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The Impact of Admission Diagnosis on Recurrent or Frequent Hospitalizations in 3 Dementia Subtypes

A Hospital-Based Cohort in Taiwan with 4 Years Longitudinal Follow-Ups

Chiung-Chih Chang, MD, PhD, Pin-Hsuan Lin, MSc, Ya-Ting Chang, MD, Nai-Ching Chen, MD, Chi-Wei Huang, MD, PhD, Chun-Chung Lui, MD, Shu-Hua Huang, MD, Yen-Hsiang Chang, MD, Chen-Chang Lee, MSc, and Wei-An Lai, MD

Abstract: Increasing numbers of patients with different types of dementia have resulted in the increasing medical care loads. It is not known whether explanatory factors for recurrent or prolong hospitalization were driven by the subtypes of dementia. We analyzed 203 dementia patients aged >65-year-old with a clinical diagnosis of Alzheimer disease (AD), vascular dementia (VaD), or Parkinsonism-related dementia (PRD). With a 4-year follow-up period, logistic regression analyses were used to identify predictors of dementia diagnosis, cerebrovascular risk factors, chronic systemic diseases, and the etiology for admission for recurrent (>4 times/4 years) or prolonged hospitalization stay (>14 days per hospitalization). There were 48 AD, 96 VaD, and 59 PRD patients that completed the 4-year study. The average length of hospital stay was significant, the shortest in AD and the longest in PRD ($P = 0.01$), whereas the frequency of hospitalization was not different among 3 dementia subtypes. Although delirium is the most common etiology for admission in the patients, diabetes mellitus (Odds ratio, $OR = 2.79$, $P = 0.02$), pneumonia ($OR = 11.21$, $P < 0.001$), and fall-related hip fracture ($OR = 4.762$, $P = 0.029$) were significantly associated with prolong hospitalization. Patients with coronary artery disease ($OR = 9.87$, $P = 0.02$), pneumonia ($OR = 84.48$, $P < 0.001$),

urinary tract infection ($OR = 55.09$, $P < 0.001$), and fall-related fracture ($OR = 141.7$, $P < 0.001$) predict recurrent hospitalization. Dementia subtypes did not influence directly on the hospitalization courses. The etiologies for admission carried higher clinical significance, compared with the coexisting systemic diseases.

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Abbreviations: AD = Alzheimer's disease, CDR = clinical dementia rating, CI = confidence interval, COPD = chronic obstructive pulmonary disease, DM = diabetes mellitus, OR = odds ratio, PRD = Parkinsonism-related dementia, VaD = vascular dementia.

INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by cognitive decline and functional impairment and accounts for ~75% of all dementia cases.¹ The percentage of individuals in Taiwan aged ≥ 65 years has increased from 4.1% in 1980 to 10.7% in 2010, and this increase in aging population leads to an increase in the prevalence of AD.² Although the high intrahospital prevalence of patients having a clinical diagnosis of dementia addresses its clinical impacts on increasing medical care loads,³ the presence of dementia also indicated longer overall hospitalization length and more frequent admissions.^{4,5} In a 3-year follow-up study,⁶ two-thirds of AD patients received at least 1 admission and 47% received 2 or more hospitalization.

Factors related to frequent admissions in dementia are different from those resulting into prolong hospital stay. The etiology for recurrent admission included syncope, falls, ischemic heart disease, gastrointestinal disease, pneumonia, and delirium.^{6,7} In contrast, explanatory etiologies for prolonged hospital stay were delirium, walking difficulties, or low social quality of life.⁸ In a large-scale study, 30% of dementia patients had coronary heart disease, 29% of diabetes mellitus (DM), 22% of congestive heart failure, 17% of chronic kidney disease and chronic obstructive pulmonary disease, 14% of stroke, and 9% of cancer.⁷ Comparing with the parameters related to frequent or prolong hospitalizations, it is not known whether the coexisting medical conditions in dementia patients or etiology for admission exert higher clinical significance. If the coexisting systemic diseases predicted the hospitalization outcomes in dementia patients, these clinical profiles deserve proper emphasis on designing treatment plans in order to reduce the economic burden in insured elderly people.

