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Nationwide analysis of medical utilization in people with severe mental illness receiving home care case management

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ABSTRACT

Aim: This nationwide study investigated the change in medical utilization of psychiatric home care case management (CM).
Methods: This nationwide study enrolled patients receiving CM (N = 10,274) from January 1, 1999 to December 31, 2010, from Taiwan's National Health Insurance Research Database. Through a 2-year mirror-image comparison weighted by the contributed person-time for each subject, we evaluated changes in medical utilization. Furthermore, a case-crossover analysis was used to verify the independent effect of CM in changing medical utilization by adjusting the time-variant variables between the pre-2-year (within 2 years before receiving CM) and post-2-year (within years after receiving CM) periods. The same methodology was applied for the subsequent 2-year comparison to assess the maintenance effect.
Results: Of the 10,274 patients receiving CM, 69.7% had schizophrenia. The results showed a chronological trend for the intervention of CM. The adjusted mirror-image analysis revealed a significant decrement of psychiatric and involuntary admissions after the intervention, and the utilization shifted toward psychiatric outpatient service. The case-crossover analysis with the adjustment of time-variant covariates confirmed the independent effect of CM on the changes of medical utilization. The comparable effect persisted after the next 2 years of intervention. However, CM showed no impact on lowering the admission rate for comorbid physical illnesses after the intervention.
Conclusions: The CM model can effectively reduce psychiatric hospitalization and involuntary admission frequency but has no effect on comorbid physical illnesses. Care models aimed at ameliorating physical problems in such patients are needed.

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1. Introduction

People with severe mental disorders often experience a chronic course that greatly affects their quality of life and require repeated hospitalizations (Patel et al., 2016). Due to the prolonged nature of their condition, long-term treatment is usually appropriate. Even the deinstitutionalization policies of the 1960s decreasing long-term hospitalization and mortality rates in psychiatric patients have not satisfactorily narrowed the gap of mortality between psychiatric patients and the general population (Nordentoft et al., 2013; Wahlbeck et al., 2011). This situation is reflected by the increase in the global disease burden attributable to mental disorders. The quality of services for mental health is often worse than that of services for physical health (Patel et al., 2018). The likelihood of death in people with severe mental disorders can contribute to preventable physical diseases or unnatural causes of death, including suicide, homicide, and accidents (John et al., 2018; Liu et al., 2017; Olfson et al., 2015). In addition, excess mortality in people with severe mental disorders is a public health concern, particularly among those not receiving proper interventions (Patel et al., 2018; Thornicroft et al., 2010). A survey (Bijl et al., 2003) in Canada, Chile,

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Germany, the Netherlands, and the United States showed that annually, one-third to two-thirds of patients with serious mental disorders received no treatment, particularly young and poorly educated men. Therefore, the provision of high-quality mental health care is vital for reducing disease burden attributable to mental disorders. Accordingly, community outreach aims to reduce health care barriers for patients with severe mental disorders and provide them with appropriate mental health services.

Intensive case management (ICM) is a widely accepted community-based care package aiming to provide long-term care for people with severe mental illness. ICM evolved from community models of the Assertive Community Treatment (ACT) and. ICM emphasizes the importance of small caseloads (typically fewer than 20) and high-intensity input. The latest meta-analysis results (Dieterich et al., 2017) indicate that ICM effectively ameliorates many symptoms of severe mental illness, reduces hospitalization, and increases retention of care. However, CM is different from ICM in that it handles caseloads of >20 people. It is likely to be a common practice in places where limited resources have been allocated to community care (Chang et al., 2013). In addition, the UK700 trial (Burns et al., 1999) suggested that caseload is not a major factor associated with improved outcomes for hospitalization of patients with psychosis. The UK700 participants were enrolled from routine clinical settings, and the findings could be not generalized to the patients requiring outreach services. To our knowledge, the effects of CM have rarely been studied and have seldom constituted the main comparator in trials; thus, research provides only limited evidence of its benefits (Dieterich et al., 2017). In Taiwan, Chang et al. (2013) studied patients with schizophrenia who received home care CM and discovered a significant reduction in psychiatric hospital admission frequency and inpatient stay duration, but the study was limited in sample size and used a local sample. Empirical studies are required for obtaining evidence-based information on the effect of home care CM. In addition, severe mental disorders are usually comorbid with physical problems, and this represents a challenge regarding the physical health needs of these patients (Wiley-Exley et al., 2013). The effects of a CM model on physical health utilization warrant further investigation.

