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【 ORIGINAL ARTICLE 】

Impact of the Hospitalist System in Japan on the Quality of Care and Healthcare Economics

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Abstract:

Objective The hospitalist system is considered successful with respect to the quality of care and cost effectiveness in the United States. Studies have consistently demonstrated an improved clinical efficiency with this system. In Japan, however, the efficacy of the hospitalist system has not yet been examined. As a "super-aged society", Japan has a high number of elderly patients with multiple comorbidities who may theoretically receive better care by the hospitalist system than by the conventional system. This study investigates the impact of the hospitalist system on the quality of care and healthcare economics in a Japanese population.

Methods We analyzed 274 patients ≥65 years of age in whom the most resource-consuming diagnosis at admission was aspiration pneumonia over a 1-year period. We categorized patients as those managed by hospitalists and those managed by various departments (control group) and compared the groups. Propensity score matching was used to minimize selection bias.

Results For matched pairs, the length of hospital stay in the hospitalist group was shorter than that in the control group. Care by the hospitalist system was associated with significantly lower hospital costs. The quality of care (rate of switching from intravenous to oral antibiotics, duration of antibiotics therapy, number of chest X-rays and blood tests during hospitalization) was also considered to be favorably impacted by the hospitalist system. There was no statistically significant difference in the mortality rate or readmission rate between the groups.

Conclusion This study showed that the hospitalist system had a favorable impact on the quality of care and cost effectiveness, suggesting the potential utility of its implementation in the Japanese medical system.

Key words: hospitalist, general internal medicine, aspiration pneumonia, quality of care, cost effectiveness, healthcare economics

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Introduction

The hospitalist system has been suggested as a potential solution to the problems faced by the current medical situation in Japan. The World Health Organization (WHO) and the United Nations define a "super-aged society" as a society in which more than 21% of the population is ≥65 years old. Since 2013, Japan has been classified as a "super-aged society" (1), and one of the challenges it faces is the large number of elderly hospitalized patients with one or more complex medical and social problems. Consequently, the Japanese medical system, which is currently organized into specialist departments, faces the challenge of coping with the complex demands of the "super-aged society." Japanese medical care is characterized by the specialization of care (2), and Japanese physicians reportedly demonstrate a high quality of care in their respective fields. However, there is increased concern over the capability of each specialist in the comprehensive and effective management of inpatients

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with multiple comorbidities, especially the elderly (3).

To overcome this situation, general internal medicine (*sogo-naika*) and general medicine (*sogo-shinryoka*) have recently been established. The Japanese Society of Hospital General Medicine defines general medicine physicians as those with a certain subspecialty who are educated on a broad range of diseases, make a diagnosis for previously undiagnosed patients in a timely manner, manage patients appropriately, and work smoothly with other specialists. Despite such a reasonable theoretical concept, whether or not such reforms are effective is unclear (2). One reasons for this lack of clarity is that the practical role of these generalists has not been defined. Historically in Japan, physicians work in several environments, including in the inpatient ward and outpatient clinic. This tradition has not changed even with the creation of the general internal medicine department (3). Exactly how the general internal medicine system can be improved in Japan is a matter of discussion. The next step may be to make changes to not only the specialization of medical fields but also to the site of care.

The “Hospitalist” phenomenon has emerged as a potential solution for similar problems in the United States (4). The concept of hospitalist is similar to that of general internal medicine in Japan, but the site of care is limited to inpatient wards. Hospitalists are therefore specialized in inpatient care supported by a high quality of evidence-based medicine. Since the inception of this concept in 1996 (5), the number of hospitalists has grown rapidly, and they now play a critical role in almost all hospitals across the United States (6). Improvements in the quality of care and cost effectiveness by the hospitalist system over the conventional system (primary care physicians and specialists) have been widely reported (7-9). However, to our knowledge, no studies have yet examined the impact on clinical practice in Japan of a hospitalist system similar to that used in the United States.

Our institution has adopted a model of the hospitalist system with a US-trained Japanese physician in attendance since 2017. To model its efficacy, we used elderly patients with aspiration pneumonia as a study population. Aspiration pneumonia is occasionally misinterpreted as a form of pneumonia that should be managed by physicians specialized in the lungs. Aspiration pneumonia actually commonly occurs as a result of several comorbidities in frail, elderly patients, which makes their inpatient care complicated. In addition to the standard care of aspiration pneumonia, multiple high-quality interventions, including early rehabilitation, prevention of hazards of hospitalization, and transition of care before discharge, may be necessary. We isolated the quality of care and healthcare economics for a comparison with those of traditional care managed by various specialized departments.