In the neurodegenerative dementia spectrum, AD, vascular dementia (VaD), Lewy body dementia, Parkinson's disease dementia, and frontotemporal dementia are considered as the

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From the Cognition and Aging Center, Department of Neurology, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan (CCC, YTC, NCC, CWH); Department of Health and Beauty, Shu-Zen College of Medicine and Management, Kaohsiung, Taiwan (PHL); Department of Radiology, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan (CCL, CCL); Department of Nuclear Medicine, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan (SHH, YHC); and Department of Family Medicine, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan (WAL).

Correspondence: Chiung-Chih Chang, Cognition and Aging Center, Department of Neurology, Kaohsiung Chang Gung Memorial Hospital, 123, Ta-Pei Road, Niasung, Kaohsiung 833, Taiwan (e-mail: neur099@adm.cgmh.org.tw).

Wei-An Lai, Department of Family Medicine, Kaohsiung Chang Gung Memorial Hospital, 123, Ta-Pei Road, Niasung, Kaohsiung 833, Taiwan (e-mail: b9005034@adm.cgmh.org.tw).

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most common disease entities.^{9,10} Cerebrovascular risk factors and physical disabilities are considered more likely to associate with VaD.^{10–12} Although AD is generally considered as a disease model targeting at the gray matter, recent advances in neuroimaging survey also highlighted the clinical significance of cerebrovascular risk factors such as silent brain infarcts, peripheral or deep white matter hyperintensities.^{13,14} For dementia patients with parkinsonism symptoms,¹⁵ gait disturbance, hallucination, and cerebral white matter changes also coexisted.¹⁶ Although most studies address the differences of risk factors between the dementia and nondementia groups,^{3,10,17,18} the associated systemic diseases among the dementia subtypes are different which may carry different weightings.

In this study, we hypothesized the major explanatory factor for recurrent or prolong hospitalization were driven by etiology for admission rather than the different coexisted systemic diseases or subtypes of dementia. In a tertiary referral hospital-based cohort and an observation period of 4 years, we explored the roles of dementia subtypes, cerebrovascular risk factors, systemic diseases, and the etiology for admission in predicting recurrent or prolong hospitalization. We also analyzed factors associated with mortality during the follow-up period.

Material and Methods

This is an observational cohort study with observation periods from 2007 to 2014 at the department of Neurology of Kaohsiung Chang Gung Memorial Hospital. Only the dementia patient that received their first admission during 2007 to 2010 was enrolled. The clinical diagnosis of dementia was reached by the comprehensive neurological, neuropsychological, and functional assessment based on a consensus in a multidisciplinary conference, as detailed previously.^{16,19,20} Logistic regression analyses were used to identify predictors of recurrent or prolong hospitalization within 4 years follow-up period.

Inclusion and Exclusion Criteria

We analyzed data from 3 types of dementia patients, AD, VaD, and Parkinsonism-related dementia (PRD). All the AD patients fulfilled the dementia criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition²¹ and the probable Alzheimer's disease criteria of the National Institute of Neurological and Communicative Disorders and Stroke-Alzheimer's Disease and Related Disorders Association.²² The VaD diagnosis was according to the NINDS-AIREN diagnostic criteria.²³ The PRD group included Parkinson disease dementia,²⁴ dementia with Lewy bodies,²⁵ and frontotemporal dementia.^{9,10} For neuroimaging studies, the diffusion weighted imaging, fluid attenuated inversion recovery, and T1 weighted images were available,¹⁹ for supporting the clinical diagnosis, differentiation for acute versus previous stroke events and for analysis of comorbid intracranial conditions.

