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Why the US spends more treating high-need high-cost patients: a comparative study of pricing and utilization of care in six high-income countries

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ABSTRACT

One of the most pressing challenges facing most health care systems is rising costs. As the population ages and the demand for health care services grows, there is a growing need to understand the drivers of these costs across systems. This paper attempts to address this gap by examining utilization and spending of the course of a year for two specific high-need high-cost patient types: a frail older person with a hip fracture and an older person with congestive heart failure and diabetes. Data on utilization and expenditure is collected across five health care settings (hospital, post-acute rehabilitation, primary care, outpatient specialty and drugs), in six countries (Canada (Ontario), France, Germany, Spain (Aragon), Sweden and the United States (fee for service Medicare)) and used to construct treatment episode Purchasing Power Parities (PPPs) that compare prices using baskets of goods from the different care settings. The treatment episode PPPs suggest other countries have more similar volumes of care to the US as compared to other standardization approaches, suggesting that US prices account for more of the differential in US health care expenditures. The US also differs with regards to the share of expenditures across care settings, with post-acute rehab and outpatient speciality expenditures accounting for a larger share of the total relative to comparators.

1. Introduction

In 2019, the US spent far more than any other country on healthcare: approximately 16.8 of the US GDP, nearly double the OECD average of 8.8% [1]. The US has consistently spent more on healthcare over the past thirty years, with this differential increasing as US expenditure growth has outpaced that of other countries [2]. Researchers have

examined differences across the US health system and other high-income countries to explain why the US spends so much more. International research concludes that price differences across countries play a definitive role [3–5]. This was most succinctly described by Uwe Reinhard in 2003 as, “It’s the Prices, Stupid” [4].

However, most of the comparative work examining US health spending has relied on aggregated, publicly available data across

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healthcare systems, primarily from the Organization of Economic Cooperation and Development (OECD). While the OECD has a wealth of information on aspects health system performance including expenditures, the aggregated nature of these data poses distinct challenges for researchers. Expenditure data collected at the population level does not allow one to determine how much cross-national variation in expenditures is driven by underlying differences in patient characteristics, the volume of care consumed, or the quality of care received [6,7]. Some international data are available to compare the price of different treatments or drugs across countries through other sources, but these are often patchy and limited to the private sector, which in many countries does not include the majority of patients.

In this paper, to better understand the drivers behind cross country differences in healthcare expenditure, we made use of data collected by the International Collaborative on Costs, Outcomes and Needs in Care (ICCONIC) for six countries: Canada (Ontario), France, Germany, Spain (Aragon), Sweden, and the US (Medicare fee-for-service). For these countries, the data included detailed comprehensive utilization and cost data across five care components - inpatient hospital care, facility-based post-acute rehabilitation, primary care MD visits, outpatient specialty MD visits, drugs - for two specific high-need high-cost patient cohorts. As further detailed in work by Figueroa et al., [8] these patient cohorts consisted of a frail older adult (65+) with a hip fracture and an older person (65–90) with complex multimorbidity, including heart failure and diabetes. Using the ICCONIC data, we were able to make comparisons of yearlong health system expenditures for these clinically similar patient cohorts. The granularity of information in data allowed us to further explore the contribution of care volume, care type, and price levels to overall expenditure.

Cross-country differences in health expenditures can be caused by differences in the volume of services provided or in the price of these services. To disentangle this, one may convert expenditures using nominal exchange rates or exchange rates adjusted for the price level in a country (purchasing power parity). The purchasing power parity has been calculated using the general price level in a country (AIC PPPs), or the price of a basket of health of goods for a specific sector (Health PPPs), or in a specific care setting (Hospital PPPs). In this paper, using the ICCONIC data, we construct the PPPs for services used for specific treatment pathways. Using these PPPs to convert national expenditures, we were interested in examining: (1) how much of the difference in yearlong expenditure for these patients across countries is attributed to price variations across countries? (2) how much of the difference in expenditure is driven by differences in the volume of care consumed over the course of a year? (3) how much of the difference in expenditure is accounted for by different types of care consumed across the care pathway?, and (4) how different are these estimates when using different purchasing power parities to convert health expenditures across countries.

