

Supplementary Appendix - Variation in Care for Patients Presenting with Hip Fracture in 6 High-Income Countries: A Cross-Sectional Cohort Study

Contents

Supplementary S1: Description of data sources and research ethics approval from each country/jurisdiction.	2
United States	2
Ontario (Canada).....	3
Manitoba (Canada).....	4
England	5
Netherlands	6
Israel.....	7
Taiwan:.....	8
Supplementary S2: List of codes used by each country to identify hip fractures, Total hip arthroplasty (THA), Hemiarthroplasty, and Internal Fixation (IF).....	9
Supplementary S3: Cohorts generation steps	14
Supplementary S4: Number of hip fracture hospitalizations by country and year	14
Supplementary S5: Age- and sex-standardized incidence of hospital admissions for hip fracture by country and year, admissions per 1000 per year ¹	15
Supplementary S6: Age and sex standardized mortality and readmissions after hospitalization for hip fracture by country, 2011-2018	16
Supplementary S7: Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture, 2011-2018.....	17
Supplementary S8: Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture for all years, by country.....	18
Supplementary S9: Stratified Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture, 2011-2018	20
Supplementary S10: Stratified Age and sex standardized mortality for hip fracture by country, 2011-2018	21
Supplementary S11: Age and sex standardized percentages of patients receiving THA, HA, and IF for patients hospitalized with hip fracture, 2011-2018 (Netherlands before upscaling).....	22

Supplementary S1: Description of data sources and research ethics approval from each country/jurisdiction.

United States

All hospitalizations for hip fracture in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using 100% Medicare fee-for-service (FFS) data. Data from 2010 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes.

During our study period, approximately 75% (2011) and 67% (2018) of the US Medicare population were enrolled in FFS Medicare and thus included in our study population, with the remainder enrolled in Medicare managed care plans.

Hip Fracture Identification and Outcomes	
<u>Data sources*</u>	<u>Use</u>
100% Medicare Part A Data (2010-2018)	a. Identification of patients hospitalized with a primary diagnosis of hip fracture b. Creation of comorbidities c. In-hospital and post-hospital utilization and outcomes
100% Medicare Beneficiary Summary File	a. Date of death
Population Count and Demographics (Used for Calculation of hip fracture Hospitalization Rates and Standardization)	
Medicare Beneficiary Summary File	Number of Medicare FFS enrollees by year Age/race/sex/ethnicity/area of residence information

Analyses were conducted at Harvard Medical School. This study was approved by the Institutional Review Board (IRB) of the Harvard Faculty of Medicine.

* For more information on US Medicare Part A Data please visit: <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/MedicareFeeforSvcPartsAB/MEDPAR>

Ontario (Canada)

All hospitalizations for hip fracture in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using 100% Ontario Discharge Abstract Database (DAD). Data from 2010 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes.

The DAD includes all admissions to all acute care hospitals in the province of Ontario and thus is inclusive of the entire Ontario population.

Analyses were conducted at ICES, which is approved for storing and analyzing data from the Ontario provincial insurance program (Ontario Health Insurance Plan), which covers all health care for all residents of the province.

Hip Fracture Identification and Outcomes	
<u>Data source*</u>	<u>Use</u>
Ontario Discharge Abstract Database (2010-2018)	a. Identification of patients hospitalized with a primary diagnosis of a hip fracture b. Creation of comorbidities c. In-hospital outcomes
OHIP Billing Data (2011-2018)	a. Post-hip fracture treatments and procedures
Registered Persons Data Base files	a. Determination of death date, birth date, and insurance coverage start and end date
Population Count and Demographics	
<u>(Used for Calculation of hip fracture Hospitalization Rates and Standardization)</u>	
Registered Persons Data Base files	Age/sex/ethnicity/area of residence information

The use of the data in this project is authorized under section 45 of Ontario’s Personal Health Information Protection Act (PHIPA) and does not require review by a Research Ethics Board.

* For more information on Ontario Discharge Abstract Data please visit <https://data.ontario.ca/dataset/discharge-abstract-database-dad-ontario-hospitals>

Manitoba (Canada)

All hospitalizations for hip fractures in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using 100% Manitoba Discharge Abstract Database (DAD). Data from 2010 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes.

The Manitoba DAD includes all admissions to all acute care hospitals in the province of Manitoba and thus is inclusive of the entire Manitoba population eligible to receive health services.

Analyses were conducted using the Population Research Data Repository housed at the Manitoba Centre for Health Policy at the University of Manitoba and utilized the administrative data from the Manitoba Ministry of Health (I.e., Manitoba Health and Seniors Care). The administrative data captures all publicly-insured health services for all residents of the province who are eligible to receive health services.

Hip Fracture Identification and Outcomes	
<u>Data source*</u>	<u>Use</u>
Manitoba Discharge Abstract Database (2010-2018)	a. Identification of patients hospitalized with a primary diagnosis of a hip fracture b. Creation of comorbidities c. In-hospital outcomes
Physician Billing Data (2011-2018)	a. Post-hip fracture treatments and procedures
Manitoba Health Insurance Registry	Determination of death date, birth date, and insurance coverage start and end dates.
Population Count and Demographics (Used for Calculation of hip fracture Hospitalization Rates and Standardization)	
Manitoba Health Population Database	Counts of the population by sex, age group, and year

The authors acknowledge the Manitoba Centre for Health Policy for the use of data contained in the Manitoba Population Health Research Data Repository (Health Information Privacy Committee project # 2019/2020-38). The results and conclusions are those of the authors, and no official endorsement by the Manitoba Centre for Health Policy, Manitoba Health, and Seniors Care, or other data providers is intended or should be inferred.