Other eligible criteria included an age >65 years and a clinical dementia rating (CDR) score of 1 or 2 on enrollment. The rationale for setting up a CDR score criteria was to avoid the advanced physical disabilities related to the brain pathology.

The exclusion criteria included end-stage renal disease defined as chronic kidney disease stage 5,²⁶ hepatic failure related to cirrhosis combines, hepatic encephalopathy, portal (gastropathy or variceal) hypertensive bleeding,²⁷ or a combination of any forms of cancer. The rationale for setting these exclusion criteria were to avoid repeated admissions that were related to irreversible single etiology. After using these

exclusion criteria, the study sample for analysis comprised 203 subjects (Figure 1). The hospital's Human Ethics Committee approved the study protocol.

Independent Variables

Gender, age, diagnosis of dementia, etiology for admission, and the systemic risk factors were considered as independent variables. If the patient was admitted to other hospital during the follow-up period, the medical records for the independent variables were also collected for further analysis.

The systemic risk factors are classified as: (1) cerebrovascular risk factors that included hypertension, DM, hyperlipidemia, coronary artery disease, and previous clinical or neuroimaging evident stroke, and (2) the chronic systemic risk factors that included chronic obstructive pulmonary disease (COPD), chronic kidney disease, liver disease, or mixed gastroenteric disease.

Hypertension was defined according to the criteria of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure with a blood pressure > 140/90 mm Hg at 2 time points.²⁸ Diabetes mellitus was defined as plasma glucose > 126 mg/dL after an overnight fast, or symptoms of diabetes with random plasma glucose > 200 mg/dL.²⁹ The diagnosis definitions for hyperlipidemia as low-density lipoprotein cholesterol (LDL-C) levels > 100, chronic kidney disease as the glomerular filtration rate between 15 and 60 mL/min/1.73 m² for 3 months²⁶ and liver disease as diagnosis record of hepatitis B/C infection or parenchymal liver disease.

Major Clinical Outcomes

The length of admission per hospitalization and frequency of admission during the 4-year follow-up period were recorded as the major outcomes. Patients with length of admission \geq 14 days per hospitalization or admission frequency \geq 4 times during the 4 years of follow-up were considered as the poor outcome group. For patients that deceased during the 4-year follow-up, we also analyzed the last admission etiology, intervals from the first admission and the comorbidities.

Statistical Analysis

Statistical analysis was performed using SPSS Statistics 12.0 (SPSS Inc, Chicago, IL). Statistical significance for intergroup difference was assessed by the chi square test for categorical variables, or by analysis of variance with post-hoc analysis for continuous variables, as appropriate. To assess the relationships between continuous variables, Pearson's correlation coefficients or Spearman's rank correlation coefficients were calculated with a corresponding 2-sided significance test at the 0.05 significance level. To assess the appropriateness of using parametric statistics for these analyses, we used the Kolmogorov-Smirnov test to examine the normality, and *P* values > 0.05 indicated no significant deviations from normality. Logistic regression analysis was chosen to determine the odds ratio (OR) and the 95% confidence interval (CI) of the established factors that included dementia diagnosis, cerebrovascular risk factors, chronic systemic diseases, etiology for admission for poor clinical outcomes groups and for mortality analysis. A *P* value < 0.05 was considered statistically significant.

RESULTS

Demographic Data Comparisons in 3 Dementia Groups

There were 203 patients that completed the study. Although age or gender effects were not significantly different

