Report Supplementary Material # 9: WP2c - Determinants of costs

Methods

A stepwise backward elimination method was applied{Faraway, 2014 #22} to identify which individual and reablement service level characteristics at baseline, as well as elements of cost and resource use incurred in the period before entry to the service, were associated with costs at discharge. The stepwise procedure enables the analyst to focus the potential explanatory variables on the subset of predictors that are significant at a specified significance level (critical alpha) using ordinary least squares (OLS) regression. The selection of predictive variables is implemented using an automated procedure that removes variables and refits the regression model at each step based on a specified alpha. On this basis, the final regression model obtained includes only the subset of variables that have a p-value lower than the critical alpha. For improved prediction performance, a critical alpha of 15-20% has been recommended.{Faraway, 2014 #22} A critical alpha of 20% was selected as the cut-off value for this analysis. All regressions in this section use clustering at site level.

The analysis aimed to predict three independent variables comprising i) hospital costs (overnight stays and visits), ii) community health care costs, and iii) social care costs at discharge. Only public sector costs were included in the estimation of each category of costs, as these costs were considered generally less uncertain than out of pocket costs given that unit costs for the former were collected from national references and did not depend on the individuals recall and interpretation of the question on how much was paid for the resource use item. The analysis did not include the prediction of the cost of informal care, major and minor adaptations and equipment costs at discharge. Due to the methods uncertainty associated with how to quantify informal care, and in which sector to place the cost of home adaptations and equipment, these costs were not included in the regression analysis.

Three models were fitted for each dependent variable. Model 1 included only individual characteristics, model 2 added reablement service characteristics to this,

and model 3 added costs at baseline as well. The three models included different subsets of predictors, as variable selection involves two opposing objectives: i) to include any variable that is a potential predictor to be included for the model to be comprehensive, and ii) to include as few variables as possible so that the impact on precision of the estimated coefficients and predicted values by irrelevant variables is minimised. Only variables referring to observables at entry were included as predictors in the models, as the intention of the analysis was to establish which information contributes towards explaining future costs for people at baseline. The hospital costs at baseline for this analysis were adjusted to reflect same time interval as for T1 questionnaire rather than the 2 months to which the baseline questionnaire referred to. This was done by multiplying hospital baseline cost by the ratio between the actual duration of reablement and 60 days. The full set of variables for each model is detailed in Table 1, as well as a description of how derived variables were constructed.

The sample for this analysis had to be restricted to the subset of observations that had complete information on both the independent and dependent variables across the models. This ensured that the models were comparable and consistently referred to the same set of individuals. This reduces the sample size however, with loss of statistical power. Another issue, is that the use of a complete case dataset can bias the results if data is not missing completely at random.{White, 2010 #88} Formal methods of dealing with missing data were not applied to address this issue, given that the sample was small. Baseline characteristics from the original sample and the subset on which the regression analysis was conducted were compared to check whether the analysis sample remained representative of the study sample based on observed characteristics. A sensitivity analysis was conducted by estimating the most comprehensive model for each category of costs using data from site C only.

The identification of cost predictors was exploratory. Stepwise models do not present a comprehensive analysis of all the potential models that could result from the combination of the variables included in the analysis. Furthermore, the sample size for the analysis is likely to preclude drawing robust conclusions from results. Cost data is known to be highly variable and right hand/positively skewed, and usually requires larger samples than outcome data for studies to be adequately powered.{Polsky, 2009 #71}

Table 1: Variables included in the regression models

	Model 1	Model 2	Model 3
Costs/ resource use at entry to reablement	-	-	Hospital costs* Community health care costs Social care costs Hours of informal care
Service characteristics	-	Type of provider (ref: in-house) Reason for Referral (ref: remain at home; 1, return home) Planned reablement weeks Single team model (ref: No)	
Individual characteristics	Age and age^2 Gender (ref: Female) Sufficient money (ref: No) Private rented house** (ref: No) Social rented house** (ref: No) Living alone (ref: No) Illness/Problem leading to reablement***: Respiratory Musculoskeletal or Fall Infection Co-morbidities****: Arthritis of any cause Cardiovascular Diabetes COPD or Asthma Other comorbidities Gross Disposable Household Income per Head 2015 EQ-5D-5L score at baseline EQ-5D VAS score at baseline ASCOT SCT4 score at baseline NEADL score at baseline GHQ-12 score at baseline		

* adjusted to reflect same time interval as for T1 questionnaire, i.e. based on actual duration of reablement provision; **If both these variables equal zero, the participant resided on their own home; *** If all the variables listed under this category equal zero, the participant had any other reason for reablement other than; **** If all the variables listed under this category equal zero, the participant had no co-morbidities.