* For more information on Manitoba data please visit: <https://umanitoba.ca/manitoba-centre-for-health-policy/data-repository>

England

All hospitalizations for hip fracture in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using the Clinical Practice Research Datalink. Data from 2010 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes. CPRD has been shown to be representative of the English population by age, sex, and ethnicity and has been validated for research.¹⁻³ Analyses were conducted at the Institute of Health Informatics, University College London using linked electronic health records from primary care (CPRD), hospitalization (HES), and the national death registry (ONS).²

Hip Fracture Identification and Outcomes	
<u>Data source</u>	<u>Use</u>
Clinical Practice Research Datalink (GOLD and Aurum)	a. Patient identification b. Demographics c. Creation of comorbidities
Hospital Episode Statistics (HES)	a. Identification of patients hospitalized with a primary diagnosis of hip fracture b. Creation of comorbidities c. In-hospital outcomes d. Inpatient procedures
Office of National Statistics	Cause-specific mortality
<u>Population Count and Demographics</u> <u>(Used for Calculation of hip fracture Hospitalization Rates and Standardization)</u>	
	Counts of population by sex, age group, and year

The study was approved by the MHRA (UK) Independent Scientific Advisory Committee 20_021, under Section 251 (NHS Social Care Act 2006). This study is based in part on data from the Clinical Practice Research Datalink obtained under licence from the UK Medicines and Healthcare Products Regulatory Agency. The data is provided by patients and collected by the NHS as part of their care and support. The interpretation and conclusions contained in this study are those of the author/s alone. HES and ONS data copyright 2022, re-used with the permission of The Health & Social Care Information Centre. All rights reserved.

Netherlands

All hospitalizations for hip fracture in Dutch adults aged ≥ 66 years at the time of hospitalization during calendar years 2013-2018 were identified using data from the national register for hospital care.⁴ Data from 2012 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes.

These data include all inpatient hospitalizations in the Netherlands. Primary and secondary diagnoses are recorded, as well as the main procedure performed during the admission. Demographic information and, if applicable, the date of death were extracted from municipality registers*.

Due to a certain number of patients each year lacking registration of their operations, we took the precaution of upscaling the surgery performed for the remaining patients to reach 100%. This was done to prevent any unjustified exclusions. To ensure that this approach did not introduce any bias, we conducted a sensitivity analysis. The results showed that the patients with missing registrations were equally distributed across geographical regions and hospitals. Supplementary S11 provides an example of the original register of procedures.

Hip Fracture Identification and Outcomes	
<u>Data sources</u> [†]	<u>Use</u>
National Register for hospital care, Landelijke Basisregistratie Ziekenhuiszorg (LBZ – 2013-2018), and Landelijke Medische Registratie (LMR – 2012)	a. Identification of patients hospitalized with a primary diagnosis of a hip fracture b. Creation of comorbidities c. In-hospital and post-hospital procedure utilization [‡] and outcomes
Municipality Register (GBAPERSOONTAB, GBAOVERLIJDENTAB)	Determination of age and sex, date of death
Population Count and Demographics (Used for Calculation of hip fracture Hospitalization Rates and Standardization)	
Municipality Register (GBA)	Counts of population by sex, age group, and year

This study was approved by the Internal Review Board (IRB) of the Erasmus School of Health Policy and Management on October 5, 2019.

* An example of another paper using the same data is García-Gómez, P., van Kippersluis, H., O'Donnell, O., & van Doorslaer, E. (2013). Long Term and Spillover Effects of Health Shocks on Employment and Income. *The Journal of human resources*, 48(4), 873–909. <https://doi.org/10.1353/jhr.2013.0031>

[†] [Statistics Netherlands \(2022\)](https://www.cbr.nl) provides detailed information on the variables and observations in these data sources, their representativity, and the procedure to get data access.

[‡] The procedures were classified using the CBV, CVV and ZA classifications. Procedure codes occurring in the cohort were translated with the “verrichtingthesaurus” (<https://trex.dhd.nl/>). Based on the translation these three classifications were assigned. Similar approach was followed by Rabbe et al. (in press).

Israel

Analyses were conducted at the Clinical Research Center (CRC) in Soroka University Medical Center and included national data of Clalit Health Services insured patients.

All hospitalizations for hip fracture in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using Clalit Health Services (CHS) Data sharing platform powered by MDClone© (<https://www.mdclone.com>). Data from 2010 was used as a “look-back” and data from 2019 were used to ascertain post-hip fracture outcomes. The data is broadly representative of the Israel population concerning age, sex, and geography. Clalit Health Services is Israel’s largest insurance company and healthcare provider, providing most of Israel’s healthcare services and health insurance to 54% of the country’s population. Services include primary, secondary, and tertiary care (including a third of Israel’s acute care beds), pharmacies, and paramedical services. CHS maintains a comprehensive database, continuously updated with information about a subject’s demographics, community and outpatient visits, laboratory tests, hospitalizations, medication prescriptions, and purchases.

Hip Fracture Identification and Outcomes	
<u>Data sources*</u>	<u>Use</u>
CHS Data warehouse using accessed by MDClone©	a. Identification of patients hospitalized with a primary diagnosis of a hip fracture b. Demographic information (Age, sex, SES) c. Creation of comorbidities
CHS Data warehouse using accessed by MDClone©	d. Procedures related to the diagnosis of hip fracture e. In-hospital and post-hospital utilization and outcomes
<u>Population Count and Demographics</u> (Used for Calculation of hip fracture Hospitalization Rates)	
CHS Data warehouse using accessed by MDClone©	The population denominator includes all Clalit members that were ≥ 66 years in each year from 2011 through 2018 and were members of Clalit one year before and after that year.

This study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Soroka University Medical Center (Ref. 0467-18)

* For more information on the Israel data from Clalit please see: <http://clalitresearch.org/about-us/our-data/>

Taiwan:

All hospitalizations for hip fracture in adults aged ≥ 66 years at the time of hospitalization during calendar years 2011-2018 were identified using Taiwan's Inpatient Expenditures data. Data from 2010 was used as a "look-back" and data from 2019 were used to ascertain post-hip fracture outcomes.