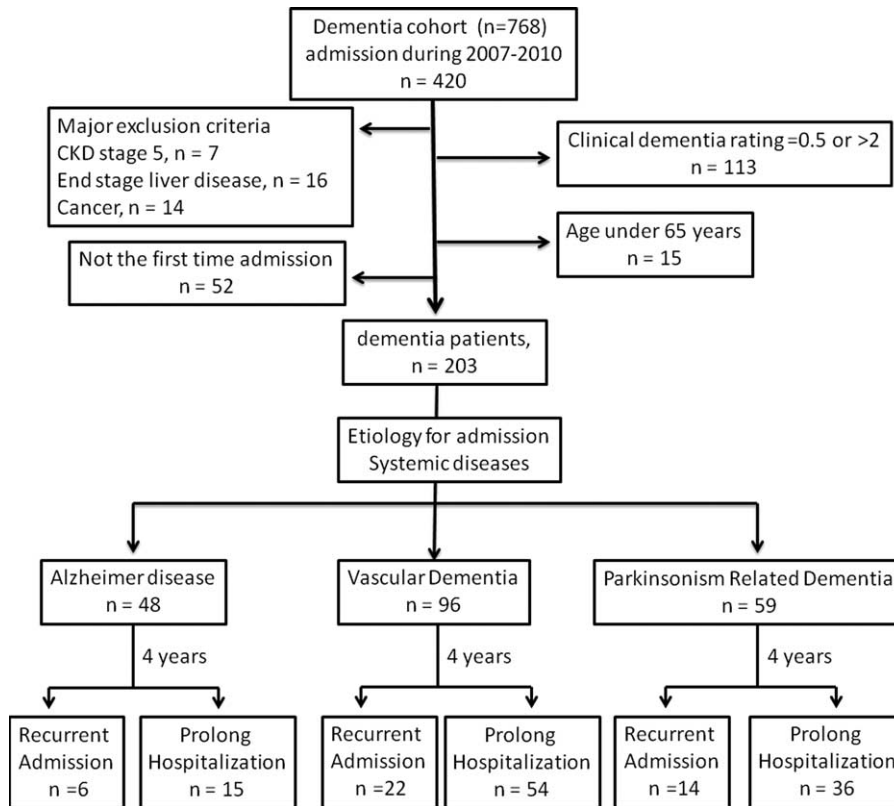


FIGURE 1. Flowchart detailing subject enrollment. The study sample for analysis comprised 203 subjects within 3 major dementia subtypes.

among 3 dementia groups, a significant shorter hospitalization stay was found in AD compared with VaD or PRD (Table 1). The admission frequencies were not different among 3 dementia groups. Using the clinical dementia rating score, we further divided the patients into 2 severity groups (CDR 1 or 2) and compared their hospitalization duration. There were no significant differences in hospitalization duration between 2 severity groups in any of the 3 dementia subtypes (all $P > 0.5$).

We examined the presence of risk factors among the dementia groups (Table 1). Patients with VaD had significant higher frequencies of clinical stroke history compared with the other 2 groups ($P < 0.001$). There were 34 VaD patients (35.4%) not knowing clinical history of stroke prior to the neuroimaging data. The neuroimaging findings of these patients included infarctions in the anterior thalamus ($n = 17$), medial temporal regions ($n = 12$), and posterior cerebral artery ($n = 2$). The VaD patients also had a significantly higher frequencies having 3 or more cerebrovascular-related risk factors compared with PRD (OR 2.382, 95% CI 1.175–4.826, $P = 0.009$) or with AD subgroup (OR 1.385, 95% CI 1.184–1.619, $P = 0.001$). The presence of chronic systemic diseases is not significantly different among 3 dementia groups (Table 1).

Logistic Regression of Primary Etiology for Admission in the Dementia Groups

For all patients, etiology for admission in descending order were acute delirium, newly onset stroke, pneumonia, fall-related hip fracture, and urinary tract infection (Table 1). For group analysis, patients with AD had higher frequency of acute

delirium compared with VaD (OR 1.829, 95% CI 1.313–2.547, $P = 0.001$) or with ODD (OR 1.639, 95% CI 1.135–2.366, $P = 0.007$). Patients with VaD had higher frequency of fall-related fracture compared with ODD (OR 4.302, 95% CI 1.014–18.261, $P = 0.026$) or with AD (OR 8.024, 95% CI 1.023–62.972, $P = 0.021$). There was no significant difference in any types of infection (pneumonia, urinary tract infection) among 3 subtypes of dementia (all $P > 0.05$).

