Inequality in 30-day mortality and the wait for surgery after hip fracture: the impact of the regional health care evaluation program in Lazio (Italy)

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Abstract

Objectives. Interventions that address inequalities in health care are a priority for public health research. We evaluated the impact of the Regional Health Care Evaluation Program in the Lazio region, which systematically calculates and publicly releases hospital performance data, on socioeconomic differences in the quality of healthcare for hip fracture.

Design. Retrospective cohort study.

Settings and participants. We identified, in the hospital information system, elderly patients hospitalized for hip fracture between 01 January 2006 and 31 December 2007 (period 1) and between 01 January 2009 and 30 November 2010 (period 2).

Main outcome measures. We used multivariate regression models to test the association between socioeconomic position index (SEP, level I well-off to level III disadvantaged) and outcomes: mortality within 30 days of hospital arrival, median waiting time for surgery and proportion of interventions within 48 h.

Results. We studied 11,581 admissions. Lower SEP was associated with a higher risk of 30-day mortality in period 1 (relative risk (RR) = 1.42, \( P = 0.027 \)), but not in period 2. Disadvantaged people were less likely to undergo intervention within 48 h than well-off persons in period 1 (level II: RR = 0.72, \( P < 0.001 \); level III: RR = 0.46, \( P < 0.001 \)) and period 2 (level II: RR = 0.88, \( P = 0.037 \); level III: RR = 0.63, \( P < 0.001 \)). We observed a higher probability of undergoing intervention within 48 h in period 2 compared with the period 1 for each socioeconomic level.

Conclusion. This study suggests that a systematic evaluation of health outcome approach, including public disclosure of results, could reduce socioeconomic differences in healthcare through a general improvement in the quality of care.

Keywords: hip fracture, socioeconomic status, outcomes, public disclosure

Introduction

Hip fracture injuries are identified as one of the most serious healthcare problems affecting older people. Consequently, much attention has been paid to comprehensive efforts to reduce the incidence and severity of this condition. Many studies have explored the associations among patient characteristics, treatment processes, time to surgery and different outcomes in patients hospitalized for hip fracture [1, 2]. Some of these studies found that patients with more comorbidities have a greater risk of postoperative complications and increased mortality [1]. Other studies have yielded conflicting results on the relationship between early surgery for hip fracture and survival [2]. The evidence of the association between socioeconomic position (SEP) and patient outcomes is controversial. Some studies have shown no effect of SEP on inpatient mortality [3] or waiting times for surgery [3–5]. In contrast, other studies have reported greater socioeconomic inequalities in the waiting times for surgery [6] and negative outcomes after hip fracture [6, 7]. Socioeconomic disparities in patient outcomes may be due to a variety of factors. One possible explanation is the differences in provision of care, but studies have not shown clear differences in diverse healthcare systems. In fact, healthcare disparities have been highlighted in both the USA [8] with health insurance and restricted public funding, and the UK [9], Canada [10], and many Western countries with universal healthcare systems [11, 12].
In Italy, where healthcare is publicly funded with universal access and comprehensive coverage under the National Health Service, inequalities in obtaining optimal care were recently reported [13–17]. In recent years, national and regional outcome research programs have been carried out [18–20]. The Regional Health Care Evaluation Program (P.Re.Val.E.) [19, 20] conducted in the Lazio region (5493308 residents [21]) elaborates and publicly releases 54 outcome and process indicators of hospital care in different clinical areas. The orthopaedic indicators measure quality of healthcare for elderly patients admitted for hip fractures in terms of mortality within 30 days, waiting time to surgery and proportion of interventions that occur within 48 h.

In a previous study, we found that lower SEP is associated with an increased risk of mortality and decreased proportion of interventions occurring within 30 days [16]. We hypothesized that public reporting of P.Re.Val.E. is associated with an improvement of quality indicators. The objective of the present study is to evaluate the change in 30-day mortality and wait for surgery after hip fracture over a 5-year period by SEP on behalf of the development of the PRe.Val.E. in the Lazio region.