In 1990, Taiwan enacted the Mental Health Act, which aimed to improve health care for patients with mental disorders by implementing criteria for involuntary hospitalizations and community-based care delivery systems. The home care CM model is part of community outreach-based care programs. In this study, we enrolled a large nationwide cohort of patients who received home care CM. The current study's main objective was to investigate the effectiveness of CM by using mirror-image analysis to compare indicators before and after home care CM. Several indicators, including psychiatric and non-psychiatric admissions, outpatient services, and involuntary admissions, were included in the analysis. Furthermore, we also estimated the maintenance effect of home care CM.

2. Methods

2.1. Data sources

In Taiwan, researchers may apply for access to the National Health Insurance Research Database (NHIRD). The database contains medical claim files for the entire population in Taiwan. The Psychiatric Inpatient Medical Claims Database is a subset of the NHIRD encompassing all patients hospitalized for psychiatric illness between January 1, 1996 and December 31, 2012 (N = 266,283) with one discharge diagnosis of mental illness according to the International Classification of Diseases, Ninth Revision (ICD-9) codes 290–319. The veracity of the database is ensured by the periodic review and recertification of each hospital providing psychiatric hospitalization in Taiwan. The accreditation for qualified psychiatric services requires board-certified psychiatrists to diagnose inpatients. In addition, the database has been used for numerous epidemiological and clinical studies published in peer-reviewed journals (Chen et al., 2017; Kuo et al., 2013). The Institutional Review Board of Taipei City Hospital approved this study. A waiver of informed consent was granted because the patient information in the national claims data from the NHIRD was deidentified before analysis. All researchers signed an agreement guaranteeing patient confidentiality before using the database.

In the service of home care CM in Taiwan, a responsible hospital provided psychiatric treatment and basic medical care. The hospital program comprised a multidisciplinary team including trained psychiatrists, psychiatric nurses, and social workers. Patients received one to four face-to-face sessions per month at home to evaluate their clinical symptoms, possible adverse reactions to drugs, and social functioning status. The program provided direct provision of medications and psychotherapy to enhance medication compliance, engage uncooperative clients, and provide patients and their families with psychoeducation and counseling.

In this study, we enrolled patients who according to the medical claims had received home care CM between January 1, 1999 and December 31, 2010, and had made at least one psychiatric visit during the 2-year period before the intervention (N = 10,274). We defined the first intervention of home care CM as the baseline.

Thus, the 2-year mirror comparison and analysis uses a 2-year observation window before January 1, 1999, and a 2-year observation window after December 31, 2010, for the 2-year mirror comparison and analysis. The study subjects should have at least one psychiatric visit before to the intervention (CM) for confirming their utilization of the health insurance system. Fig. 1 presents the flowchart of subject enrollment (N = 10,274). For further analysis of the 4-year maintenance effect, we restricted analysis to patients who received intervention from January 1, 1999 to December 31, 2008 (N = 7871). Thus, we have a 4-year observation window after December 31, 2008.