2. Data

Individual patient level data from 2016 to 2017 were obtained from six countries participating in the ICCONIC collaborative: Canada (Ontario), France, Germany, Spain (Aragon), Sweden, and the US (Medicare fee-for-service) (Appendix 1 & 2). Across countries, the data spanned five care components, inpatient hospital care, facility-based post-acute rehabilitation, primary care MD visits, outpatient specialty MD visits, and drugs, and included information on patient characteristics, comorbidities, utilization, spending, and outcomes [8]. Data were obtained for two patient cohorts selected to represent individuals with high-needs and high-costs, such that they will use care across health services, and that their costs represent a significant proportion of overall health spending, see for example Tanke et al., (2019) [9]. The hip cohort, was selected to represent a frail elder, which was identified as an individual aged 65+ years with a hospital admission for a hip fracture (ICD-10 S72.0, S72.1 or S72.2) treated with a hip replacement or

osteosynthesis/pinning. The CHF cohort was selected to represent a complex, multi-morbid patient, and was identified as an individual aged 65–90 years admitted to hospital for congestive heart failure (CHF) (with a main diagnosis of ICD-10 I50) with diabetes as a secondary diagnosis (ICD-10 E11, E12, E13 or E14). As detailed in a previous body of work, [10,11] the cohort selection process yielded a similar set of patients for comparison across countries (Appendix 3 & 4).

Using each cohort of patients identified across the countries, the ICCONIC project examined individual-level information on utilization and expenditure in each care setting, over a period of 365 days after the index admission. In some countries, samples payment rates set by specific payers were used to calculate prices, such as Medicare fee-for-service data which were used to impute prices for hospitalization and a specialist visit in the US. Similarly, France used administrative claims data from the national sickness fund to impute prices for hospitalisations and specialist visits. This may lead to bias in results for some countries where these rates significantly differ from other providers, such as the US where federal payment rates have been shown to differ from negotiated prices in commercial insurance [12]. Detailed information on the data sources and the representativeness of the datasets are outlined in Appendices 1 and 2. Routinely collected data linked across care settings were used to examine the entire care pathway for the two cohorts for 2017, the reference year. A unit price for a hospital inpatient stay, a day in a rehabilitative facility, a visit to primary care, a visit to a specialist and unique drugs prescribed was gathered from each country (Table 1). Information on utilization of each of these services, per country is detailed in Appendix 5. Prices were estimated for participating countries in different ways, reflecting different payment models and national cost accounting methods (Appendix 6). Some countries were able to report direct spending from incurred costs (those with full costing systems) while others provided information on reimbursement for specific episodes (e.g. DRGs) or an unweighted average unit prices. For instance, in Canada (Ontario), Spain (Aragon), and Sweden, values were mainly set by allocating expenditures to units of activity/inpatient weighted cases, whereas negotiated prices or fees/tariffs were the value mainly used by France, Germany, and the US (Medicare fee-for-service). For drugs, all countries used the amount paid to the pharmacy, including dispensing fees. In addition, the inclusion of capital expenditure also varied across systems: hospital prices did not include payment for capital expenditure in Germany, Spain (Aragon), Sweden and the US (Medicare fee-for-service), whereas only capital expenditure for large scale projects were excluded from prices for Canada (Ontario) and payment for capital expenditure was partly included for France.

3. Methods

Purchasing Power Parities (PPPs) are used to cover the price of a basket of goods and services in one currency to the equivalent price for same basket in another. When PPPs are applied to express expenditure in a common unit, the results reflect a uniform price level and thus the expenditure comparison reflects only the differences in the volume of goods and services consumed across countries. This can allow policy makers to better determine how much expenditure differences across countries are the result of differences in price levels or volumes of care.

