One-year health and care costs after hip fracture for home-dwelling elderly in Norway. Results from the Trondheim Hip Fracture Trial

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Abstract

Aims: The aim of this study was to estimate the one-year health and care costs connected to a hip fracture for home dwelling patients 70 years and older in Norway, paying specific attention to patient status at the time of the fracture and cost differences due to various patient pathways after the fracture.

Methods: Data on health and care service provision were extracted from hospital and municipal records and from national registries, while data on unit costs were collected from the municipality, the hospital administrations, and published studies. Four different patient pathways were identified and total costs for sub-groups of patients according to age, gender, fracture type, and instrumental activity of daily living at fracture incidence were calculated. Descriptive statistics were used to identify cost estimates.

Results: The mean total one-year costs per patient were 68,376 EUR, and the costs for patients alive one year after the hip fracture constituted 71,719 EUR. The patients' age and pre-fracture functional status contributed most to the total costs.

Conclusion: On average, care costs amounted for more than 50% of the total costs, and even for patients with good functional status before the hip fracture, care costs amounted to 40% as compared to hospital costs of 38%. To reduce the financial costs of hip-fractures for the care sector, the results point to the importance of preventive programs to reduce the risk of a hip fracture, but also to the importance of comprehensive geriatric care in the initial phase after a hip fracture.

Key Words: Hip fracture, costs, hospital services, rehabilitation, care services, patient pathways, prevention, comprehensive geriatric care

Background

Hip fractures are a major public health concern. Having a hip fracture is a life-changing event that represents important causes of mortality, morbidity, and disability in older people [1]. The Scandinavian countries have the highest reported incidence of hip fractures worldwide [2]. The age and gender specific annual hip fracture incidence in Norway for the age group 75-79 is about 12/1000 for women and 6/1000 for men, and increases to about 52/1000 for women and 35/1000 for men in the age group 90+ [3, 4]. The lifetime risk of a hip fracture for 50-year-old women in Norway is 24.5 % [5]. Considering demographic changes with increasing numbers of old people, hip fractures will be an increasing challenge for health care services in the future [6]. Hip fracture threatens independence in daily life. Osnes et al. found that 56% of people who were independent before the fracture needed assistance at home and a walking aid after the fracture [1]. Furthermore, older age is consistently associated with not regaining basic mobility following the fracture, and several studies have found impaired pre-fracture functional level to be the most consistent predictor of unfavorable outcomes in older persons after hip fracture rehabilitation [7-10]. Functional impairment can induce changes in living situation, and a Canadian study showed that community residents transferred to long-term care implied substantially increased costs [11].

Hip fractures are associated with substantial health and care costs both because of high incidence rates and because of extensive use of health and long-term care services in connection to the fracture. A systematic review from 2005 found health care costs associated with hip-fractures to be three times higher than the costs for matched controls without a hip-fracture [12]. Costs attributed to a hip fracture are particularly high the first year after the fracture [13]. A study from the Netherlands with 2-year follow-ups showed that rehabilitation centres and nursing homes accounted for 49% of the total treatment costs [14]. Older age,

being female, sustaining an intra-capsular fracture, and low functional status before the fracture are associated with increased first year costs [15].

The costs attributed to the fracture are shown to be strongly related to the pre-fracture site of residence. A study from Sweden found excess costs close to zero the first year after the fracture for patients residing at long-term care facilities before the fracture, while being home-dwelling was associated with substantial excess costs [16]. Nikitovic et al. (2013) found similar results in a study from Canada [17]. In a study from Norway [18] , costs related to femoral neck fractures were reported to be more than twice as high as similar estimates from the Netherlands [14]. However, comparison of cost estimates between studies must take into account differences in follow-up time, case-mix, included cost components, and the nature of the study design (i.e. randomized control trial or based on register data). Different health care systems and other country-specific factors like price levels also matters. A thorough presentation of context and results is in other words important.

The aim of this study was to estimate the one-year health and care costs connected to a hip fracture for home dwelling patients in Norway, paying particular attention to patient status at the time of the fracture and cost differences due to various patient pathways after the fracture. Hospital treatment and the use of a wide range of primary health and care services the first year after the fracture are included in the cost estimates. The results specify whether costs are connected to the index hospital stay, to post discharge rehabilitation, to extra hospital services or to primary health care services, and whether the resident's municipality or the state is the financing body of the different cost components. The calculations explore data from a randomized clinical trial carried through in 2008-2011. We argue that detailed service utilization data thoroughly collected in clinical trials provide cost estimates that can shed light on how different service types contribute to the total costs.