Methods

Data sources

This study is based on the information from the Hospital Information System (HIS), the Healthcare Emergency Information System (HEIS) and the Mortality Information System (MIS) of Lazio (a central Italian region whose capital city is Rome). Discharge abstracts, from both public and private hospitals, are routinely collected by the HIS and contain patient demographic data (gender, age, place of birth and census block of residence for residents of Rome), admission and discharge dates, up to six discharge diagnoses (International Classification of Disease, 9th Revision, Clinical Modification [ICD-9-CM]), medical procedures or surgical interventions (up to 6) and status at discharge (alive, dead and transferred to another hospital). The HEIS collects all emergency department (ED)-visit records in the Lazio region, including information on patient characteristics, four categories of patient severity based on triage (red, yellow, green and white), main diseases, some clinical parameters, performed treatments and diagnoses at discharge (most information is codified according to ICD-9-CM).

The MIS lists places and causes of death coded according to ICD-9 for all deaths of residents of the Lazio region, as well as information on demographic characteristics.

Study population

We conducted a retrospective cohort study of patients aged at least 65 years who were residents in Rome and admitted to an acute care hospital for a hip fracture (ICD-9-CM diagnosis codes 820.0–820.9 in any position) between 1 January 2006 and 31 December 2007 (period 1) and between 1 January 2009 and 30 November 2010 (period 2). We excluded hospitalizations for hip fracture in 2008 because it was a transition period in which the regional health care evaluation program was developed in the Lazio region. We excluded patients according to the following criteria, those who were hospitalized for hip fracture in the previous 2 years; were transferred from another acute care hospital or ED (patients admitted to a given ED or hospital for hip fracture and coded as ‘transferred from’ other unidentified acute care facility or ED); had multiple significant trauma (DRGs 484–487); had a principal or secondary diagnosis of malignant neoplasm (codes 140.0–208.9) in the index admission (current admission for hip fracture) or in previous hospitalizations during the last 2 years.

Outcomes

We defined three different outcomes.

(1) Mortality within 30 days of hospital arrival for hip fracture. Deaths during the study period were identified using both the HIS (discharge disposition: death) and MIS.

(2) Intervention within 48 h (0–1 day) of hospital arrival. Date of hospital arrival corresponded to the date of the index or ED admission.

(3) Waiting time for surgery. When we considered the last two outcomes, we excluded patients if they were directly admitted to intensive care units or died within 48 h of admission without intervention (patients who could have not have undergone surgery due to poor baseline clinical conditions).

The interventions were identified by the following ICD-9-CM codes: total or partial hip replacement codes 81.51 and 81.52, and reduction of fracture codes 79.00, 79.05, 79.10, 79.15, 79.20, 79.25, 79.30, 79.35, 79.40, 79.45, 79.50 and 79.55.

Index of SEP

SEP was the primary-independent variable. We used a city-specific index constructed for Rome based on census data aggregated at the level of the census tract of residence.

Detailed construction of this index has been described elsewhere [17, 22]. To obtain categorical values for the aggregate indicator of SEP, the quintiles from the distribution by census tract were calculated. We combined quintiles 2–4 to highlight the differences between the extreme categories, as the middle ones may be misclassified. Therefore, we defined three levels of SEP: I (high), II (intermediate) and III (low) [16]. The city-specific index was assigned to patients on the basis of location of residence at discharge.

Comorbidities

The risk factors potentially associated with the outcomes being studied were chosen from among the conditions
identified in the literature [1, 2, 6]. Comorbidities were identified on the basis of ICD-9-CM codes registered in either the index hospitalization or previous hospital or ED admissions during the last 2 years [16, 17]. Acute events that occurred during the index admission that could be complications of care were not included. Details and ICD-9-CM codes are reported in the Appendix 1.

Statistical analysis

Crude 30-day mortality rates, median waiting times for hip surgery and proportion of interventions performed within 48 h were calculated. We used multivariate regression analysis to assess the effect of SEP on 30-day mortality and chance of intervention within 48 h of hospital arrival, adjusting for other factors (age, gender and comorbidities) that could affect the outcomes being studied. Among all factors potentially associated with the outcomes, age and gender were considered a priori risk factors; the others were selected by a stepwise bootstrap procedure to assign an importance rank for predictors in logistic regression. In this approach, the logistic regression with all predictors was run 100 times on random samples drawn with replacement from the original data set. Only the risk factors identified at least 30 times as significant ($P \leq 0.05$) were included in the predictive model.