2.2. Variables

We conducted a broad search through all claims data; the collected data included demographics, diagnoses, prescriptions, and medical expenditures from between January 1, 1997 and December 31, 2012. Information including age at the time of the first home care CM intervention, number of new incident cases per year, types of hospitals providing home care CM programs, and urbanization of hospital

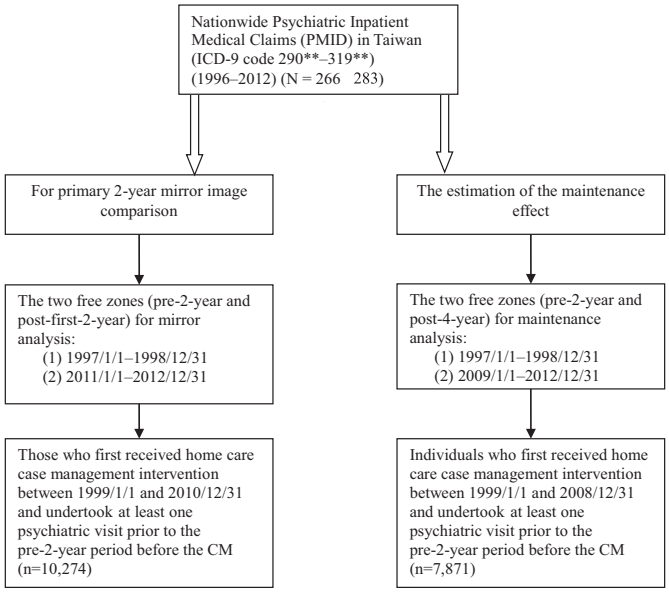

Fig. 1. Study flow diagram.

locations was recorded. We adopted urbanization stratification (Liu et al., 2006) specifically used in Taiwan, and urbanization levels were categorized as level 1 (highly urbanized area), 2 (moderately urbanized area), 3 (township area), or 4 (rural area).

We obtained Charlson comorbidity score (Charlson et al., 1987), information on physical illnesses, and information on medications used for patients receiving home care CM within 1 year before the baseline. The Charlson comorbidity index (Charlson et al., 1987) evaluates the severity of physical comorbidity for 17 comorbid conditions identified from ICD-9 codes for primary and secondary diagnoses in the NHIRD. The indices of medical utilization comprise the number of admissions, length of stay for admission, number of emergency visits, and number of outpatient visits. We further stratified the indices of medical utilization into the use of psychiatric and non-psychiatric services.

2.3. Mirror-image analysis

We applied mirror-image analysis to compare medical utilization before and after the intervention of home care CM to evaluate its effectiveness. The indices of medical utilization within 2 years before the baseline (pre-2-year period) were compared with the same period after the baseline (post-first-2-year period). For the assessing assessment of the maintenance effect of home care CM, the indices between the third and fourth years after the baseline (post-second-2-year period) were also compared with those in the 2-year period before the baseline (pre-2-year period). In both of the respective analyses, the number of each index for medical utilization was weighted according to the contributed person-time because patients could have died after the baseline. For comparability, we adjusted the number of services based on their contributed times for those who died during the study period after the baseline. For instance, if a patient died 1.5 years after the baseline and underwent two psychiatric admissions during the same 1.5-year period, we adjusted the number of psychiatric admissions using $(2 \times 2) / 1.5 = 2.67$ for the 2-year interval after the baseline. The mirror-image comparison framework is depicted in Supplementary e-Fig. 1.

2.4. Statistical analysis

The chi-square test and Student *t*-test were used to compare the demographic and clinical characteristics between male and female patients receiving home care CM. The trend for new incident cases per year in chronological order was analyzed using Spearman correlation. We calculated the distribution for comorbidities and medications used within 1 year before the baseline in the study participants. Paired *t*-tests were used in the mirror image analysis to assess the effect of home care CM between the pre-2-year and post-first-2-year periods, and the maintenance effect which was as described previously.

Regression analyses were employed to verify the significance of mirror image comparison. The potential confounders (such as physical comorbidity and concomitant medications) specifically could have influenced the medical utilization between the pre-2-year and post-first-2-year periods. Therefore, we selected the covariates related to physical comorbidity and concomitant medications for further adjustment. The covariates were also considered surrogates for disease severity. Because of the self-controlled design, we used case-crossover analysis to test the statistical significance between the pre-2-year period (control window) and post-first-2-year period (case window) by adjusting such time-variant covariates. The framework for case-crossover study is also depicted in Supplementary e-Fig. 1. All analyses were conducted using SAS (version 9.4; SAS Institute Inc.; Cary, NC, USA), and a p of <0.05 was considered significant.