Key data files included the National Health Insurance (NHI) Inpatient Expenditures by Admission file, which contains all admissions to all acute care hospitals in Taiwan and thus is inclusive of Taiwan population. The NHI Registry for Beneficiaries file includes demographic and socioeconomic status information of all NHI beneficiaries. Because all legal residents in Taiwan are eligible to enroll in the NHI program and the enrollment rate has exceeded 99% since 2000, these data are population representative. The Cause of Death Data provides information on the cause and date of all reported deaths in Taiwan. Analyses were conducted at the Yang-Ming branch of the Health and Welfare Data Science Center, Taiwan Ministry of Health and Welfare. The primary data sources were the National Health Insurance Research Database and Cause of Death Data.⁵

Hip Fracture Identification and Outcomes	
<u>Data sources*</u>	<u>Use</u>
Inpatient Expenditures by Admissions (2010-2018)	a. Identification of patients hospitalized with a primary diagnosis of a hip fracture ⁶ b. Creation of comorbidities c. In-hospital and post-hospital utilization and outcomes
Cause of Death Data	Determination of death date
Population Count and Demographics	
<u>(Used for Calculation of hip fracture Hospitalization Rates and Standardization)</u>	
Registry for Beneficiaries	a. Counts of the population by sex, age group, and year b. Determination of birth date and sex

This study was approved by the Institutional Review Board of National Yang Ming Chiao Tung University (IRB number: YM110134E).

References

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6. Saw SM, Hong CY, Lee J, et al. Awareness and health beliefs of women towards osteoporosis. *Osteoporos Int* 2003;14(7):595-601.

* For more information on US Medicare Part A DataTaiwan's NHI Data and Cause of Death Data please visit: <https://dep.mohw.gov.tw/dos/cp-5119-59201-113.html> (in Chinese)

Supplementary S2: List of codes used by each country to identify hip fractures, Total hip arthroplasty (THA), Hemiarthroplasty, and Internal Fixation

(IF).^{*}

ICD = International Classification of Diseases, CCI = Canadian Classification of Interventions.

	United States	Canada	England	Netherlands	Israel	Taiwan
Hip fracture diagnosis in admission	ICD-9: 820.0x 820.20 820.21 820.1 820.22 820.3 820.8 820.9 Icd-10: S72.0x S72.1x S72.2x	ICD-10-CA: S72.0x S72.1x S72.2x	ICD-10: S72.0x S72.1x S72.2x	ICD-10: S72.0x S72.1x S72.2x	ICD-9: 820.0x 820.20 820.21 820.1 820.22 820.3 820.8 820.9	ICD-9: 820.0x 820.20 820.21 820.1 820.22 820.3 820.8 820.9 Icd-10: S72.0x S72.1x S72.2x
<u>Codes for THA, HA, and IF by country</u>						
THA	ICD-9: 81.51 ICD-10: 0SRB019 0SRB0J9 0SRB0JA 0SRB0JZ 0SRB01A 0SRB01Z 0SRB029 0SRB02A 0SRB02Z 0SRB039 0SRB03A 0SRB03Z 0SRB049 0SRB04A 0SRB04Z 0SRB069	CCI: 1.VA.53.LA.PN	OPCS-4: W37.1 W37.8 W37.9 W38.1 W38.8 W38.9 W39.1 W39.8 W39.9 W93.1 W93.8 W93.9 W94.1 W94.8 W94.9 W95.1 W95.8 W95.9	ZA codes: 038567 190305 038569 038568 CVV codes: 58150 581652 581520 CBV codes: 338568K 338568J 338568A 338567K 338568B 338567J 338568L	81.51	ICD-9: 81.51 ICD-10: 0SRB019 0SRB0J9 0SRB0JA 0SRB0JZ 0SRB01A 0SRB01Z 0SRB029 0SRB02A 0SRB02Z 0SRB039 0SRB03A 0SRB03Z 0SRB049 0SRB04A 0SRB04Z 0SRB069

* Within a general framework similar to the US, countries were allowed to adapt coding schemes to fit local context and practice.

	OSRB06A OSRB06Z OSRB07Z OSRB0EZ OSRB0J9 OSRB0JA OSRB0JZ OSRB0KZ Right= 9 OSR90JA OSR90JZ OSR9019 OSR901A OSR901Z OSR902A OSR902Z OSR9039 OSR903A OSR903Z OSR9049 OSR904A OSR904Z OSR9069 OSR906A OSR906Z OSR907Z OSR90EZ OSR90J9 OSR90JA OSR90JZ OSR90KZ OSR9019 OSR9029			338568P 338569K 338568W 338569D 338568U 338567A 338568Z 338569		OSRB06A OSRB06Z OSRB07Z OSRB0EZ OSRB0J9 OSRB0JA OSRB0JZ OSRB0KZ Right= 9 OSR90JA OSR90JZ OSR9019 OSR901A OSR901Z OSR902A OSR902Z OSR9039 OSR903A OSR903Z OSR9049 OSR904A OSR904Z OSR9069 OSR906A OSR906Z OSR907Z OSR90EZ OSR90J9 OSR90JA OSR90JZ OSR90KZ OSR9019 OSR9029
HA	Icd-9: 81.52 Icd-10: OSR.A009 OSR.A00A OSR.A00Z OSR.A019 OSR.A01A OSR.A01Z OSR.A039 OSR.A03A OSR.A03Z OSR.A07Z OSR.A0J9	CCI: 1.VA.53.LA.PM, 1.SQ.53.LA.PM	OPCS-4: W46.1 W46.8 W46.9 W47.1 W47.8 W47.9 W48.1 W48.8 W48.9	ZA codes: 038565 190376 190344 038570 038524 038560 CVV codes: 58160 581651 581521 581513 581525	81.52	Icd-9: 81.52 Icd-10: OSR.A009 OSR.A00A OSR.A00Z OSR.A019 OSR.A01A OSR.A01Z OSR.A039 OSR.A03A OSR.A03Z OSR.A07Z OSR.A0J9

