Injury 52 (2021) 3434–3439

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Health care services and costs after hip fracture, comparing conventional versus standardised care: A retrospective study with 12-month follow-up

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ARTICLE INFO

Article history:
Accepted 23 January 2021

Keywords:
Hip fracture
Standardised care
Cost analysis
Specialist care costs
Primary care costs
Health care services and costs
Conventional care

ABSTRACT

Aims: To compare costs related to a standardised versus conventional hospital care for older patients after fragility hip fracture and determine whether a shift in hospital care led to cost-shifts between specialists and primary health care.

Methods: We retrospectively collected and calculated volumes of care and accompanying costs from fracture time until 12 months after hospital discharge for 979 patients. All patients aged ≥ 65 years had fragility hip fractures. The data set had few missing data points because of the patient registry, administrative databases, and a low migration rate.

Results: Total costs per patient at 12 months were EUR 78 164 (standard deviation [SD] 58 056) and EUR 78 068 (SD 60 131) for conventional and standardised care, respectively ($p = 0.480$). Total specialist care costs were significantly lower for the standardised care group ($p < 0.001$). Total primary care costs were higher for the standardised care group ($p = 0.424$). Total costs per day of life for the conventional and standardised care groups were EUR 434 and EUR 371, respectively ($p = 0.003$). Patients in the standardised care group had 17 more days of life.

Conclusions: Implementation of a standardised care to improve outcomes for patients with hip fracture caused lower specialist care costs and higher primary care costs, indicating care- and cost-shifts from specialist to primary health care.

Introduction

Patients suffering from a fragility hip fracture have a high prevalence of comorbidity and mortality [1]. The care involves increased use of health care services and costs and represents a significant public health concern [1,2]. Guidelines recommend standardised hospital procedures, including early surgery and early postoperative mobilisation [3,4]. Despite this, many hospitals have not adjusted their practice and have instead used conventional or 'usual' care.

A standardised care often uses principles from lean methodology [5] to improve patient outcomes and hospital efficiency, leading to decreased hospital length of stay (LOS) [6]. A standardised care for patients with a hip fracture at our hospital led to a reduction of 3.4 days in LOS, with no increase in mortality or readmission [7], consistent with other studies [8–11]. A reduction in LOS may counter the increased demand for hospital care and expanding costs [12]. However, such savings may lead to higher expenses following hospital discharge.

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https://doi.org/10.1016/j.injury.2021.01.034

The health care system in Norway includes specialist care and primary care. The state is responsible for public hospitals and specialist rehabilitation (specialist care). Public hospitals treat all patients with hip fracture. Municipalities are responsible for home services, rehabilitation and nursing homes (primary care). Patients allocated to institutional dwellings need more help than can be provided by home services.

This study aimed to compare costs associated with conventional and standardised care for patients with fragility hip fracture, from the time of fracture through 12 months after discharge, and evaluate whether a shift in hospital care led to a cost-shift between specialist and primary health care.

Materials and methods

This was a single-centre, retrospective, before-and-after study comparing conventional and standardised care. We included patients $\geq$ 65 years with a primary diagnosis of ICD-10 codes S72.0, S72.1, or 72.2 after low-energy trauma and residing in Trondheim municipality. The patients underwent surgery at St. Olavs Hospital, Trondheim University Hospital (Trondheim, Norway) between April 2008 and September 2011 (conventional care) or between October 2011 and December 2013 (standardised care).

The index stay was the hospitalisation for hip fracture. Follow-up time was 12 months after discharge from the index stay. Volumes of care and the accompanying costs were collected and calculated. The Regional Committee of Ethics in Medical Research approved the study. Clinical guidelines for the care of hip fractures provided the basis for standardised hospital care [3].

Conventional care

The general practitioner on-call at the time of fracture initiated conventional care. If there was suspicion of hip fracture, an emergency ambulance transported the patient to the hospital emergency department (ED) where the patient awaited admission to the radiology department. A hospital porter transferred the patient to X-ray examination. After X-ray examination, a hospital porter transferred the patient back to the ED for examination, followed by admission to the orthopaedic ward. Each transport lap (back and forth) involved waiting at each step of the process. There was no standardised pain control, scheduling for surgery, postoperative mobilisation regimen.

