Within and across country variations in treatment of patients with heart failure and diabetes

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Within and cross country variations in treatment of patients with heart failure and diabetes

Objective: To compare within-country variation of healthcare utilization and spending of patients with chronic heart failure (CHF) and diabetes across countries.

Data Sources: Patient-level linked data sources compiled by the International Collaborative on Costs, Outcomes, and Needs in Care across nine countries: Australia, Canada, England, France, Germany, New Zealand, Spain, Switzerland, and the United States.

Data Collection methods: Patients were identified in routine hospital data with a primary diagnosis of CHF and a secondary diagnosis of diabetes in 2015/2016.

Study Design: We calculated the care consumption of patients after a hospital admission over a year across the care pathway—ranging from primary care to home health nursing care. To compare the distribution of care consumption in each country, we use Gini coefficients, Lorenz curves and female-male ratios for eight utilization and spending measures .

Principal Findings: In all countries, rehabilitation and home nursing care was highly concentrated in the top decile of patients, while the number of drug prescriptions were more uniformly distributed. On average, the Gini coefficient for drug consumption is about 0.30 (95% CI: 0.27-0.36), while it is, 0.50 (0.45-0.56) for primary care visits, and more than 0.75 (0.81-0.92) for rehabilitation use and nurse visits at home (0.78; 0.62-0.9). Variations in spending were more pronounced than in utilization. Compared to men, women spend more days at initial hospital admission (+5%,1.01-1.06), have a higher number of prescriptions (+7%, 1.05-1.09) and substantially more rehabilitation and home-care (+20% to 35%, 0.79-1.6, 0.99-1.64), but have fewer visits to specialists (-10%; 0.84-0.97).

Conclusions: Distribution of healthcare consumption in different settings vary within countries, but there are also some common treatment patterns across all countries. Clinicians and policy makers need to look into these differences in care utilization by sex and care setting to determine whether they are justified or indicate suboptimal care.

Key Words: Inequalities, international comparisons, multimorbidity, gender, care pathways, heart failure, diabetes.

Call out Box:

What is known on this topic?

- Patients with similar health needs are treated very differently within countries.
- Most cross-national studies examine variations in care use and resources for hospital care.
- There are very few sources of comparable cross-country data on the utilization patterns of patients with similar multi-morbidity across the different care settings.

What this study adds?

- There are significant within-country variations in care consumption patterns of patients with chronic heart failure and diabetes, but also common differences in consumption between men and women across all countries.
- Within all countries, hospital care and drug prescriptions are more uniformly distributed across patients while primary, specialist and rehabilitation care are more concentrated amongst fewer patients.
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Across countries, the differences in variation of care consumption may reflect differences in treatment practices, financial or geographic accessibility of care and other health-system characteristics.

Introduction

All healthcare systems are under pressure for containing the growth of health spending while maintaining the improvements in access and quality of care. Yet, across countries with similar economic level, healthcare utilization and spending vary significantly. These variations can be explained by many factors such as the level and mix of health resources, geographic and financial accessibility, social and demographic factors and differences in medical practice.[1-4] There is a growing international literature showing that within the same health system, patients with similar needs can receive very different treatments.[5-8] These differences can impact both the quality and cost of services. Measuring and questioning existing variations in care consumption is therefore crucial for improving the overall system performance. International comparisons of healthcare consumption can provide valuable lessons for improving system performance and allocative efficiency since differences in consumption reflect structural differences in how resources are allocated across different providers and their accessibility.

The bulk of international comparisons have focused on comparing averages of utilization or costs of health services per capita in the general population.[9-11] While these comparisons give an overview of the situation in a country compared to others, the average consumption may hide significant differences in distribution of care across clinically similar patients within a country. Some variation in care consumption across patients is inevitable and justified by needs or patients' preferences. Yet, across countries, the differences in variation of care consumption may reflect differences in treatment practices, financial or geographic accessibility of care and other health-system characteristics. However, measuring the distribution of care is challenging because of the difficulty of having data on patients' care consumption controlling for needs.

The research examining within country variations in medical care utilization has mainly concentrated on hospital care and compared differences between small geographic areas.[12-15] However, focusing solely on variations in one setting, such as hospitals, can be misleading given that care utilization in one setting is often influenced by service availability in another. This is particularly relevant for patients with high health care needs who require coordinated care from multiple providers, and are thus the most vulnerable to problems in care organization and poor quality of care.[16] Yet, there is limited work examining within-country variations in care across different components of the care pathway, from the management of health problems in primary care and outpatient specialty care to the use of hospital and post-acute rehabilitative care. In addition, certain sources of variation in care consumption, such as sex and gender, have received much less attention in the literature. Scholars often assume that variations by age and sex are explained by the health needs of patients, disregarding the fact that healthcare utilization can also be socially determined within countries.[17,18] For example,

in England, it was shown that older people and women are less likely to be admitted to hospital as electives for colorectal and lung cancer.[19]

In this paper, we propose a novel comparison of variations in care consumption across the care pathway within and across countries based on data derived from the International Collaborative on Costs, Outcomes, and Needs in Care (ICCONIC). We focus on one high-need, high-cost patient profile: an older adult with heart failure and diabetes and use the Gini framework to compare within country variations in care consumption. Focusing on a unique patient profile identified in the same way across countries allow us to have a cohort of patients with similar needs. Heart failure and diabetes are chronic conditions that require regular treatment from a variety of care providers, which places individuals living with these conditions at risk of experiencing fragmented and uncoordinated care.[20] Heart failure is also a leading cause of preventable hospitalizations, despite clear guidelines for managing both heart failure and diabetes in primary care settings and for avoiding repeated hospitalizations.[21,22]

By comparing care consumption patterns across the healthcare pathway, we aim to examine how health resources are distributed for patients with the same health condition in each health system. We further aim to understand the extent to which within-country variations in utilization were driven by sex. Overall, by way of an international comparison we aim to provide a benchmark for questioning the size of inequalities observed in care consumption in different care settings and for evaluating how countries use available health resources.