There was a total of 478 times of admission within 4 years (Table 2). Acute delirium still represent the most frequent diagnosis for admission (26.5%), followed by infection, acute stroke, seizure, heart disease, fall-related fracture, gastrointestinal disease, and parkinsonism.

There were 188 admissions that had hospitalization over 14 days (Table 2). The etiologies in descending order included infection (31%), acute stroke (20%), and acute delirium (14%). There were 42 patients that received ≥ 4 times admission in 4 years. After a review of the etiology for admission, infection (60%), seizure (12%), and heart disease (10%) were found.

Analysis of Predictors for Prolong or Recurrent Admission

Table 3 shows the results of the multivariable logistic regression analyses conducted to clarify the predictors of prolonged hospitalization or recurrent admission according to the predefined factors.

Age showed no relationships with either prolonged hospital stay ($r = 0.089$, $P = 0.209$) or recurrent hospitalization ($r = 0.076$, $P = 0.280$). The clinical subtypes of dementia

TABLE 1. Clinical Data of the Patients With Different Dementia Subtypes

	All Patients (n = 203)	Dementia Subtype			P Value
		Alzheimer Disease (n = 48)	Vascular Dementia (n = 96)	Parkinsonism-Related Dementia (n = 59)	
Age, years	77.6 ± 6.0	77.6 ± 6.0	78.0 ± 6.1	77.1 ± 5.9	0.664
Gender, male/female	111/92	22 / 26	53 / 43	36 / 23	0.289
Admission frequencies in 4 years (total)	2.3 ± 1.8 (472)	1.8 ± 1.2	2.5 ± 1.9	2.5 ± 2.0	0.056
Average stay per hospitalization (days)	15.4 ± 13.6	10.2 ± 9.2	16.8 ± 12.9*	17.4 ± 16.5*	0.010
Death	9 (4.4%)	2 (4.2%)	3 (3.1%)	4 (11.9%)	0.559
Cerebrovascular risk factor					
Diabetes mellitus	67 (33.3%)	10 (20.8%)	33 (34.4%)	24 (40.7%)	0.088
Hypertension	130 (6.4%)	28 (58.3%)	67 (69.8%)	35 (59.3%)	0.269
Hyperlipidemia	33 (16.3%)	8 (16.7%)	17 (17.7%)	8 (13.6%)	0.791
Coronary artery disease	16 (7.9%)	4 (8.3%)	6 (6.3%)	6 (10.2%)	0.673
Presence of stroke	103 (50.70%)	0 (0.0%)**	96 (100%)	7 (11.9%)**	<0.001
Chronic systemic disease					
Liver disease	5 (2.5%)	0 (0.0%)	2 (2.1%)	3 (5.1%)	0.228
Chronic kidney disease	29 (14.3%)	4 (8.3%)	13 (13.5%)	12 (20.3%)	0.202
Chronic obstructive pulmonary disease	14 (6.9%)	1 (2.1%)	9 (9.4%)	4 (6.8%)	0.266
Mix gastroenteric disease	11 (5.4%)	1 (2.1%)	6 (6.3%)	4 (6.8%)	0.500
Five primary etiology for admission					
Acute delirium	91 (44.8%)	32 (66.7%)	35 (36.5%)*	24 (40.7%)*	0.002
Newly onset stroke	49 (24.1%)	5 (10.4%)**	33 (34.4%)	11 (18.6%)**	0.003
Pneumonia	36 (17.7%)	5 (10.4%)	19 (19.8%)	12 (20.3%)	0.314
Fall-related hip fracture	17 (8.4%)	1 (2.1%)**	14 (14.6%)	2 (3.4%)**	0.010
Urinary tract infection	15 (7.3%)	3 (6.2%)	8 (8.3%)	4 (6.8%)	0.883

Values are expressed in mean ± standard deviation or number (percentage).

