Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care

Benchmark community care models for care-dependent older persons on costs of care (WP5)

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Content

1 Background

Throughout Europe, the proportion of older adults aged 65 years and older is expected to increase steadily over the next decades[1]. In 2014, the group of older adults accounted for 19% of the total population in Europe ranging from 13% in Ireland to 21% in Italy and Germany. By 2080, older adults are expected to account for up to 29% of the total population in Europe[2]. Since increasing age is strongly associated with multimorbidity and limitations in daily activities, this considerable growth of the aged population is expected to result in a significant increase in the number of older adults in need of long term care services[3]. Currently, the level of public expenditure on long term care in Europe is 1.7% of GDP. The European Commission predicts that spending on long-term care will increase with 71% between 2013 and 2060 in Europe[3]. This prospect in combination with a shrinking workforce threatens the financial stability and sustainability of health systems across Europe.

In order to restrain the rising expenditures on long-term care, interest in home care has grown. It is generally assumed that home care is associated with lower costs than long-term institutionalized care. Therefore, good quality home care is considered to be a sustainable approach to prevent or postpone acute or long-term institutionalization and to maintain individuals in their home and community as long as possible[4]. Ageing in their own home is preferred by the older adults themselves and their families, and this is also promoted by various policies across Europe. As a result, home care is currently one of the fastest growing sectors in health care in Europe. The majority of the countries in Europe is now offering a wide range of home care services for older adults living in the community, including home health care, personal care, social care, various therapies and other types of services. However, the availability and distribution of care services varies strongly within and across countries. Also, the way in which home care is delivered by care organizations within and across European countries varies considerably. Variation exists in terms of funding, organizational structures, care processes, access and quality of services, reimbursement systems, and public versus private delivery[4]. These variations in home care delivery can be expected to lead to differences in costs of care utilisation. To prepare for a future increase in long term care needs of dependent older adults, it is important to get more insight in community care provision and associated costs for society across different types of home care models within and across countries. When differences in costs between home care models are identified, there may be opportunities for significant cost savings by learning from best practices.

Our aim was to benchmark costs of community care models for care-dependent community dwelling older adults. To reach this overall aim, the following objectives were addressed in this study:

1. To compare societal care costs of clients receiving home care in different community care models.
2. To identify community care models with the lowest societal costs.

Societal costs across community care models were calculated and benchmarked using data of the FP5 AdHOC (Aged In Home Care) project[5] (Chapter 3) and the FP7 IBenC (Identifying best practices for care-dependent

elderly by Benchmarking Costs and outcomes of community care) project[6] (Chapter 4). This comparison provides a better understanding and evidence base for policy makers to facilitate best practices in their countries.

2 Societal costs of different community care models using AdHOC data

2.1 Method

2.1.1 Study design

Data were obtained from the AdHOC project, an international study funded by the EU within FP5 with a prospective longitudinal design. The aim of the AdHOC project was to identify models of home care for older adults through the analysis of the structural and organizational characteristics of home care services, and the clinical and functional characteristics of their clients in 11 European countries[5]. Data were collected during 2001 and 2003. Ethical approval for the study was obtained in all countries according to local regulations.

2.1.2 Setting and sample

Participants of the AdHOC study were community dwelling older adults aged 65 years and older who received home care services at the start of the study. A total of 4010 home care clients from selected urban areas in 11 European counties (Czech Republic, Denmark, Finland, France, Germany, Iceland, Italy, The Netherlands, Norway, Sweden, United Kingdom) were included.

2.1.3 Procedure

Information on client characteristics, health outcomes and care utilization was collected at baseline, and after six and 12 months using the interRAI version 2.0 Minimum Data Set for Home Care (MDS-HC) instrument[7;8]. The MDS-HC was developed to guide comprehensive care and service planning in community-based settings. Assessments were conducted by trained home care staff (Finland, France, Germany, and Iceland) or research assistants (Czech Republic, Denmark, Italy and the Netherlands) in the homes of the clients.

Additionally, characteristics of different home care services were assessed cross-sectionally by means of the European-Home Care Service (EU-HCS) questionnaire that was developed within the AdHOC project. The EU-HCS included questions on setting, service structures, and service delivery[9]. The questionnaire was completed by the person who was in charge of implementing the AdHOC project in each country (chief or research nurse).

2.1.4 Community care models

Based on data collected with the EU-HCS, Henrard et al (2006) developed a classification of community care models[9]. These models were identified by looking at the organisational structures and the level of process-centred integration of the AdHOC home care organisations. Organisational structure involves the extent to which staff and resources are organised in one single organisation under one hierarchical structure. An integrated organisation structure, allows single home care agency to provide a range of services, from social care, personal ADL, primary health nursing, to secondary health care. This is in contrast with a fragmented structure, where different types of care are provided by different care providers. Process-centred integration involves the presence of collaborative actions between multiple health and social care services and practitioners, also called “working arrangements”. Examples of working arrangements are the use of a standardized comprehensive geriatric assessment; the presence of a multi-disciplinary team approach for

assessment; the presence of a team meeting for care planning; the participation of a general practitioner to the team meeting).

Henrard et al distinguished the following four community care models; the *medico-social model*, the *medical model*, the *fragmented model,* and the *mixed model.* The medico-social model is characterized by extensive social care with very little working arrangements inside or outside the care organisation. The medical model includes working arrangements within the care organisation with predominance of health care and little or no social care delivery. The fragmented model is characterized by relatively few provisions of formal therapies and nursing care and few or no working arrangements within and between care organisations. The fourth model, the mixed model is a mix of the medico-social model and the medical model. It is characterized by having working arrangements within the care organisation in combination with the supply of social care[9].

2.1.5 Care utilisation

Information on the utilisation of home health aide, home nursing, homemaking services, physical therapy, and occupational therapy was collected by registering the number of days and the total number of minutes of care received in the seven days prior to the assessment. For physical therapy and occupational therapy, we assumed that the number of days per week the service was received, reflected the number of sessions received during a week. Contacts with a social worker and utilisation of the supportive care service "meals on wheels" was registered in number of days the service was used during the seven days prior to the assessment. The number of hospital admissions, emergency room visits and visits to a physician (specialist, authorised assistant or general practitioner) were registered over the 90 days prior to the assessment. The total number of hours of all informal care provided by informal carers to a participant was assessed over the last seven days across five weekdays and two weekend days. The number of hours of informal care received per participant were summed to calculate the total number of hours of informal care received over a 7-day period.

2.1.6 Costs of care utilisation

In order to calculate cost of care utilisation over a period of 12 months, resource utilisation items with a recall period of seven days were first multiplied by 13 to reflect a period of three months. Resource utilisation estimates (number of days, hours of care, or number of sessions) were multiplied by 13, as three months correspond to 13 weeks. In order to estimate costs of hospital stay, length of stay was estimated using country-specific averages of length of stay during hospital admission in the year 2002[10] (see Table 1), multiplied by the number of hospital admissions in the 90 days prior to assessment.

Subsequently, units of resource utilisation were multiplied by their standard costs according to the Dutch guideline for costing studies to calculate the costs of formal and informal care utilisation[11]. The care services per cost category and costs per unit are listed in Table 1. The following six cost categories were distinguished: home care (home health aide, home nursing), physician visits, other health care services (physical therapy, occupational therapy, social worker), hospital admissions, supportive care services (meals on wheels, homemaking services), and informal care. Additionally, these cost categories were summed into total societal costs.

Costs between measurements were linearly interpolated by multiplying costs at baseline assessment by 0.5; costs at six months after baseline by 2 and costs at 12 months after baseline by 1.5.