Currently, the OECD uses Actual Individual Consumption (AIC) PPPs as the most reliable and up-to-date conversion rates for health expenditure [1]. AIC PPPs are designed to capture prices of a basket of goods and services that households consume, including for example – in addition to healthcare – food and beverages, transport and culture. While AIC PPPs can be very useful to compare household income across countries, there are particular issues one needs to consider when using them to compare spending on goods and services supplied by non-market producers such as governments, where prices may be imperfect signals of market value [13]. To address these challenges in healthcare, Actual Individual Consumption of Health PPPs or “health PPPs” have also been used to convert health expenditure for

Table 1
Expenditures by country.

	United States	Canada (Ontario)	France	Germany	Spain (Aragon)	Sweden
Hip cohort						
Number of patients	21,803	6305	21,957	10,583	1270	4615
Total expenditure in national currency (at US exchange rates)	55,248	47,915 (36,857)	17,583 (19,755)	17,670 (19,853)	13,125 (14,747)	207,912 (24,317)
Unit price at US exchange rates						
Inpatient hospital	13,782	12,164	6,659	7,813	7,365	9,142
Facility-based post-acute rehabilitation	545	479	248	163	43	284
Primary care MD visits	244	54	37	36	63	199
Outpatient Specialty MD visits	384	87	129	67	74	327
Drugs	298	133	64	133	135	80
CHF cohort						
Number of patients	29,134	9,872	42,849	13,998	1,859	14,764
Total expenditure in national currencies (at US exchange rates)	55,391	42,094 (32,380)	20,395 (22,915)	19,450 (21,853)	12,982 (14,586)	233,835 (27,349)
Unit price at US exchange rates						
Inpatient hospital	11,436	9,340	5,509	6,136	4,483	6,560
Facility-based post-acute rehabilitation	525	480	270	170	55	284
Primary care MD visits	237	60	37	34	87	200
Outpatient Specialty MD visits	637	95	159	86	77	369
Drugs	389	173	84	172	118	106

international comparisons. Health PPPs are computed based on a representative basket of 267 items from the healthcare sector, 198 goods (of which 159 are pharmaceutical products) and 69 health services [13]. As an example, the price of a 15–20 min visit to a general practitioner and the price of an intramuscular injection of influenza vaccine by a nurse are gathered and compared across countries.

Yet, even if specific to health, health PPPs are still based on a representative sample of the whole health sector, which is not likely to reflect differences in the prices of the types of goods and services consumed across care pathways for specific patient groups who will make use of a distinct set of services. To compare healthcare spending for distinct patient cohorts across countries, this paper develops and uses “treatment episode PPPs”. These new PPPs are constructed using information on prices specific to the treatment episode of the patients being investigated, allowing one to better understand whether expenditures differ because of variations in prices or in the volumes of care within and across care settings.

Multilateral PPPs can be computed using different methods. The method selection is based on base country invariance and transitivity. If the PPP between any two countries is the same whether computed directly or indirectly through a third country, then the PPPs are transitive. PPPs are base country invariant if the PPP between any two countries is the same regardless of the choice of base country. To derive multilateral treatment episode PPPs that satisfy the property of invariance and transitivity, a set of binary price indexes or parities between each pair of countries – the partner country and the numeraire or base country – was computed (see the Appendix 7 for a detailed description). Item-level price ratios between each pair of countries were first weighted using the base country’s weights (Laspeyres-type index), and then weighted again using the partner country’s weights (Paasche-type index). To maintain symmetry, the geometric mean of the two indices was computed for every pair of countries in the comparison (Fisher-type index). The Fisher-type indexes between each pair of countries were then converted into transitive, invariant multilateral indexes using the Elteko-Koves-Szulc (EKS) method [14,15]. Those indexes are the treatment episode parities or PPPs.