Standardised care

The emergency ambulance personnel initiated standardised care at the time of fracture. On suspicion of a hip fracture, ambulance personnel reported a tentative diagnosis of 'hip fracture', provided initial care, and managed the patient pain before hospital admission. The same ambulance personnel transported the patient directly to the radiology department and subsequently to the orthopaedic ward, bypassing the ED. On arrival to the orthopaedic ward, the patient received standardised nursing routine practice (i.e., pain control, nutrition, fluid therapy, and pressure sore prevention). The patient received regional anaesthesia in the form of a femoral block, while an orthopaedic resident on-call examined the patient and scheduled surgery within 24 h. Whenever possible, the patient mobilised on the first postoperative day with the assistance of a physiotherapist. Ward-based pharmacists evaluated medication lists, using the medication reconciliation method [13,14]. Discharge planning began on the day of admission, in coordination with primary care.

Discharge criteria were identical for the conventional and standardised care; patients were discharged when the orthopaedic surgeon concluded there was no longer need for inpatient care.

Data collection

We used the Charlson Comorbidity Index (CCI) [15–17] to measure health differences between the two groups. We based CCI scores on all primary and secondary ICD-10 diagnoses occurring in the 3 years before the current episode, based on the standards of the Norwegian Knowledge Centre for Health Services [18], and from the current episode.

Using manual review of hospital medical records, our internal hip fracture registry, hospital administrative databases, and the Trondheim Hip Fracture Trial study [19], we gathered specialist care data, including hospitalisation, hospital outpatient visits and days in specialist rehabilitation. We defined readmission as any non-elective admission, including any subsequent hip fracture during the 12-month follow-up period. We registered only readmissions to St. Olavs Hospital. This was adequate as all patients resided in the municipality of Trondheim, and St. Olavs Hospital served the total regional population and was the only local hospital. We obtained primary care data, including the use of home services and institutional dwelling, from Trondheim municipality.

Cost calculations

We divided specialist care costs into index stay and after discharge. We calculated costs associated with the length of stay as a per diem rate for each inpatient day. We calculated costs of surgery as a fixed unit cost per minute, including surgery time, surgeons, the surgery team and anaesthesia. The characteristics of hip fractures vary anatomically and biomechanically. We chose implants to adapt to specific patients, and these varied in cost. Girdlestone (no implant) carried no cost, and total hip arthroplasty was the most expensive. Costs for an emergency ambulance, roentgen, and stay in ED were fixed costs per visit. We calculated pharmacist and physiotherapists services by a fixed unit cost per hour. After discharge, we calculated costs for any readmission and specialist rehabilitation as a per diem rate for each inpatient day. We calculated outpatient visits as fixed unit costs per visit. Primary care costs included a general practitioner visit at the time of fracture, and we calculated this as a fixed unit cost. Home services included personal and household assistance, nursing care, safety alarm, meals, rehabilitation, physiotherapy and occupational therapy, support, care benefit and visits to day centres; we calculated all the former as fixed unit costs. We calculated institutional dwelling in a nursing home or temporarily in rehabilitation centres as a per diem rate for each inpatient day.

We used volumes of care by visits, minutes, hours, days, and months to facilitate comparisons among different healthcare systems. We obtained unit costs from St. Olavs Hospital and the municipality of Trondheim. We indexed all unit costs with the national consumer price index to 2012 Euros (EUR). We calculated mean costs per patient by multiplying volumes of care with corresponding unit costs from the time of fracture until 12-months after discharge. By applying fixed unit costs, we assured that any differences in aggregates between conventional care and standardised care reflected differences in health services use.

Total costs

We presented the following cost categories: a) total specialist care costs, including index stay costs and costs after discharge; b) total primary care costs including home services and institutional dwelling; and c) total costs, including total specialist care costs and total primary care costs. In the context of this study, death meant stopping costs because any patient who died during the follow-up accrued zero costs. Therefore, we also presented costs per day of life.

Table 1
Study group characteristics (n = 979).

