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Economic Evaluation of Mobile Mental Health Units in Greece: The Case of Cyclades Islands

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Abstract

Background: In Greece, the provision of mental health services is limited to people residing in rural and remote areas. The operation of Mobile Mental Health Units (MMHUs) has been introduced in the Cyclades islands. It is an innovative policy intervention that has been shown to be effective and efficient internationally. **Objective:** The aim was to evaluate the operation of MMHUs in the Cyclades islands based on real-world evidence (RWE), from a societal perspective. **Methods:** A cost-effectiveness analysis was performed where outcomes and costs were elaborated and classified based on two comparators, 1) with MMHUs' operation and 2) without MMHUs' operation. Clinical primary outcomes were based on RWE data and were elaborated for the Disability-Adjusted Life Years (DALYs) values calculation, for a 12 months' time horizon. Data descriptive statistics were performed with SPSS Statistics 22.0. Direct medical, non-medical and indirect costs were incorporated. Unit costs and monetary values were extracted from published data. Sensitivity analysis was undertaken to test the robustness of the results. **Results:** The operation of MMHUs in the Cyclades islands led to an incremental cost of €12,250.78 per DALY averted. A substantial higher increase is observed in the direct non-medical costs of the non-MMHUs' operation where patients had to pay approximately €2,602 per capita annually for their transportation and accommodation due to hospitalization and outpatient care. Informal care expenses are 3 fold increasing in the non-MMHUs' operation arm. Both direct non-medical and informal care costs correspond to high out of pocket payments totally covered by the patients. The sensitivity analyses demonstrated that the decision does not change when we varied the unit costs by ±10%. **Conclusions:** The operation of MMHUs appears to be a cost-effective option for treating patients with mental disorders in remote areas and islands

in Greece. MMHUs appear to overcome the existing NHS structural inefficiencies by minimizing public expenditures and patients' income losses by preventing and improving their mental health status.

1. Introduction

The burden of illnesses from mental health disorders is by far the highest of all health problems worldwide, ranging from 10% to 13% of the total burden of illness from all diseases and accounting for 32.4% of years lost due to mental illness or disability (YLDs) and 13% of Disability-Adjusted Life Years (DALYs) [1] [2] [3].

In Greece, the provision of mental health is limited to people residing in rural and remote areas although the universal and free access to health care constitutes fundamental principles of the National Health System (ESY) since its establishment in 1983. This has been discussed and characterized as a major public health problem with marked consequences for society [4] [5] [6]. Numerous studies in the country report increases in mental health disorders, such as major depression, diseases of nervous system, even suicides *et al.* [6] [7] [8] [9].

Greece is a country with a plethora of islands. Hence the authorities diachronically are confronted with the severe structural dysfunction of inadequate provision of medical care in the islands [10]. The operation of Mobile Mental Health Units (MMHUs) has been introduced in the Cyclades islands. It is an innovative policy intervention that has been shown to be effective and efficient internationally [11] [12] [13] [14] [15]. The MMHUs have a community orientation and are based on the interconnection with the local medical bodies of the islands in order to enable the development of actions for the promotion of public mental health [16]. The operation of MMHUs is mainly aimed at the provision of primary mental health services, but also workshops, educational seminars to health professionals, teachers and other professional groups e.g. police officers, have been organized so as to be able to identify, manage and refer people in need for mental health care [17].

The Association for Regional Development and Mental Health (EPAPSY) has taken over the responsibility of the MMHUs operation in the northeastern and western Cyclades, an initiative funded by the Greek Ministry of Health and local authorities. The mission of the MMHUs is to provide free access to mental health services in the 12 islands of Cyclades, in accordance to the principles of community psychiatry [16]. Prior to the MMHUs operation, mental care provision for the residents of Cyclades was very restricted [17]. The majority of patients with mental disorders were either not treated or mistreated due to the lack

of continuity in their treatment, since they had to travel to Syros, the administrative district of Cyclades, or to Athens, the capital of Greece, to seek mental care.

Taking into consideration the MMHUs experience, the aim of this study was to evaluate the operation of MMHUs in Cyclades islands in Greece, based on real world evidence data (RWE), from a societal perspective.