To estimate the adjusted 30-day mortality and intervention within 48 h of hospital arrival, a multivariate logistic regression analysis with no intercept and including centred covariates and an interaction term between SEP and study period was applied.

This model estimates log odds of 30-day mortality and intervention within 48 h by SEP. Adjusted proportions were obtained for each level of SEP by back-transforming parameter estimate using the following formula [23].

$$\text{Adj proportion} = \frac{\exp(\text{estimate})}{(1 + \exp(\text{estimate}))} \times k,$$

Where $k$ is a correction coefficient introduced to take into account the non-linear nature of the logistic model.

$K$ is calculated as follows:

$$K = \frac{\text{actual number of events}}{\sum_{j=1}^{m} p_j \times n_j},$$

Where $p_j$ is the adjusted proportion, $n_j$ is the group size and $m$ is the number of groups.

This method allowed the estimation of relative risk (RR) instead of odds ratio, which is not a good approximation of RR in the case of common (non-rare) events.

RR by SEP was estimated to compare the 30-day mortality and proportion of intervention within 48 h between periods 1 and 2. To estimate median waiting times for surgery by SEP, adjusted survival curves obtained from a stratified Cox model were calculated, as, after testing, the proportionality assumption did not hold. All statistical analyses were performed using SAS Version 9.2.

Results

The main characteristics of the study population in both periods are shown in Table 1. We studied a total of 11 581 admissions for hip fracture in Rome, comprising 5880 in period 1 and 5701 in period 2. The mean age was 82.5 (SD: 7.3) years in period 1 and 83.1 (SD: 7.1) years in period 2. The proportion of females varied from 78.2 to 77.7%.

Patient characteristics, including distribution by SEP, were essentially similar in both periods (Table 1).

The crude 30-day mortality after hip fracture was similar in both periods (7.7 and 7.7% in periods 1 and 2, respectively), the crude proportion of intervention performed within 48 h was higher in period 2 compared with period 1 (13.9 and 20.3%, respectively) and the wait for surgery after hip fracture was shorter in period 2 compared with period 1 (median 7 and 6 days, respectively, Table 2).

Tables 3 and 4 report the results of the association between SEP and 30-day mortality, intervention within 48 h and wait for surgery. We found that lower SEP (level III) was significantly associated with a higher risk of 30-day mortality, even after controlling for patient characteristics such as age, gender and comorbidities (adjusted RR = 1.42; $P = 0.027$) in period 1. Conversely, no significant differences between SEP levels were found in period 2 (Table 3). Comparing the adjusted proportion in period 2 to the adjusted proportion in period 1 by SEP, we observed a lower risk of 30-day mortality in period 2, mainly in level III (adjusted RR = 0.77, $P = 0.130$).

As shown in Table 3, people in socioeconomic levels II and III were less likely to undergo intervention within 48 h.
compared level I (level II: adjusted RR = 0.72, \( P < 0.001 \); level III: adjusted RR = 0.46, \( P < 0.001 \)) in period 1. In period 2, we observed a lower probability of undergoing intervention within 48 h in disadvantaged persons (levels II and III) compared with the most privileged persons in level I (level II: adjusted RR = 0.88, \( P = 0.037 \); level III: adjusted RR = 0.63, \( P < 0.001 \)).

We observed a higher probability of undergoing intervention within 48 h in period 2 than in period 1 by socioeconomic level (level I: adjusted RR = 1.27, \( P = 0.002 \); level II: adjusted RR = 1.54, \( P < 0.001 \); level III: adjusted RR = 1.74, \( P < 0.001 \)).

Small differences were found in the adjusted waiting times for surgery in period 1, ranging from 7 days for the individuals in level I to 8 days in level III, and period 2, and ranging from 5 days in level I to 6 days in level III (Table 4).

### Discussion

We found no differences in overall 30-day mortality after hip fracture between the two periods, but the low socioeconomic group (level III) had a significantly higher risk of 30-day mortality in period 1 compared with level I. This socioeconomic difference seems to have disappeared in period 2. We observed a higher proportion of interventions performed within 48 h in period 2 compared with period 1, and the socioeconomic difference observed in period 1 decreased in period 2.