	OSR.A0JA OSR.A0JZ OSR.S019 OSR.S01A OSR.S01Z OSR.S039 OSR.S03A OSR.S03Z OSR.S07Z OSR.S0J9 OSR.S0JA OSR.S0JZ OSR.S0KZ Right= E, R OSR.E009 OSR.E00A OSR.E00Z OSR.E019 OSR.E01A OSR.E01Z OSR.E039 OSR.E03A OSR.E03Z OSR.E07Z OSR.E0J9 OSR.E0JA OSR.E0JZ OSR.E0KZ OSR.R019 OSR.R01A OSR.R01Z OSR.R039 OSR.R03A OSR.R03Z OSR.R07Z OSR.R0J9 OSR.R0JZ OSR.R0KZ			581522 581523 CBV codes: 338567 338567H 338567W 338567L 338567R 338567D 338567E 190344 190345 338567F 338567G 338567C 338567Y		OSR.A0JA OSR.A0JZ OSR.S019 OSR.S01A OSR.S01Z OSR.S039 OSR.S03A OSR.S03Z OSR.S07Z OSR.S0J9 OSR.S0JA OSR.S0JZ OSR.S0KZ Right= E, R OSR.E009 OSR.E00A OSR.E00Z OSR.E019 OSR.E01A OSR.E01Z OSR.E039 OSR.E03A OSR.E03Z OSR.E07Z OSR.E0J9 OSR.E0JA OSR.E0JZ OSR.E0KZ OSR.R019 OSR.R01A OSR.R01Z OSR.R039 OSR.R03A OSR.R03Z OSR.R07Z OSR.R0J9 OSR.R0JZ OSR.R0KZ
Internal fixation	Icd-9: 79.35 78.55 79.25 79.15 Icd-10: OQS.604Z OQS.704Z	CCI: 1.VA.74, 1.VC.74	OPCS-4: W19.1 P W24.1	ZA codes: 038535 038533 038534 038556 038527 038532 038529 038426	79.35 78.55 79.25 79.15	Icd-9: 79.35 78.55 79.25 79.15 Icd-10: OQS.604Z OQS.704Z

0QS.804Z 0QS.904Z 0QS.B04Z 0QS.C04Z 0QH.604Z 0QH.634Z 0QH.644Z 0QH.704Z 0QH.734Z 0QH.744Z 0QH.804Z 0QH.834Z 0QH.844Z 0QH.904Z 0QH.934Z 0QH.944Z 0QH.B04Z 0QH.B34Z 0QH.B44Z 0QH.C04Z 0QH.C34Z 0QH.C44Z 0QS.60ZZ 0QS.70ZZ 0QS.80ZZ 0QS.90ZZ 0QS.B0ZZ 0QS.C0ZZ 0QS706Z 0QS606Z 0QH706Z 0QH606Z 0QS906Z 0QS806Z 0QS806Z 0QSB06Z 0SSB04Z 0SS904Z 0QSC06Z 0QH906Z 0QH806Z 0QHB06Z 0QHC06Z 0SHB04Z 0SHB04Z 0SH904Z 0QS.634Z 0QS.644Z 0QS.734Z 0QS.744Z			038525 CVV codes: 579013 579096 579267 579056 579266 579260 579269 579264 579223 579216 579263 579268 579262 579006 579261 579296 82043 578706 579024 579086 579265 82049 578726 CBV codes: 338534R 338534E 338536X 338533Y 338533Q 338534S 338533 338534P 338536 338533X 338534G 338534Q 338539L 338533W 338534N 338533R 338536F 338534R 338533G 338533H 338536E 338533C	0QS.804Z 0QS.904Z 0QS.B04Z 0QS.C04Z 0QH.604Z 0QH.634Z 0QH.644Z 0QH.704Z 0QH.734Z 0QH.744Z 0QH.804Z 0QH.834Z 0QH.844Z 0QH.904Z 0QH.934Z 0QH.944Z 0QH.B04Z 0QH.B34Z 0QH.B44Z 0QH.C04Z 0QH.C34Z 0QH.C44Z 0QS.60ZZ 0QS.70ZZ 0QS.80ZZ 0QS.90ZZ 0QS.B0ZZ 0QS.C0ZZ 0QS706Z 0QS606Z 0QH706Z 0QH606Z 0QS906Z 0QS806Z 0QS806Z 0QSB06Z 0SSB04Z 0SS904Z 0QSC06Z 0QH906Z 0QH806Z 0QHB06Z 0QHC06Z 0SHB04Z 0SHB04Z 0SH904Z 0QS.634Z 0QS.644Z 0QS.734Z 0QS.744Z
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Supplementary S3: Cohorts generation steps

Country	US*	Canada	England**	Netherlands	Israel	Taiwan
Initial Cohort	2,054,254	101,483	104,327	118,120	29,389	185,421
Step 1: Exclude if not first hip fracture admission in the past 180 days (look back 180 days from the index date to the prior DISCHARGE date)	104,613	1,584	14,281	2,570	152	6,369
Step 2: Delete patients with missing age or sex	114	52	0	0	0	743
Step 3: Delete Age<66	124,603	11,416	8,495	16,558	3,908	34,080
Step 4: Delete Episodes Associated with Trauma***	7,094	4,834	5,355	12,867	1,152	10,488
Step 5: Resides out of area	8,973	91	0	72	6	0
Step 6: Exclude if without 12-month continuous enrolment (pre-index)	47,623	435	2,087	0	204	0
Step 7: Exclude if without 12-month continuous enrolment unless died within one year (post index)	633	104	4,758	0	26	0
Step 8: Exclude if 2+ months consecutive MA within 12 months prior to the index admission	509,910	NA	NA	NA	NA	NA
Step 9: Exclude if 2+ months consecutive MA within 12 months post-index admission	30,995	NA	NA	NA	NA	NA
Final cohort	1,219,696	82,967	69,351	86,053	23,941	133,741

* Because complete data on in-hospital and out-of-hospital treatments was lacking for patients enrolled in Medicare Advantage (MA) plans, we excluded them from the analysis.