Material and methods

The delivery of health and care services in Norway

The health care sector in Norway is divided into specialist health care and primary health care, each subject to different funding systems, laws, and central regulations. Four regional health enterprises owned by the state are responsible for the provision of hospital services, while rehabilitation services can either be delivered by private non-profit enterprises or by the municipalities. The provision of primary health and care services (both nursing homes and home caring) is the responsibility of the municipalities, which is the lowest governmental level. Hence, when an old patient is hospitalised and when he or she is discharged from the hospital, the medical and care responsibility is carried over to another governmental level.

Study design

The study is a part of the Trondheim Hip Fracture Trial, which is a single-centre, randomized, controlled trial (RCT) performed at St Olav Hospital. The study population was 70 years and older and home-dwelling prior to the hip fracture. The included patients had been able to walk 10 meters before the fracture. Exclusion criteria were patients with pathological fractures and multi trauma injuries. The data set was collected in the period 2008-2011 and consists of 396 patients. The trial assessed the effect and cost-effectiveness of comprehensive geriatric care versus usual orthopedic care during the initial hospital stay. The primary study outcome was mobility assessed by the Short Physical Performance Battery (SPPB) four months following surgery [19]. The study protocol, the description of the intervention, and trial results have been published previously [20-22]. Beneficial comprehensive geriatric care results were reported both in terms of mobility and cost-

effectiveness. The present study further explored the health and care service utilization the first year after the hip fracture as a basis for estimation of costs for sub-groups of patients. Data for the index stay, readmissions to hospital, and out-patient visits were collected from the hospital records; rehabilitation stays were collected from The Norwegian Patient Registry (NPR) and from municipality records; visits to general practitioners (GPs) and physiotherapists from the Norwegian Health Economic Administration (HELFO); and nursing home stays and other primary care services were extracted from the municipality records (Table 1). Data on unit costs were collected from the municipality, the hospital administrations, or from published studies. Unit costs were adjusted to the 2013 price level and presented in Euro (EUR).

Cost categories and cost calculation

Costs were aggregated into the following cost categories:

(1) Hospital costs, including the initial index stay, subsequent outpatient service costs, and costs for hospital readmissions.

(2) Rehabilitation costs, including inpatient stays in private not for profit enterprises, and rehabilitation centres organized and financed by the municipalities.

(3) Care costs, including short- and long-term nursing home stays, as well as a range of services offered to home-dwelling patients, as described in detail in Table 1.

(4) Costs connected to visits to GPs.

Table 1 shows the service utilization for the different cost categories in addition to unit cost and sources of information.

Costs for the index stay were calculated as the sum of costs connected to surgery and length of stay (LOS) due to the hospitalization. Surgery costs were assumed to be equal across patients and calculated based on unit prices published in Frihagen et al. (2010) [18]. LOS was

multiplied by unit price per day based on staff levels [22]. For all other services, the observed service utilization per patient was multiplied with unit costs to calculate the total cost per patient. Inpatient stays and outpatient visits following the index stays were included in the cost calculation and contribute to the sum of hospital costs. Patients who died during the trial were allotted zero costs from the date of death.

<Table 1 here>

Patient sub-groups and patient pathways

Costs were calculated for sub-groups of patients according to age, gender, fracture type, and instrumental activity of daily living (I-ADL) at fracture incidence. Age was dichotomized into 70-84 years and 85 years and older, and fracture type in intra capsular- (femoral neck), and extra capsular fractures (trochanteric and sub trochanteric). I-ADL was measured by the Nottingham Extended ADL Scale (NEAS) [23], in which the score interval is 0-66 and a high score indicates better I-ADL. The median NEAS score at fracture incidence was 45. Patients with a score < 45 were considered "functionally impaired" and patients with a score ≥ 45 considered "not functionally impaired".

We identified four different pathways that form the basis for the cost calculations, as shown in Table 4:

(a) died within the period.

(b-1) discharged home without rehabilitation or nursing home stay.

(b-2) discharged to a rehabilitation institution, then discharged home.