Materials and Methods

Study population and data collection

Takatsuki General Hospital is a 477-bed community-based teaching hospital located in Takatsuki, Osaka, Japan. The General Internal Medicine (GIM) Department started the hospitalist system in April 2017. Until that point, patients with aspiration pneumonia had been managed by various specialist departments (respiratory medicine, cardiology, gastroenterology, nephrology, neurology, hematology, and endocrinology). Starting in 2017, however, patients diagnosed with aspiration pneumonia were assigned to the GIM Department if they had not previously been seen at Takatsuki General Hospital. If patients had been seen by other departments, they continued their treatment at those departments as before.

The GIM Department is comprised of three members: two post-graduate year (PGY) 3 senior residents supervised by a PGY 14 attending physician with hospitalist training in the US. All followed the guidelines from both the US and Japan. Treatment was given based on the current Japanese health insurance system guidelines. The physicians in the control group typically had between 3 and 15 PGY's experience, with or without supervision. In the control group, there were no documented pre-scheduled order sets for aspiration pneumonia. In the hospitalist group, there was a consensus concerning the management of the study population, and all treatment plans (Table 1) were basically performed for each patient.

We used the Japanese diagnostic procedure combination (DPC) system to identify patients whose most resource-consuming admission diagnosis was aspiration pneumonia. We enrolled 307 patients who were ≥65 years of age between April 1, 2017, and March 31, 2018, at our hospital. To calculate the readmission rate, initial admission data of patients readmitted within 1 month of discharge were analyzed; readmission within 1 month was counted for each group (hospitalist; n=15, control; n=9). We excluded 11 patients whose primary diagnosis was not aspiration pneumonia through a chart review. Ultimately, we analyzed 272 patients (hospitalist; n=161, control; n=111).

We compared the baseline characteristics of patients between study groups. To predict the risk of aspiration pneumonia, the following patient characteristic covariates were included, based on previous studies: age, gender, activity of daily living (ADL), dysphagia, antipsychotic drug use, history of chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), dementia, cerebrovascular disease and neurological disease (10-12). We evaluated the ADL using a functional independence measure (FIM). The FIM's assessment of the degree of disability depends on the patient's score in 18 categories focusing on the motor and cognitive function, each rated on a 7-point scale. The score ranges between 18 and 126, with higher scores representing a better

Table 1. Treatment Protocol for Aspiration Pneumonia in the Hospitalist Group.

Initial assessment	Management during hospitalization	Before discharge
Obtain chest X-ray and sputum culture	Taper down oxygen if SpO_2 remains above 92%	Inform family or facility staff of the appropriate diet texture
Obtain two sets of blood culture if there are any signs of sepsis	Change antibiotics or switch to oral antibiotics based on sputum culture and clinical course	Educate family or facility staff on prevention of aspiration pneumonia
Consider evaluation of tuberculosis if there are any suggestive signs	Set the duration of antibiotics based on current guidelines	Discuss advance care planning with patient and family
Site the patient in isolation until tuberculosis is ruled out	Begin early rehabilitation (PT, OT) from day 1 or 2 if the patient is stable	Check vaccination status and schedule vaccination if necessary
Begin antibiotics if suspicion of aspiration pneumonia is high	Obtain blood test only if any sign of deterioration or presence of active co-morbidity	
Begin oxygen therapy if SpO_2 <88%	Obtain chest X-ray only when patient shows signs of deterioration	
	Evaluate oral hygiene and swallowing function (ST) from day 1 or 2 if the patient is stable	
	Restart diet if patient has enough capacity for swallowing without high risk conditions (AMS, respiratory distress/failure, hemodynamic instability)	
	Modify diet based on ST evaluation	

PT: physical therapist, OT: occupational therapist, ST: speech therapist, AMS: altered mental status

ADL. We assessed the severity of dysphagia of each patient using an eating status scale (ESS), food intake level scale (FILS) and functional oral intake scale (FOIS). In the ESS, the nutrient and water intake was classified as 1) tube feeding only, 2) more by tube than orally, 3) more orally than by tube, 4) oral feeding (modified) and 5) oral feeding (unmodified). The FILS is a 10-point observer-rating scale for measuring the severity of dysphagia, with higher scores representing a better function. The FOIS is a 7-point observer-rating tool scale for measuring the severity of dysphagia, with higher scores representing a better function. The components of CURB-65 and A-DROP on admission were collected to evaluate the severity of pneumonia.