** N= 81,026 patients in England excluded because hip fractures occurred outside of the patient's follow-up time in CPRD

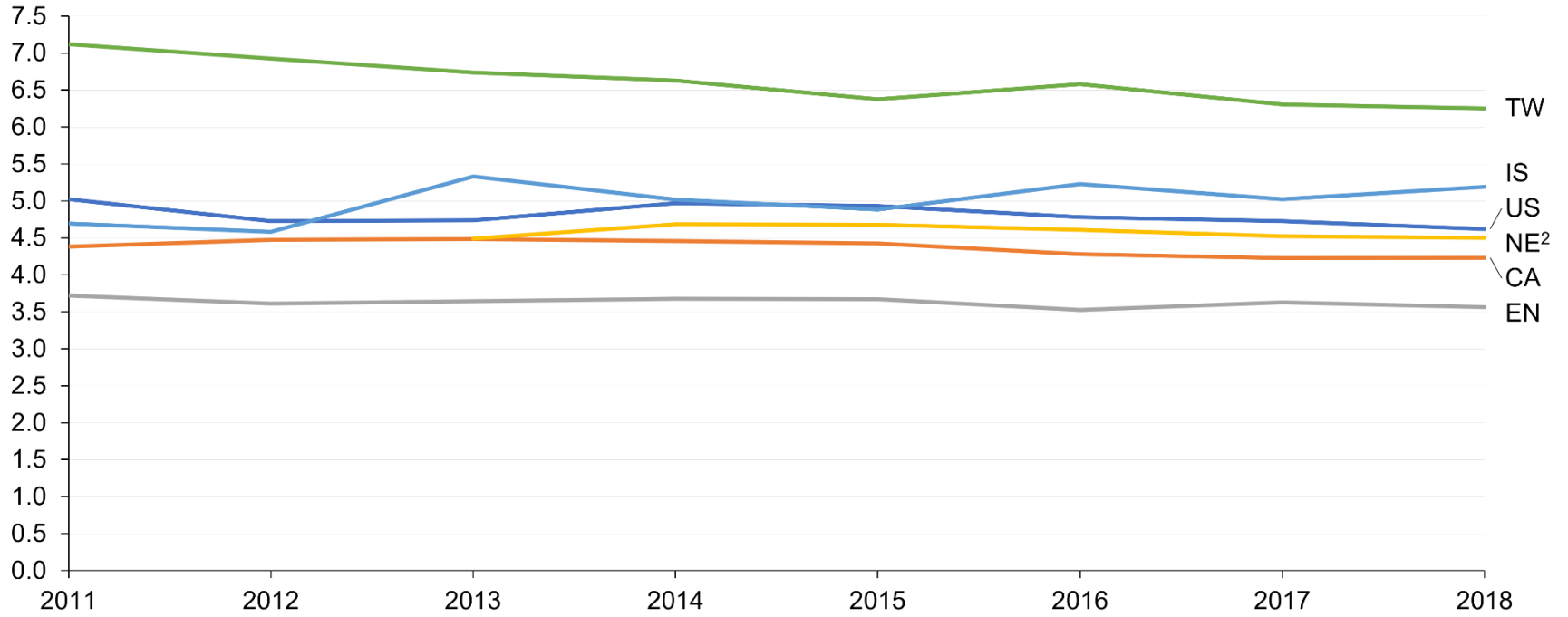
The following ICD-10 codes or equivalent were used to exclude hip fractures associated with trauma: E800-E848, E881-884, E908-909, E916-928

Supplementary S4: Number of hip fracture hospitalizations by country and year

	2011	2012	2013	2014	2015	2016	2017	2018	Total
US	161,626	152,083	152,159	157,026	155,066	150,695	147,712	143,329	1,219,696
Canada	9,495	10,021	10,410	10,574	10,411	10,408	10,642	11,006	82,967
England	9,603	9,347	9,456	8,996	8,707	7,891	7,820	7,531	69,351
Netherlands*	NA	NA	12,945	14,004	14,446	14,654	14,834	15,170	86,053
Israel	2,628	2,624	3,130	2,977	2,931	3,220	3,133	3,298	23,941
Taiwan	15,792	15,910	16,181	16,457	16,498	17,519	17,467	17,917	133,741

*Data for 2011 and 2012 was not available from the Netherlands

Appendix 5: Age- and sex-standardized incidence of hospital admissions for hip fracture by country and year, admissions per 1000 per year¹



1. US = United States; CA = Canada; EN = England; NE = Netherlands; IS = Israel; TW = Taiwan
 2. Data unavailable for 2011-12

Supplementary S6: Age and sex standardized mortality and readmissions after hospitalization for hip fracture by country, 2011-2018

Country	Metric	All							
		2011	2012	2013	2014	2015	2016	2017	2018
US	Death within 30 days	0.079	0.081	0.080	0.078	0.078	0.077	0.078	0.072
	Death within one year	0.275	0.279	0.260	0.274	0.269	0.276	0.276	0.262
	Readmission within 30 days	0.136	0.130	0.121	0.120	0.120	0.118	0.118	0.116
Canada	Death within 30 days	0.085	0.085	0.077	0.079	0.075	0.071	0.077	0.077
	Death within one year	0.258	0.258	0.242	0.244	0.241	0.233	0.245	0.244
	Readmission within 30 days	0.090	0.083	0.081	0.082	0.081	0.078	0.083	0.078
England	Death within 30 days	0.058	0.065	0.069	0.064	0.061	0.067	0.062	0.060
	Death within one year	0.185	0.195	0.195	0.199	0.189	0.200	0.202	0.194
	Readmission within 30 days	0.160	0.161	0.166	0.173	0.169	0.165	0.183	0.176
Netherlands*	Death within 30 days	NA	NA	0.095	0.096	0.102	0.101	0.100	0.103
	Death within one year	NA	NA	0.279	0.288	0.288	0.289	0.280	0.275
	Readmission within 30 days	NA	NA	0.108	0.096	0.091	0.091	0.087	0.080
Israel	Death within 30 days	0.042	0.053	0.047	0.048	0.058	0.040	0.043	0.053
	Death within one year	0.228	0.231	0.220	0.232	0.219	0.198	0.188	0.213
	Readmission within 30 days	0.163	0.166	0.159	0.165	0.147	0.142	0.145	0.169
Taiwan	Death within 30 days	0.028	0.031	0.030	0.029	0.030	0.028	0.030	0.030
	Death within one year	0.161	0.164	0.166	0.158	0.164	0.166	0.170	0.157
	Readmission within 30 days	0.137	0.140	0.135	0.134	0.134	0.137	0.139	0.127