Table 1. Overview of used unit cost (in € 2015) and average length of stay (days)

Care service	**Costs (€) per unit**
Home care	
Home health aid	50 per hour
Home nursing	73 per hour
Physician visits	
General practitioner visit / Outpatient clinic visit	92 per visit
Other health care services	
Physical therapy	33 per session
Occupational therapy	34 per session
Social worker	64 per session
Hospital admissions	
Hospital admission with overnight stay	479 per day with overnight stay
Average length of hospital stay*	
Year 2002	
Czech Republic	11.1 days
Denmark	6.1 days
Iceland	5.5 days
Italy	7.4 days
Netherlands	8.0 days
United Kingdom	9.3 days
Year 2012	
Belgium	-
Finland	11.0 days
Germany	9.2 days
Iceland	5.8 days
Italy	7.7 days
Netherlands	5.2 days
Emergency room visit (without overnight stay)	261 per visit
Supportive care services	
Home making services	23 per hour
Meals on wheels	7.50 per day
Institutionalised care	
Nursing home	168 per day
Psychiatric hospital	302 per day
Rehabilitation institute	460 per day
Informal care	
Informal care	14.08 per hour

*Source OECD 2015

2.1.7 Case mix variables

Several case mix variables consisting of multi item summary scales are embedded in the MDS-HC, and used in this study. Case Mix Index (CMI) informal care, this is a measure to indicate the amount of resources of formal and informal care that are likely needed to support clients based on their clinical characteristics. Higher CMI informal care values reflect higher needs[12]. Cognitive functioning was assessed using the Cognitive Performance Scale (CPS, range 0-6). Moderate or severe cognitive impairment was considered to be present if the CPS score was 3 or higher[13]. Depressive symptoms were assessed using the Depression Rating Scale (DRS, range 0-14). A score of three or higher on the DRS indicates the possible presences of minor or major depressive disorder[14]. Activities of daily living (ADL) needs were assessed using the interRAI Activities of Daily Living Hierarchy Scale (ADLH, range 0-6) with higher scores indicating higher ADL needs[15]. Difficulties in performing instrumental activities (iADL) were assessed using the interRAI Instrumental ADL Performance Scale (iADLP, range 0-48) with higher scores indicating more iADL dependencies[16]. Medical complexity/health instability was assessed using the Changes in Health, End-Stage Disease, Signs, and Symptoms Scale (CHESS, range 0-5). CHESS is a summary measure based on a count of decline in ADL, decline in cognition, presence of symptoms such as weight loss, shortness of breath, and edema, and a life expectancy of less than six months. Higher scores indicate higher levels of medical complexity or health instability (5=highly unstable) and are associated with adverse outcomes like mortality and hospitalization[17;18].

2.1.8 Analytic approach

For the present study, participants with at least a baseline and 12-month assessment were included. The analyses were performed using SPSS statistics 20 and STATA 12 SE. Demographic and clinical characteristics of the participants at baseline across community care models were described using descriptive statistics and frequencies. Missing data on costs at six months were imputed using multiple imputation with chained equations (MICE)[19] using predictive mean matching (PMM) in SPSS. PMM randomly selects the imputed value from observed values closest to the predicted estimate[20]. Predictive mean matching was used to account for the skewed distribution of societal costs. Five imputed datasets were created, and the results of the analyses were pooled using Rubin's rules[21].

Disaggregated cost categories and total societal costs over a 12-month period per client in the different community care models were described using means and standard errors. Differences in costs between community care models were analysed using linear regression models. Dummy variables were created to compare total societal costs between the three community care models. Because of the skewed distribution of cost data, 95% confidence intervals (CIs) were estimated using bias-corrected accelerated bootstrapping with 5000 replications. Differences were adjusted for case mix variables, including 1) CMI informal care and 2) age, gender, cognitive impairment (CPS ≥ 3), depressive symptoms (DRS ≥ 3), ADLH, iADLH and CHESS. Collinearity between covariates was investigated using Pearson correlation coefficients (cut-off value r>0.4 was used to indicate correlation).

2.2 Results

2.2.1 Study sample

Of the 4010 participants included in the AdHOC study, 2536 subjects (63%) were excluded from the analyses because they did not have a complete 12-month follow-up assessment. For 394 subjects missing data on costs at six months of follow-up was imputed. Thus, a total of 1080 participants were included in this study Participants in Denmark (n=292) and the Netherlands (n=70) received care that was mostly provided according to the medico-social model (n=362, 33.5%); in Iceland (n=239), Italy (n=31) and United Kingdom (n=124) according to the medical model (n=394, 36.5%), and in the Czech Republic (n=324) according to the fragmented model (n=324, 30.0%). Table 2 shows the baseline characteristics of the study population per community care model. The majority (78%) of the participants in the study sample were female and the mean age was 81.5 (SD 7.0). Approximately 16% of the persons in the medical model had cognitive impairment, against 8% in the medico-social model and 7% in the fragmented model. Depressive symptoms were most frequently reported in the fragmented model (36%).

Table 2. Characteristics of the study population per community care model

	Medico-social model n=362	Fragmented model n=324	Medical model n=394	Total n=1080
Country	DK, n=292 (80.7%) NL, n=70 (19.3%)	CR, n=324 (100%)	IS, n=239 (60.7%) IT, n=31 (7.9%) UK, n=124 (31.5%)	CR, n=324 (30.0%) DK, n=292 (27.0%) IS, n=239 (22.1%) IT, n=31 (2.9%) NL, n=70 (6.5%) UK, n=124 (11.5%)
Mean age (SD)	82.3 (7.0)	80.9 (6.9)	81.0 (7.0)	81.5 (7.0)
Female (n, %)	308 (79.0)	262 (80.9)	318 (74.5)	845 (78.2)
Cognitive impairment (CPS ≥ 3) (n, %)	32 (8.2)	23 (7.1)	68 (16.0)	120 (11.1)
Depressive symptoms (DRS ≥ 3) (n, %)	40 (12.6)	87 (36.1)	66 (18.8)	184 (21.4)
Mean ADLH score (SD)	0.2 (0.8)	0.4 (1.2)	0.7 (1.6)	0.5 (1.3)
Mean iADLH score (SD)	6.4 (5.3)	9.9 (5.1)	9.9 (6.2)	8.8 (5.9)
CHESS (SD)	0.8 (0.9)	1.6 (1.1)	1.0 (1.0)	1.1 (1.0)
CMI informal care	0.5 (0.4)	0.7 (0.4)	0.8 (0.5)	0.7 (0.5)
Mean hours home care per week (SE)	23.3 (1.4)	18.8 (1.0)	19.7 (1.0)	20.7 (0.7)
Mean informal care per week (SE)	6.9 (1.0)	14.7 (1.4)	27.0 (2.8)	16.4 (1.1)

CR = Czech Republic, DK = Denmark, IS = Iceland, IT = Italy, NL = Netherlands, UK = United Kingdom.