* P < 0.05 versus Alzheimer disease

** P < 0.05 versus Vascular dementia.

showed no significant differences in either duration or frequency outcomes ($P > 0.05$). In cerebrovascular risk factors, DM (OR 2.794, 95% CI 1.173–6.656, $P = 0.02$) was associated with prolonged hospitalization whereas coronary artery disease (OR 9.873, 95% CI 1.369–71.188, $P = 0.023$) was associated with frequent admission. There was no significance with regard

to chronic systemic disease for either prolonged hospitalization or frequent admission.

For admission etiology analysis, pneumonia and fall-related fracture independently determined higher hospitalization duration, whereas pneumonia, urinary tract infection, or fall-related fracture predicted recurrent institution.

TABLE 2. Outcome Analysis of 472 Admissions Involving 203 Patients Within the 4-Year Follow-Up Period

	Number (%) (n = 472)	Average Duration (days)	≥ 14 Days Per Hospitalization (%) (n = 188)	≥ 4 Times Hospitalization in 4 Years (%) (n = 42)
Acute delirium	125 (26.5%)	12.9 ± 17.5	27 (14%)	0
Infection	111 (23.5%)	21.0 ± 17.9	59 (31%)	25 (60%)
Acute stroke	75 (15.9%)	18.3 ± 15.0	37 (20%)	0
Seizure	25 (5.5%)	30.5 ± 32.8	18 (10%)	5 (12%)
Heart disease	24 (5.1%)	17.6 ± 22.8	9 (5%)	4 (10%)
Fall-related fracture	22 (4.7%)	13.7 ± 13.2	6 (3%)	0
Gastrointestinal disease	20 (4.2%)	17.6 ± 10.8	11 (6%)	0
Parkinsonism	16 (3.4%)	11.0 ± 7.1	4 (2%)	0

Values are expressed in mean ± standard deviation.

Infection: pneumonia, urinary tract infection, cellulitis, intra-abdomen infection, diverticulitis, cholecystitis, liver abscess, biliary tract infection, colitis, empyema, pressure sore.

Gastrointestinal disease: upper gastrointestinal bleeding, jaundice, abdomen distention with constipation, bowel perforation, nausea and vomit, biliary duct stone.

Heart disease: acute coronary syndrome, acute myocardial infarction, heart failure, aneurysm rupture, syncope.

TABLE 3. Logistic Regression Analysis for Determinants of Poor Outcome Within the 4 Year Follow-Up Period

	≥ 14 Days Per Hospitalization			≥ 4 Times Admission in 4 Years		
	Odds Ratio	95% CI	P Value	Odds Ratio	95% CI	P Value
Male gender	1.329	0.668–2.646	0.418	3.230	0.900–11.595	0.072
Alzheimer dementia	2.377	0.927–6.091	0.071	1.179	0.242–5.742	0.839
Vascular dementia	1.236	0.480–3.178	0.661	5.308	0.799–36.171	0.088
Parkinsonism-related dementia	1.566	0.792–3.096	0.197	1.250	0.564–2.771	0.583
Cerebrovascular risk factors						
Diabetes mellitus	2.794	1.173–6.656	0.020	1.669	0.416–6.691	0.470
Hypertension	0.752	0.356–1.589	0.445	0.395	0.107–1.453	0.162
Hyperlipidemia	0.382	0.131–1.120	0.080	1.119	0.129–9.721	0.919
Coronary artery disease	1.171	0.392–3.499	0.778	9.873	1.369–71.188	0.023
Presence of stroke	0.539	0.179–1.621	0.271	2.415	0.299–19.484	0.408
≥3 Cardiovascular risk factors	1.500	0.419–5.362	0.533	0.609	0.060–6.200	0.675
Chronic systemic disease						
Liver disease	1.760	0.150–20.664	0.653	1.837	0.017–204.166	0.800
Chronic kidney disease	0.881	0.316–2.456	0.808	0.630	0.096–4.151	0.631
Chronic obstructive pulmonary disease	3.588	0.583–22.091	0.168	0.495	0.053–4.649	0.538
Mix gastroenteric disease	3.460	0.422–27.067	0.237	2.784	0.277–27.949	0.384
Etiology for admission						
Acute delirium	0.637	0.307–1.322	0.226	2.154	0.615–7.546	0.230
Newly onset stroke	1.924	0.839–4.414	0.122	2.574	0.576–11.504	0.216
Pneumonia	11.213	3.396–37.017	<0.001	84.484	18.943–394.829	<0.0001
Urinary tract infection	2.430	0.615–9.591	0.205	55.094	7.745–391.889	<0.0001
Fall-related fracture	4.762	1.176–19.288	0.029	141.704	14.693–1366.658	<0.0001