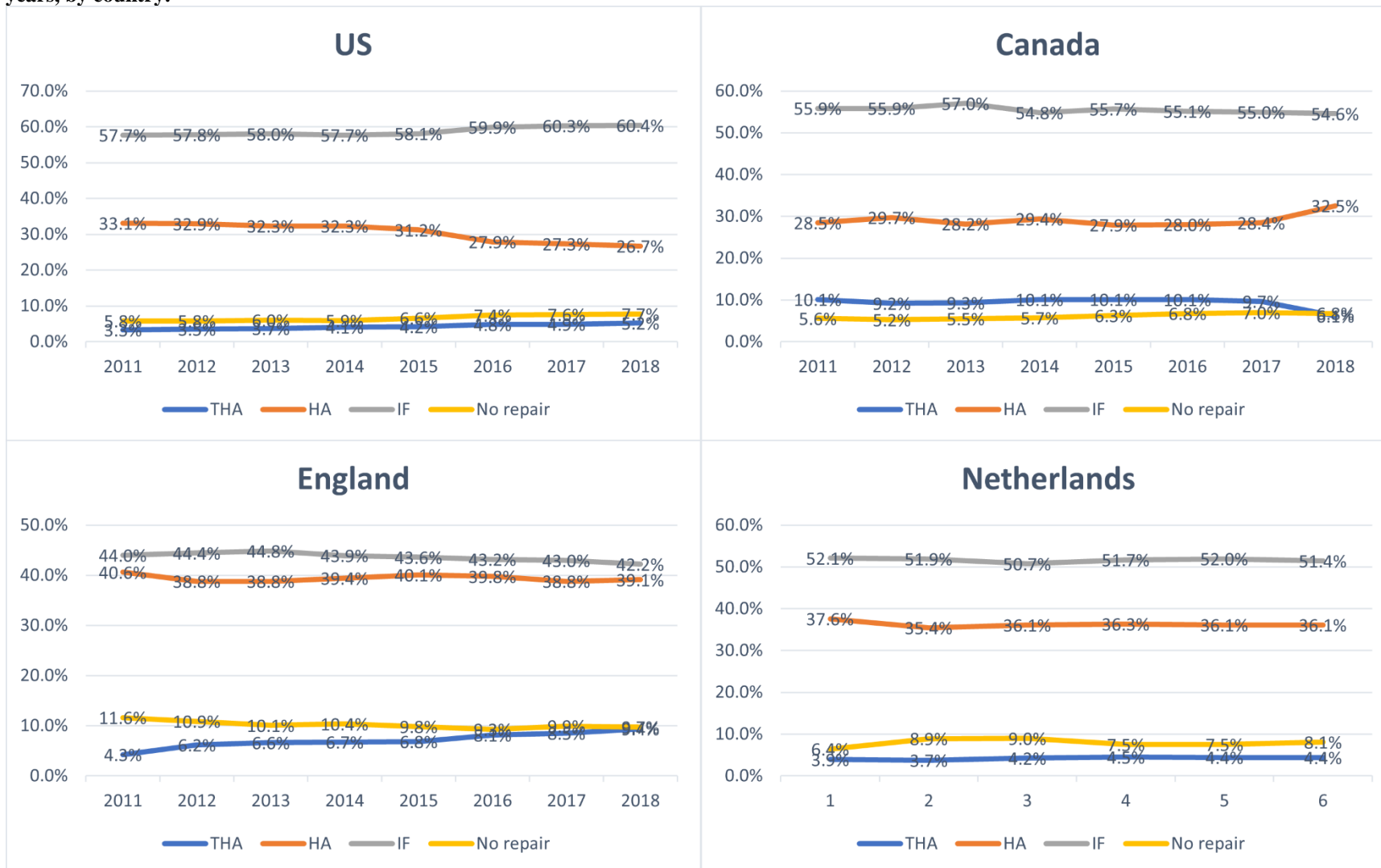
* Data unavailable in 2011 and 2012

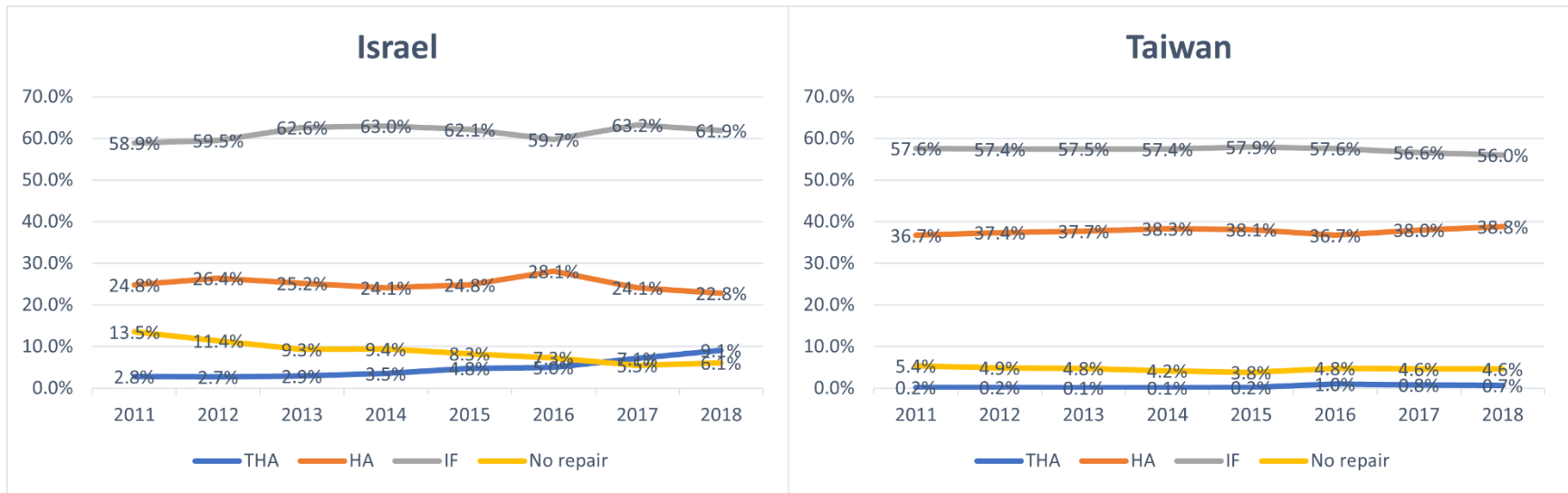
Supplementary S7: Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture, 2011-2018