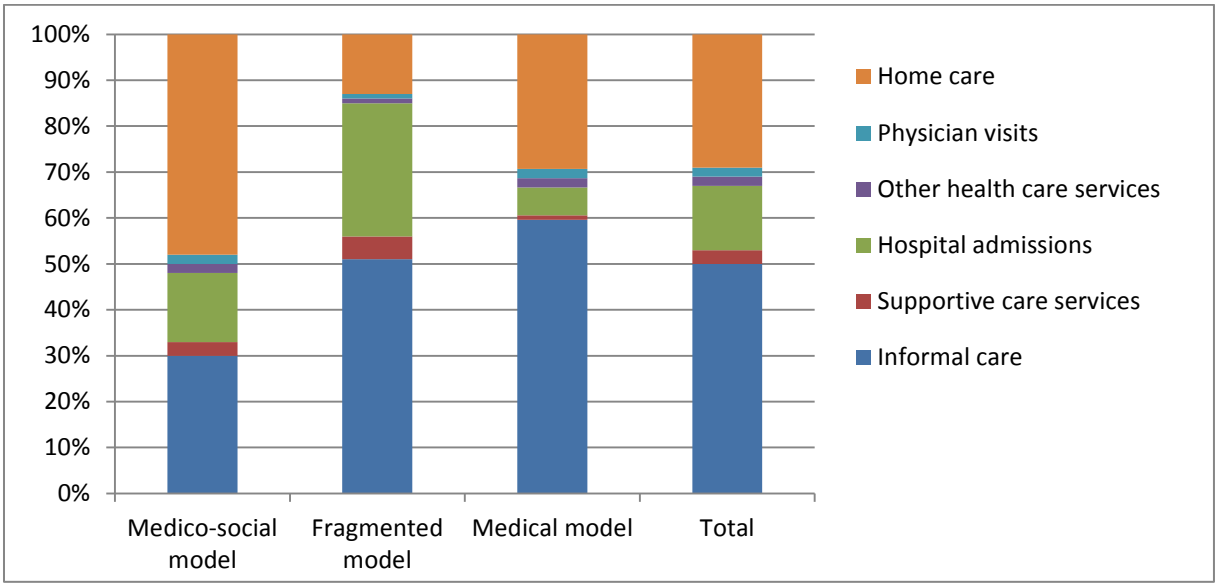
2.2.2 Costs per community care model

Table 3 presents the unadjusted cost estimates for the medico-social model, the medical model, the fragmented model, and for the total sample over the follow-up period of 12 months. Mean total societal costs per client in the medico-social model were €15923 (SE 909), in the fragmented model €21945 (SE 933), and in the medical model €32886 (SE 1991). Cost of informal care provision was the largest cost category in the medical model and fragmented model (59% and 51% of the total societal costs, respectively), and the second largest cost category in the medico-social model (30% of the total societal cost). Home care costs accounted for 48% of the total societal cost in the medico-social model, but only 29% in the medical model, and 13% in the fragmented model. Hospitalisation costs represented 6% of the total societal costs in the medical model, 15% in the medico-social model, and 29% in the fragmented model. Costs of physician visits, other health care services and supportive care services together accounted for less than 10% of the total societal costs in all three types of community care models (Figure 1).

Table 3. Cost of care estimates (€, 2015) across community care models over 12 months

Cost category	Medico-social model n=368	Fragmented model n=325	Medical model n=402	Total n=1095
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Home care	7609 (527)	2919 (247)	9695 (531)	6963 (285)
Physician visits	338 (40)	259 (38)	585 (59)	404 (28)
Other health care services	256 (44)	307 (71)	622 (102)	405 (46)
Hospital admissions	2353 (277)	6282 (516)	2136 (225)	3452 (206)
Supportive care services	530 (46)	1082 (37)	316 (35)	618 (25)
Informal care	4837 (582)	11095 (650)	19534 (1764)	12076 (723)
Total societal costs	15923 (909)	21945 (933)	32886 (1991)	23918 (862)

Figure 1. Distribution of costs within community care models



2.2.2 Differences in costs between community care models

Table 4 describes the unadjusted mean differences in costs per client over the follow-up period of 12 months between the three community care models. Total societal costs in the fragmented model were statistically significantly higher than in the medico-social model (mean difference €6023, 95% CI 3447; 8516). Also, total societal costs in the medical model were statistically significantly higher than in the fragmented model (mean difference €10941, 95% CI 6826; 15464) and medico-social model (mean difference €16964, 95% CI 12933; 21455). In all three comparisons, informal care costs were the main contributor to the difference in total societal costs.

Table 4. Mean differences cost categories and total societal costs (€, 2015) between the three community care models (medico-social model, medical model and fragmented model)

	Fragmented model versus medico-social model	Medical model versus medico-social model	Medical model versus fragmented model
Cost category	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Home care	-4690 (-6029; -3727)	2085 (568; 3482)	6775 (5705; 7990)
Physician visits	-79 (-184; 29)	247 (117; 378)	326 (198; 459)
Other health care services	52 (-90; 237)	366 (182; 626)	314 (92; 570)
Hospital admissions	3929 (2817; 5102)	-217 (-981; 399)	-4146 (-5297; -3112)
Supportive care services	552 (437; 664)	-214 (-326; -104)	-766 (-861; -666)
Informal care	6258 (4531; 7883)	14697 (11264; 18577)	8439 (4984; 12349)
Total societal costs	6023 (3447; 8516)	16964 (12933; 21455)	10941 (6826; 15464)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

Table 5 presents the differences in total societal cost estimates over a period of 12 months between the three community care models using an unadjusted model (model A), a model adjusted for CMI informal care (model B), and a model adjusted for age, gender, CPS, DRS, ADL, IADL, and CHESS (model C). In models B and C, differences in total societal costs were still statistically significant in the medical model as compared to the medico-social model and the fragmented model. However, after adjusting for CMI informal care in model B the difference in total societal costs between the fragmented model and the medico-social model became smaller than in the unadjusted model and was not significant anymore. In model C, the difference in total societal costs between the fragmented and medico-social model turned around and was not significant anymore (Figure 2).

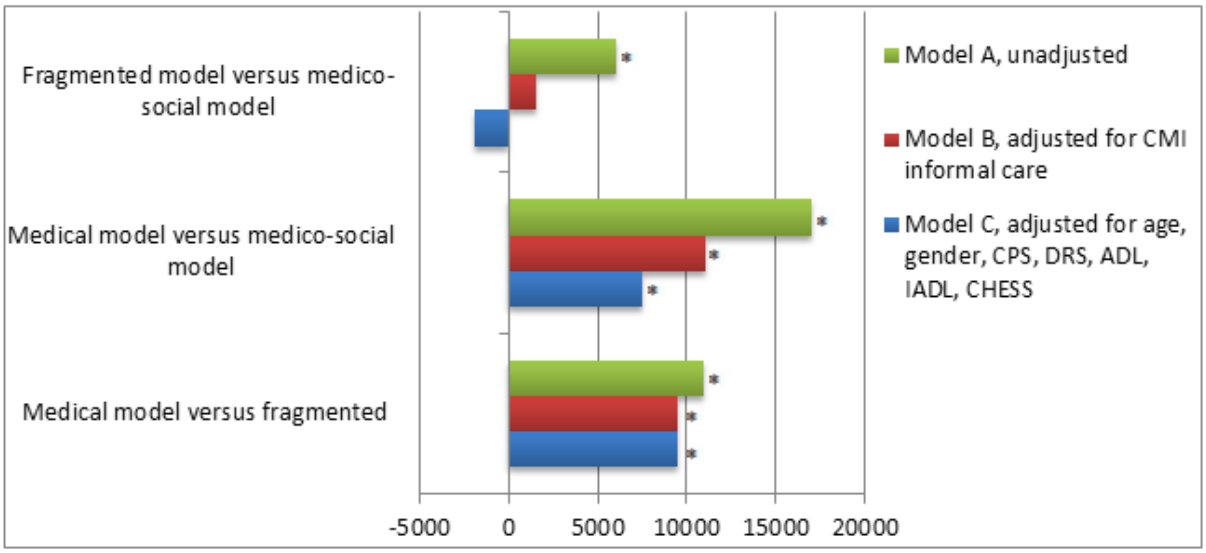
Detailed information on the adjusted disaggregated cost differences between the medico-social model, medical model and fragmented model can be found in Appendix I (Table A and B).