Data were collected and examined by two physicians (O. H., T.T.). The Takatsuki General Hospital Institutional Review Board approved the study protocol. The study was carried out in accordance with the approved guidelines. Since this was a retrospective study, informed consent was obtained in the form of opt-out on the hospital website.

Outcomes

The study outcomes were healthcare economics (length of stay, hospital costs and DPC hospitalization period) and the quality of care (duration of antibiotics therapy, rate of switching from intravenous to oral antibiotics, number of chest X-rays and blood tests during hospitalization). Hospital costs per patient were calculated as the sum of each medical care expense. The DPC-based payment system for each diagnosis is divided into several subgroups based on the sex, age group, prognosis at discharge, most resource-consuming diagnosis, type of surgery or procedure provided (if any), comorbidity and severity of disease. The average length of stay of each diagnosis is classified into three hospitalization periods (period I: first quartile of the total length of the stay for each diagnosis, period II: average length of stay for each diagnosis, period III: average length of stay for each disease plus two standard deviations). We also analyzed the DPC hospitalization period of each case, mortality rate and readmission within one month.

Statistical analyses

Demographic data differences between the two groups were determined by Wilcoxon test for continuous and ordinal variables, and chi-squared test for categorical variables. The multiple logistic regression model was used to calculate the propensity score for each individual, which was the probability of the patient being managed by hospitalists. Independent variables were the age, gender, ADL (FIM), status of dysphagia (ESS, FILS and FOIS), severity of pneumonia (A-DROP and CURB 65), antipsychotic drug use, history of COPD, DM, dementia, cerebrovascular disease and neurological disease. One-to-one propensity score matching (PSM) without replacement was completed using the nearest neighbor match on the logit of the propensity score for each individual with the caliper width set to 0.05 times the standard deviation of the logit of the propensity score. Differences between the matched patients were evaluated using the Wilcoxon test. The rate of switching from intravenous to oral antibiotics, readmission within one month and mortality were summarized with frequencies and proportions using the Clopper & Pearson 95% confidential interval. Fisher's exact test was used to compare the hospitalist group and the control group. All analyses were performed using the JMP software program, version 13 (SAS

Table 2. Baseline Characteristics before and after Propensity Score Matching.

Variable	Before propensity score maching			After propensity score matching		
	Hospitalist (n=161)	Control (n=111)	p value	Hospitalist (n=42)	Control (n=42)	p value
Age (SD)	85.05(7.3)	83.71(6.6)	0.124	84.38(7.93)	83.60(6.8)	0.627
Male (%)	78(48.4)	75(67.6)	0.002	20(47.6)	23(54.8)	0.663
COPD (%)	10(6.2)	30(27.0)	<0.001	8(19.0)	10(23.8)	0.791
DM (%)	36(22.4)	30(27.0)	0.391	11(26.2)	11(2.2)	1
Antipsychotic drug use (%)	94(58.4)	36(32.4)	<0.001	13(31.0)	17(40.5)	0.495
Neurological disease (%)	58(36.0)	10(9.0)	<0.001	9(21.4)	8(19.0)	1
Dementia (%)	90(55.9)	28(25.2)	<0.001	11(26.2)	16(38.1)	0.35
Cerebrovascular disease (%)	70(43.5)	40(36.0)	0.258	17(40.5)	17(40.5)	1
A-DROP (SD)	2.71(1.05)	2.53(1.14)	0.19	2.60(1.17)	2.52(1.17)	0.781
CURB 65 (SD)	2.34(0.87)	2.12(1.04)	0.061	2.19(0.97)	2.24(1.16)	0.839
FIM (SD)	33.41(20.38)	58.50(31.64)	<0.001	43.52(28.14)	43.90(28.39)	0.951
ESS (SD)	4.09(1.03)	4.23(1.20)	0.28	3.71(1.50)	3.98(1.32)	0.398
FILS (SD)	6.07(2.46)	8.06(2.77)	<0.001	6.86(3.10)	7.36(2.99)	0.454
FOIS (SD)	5.23(1.67)	5.69(1.92)	0.035	4.83(2.25)	5.17(2.06)	0.481

Data are presented as the number (%) or mean (standard deviation).

SD: standard deviation, COPD: chronic obstructive pulmonary disease, DM: diabetes mellitus, FIM: functional independence measure, ESS: eating status scale, FILS: food intake level scale, FOIS: functional oral intake scale

Institute, Cary, USA) and EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan). All statistical tests were two-sided, and statistical significance was defined as p <0.05.