3. Results

3.1. Patient characteristics

Demographic and clinical characteristics of patients receiving home care CM are detailed in Table 1 (N = 10,274). The mean age of patients was 42.5 years, and up to 69.7% of them had a diagnosis of schizophrenia. More than half (56.0%) of the home care CM interventions were provided by a regional hospital, and 36.9% of the hospital providers were located in highly urbanized areas. Data indicated that the number of incident cases receiving home care CM increased significantly each year (Spearman correlation, $p < 0.001$). The mean age was slightly higher in women than in men (44.8 vs. 40.5 years, $p < 0.001$).

3.2. Physical comorbidity and concomitant medications

About the comorbidity and medications used within the 1 year before the first use of home care CM intervention (e-Table 1 in supplement), 27.9% had at least one score of Charlson comorbidity index. A substantial portion of the patients had physical illnesses: 20.9% had cardiovascular diseases, 9.2% had diabetes mellitus, and 7.6% had chronic hepatic disease. Not including psychiatric agents, the patients were frequently using concomitant medications: 51.0% were using cardiovascular drugs, 69.2% were using respiratory drugs, and 19.2% were systemically using corticosteroids, implying complex physical problems in patients who received home care CM.

3.3. Mirror-image analysis

Mirror-image analysis (Table 2) exhibits a decrement in the number of psychiatric hospital admissions (mean difference −0.29, $p < 0.001$) after the first use of home care CM. The number of psychiatric hospitalizations decreased, but this was not the case for non-psychiatric admissions. In addition, the mean duration of stay in psychiatric facilities decreased significantly by 19.23 days. The number of involuntary admissions decreased considerably in the post-first-2-year period ($p < 0.001$). Furthermore, the number of psychiatric emergency visits significantly decreased in the post-first-2-year period.

Incrementally more psychiatric outpatient visits (n = 19.16, $p < 0.001$) were observed in the post-first-2-year period than in the pre-2-year period, but this pattern did not apply to non-psychiatric outpatient visits. The mean number of home care CM visits within 2 years after the baseline was 19.27.

3.4. Maintenance effect

Table 3 presents the maintenance effect of medical utilization between the pre-2-year and post-second-2-year (third to fourth year) period after the first-use intervention. As in mirror-image analysis (primary analysis), the number of psychiatric service admissions declined significantly for inpatient psychiatric hospitalizations and involuntary admissions. The number of psychiatric emergency visits also declined significantly. The mean length of stay declined for psychiatric admissions but slightly increased for non-psychiatric admissions. In addition, we found a distinct increment in the number of psychiatric outpatient visits (n = 9.74, $p < 0.001$).

We furthermore conducted mirror-image analysis to compare the indices between the first and second 2-year periods after the first-use intervention (baseline; Supplementary e-Table 2). Nearly all the indices listed in Supplementary e-Table 2 declined in the later period, including the number of admissions (psychiatric and nonpsychiatric), length of hospital stay, number of involuntary hospital admissions, number of emergency visits, and number of outpatient visits. The mean number of home care CM visits also decreased from 19.25 to 11.20.

Table 1
Clinical and demographic characteristics of patients receiving home care case management (N = 10,274).