Table 5. Mean adjusted and unadjusted differences in total societal costs (€, 2015) between the three community care models

	Fragmented model versus medico-social model	Medical model versus medico-social model	Medical model versus fragmented model
	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Model A, unadjusted			
Societal costs	6023 (3447; 8516)	16964 (12933; 21455)	10941 (6826; 15464)
Model B, adjusted for CMI informal care			
Societal costs	1589 (-1129; 4280)	11089 (7802; 14567)	9501 (5839; 13518)
Model C, adjusted for age, gender, CPS, DRS, ADL, IADL, CHESS			
Societal costs	-1953 (-5725; 1624)	7517 (4354; 10927)	9469 (5197; 14364)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

Figure 2. Mean adjusted and unadjusted differences in total societal costs (€, 2015) between the three community care models



* $p < 0.05$

2.2.3 Ranking community care model on costs

In the unadjusted analysis, the medico-social model was associated with the lowest costs per client and the medical model with the highest costs per client. After correcting for CMI informal care, the ranking of care models based on costs remains the same as in the unadjusted analysis although the difference in costs between the medico-social model and the fragmented model was not significant. However, after correcting for age, gender, CPS, DRS, ADL, IADL, and CHESS, the fragmented model is associated with the lowest costs per client although the difference with the medico-social model is not significant, while the medical model remains the model with the highest costs per client.

2.2.4 Implications for policy and home care organisations

The results of the analyses based on AdHOC data showed that community care provided according to the medical model, in which health care services predominantly are provided within a home care organisation, resulted in the highest costs for society over a period of 12-months, as compared to the medico-social and the fragmented model, in which extensive social care as part of community care (including assistance with ADL, IADL, and supervision) is provided. The medical model remained the most expensive model even after correcting for case mix variables. Furthermore, in the unadjusted analysis, the lowest total societal costs were found for the medico-social model. However, after adjustment for case mix variables no significant cost differences existed between the medico-social and the fragmented models making a clear preference for either one of these models not possible.

The main contributor to the differences in total societal costs between the three models were the costs of informal care; informal care costs were significantly higher in the medical model as compared to the medico-social and the fragmented model. This finding may suggest that in the absence of social care services, relatively more people rely on the help of informal caregivers resulting in high societal costs. It can be discussed whether this is a favourable development or not. Besides the high costs of informal care for society in the medical model, informal caregiving is associated with a negative impact on the informal caregiver's health status. Informal carers are at risk of depression, social isolation, and carer burden, which can increase to a level that carers are unable to care for their relatives[22;23]. Also, the availability of informal care is expected to decline in coming years in some European countries, as informal caregivers get more involved in the labour market and new family structures may involve less support to the older generations[3]. In order to lower societal cost of resource utilisation and to reduce the expected additional pressure on the informal carers in the future, an expansion of formal social care options for older adults living in the community might be an appropriate action to help to meet future demands.

3 Societal costs of different community care models using IBenC data

3.1 Method

3.1.1 Study design

Data from the IBenC (Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care) project were used. IBenC was a prospective EU-funded international study (FP7) with a follow-up of 12 months. The IBenC project aimed to provide insight into the costs and quality of community care delivery systems across Europe (IBenC, 2016). Data were collected during 2013 and 2015. The study was approved by relevant legal authorized medical ethical committees in all participating countries.

3.1.2 Setting and sample

Participants of the IBenC study were community dwelling adults aged 65 years and older who received care by a home care or community care organization, or by a primary care nurse, and who were expected to receive care for at least six more months at baseline. Clients with a life expectancy shorter than 6 months at baseline and persons with cognitive impairments (score of three or higher on the Cognitive Performance Scale (CPS)) who did not have a close relative, legal representative, or legal guardian who was willing to participate as a proxy, were not included in the study. Also, clients for whom admittance to a long term care or a relocation to another area out of the range of the serving community care organization within 6 months from baseline was planned were not included in the study.

3.1.3 Procedure

Clients receiving care from community care organizations that participated in the IBenC project and who fulfilled the inclusion criteria were invited to participate, or automatically enrolled in the IBenC study in accordance with local ethical regulations. Written informed consent was obtained from the participants. When a participant had cognitive impairments (CPS ≥ 3), informed consent from a close relative, legal representative or legal guardian on behalf of the participant was obtained.

3.1.4 Client

Information on client characteristics, health outcomes and care utilization was collected at baseline, and after 6 and 12 months using the interRAI-Home Care (interRAI-HC) instrument version 9.1.2. The interRAI-HC is a standardized multidimensional geriatric assessment instrument that has been designed to assist in care planning, outcome measurement, quality improvement, and resource allocation for clients who receive care at home[24;25]. Data collection took place in the home of the care recipient and was executed by trained assessors.

3.1.5 Community care models

In this study, costs were compared between community care models based on the classification of community care models according to Henrard et al (2006)[9]. In his work, community care models were identified by looking at the organizational structures and the level of process-centred integration of the AdHOC home care organisations. Organisational structure involves the extent to which staff and resources are organised in one single organisation under one hierarchical structure. An integrated organisation structure, allows single home

care agency to provide a range of services, from social care, personal ADL, primary health nursing, to secondary health care. This is in contrast with a fragmented structure, where different types of care are provided by different care providers. Process-centred integration involves the presence of collaborative actions between multiple health and social care services and practitioners, also called "working arrangements". Examples of working arrangements are the use of a standardized comprehensive geriatric assessment; the presence of a multi-disciplinary team approach for assessment; the presence of a team meeting for care planning; the participation of a general practitioner to the team meeting).

Henrard et al (2006) distinguished the following four community care models; the *medico-social model*, the *medical model*, the *fragmented model,* and the *mixed model.* The medico-social model is characterized by extensive social care with very little working arrangements inside or outside the care organisation. The medical model includes working arrangements within the care organisation with predominance of health care and little or no social care delivery. The fragmented model is characterized by relatively few provisions of formal therapies and nursing care and few or no working arrangements within and between care organisations. The fourth model, the mixed model is a mix of the medico-social model and the medical model. It is characterized by having working arrangements within the care organisation in combination with the supply of social care[9].

3.1.6 Care utilisation

Recently, the interRAI-HC was shown to be a valid instrument to assess the use of care services (Van Lier et al, in preparation). Information on the utilisation of home health aide, home nursing, homemaking services, physical therapy, occupational therapy, and psychological treatment, was collected by registering the number of days and the total number of minutes of care received in the seven days prior to the assessment. For physical therapy, occupational therapy, and psychological treatment, we assumed that the number of days per week the service was received, reflected the number of sessions received during a week. The utilisation of the supportive care service "meals on wheels" was registered in number of days the service was used during the seven days prior to the assessment. The number of hospital admissions, emergency room visits and visits to a physician (specialist, authorised assistant or general practitioner) were registered over the 90 days prior to the assessment. In Belgium, the total number of hospital nights was registered instead of the number of hospital admissions. The total number of hours of all informal care provided by informal carers to a participant were assessed over the three days prior to the assessment.

3.1.7 Costs of care utilisation

In order to calculate cost of care utilisation over a period of 12 months, resource utilisation items with a recall period of seven days were first multiplied by 13 to reflect a period of three months days. Resource utilisation estimates (number of days, hours of care, or number of sessions) were multiplied by 13, as 90 days months correspond to 13 weeks. Informal care hours were divided by three and multiplied by 91 days. In order to estimate costs of hospital stay, length of stay was estimated using country-specific averages of length of stay during hospital admission in the year 2012[10] (see Table 1), multiplied by the number of hospital admissions in the 90 days prior to assessment. This was done for Finland, Germany, Iceland, Italy, and The Netherlands.