(b-3) permanent nursing home stay within the period.

Statistical analysis

There were no missing data. Descriptive statistics were used to present cost estimates, and due to skewed cost data confidence intervals based on nonparametric bootstrapping (1000 replicates) and bias-correction was applied. The independent samples T-test based on bootstrapped confidence intervals was used to compare mean costs across subgroups [24]. Significance levels below 1, 5 and 10 % respectively is reported. Data preparation and statistical analysis was performed using Microsoft Excel Professional Plus 2010 and IBM SPSS 22.0.

Results

The majority of the included patients were females (73.7%). The mean age was 83.3 years, and 54.5% of the patients were in the youngest age group (70-84 years). The mean NEAS score was 42.2 (SD=17.6). The majority of the fractures were of the intra capsular type (62.1%), and 17% of the patients died within the first year.

<Table 2 here>

As shown in Table 2, the mean total one-year costs per patient were 68,376 EUR. Hospital costs amounted for 31.0%, rehabilitation costs were 14.7%, care costs were 52.9%, and GP costs were 1.4%. Median was considerably below mean for all cost components except for the index stay, rehabilitation costs and GP visits. This illustrates skewed distributions with tails of high-utilization/high-cost patients.

<Table 3 here>

As shown in Table 3, there were no differences in total costs between men and women. However, there were slightly higher costs for female patients connected to home-

based services (home care and home nursing), while nursing home costs and hospital costs were slightly higher for men, though no significant differences. The total costs for patients in the oldest age group (85+) were 12,418 EUR higher than for the youngest age group (70-84) ($p=0.015$), and this difference is attributable to rehabilitation and nursing home costs and costs connected to home care and home nursing. Cost were more than 40% (35,989 EUR) higher for patients with low functional status before the fracture (NEAS<45) than for patients with better functional status ($p<0.001$). Extra hospital and nursing home stays contributed to the increased costs. No significant cost differences were found between the two fracture types.

<Table 4 here>

As shown in Table 4, one-year health and care costs for patients that were alive one year after the hip-fracture constituted 71,719 EUR. The lowest costs were found for patients admitted directly to their home with no additional institutional services after the index stay (31,962 EUR). The total costs increased to 59,141 EUR ($p<0.001$) for patients with a rehabilitation stay or a hospital stay after the index hospitalization. For patients admitted permanently to a nursing home within the first year, the total costs increased further to 142,808 EUR ($p<0.001$). The different cost components related to the four different patient pathways are illustrated in Figure 1.

<Figure 1 here>

Discussion

One-year health and care costs for the total sample of patients included in the Trondheim Hip Fracture Trial were 68,376 EUR per patient. For those alive one year after the

hip fracture, the total costs constituted 71,719 EUR. This cost estimate is in line with a previous Norwegian study [18] , but higher than published costs from other western countries demonstrating estimates below 30,000 EUR [14]. Different wage and cost levels and different organization of the health- and long-term care services prevent estimates from different countries from being directly comparable. The patients' age and pre-fracture functional status contributed most to the total costs, which is in line with previous findings [7, 15]. No significant differences in total costs were found between fracture types and gender.

Nearly 17% of these originally home-dwelling patients changed their living site permanently to a nursing home after the fracture, which is slightly higher than the 14% reported by Parker and Palmer (1995) [8]. The mean total costs for these patients were 142,808 EUR, which is twice as high as the mean total costs for the whole sample. This estimate is comparable to a study from Finland, which found the average cost to be 2.5 times higher for patients admitted to permanent institutional care than for patients who were able to live in their own home after the hip fracture [25].

Focusing on optimal rehabilitation in order to improve patients' physical independence may increase the rate of patients remaining home-dwellings after a hip-fracture [26]. Results from the Trondheim Hip Fracture Trial showed that immediate admission before initial surgery to a ward delivering comprehensive geriatric care (CGC) improved mobility at four months as compared with the usual orthopaedic care (OC). The proportion of patients discharged directly to their home was 25% with CGC as compared to 11% with OC [22]. Hence, increased efforts like CGC as part of the initial hospital stay may reduce long-term care costs in the subsequent periods. However, CGC will most likely increase hospital costs in the short-term. In the Trondheim Hip Fracture Trial, the average LOS was prolonged by 1.7 days for patients who were offered CGC, while during the following year, CGC reduced hospital use by 2.6 days, thereby compensating for the higher initial costs of CGC. Hence,

despite it being cost neutral for the hospital in a longer perspective, such interventions might not be implemented because the positive gains are not measurable in the short run.