Characteristics at baseline	Men (n = 5573) n (%)*	Women (n = 4701) n (%)*	Total (n = 10,274) n (%)*	*p*-Value
Age (y), mean ± SD	40.5 ± 12.9	44.8 ± 14.4	42.5 ± 13.7	<0.001
Age (categorical, y)				<0.001
<18	35 (0.6)	17 (0.4)	52 (0.5)	
18–29	1001 (18.0)	624 (13.3)	1625 (15.8)	
30–39	1909 (34.3)	1233 (26.2)	3142 (30.6)	
40–49	1546 (27.7)	1272 (27.1)	2818 (27.4)	
50–59	617 (11.1)	819 (17.4)	1436 (14.0)	
60–69	232 (4.2)	409 (8.7)	641 (6.2)	
70–79	176 (3.2)	240 (5.1)	416 (4.0)	
≥80	57 (1.0)	87 (1.9)	144 (1.4)	
Principal psychiatric diagnosis (ICD-9 code)				<0.001
Schizophrenia (295, except 295.7)	3972 (71.3)	3190 (67.9)	7162 (69.7)	
Schizoaffective disorder (295.7)	186 (3.3)	198 (4.2)	384 (3.97)	
Bipolar disorder (296.0–296.16, 296.4–296.81, 296.89)	370 (6.6)	418 (8.9)	788 (7.97)	
Others	1045 (18.8)	895 (19.0)	1940 (19.7)	
Hospital level providing home care CM				<0.001
Medical center	566 (10.2)	640 (13.6)	1206 (11.7)	
Regional hospital	3095 (55.5)	2660 (56.6)	5755 (56.0)	
District hospital	1831 (32.9)	1343 (28.6)	3174 (30.9)	
Local clinic	9 (0.2)	5 (0.1)	14 (0.1)	
Others	72 (1.3)	53 (1.1)	125 (1.2)	
Urbanization†				<0.001
Level 1	1934 (34.7)	1856 (39.5)	3790 (36.9)	
Level 2	1071 (19.2)	953 (20.3)	2024 (19.7)	
Level 3	669 (12.0)	469 (10.0)	1138 (11.1)	
Level 4	1289 (23.1)	920 (19.6)	2209 (21.5)	
Level 5	610 (10.9)	503 (10.7)	1113 (10.8)	
New incident cases per year				0.090
1999	348 (6.2)	262 (5.6)	610 (5.9)	
2000	466 (8.4)	352 (7.5)	818 (8.0)	
2001	295 (5.3)	240 (5.1)	535 (5.2)	
2002	406 (7.3)	299 (6.4)	705 (6.9)	
2003	341 (6.1)	309 (6.6)	650 (6.3)	
2004	390 (7.0)	349 (7.4)	739 (7.2)	
2005	457 (8.2)	404 (8.6)	861 (8.4)	
2006	416 (7.5)	386 (8.2)	802 (7.8)	
2007	566 (10.2)	538 (11.4)	1104 (10.7)	
2008	566 (10.2)	481 (10.2)	1047 (10.2)	
2009	715 (12.8)	551 (11.7)	1266 (12.3)	
2010	607 (10.9)	530 (11.3)	1137 (11.1)	

* Data represented as percentages unless indicated otherwise.
† Level 1 indicates a highly urbanized area.

Table 2
Mirror-image analysis for medical utilization between pre-2-year and post-first-2 year periods after home care case management and the multivariate case-crossover study to test the significance for each index of medical utilization (N = 10,274).

Medical utilization index	Pre-2-year period (within 2 years before baseline)	Post-first-2-year period (within 2 years after baseline)[a]	Difference	Paired *t*-test	*p*-Value	Adjusted risk ratio[b]	95% CI	*p*-Value
	Mean ± SD	Mean ± SD						
Admissions (n)								
Psychiatric	1.61 ± 1.89	1.32 ± 2.38	−0.29	14.90	<0.001	0.973	0.962–0.985	<0.001
Non-psychiatric	0.42 ± 1.16	0.42 ± 1.20	0.00	0.00	1.00	1.001	0.983–1.020	0.875
Length of stay (days)								
Psychiatric	46.32 ± 80.29	27.09 ± 76.57	−19.23	18.33	<0.001	0.998	0.998–0.999	<0.001
Non-psychiatric	0.95 ± 5.20	2.18 ± 18.76	1.23	4.49	<0.001	1.002	1.001–1.004	0.004
Involuntary admissions (n)	0.10 ± 0.46	0.06 ± 0.42	−0.04	8.01	<0.001	0.891	0.843–0.942	<0.001
Emergency visits (n)								
Psychiatric	0.35 ± 1.35	0.25 ± 1.04	−0.10	8.28	<0.001	0.964	0.943–0.986	0.001
Non-psychiatric	1.44 ± 4.41	1.50 ± 9.26	0.06	0.72	0.473	0.998	0.993–1.003	0.388
Outpatient visits (n)								
Psychiatric	21.71 ± 16.96	40.87 ± 23.91	19.16	79.99	<0.001	1.014	1.013–1.014	<0.001
Non-psychiatric	30.84 ± 41.49	31.17 ± 41.69	0.33	0.85	0.394	1.000	1.000–1.001	0.768
Home care CM visit (n)	0	19.27 ± 19.32	19.27	100.44	<0.001	1.023	1.022–1.024	<0.001