2. Methodology

An economic evaluation analysis has been performed and more precisely, a cost-effectiveness analysis (CEA). Outcomes and costs were elaborated and classified based on two comparators, 1) with MMHUs' operation and 2) without MMHUs' operation. Clinical primary outputs were based on RWE data obtained by EPAPSY. The survey was granted an EPAPSY's approval.

2.1. Sample

In 2015, 724 people visited MMHUs in the northeastern and western Cyclades, out of which 604 received regular and continuous mental health treatment during the year and 120 visited MMHUs once for receiving a certificate of psychological evaluation or counseling. RWE data were based on medical records and included patients' demographic, socio-economic and epidemiological characteristics, health services' utilization and patients' disease management as well as related costs. Patients' diagnosis is registered according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10th Revision) [18].

2.2. Data Analysis

Descriptive statistics have been performed for RWE data elaboration using SPSS Statistics 22.0 (Statistical Package for Social Sciences). DALYs have been used as the outcome measures in the CEA. DALYs is a metric which combines mortality measured as Years of Life Lost (YLLs) from premature death with morbidity measured as Years Lost due to Disability (YLDs) [19] [20] [21].

DALYs were calculated by the formula:

$$DALYs = YLLs + YLDs$$

YLLs were estimated by the number of deaths (N) multiplied by the standard life expectancy at age of death in years (L), by the formula:

$$YLLs = N * L$$

YLDs were estimated by the number of prevalent cases (P) multiplied by the disability weight (D) for each disease, by the formula:

$$YLDs = P * D$$

It should be noted that disability weights of each disease in the study group have been extracted from the WHO Global Burden of Disease (GBD) in 2015 [22]. Due to the fact that our study population included patients who suffered

from multiple mental disorders and other comorbidities, relevant adjustments were made in order to take into account each disability and to calculate all causes of YLDs [20]. The calculation was formulated as follows:

$$YLD_{1+2} = 1 - (1 - YLD_1) * (1 - YLD_2).$$

2.3. Cost Data

The human capital approach, and most particularly direct medical and non-medical costs as well as indirect costs, were incorporated in the analysis and classified among two comparators (with MMHUs' operation and without MMHUs' operation). Cost calculations included: 1) MMHUs' operating costs, extracted from EPAPSY's financial data, 2) costs of outpatient visits for mental services and hospitalization based on the Greek Diagnosis Related Groups (KEN) were taken from the National Insurance Organization (EOPYY) and the Ministry of Health (MoH) respectively [23], 3) medication costs were based on the drugs' positive list prices and included all the necessary cycles of medication as administered by the mental health professionals [24]. The direct non-medical cost included patients' travel and accommodation expenses related to their hospitalization and outpatient care to Syros and/or Athens, due to the absence of relevant providers in the other islands. Data were derived from EPAPSY's registries and costs were estimated based on officially published prices.

The indirect cost estimation included: 1) patients' productivity losses due to early retirement, 2) income losses due to mortality and disability, 3) disability benefits as well as 4) informal care provided by caregivers for the seriously ill patients [3] [19]. All values were taken from published European and Greek sources [25] [26] [27].

2.4. Economic Evaluation Analysis

Costs and outcomes estimates for both comparators were used for the conduction of CEA and more specifically, for the incremental cost effectiveness ratio (ICER) estimation. Thus, relevant costs and DALYs of each arm have been compared. The ICER corresponds to the estimation of cost per DALY averted and is estimated by the following formula:

ICER = (Cost of MMHUs' operation – Cost of operation without MMHUs)/
(DALYs of MMHUs' operation – DALYs without MMHUs' operation).

The societal perspective was used in the analysis for a 12-month time horizon, given that overall direct and indirect costs are incorporated, illustrating both governments' expenses, a part of which is the NHS, and patients' private expenses.

2.5. Sensitivity Analysis

We have patient-level cost data which are right-skewed (small proportion of patients will have large costs which distort the mean value of the sample). For this reason, in order to compare the means of the two interventions, we used

non-parametric bootstrapping. The method uses re-sampling from the data with replacement to generate an empirical estimate of the sampling distribution of means costs. A 10,000 bootstrap simulation was run in Microsoft Excel to test the difference in mean costs between the two interventions. In addition, we conducted sensitivity analyses where the unit costs were ranged to ±10% of the base case unit costs.