Hip fractures are a burden for the individual patient and imply high costs for the society. As treatment outcomes are poor, preventive measures focusing on osteoporosis and falls are important. Osteoporosis is prevalent in older persons, and half of women and a fifth of men will suffer a low-energy osteoporotic fracture in their lifetime [27]. As lifestyle and pharmacological treatment have been shown to prevent fractures, health care programs focusing on prevention, identification, and treatment of osteoporosis is important [28]. According to Gillespie et al., effective prevention of falls can be achieved through a multidimensional approach [29]. In an earlier study, we estimated the cost-effectiveness of implementing an exercise-based fall prevention program for home-dwelling elderly women, and found that the reduction in healthcare costs following falls more than offset the cost of the prevention program [30]. However, we also concluded that because the positive gains of such programs do not necessarily go to the provider who finances it, it may not be implemented. An implication of the current study is that prevention programs for older persons designed to increase their functional status also might reduce the municipalities' costs following hip fractures. For the municipalities, a barrier impeding the implementation of such interventions is linked to the fact that the effect of the prevention programs is most likely not measurable within a budget year.

The strength of this study was the thorough and detailed collection of health care utilization data within a randomized controlled study design, including patient information of great value for sub-group estimates. The study estimated costs the first year following a hip fracture incidence based on utilization of all relevant health services. Hence, it included not only re-admissions, but all kinds of relevant health- and care services the patients received. Other authors have focused on hip fracture costs in terms of excess costs applying matched

controls without a fracture [17] or using patients as their own control [16]. Among the cost types in this study, researchers were able to examine hospital service utilization and short-term nursing home utilization the year before fracture incidence only. Few hospital admissions and short-term nursing home stays and hence, only minor costs were observed. Data on home-based service utilization the year before fracture were not available, but it is likely that patients with low functional status received such services to some extent.

Conclusion

One year after the hip fracture care costs accounted for more than 50% of the total costs following the fracture, and even for patients with good functional status before the hip fracture (NEAS>45), care costs amounted to 40% compared to hospital costs of 38%. We were not able to calculate care costs in a longer perspective, but most likely the need for home based care or nursing home care will proceed in the following years. This illustrates the high financial burden hip fractures put on the municipalities, which in the Norwegian context provide both home-based care and long-term care in nursing homes. To reduce the financial costs of hip-fractures for the care sector, the results point to the importance of preventive programs for falls and treatment of osteoporosis to reduce the risk of a hip fracture, but also to the importance of comprehensive geriatric care at the hospital in the initial phase after a hip fracture.

In Norway health and long-term care institutions are expected to balance running expenses and income within a year. This implies incentives for reduction in hospital length of stays and might imply taking insufficient account of potential readmissions. It may also imply incentives against implementing prevention programs because the effects are not measurable within a year. Hence, economic incentives designed to increase institutional efficiency can

conflict with the health policy goal of efficient use of the health and long-term care resources in a longer perspective.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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Table 1 Cost categories, utilization volumes and unit cost information

Cost categories (type of unit**)**	Mean service utilization (SD) (n=396)		% patients with service	Unit cost (EUR)	Source of unit cost information
Hospital costs					
Index stay (LOS)	11.8	(7.0)	100,0	*	*Prestmo et al (2015)*
Inpatient stays** (days)	7.0	(14.0)	47.2	1237	*Norwegian Directorate of Health. average cost per diem (b)*
Outpatient visits (visits)	3.7	(4.8)	84.6	153	*Norwegian Directorate of Health (c)*
Rehabilitation costs					
Rehab-inpatient stays (days)	23.9	(27.4)	66.2	412	*Municipality; private providers of care*
Care costs					
Nursing home (days)	58.6	(109.9)	35.9	364	*State-Municipality reporting (d)*
Home nursing care (hours)	21.0	(45.9)	47.5	122	*Confederation of Norwegian Enterprise (e)*
Home care services (hours)	83.5	(151.8)	55.3	70	*Confederation of Norwegian Enterprise (e)*
Outpatient rehabilitation (hours)	27.0	(57.7)	64.6	113	*Physiotherapist tariff (f)*
Safety alarm (days)	155.1	(155.4)	54.5	3	*Municipality web sides/local experts*
Meals on wheels (meals)	40.0	(98.5)	17.9	11	*Municipality web sides/local experts*
Day-care centre (visits)	23.5	(73.1)	11.6	111	*Vossius et al.2012 (g)*
General practitioner cost					
GP-visit (visits)	14.9	(13.0)	97.0	63	*GP tariff (h).Norwegian guidelines for economic evaluation (i)*