[a] Adjusted number for each index of medical utilization based on the contributed time for each participant within the specified period.
[b] Based on a case-crossover study; case window: post-intervention (within 2 years after baseline); control window: pre-intervention (within 2 years before baseline). Covariates for adjustment: including physical comorbidity, concomitant medications among pre-intervention and post-first-2-year intervention periods (listed in the supplement, e-Table 3) to examine the independent effects of home care CM.

Table 3
Mirror-image analysis for maintenance effect of medical utilization between pre-2-year and post-second-2 year (3rd–4th) periods after home care case management and the multivariate case-crossover study to test significance for each index of medical utilization (N = 7871).

Medical utilization index	Pre-2-year period (within 2 years before baseline)	Post-second-2-year period (3–4 years after baseline)[a]	Difference	Paired *t*-test	*p*-Value	Adjusted risk ratio[b]	95% CI	*p*-Value
	Mean ± SD	Mean ± SD						
Hospital admissions (n)								
Psychiatric	1.59 ± 1.91	1.05 ± 1.95	−0.54	20.83	<0.001	0.960	0.946–0.975	<0.001
Non-psychiatric	0.42 ± 1.20	0.47 ± 1.73	0.05	2.47	0.014	1.003	0.981–1.024	0.804
Length of stay (days)								
Psychiatric	46.15 ± 82.18	21.54 ± 67.92	−24.61	21.51	<0.001	0.998	0.997–0.998	<0.001
Non-psychiatric	0.95 ± 4.98	1.93 ± 15.6	0.98	5.36	<0.001	1.003	1.000–1.005	0.009
Involuntary admissions (n)	0.08 ± 0.40	0.05 ± 0.47	−0.03	4.60	<0.001	0.914	0.848–0.985	0.019
Emergency visits (n)								
Psychiatric	0.37 (1.45)	0.20 ± 1.05	−0.17	9.40	<001	0.954	0.927–0.981	0.001
Non-psychiatric	1.37 (4.30)	1.35 ± 5.64	−0.01	0.19	0.846	1.003	0.998–1.007	0.248
Outpatient visits (n)								
Psychiatric	22.24 ± 17.52	31.98 ± 24.02	9.74	33.25	<0.001	1.011	1.010–1.011	<0.001
Non-psychiatric	31.29 ± 42.63	31.20 ± 45.17	−0.09	0.19	0.851	1.000	1.000–1.001	0.279
Home care CM (n)	0	11.20 ± 17.84	11.20	55.72	<0.001	1.020	1.019–1.021	<0.001

[a] Adjusted number for each index of medical utilization based on the contributed time for each participant within the specified period.
[b] Based on a case-crossover study: case window: post-intervention (3–4 years after baseline); control window: pre-intervention (within 2 years before baseline). Covariates for adjustment: including physical comorbidity, concomitant medications among pre-intervention and post-second-2 year intervention periods (listed in the supplement, e-Table 4) to examine the independent effects of home care CM.