Methods

Data and selection criteria

The analysis is based on patient-level linked routine data sources on healthcare utilization and spending from nine countries: Australia, Canada, England, France, Germany, New Zealand, Spain, Switzerland, and the United States. The datasets used covered either the entire population (New Zealand, Switzerland) or large representative samples (England, France, Germany and the United States). In three countries, data covered the entire population from one region: Australia (New South Wales), Canada (Ontario), and Spain (Aragon). Specific details of each dataset used and their level of representativeness can be found respectively in Appendix Table 1 and Table 2 Using these datasets we identified individuals aged 65 to 90 years old, who were hospitalized for congestive heart failure (CHF) (with a primary diagnosis of ICD-10 I50, as defined by the World Health Organization) and diabetes as a secondary diagnosis (ICD E11, E12, E13 or E14) coded during the index hospitalization.

Patients are identified by the first hospitalization (the index episode) in 2016 (or 2015 in some countries) and tracked for 365 days after the index hospitalization to calculate care utilization and spending throughout the care pathway. We do not know if the index hospitalization is the first incident case but across countries on average patient cohorts have similar demographic characteristics (Appendix Table 3). Further details regarding how patients have been selected, and cohort characteristics in each country are provided in Papanicolas et al.[23]

Measures of utilization and spending

To measure utilization and spending, we use a set of eight utilization and eight spending measures, which originated from the ICCONIC framework.[24] Indicators cover utilization across the following care settings: acute hospital care, facility-based post-acute rehabilitation care, home or community-based rehabilitation care, primary care, outpatient visits to medical and diagnostic specialists, home health nursing care, and outpatient drug prescriptions. Of note, not all countries had data across all of these different components of health care services, notably on home-based rehabilitation and home nursing care. We examine both care consumption during index hospitalization and total hospital days in the year (365 days) following the index admission. Utilization is measured either by the number of days spent in a facility or by the number of unique visits to a health professional. Spending was measured in the national currency unit. Please refer to Appendix Table 2 for a definition of each utilization and spending variable.

Measures of variation

In order to compare the within-country variation in care utilization and spending across the care pathway, we calculated two measures of inequality: Gini coefficients and female/male ratios. The classic measures of variation, such as the coefficient of variation (CV) and high/low ratios, have known limitations when data analyzed do not have a normal distribution.[25] For example, CV is calculated by dividing the standard deviation of a given distribution by its mean value; however, typically care consumption of a given patient population follows a positively skewed distribution, and there are often many zeroes at the low end of the distribution. High/low ratios—while providing a measure of the range of variation—do not take into account the entire distribution, thus leaving out important information to assess country differences. Therefore, calculation of both standard deviation and decile ratios from heavily skewed data can be misleading.

Gini coefficient, on the other hand, is a measure derived from the Lorenz curve[26,27], which plots the entire distribution of a cohort. The Lorenz curve shows the cumulative percentage of total spending and care utilization by cumulative percentage of the cohort population. In a perfectly equal distribution, the Lorenz curve would follow the path of the 45° line of equality. For example, the first

25% of the patients would account for 25% of the total expenditure. As concentration increases, the Lorenz curve deviates from the line of equality. This approach is commonly used to evaluate income and consumption inequalities across countries since it provides a clear rationale for comparing the deviations from the line of equality, but rarely employed for analyzing healthcare consumption. The framework allows generating a single summary statistic of the distribution of spending/utilization across patients. The Gini coefficient is equivalent to the size of the area between the Lorenz curve and the 45° line of equality divided by the total area under the 45° line of equality.[25,28] It takes values between 0 and 1, where a value closer to 1 indicates a greater concentration of spending/utilization amongst a smaller group of patients, and zero corresponds to a perfectly equal distribution. In this study, the Gini coefficient indicates the extent to which healthcare consumption is skewed on a few patients in a cohort of patients who have similar health conditions.

In order to assess the gender variations in utilization/spending across the care pathway, we compared the average age-standardized utilization/spending of female versus male patients. To account for the difference in age structure (life expectancy) of male and female patient populations, we employed a direct standardization approach using the age structure of the US female patient population as the reference population.

Ethics Approval

In Canada, participation in this project was authorized under section 45 of Ontario's Personal Health Information Protection Act (PHIPA) and does not require review by a Research Ethics Board. In Germany, ethical clearance was provided by the Ethical Review Board of the Faculty of Business, Economics and Social Sciences of Universität Hamburg. In Spain, participation in this project was approved by Ethics Committee for Clinical Research in Aragon (2018-02-28, ref PI17/0411, Acta N 04/2018). In Switzerland, ethical clearance was provided by the Ethical Review Board of the Faculty of Business, Economics and Social Sciences of University of Bern. In the US, the Institutional Review Board at the Harvard T.H. Chan School of Public Health approved this study.

Results

Sample sizes range from 751 patients in England and 1,270 patients in Spain (Aragon), to 10,583 patients in Germany, 21,803 patients in the United States and 21,957 patients in France (Appendix Table 2). The sample size for following 'outpatient drugs' is slightly smaller in the US (15,946 patients), because this information is only available for a sub-sample of patients enrolled in Medicare Part D.

Table 1 presents the average level of care utilization and spending across care continuum in different countries relative to the United States, while Figure 1 presents the distribution of care amongst

patients, i.e. Gini coefficients for health care utilization and spending at different segments of the care pathway..