	Metric	All							
		2011	2012	2013	2014	2015	2016	2017	2018
US	THA	0.033	0.035	0.037	0.041	0.042	0.048	0.049	0.052
	HA	0.331	0.329	0.323	0.323	0.312	0.279	0.273	0.267
	IF	0.577	0.578	0.580	0.577	0.581	0.599	0.603	0.604
	No-repair	0.058	0.058	0.060	0.059	0.066	0.074	0.076	0.077
Canada	THA	0.101	0.092	0.093	0.101	0.101	0.101	0.097	0.061
	HA	0.285	0.297	0.282	0.294	0.279	0.280	0.284	0.325
	IF	0.559	0.559	0.570	0.548	0.557	0.551	0.549	0.546
	No-repair	0.056	0.052	0.055	0.057	0.062	0.068	0.070	0.068
England	THA	0.042	0.062	0.066	0.067	0.068	0.081	0.085	0.094
	HA	0.406	0.388	0.388	0.394	0.401	0.398	0.388	0.391
	IF	0.440	0.444	0.448	0.439	0.436	0.432	0.430	0.422
	No-repair	0.116	0.109	0.101	0.103	0.098	0.093	0.099	0.097
Netherlands**	THA	NA	NA	0.039	0.037	0.042	0.045	0.044	0.044
	HA	NA	NA	0.376	0.354	0.361	0.363	0.361	0.361
	IF	NA	NA	0.521	0.519	0.507	0.517	0.520	0.514
	No-repair	NA	NA	0.064	0.089	0.090	0.075	0.075	0.081
Israel	THA	0.028	0.027	0.029	0.035	0.048	0.05	0.071	0.091
	HA	0.248	0.264	0.252	0.241	0.248	0.281	0.241	0.228
	IF	0.589	0.595	0.626	0.63	0.621	0.597	0.632	0.619
	No-repair	0.135	0.114	0.093	0.094	0.083	0.073	0.055	0.061
Taiwan	THA	0.002	0.002	0.001	0.001	0.002	0.010	0.008	0.007
	HA	0.367	0.374	0.377	0.383	0.381	0.367	0.380	0.388
	IF	0.576	0.574	0.575	0.574	0.579	0.576	0.566	0.560
	No-repair	0.054	0.049	0.048	0.042	0.038	0.048	0.046	0.046

* THA = Total hip arthroplasty, HA = Hemiarthroplasty, IF = Internal fixation ** Data unavailable in 2011 and 2012

Supplementary S8: Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture for all years, by country.





*THA = Total hip arthroplasty, HA = Hemiarthroplasty, IF = Internal fixation

Supplementary S9: Stratified Age and sex standardized percentages of patients receiving THA, HA, and IF* for patients hospitalized with hip fracture, 2011-2018

	Metric	<90								90+							
		2011	2012	2013	2014	2015	2016	2017	2018	2011	2012	2013	2014	2015	2016	2017	2018
US	THA	0.037	0.039	0.042	0.047	0.049	0.057	0.059	0.063	0.017	0.018	0.016	0.017	0.018	0.023	0.021	0.021
	HA	0.337	0.333	0.327	0.325	0.313	0.278	0.270	0.264	0.316	0.317	0.313	0.318	0.308	0.277	0.276	0.27
	IF	0.570	0.573	0.573	0.571	0.576	0.592	0.597	0.597	0.593	0.588	0.591	0.588	0.589	0.608	0.611	0.614
	No-repair	0.024	0.023	0.025	0.023	0.026	0.031	0.030	0.030	0.074	0.077	0.079	0.077	0.085	0.092	0.093	0.095
Canada	THA	0.109	0.097	0.100	0.109	0.111	0.107	0.102	0.069	0.069	0.072	0.069	0.077	0.072	0.077	0.079	0.039
	HA	0.286	0.299	0.284	0.298	0.278	0.284	0.285	0.332	0.281	0.288	0.279	0.284	0.284	0.271	0.283	0.306
	IF	0.553	0.555	0.566	0.540	0.552	0.543	0.547	0.535	0.580	0.576	0.582	0.568	0.571	0.577	0.556	0.576
	No-repair	0.052	0.049	0.050	0.052	0.059	0.066	0.065	0.064	0.070	0.064	0.070	0.071	0.074	0.075	0.082	0.079
England	THA	0.048	0.070	0.077	0.079	0.082	0.100	0.105	0.118	0.008	0.010	0.012	0.010	0.008	0.011	0.011	0.012
	HA	0.415	0.388	0.392	0.399	0.401	0.396	0.381	0.392	0.392	0.410	0.403	0.405	0.418	0.420	0.424	0.399
	IF	0.427	0.437	0.438	0.426	0.426	0.415	0.420	0.402	0.484	0.472	0.478	0.476	0.465	0.479	0.457	0.481
	No-repair	0.114	0.108	0.096	0.101	0.094	0.092	0.096	0.092	0.120	0.110	0.110	0.112	0.112	0.093	0.110	0.112
Netherlands **	THA	NA	NA	0.045	0.045	0.052	0.058	0.057	0.060	NA	NA	0.011	0.006	0.009	0.006	0.006	0.000
	HA	NA	NA	0.381	0.358	0.361	0.366	0.360	0.357	NA	NA	0.367	0.353	0.356	0.348	0.361	0.359
	IF	NA	NA	0.506	0.511	0.501	0.509	0.513	0.512	NA	NA	0.573	0.546	0.533	0.549	0.544	0.530
	No-repair	NA	NA	0.068	0.086	0.086	0.068	0.069	0.071	NA	NA	0.049	0.095	0.102	0.097	0.090	0.111
Israel	THA	0.034	0.031	0.036	0.040	0.058	0.059	0.084	0.112	0.003	0.014	0.004	0.012	0.019	0.018	0.029	0.032
	HA	0.248	0.269	0.253	0.239	0.247	0.267	0.240	0.220	0.240	0.258	0.244	0.249	0.254	0.331	0.242	0.244
	IF	0.585	0.586	0.620	0.631	0.619	0.603	0.622	0.618	0.623	0.620	0.644	0.624	0.622	0.572	0.667	0.625
	No-repair	0.132	0.114	0.090	0.090	0.077	0.072	0.054	0.050	0.134	0.108	0.107	0.115	0.105	0.078	0.062	0.099
Taiwan	THA	0.003	0.003	0.001	0.002	0.002	0.011	0.008	0.008	0.002	0.001	0.000	0.000	0.001	0.009	0.006	0.005
	HA	0.387	0.389	0.397	0.400	0.400	0.386	0.399	0.406	0.314	0.339	0.326	0.344	0.325	0.314	0.329	0.336
	IF	0.565	0.565	0.560	0.564	0.565	0.559	0.551	0.546	0.607	0.587	0.604	0.588	0.618	0.617	0.602	0.593
	No-repair	0.046	0.043	0.042	0.034	0.033	0.044	0.042	0.040	0.076	0.073	0.069	0.068	0.056	0.060	0.062	0.066