		Conventional care	Standardized care	P-value
Sex	Female	338 (73.2%)	377 (72.9%)	0.933
	Male	124 (26.8%)	140 (27.1%)	
Age at admission (years)	Mean (SD)	83.4 (7.34)	83.2 (7.68)	0.791
	Median (min–max)	84 (65–104)	84 (65–102)	
Hip fracture (ICD10)	S72.0	295 (63.9%)	318 (61.5%)	0.738
	S72.1	143 (31.0%)	169 (32.7%)	
	S72.2	24 (5.2%)	30 (5.8%)	
CCI score	Mean (SD)	1.07 (1.59)	0.97 (1.59)	0.700
	Median (min–max)	0 (0–9)	0 (0–10)	
Preoperative waiting time for surgery (hours)	Mean (SD)	33 (25)	25 (21)	< 0.001
	Median (min–max)	27 (1–248)	21 (0–210)	
LOS (days)	Mean (SD)	10.3 (9)	6.4 (6)	< 0.001
	Median (min–max)	9 (1–120)	5 (1–50)	
LOS After Surgery (days)	Mean (SD)	7.9 (8.4)	4.4 (5.9)	< 0.001
	Median (min-max)	6 (1-112)	3 (1-46)	

CCI, Charlson Comorbidity Index; ICD-10, 10th revision of the International Statistical Classification of Diseases and Related Health Problems; LOS, hospital length of stay; min, minimum; max, maximum; SD, standard deviation

Statistical analysis

We analysed data distributions by visual inspection of histograms. We used the chi-squared test for comparisons of nominal variables (sex and hip fracture). The normally distributed data (age at the time of admission) was analysed using the independent Student's t-test. For non-normally distributed data (all remaining variables in the analyses), we used the non-parametric Mann–Whitney U-test. We used descriptive statistics to present use of services and costs (Tables 2 and 3) and calculated confidence intervals (95%) using bootstrap analysis of cost data, with 1000 replicates.

We presented costs as mean and standard deviation (SD), and the mean costs per patient was calculated as the sum of costs for all patients divided by the total number of patients included. The median and interquartile range (IQ) were presented, when appropriate. Statistical analysis was carried out using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

Results

Patient characteristics

We included 979 patients, 462 receiving conventional care and 517 receiving standardised care. There were no statistically significant differences between the two groups regarding sex, age, type of hip fracture, or comorbidity at the fracture time. Preoperative waiting time for surgery ($p < 0.001$) and index LOS ($p < 0.001$) differed significantly between the groups (Table 1). Nineteen (4.1%) patients in the conventional care group, and 11 (2.1%) in the standardised care group died during the index stay. A total of 125 (28.2%) in the conventional care group, and 123 (24.3%) in the standardised care group died within one year of discharge. The mean numbers of days of life for patients in the conventional and standardised groups were 286 and 303, respectively, a difference of 17 days.

Specialist care services and costs

LOS was higher for conventional care. Index stay costs were significantly higher for the conventional care than for the

Table 2
Specialist care services and costs (EUR) per patient, until 12-months of follow-up.

	Service type	Use of resources per patient		Unit cost	Cost per patient					
		Conventional Care	Standardized care		Conventional care			Standardized care		
		Mean (SD)	Mean (SD)		Mean (SD)	95% CI [a] Lower bound	95% CI [a] Upper bound	Mean (SD)	95% CI [a] Lower bound	95% CI [a] Upper bound
Index stay	Emergency ambulance (visit)	1 (0)	1 (0)	628	628 (0)	-	-	628	-	-
	Roentgen (visit)	1 (0)	1 (0)	579	579 (0)	-	-	579	-	-
	Short stay in emergency unit (visit)	1 (0)	0 (0)	521	521 (0)	-	-	0	-	-
	Pharmacist (hours)	0 (0)	1 (0)	120	0 (0)	-	-	120	-	-
	LOS (days)	10.3 (9)	6.4 (6)	1291	13 626 (11 210)	12 624	14 733	8832 (7691)	8176	9539
	Surgery (minutes)	68 (39)	72 (36)	20.9	1429 (815)	1357	1513	1504 (760)	1439	1576
	Implant	1 (0)	1 (0)	0–826[1]	397 (247)	375	419	430 (246)	409	451
	Physiotherapy (hours)	0.33 (0)	1 (0)	101	33 (0)	0	0	101 (0)	0	0
Costs, Index stay					**17 214 (11 408)**	16 238	18 304	**12 195 (7800)**	11 585	12 970
After discharge	Readmission (days)	6.3 (12.5)	5.5 (11.4)	1291	8079 (16 089)	6726	9652	7139 (14 679)	5896	8478
	Outpatient visit (visit)	2.6 (3.7)	3.0 (4.8)	245	625 (906)	550	709	736 (1164)	639	847
	Specialist Rehabilitation (days)	4.2 (11.9)	3.8 (10.0)	417–610[2]	1760 (4971)	1316	2199	1977 (4680)	1547	2405
Costs, After discharge					**10 463 (17 109)**	8929	12 112	**9 852 (15 690)**	8 473	11 292

[a] Bootstrapped
[1] Different types of implants vary in cost, from EUR 0 to 826. [2] Specialist rehabilitation care varies in cost, from EUR 417 to 610 per diem.CI, 95% confidence interval of the mean; SD, standard deviation

standardised care group, EUR 17 214 versus 12 195 respectively, with a difference of EUR 5 019 ($p < 0.001$) (Table 2).