To examine how much health system expenditure for the patient cohorts is attributed to price and volume variations, we applied different PPP indices to the expenditure data obtained for each cohort. Taking the overall expenditure across all five care settings over the course of 365 days following their index admission, we first standardised the data using AIC PPPs using the US as the base country. We then compare these estimates to hospital expenditures standardized using Health PPPs and

the specific-treatment episode PPPs. Each of these indices will convert expenditures to the uniform price levels as indicated by the respective baskets of goods and services and allowing the relative comparison of expenditure to reflect only the difference in the volume of goods and services consumed. Next, to illustrate more concretely the difference in prices across countries, we calculated the price levels for each country by dividing the PPPs by exchange rates. We present this for the general economy (AIC), the health sector (Health) and each of the treatment episodes. Finally, to estimate the differences in volumes of care consumed for each care setting, we divided mean health spending (expressed in national currencies) for each care setting for the hip and the CHF cohorts by the treatment episode PPPs that came from this study.

4. Results

Across the countries in this study, the data included information on the following number of patients in the hip cohort: 6,305 (Canada, Ontario), 21,957 (France), 10,583 (Germany), 1,270 (Spain, Aragon), 4,615 (Sweden) and 21,803 (US); and the following number of patients in the CHF cohort: 9,872 (Canada, Ontario), 42,849 (France), 13,998 (Germany), 1,859 (Spain, Aragon) 14,764 (Sweden) and 29,134 (US) (Table 1). Differences in the size of the cohorts of patients in each country reflect the sizes of the samples of study (see Appendix 2).

4.1. Differences in treatment expenditure across countries over a year in care

Fig. 1 illustrates the total expenditure across countries over the course of a year for the Hip Cohort expressed in 2017 US dollars,

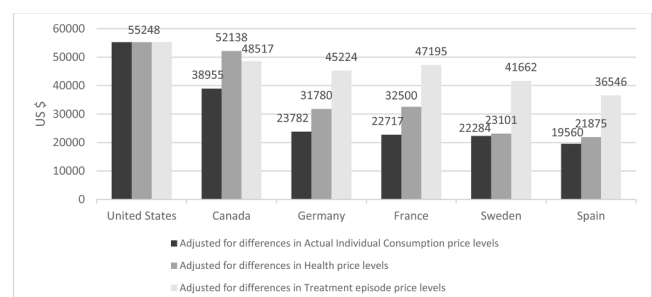


Fig. 1. Total expenditure for a year of care, hip cohort, 2017.

standardized using the three different PPP indices – AIC, Health and Treatment Episode - with the US selected as the base country for ease of interpretation. When we use AIC PPPs to standardize expenditures using general economy prices, the US patients has the highest expenditure at \$55,248 on average per Hip patient over the course of a year. This is followed by Canada, who spends \$38,955 on average per patient. Spain spends the least for a year of care, at \$19,560 on average.

Using the health and treatment-episode PPPs allows us to standardize for the differences in health prices across countries, both in the general healthcare setting but also specifically for the types of goods and services used to treat the patients in each cohort. The expenditure standardized using these indices allow us to compare what expenditure would look like at the same price levels for the different volumes of care consumed in each country.

Using the health PPPs brings the relative expenditure estimates for all comparators closer to the US expenditure. This is change is most pronounced in Canada, Germany and France, and least pronounced in Sweden and Spain and illustrates how much of the difference in health expenditures across these countries is accounted for by differences in price levels in the general health sector, relative to the US. When using treatment episode PPPs, the expenditure gap between the US and other countries narrows further, apart from Canada. These changes illustrate that a large part of the expenditure difference between the US and other countries has to do with higher prices in the health setting, but even more so for the treatment for the patients in the hip cohort. Once we account for the differences in price levels, we can see that volumes of care consumed are more similar across countries, but are the highest in the U.S.

Fig. 2 presents the same comparison for the CHF cohort. When we use AIC PPPs, the US cohort has the highest expenditure at \$55,391 on average per CHF patient over the course of a year. This is followed by Canada, who spends \$34,223 on average per patient. Spain spends the least for a year of care, at \$19,347 on average. As with the hip cohort, adjusting for prices differences across countries using the health and treatment-episode PPPs brings other countries total volume of care consumed closer to the US estimates. As with hip, the changes in the expenditure difference signal how much prices differ between the general economy and the health and episode settings. The results show that the relative prices on the goods and services required for the treatment for a patient in the CHF cohort are higher in the US relative to the comparators than those in the broader health sector. Relative to the comparators, the US is consuming similar volumes of care for this patient type, although less than countries such as France.