*THA = Total hip arthroplasty, HA = Hemiarthroplasty, IF = Internal fixation ** Data unavailable in 2011 and 2012

Supplementary S10: Stratified Age and sex standardized mortality for hip fracture by country, 2011-2018

Country	Metric	<90								90+							
		2011	2012	2013	2014	2015	2016	2017	2018	2011	2012	2013	2014	2015	2016	2017	2018
US	Death within 30 days	0.063	0.066	0.066	0.061	0.061	0.059	0.060	0.054	0.130	0.131	0.129	0.129	0.129	0.130	0.128	0.123
	Death within one year	0.240	0.244	0.228	0.234	0.230	0.231	0.230	0.215	0.398	0.400	0.372	0.396	0.389	0.407	0.404	0.390
	Readmission within 30 days	0.134	0.129	0.119	0.119	0.118	0.116	0.116	0.113	0.144	0.135	0.129	0.126	0.128	0.123	0.122	0.124
Canada	Death within 30 days	0.067	0.067	0.063	0.059	0.057	0.055	0.056	0.058	0.148	0.148	0.126	0.143	0.131	0.125	0.139	0.133
	Death within one year	0.218	0.221	0.206	0.201	0.199	0.197	0.200	0.200	0.401	0.384	0.365	0.380	0.365	0.354	0.380	0.372
	Readmission within 30 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
England	Death within 30 days	0.049	0.053	0.056	0.050	0.049	0.055	0.052	0.047	0.090	0.109	0.110	0.109	0.100	0.104	0.097	0.097
	Death within one year	0.167	0.169	0.172	0.170	0.165	0.173	0.176	0.164	0.257	0.290	0.275	0.295	0.270	0.288	0.288	0.284
	Readmission within 30 days	0.159	0.157	0.161	0.169	0.168	0.169	0.179	0.173	0.166	0.178	0.179	0.184	0.174	0.158	0.194	0.188
Netherlands *	Death within 30 days	NA	NA	0.072	0.073	0.076	0.075	0.072	0.075	NA	NA	0.174	0.163	0.177	0.175	0.178	0.181
	Death within one year	NA	NA	0.229	0.231	0.234	0.232	0.220	0.215	NA	NA	0.437	0.459	0.447	0.453	0.451	0.442
	Readmission within 30 days	NA	NA	0.113	0.098	0.092	0.092	0.089	0.081	NA	NA	0.082	0.083	0.084	0.086	0.074	0.068
Israel	Death within 30 days	0.034	0.045	0.038	0.035	0.049	0.034	0.034	0.042	0.072	0.083	0.085	0.093	0.085	0.056	0.070	0.090
	Death within one year	0.197	0.201	0.185	0.202	0.193	0.175	0.157	0.176	0.347	0.327	0.336	0.330	0.305	0.268	0.283	0.328
	Readmission within 30 days	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Taiwan	Death within 30 days	0.023	0.021	0.022	0.023	0.023	0.020	0.024	0.022	0.046	0.064	0.055	0.050	0.052	0.056	0.048	0.057
	Death within one year	0.128	0.132	0.135	0.130	0.136	0.137	0.141	0.130	0.257	0.255	0.261	0.246	0.250	0.261	0.253	0.231
	Readmission within 30 days	0.126	0.126	0.125	0.123	0.123	0.128	0.129	0.119	0.165	0.179	0.165	0.164	0.166	0.169	0.167	0.148

* Data unavailable in 2011 and 2012

Supplementary S11: Age and sex standardized percentages of patients receiving THA, HA, and IF for patients hospitalized with hip fracture, 2011-2018 (Netherlands before upscaling)

Full cohort		2013	2014	2015	2016	2017	2018
Netherlands	THA	0.027	0.035	0.040	0.044	0.043	0.044
	HA	0.261	0.334	0.343	0.355	0.356	0.360
	IF	0.361	0.489	0.483	0.506	0.511	0.513
	No-repair	0.045	0.084	0.085	0.073	0.074	0.081
	No registration	0.306	0.058	0.049	0.022	0.016	0.002

*THA = Total hip arthroplasty, HA = Hemiarthroplasty, IF = Internal fixation