--- insert Table 1 and Figure 1 about here ---

Table 1 shows that the average level of care utilization is lower in the United States compared to other countries in all care settings, except for rehabilitation in facility and in community, but the average spending in all care settings is higher. For more detailed descriptions on mean spending and utilization across countries for heart failure patients with diabetes, please refer to Figueroa et al.[29].

Within-country variation across the care settings

Overall, across countries, the greatest concentration of utilization is observed in rehabilitation care and home nursing services, while the number of hospital days and drug prescriptions are more equally distributed across patients. On average, the Gini coefficient for drug consumption is about 0.30 (SD: 0.05; 95% CI: 0.27-0.36), while it is 0.40 for index hospitalization (SD: 0.08; 95% CI: 0.33-0.46), 0.50 for primary care visits (SD: 0.06; 95% CI: 0.45-0.56), and more than 0.75 for rehabilitation use (SD: 0.05; 95% CI: 0.81-0.92) and nurse visits at home (SD: 0.09; 95% CI: 0.62-0.9). Moreover, in all countries, inequality in index hospitalization days is lower compared to overall hospital utilization during the year. For example, Gini coefficients for index hospitalization days range from 0.31 in the US to 0.55 in Australia, while Gini coefficients for total hospital days vary between 0.42 in France and 0.60 in Australia. In comparison, Gini coefficients for primary care vary from 0.43 in Germany and France to 0.60 in Canada.

Gini coefficients related to rehabilitation at post-acute facilities—ranging between 0.78 and 0.90—were quite high (above average) across countries. However, we do not have data on community-based rehabilitation in all countries to compare the distribution in alternative settings. In countries for which we have data, situations differ. For example, in France, the distribution of home and facility-based rehabilitation is heavily skewed (Gini of 0.82) but the nursing home visits are more equally distributed (0.67). In the US and Canada, on the other hand, while home-based rehabilitation is slightly more equally distributed inequality is higher for home nursing care (0.86 and 0.81, respectively).

Variation in spending versus utilization

Spending captures both the differences in prices paid for services and in the intensity of care provided (for example, the number of tests in hospitals, type of drugs, treatments prescribed). Across the care

pathway, on average, spending inequality (0.62) is slightly higher than utilization inequality (0.58), but this is more or less pronounced at different settings along the pathway.

Gini coefficients for spending for rehabilitation care—community- or facility-based—remain high, similar to those for utilization. On the other hand, spending inequality related to pharmaceuticals is much higher than that of utilization in all countries, albeit with notable variations across countries. For example, France has a much lower Gini for drug spending (0.49) than the US (0.61), despite having the same level of variation in the number of prescriptions as the US (0.31). Spain has the lowest disparity between utilization and spending inequality (8 percentage points) and the US the highest (30 percentage points). In some countries, such as the US, Germany, Australia and New Zealand we see the same pattern for spending for outpatient specialists where the Gini coefficients are much higher compared to utilization. Inequalities in primary care spending, on the other hand, appear to be very close to that of care utilization in all countries with Gini coefficients ranging between 0.43 for Germany and 0.54 in Canada and 0.60 in the US.

--- insert Figures 2 (Lorenz curves) about here ---

Comparing the variation in consumption across countries

The Lorenz curves in Figure 2.1 and Figure 2.2 show the distribution of utilization and spending across countries by care setting. Horizontal axis gives the cumulative percentage of patients in each cohort while vertical axis gives the cumulative percentage of total spending/utilization in each setting. In countries closer to the diagonal 45° line the distribution of utilization/spending is more equally distributed amongst patients. The US, France and Spain show the smallest inequality in the distribution of index hospital days while Australia, England and Canada have the highest. Inequality in the total number of days in hospital is more pronounced than the index admission days in all countries except England and Australia. These inequalities do not appear to be always linked to the level of care utilization: while patients Australia and the US have on average similar number of days in hospital (Table 1), in Australia, 25% of CHF patients consume 70% of hospital days against around 45% of days in the US.

Concerning specialist visits, while inequality is high in all countries, Australia and New Zealand stand out. For primary care visits, France, Germany and Spain have more equal distributions compared to other countries. Canada and the US are the only two countries where inequality is greater in primary care rather than in specialist care utilization. Canada and the US have also, on average, the lowest number of primary care visits.[29]

The largest cross-country differences in care distribution are however for rehabilitation care, provided either at home or in a facility. For example, concerning days spent at a rehabilitation facility, Lorenz curves show that the upper 25% of the CHF patients concentrate more than 85% of days in a post-acute rehabilitation facility in France and the US. The US has a more equal distribution of community-based rehabilitation than France, but much higher inequality concerning home nursing care.

Inequalities in specialist spending with prescriptions, are more pronounced across all countries, but in the US primary care spending is also highly skewed. For example, For example, in Germany and France 25% of CHF patients concentrate 50% of primary care spending against 10% of patients in the US.. We also note that the US, which is in the middle position in terms of the distribution of specialist visits, primary care and prescription drugs, shifts to the high end of inequality when we examine spending in these care settings.

Differences in utilization and spending by sex

Figure 4 presents variations in care utilization and spending of female patients compared to male patients, on average, across nine countries, expressed as percentage differences. Individual country results are presented in Table 2.

Across the care pathways, we see some common differences in care utilization by sex. First, during the index hospitalization for heart failure, on average across countries, women have about 5% more days spent in hospital compared to men. This difference disappears when we look at the days spent in the hospital during the follow-up year.

Second, the number of specialist visits in the year after hospitalization is on average 10% lower for women. This difference in specialist visits is observed in all countries, except Australia and New Zealand, where there is no gender difference. In other countries, women have between 11% (in Canada, Germany, Spain and the US) and 20% (in England) fewer specialist visits than men. In Germany, France, Canada and the US women have a higher number of primary care visits while in other counties there is no gender difference in primary care utilization.