3. Results

Descriptive statistics, as presented in Table 1, revealed that the majority of participants were Greek with a mean age of 50.1 years old and 60.9% were women. 62.9% were married with a median number of 2 children. Moreover, 71.0% of the participants stayed with their family and 13.7% alone. Approximately half of the patients were secondary school graduates and 29% were university graduates. 45.2% worked on a permanent basis while 15% were part-timers, seasonal workers and unemployed. Only 4.3% of the participants were uninsured.

Table 1. Characteristics of the sample.

Sample characteristics		N	%
Reference Island	Milos	68	9.4
	Sifnos	31	4.3
	Serifos	14	1.9
	Kythnos	31	4.3
	Kea	31	4.3
	Paros	155	21.4
	Syros	89	12.3
	Tinos	112	15.5
	Andros	69	9.5
	Mykonos	121	16.7
	Antiparos	3	0.4
	Total	**724**	**100**
Gender	Male	283	39.1
	Female	441	60.9
	Total	**724**	**100**
Age, Mean (SD)		50.1 (17.0)	
Occupation	Full time	327	45.2
	Part time/seasonal/unemployed	109	15
	Household	156	21.5
	Pupil/student	4	0.6
	Retired	128	17.7
	Total	**724**	**100**

The classification of patients' diagnoses and the DALYs' calculations between both comparators are presented in Table 2. The majority of cases were diagnosed in the following categories 1) factors affecting the health status and the contact with health services and counseling (Z03-Z99), 2) mood disorders (F30-F39) and 3) neurotic disorder related to anxiety and somatoform disorders (F40-F48). It can be seen that cases classified in these categories revealed the highest DALYs scores in both comparators. Also, the highest DALYs' scores are found in the without MMHUs' operation in all diagnostic categories compared to the other comparator. In addition, the highest DALYs' scoring (79.89) among all categories was found in the "Schizophrenia F20-F29" category in the without MMHUs' operation arm. DALYs' calculation for all diagnostic categories and all patients was 17.98 for the MMHUs' operation arm and 115.79 for the without MMHUs' operation arm.

Table 2. DALYs estimation per diagnostic category.

Diagnostic Categories ICD-10	With MMHUs' operation			Without MMHUs' operation		
	N	YLD	YLL	DALYs	YLD	YLL	DALYs
Organic, including symptomatic, mental disorders [F00-F09]	39	1.17	0.00	1.17	1.69	0.00	1.69
Mental and behavioural disorders due to psychoactive substance use [F10-F19]	5	0.03	0.00	0.03	0.04	0.00	0.04
Schizophrenia, schizotypal and delusional disorders [F20-F29]	20	0.43	0.00	0.43	0.49	79.40	79.89
Mood [affective] disorders [F30-F39]	130	9.49	0.00	9.49	15.60	0.00	15.60
Neurotic, stress-related and somatoform disorders [F40-F48]	127	4.53	0.00	4.53	10.79	0.00	10.79
Behavioural syndromes associated with physiological disturbances and physical factors [F50-F59]	5	0.05	0.00	0.05	0.05	0.00	0.05
Disorders of adult personality and behavior [F60–F69]	12	0.13	0.00	0.13	0.13	0.00	0.13
Mental retardation [F70-F79]	4	0.00	0.00	0.00	0.00	0.00	0.00
Disorders of psychological development [F80-F89]	1	0.00	0.00	0.00	0.00	0.00	0.00
Unspecified mental disorder [F99]	40	0.24	0.00	0.24	0.41	0.00	0.41
Examination for administrative purposes [Z00-Z02]	62	0.15	0.00	0.15	0.65	0.00	0.65
Factors influencing health status and contact with health services, counseling [Z03-Z99]	279	1.75	0.00	1.75	6.53	0.00	6.53
Total	724	17.98	0.00	17.98	36.39	79.40	115.79