** See Material and methods*

*** Inpatient stays after the initial index stay*

Table 2 One-year health and care costs per patient following a hip fracture. Total sample (n=396). Costs in Euros.

Cost categories	Mean (n=396)	SD	Min.	Max.	***95% CI****
Hospital costs	**21 435**	**18 658**	**4 321**	**137 134**	***19 813 – 23 162***
Index stay	12 158	5 044	**4 321**	**42 058**	***11 676 – 12 666***
Inpatient stays	8 646	17 345	**0**	**119 941**	***7 101 – 10 321***
Outpatient visits	631	1 354	**0**	**23 238**	***531 - 748***
Rehabilitation costs**	**9 833**	**11 274**	**0**	**68 762**	***8 787 – 10 876***
Care costs	**36 176**	**39 409**	**0**	**132 270**	***32 436 – 40 219***
Nursing home	21 338	40 061	**0**	**132 270**	***17 382 – 25 411***
Home nursing care	2 557	5 576	**0**	**40 307**	***2 034 – 3 092***
Home care	5 800	10 551	**0**	**74 371**	***4 798 – 6 816***
Outpatient rehabilitation	3 037	6 493	**0**	**44 123**	***2 422 – 3 700***
Safety alarm	388	388	**0**	**913**	***351 - 425***
Meals on wheels	454	1 119	**0**	**4 078**	***357 - 561***
Day-care centre	2 603	8 083	**0**	**39 052**	***1 885 – 3 373***
GP visits	**932**	**811**	**0**	**4 625**	***854 – 1 009***
Total costs	**68 376**	**49 083**	**4 384**	**226 178**	***64 112 – 73 054***

**** Bootstrapping (1000 replicates), bias-corrected confidence interval***

*** Inpatient rehabilitation*

Table 3 Mean one-year health and care costs (per patient) following hip fracture for patient categories. Costs in Euros

	Patient characteristics							
	Gender		Age		I-ADL		Fracture type	
Cost categories	Male (n=104)	Female (n=292)	70-84 (n=216)	85+ (n=180)	"Not functionally impaired" NEAS≥45 (n=196)	"Functionally impaired" NEAS<45 (n=200)	Intra capsular (n=246)	Extra capsular (n=150)
Hospital costs	**23 069**	**20 854**	**22 842**	**19 748***	**18 915**	**23 906*****	**21 432**	**21 441**
Index stay	12 509	12 033	11 956	12 401	11 058	**13 236*****	11 712	**12 890****
Inpatient stays	9 808	8 232	10 103	**6 897***	7 028	**10 232***	9 112	7 880
Outpatient visits	752	589	782	**450***	828	**438***	608	671
Rehabilitation costs	**8 738**	**10 223**	**8 433**	**11 513****	**10 254**	**9 421**	**9 102**	**11 032**
Care costs	**35 867**	**36 286**	**30 492**	**42 996*****	**19 985**	**52 043*****	**35 356**	**37 522**
Nursing home	22 753	20 835	17 634	**25784****	5575	**36 786*****	20479	22747
Home nursing care	2398	**2613**	2 112	**3 090***	2411	2 699	2281	3009
Home care	4642	**6212**	4 289	**7 612*****	4853	**6 728***	5823	5762
Outpatient rehabilitation	3708	2798	3 684	**2 261****	3655	2 431*	2916	3235
Safety alarm	245	**439*****	334	**452*****	444	**333*****	381	399
Meals on wheels	243	**529*****	361	**565***	513	396	400	543
Daycentre	1 880	2 860	2 078	3 232	2534	2 670	3077	1825
GP costs	**880**	**950**	**965**	**892**	**1 046**	**819*****	**947**	**858**
Total costs	68 554	68 313	62 732	**75 150****	50 200	**86 189*****	66 866	**70 853**

Stars denote significance levels at 1% (***), 5% (**) and 10% (*) between genders, age, I-ADL and Fracture type, respectively, according to Independent Samples T-test with bootstrapping (1000 replicates) and bias-corrected confidence intervals

Table 4 One-year costs following a hip fracture according to patient pathways the first year after the fracture. Costs in Euros.