Numbers of readmission days were higher for the conventional (6.3 days) than for the standardised care (5.5 days) group, while numbers of outpatient visits were somewhat higher for the standardised care (2.6 and 3.0, respectively). After discharge, costs were EUR 10 463 versus EUR 9 852 with a difference of EUR 611 ($p = 0.706$) for the conventional and the standardised care groups, respectively (Table 2).

Primary care services and costs

Use of all home services, except physiotherapy and occupational therapy, were higher for the standardised care group. Days in rehabilitation centres were 22 and 24 days, and days in nursing homes were 84 and 96 days for the conventional and standardised care groups, respectively. Mean days spent in one's own home were 174 and 179 for patients in the conventional and standardised care groups, respectively. Before fracture, approximately 75% of patients in both groups were home-dwelling. Of those, 68% and 72% of patients in the conventional and standardised care groups, respectively, were immediately discharged to rehabilitation; the rate of discharge to their own home was similar between the groups (26% and 24%, respectively).

Pre-hospital and home services costs were EUR 9 575 for the conventional group and EUR 10 129 for the standardised care group, a difference of EUR 554 ($p = 0.459$). Institutional dwelling costs were EUR 40 761 for the conventional group and EUR 45 892 for the standardised care group, a difference of EUR 5 131 ($p = 0.078$) (Table 3).

Table 3
Primary care services and costs (EUR) per patient, until 12-months of follow-up.

	Service type	Use of resources		Unit Cost	Costs per patient					
		Conventional care	Standardized care		Conventional care			Standardized care		
		Median (Q1–Q3) Mean (min–max) (SD)	Median (Q1–Q3) Mean (min–max) (SD)		Mean (SD)	95% CI of mean [a]		Mean (SD)	95% CI of mean [a]	
						Lower bound	Upper bound		Lower bound	Upper bound
Other services	Pre-hospital GP (visit at time of fracture)	1	0	151	151	-	-	0	-	-
Home services	Personal and household assistance (hours)	0 (0–51) 66 (0–4203) (244)	0 (0–37) 74 (0–4703) (277)	95	6221 (23 153)	4381	8858	7040 (26 279)	5041	9835
	Nursing care [1] (hours)	0 (0–6.2) 9.7 (0–308) (30)	0 (0–8.7) 16.0 (0–582) (50)	97	940 (2930)	707	1217	1552 (4870)	1169	1980
	Safety alarm (months)	1.3 (0–365) 4.6 (0–365) (5.3)	1.2 (0–352) 4.6 (0–365) (5.3)	5	23 (27)	21	25	23 (27)	21	26
	Meals on wheels (months)	0 (0-0) 0.6 (0–12) (2.1)	0 (0-0) 0.4 (0–12) (1.7)	21	12 (44)	8	16	8 (36)	5	11
	Physiotherapy (hours)	0 (0–19) 17.3 (0–189) (33.4)	0 (0–5) 5.7 (0–152) (13.1)	101	1748 (3371)	1464	2050	575 (1323)	473	702
	Ambulatory rehabilitation (hours)	0 (0–0) 0 (0–0) (0)	0 (0–0) 2.8 (0–155) (13.3)	96	0			266 (1280)	163	376
	Occupational therapy (hours)	0 (0–0) 4.6 (0–143) (13.2)	0 (0–1.4) 2.5 (0–39) (6.1)	96	443 (1264.4)	331	559	240 (587)	194	292
	Support (hours)	0 (0–0) 0.6 (0–156) (9.5)	0 (0–0) 2.2 (0–336) (20.8)	95	59 (902)	0	151	208 (1972)	54	397
	Care benefit (hours)	0 (0–0) 0.2 (0–72) (3.6)	0 (0–0) 1.3 (0–154) (9.2)	25	5 (90)	0	16	33 (230)	15	55
	Visit to day Center (visits)	0 (0–0) 1.1 (0–84) (6.5)	0 (0–0) 1.8 (0–88) (8.5)	94	101 (610)	52	163	167 (796)	101	237
	Day-based rehabilitation (days)	0 (0–0) 0.1 (0–42) (2.0)	0 (0–0) 0.09 (0–46) (2.0)	196	24 (401)	0	66	17 (397)	0	52
Costs, Home and other services					**9575 (24 891)**	7534	12 017	**10 129 (29 414)**	7806	12 728
Institutional dwelling	Rehabilitation (days)	0 (0-35) 22 (0-227) (35)	0 (0-31) 24 (0-247) (38)	385	8417 (13 556)	7170	9608	9088 (14 570)	7892	10 359
	Nursing home (days)	0 (0-163) 84 (0-365) (135)	0 (0-205) 96 (0-365) (143)	385	32 344 (51 906)	27 591	37 405	36 804 (55 075)	32 146	41 721
Costs, Institutional dwelling					**40 761 (52 017)**	35 007	45 638	**45 892 (54 608)**	41 261	50 336