---- Insert Figure 3 here ---

Third, after hospitalization for CHF women use significantly more rehabilitation both at a post-acute facility and in the community, and also more nursing care at home (except in Spain).

Finally, we note that the gap between men and women is more pronounced in spending than in utilization. Variations in average spending reflect the differences in care utilization level but also convey something about the variations in the intensity of care or treatment patterns (type of medication, diagnostic tests, etc.). Interestingly, while women spend more days in hospital after admission, the spending for this care is about 8% less than for men. We observe the same pattern for facility-based rehabilitation and prescriptions, while women on average spend more days in a facility and receive more prescription drugs, they can have lower spending for these compared to men.

On the other hand, women have significantly higher spending for community-based rehabilitation (between 15% and 30% more), and have also higher home nurse spending mirroring the higher utilization rates.

---Insert Table 2 here---

Discussion

In this paper we show that patients with similar care needs may be treated differently within and across health care systems. Our results are complementary to the international comparisons of average spending, utilization and outcomes of patients with multimorbidity. Comparing care utilization and spending patterns in different care settings across countries is useful for understanding how resources are allocated across patients and questioning the appropriateness and efficiency of care provision. We find substantial within-country variations in care consumption, for a complex persona with heart failure and diabetes. We also find remarkable common differences in utilization and spending by sex across countries, with women utilizing less specialist care and more rehabilitation and home nursing care than men.

Our analysis of within country difference in care consumption show that treatment patterns vary across countries reflecting partly differences in care organization and financing. For example, in France equal share of patients use facility based and community based rehabilitation, while in Canada and the US a smaller proportion of patients use facility based care while more patients use community based rehabilitation. This reflects wide accessibility (financially and geographically) facility based rehabilitation in France, but questions the cost-efficiency of rehabilitation care.

Within country variations of different segments of the care pathway reflect differences in the supply of services, how they are paid but also organization and management of patient care. For example, the relatively high inequality for primary care utilization, compared with specialist utilization in the US and

Canada may be linked to relatively easier access to specialists in urban settings, but may also reflect a less central role of primary care providers in managing CHF patients.[30,31] On average, relative to the other countries, the US and Canada make less use of primary care relative to specialist care overall.[29] This may also reflect differences in policies aimed at strengthening access to primary care providers across countries. In France, for example, there are targeted programs for patients hospitalized for heart failure to encourage them to visit a primary care professional after discharge, to reduce readmission rates.[32]

Our results also show that disparities in health spending do not always mirror the disparities in care utilization. In many countries, inequalities in spending for outpatient specialists and drugs are higher than for utilization in these settings. The differences in drug spending may reflect differences in regulation of pharmaceutical prices across countries, but also differences in prescription patterns within a country, market penetration of generics and rules of access to publicly funded expensive new medications. European countries, where prices are regulated with similar tools, show smaller inequalities in drug spending as compared to the US and Australia. . Variations in specialist care spending reflect, beyond access, the variations in prices of visits and intensity of care. The higher inequality in specialist spending, compared to utilization, with Gini coefficients over 0.70 in Australia, Switzerland and the US, suggests that a small proportion of patients would cost much more than others for the same share of utilization.[33]

Furthermore, our results suggest that there are some common sex differences in care consumption across all countries. We find that women spend more days in the hospital at initial CHF admission (+5%), but this gap disappears when we look at the total number of days spent in the follow-up year. In all countries, women also have a higher number of prescriptions (+7%) and substantially more rehabilitation and home-based care. On the other hand, women have fewer visits to specialists (-10%), while there is either no difference in primary care visits or women have a slightly higher number of visits. Our results also show that the gap between men and women is more pronounced for spending than for utilization. On average across countries, in the year after CHF hospitalization, women spend nearly 8% less than men for hospital care, while there is no difference in the number of days spent in the hospital. The patterns of spending vary across countries for specialist care, but suggest that in some countries men use more expensive specialist care, or they receive more expensive diagnostic tests during outpatient visits. Similarly, despite women utilizing, on average, a higher number of prescription drugs, the spending for these drugs is lower than for men.

While some of these differences between men and women in care consumption reflect differences in biology, clinical needs and ,[34] different patient preferences, they can also reflect the influence of a gender bias, differences in social roles and care-seeking behavior.[35,17] Care providers can also have differential treatment of male and female patients. For example, in the United States it is shown that after accounting for illness behavior differences and all other factors, the odds of prescribed activity restrictions among female patients of male physicians is four times that of equivalent male patients of those physicians.[36]

Concerning CHF, clinical literature shows that the nature of cardiac symptoms experienced by women may differ from that of men, and it can be more difficult for patients and care providers to recognize or interpret these symptoms.[37-39] Some studies suggested that female patients with heart failure may have a lower propensity to receive guideline-indicated treatments.[40] In Australia, it is shown that women attending primary healthcare services were less likely than men to have risk factors measured to assess cardiovascular disease risk.[41]

Our results focusing on patients who were hospitalized for heart failure with diabetes complement these findings. The initial differences observed in index hospitalization days may also be explained by the initial delay in help-seeking behavior when experiencing symptoms. Women hospitalized for CHF may have more severe symptoms which may explain the higher rates of rehabilitation use by women. Further studies are needed to determine whether differences in utilization of certain services reported in our study are justified by differences in needs or may have consequences for health outcomes among women.