Subsequently, units of resource utilisation were multiplied by their standard costs according to the Dutch guideline for costing studies to calculate the costs of formal and informal care utilisation[11]. The care services per cost category and costs per unit are listed in Table1. The following six cost categories were distinguished: home care (home health aide, home nursing), physician visits, other health care services (physical therapy, occupational therapy, psychological treatment), hospital admissions, supportive care services (meals on wheels, homemaking services), and informal care. Additionally, these cost categories were summed into total societal costs.

Costs between measurements were linearly interpolated by multiplying costs at baseline assessment by 0.5; costs at six months after baseline by 2 and costs at 12 months after baseline by 1.5.

3.1.8 Case mix variables

Several case mix variables consisting of multi item summary scales are embedded in the InterRAI-HC, and used in this study. Case Mix Index (CMI) informal care, this is a measure to indicate the amount of resources of formal and informal care that are likely needed to support clients based on their clinical characteristics. Higher CMI informal care values reflect higher needs[12]. Cognitive functioning was assessed using the Cognitive Performance Scale (CPS, range 0-6). Moderate or severe cognitive impairment was considered to be present if the CPS score was 3 or higher[13]. Depressive symptoms were assessed using the Depression Rating Scale (DRS, range 0-14). A score of three or higher on the DRS indicates the possible presences of minor or major depressive disorder[14]. Activities of daily living (ADL) needs were assessed using the interRAI Activities of Daily Living Hierarchy Scale (ADLH, range 0-6) with higher scores indicating higher ADL needs[15]. Difficulties in performing instrumental activities (iADL) were assessed using the interRAI Instrumental ADL Performance Scale (iADLP, range 0-48) with higher scores indicating more iADL dependencies[16]. Medical complexity/health instability was assessed using the Changes in Health, End-Stage Disease, Signs, and Symptoms Scale (CHESS, range 0-5). CHESS is a summary measure based on a count of decline in ADL, decline in cognition, presence of symptoms such as weight loss, shortness of breath, and edema, and a life expectancy of less than six months. Higher scores indicate higher levels of medical complexity or health instability (5=highly unstable) and are associated with adverse outcomes like mortality and hospitalization[18;26].

3.1.9 Analytic approach

All analyses were performed using SPSS statistics 20 and STATA 12 SE. Demographic and clinical characteristics of the participants at baseline across community care models were described using descriptive statistics and frequencies. Differences in baseline characteristics between participants from different community care models were evaluated using Chi-square tests for categorical variables and ANOVAs for continuous variables. A number of participants dropped out in the course of the IBenC study and did not complete all follow up assessments. Reasons for drop-out were described. Differences in baseline characteristics between drop outs and 'completers' were evaluated using Chi-square tests for categorical variables and ANOVAs for continuous variables.

Missing data on costs were imputed using multiple imputation with chained equations (MICE)[19] using predictive mean matching (PMM) in SPSS. For respondents who passed away, we assumed that costs were zero after death which we considered to have taken place halfway between two measurements. For respondents who were admitted to a nursing home, psychiatric hospital or a rehabilitation institute during the follow up period, we assumed that the client was admitted halfway between two measurements, and that the costs per day for the admission period were equal to the standard cost per admission day for this specific care facility. For all drop outs for which with reasonable cause could be assumed that they would continue to receive care in the community after declining from the study. Predictive mean matching was used to account for the skewed distribution of societal costs. Characteristics that were included in the imputation model were baseline characteristics that differed significantly between care models and between respondents with and without follow-up, and baseline characteristics that were significantly associated with costs after 12 months. The number of imputed datasets was increased until the loss of efficiency was smaller than 5%. Each imputed dataset was analysed separately, and the results of the analyses were pooled using Rubin's rules[21].

Mean disaggregated cost categories and total societal costs per client over a 12-month period in the different community care models were described using means and standard errors. The different community care models were ranked according to their societal costs. Differences in costs between community care models were analysed using linear regression models. Dummy variables were created to compare costs between the three community care models from a societal perspective. Because of the skewed distribution of cost data, 95% confidence intervals (CIs) were estimated using bias-corrected accelerated bootstrapping with 5000 replications. Differences were adjusted for case mix variables, including 1) CMI informal care, and 2) age, gender, cognitive impairment (CPS ≥ 3), depressive symptoms (DRS ≥ 3), ADLH, iADLH and CHESS. Collinearity between covariates was investigated using Pearson correlation coefficients (cut-off value $r>0.4$ was used to indicate correlation).

The amount of informal caregiving time was not assessed in Belgium, because this item was not available in the Belgian interRAI-HC software. Therefore, a secondary analysis was performed from the health care perspective. In this sensitivity analysis, Belgian participants were included.

3.2 Results

3.2.1 Study sample

The IBenC sample consisted of 2796 participants. Data from one Dutch organisation (WFHO, n=228) were excluded from the analysis because this organisation stopped using interRAI in routine care temporarily during the follow-up period of IBenC due to software problems. Also, all Belgian data (n=525) were excluded from the main analysis since the amount of informal caregiving time was not included in their interRAI assessment software.

The number of participants that dropped out was 316 (15%). The main reason for drop out was discharge from the participating home care organisation (n=123, 39%). Other reasons included admission to a nursing home (n=84, 27%), deceased (n=74, 23%), acute hospital admission (n=17, 5%), admission to a rehabilitation or a psychiatric hospital (n=13, 4%) or other reasons (n=5, 2%) (Figure 3). Compared to the completers, the drop outs had statistically significantly ($p < 0.05$) more iADL dependencies.

A total of 2043 participants were included in this study. Participants in Italy (n=411) and Iceland (n=420) received care that was mostly provided according to the medical model (n=831, 20%); in Finland (n=456) and the Netherlands (n=263) according to the medico-social model (n=719, 35%), and in Germany (n=493) according to the mixed model (n=493, 24%). Approximately two third of the participants in the study sample were female and the mean age was 83.8 (SD 7.4). On average, 60% of the participants lived alone, ranging from 36% in the medical model, to 78% in the mixed model.

Baseline characteristics of the study population per community care model are presented in Table 6. Approximately 30% of the persons in the medical model were suffering from cognitive impairment, 27% in the mixed model, and only 7% in the medico-social model. Depressive symptoms were most frequently reported in the medical model (21%), followed by the mixed model (19%), and 13% in the medico-social model.

Figure 3. Flow chart (societal perspective)