[a] Bootstrapped
[1] Nursing care and night serviceCI, 95% confidence interval; SD, standard deviation; (Q1–Q3), Interquartile range

Total costs

Total specialist care costs per patient were EUR 27 677 for the conventional group and EUR 22 047 for the standardised care group, a difference of EUR 5 630 ($p < 0.001$). Total primary care costs per patient were EUR 50 486 for the conventional group and EUR 56 021 for the standardised care group, a difference of EUR 5 536 ($p = 0.424$). Total costs per patient at 12 months covering aggregated specialist and primary care were EUR 78 164 for the conventional group and EUR 78 068 for the standardised care group, a difference of EUR 96 ($p = 0.480$). Total costs per day of life per patient were EUR 434 for the conventional group and EUR 371 for the standardised care group, a difference of EUR 63 ($p = 0.003$).

Discussion

We compared costs associated with conventional or standardised care for patients with hip fracture from the time of fracture through 12 months after discharge. Total specialist care costs were statistically significantly lower for the standardised care group. This was primarily the result of lower LOS. A decrease in LOS of approximately 4 days may not unexpectedly lead to an increased need for primary care. Total primary care costs were higher for the standardised care group due to higher use of home care services, rehabilitation, and nursing homes.

Our results show a relatively large variation in the use of primary care services. This is probably due to substantial inequalities among patient health statuses. CCI scores indicate variation in health status. We included patients irrespective of health condition. Some patients needed considerable, while others were self-reliant. Total costs per day of life were significantly lower for patients receiving standardised care, and they lived for an average of 17 more days than those receiving conventional care. Hence, patients in the standardised care group spent more days in a nursing home and more days in their own homes, which can be explained by lower mortality, shorter LOS, and fewer readmission days.

Use of medication reconciliation during index stay might assist patient recovery and help prevent additional fractures or drug-related adverse events, all which could contribute to the higher mean number of days of life and lower number of readmissions in the standardised care group. According to a Swedish study, the number of medications predicted readmissions after hip fracture surgery, and the most common cause of readmission was a new fall [20].

During the study period, there was a gradual decrease in the use of hip screws and a corresponding increase in the use of hemiprostheses to treat intracapsular fractures [7]. Hemiprostheses have several advantages in treating hip fractures; they result in better functional outcome, fewer readmissions, and reoperations [3,21]. These changes may contribute our finding of a lower number of readmission days [22], and perhaps the lower use of physiotherapy in primary care for patients in the standardised care group.

The majority (~70%) of the previously home-dwelling patients went to rehabilitation, which prepares them for home-dwelling, while about 25% went directly to their own homes. These findings are similar to those of a study of comprehensive geriatric care, involving a healthier home-dwelling study population, in which 25% went home directly [19]. In that study, there was a total 12-month mean cost per patient of EUR 68 376, somewhat lower than that of the present study, probably due to the better health in their group of patients [23].