Ethnicity was not included in the model given the small variation at baseline (178 of respondents at baseline were of White British ethnicity). Barthel index score at baseline was not included due to high level of missingness (approximately 27%) but functional status was included via the NEADL score at baseline. Education level was not included as it was inconsistently reported. Hours of informal care at entry was included instead of the variable resulting from question on whether the participant had an informal carer, as there were discrepancies between the baseline characteristic information and the resource use corresponding question. Hours of

informal care is also more informative allowing to control for whether the participant had any informal care, but for the frequency of it.

The variables relating to reason leading to reablement and to comorbidities are derived from Question 10 and 11 on the Demographic Form of the baseline questionnaire. For both set of variables the free text field was examined and key reasons/conditions were identified. Dummy variables were created for the most frequent (>10% of the observations) reasons/conditions. For reason leading to reablement four variables were created: Respiratory; Musculoskeletal or Fall; Infection; and Other reason. Musculoskeletal issues (which included fractures and any orthopaedic surgery) and Falls were grouped together, as there was considerable overlap. The variable Other reason was omitted from the regression, thus becoming the reference category for this set of dummy variables. A similar rationale was followed for the creation of comorbidities variables, with the following variables generated: Arthritis; Cardiovascular; Diabetes; COPD or Asthma; Other comorbidities; No Comorbidities. Cardiovascular included a number of cardiac conditions and high blood pressure. The variable Other comorbidities was created for participants who had none of the key comorbidities (Arthritis, Cardiovascular, Diabetes, COPD or Asthma), but reported any other comorbidity. The other comorbidities variable was highly heterogeneous in terms of conditions it referred to. It included a wide range of conditions such as dementia, cerebrovascular disease, Parkinson, hearing difficulties, etc. The variable No comorbidities was omitted from the regression, thus becoming the reference category for this set of dummy variables.

The variables pertaining to type of house tenure were derived from Question 8 on the Demographic Form of the baseline questionnaire. Three dummy variables were created: Home ownership; Private rented; and Social rented. Home ownership was omitted from the regression, thus becoming the reference category for this set of dummy variables.

Results

Table 2: Baseline individual characteristics, service level characteristics and costs/ resource use for full sample and analysis sample

Variable		Full sample (N=186)	Analysis sample (N=86)
Individual Characteristics		N (%)	N (%)
Gender (ref: Female)	Male	67 (36.02)	25 (29.07)
Living alone (ref: No)	Yes	107 (57.53)	53 (61.63)
Sufficient money (ref: No)	Yes	149 (82.78)	73 (84.88)
House tenure			
	Private rented house	15 (8.06)	6 (6.98)
	Social rented house	32 (17.20)	16 (18.60)
	Own home	138 (74.19)	64 (74.42)
	Other	1 (0.54)	0 (0.00)
Illness/Problem leading to reablement			
	Respiratory	20 (10.75)	12 (13.95)
	Musculoskeletal or Fall	115 (61.83)	55 (63.95)
	Infection	20 (10.75)	10 (11.63)
	Other illness	43 (23.12)	14 (16.28)
Co-morbidities			
	Arthritis	33 (17.74)	16 (18.60)
	Cardiovascular	68 (36.56)	32 (37.21)
	Diabetes	34 (18.28)	14 (16.28)
	COPD or Asthma	32 (17.20)	16 (18.60)
	Other comorbidities	46 (24.73)	21 (18.60)
	No comorbidities	21 (11.29)	9 (10.47)
		Mean (SD)	Mean (SD)
Age		80.85 (9.13)	80.12 (9.56)
GDI (gross disposable household income) per Head 2015 (£)		20,225.56 (3,661.64)	20,269.17 (4,034.66)
T0 EQ-5D-5L index score		0.507 (0.228)	0.524 (0.240)
T0 EQ-5D VAS score		51.83 (20.23)	51.50 (19.81)
T0 ASCOT SCT4 score		0.713 (0.170)	0.731 (0.159)
T0 NEADL score		9.65 (5.48)	10.05 (5.50)
T0 GHQ-12 score		4.14 (2.85)	4.02 (3.06)
Service Level Characteristics		N	N