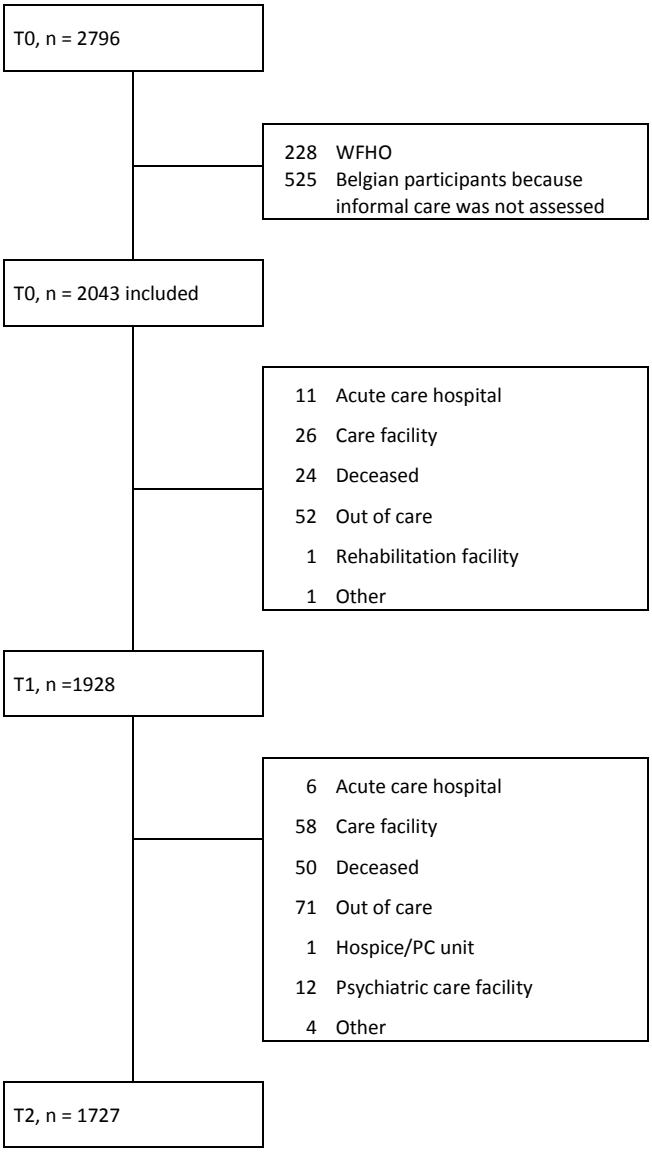


Table 6. Characteristics of the study population per community care model

	Mix medico-social & medical model n=493	Medical model n=831	Medico-social model n=719	Total n=2043
Country	GE, n=493 (100%)	IT, n=411 (49.5) IS, n=420 (50.5)	NL, n=263 (36.6%) FI, n=456 (63.4%)	IT, n=411 (20.1%) FI, n=456 (12.9%) GE, n=493 (20.6%) IS, n=420 (22.3%) NL, n=263 (24.1%)
Mean age (SD)	84.1 (7.6)	84.6 (7.2)	82.5 (7.2)	83.8 (7.4)
Female (n, %)	348 (70.6)	556 (66.9)	433 (60.2)	1337 (65.4)
Living alone (n,%)	359 (72.8)	301 (36.2)	560 (77.9)	1220 (59.7)
Cognitive impairment (CPS ≥ 3) (n, %)	135 (27.4)	247 (30.4)	52 (7.2)	434 (21.4)
Depressive symptoms (DRS ≥ 3) (n, %)	92 (18.7)	168 (20.7)	91 (12.7)	351 (17.3)
Mean ADLH score (SD)	2.2 (1.7)	2.5 (2.4)	0.7 (1.3)	1.8 (2.1)
Mean iADLH score (SD)	28.7 (14.9)	30.3 (14.2)	24.3 (12.9)	27.8 (14.2)
CHESS (SD)	0.6 (0.9)	1.3 (1.1)	1.0 (1.0)	1.0 (1.1)
CMI informal care	1.0 (0.5)	1.2 (0.7)	0.8 (0.4)	1.0 (0.6)
Mean hours home care per week (SE)	6.7 (0.3)	1.5 (0.1)	4.4 (0.2)	3.8 (0.1)
Mean informal care per week (SE)	11.5 (1.2)	36.5 (1.6)	13.9 (1.2)	22.5 (0.9)

FI = Finland, GE= Germany, IS = Iceland, IT = Italy, NL = Netherlands.

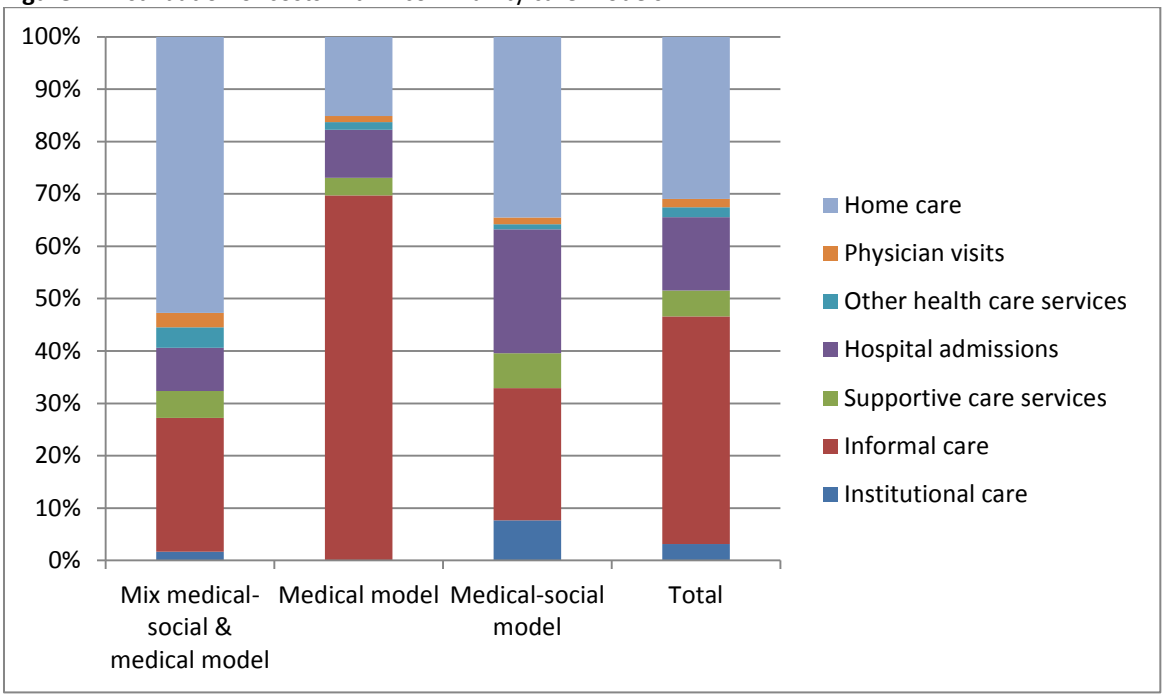
3.2.2 Costs per community care model

Table 7 presents the unadjusted cost estimates for the medico-social model, the mixed model, and the medical model, and for the total sample over the follow-up period of 12 months. Mean total societal costs per client in the medico-social model were €37288 (SE 1780), in the mixed model €37493 (SE 1643), and in the medical model €37758 (SE 1589). Costs of informal care provision was the largest cost category in the medical model (70% of the total cost), and the second largest cost category in the mixed model (26%) and in the medico-social model (25%). Home care was the largest cost category in the mixed model and the medico-social model (53% and 35%, respectively), and accounted for only 15% of the total cost in the medical model. The costs of hospital admissions accounted for 24% of total costs in the medico-social model, against 9% in the medical model, and 8% in the mixed model. Furthermore, costs of institutionalisation accounted for 8% of the total costs in the medico-social model, 2% in the mixed model, and less than 1% in the medical model. The share of costs of supportive care, physician visits, and other health care services ranged from 1% to 7% of the total cost across the three care models (Figure 4).

