min, Max)	29 [4,151]
Clinical data	
<b>Diagnosis</b> (% , n)	
Parkinson's disease	22.1% (23)
Stroke	13.5% (14)
Dementia syndromes	9.6% (10)
Alzheimer's disease	8.7% (9)
Lewy body dementia	7.7% (8)
Atypical Parkinsonism	4.8% (5)
Multiple system atrophy	3.8% (4)
Progressive Supranuclear Palsy	3.8% (4)
Bipolar disorder	3.8% (4)
Frontotemporal dementia	2.9% (3)
Traumatic brain injury	2.9% (3)
Vascular Parkinsonism	2.9% (3)
Others (n ≤ 2)	13.5% (14)
<b>Patients with at least one event of interest</b>	78.5% (84)
Events of interest	
<b>Falls</b>	
Total number of falls (n)	25
Total number of near falls (n)	6
Patients with at least one fall (% , n)	15.4% (16)
<b>Characterization of falls and near falls</b> (% , n)	
<i>Daytime period</i>	
Until 11:00 am	36% (9)
Until 2:00 pm	4% (1)
2:00 - 08:00 pm	20% (5)
After 08:00 pm	8% (2)
Unknown	32% (8)
<i>Local</i>	
Bathroom	28% (7)
Bedroom	4% (1)
Dining Room	12% (3)
Gymnasium	4% (1)
Living room	20% (5)
Unknown	32% (8)
<i>Consequences</i>	
Bruise	4% (1)
Soft-tissue injuries	16% (4)
Fracture	4% (1)
No consequences	32% (8)
Pain	4% (1)
Unknown	40% (10)
<i>Register by</i>	
Nurse	80% (20)
Physician	12% (3)
Nurse/Physician	8% (2)

TABLE 4. (continue)

Choking events			
Total number of choking events (n)	18		
Patients with at least one choking event (% , n)	9.6% (10)		
<b>Characterization of choking events</b> (% , n)	<i>Daytime period</i>	Meals	61.1% (11)
		Taking medication	5.6% (1)
		Oral hygiene	5.6% (1)
		Unknown	27.8% (5)
	<i>Cause</i>	Fluids	66.7% (12)
		Solids	5.6% (1)
		Unknown	27.8% (5)
	<i>Consequences</i>	No consequences	100% (18)
	<i>Register by</i>	Assistive personnel	11.1% (2)
		Nurse	83.3% (15)
		Physician	5.6% (1)
	Dehydration events		
Total number of dehydration events (n)	0		

were also frequently referred by health professionals. According to participants general opinion, this can be overcome by instructing nursing home staff to put the bracelets over the clothes or rolling up the sleeves so that the bracelets are always visible.

Despite these issues, health professional classified the risk reminders as very useful. They were considering a helpful and easy to use strategy to be alert for the residents' risks, to improve communication among health professionals of the multidisciplinary team and to optimize personalized integrated care.

#### **Characterization of events**

Our results showed that falls and choking events occur in a nursing home. Although we didn't register any dehydration events, we are aware that they are frequent in nursing homes. Our aim in conducting this characterization was to explore patterns related to location, time of day, or other characteristics associated with the events of interest.

#### **Fall events**

Data from electronic clinical records showed bathing time and the afternoon (between snack and dinner) as the most problematic periods, consistent with the locations where most of the falls occur (bathroom and living room). Mackenzie & Byles review [11], reported the bathroom and early morning as associated with a high frequency of falls due to the demands of the task, especially the high number of transfers needed.

We hypothesize that the high frequency of falls during the afternoon is related to residents spending most of this time engaging in activities in the living room and our sample being mainly composed of residents with neurological diseases associated with gait problems. Most falls in our study did not have consequences, with only one recorded instance of a fall-related fracture. These results are supported by a previous review on falls and near-falls in nursing homes [10], which reported that individuals with substantial gait disorders have a prevalence of falls 2.4 to 4.8 times higher than those without gait problems. Additionally, the review found that only 4% of falls result in fractures.

#### **Pulmonary aspiration events**

The most common events of pulmonary aspiration occurred during meals, involving fluids and typically without consequences. These findings align with evidence demonstrating significant changes in the swallowing mechanism as people age. Elderly neurological patients, experiencing cognitive and perceptual changes alongside impaired functional status – characteristics prevalent in our population – are more likely to be associated with swallowing and eating impairments, leading to pulmonary aspiration events [15–17].

#### **Dehydration events**

In both electronic clinical records and diary records, no dehydration events were documented. Dehydration is typically associated with frailty, poor cogni-

tion, falls, delirium, and disability; thus, we expected to find some mild forms in our study [13]. Despite the teaching sessions provided to health professionals on how to detect mild forms of dehydration, these events are not as easily noticeable as falls. It is possible that some mild forms of dehydration might have gone unnoticed. There were no recorded hospital transfers for this reason

## CONCLUSION

The use of risk reminders, given its simplicity, low complexity, and minimal physical requirements, appears to be an interesting tool for managing falls, pulmonary aspiration, and dehydration events in nursing homes. Our results demonstrated good adherence and acceptance of risk reminders by both residents and health professionals. It was viewed as a simple and effective method to stay alert to the risks faced by residents in nursing homes, serving as a strategy to optimize personalized integrated care.