Results

The characteristics of the 272 patients are shown in Table 2. Patients in the hospitalist group were more likely to have a low ADL, dysphagia, antipsychotic drug use and history of dementia and neurological disease and were more commonly women than those in the control group. In contrast, patients in the control group were more likely to have a history of COPD and were more commonly men. There were significant differences in the majority of the characteristics between two groups, showing that any comparisons between these two groups of patients would be influenced by selection bias. Therefore, to minimize selection bias, we used PSM. After PSM, the patient characteristics in the hospitalist group were adjusted to match those of the control group. Multiple logistic regression of propensity had an area under the receiver operating characteristics curve of 0.897, indicating good discrimination of patients in the hospitalist group and the control group. There were 84 patients in 42 pairs in the hospitalist group and the control group who were successfully matched for propensity score (Table 2). There were no marked differences detected in these 84 patients.

The study outcomes are shown in Table 3. For matched pairs, the length of stay among the patients in the hospitalist group was shorter than among those in the control group [12.0 days (interquartile range, 4.0-41.0) vs. 16.5 days (interquartile range, 6.0-75.0); p=0.004]. Management by the hospitalist group was associated with significantly lower total hospital costs [¥550,950 (interquartile range, ¥229,970-¥1,479,120) vs. ¥770,810 (interquartile range, ¥341,800-¥2,768,152); p=0.003]. Trends towards an increased rate of period I and decreased rate of period III were detected without statistical significance in the hospitalist group. The rate of switching from intravenous to oral antibiotics was 26.2% and 2.4% (p=0.003) in the hospitalist and control groups, respectively. The duration of antibiotics therapy in the hospitalist group was shorter than in the control group (6.0 days vs. 8.0 days; p<0.001). The numbers of chest X-rays (1.0 vs. 4.0; p<0.001) and blood tests (5.0 vs. 6.0; p=0.033) were consistently lower in the hospitalist group than in the control group. For matched pairs, there were no readmissions and no marked difference in the mortality rate between these two groups. Before PSM, patients in the hospitalist group tended to show a decreased mortality: 21/161 (13.0%) in the hospitalist group vs. 16/111 (14.4%) in the control group. After PSM, although there was no statistically significant difference, the hospitalist group had a lower mortality than the control group: 2/42 (4.8%) in the hospitalist group vs. 7/42 (16.7%) in the control group; p=0.156. After PSM, there were no readmissions in either group.

Discussion

To our knowledge, this is the first observational study to examine the effectiveness of the hospitalist system in Japan. The implementation of the GIM hospitalist-centered system was shown to result in a shorter length of stay, lower hospital costs and better quality of care than the conventional system.

The DPC code of aspiration pneumonia is divided into six categories based on the need for surgery or intervention and pre-defined concomitant diseases, such as tracheostomy, gas-

Table 3. Results before and after Propensity Score Matching.

	Before propensity score matching			After propensity score matching		
	Hospitalist (n=161)	Control (n=111)	p value	Hospitalist (n=42)	Control (n=42)	p value
Length of stay mean[25%, 75%]	12.0[8.0, 17.0]	15.0[10.0, 26.0]	<0.001	12.0[4.0, 41.0]	16.5[6.0, 75.0]	0.004
Costs mean [25%, 75%]	556,070 [459,860, 750,470]	699,022 [527,150, 1,116,703]	<0.001	550,950 [229,970, 1,479,120]	770,810 [341,800, 2,768,152]	0.003
DPC hospitalization period(%)						
period I	70(43.5)	34(30.6)	0.006	18(42.9)	10(23.8)	0.076
period II	63(39.1)	43(38.7)		15(35.7)	14(33.3)	
period III	28(17.4)	34(30.6)		9(21.4)	18(42.9)	
Antibiotics - IV to oral switch (%)	38(23.6)	2(1.8)	<0.001	11(26.2)	1(2.4)	0.003
Duration of antibiotics therapy mean [25%, 75%]	6.0[5.0, 8.0]	8.0[7.0, 10.0]	<0.001	6.0[5.0, 8.0]	8.0[7.0, 10.8]	<0.001
Number of CXR mean[25%, 75%]	1.0[1.0, 2.0]	4.0[2.0, 6.0]	<0.001	1.0[1.0, 2.0]	4.0[2.0, 7.0]	<0.001
Number of blood tests mean[25%, 75%]	4.0[3.0, 6.0]	5.0[4.0, 8.0]	<0.001	5.0[3.0, 6.8]	6.0[4.0, 10.0]	0.033
Readmission (%)	15(9.3)	9(8.1)	0.83	0(0)	0(0)	-
Mortality (%)	21(13.0)	16(14.4)	0.857	2(4.8)	7(16.7)	0.156

Data are presented as the number (%) or mean (25th and 75th percentiles).