We should note some limitations of this study. Despite our efforts to ensure data comparability across countries, there are some differences in national coding and cost accounting practices, and data representativeness that may have influenced our results. Moreover, we were unable to determine whether the hospitalization was the first CHF encounter or a recurrent one or measure the degree of severity for the heart failure in our dataset, which is mostly administrative claims. However, the analysis of the patients' demographic characteristics and comorbidities across countries is reassuring and suggest that the average characteristics of patients across countries were comparable. Furthermore, we were not able to compare the entire care pathway across all countries, because the data on utilization or spending were missing for some care settings—particularly on post-acute and long-term care. While this does not constitute a major issue for our analysis focusing on within-country distribution at each setting, it is difficult to interpret the results on facility-based rehabilitation when data is missing on the alternative settings. Therefore, caution is called for in comparing differences across countries and genders in some care settings. Nevertheless, the linked data used in this study

are amongst the most comprehensive available for analyzing variations in care pathways at country level.

Conclusion

Our analysis show that while the distribution of healthcare spending and treatments provided in different care settings for patients with similar care needs vary within countries, there are also some common treatment patterns across countries. Despite the differences in care organization across countries there are also surprisingly similar gender disparities in care consumption.

While some variation in care consumption amongst patients is inevitable, international comparisons of within-country variations in care trajectories provide a unique way of benchmarking patientcare and questioning the performance of the health system. The inequalities observed may be accounted for by patients' clinical needs and care preferences, but they also indicate potential inefficiencies in care delivery, issues in access to services in different care settings or problems in managing care pathways for specific patient groups. Clinicians and health policy makers need to look into these differences in care utilization by sex and care setting to determine whether they are justified or indicate suboptimal care.

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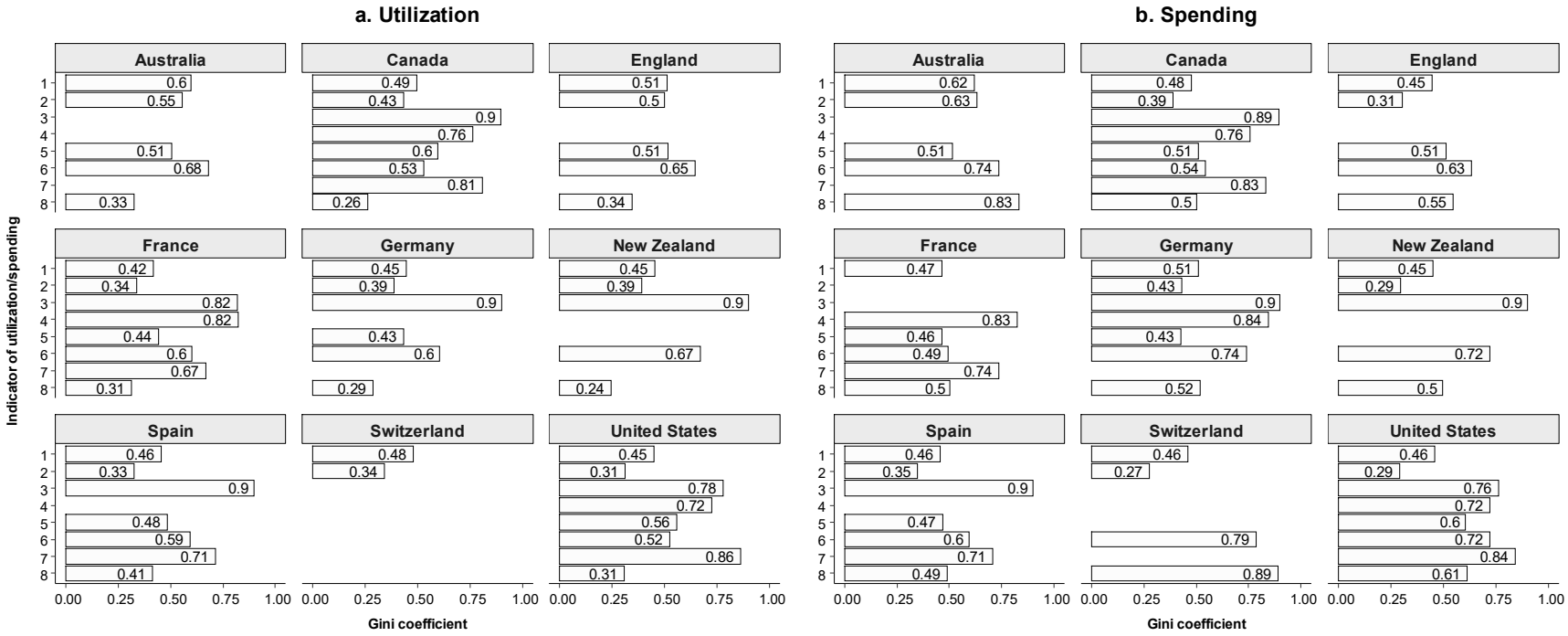
Main Figures

Figure 1: Gini coefficients for utilization and spending for patients with CHF and diabetes across eight segments of the care pathway in nine countries



1) Total Acute Hospital Care measured in a) days b) national currency units (NCU);
2) Index Acute Hospitalization a) days b) NCU; 3) Facility-based Rehabilitation a) days b) NCU;
4) Community/home-based Rehabilitation a) service days b) NCU; 5) Primary Care a) no. of visits b) NCU;
6) Specialist Care a) no. of visits b) NCU; 7) Home Nursing a) service days b) NCU; 8) Drugs a) no. of prescriptions b) NCU