Variable		Full sample (N=186)	Analysis sample (N=86)
		(%)	(%)
Provider type (ref: in-house)	Outsourced	67 (36.02)	26 (30.23)
Referral reason (ref: Remain at home)	Return to home	75 (40.32)	35 (40.70)
Single team model (ref: No)	Yes	110 (59.14)	54 (62.79)
		Mean (SD)	Mean (SD)
Planned reablement weeks		5.72 (1.05)	5.68 (1.06)
Costs/ resource use at T0			
Hospital stays and visits costs* (£)		2,740.18 (3236.95)	3,118.77 (3,504.56)
Community health care costs(£)		54.06 (56.52)	53.30 (61.27)
Social care costs (£)		87.96 (65.78)	78.85 (66.17)
Hours of Informal care		23.77 (35.76)	22.00 (36.81)

*adjusted to reflect same time interval as for T1 questionnaire, i.e. based on actual duration of reablement provision.

Table 3: Regression outputs for most comprehensive model (Model 3)

Costs during reablement period	Hospital	Community	Social care
Predictors (at baseline/prior to reablement)	**Coefficient (s.e.)**	**Coefficient (s.e.)**	**Coefficient (s.e.)**
Age	-	5.692* (0.647)	-
Age2	-	-0.0362* (0.00420)	-
Gender	-	-18.55* (3.717)	-
Money	-	37.96* (5.566)	-
GDI per head 2015 (£)	0.0218* (0.00226)	0.00234* (0.000362)	-0.00241* (0.000344)
Private rent	-	-	27.55* (05.223)
Social rent	-	-3.291 (1.190)	-
EQ-5D-5L	-	-	24.67* (4.286)
EQ-5D VAS	-	-0.478+ (0.0.140)	-
GHQ-12	-	2.384*** (0.0457)	-
Problem leading to reablement: Musculoskeletal/Fall	-	-35.51* (5.651)	-
Problem leading to reablement: Infection	-	-31.97*** (0.693)	-
Problem leading to reablement: Respiratory	-	-22.09 (10.59)	-
Co-morbidities: Arthritis	-	-	23.22* (5.069)

Costs during reablement period	Hospital	Community	Social care
Predictors (at baseline/prior to reablement)	**Coefficient (s.e.)**	**Coefficient (s.e.)**	**Coefficient (s.e.)**
Co-morbidities Cardiovascular	-	-11.90 (4.670)	-18.20* (1.990)
Co-morbidities COPD/Asthma	-	12.04 (5.130)	12.51* (2.4426)
Other comorbidities	-	8.899** (0.467)	-
Type of Provider	255.1* (56.35)	36.78 (12.88)	-41.75*** (0.443)
Reason for Referral		- 9.356** (5.130)	-
Single team	-	39.90+ (13.05)	-
Community health care costs (£)	-0.558+ (0.188)	-	-
Hospital cost (£)	-	0.00389*** (0.000227)	0.00228** (0.000161)
Social care cost (£)	-	0.0391* (0.00807)	0.549** (0.0322)
Hours of informal care	-	0.176+ (0.0.0458)	-
Constant	-311.4* (32.16)	-261.4** (17.82)	51.86+ (13.02)
R2	0.104	0.471	0.637

+ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

COPD, chronic obstructive pulmonary disease; MSK, musculoskeletal

Table 4: Hospital costs over reablement - full regression output

	Model 1	Model 2
N=86	**Coefficients (S.E.)**	**Coefficients (S.E.)**
Money	-	111.5 (40.85)
MSK/Fall	-	-126.9 (64.38)
Type of Provider	-	246.9* (42.96)
GDI per head 2015	-	0.0195*** (49.16)
Constant	178.4 (69.75)	305.4** (24.38)
R^2	0.00	0.31

+ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

Table 5: Community health care costs over reablement - full regression output

	Model 1	Model 2
N=86	**Coefficients (S.E.)**	**Coefficients (S.E.)**
Age	8.442* (1.373)	85.654+ (1.496)
Age^2	-0.0500* (0.00986)	-0.0330+ (0.00985)
Gender	-9.465+	-14.20*