Table 7. Cost of care estimates (€, 2015) across community care models over 12 months

Cost category	Medico-social model n=719	Mix medico-social & medical model n=493	Medical model n=831	Total n=2043
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Home care	12878 (692)	19765 (1020)	5707 (708)	11623 (460)
Physician visits	462 (37)	1026 (64)	434 (26)	587 (21)
Other health care services	382 (48)	1473 (137)	560 (65)	718 (45)
Hospital admissions	8800 (1310)	3104 (600)	3456 (332)	5252 (501)
Supportive care services	2489 (108)	1908 (104)	1286 (85)	1860 (59)
Informal care	9415 (777)	9595 (1019)	26277 (1301)	16317 (687)
Institutional care	2861 (358)	620 (136)	37 (26)	1172 (133)
Total societal costs	37288 (1780)	37493 (1643)	37758 (1589)	37528 (981)

Figure 4. Distribution of costs within community care models



3.2.3 Differences in costs between community care models from a societal perspective

Table 8 presents the unadjusted mean differences in costs per client over the follow-up period of 12 months between the three community care models. Total societal costs in the mixed model and the medical model were higher than in the medico-social model, but these differences were not statistically significant (mean differences €205, 95% CI -4216; 4213 and €470, 95% CI -4012; 4546, respectively). Total societal costs in the medical model were non significantly higher than in the mixed model (mean difference €265, 95% CI -3584; 4064).

The main contributor to the difference in total societal costs between the mixed model and the medico-social model was home care costs (mean difference €6888, 95% CI 4874; 9061), and informal care costs was the main contributor to the differences in total societal costs between the medical model and the medico-social model, and medical model and the mixed model (mean differences €16862, 95% CI 14214; 19602 and €16681, 95% CI 13747; 19576, respectively).

Table 8. Mean differences cost categories and total annual societal costs (€, 2015) between the three community care models (medico-social model, medical model and fragmented model).

	Mix medico-social and medical model versus medico-social model	Medical model versus medico-social model	Medical model versus mix medico-social and medical model
Cost category	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Home care	6888 (4874; 9061)	-7170 (-8712; -5104)	-14058 (-16129; -11771)
Physician visits	564 (465; 669)	-28 (-108; 45)	-592 (-694; -504)
Other health care services	1092 (877; 1337)	178 (55; 317)	-913 (-1169; -682)
Hospital admissions	-5696 (-9045; -3644)	-5344 (-8770; -3451)	352 (-827; 1167)
Supportive care services	-581 (-821; -337)	-1203 (-1424; -975)	-622 (-850; -394)
Informal care	180 (-2054; 2581)	16862 (14214; 19602)	16681 (13747; 19576)
Institutional care	-2241 (-3055; -1547)	-2825 (-3598; -2188)	-583 (-905; -350)
Total societal costs	205 (-4216; 4213)	470 (-4012; 4546)	265 (-3584; 4064)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

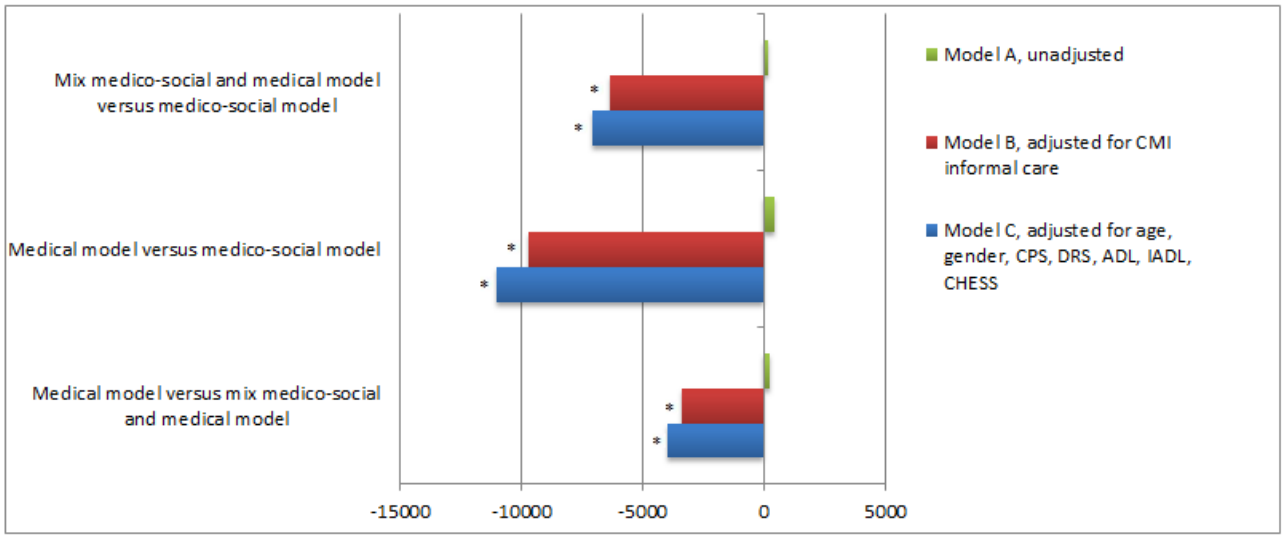
Table 9 describes the differences in total societal cost estimates over a period of 12 months between the three community care models using an unadjusted model (model A), a model adjusted for CMI informal care (model B), and a model adjusted for age, gender, CPS, DRS, ADL, IADL, and CHESS (model C). These differences are also graphically presented in Figure 5. In model A, none of the differences in total societal between the community care models were statistically significant. In models B and C, differences in total societal costs between all three models became larger and were statistically significant (Table 9).

Table 9. Mean adjusted and unadjusted differences in total societal costs (€, 2015) between the three community care models

	Mix medico-social and medical model versus medico-social model	Medical model versus medico-social model	Medical model versus mix medico-social and medical model
	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Model A, unadjusted			
Societal costs	205 (-4216; 4213)	470 (-4012; 4546)	265 (-3584; 4064)
Model B, adjusted for CMI informal care			
Societal costs	-6331 (-10572; -2491)	-9733 (-13782; -6180)	-3402 (-6846; -40)
Model C, adjusted for age, gender, CPS, DRS, ADL, IADL, CHESS			
Societal costs	-7080 (-11548; -2874)	-11053 (-15705; -7269)	-3973 (-7850; -176)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

Figure 5. Mean adjusted and unadjusted differences in total societal costs (€, 2015) between the three community care models



$p < 0.05$

3.2.4 Ranking community care model on societal costs

In the unadjusted analysis, the medico-social model was associated with the lowest costs per client and the medical model with the highest costs per client. However, the cost-differences between the three models in the unadjusted analysis were not statistically significant. After adjustment for case mix variables, the medical model was associated with the lowest costs per client, and the medico-social model was associated with the highest costs per client. These cost-differences were statistically significant.

3.2.5 Differences in costs between community care models from a health care perspective

A secondary analysis was performed from the health care perspective. In this sensitivity analysis, Belgian (n=525) participants were included. Belgian participants received care that was mostly provided according to the mixed model.

The differences in total health care cost estimates over a period of 12 months between the three community care models using an unadjusted model (model A), a model adjusted for CMI informal care (model B), and a model adjusted for age, gender, CPS, DRS, ADL, IADL, and CHESS (model C) are described in Table 10. In models A, B, and C, total health care costs were statistically significantly lower for the medical model compared to the medico-social model and the mixed model. Health care costs in the medico-social model were non-significantly lower than in the mixed model in the unadjusted analysis. After adjustment for case mix variables (models B and C), however, the cost difference turned around, and costs in the medico-social model were non-significantly higher than in the mixed model.

Table 10. Mean adjusted and unadjusted differences in total health care costs (€, 2015) between the three community care models

	Mix medico-social and medical model versus medico-social model	Medical model versus medico-social model	Medical model versus mix medico-social and medical model
	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Model A, unadjusted			
Health care costs	2027 (-1693; 4878)	-16392 (-20033; -13536)	-18419 (-20243; -16169)
Model B, adjusted for CMI informal care			
Health care costs	-557 (-4103; 2221)	-19673 (-23160; -16999)	-19117 (-20962; -16983)
Model C, adjusted for age, gender, CPS, DRS, ADL, IADL, CHESS			
Health care costs	-2418 (-6521; 928)	-19664 (-23811; -16696)	-17245 (-19507; -14019)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

3.2.6 Ranking community care model on health care costs

In all analyses, the medical model was associated with the lowest total health care costs per client. In the unadjusted analysis, health care costs per client were highest in the mixed model. After adjustment for case mix variables, the medico-social model was associated with the highest costs per client. However, cost-differences between the mixed model and the medico-social model were not significant in any of the analyses.