Further studies are needed to investigate the efficacy of risk reminders in reducing the frequency of events in nursing homes.

## REFERENCES

- Young A, Froggatt K, Brearley SG. 'Powerlessness' or 'doing the right thing' – Moral distress among nursing home staff caring for residents at the end of life: An interpretive descriptive study. *Palliat Med*. 2017;31: 853–860. doi:10.1177/0269216316682894
- Ibrahim JE, Bugeja L, Willoughby M, Bevan M, Kipsaina C, Young C, et al. Premature deaths of nursing home residents: an epidemiological analysis. *Med J Aust*. 2017;206: 442–447. doi:10.5694/mja16.00873
- Jerez-Roig J, De Brito MacEdo Ferreira LM, De Araújo JRT, Lima KC. Functional decline in nursing home residents: A prognostic study. *PLoS One*. 2017;12: 1–14. doi:10.1371/journal.pone.0177353
- Kayser-Jones J, Schell ES, Porter C, Barbaccia JC, Shaw H. Factors contributing to dehydration in nursing homes: inadequate staffing and lack of professional supervision. *J Am Geriatr Soc*. 1999;47: 1187–94. Available: <http://www.ncbi.nlm.nih.gov/pubmed/10522951>
- Pauly L, Stehle P, Volkert D. Nutritional situation of elderly nursing home residents. *Zeitschrift für Gerontol und Geriatr*. 2007;40: 3–12. doi:10.1007/s00391-007-0430-x
- Wolff A, Stuckler D, McKee M. Are patients admitted to hospitals from care homes dehydrated? A retrospective analysis of hypernatraemia and in-hospital mortality. *J R Soc Med*. 2015;108: 259–65. doi:10.1177/0141076814566260
- Twersky JI. Falls in the nursing home. *Clin Fam Pract*. 2001;3: 653–666. doi:10.1016/S1522-5720(05)70119-7
- Kiely DK, Kiel DP, Burrows AB, Lipsitz LA. Identifying nursing home residents at risk for falling. *J Am Geriatr Soc*. 1998;46: 551–5. Available: <http://www.ncbi.nlm.nih.gov/pubmed/9588366>
- Pick N, McDonald A, Bennett N, Litsche M, Dietsche L, Legerwood R, et al. Pulmonary aspiration in a long-term care setting: clinical and laboratory observations and an analysis of risk factors. *J Am Geriatr Soc*. 1996;44: 763–8. Available: <http://www.ncbi.nlm.nih.gov/pubmed/8675922>
- Rubenstein LZ, Josephson KR, Robbins AS. Falls in the Nursing Home. *Ann Intern Med* (ANN INTERN MED). 1994;121: 442–451. doi:10.1059/0003-4819-121-6-199409150-00009
- Mackenzie LA, Byles JE. Circumstances of Falls With Fractured Femur in Residents of Australian Nursing Homes. *J Aging Health*. 2017; 1–20. doi:10.1177/0898264317690667
- Hollaar V, van der Maarel-Wierink C, van der Putten G-J, van der Sanden W, de Swart B, de Baat C. Defining characteristics and risk indicators for diagnosing nursing home-acquired pneumonia and aspiration pneumonia in nursing home residents, using the electronically-modified Delphi Method. *BMC Geriatr*. 2016;16: 60. doi:10.1186/s12877-016-0231-4
- Lima Ribeiro SM, Morley JE. Dehydration is difficult to detect and prevent in nursing homes. *J Am Med Dir Assoc*. 2015;16: 175–176. doi:10.1016/j.jamda.2014.12.012
- Duarte M, Bouça-Machado R, Domingos J, Godinho C, Ferreira JJ. Feasibility of using risk prompts to prevent falls, dehydration and pulmonary aspiration in nursing homes: a clinical study protocol. doi:10.1186/s40814-018-0236-1
- Polverino E, Dambrava P, Cilloniz C, Balasso V, Marcos MA, Esquinas C, et al. Nursing home-acquired pneumonia: a 10 year single-centre experience. *Thorax*. 2010;65: 354–359. doi:10.1136/thx.2009.124776
- Lanspa MJ, Peyrani P, Wiemken T, Wilson EL, Ramirez JA, Dean NC. Characteristics associated with clinician diagnosis of aspiration pneumonia: a descriptive study of afflicted patients and their outcomes. *J Hosp Med*. 2015;10: 90–6. doi:10.1002/jhm.2280
- Nogueira D, Reis E. Swallowing disorders in nursing home residents: how can the problem be explained? *Clin Interv Aging*. 2013;8: 221–7. doi:10.2147/CIA.S39452