	Model 1	Model 2
N=86	**Coefficients (S.E.)**	**Coefficients (S.E.)**
	(2.231)	(2.517)
Private rented	-18.69^{+} (5.623)	-13.34 (6.883)
Money	20.25* (3.165)	20.46* (2.155)
GDI per head 2015	-	0.00331** (0.000187)
EQ-5D-5L T0	-42.05 (15.22)	-41.47* (5.131)
EQ-5D VAS T0	0.428 (0.175	-
MSK/Fall	-27.49* (4.100)	-38.53** (3.169)
Respiratory	-	-25.12 (9.260)
Arthritis	14.73** (1.181)	9.434* (1.756)
Cardiovascular	-9.379^{+} (2.547	-12.46 (4.464)
COPD/Asthma	-	12.04 (5.130)
Other comorbidities	-	8.839** (0.886)
Infection	-17.90^{+} (5.659)	-15.92*** (0.263)
GHQ-12 T0	-	1.148** (0.0457
NEADL T0	0.933 (0.347)	0.604 (0.221)
Reason for Referral	-	-
Type of provider	-	48.21^{+} (11.52)
Single team	-	50.45^{+} (12.88)
Other comorbidities	13.62 (5.993)	18.19^{+} (4.304)
Hospital cost T0	-	-
Social care cost T0	-	-
Constant	-272.6* (45.04)	-301.4* (48.07)
R^2	0.290	0.381

$^{+}$ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

Table 6: Social care costs - full regression output

	Model 1	Model 2
	Coefficients (S.E.)	**Coefficients (S.E.)**
Age	12.94** (1.265)	11.91* (3.006)
Age^2	-0.08961* (0.01141)	-0.0760* (0.0161)
Gender	20.95^{+} (5.006)	14.39* (2.007)
Money	-49.84^{+} (13.46)	-27.66^{+} (6.442)
EQ-5D-5L T0	-	27.29^{+} (6.617)
Social rented	-14.80 (7.376)	-
NEADL T0	-2.274 (1.153)	-1.777 (0.678)

	Model 1	Model 2
	Coefficients (S.E.)	**Coefficients (S.E.)**
ASCOT T0	47.87^{+} (11.18)	-23.53 (10.41)
Alone	25.07* (3.147)	-
GDI per head 2015	-	-0.00211 (0.000777)
Single team	-	60.36^{+} (14.26)
Constant	-409.4** (30.78)	-358.6* (76.23)
R^2	0.180	0.387

$^{+}$ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

Table 7: Regression outputs for most comprehensive model (Model 3) for site C (N=61)

Costs over reablement period	**Hospital**	**Community**	**Social care**
Predictors (at baseline)	**Coefficient (s.e.)**	**Coefficient (s.e.)**	**Coefficient (s.e.)**
Age	-	16.02** (5.603)	**17.17*** **(8.540)**
Age^2	-	-0.0964** (0.0356)	**-0.110*** **(0.0538)**
Gender	**-80.73*** **(39.49)**	-	-
GDI per head 2015 (£)	0.0266*** (0.00575)	-	-0.00377* (0.00177)
Private rent	**-192.3*** **(93.30)**	-	60.40* (29.21)
EQ-5D-5L	-	-	82.15* (32.79)
NEADL	**17.34***** **(3.771)**	1.549^{+} (0.903)	-2.216^{+} (1.302)
GHQ-12	-	3.259^{+} (1.727)	**7.329*** **(2.999)**
Musculoskeletal/Fall	**-83.14*** **(40.72)**	-16.20 (10.53)	-
Infection	-	-25.65^{+} (13.80)	-30.46 (18.31)
Arthritis	-96.62^{+} (57.62)	-	-
COPD/Asthma	-	16.85 (11.02)	32.96* (15.99)
Diabetes	**172.6**** **(54.41)**	-	-
Other comorbidities	**144.9**** **(50.62)**	-	-
Type of Provider	166.4** (51.10)	-	-51.00** (16.91)
Planned reablement weeks	-	-	-
Community health care costs (£)	-	**0.468***** **(0.125)**	-
Hospital cost (£)	-	0.00197^{+} (0.00114)	0.00290^{+} (0.00160)
Social care cost (£)	-	-	0.528*** (0.104)
Hours of informal care	-	**0.500*** **(0.208)**	-

Costs over reablement period	**Hospital**	**Community**	**Social care**
Predictors (at baseline)	**Coefficient (s.e.)**	**Coefficient (s.e.)**	**Coefficient (s.e.)**
Constant	-606.2*** (132.7)	-669.1** (226.0)	-618.7+ (336.9)
R^2	0.525	0.480	0.558

+ p<0.10; * p<0.05; ** p<0.01; *** p<0.001

Coefficients in bold were significant (α=5%) in the sensitivity analysis, but not on the base-case analysis. Coefficients underlined were significant (α=5%) in both analyses.