Our results seem to confirm the hypothesis that public reporting is associated with an improvement of quality indicators and suggest an indirect effect on reducing social inequality. In 2007, PRe.Val.E. [19, 20] was launched with the aim of improving the quality of healthcare. The PRe.Val.E. indicators are periodically updated and discussed with managers and clinicians. In particular, in 2008—the year between the two examinations in this study—data about quality in orthopaedic surgery were published and deeply discussed with surgeons and health care providers. The impact of the PRe.Val.E. on the quality of healthcare for orthopaedic patients compared with other Italian regions was evaluated in a recent study [24]. Moreover, in 2008 the Agency for Public Health of Lazio designed a clinical pathway for elderly patients with hip fracture, and in 2009 a regional law required Lazio hospitals to adopt a clinical pathway for elderly patients with hip fracture, introducing a compensation system for hospitals based on the quality of healthcare. The awareness of orthopaedic surgeons for the need to improve the quality of hospital care for patients with hip fracture increased in that period. A number of initiatives of in-hospital ‘clinical audit’ were carried out to find out the critical points in care. Organizational problems leading to unexpectedly high waiting times were found in many hospitals and a number of procedures were set up to reduce time to surgery. The reduction of the proportion of patients who waited >48 h before surgery between the two periods suggests that a better organization of in-hospital care may have played a substantial role in this result. Unfortunately, given the before–after study design without a comparison group, we were not able to quantify the role of other potential unmeasured factors that have been changed over time and may have had a role in improving care and reducing disparities.

The lack of improvement in the 30-day mortality in the second period, in spite of the reduced proportion of patients waiting >48 h to surgery, is not a surprising result. In fact, the estimated improvement in outcome indicators attributable to process improvement is not consisted across studies [25, 26] and the complex relationship between process and outcomes indicators is still a matter of concern.

Our study contribute to the debate on the role of publicly releasing performance data in improving quality of care. Rigorous evaluation of many major public reporting systems is lacking. Evidence suggests that public reporting stimulates quality improvement activity at the hospital level, but its effect on effectiveness, safety and patient-centeredness remains uncertain. Even though, Fung et al. [27] found evidence for the conclusion that public reporting stimulates improvements in hospital quality, Jung et al. found that the public release of quality information may lead to improvements in quality. Moreover, the improvement after public reporting is not universal across all quality measures. In particular, the disclosure has positive effects on the quality of chronic care services [28].

Tackling health inequalities is one of the priority areas of the health policy agenda for developed and developing countries [29]. Though health behavioural risk factors and environmental exposures are the main causes of poor health among socially disadvantaged people, a role of health care systems in the widening health gap has been shown [30, 31]. Even in countries with universal coverage, such as Italy, a gap in health care quality, especially in terms of the homogeneous use of effective care for various conditions and settings, has been documented [15, 32, 33]. In a recent review, health inequalities and its social determinants across Europe, together with policies to address social determinants of health, have extensively been examined [29]. However, no
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<td>Adjusted percentage</td>
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<td>I (high)</td>
<td>1324</td>
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<td>7.52</td>
<td>7.27</td>
<td>1.01</td>
<td>0.94</td>
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<td>898</td>
<td>9.02</td>
<td>9.54</td>
<td>1.42*</td>
<td>916</td>
<td>7.21</td>
<td>7.37</td>
<td>1.02</td>
<td>0.77</td>
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<tr>
<td>Intervention within 48 h&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>I (high)</td>
<td>1319</td>
<td>18.95</td>
<td>18.57</td>
<td>1.00</td>
<td>1241</td>
<td>23.93</td>
<td>23.58</td>
<td>1.00</td>
<td>1.27</td>
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<td>II (intermediate)</td>
<td>3592</td>
<td>13.39</td>
<td>13.42</td>
<td>0.72*</td>
<td>3474</td>
<td>20.61</td>
<td>20.70</td>
<td>0.88*</td>
<td>1.54</td>
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<td>III (low)</td>
<td>891</td>
<td>8.42</td>
<td>8.50</td>
<td>0.46*</td>
<td>909</td>
<td>14.30</td>
<td>14.78</td>
<td>0.63*</td>
<td>1.74</td>
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<sup>a</sup>Percentage and RR adjusted for: age, gender, nutritional deficiencies, nutritional deficiencies current admission (CA), obesity, obesity CA, dementias, other forms of chronic ischaemic heart disease, cardiomyopathy, cardiomyopathy CA, cardiac arrhythmias, heart failure, ill-defined descriptions and complications of heart disease, cerebrovascular disease, cerebrovascular disease CA, COPD, chronic renal disease, chronic renal disease CA, other chronic disease, other chronic disease CA.