IV: intravenous, and CXR: chest X-ray

Table 4. The Mean [25th, 50th (median), 75th Percentiles] of the Length of Stay for Each Subgroup in Our Hospital and Nationally in 2016.

		Our hopital	Nationwide survey
Length of stay mean[25%, 50%, 75%]	group 1	19.7 [12.0, 17.0, 24.0]	21.3 [11.0, 17.0, 27.0]
	group 2	38.0 [20.0, 35.0, 52.0]	41.3 [22.0, 35.0, 55.0]
	group 3	13.8 [7.8, 12.5, 18.5]	23.7 [9.0, 18.0, 31.0]
	group 4	59.5 [53.8, 59.5, 65.3]	54.0 [26.0, 44.0, 71.0]

trostomy, mechanical ventilation and *Clostridium difficile* infection. The Japanese Health, Labor and Welfare Ministry released the average of length of stay of aspiration pneumonia for each category nationwide until 2016. A total of 222 patients with aspiration pneumonia were admitted to our hospital in 2016. They were divided into four out of six categories. The most predominant group needed no surgery or intervention without concomitant disease (group 1: 87%). Smaller groups required surgery or intervention without concomitant disease (group 2: 9.5%), required intervention without concomitant disease (group 3: 1.8%) and required surgery and intervention without concomitant disease (group 4: 0.9%). The differences between the mean [25th, 50th (median), 75th percentiles] of the length of stay for each subgroup in our hospital and the national average are summarized in Table 4. There were no significant differences between the groups, suggesting that the quality of care in our hospital was reflective of that of the national standard, even before the implementation of the hospitalist system.

The implementation of the hospitalist system resulted in a shorter length of stay, lower costs and better quality of care in elderly patients with aspiration pneumonia, according to our observational study. There are several possible explanations for these results. Regarding the quality of care, our hospitalist group was trained to comply with both American and Japanese guidelines. McCulloh et al. reported that hospitalists adhere to guidelines better than specialists, thus providing higher quality of care (13). Conversely, it was hard to assess how each physician in the control group treated the patients because there is variation in treatment methods between each physician. In the hospitalist group, the selection of empiric antibiotics treatment was based on the site of care, risk factors for drug-resistant pathogens, comorbidities and epidemiologic factors. The duration of antibiotics treatment was based on the individual patient's clinical response, severity of their condition, pathogen and any guideline-directed fixed duration. Frequent chest X-ray monitoring was disregarded in the hospitalist group because X-ray is not proven to reflect the immediate clinical response to treatment (14). Blood tests were also performed minimally in the hospitalist group. The C-reactive protein assessment, a blood test often used in Japan, has also not been proven to be a good monitor for evaluating the response compared with the patient's symptoms and physical findings. There were no cases of treatment failure secondary to the choice of antibiotics. All patients in both groups received appropriate antibiotics for aspiration pneumonia. The significant differences in the rate of switching from intravenous to oral antibiotics, number of X-rays and blood test results are likely a reflection of the differences in care the between two groups.

We considered our findings to reflect the cost effectiveness and improved quality of care of the hospitalist system over conventional methods. The shorter length of stay might be the most influential factor for the cost effectiveness. The average costs per day, calculated as the total hospital costs divided by the average length of stay of each group, were similar between groups. The shorter length of stay in the hospitalist group cannot simply be attributed to the shorter duration of antibiotics therapy because there were gaps between the difference in the mean length of stay and the mean duration of antibiotic therapy in each group. In addition to antibiotics strategy, at least in the hospitalist group, several interventions were performed, such as early rehabilitation (15), prevention and management of hazards of hospitalization (16) and the involvement of a multi-disciplinary team for the high-quality transition of care (17). Although we did not analyze these factors in this study, all may have contributed to the reduced hospital stay. Carey et al. reported that a shorter length of stay is associated with an increased rate of readmission (18). In our study, there was no statistically significant difference in the readmission rate before and after PSM, suggesting that the quality of care was not worsened by reducing the length of stay. The management flow of outpatients after discharge was similar between the two groups. There were basically no follow-up visits after admission for aspiration pneumonia unless patients experienced recurrent symptoms. A previous study suggested that a shorter length of stay might be associated with an increased rate of readmission (18). However, despite the shorter length of stay in the hospitalist group, the readmission rate was not higher than in the control group. This is presumably due to multiple preventable measures that may have counter-balanced the inferiority. For these reasons, the hospitalist system may come to play a major role in the inpatient care of elderly people at acute care hospitals in the near future.