Cost categories	Patient pathways first year after fracture				
	(a) Deceased[(I)] n=67	(b) Alive n=329	(b-1) Home, without additional institutional stay[(II)] n=54	(b-2) Home, after institutional stay n=208	(b-3) Permanent nursing home stay after 12 month[(III)] n=67
Hospital costs	**22 118**	**21 296**	**15 916***	**20 176**	**29 110****
Index stay	12 565	12 075	**10 466*****	**11 920**	13 855**
Inpatient stays	9 338	8 505	4 694	7 473	**14 783****
Outpatient visits	**214*****	716	756	784	**472***
Rehabilitation costs	**5 236*****	**10 769**	**-*****	**13 128**	**12 125**
Care costs	**24 205*****	**38 614**	**14 926****	**24 659**	**101 028*****
Nursing home	20 514	21 506	**-*****	**3 299**	**95 364*****
Home nursing care	**707*****	2 933	2 402	3 666	**1 086*****
Home care	**2 094*****	6 554	6 480	**7 884**	**2 488*****
Outpatient rehabilitation	**633*****	3 526	5 292	3 988	**669*****
Safety alarm	**89*****	449	**339*****	570	**160*****
Meals on wheels	**168*****	512	**413**	635	**212*****
Daycentre	**-*****	3 133	**-*****	**4 617**	**1 049*****
GP costs	**404*****	**1 039**	**1 120**	**1 177**	**545*****
Total costs	**51 963*****	**71 719**	**31 962*****	**59 141**	**142 808*****

Stars denote significance levels at 1% (***), 5% (**) and 10% (*) respectively, according to Independent Samples T-test with bootstrapping (1000 replicates) and bias-corrected confidence intervals

(I) "Deceased" (a) was compared with "alive" (b) equal to the aggregate of (b-1) plus (b-2) plus (b-3).
(II) Patient pathway (b-1) was compared with (b-2).
(III)Patient pathway (b-3) was compared with (b-2).

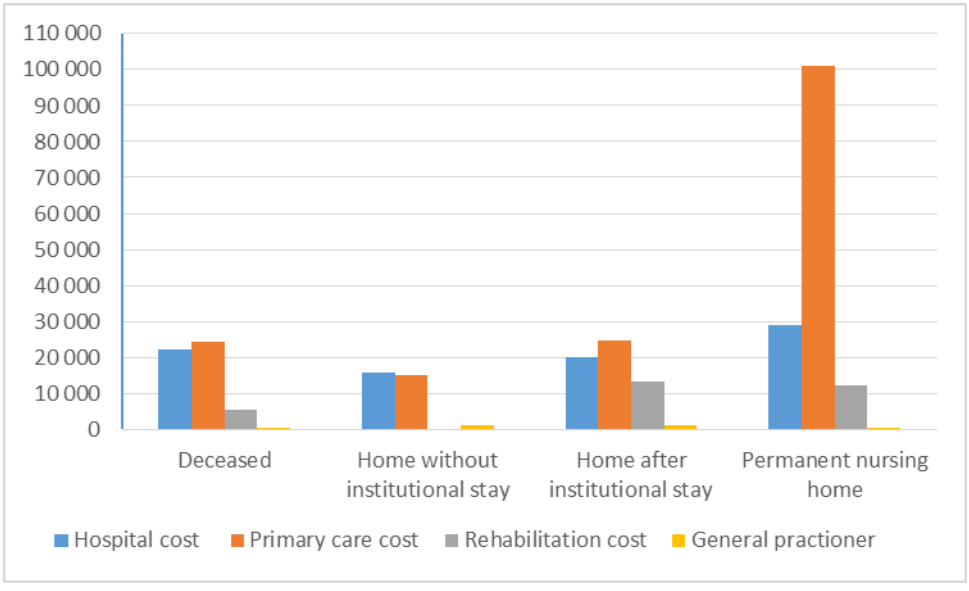

Fig 1: Cost component differences between four different patient pathways.