CI = confidence interval.

Mortality Analysis

During the 4-year follow-up period, there were 9 patients (AD, n = 2; VaD, n = 3; PRD, n = 4) that died with an average age of 74 ± 5.7 (range: 67–82) year old. The majority etiology at the last admission was sepsis related to pneumonia (78%) (Supplementary Table 1, <http://links.lww.com/MD/A523>). Comorbidities and cerebrovascular risk factors were not different between the survival and mortality groups (Supplementary Table 2, <http://links.lww.com/MD/A523>).

DISCUSSION

Major Findings

With a 4-year follow-up period, the study investigated whether dementia diagnosis, predefined risk factors, and etiology for admission can influence the recurrent or prolonged hospitalization. Our study showed that the etiologies for admission provided higher clinical weighting, compared with the dementia subtypes or coexisted medical conditions, for prediction of prolonged or recurrent hospitalization. Fall-related hip fracture and pneumonia were important explanatory factors for both recurrent and prolong hospitalization. In contrast, the most frequent etiology for admission in the patients was delirium, but it was not related either to prolonged or recurrent admission. Second, the dementia subtypes are associated with unique etiology for admission. On the ground of similar demographic data and risk determinants, a higher proportion in AD received admission for acute delirium while VaD with fall-related hip fracture or newly onset stroke. Third, the only significant systemic risk factor to differentiate the dementia subtype is

stroke in VaD. The observation suggested a relatively parallel systemic disease load among 3 subtypes of dementia.

Predictors Associated With Prolong or Recurrent Admission

As dementia is considered as the most frequent disease in hospitalized elderly patients,¹⁷ the medical complications in dementia have received increasing attention. Patients with dementia had higher risks for pneumonia,^{30,31} atherosclerosis or cerebrovascular disease, fall-related hip fracture, and delirium³¹ and lower risks for cancer, mix gastroenteric disease,¹⁰ or circulatory disorders.³¹ Consistent with the coexisted systemic diseases profiles in the literature, our study results further pointed to the differences of dementia subtypes with regard to the duration of hospitalization. Alzheimer disease patients had the shortest and the PRD had the longest stay although the systemic diseases were not significantly different between these 2 subtypes. Of specific note, our study suggested that the etiology for frequent or prolong hospitalization was not driven by any single medical condition or dementia diagnosis.

Pneumonia is 1 independent etiology accounting for recurrent and prolonged hospitalization in this study among 3 dementia subtypes. Although pneumonia is often considered as treatable, the treatment outcome might not be reversible in this study as the majority of mortality cases were related to sepsis from pneumonia. The presence of oropharyngeal dysphagia³² or impaired cough reflex³³ is strongly linked with pneumonia risk in dementia patients which could be deteriorating as disease progress. Of specific notes, as our study population represented mild to moderate dementia patients, the effect

of pneumonia can be much severe in the advanced stage patients. That is to say, our study results may underestimate the impact of pneumonia in dementia population.