3.5. Case-crossover analysis

Supplementary e-Tables 3 and 4 list the potential time-variant factors related to physical comorbidity and concomitant medications. After adjustments for such potential time-variant factors, case-crossover analysis (Table 2) confirmed the statistical significance ($p < 0.05$) for nearly all indices from paired *t*-tests in the mirror-image results (Table 2). The findings from the analysis for maintenance effect were similar (Table 3). Therefore, the time-variant factors did not confound the calculation of various indices for medical utilization.

4. Discussion

4.1. Strengths of the study

To our knowledge, this study is the first to use nationwide data for investigating the effectiveness of a home care CM model to help patients with severe mental disorders. One strength of the study is that it tracked each medical visit through the population-wide health insurance system. Furthermore, we used a novel investigative methodology to quantify service change by using adjusted mirror-image analysis and a case-crossover design to test the significance of changing services.

4.2. Characteristics of patients and service providers

Most patients (69.7%) in our cohort who received home care CM were diagnosed as having schizophrenia—consistent with most community management studies on patients with psychosis (Dieterich et al., 2017). In our study sample, 20.9% of patients had concomitant cardiovascular disease and 9.2% had diabetes mellitus. These findings are comparable to those of our previous study (Kuo et al., 2013), in which inpatients with schizophrenia had comorbidity of cardiovascular disease (18.8%) and diabetes mellitus (8.6%). These findings are also consistent with other studies (Dixon et al., 1999; Fagiolini and Goracci, 2009; Scott et al., 2012), reporting that patients with severe mental illness were likely to have comorbid chronic physical disorders, especially cardiovascular disease and diabetes (Fagiolini and Goracci, 2009).

The combination of inadequate access to medical care, poor lifestyle, and lack of disease insight make patients with severe mental disorders candidates for receiving home care CM and less linked with the institutional health care delivery system. Somatic health care as well as access to the mental health care delivery system should be emphasized for patients with severe mental disorders.

4.3. Psychiatric service evaluation

Using a nationwide cohort, this study provides robust evidence for the effectiveness of home care CM. As expected, the home care CM model in Taiwan reduced the numbers of psychiatric admissions and numbers of days spent in psychiatric wards and increased psychiatric outpatient clinic visits. The effect is comparable (equivalent) to previous research pointing out the effectiveness of both intensive and standard CM (Burns et al., 1999).

Psychiatric admissions often result from poor medication compliance, lack of support systems, poor insight, substance abuse, or social pressures. Accordingly, a CM program can conduct home visits, confer with patients and family, and educate patients and their families on the subject of medication. Another protective factor includes improved availability of community resources through interdisciplinary team members. These factors together aid patients in engaging in the community with decreased hospitalization risk. Thus, this enhanced support and supervision with medication management and continuing assessment with monitoring by the CM program can reduce hospitalization rates and hospital stay durations. This study furthermore illustrated the shift of medical utilization toward psychiatric outpatient visits following home care CM. Because of the chronic nature of severe mental illness, using the mental health delivery system in the form of psychiatric outpatient services can help stabilize psychiatric conditions.

Despite home care CM having a higher caseload (over 20 people) and lesser expenditures than ICM, we approved of an earlier program with an effect similar to ICM. Furthermore, we demonstrated that home care CM has a maintenance effect against the exacerbation of psychiatric illnesses. Thus, home care CM could become a regular long-term practice allocated to community care, especially in places with limited resources (Chang et al., 2013).

4.4. Involuntary admissions

In Taiwan, patients requiring hospitalization should fulfill the following criteria: First, the patient must be in an active psychotic state with poor recognition of reality. Second, the patient should present a prominent suicide or homicide risk. We assessed the effect of home care CM on the risk of involuntary psychiatric admissions; intriguingly,

we found a significant reduction of the rate of the involuntary admissions after the home care CM, which was maintained for at least 4 years.