4.2. Differences in price levels across countries

Table 2 illustrates comparative price levels across countries, computed using AIC, health and treatment episode PPPs. An index higher than 100 indicates a higher price level in one country relative to the US and an index lower than 100 signals a lower price level in one country relative to the US. Almost all countries showed a comparative price level lower than the US using any of the price levels. The exception

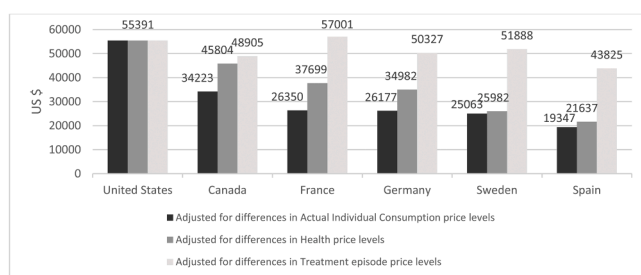


Fig. 2. Total expenditure for a year of care, congestive heart failure cohort, 2017.

to this was Sweden, when using AIC and health comparative price levels.

For France, Germany and Spain, the treatment episode price levels were approximately 20 percentage points lower than the health price levels, while for Sweden treatment episode price levels were around 50 percentage points lower than health price levels. For Canada, the treatment episode price level of the hip cohort was 76% of the US price level as compared to 71% for the health price level. This difference was even more pronounced when compared to AIC price levels.

4.3. Relative expenditure driven by volume of care across care settings

Fig. 3 illustrates how the relative share of volume by care setting differed between the two cohorts, across all countries. Across countries, hospital and post-acute rehabilitation accounted for three-quarters or more of the volume of care consumed by both hip and CHF cohorts. Yet facility-based rehabilitation contributed more to higher spending for the hip cohort as compared to the CHF cohort. The volume of primary and specialty care consumed by the hip and CHF cohorts represented less than 10% of the total volume of care in all countries, apart for the US. The percent share of outpatient drugs was systematically higher for the CHF cohort as compared to the hip cohort. The US had notably different resource use patterns for both cohorts. For the hip cohort, the rehabilitative care setting accounted for the majority of the volume of care, surpassing hospital care. For the CHF cohort, the volume of specialist care consumed by the CHF cohort accounted for 13% of the total.

5. Discussion

Using linked patient level data for two types of complex patients, a frail older person, and an older person with multimorbidity, from six countries, we were able to produce detailed comparisons of healthcare expenditures. When we applied treatment specific PPPs to convert expenditure across countries, we found that the differences in the volumes of care between countries was smaller as compared to estimates produced by AIC PPPs or health PPPs. Our results also showed that higher price levels accounted for the vast difference in total expenditure in the Medicare fee for service program in the US as compared to other countries, with US patients having slightly higher volumes of care for both cohorts, most pronounced for the frail elder. US patients consumed relatively more healthcare for specific settings, particularly rehabilitation and outpatient care. Finally, the comparison between different PPP indices suggests that for these complex patients the price difference between the US and other countries is underestimated when using health specific or AIC price levels. Taken together these results suggest higher healthcare expenditures in the US are driven predominantly by higher price levels, which appear to be higher for high-need high-cost patients, but also exacerbated by greater volumes of care use in certain settings such as rehabilitation and outpatient specialty. The results also show that treatment episode PPPs can provide different and meaningful insights above economy-wide or sector-wide PPPs, when used in cross-country comparisons.

Our results have important implications for US policy makers interested in better identifying areas to reduce inefficiencies and lower health spending for these complex patient types. First, our results reinforced previous findings suggesting that one of the main factors driving greater expenditures in the US are higher price levels. Notably, our sample was constructed from patients receiving care in the fee for service Medicare program, where payment rates are known to be lower than the commercial market, suggesting that this effect is underestimated. In addition, the methods used in this paper show that the difference in price levels between the US fee for service Medicare patients and the other countries may be greater for particular high-use patient types. This paper made use of treatment episode PPPs to produce more comparable estimates of expenditure across countries than other price indices. These PPPs are constructed from a basket of specific goods and services consumed by the set of patients being investigated and thus more

Table 2

Actual Individual Consumption (AIC), health and treatment episode comparative price levels, 2017, US = 100^{a b}.