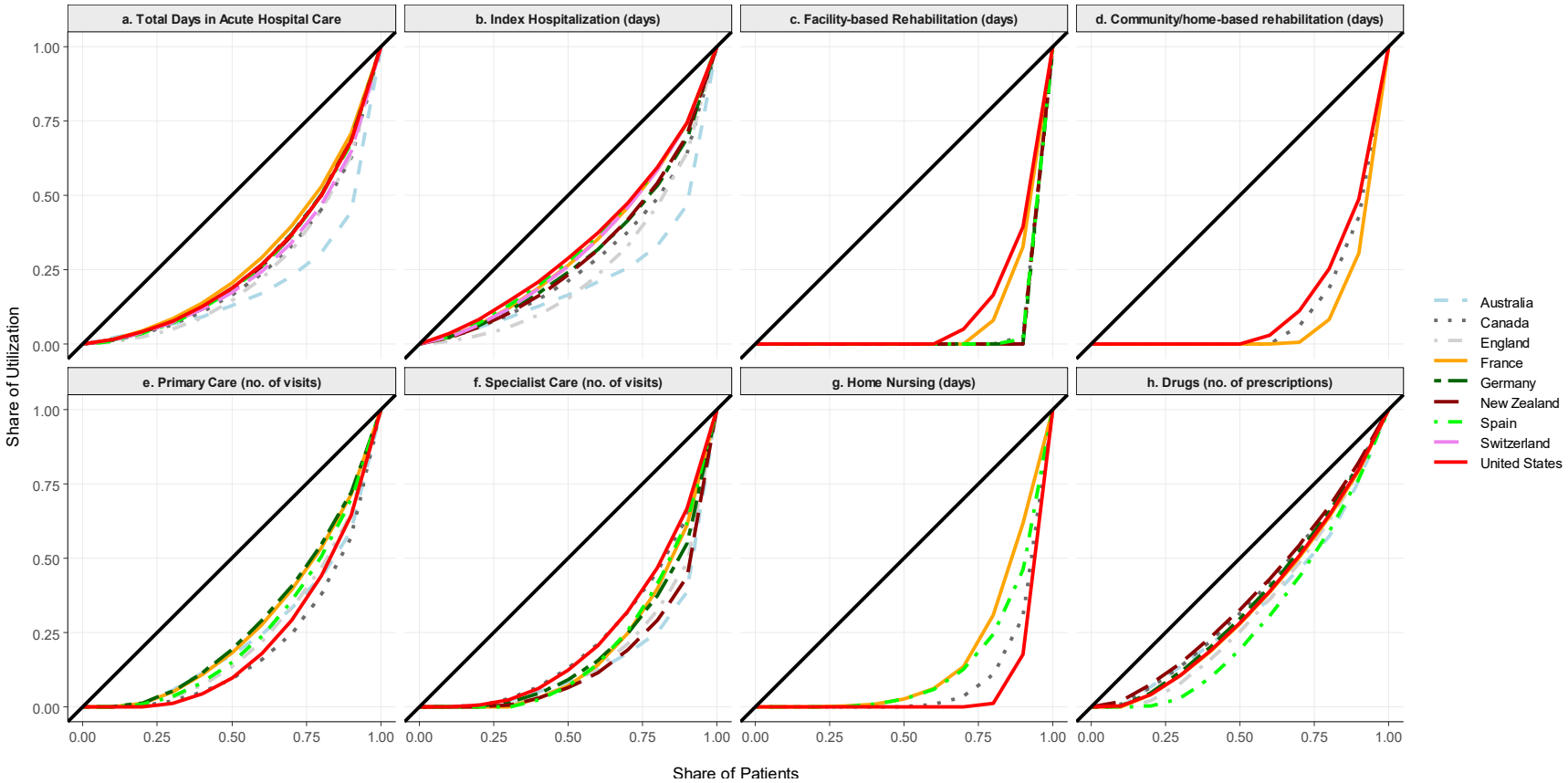
Notes:

Gini coefficients vary between 0 and 1. Higher the coefficient higher the inequality in distribution. For example, in the United States, prescription drugs and hospital days were more equally distributed amongst patients than home nursing days.

Analysis for Australia, Canada, and Spain is based on regional data from New South Wales, Ontario, and Aragon respectively.

Figure 2: Lorenz curves of distribution of healthcare amongst patients hospitalized with CHF and diabetes in 2016 across care settings and countries