3.2.7 Implications for policy and home care organisations

The results of the analyses based on IBenC data showed that, after adjustment for case mix, community care provided according to the medical model resulted in the lowest societal costs, as compared to the medico-social and the mixed model. Although the medical model resulted in the lowest societal cost per client in this study, it is questionable whether this model will suffice to support the growing proportion of older adults with chronic conditions and co-morbidities in the future. As these persons often have limitations to carry out basic daily activities, they will not only require medical care as provided in the medical model, but also extensive social support which is not a key feature of the medical model. Also, approximately 2.5 times higher informal care costs were found in the medical model than in the care models in which the provision of social care services was part of community care. This suggests that in the absence of social care provisioning, clients rely more heavily on their relatives, which might be an issue for concern.

The highest societal cost per client were found for the medico-social model. In this model, significantly higher costs were found for hospital admissions and institutionalized care compared to the mixed model. Compared to the mixed model, the medico-social model had a lower level of process-centred integration, meaning fewer collaborative actions between multiple health and social care services and practitioners. The results may imply that a low level of process-centred integration may lead to relatively more hospital admissions and admissions to care facilities.

4. Discussion

4.1 Main findings

The results of this study provide insight in the societal and health care costs of older adults receiving community care according to different care models across European countries. Costs per client over 12 months in different care models– medico-social model, medical model, fragmented model, mixed model – were benchmarked from a societal and health care perspective using data from two longitudinal European studies among community care users of 65 years and older (AdHOC and IBenC). In the study based on AdHOC data from 2002-2004, no mixed model was available and in the study based on IBenC data from 2013-2015, no fragmented model was available. These care models were classified based on the extent to which staff and resources are organised in one single organisation under one hierarchical structure, and on the level of process-centred integration of the care organisations. Results based on data from the AdHOC study showed that the medical model was associated with the highest costs per client. In contrast, based on data from the IBenC study, after adjustment for case mix variables, the medico-social model was associated with the highest costs per client and the medical model was associated with the lowest cost per client. In AdHOC, the care model with the lowest costs per client could not be identified, since the differences between the care models with the lowest costs were not statistically significant.

Possible explanations for the differences in the results between the studies are, first, the classification of care models that was used. We used a model classification that was developed by using data collected within the AdHOC study[9]. We also applied this classification to IBenC data, but whether this is a valid way to classify community care models in IBenC is not clear. The AdHOC study was conducted between 2002 and 2004, while the IBenC study was conducted during 2013 and 2015. It is possible that in the last decade changes were implemented to the way in which community care is delivered within the countries that participated both in AdHOC and IBenC. These changes are not covered in this classification. Moreover, Belgium did not participate in AdHOC and was classified into one of the care models based on the current system characteristics. Secondly, great diversity exists across participating community care organisations within countries in the IBenC study. Therefore, classification of community care models on country level, as was done in this study using the classification of Henrard, might neglect differences across care organisations. Finally, slightly different populations were included in AdHOC and IBenC. Compared to participants from the AdHOC study, participants from the IBenC study were older (83.8 versus 81.5), suffered relative more often from cognitive impairment (21% versus 11%) and scored on average higher on IADL (27.8 versus 8.8). This may have led to different patterns of health and social care utilisation. Moreover, in the AdHOC study, Icelandic clients with lighter care needs receiving only social care services and clients with higher needs receiving nursing care were proportionally included by a 25:75 ratio. This sampling strategy was not used in the IBenC study.

4.2 Comparison with existing literature

Up till now evidence of cost differences between community care models remained limited. Most studies that compare community care models focus on the outcomes of care, and less frequently on the associated costs

for society. A study of Looman et al (2016) estimated the cost-effectiveness of a chronic care model for frail older adults as compared to usual care in the Netherlands[27]. The estimates of the total societal cost of the usual care model over a period of twelve months reported in that study were in line with the cost estimates based on AdHOC data, but approximately half the estimates based on IBenC data. This difference can be attributed to the difference in cost of hospital admissions, since cost of hospital admissions were approximately seven times higher based on IBenC data compared to the estimates in the study of Looman et al.

4.3 Next step

This study is one of the first attempts to benchmark care models on societal and health care costs in Europe. To allow for a more appropriate comparison of care models within the IBenC study, information on community care organisations with respect to management structures, care processes and reimbursement systems was assessed using a cross-sectional questionnaire that was designed specifically for use in the study. Using these data, distinct community care models within and across countries will be identified. In a next step, these community care models will also be related to societal costs.

5 Conclusions

Based on data from the IBenC study, the medical model was associated with the lowest costs per client and the medico-social model was associated with the highest costs per client. Based on data from the AdHOC study, the medical model was associated with the highest costs per client. We were not able to identify the care model with the lowest costs per client based on AdHOC data, because differences between community care models with the lowest costs were not significant.

This study provides important information on the costs associated with different community care models. With this information we will support policymakers and other stakeholders in identifying efficient community care models for older adults.

Appendix I

The results presented in the tables below are based on data from AdHOC.

Table A. Mean differences disaggregated costs and total societal costs (euro €2015) between the fragmented model, the medical model, and the medico-social model, adjusted for CMI informal care.

	Fragmented model versus medico-social model	Medical model versus medico-social model	Medical model versus fragmented model
Cost category	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Home care	-5709 (-7340; -4594)	735 (-1088; 2003)	6444 (5405; 7594)
Physician visits	-143 (-257; -29)	162 (40; 287)	305 (184; 429)
Other services	43 (-105; 243)	354 (159; 642)	311 (92; 575)
Hospital admissions	3780 (2596; 4965)	-415 (-1445; 226)	-4195 (-5354; -3157)
Supportive care services	546 (427; 660)	-223 (-341; -109)	-769 (-864; -668)
Informal care	3073 (970; 5032)	10476 (7684; 13652)	7404 (4302; 10927)
Societal costs	1589 (-1129; 4280)	11089 (7802; 14567)	9501 (5839; 13518)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

Table B. Mean differences disaggregated costs and total societal costs (euro €2015) between the fragmented model, the medical model, and the medico-social model, adjusted for age, gender, CPS, DRS, ADL, IADL, CHESS.

	Fragmented model versus medico-social model	Medical model versus medico-social model	Medical model versus fragmented model
Cost category	Mean difference (95% CI*)	Mean difference (95% CI*)	Mean difference (95% CI*)
Home care	-5829 (-8108; -4498)	136 (-1908; 1491)	5965 (4624; 7470)
Physician visits	-127 (-275; 15)	134 (1; 266)	260 (112; 413)
Other services	-16 (-203; 221)	344 (138; 614)	360 (88; 646)
Hospital admissions	2594 (1196; 3924)	-682 (-1732; 9)	-3276 (-4525; -2140)
Supportive care services	520 (379; 655)	-264 (-393; -134)	-784 (-897; -666)
Informal care	906 (-1975; 3541)	7849 (5129; 10913)	6943 (3293; 11440)
Societal costs	-1953 (-5725; 1624)	7517 (4354; 10927)	9469 (5197; 14364)

* Confidence interval estimated using bias-corrected and accelerated bootstrapping with 5000 replications

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