	United States	Canada (Ontario)	France	Germany	Spain (Aragon)	Sweden
Actual Individual Consumption	100	94.8	87.5	84.0	75.8	109.1
Health	100	70.8	61.1	62.8	67.8	105.3
Hip treatment episode	100	76.1	42.1	44.1	40.6	58.4
CHF treatment episode	100	66.3	40.4	43.7	33.5	52.7

^a Authors' analysis of data from the ICCONIC dataset, 2021.^b OECD Health Statistics².

Panel A: Hip cohort

	United States		Canada		France		Germany		Spain		Sweden	
	Level	Share	Level	Share	Level	Share	Level	Share	Level	Share	Level	Share
Total	55 248		48 517		47 195		45 224		36 546		41 662	
Hospital	23 429	42%	28 618	59%	30 109	64%	35 923	79%	30 126	82%	33 045	79%
Rehabilitation	25 216	46%	15 906	33%	13 567	29%	3 591	8%	228	1%	4 551	11%
General practitioners	831	2%	1 019	2%	640	1%	1 425	3%	1 340	4%	1 336	3%
Specialists	2 608	5%	808	2%	719	2%	1 307	3%	1 549	4%	1 031	2%
Drugs	3 164	6%	2 166	4%	2 160	5%	2 977	7%	3 303	9%	1 700	4%

Panel B: CHF cohort

	United States		Canada		France		Germany		Spain		Sweden	
	Level	Share	Level	Share	Level	Share	Level	Share	Level	Share	Level	Share
Total	55 391		48 905		57 001		50 327		43 825		51 888	
Hospital	30 877	56%	38 170	78%	46 736	82%	39 343	78%	34 019	78%	41 439	80%
Rehabilitation	10 083	18%	3 661	7%	3 670	6%	952	2%	115	0%	2 410	5%
General practitioners	1 304	2%	778	2%	902	2%	1 578	3%	2 802	6%	2 170	4%
Specialists	6 946	13%	1 642	3%	1 165	2%	2 743	5%	1 901	4%	2 567	5%
Drugs	6 181	11%	4 654	10%	4 528	8%	5 710	11%	4 990	11%	3 301	6%

Fig. 3. Comparison of the percent share of expenditure by care settings across countries.

representative of the true price levels they are likely to face. By using these treatment episode PPPs to standardize expenditures across countries we found a difference in price levels greater than what would be observed using other price standardization methods that use prices from the general economy or the health sector as a whole. Finally, as the two cohorts selected for study reflect high-need high-cost patient types,⁸ these findings are directly relevant for a significant proportion of health system spending and likely reflective of similar issues applying to other high-need high-cost patients. Given that these patients use disproportionate amounts of care to the general population, correcting these inefficiencies can have meaningful effects on total health spending.

Our results also suggest that the patients seen by fee for service Medicare in the US differ with regards to the volumes of care used, overall and across the care pathway for both cohorts. While other comparative studies of the US population to other high-income countries have noted that the US has relatively average utilization across the board, [2–4] our study of complex patients shows that for these groups of patients the US utilizes more care, concentrated in certain settings such as rehabilitative and outpatient specialist care. For both the Hip and CHF cohorts the volume of inpatient rehabilitative care in the US makes up considerably more of the total volume than other countries (46% of total volume for Hip and 18% for CHF). This is around two times the volume of care provided by Canada and France – the other high-volume countries for inpatient rehabilitation. In contrast, the US has the lowest volume of the inpatient hospital care relative to other countries in the study, both in levels and as a percent share of total volume. It is possible that more intense use of post-acute services in the US is related to the higher profit margins for rehabilitation facilities relative to hospitals (14.3% versus –8.7% in 2019) [16]. Moreover, the difference in intensity of rehabilitation delivery does not appear to yield significant benefits to the outcomes of these patients relative to comparators, as reported for the same cohorts of patients elsewhere [8]. These results suggest that the provision of rehabilitative care is an area where potential efficiency gains could be made for the fee for service Medicare program in the US system, as the extra costs associated with

this setting do not appear to generate improved outcomes relative to comparators.