2.1. Lorenz curves of distribution of healthcare utilization

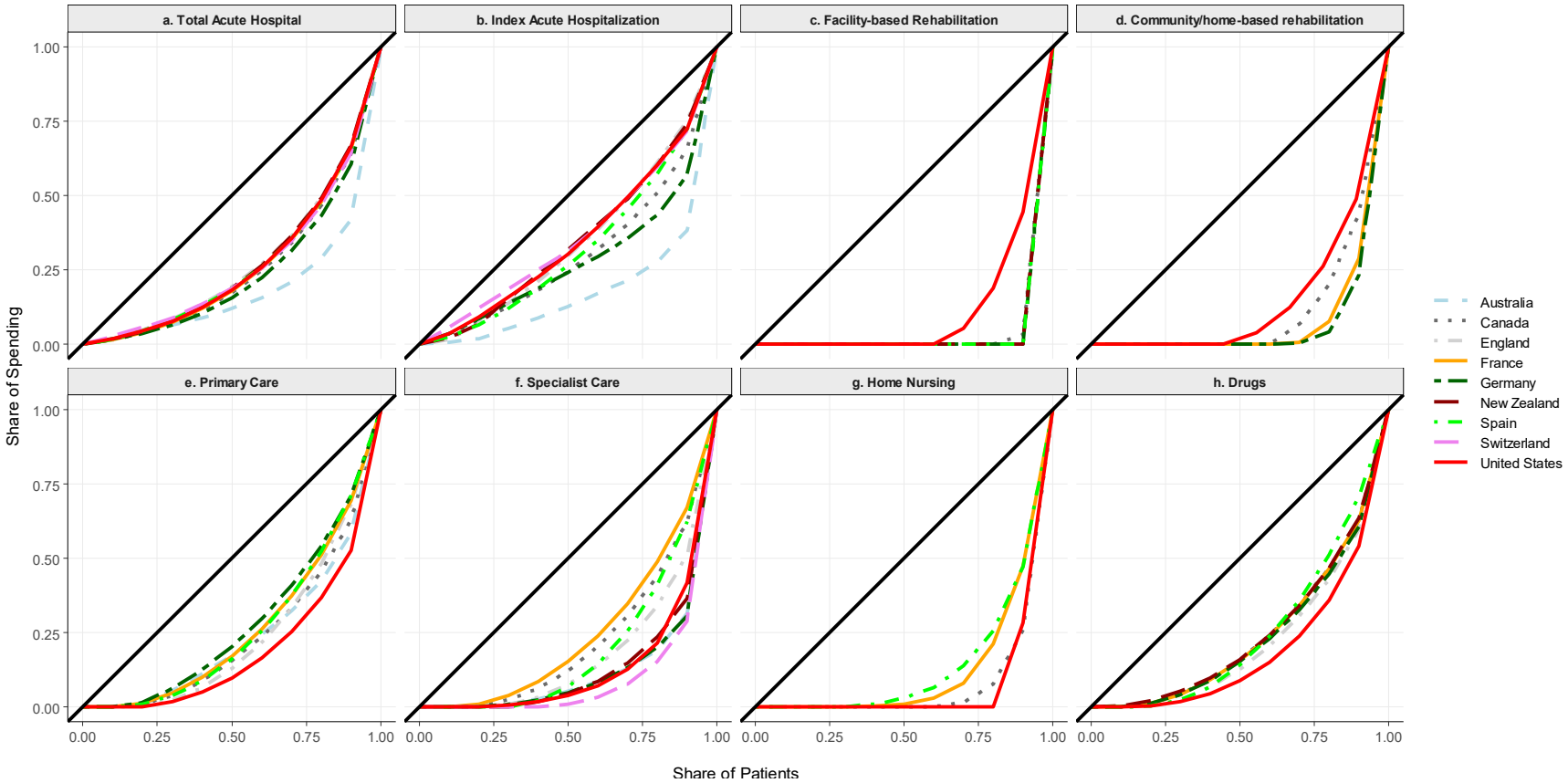


Notes:

The Lorenz curve shows the cumulative percentage of the cohort population (on the horizontal axis) against cumulative percentage of total care utilization ordered from those with the smallest amount of utilization to those with the highest (on the vertical axis). In a perfectly equal distribution, the Lorenz curve would follow the path of the 45° line of equality. The total number of days in Acute Hospitals are distributed similarly amongst patients in most countries except in Australia where about 10% of patients diagnosed with CHF and diabetes concentrate 50% of all the days spent at hospital.

Analysis for Australia, Canada, and Spain is based on regional data from New South Wales, Ontario, and Aragon respectively.

2.2. Lorenz curves of distribution of healthcare spending

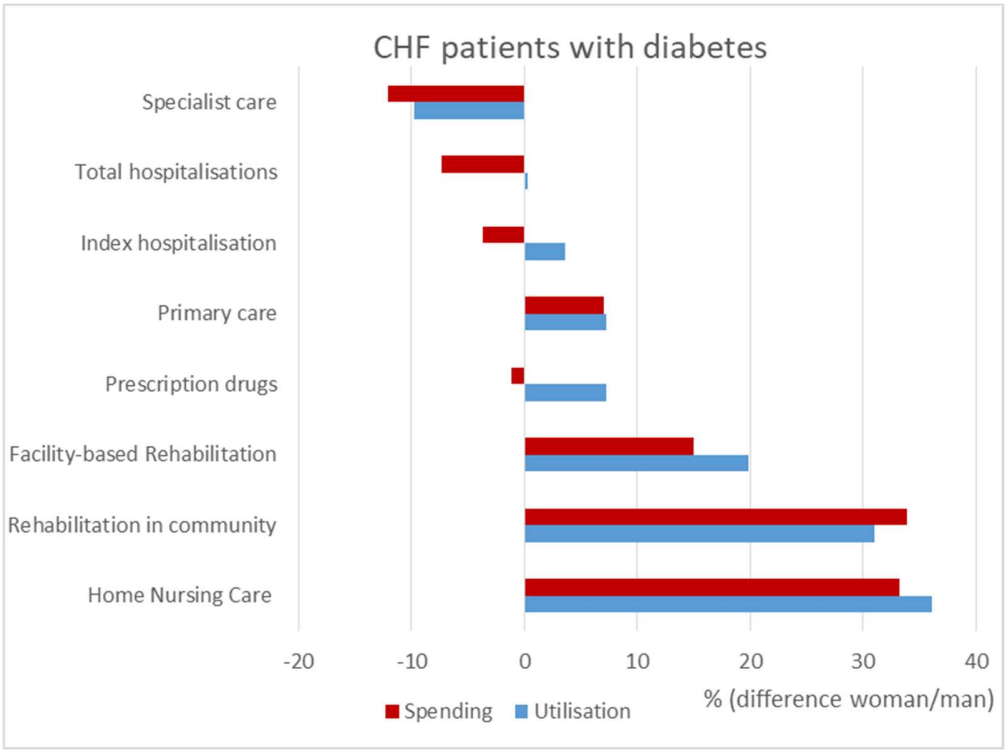


Notes:

The Lorenz curve shows the cumulative percentage of the cohort population (on the horizontal axis) against cumulative percentage of total spending ordered from those with the smallest amount of spending to those with the highest (on the vertical axis). In a perfectly equal distribution, the Lorenz curve would follow the path of the 45° line of equality. For example, in Germany and France 25% of CHF patients concentrate 50% of primary care spending while in the US 10% of patients concentrate 50% of the spending.

Analysis for Australia, Canada, and Spain is based on regional data from New South Wales, Ontario, and Aragon respectively.