In Table 3, overall costs between both comparators are analytically presented. Our costing analysis showed that the direct medical costs for the MMHUs' operation arm was the only higher cost component compared to the other one, due to MMHUs' operational costs. Adversely, all other cost categories such as the direct non-medical and indirect costs were lower in the with MMHUs' operation than the other comparator. The MMHUs' operational as well as medication costs were found to be the most costly components of the direct medical costs in the MMHUs' operation arm. It should also be noted that the direct non-medical costs in the MMHUs' operation (€2,435.20) corresponds to private expenses for transportation and accommodation of patients who needed hospitalization and had to visit Athens, since they could not be hospitalized elsewhere. Adversely, in the non-MMHUs' operation arm relevant costs (€1,543,651) correspond to patients who needed mental outpatient and inpatient care and had to visit Syros or/and Athens. Also, the informal care costs refer to private expenses/out of pocket payments covered by the patients. All other cost categories refer to public expenditures, covered by the government and particularly the NHS and the social insurance funds. However, despite the payer of the mental health services provision, the annual total cost of the MMHUs' operation is almost 50% lower than the other arm. In addition, as shown in the table, all indirect cost components were reduced with the MMHUs' operation.

Table 3. Cost analysis of treating patients in Cyclades islands, in 2015, in €.

Cost Components	With MMHUs' operation	Without MMHUs' operation
Direct medical costs		
Operational cost	546,069.29	
Medical care (visits, psychotherapies)	239,296.80	239,296.80
Hospital care	14,334.00	43,601.00
Medication cost	79,325.16	52,182.24
Total	**879,025.25**	**335,080.04**
Direct non-medical costs Expenses for transportation, accommodation etc.		
Total	**2,435.20**	**1,543,650.70**
Indirect costs		
Informal care [a]	32,820.48	90,256.32
Productivity losses due to early retirement [b]	52,920.00	84,672.00
Disability benefits [b]	10,584.00	37,044.00
Income losses due to mortality & disability [c]	85,400.00	170,800.00
Total	**181,724.48**	**382,772.32**
Total annual cost	**1,063,184.93**	**2,261,503.06**

Sources: (a) Eurostat (2015); (b) Idika (2015) (in greek); (c) Eurostat (last update: 14/05/2020).

The CEA results showed that the incremental cost effectiveness ratio (ICER) of the MMHUs operation is estimated at €12,250.78 per DALY averted, as presented in Table 4.

Table 4. Cost-Effectiveness analysis.

	Without MMHUs' operation	With MMHUs' operation	Incremental Cost and Effectiveness
Costs (€)	2,261,503.06	1,063,184.93	1,198,318.13
Effectiveness (DALYs)	115.79	17.98	97.82
ICER		12,250.78	

Table 5 shows the results of the mean difference between the two treatment arms for the base case analysis and two sensitivity analyses (±10% in unit costs) calculated following bootstrap simulation. The ICER in the base case analysis is 4,390.40, while when the unit costs are 10% higher/lower than the base case, then ICER takes the value of 1,865.74 and 5,730.66 respectively. The sensitivity analyses demonstrated that the decision does not change when we varied the unit costs by 10%.

Table 5. Bootstrap simulation results.

	Mean difference in costs between treatments (SD)	95% CI	ICER
Basic scenario	3033.20 (67.04)	2903.85 - 3161.78	4390.40
Sensitivity analysis: % change in unit costs			
+10% from base case	3442.06 (67.34)	3311.45 - 3577.32	1865.74
−10% from base case	2816.15 (54.21)	2711.88 - 2924.24	5730.66

+Costs in Euros.

4. Discussion

The increasing prevalence of mental disorders has severe implications in terms of costs and burden of disease since they are related to severe distress and functional impairment that can have dramatic consequences not only for those affected but also for their families and their social and work-related environment. The burden from mental disorders worldwide is ranging from 10% to 13% of the global burden of disease and is identified as the leading cause for patients with disabilities among all disease groups [1] [2] [3].

In the European Union (EU), due to the continuing demographic changes and the longer life expectancy, the long-term burden of mental disorders is even expected to double by 2030, in both direct and indirect costs [28] [29]. It should be also noted that in many high-income as well as EU countries, access to mental health care is generally restricted due to lack of qualified personnel, infrastructure and preventive programs as well as effective evidence-based treatments [30] [31].