Several limitations associated with the present study warrant mention. First, our study is an observational study, not a randomized controlled trial. While we have made adjustments to address selection bias by PSM, the possibility of missing important variables cannot be entirely excluded. Second, this study represents the practice of only one hospital. The imperative for the wider dissemination of this hospitalist model will be enhanced when others replicate our findings in additional cohorts at other hospitals.

Conclusion

In this observational study, the implementation of a hospitalist system led to significant reductions in the length of stay and costs compared with the conventional specialty-based system. Improvement in the quality of care was also noted. This study suggests that the hospitalist system can be successfully applied to the Japanese medical system.

The authors state that they have no Conflict of Interest (COI).

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References

1. Arai H, Ouchi Y, Toba K, et al. Japan as the front-runner of super-aged societies: perspectives from medicine and medical care in Japan. Geriatr Gerontol Int **15**: 673-687, 2015.
2. Iwata K, Mosby DJ, Sakane M. Board certification in Japan: corruption and near-collapse of reform. Postgrad Med J **93**: 436, 2017.
3. Ishiyama T. Critical roles of "J-Hospitalist." J Gen Fam Med **16**: 153-157, 2015.
4. Messler J, Whitcomb WF. A history of the hospitalist movement. Obstet Gynecol Clin North Am **42**: 419-432, 2015.
5. Wachter RM, Goldman L. The emerging role of "hospitalists" in the American health care system. N Engl J Med **335**: 514-517, 1996.
6. Wachter RM, Goldman L. Zero to 50,000 - The 20th Anniversary of the Hospitalist. N Engl J Med **375**: 1009-1011, 2016.
7. Auerbach AD, Wachter RM, Katz P, Showstack J, Baron RB, Goldman L. Implementation of a voluntary hospitalist service at a community teaching hospital: improved clinical efficiency and patient outcomes. Ann Intern Med **137**: 859-865, 2002.
8. Wachter RM, Katz P, Showstack J, Bindman AB, Goldman L. Reorganizing an academic medical service: impact on cost, quality, patient satisfaction, and education. JAMA **279**: 1560-1565, 1998.
9. Auerbach AD, Wachter RM, Cheng HQ, et al. Comanagement of surgical patients between neurosurgeons and hospitalists. Arch Intern Med **170**: 2004-2010, 2010.
10. van der Maarel-Wierink CD, Vanobbergen JNO, Bronkhorst EM, Schols JMGA, de Baat C. Risk factors for aspiration pneumonia in frail older people: a systematic literature review. J Am Med Dir Assoc **12**: 344-354, 2011.
11. Wada H, Nakajoh K, Satoh-Nakagawa T. Risk factors of aspiration pneumonia in Alzheimer's disease patients. Gerontology **47**: 271-276, 2001.
12. Susan E, Langmore. Risk factors for aspiration pneumonia. Nutr Clin Pract **14**: S41-S44, 1999.
13. McCulloh RJ, Smitherman S, Hospital SA. Hospitalist and non-hospitalist adherence to evidence-based quality metrics for bronchiolitis. Hosp Pediatr **2**: 19-25, 2012.
14. Niederman MS. In the clinic: community-acquired pneumonia. Ann Intern Med **163**: ITC1-ITC17, 2015.
15. Gruther W, Pieber K, Steiner I, Hein C, Hiesmayr JM, Paternostro-Sluga T. Can early rehabilitation on the general ward after an intensive care unit stay reduce hospital length of stay in survivors of critical illness?: a randomized controlled trial. Am J Phys Med Rehabil **96**: 607-615, 2017.
16. Schimmel EM. The hazards of hospitalization. Qual Saf Health Care **12**: 58-64, 2003.

17. Allen J, Hutchinson AM, Brown R, Livingston PM. Quality care outcomes following transitional care interventions for older people from hospital to home: a systematic review. BMC Health Serv Res **14**: 346, 2014.
18. Carey K, Lin M-Y. Hospital length of stay and readmission: an early investigation. Med Care Res Rev **71**: 99-111, 2014.

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