Another predictor for prolong or recurrent admission is hip fracture related to fall. Although it is especially significant in our VaD patients, our patients with AD and PRD also experienced hip fracture related to falls. Although dementia already been known to represent a risk factor for easily falls,³⁴ a relatively conservative attitude in physician to orthopedic surgery may be encountered.³¹ The association with frequent admissions and longer hospitalization stays here pointed to the importance of sophisticated treatment plan setting at the first admission if it was related to falls. Other actions to reduce such admissions should be taken. Both exercise training³⁵ and adequate balance in protein and energy supply³⁶ were considered as efficient solutions to strengthen the core body muscle as sarcopenia was frequently found in the elders. At the same time, the physical training may also improve the cognitive and behavior functions in these patients.

Unique Etiologies for Admission Stratified by Dementia Subtypes

In a systemic review, the prevalence of delirium was 22% to 89% in the hospitalized dementia populations of age >65.^{37,38} Dementia and delirium were highly correlated because the presence of dementia was found to be independently associated with the development of delirium in the institution.³⁸ The insufficient physiological reserves to cope with metabolic disturbances, age-related cerebral blood flow decline, or lower concentrations of brain neurotransmitters are possible pathophysiologic mechanisms that explain why dementia patients are more likely to develop delirium.³⁹ Consistent with the age of the aforementioned study population, our study identified that delirium was the most frequent etiology for admission in dementia patients. It accounts for 44.8% of patient population at the first admission in our study population and 26.5% of admission within 4 years. In dementia subtypes analysis here, delirium is the most frequent etiology for admission in AD. Of specific notes, although delirium is commonly encountered in dementia population, our study suggested a relatively benign course. Further investigation is needed to understand why delirium is more commonly seen in our AD cohorts compared with the other 2 subtypes.

Analysis of Cerebrovascular Risk Factors Among Dementia Subtypes

In this study, DM was found to relate to the prolong hospitalization that could be driven by DM-related complications such as neuropathy or angiopathy highly associated with events of falls.⁴⁰ However, the prolonged hospitalization stays could also be related to the synergic effects of the complications such as stroke, cardiovascular disease, or peripheral vascular disease.^{41–43}

Evidence suggests that other cerebrovascular risk factors including cerebral atherosclerosis, vasculopathies, or uncontrolled hypertension are important in the pathogenesis of late-onset AD,⁴⁴ VaD,⁴⁵ and PRD.^{10,46} Although comparable systemic disease loads in our 3 dementia subtypes was found, it may be related to our statistic model because we treated the systemic diseases as independent variables. As these factors can be highly coherent, how 1 single risk factor exerts its independent clinical impact that modulates the clinical profiles in dementia subtypes is not established here.

Limitations

There were several limitations in our study. The first limitation is related to the patient selection criteria. As we only selected mild to moderate dementia patients, our study results may have underestimated the effect of systemic diseases related to the advanced degeneration process and therefore, some systemic diseases may show higher impacts. However, as the mild to moderate dementia population still retained partial functions for daily livings, the selection criteria were made to emphasize the possible intervention strategies in the clinical setting. Second, the results here pointed to the clinical weightings among these risk factors but they were treated as independent variables in this study. There may be complex interactions among these factors that should not be over-simplified. Meanwhile, although we pointed out the etiologies for prediction of prolong and recurrent hospitalization, the upstream and downstream relationships among these factors are not established here. Lastly, the national health insurance system in Taiwan is unique, as the entire Taiwanese residents received full insurance reimbursement within 1 care system. Therefore, the study results may not represent general situation in other countries shared different medical care systems.

CONCLUSION

In conclusion, our study suggested the etiology for admission, rather than the dementia subtypes or coexisted systemic disease, had higher predictive values for frequent and prolong hospitalization in dementia patients. Admission related to pneumonia and fall-related fractures are important factors associated with recurrent and longer hospitalization. On the ground of similar systemic diseases profiles, the etiologies for admission and the average length of stay are different among dementia subtypes. Patients with AD stayed in the hospital shorter and they often received admission for delirium. Vascular dementia patient often admitted for stroke and fall-related hip fracture and the longest hospital stay is the PRD patients.

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