Given the increased prevalence and associated costs of mental disorders in Greece [6] [7] [9] [32] [33], it is obvious that health care policy makers would be seeking cost-effective treatments to control patients' course of disease. This was the aim of our study.

To the best of our knowledge, this is the first economic evaluation study of the MMHUs' operation in remote areas in Greece, incorporating real-world evidence (RWE), which is becoming increasingly important in reimbursement decisions. The present study showed that the MMHUs' operation seems to be cost-effective in Cyclades islands. The ICER of the MMHUs' operation was €12,251 per DALY averted, which is below the commonly accepted €30,000 cost-effectiveness threshold.

Threshold values are mainly reported in studies that use Quality Adjusted Life Years (QALYs) and are conducted from the NHS perspective. However we believe that the threshold criterion should be discussed within our study. Although this analysis focuses on the societal perspective and thresholds are not yet issued in Greece. An ICER at €12,251 is much lower than the Gross Domestic Product per capita (€17,080 in 2015) [27], a finding that might reinforce health policy makers to invest in the MMHUs' establishment across the country.

Indirect cost that usually constitutes a major component of total costs of mental disorders, in this study is reaching approximately 17% in both categories, although it is decreasing to more than half in the MMHUs' operation arm. Several studies report that the indirect costs approached 68% of global costs of mental disorders in 2010, including substance use disorders, and across the EU countries reached approximately 40% of total mental disorders costs in 2015 [3] [28] [29] [34] [35]. Obviously, the results of the present study are not comparable with the above studies, given that data are based on a specific population and RWE. Income and productivity losses as well as informal care expenses constitute the highest cost components of indirect costs in both comparators and they are much higher in the operation without MMHUs.

A substantial higher increase is observed in the direct non-medical costs of the non-MMHUs' operation arm where patients had to pay approximately a sum up of €2,602 per capita annually for their transportation and accommodation due to hospitalization (approximately €460), and outpatient care (€2,142) in Athens. Similarly, informal care expenses are 3 fold increasing in the non-MMHUs' operation arm. Both direct non-medical and informal care costs correspond to high out of pocket payments totally covered by the patients.

Generally, the results of the present study reveal an increase in all cost drivers against the MMHUs non-operation arm, with an exception of medication costs. This is a positive and rather expected finding given that the relevant increase in the MMHUs' operation arm facilitates patients' access to medication and consequently covers the existing unmet needs that deteriorate their mental health status. Adversely, all other direct healthcare cost components, such as medical visits and hospitalization in the MMHUs' non-operation arm, had to be pro-

vided by specialists located in Athens or even in Syros, impacting negatively patients' income. This is the reason for which the societal perspective was chosen in this economic evaluation and broader outcomes of the direct and indirect costs were taken into account since the effects of any mental intervention strongly rely on social outcomes.

Nonetheless, the operation of Mobile Health Units (MHUs) has already been shown as a cost-effective and cost saving option by other researchers and its use in the field of mental health is suggested [36] [37] [38] [39]. In addition, the findings of this study are in accordance with the results of a study conducted in New Hampshire which estimated the operational cost of the MMHUs to be €495,858 in 2015 [40].

A potential limitation of the study is that it focuses only on a specific area and the results cannot be generated in the country. However, the use of RWE in a remote geographical area confirms our results, mapping the existing unmet needs and the necessity of the MMHUs' operation. Another limitation of the study is the use of one year analytical clinical and economic data in the economic evaluation analysis, given the lack of comparable data. Obviously, the existence of time-series data would provide more reliable and robust results.

5. Conclusion

The operation of MMHUs in geographical areas where access to mental care is limited, appears to be a cost-effective option for patients suffering from mental disorders. In Greece, a country with a large number of inaccessible and sparsely populated remote areas, MMHUs appear to overcome the existing NHS structural inefficiencies by minimizing public expenditures as well as patients' income and productivity losses and improving their mental health status. Economic evaluation studies' results based on the use of RWE should support rational resources' allocation and health policy decision making.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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