The fewer deaths, shorter LOS, and fewer readmission days in the standardised group have consequences beyond the economic aspects. Many elderly people want to 'age in place' and remain in their own homes, even if they have health challenges. Quantification of the number of days spent in own home can be an essential measure of improved quality of life and patient health status; however, home-dwelling may not necessarily represent the state of health, but rather may represent the availability of rehabilitation and home nursing facilities [24]. Both the availability and framing of healthcare systems give rise to variations in home and institutional dwelling [25]; different healthcare systems may offer different options. Lack of primary care services can delay hospital discharge. Appropriate dwelling after discharge must ideally centre on quality of care for the individual patient. Our findings indicate that patients receiving standardised care go home promptly, but not prematurely, supported by the higher mean number of days of life and the fewer readmission days.

There are arguments against the trends toward decreased LOS for patients with hip fracture [26]. However, guidelines recommend early discharge for patients admitted from institutions for a systematic rehabilitation approach [3]. Studies support the notion that standardised care is safe [8,27].

The results presented from 2008 to 2013 are mainly caused by the shift from conventional to standardised care. In 2012, during the period of the present study, the Norwegian Coordination Reform was launched [28], to reduce bed-blocking in hospitals, improve coordination between hospitals and primary care, and facilitating timely primary care for patients discharged from hospital. A reduction of 1.2 days in LOS for patients with hip fracture was associated with the reform [29]. The general LOS was reduced in Norway from 2008 to 2013, from 6.8 to 5.5 days [30]. Improvements in medical care and treatments impacting survival and quality of life over such a prolonged duration may have caused the general reductions in LOS.

Differences in healthcare financing, the presence of public and private institutions, cost components, and price levels are country- and study-specific, rendering direct comparisons elusive. The current study included all patients 65 years and older with fragility

Table 4
Total costs (EUR) per patient, until 12-months of follow-up.

Costs per patient	Conventional care			Standardized care			p-value
	Median (Q1–Q3) Mean (SD)	95% CI of mean [a]		Median (Q1–Q3) Mean (SD)	95% CI of mean [a]		
		Lower bound	Upper bound		Lower bound	Upper bound	
Total specialist care costs	**21 441 (13 067- 35 321) 27 677 (22 833)**	25 741	29 923	**15 967 (10 348-28 686) 22 047 (17 653)**	20 540	23 671	< 0.001
Total primary care costs	**26 206 (5 787-86 282) 50 486 (54 795)**	45 854	55 641	**58 369 (6 183-115 367) 56 021 (58 369)**	51 009	61 273	0.424
Total costs	**59 609 (31 003-125 319) 78 164 (58 056)**	73 639	83 331	**57 237 (26 267-144 562) 78 068 (60 131)**	72 717	83 166	0.480

CI, 95% Confidence Interval; SD, Standard Deviation; (Q1–Q3), Interquartile range

hip fractures to reflect the hip fractures population and increase the study's clinical utility.

We observed a cost-shift from hospital to primary care after implementing a standardised care. Higher total primary care costs outweighed the reduction in total hospital costs. Total costs did not differ significantly between the two groups. The main costs were due to institutional dwelling. For a reduction in costs institutional dwelling must be reduced, but it must not compromise with the highest health care quality for the individual patient.

Standardised care may improve hospital care without increased costs. The strengths of our study are the inclusion of patients irrespective of health status, making the results more generalisable for the clinical population of hip fractures. We used a data set with few missing data points because of the patient registry, administrative databases and a low migration rate. The main limitation of the investigation is its retrospective design. Finally, we only investigated one municipality; hence, the results may not be generalisable to other populations.

Conclusion

Our results describe a care- and cost-shift from specialist care to primary care when implementing standardised care after hip fracture, without any harm to the patients.

Funding

Funding for this study was provided by St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway. The funding source had no effect on the analyses, interpretation, or presentation of the data. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Table 4

Declaration of Competing Interest

The Authors declares that there is no conflict of interest.

Acknowledgments

We want to thank Helge Garåsen, City Executive for Health and Welfare Services, City of Trondheim for making the study collaboration between our hospital and Trondheim municipality possible, and the mercantile staff at Department of Health and Welfare Services, City of Trondheim for help with data quality assurance. Vigleik Jessen, head of Clinic of Orthopaedy, Rheumatology and Dermatology, St. Olavs Hospital for making the study possible and the mercantile staff at Orthopaedic Department, St. Olavs Hospital for help with data quality assurance. We thank Jomar Klaksvik, Orthopaedic Department, Orthopaedic Research Centre, St. Olavs Hospital for help with the preparation of the data files.

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