For an ICM model, a systematic review investigating suicide mortality revealed that the risk of self-harm or death due to suicide did not differ statistically between ICM and standard or non-ICM care (Dieterich et al., 2017; Walsh et al., 2001b). Additionally, in a randomized, controlled clinical trial, the prevalence of violence in psychotic patients was not significantly reduced with ICM compared with standard care (Dieterich et al., 2017; Walsh et al., 2001a). Our findings add the new evidence-based information on a nationwide basis and suggest that home care CM could reduce the risk of suicide deaths or severe violence due to lowering the frequency of involuntary hospital admissions. A possible explanation may be that early recognition of psychotic relapse prevents suicide or violent incidents. Alternatively, therapeutic alliances established during the course of home care CM could render patients more willing to volunteer for hospital admission instead of being involuntarily admitted if their condition becomes exacerbated.

4.5. Physical service evaluation

For both hospital admission and outpatient visits, minimal changes in medical utilization for non-psychiatric services were identified in this study. The findings indicated no effect for home care CM on physical illnesses, despite a significant effect on psychiatric conditions. The absence of physical health utilization improvements could indicate that home care CM services are currently insufficiently developed for addressing physical conditions, but the situation could also partly reflect the increasing age of the population.

The physical health care of people with mental health problems is often neglected on a global scale and is seldom considered a direct outcome in intervention studies (Grigoletti et al., 2009; Laursen et al., 2014). Relevant research is limited, and few studies have produced controversial results related to changes in total health care costs for ICM intervention (Dieterich et al., 2017). In addition, by using all-cause mortality as the index, studies (Bush et al., 1990; Johnston et al., 1998; Singh et al., 2000) have noted no significant differences between ICM and other community interventions.

The global demand for treatment of physical comorbidities in patients with severe mental disorders is increasing, particularly given the effects associated with aging in the specified population (Kuo et al., 2013). The integration of interventions, such as CM, ICM, and ACT, into the health care system for physical illnesses in the specified population requires greater attention from health care policymakers, service providers, and professionals. Accordingly, we suggest additional large-scale studies to identify whether an updated care model would have a mitigating effect on concomitant physical illnesses.

4.6. Limitations

Our study has several limitations: First, we obtained no information about the fidelity of the home care CM model in Taiwan, such as the established formal protocol of home care CM. However, each hospital that provides the relevant services is under periodic review and accreditation by the Taiwan Joint Commission on Hospital Accreditation, an independent nongovernmental organization. Second, some outcome measures of a community therapy model, such as quality of life for both patients and their families, were unavailable. Relevant outcomes in this patient population warrant further investigation. Third, we only included patients with a history of at least one psychiatric admission and home care CM. Therefore, the study findings cannot be generalized to all patients receiving home care CM. To verify the protective effect identified in this study, subsequent research should include all patients receiving home care CM. Fourth, the mirror-image design has limitations. For instance, homeless patients without any social support or access to the health care system might not be referred to the service model; moreover, patients without psychiatric admission records may not be enrolled in the dataset. Thus, caution should be exercised in interpreting findings when results are generalized to all people with severe mental illness in a community. Fifth, an intervention aimed at a group of patients deviating from the average may appear to be successful because of regression to the mean (Morton and Torgerson, 2003). In this study, the patients may have had severe symptoms if recruited during a peak period of their mental illness but subsequently have had an improvement in their mental health. This bias could have led to overestimation of the protective effect of CM. However, we used a regression model strategy (case-crossover study) to minimize the confounding effects by adjusting physical comorbidity and medication as surrogates of disease severity to confirm the independent effect of CM. Additional well-controlled trials are required to examine the causal relationship in question.

4.7. Implications

This study demonstrated a trend of psychiatric home care CM utilization in Taiwan. Nationwide data revealed a significant decrement in psychiatric utilization (including psychiatric and involuntary hospital admissions) after home care CM interventions, but not in the admission rate for physical illnesses.

Additional outreach approaches are required integrating core mental health service packages with primary healthcare. Adequate community-based rehabilitation for people with chronic mental illness should also be used to ameliorate physical problems, particularly due to the emerging effect of aging in the specified population.

Conflict of interest

The authors have declared that no competing interests exist.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2019.04.024.

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