Figure 3: The percentage difference in care utilization and spending between female and male patients hospitalized for CHF with diabetes (average across countries)



Notes: The average utilization/spending for female patients, across countries for which we have data, divided by the average for male patients multiplied by 100. Country averages by sex are standardized by the age structure of the US female population to account for differences in life expectancy between male and female cohorts. See table 2 for countries used in each setting. For example, on average women have 10% less specialist visits than men across the eight countries for which we have data (excluding Switzerland), the spending for these visits costs 12% less compared to men.

Analysis for Australia, Canada, and Spain is based on regional data from New South Wales, Ontario, and Aragon respectively.

Table 1: Standardized utilization and spending of patients hospitalized for congestive heart failure and have diabetes in nine countries (United States=1)[a]

	Indicator	Australia [b]	Canada [b]	England	France	Germany	New Zealand	Spain [b]	Switzerland	United States
Utilization	Acute Care Hospital (days)	1.02	1.39	1.27	1.75	1.78	1.01	1.43	1.39	1
	Index Hospitalization (days)	1.78	1.59	1.47	1.80	2.16	1.08	n/a	1.96	1
	Post-acute rehabilitation care at facility (days)	n/a	0.26	n/a	0.60	0.14	0.10	0.04	n/a	1
	Home or community-based rehabilitation (days)	n/a	0.06	n/a	0.33	n/a	n/a	n/a	n/a	1
	Primary care visits (no. of)	1.48	1.22	2.18	1.41	2.84	n/a	3.12	n/a	1
	Outpatient MD & diagnostic specialist care visits (no. of)	5.60	2.36	1.56	1.21	2.85	0.89	1.55	n/a	1
	Home Health Nurse Service (days)	n/a	0.76	n/a	4.93	n/a	n/a	0.46	1.74	1
	Prescription drugs (no. of)	0.80	1.14	0.98	1.41	0.93	1.16	0.90	n/a	1
Spending	Acute Care Hospital	n/a	0.88	0.36	0.73	0.70	0.43	0.48	0.72	1
	Index Hospitalization	1.01	0.95	0.45	n/a	0.85	0.45	n/a	1.07	1
	Post-acute rehabilitation care at facility	n/a	0.25	n/a	n/a	0.05	0.09	n/a	n/a	1
	Home or community-based rehabilitation	n/a	0.08	n/a	0.14	0.16	n/a	n/a	n/a	1
	Primary care	0.14	0.19	0.18	0.27	0.28	n/a	0.52	n/a	1
	Outpatient MD & diagnostic specialist care	0.18	0.23	0.24	0.26	0.27	0.18	0.15	0.34 [c]	1
	Home Health Nurse Service Days	n/a	1.24	n/a	3.66	n/a	n/a	0.74	n/a	1
	Prescription drugs	0.23	0.54	0.13	0.37	0.51	0.19	0.36	n/a	1

[a] Average care utilization/spending per patient by country, relative to the US. To account for differences in age and sex structure of patients across countries, the care utilization and spending is standardized using direct standardization approach and taking the age/sex structure of the US patient population as the reference. For example, in France patients hospitalized for CHF with diabetes spend 75% more days in hospital over the year after admission, compared to patients in the US. But the average hospital spending for these patients is 27% less in France than in the US.

[b] Data for Australia, Canada, and Spain correspond to New South Wales, Ontario, and Aragon regions respectively.

Table 2: Gender ratios of age-standardized utilization and spending by country (female/male)

	Indicator	Australia [a)]	Canada [a)]	England	France	Germany	New Zealand	Spain [a)]	Switzerland	United States
Utilization	Acute Care Hospital	1	1.05	1.05	0.98	1.02	1.01	0.87	0.99	1.05
	Index Hospitalization	1.07	1.09	0.99	1.03	1.05	1.01	..	1.02	1.03
	Post-acute rehabilitation care at facility	..	1.31	..	1.22	1.05	1.65	0.53	..	1.43
	Home or community-based rehabilitation	..	1.18	..	1.44	..	..	..	..	1.32
	Primary care	1.02	1.09	1.01	1.08	1.09	..	1.02	..	1.2
	Outpatient MD and diagnostic specialist care	1.01	0.89	0.8	0.83	0.89	1.01	0.89	..	0.89
	Home Health Nurse Service Days	..	0.87	..	1.32	..		1.96	..	1.3
	Prescription drugs	1.09	1.06	1.07	1.07	1.04	1.07	1.06	..	1.13
Spending	Acute Care Hospital	..	0.99	0.94	0.92	0.94	0.92	0.85	0.89	0.97
	Index Hospitalization	0.89	1.03	1	0.94	0.97	0.98	..	0.92	0.95
	Post-acute rehabilitation care at facility	..	1.3	..	..	1.08	1.53	0.52	..	1.3
	Home or community-based rehabilitation	..	1.17	..	1.42	1.43	..	..	..	1.33
	Primary care	1.04	1.07	1.04	1.08	1.08	..	1.11	..	1.06
	Outpatient MD and diagnostic specialist care	0.94	0.88	0.8	0.85	0.85	1.08	0.9	0.82[b)]	0.8
	Home Health Nurse Service Days	..	0.93	..	1.42	..	..	1.86	..	1.11
	Prescription drugs	1.1	1.02	1.13	0.95	1	1	0.97	0.57[b)]	1.17

Legend The average care utilization/spending of female patients divided by the average for male patients in each country and care setting. To account for the difference in age structure (life expectancy) of male and female patient populations, we employed a direct standardization approach using the age structure of the US female patient population as the reference population.

[a)] Analysis for Australia, Canada, and Spain is based on regional data from New South Wales, Ontario, and Aragon respectively.

[b)] Only outpatient drugs provided at the hospital. In general, about 50% of the overall outpatient specialist care is provided at hospital in Switzerland.