For both cohorts, but most pronounced for the CHF cohort, the US also has notably higher volumes of specialist care; between 2.5 and 6 times higher than comparator countries. For the CHF cohort specialist care and represents the largest percent share of total volume in the US (13%). Less reliance on primary care in the US than in the other countries in this study may explain the differences observed. Other comparative and domestic work have suggested that this may be related to primary care physician supply or differences in gatekeeping across systems [17]. More work is needed to better understand where the management of CHF patients occurs across systems to explore whether other care models are more efficient for treating these patients.

While our results show that US price levels account for more of the difference in health expenditure than volumes of care, we also find that this result is sensitive to the type of PPP conversion rate used. When comparing the US to other countries using AIC or health PPPs we find that these PPPs underestimate the contribution of price levels and overestimate the contribution of volumes of care. As PPPs are available at different levels (economy-wide level, health sector, hospital sector), our results emphasize importance of using treatment episode PPPs when disentangling price and volume at cohort level for international comparisons.

This study makes important contributions to the literature on health system comparison and determinants of US health system spending. While several other studies have used a comparative approach to examine the factors related to health system spending, these have been done largely at the population level [2–4]. As a result, it is often difficult to determine the extent to which variations in expenditure are related to differences in the population characteristics and/or intensity of care delivered. Our study examines specific patients that are more comparable from one country to another allowing us to be more confident that the variations we see in spending are indeed attributable to differences in the volumes of care received and/or price levels. In addition, we draw further insights about the relative expenditures that correspond to

different care settings in the different countries, and how much these are driven by differences in prices of care in that treatment setting versus volume of care. While other studies have examined the role that factors such as administrative costs, salaries and drug prices contribute to differences in health system expenditures, we are not able to breakdown expenditure by these components, although they will factor into the differences in price that we observe across countries and care settings [3, 4,18]. Finally, most comparative health systems work uses existing standardization methods to convert expenditures to a common unit such as exchange rates and AIC or health PPPs [19, 20]. In our work, we constructed treatment episode PPPs using the information on prices from the different countries, which allows a more precise comparison and allows us to compare the difference between these approaches. In particular, treatment episode PPPs better capture price differences in complex markets such as the US one by focusing on the financing scheme responsible for payment, and do not make assumptions on the relative importance of the different areas of spending (e.g. hospitals, pharmaceuticals) in the price index computation as the health PPPs approach does.

Our study has some limitations. First, there are some differences in the representativeness of data across countries and the types of data used. This may influence the comparability across certain categories, and bias some of the results where prices are known to differ for other payers. For example, in the US, the sample of data represents patients covered by the Medicare fee-for-service system, these patients may have different spending patterns than patients covered through commercial insurance representing both groups under 65 and those enrolled in Medicare advantage. Second, national coding and cost accounting practices across countries differ, this in turn may influence the results. For example, countries with global budgets where prices have been estimated by dividing expenditure by utilization (a top-down approach) may have less precise estimates than those with fee-for-service systems. Third, the expenditure estimates, for the most part, do not capture any additional household out-of-pocket payments, which are likely to vary across countries and care settings. Finally, we do not adjust for comorbidities, which may influence expenditure and utilization. For example, if the United States has higher comorbidities for this patient group than other countries, this may contribute to higher spending. However, as shown elsewhere, [8] the patients identified for comparison across countries are very similar in terms of age, sex and number of recorded comorbidities.

6. Conclusions

Our results comparing expenditures across two high-need high-cost patient types across countries using treatment episode PPPs show that when comparing similar types of patients, the US is paying significantly more for similar levels of care and proportionally more for post-acute care than other countries. Policy makers interested in improving efficiency in Medicare should examine other care models for rehabilitation and care management that make more use of home care and primary care settings, similar to other countries with lower expenditures and better outcomes.

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Declarations of Competing Interest

None.

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Supplementary materials

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References

- [1] OECD. Health at a glance 2021. Paris: OECD Indicators. OECD Publishing; 2021. <https://doi.org/10.1787/ae3016b9-en>.
- [2] OECD health statistics. Paris: OECD Publishing; 2021. <https://doi.org/10.1787/health-data-en>.
- [3] Papanicolas I, Woskie LR, Jha AK. Health care spending in The United States and other high-income countries. *JAMA* 2018;319(10):1024–39.
- [4] Anderson GF, Reinhardt UE, Hussey PS, Petrosyan V. It is the prices, stupid: why the United States is so different from other countries. *Health Aff* 2003;22(3):89–105.
- [5] Anderson GF, Hussey P, Petrosyan V. It's still the prices, stupid: why the US spends so much on health care, and a tribute to Uwe Reinhardt. *Health Aff* 2019;38(1):87–95.
- [6] Street A, Smith P. How can we make valid and useful comparisons of different health care systems? *Health Serv Res* 2021;56(Suppl. 3):1299–301.
- [7] Baicker K, Chandra A. Challenges in understanding differences in health care spending between the United States and other high-income countries. *JAMA* 2018;319(10):986–7. doi:10.
- [8] Figueroa JF, Horneffer KE, Riley K, et al. A methodology for identifying high-need, high-cost patient personas for international comparisons. *Health Serv Res* 2021;56(Suppl. 3):1302–16.
- [9] Tanke Marit AC, et al. A challenge to all. A primer on inter-country differences of high-need, high-cost patients. *PLoS One* 2019;14(6):e0217353.
- [10] Papanicolas I, Figueroa JF, Schoenfeld AJ, et al. Differences in health care spending and utilization among older frail adults in high-income countries: ICCONIC hip fracture persona. *Health Serv Res* 2021;56(Suppl. 3):1335–46.

- [11] Figueroa JF, Papanicolas I, Riley K, et al. International comparison of health spending and utilization among people with complex multimorbidity. *Health Serv Res* 2021;56(Suppl. 3):1317–34.
- [12] Chernew Michael E, Hicks Andrew L, Shah Shivani A. Wide State-Level Variation In Commercial Health Care Prices Suggests Uneven Impact Of Price Regulation: an examination of state-level price variation in the commercial market, relative to Medicare, for a broader set of states and a wider set of services than had been previously examined. *Health Aff* 2020;39(5):791–9.
- [13] Eurostat and OECD. Eurostat-OECD methodological manual on purchasing power parities. 2012th ed. Luxembourg: European Union; 2012.
- [14] Éltető O, Köves P. On an index number computation problem in international comparison (in Hungarian). *Statisztikai Szemle* 1964;42:507–18.
- [15] Szulc B. Index numbers of multilateral regional comparisons (in Polish). *Przegląd Statystyczny* 1964;3:239–54.
- [16] MEDAPAC. 2021 Report to the congress. Medicare Payment Policy; March 2021.
- [17] Schneider EC, Shah A, Doty MM, Tikkanen R, Fields K, Williams II RD. Mirror, mirror 2021 — reflecting poorly: health care in the U.S. compared to other high-income countries. Commonwealth Fund; 2021.
- [18] Richman Barak D, et al. Billing and insurance-related administrative costs: a cross-national analysis: study examines health care billing and insurance related administrative costs across several countries. *Health Aff* 2022;41(8):1098–106.
- [19] Busse R, Schreyögg J, Smith PC. Variability in healthcare treatment costs amongst nine EU countries - results from the Health Basket project. *Health Econ* 2008;17(1 Suppl):S1–8.
- [20] Busse R, on behalf of the EuroDRG group. Do Diagnosis-related groups explain variations in hospital costs and length of stay? – analyses from the EuroDRG project for 10 episodes of care across 10 European countries. *Health Econ* 2012;21(S2): 1–5.