<sup>b</sup>Percentage and RR adjusted for: age, gender, obesity, blood disorders, blood disorders current admission CA, dementias, dementias CA, previous myocardial infarction, other forms of chronic ischaemic heart disease, cardiac arrhythmias, ill-defined descriptions and complications of heart disease, other heart conditions, cerebrovascular disease, cerebrovascular disease CA, vascular disease, chronic renal disease, chronic renal disease CA, rheumatoid arthritis, rheumatoid arthritis CA.

<sup>*</sup>P-value < 0.05.
definitive evidence exists on effective interventions for reducing inequalities in health care in the context of the different European health systems. In a qualitative analysis in England, various strategies implemented to reduce the gap in health care outcomes across populations at the level of local authorities have been discussed. For cardiovascular disease, six factors were associated with narrowing, among them the location of a primary care trust budget near the target, smoking cessation services and presence/absence of a few major programmes [34]. Effective strategies to reduce the inequalities in health care depend on the political context and organization of the health system in each country. Despite the evidence of inequalities in health care in Italy, no systematic national programmes have been put in place to monitor and reduce the differential in care access and outcomes.

Several studies have evaluated the relationship between SEP, waiting times and outcomes after total hip replacement surgery [5, 14, 35–37]. In general, more socioeconomically disadvantaged people experience longer waiting times [35, 36] and worse outcomes [14, 37]. However, little is known about the effect of social factors on short-term mortality and time to surgery after hip fracture. Many studies have demonstrated the advantages of early surgery in hip-fracture patients [6, 38, 39], but few have evaluated the relationship between the timing of hip-fracture surgery and the level of socioeconomic deprivation [3, 6, 16].

The strengths of this study include the before–after design, the large data sample available for analysis, the validated algorithm for cohort selection and variable definitions and the robust outcomes. Some limits should be considered. The study is based on administrative data and, despite their broad and valued use as a source for healthcare research, hospital discharge data have several limitations that have been recognized repeatedly [40]. In addition, although several covariates were included in the models to adjust for differences in patient characteristics, immeasurable or unmeasured covariates that could affect the risk of 30-day mortality and intervention within 48 h may not have been taken into account. However, different coding practises across hospitals and misclassification of comorbidity are unlikely to be associated with socioeconomic status. Time to surgery was computed based on the dates of hospital arrival and surgery and was not refined to the actual hour of admission and surgery.

Another potential limitation is the use of area-based indices as a proxy for individual traits that could lead to a misclassification of individual SEP [41]. This problem has already been observed [42], even though the small area indicator is considered to be a good proxy for individual data [43]. However, using a small area-based index of SEP could capture the characteristics of the area that are not captured using an individual index. Because the census tracts in Rome are rather small (average population: 500 inhabitants), the misclassification effect, if any, is likely to be low. As a consequence, attributing an aggregated indicator to the individual can underestimate the true association [42].

In conclusion, this study contributes to the debate on effective strategies for tackling inequality in health and suggests that a systematic evaluation of health outcomes that includes

<p>| Table 4: Association between socioeconomic position and wait for surgery in periods 1 and 2 |</p>
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<tr>
<td>(n admissions)</td>
<td>(median waiting time (days))</td>
<td>(median waiting time (days))</td>
<td>(median waiting time (days))</td>
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<td>(median waiting time (days))</td>
<td>(median waiting time (days))</td>
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<tr>
<td>Period 1</td>
<td>Period 2</td>
<td>Period 1</td>
<td>Period 2</td>
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<tr>
<td>I (high)</td>
<td>1319</td>
<td>89.76</td>
<td>6</td>
<td>7</td>
<td>1241</td>
<td>91.38</td>
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<tr>
<td>II (intermediate)</td>
<td>3592</td>
<td>87.25</td>
<td>7</td>
<td>8</td>
<td>3474</td>
<td>92.63</td>
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<tr>
<td>III (low)</td>
<td>891</td>
<td>85.41</td>
<td>8</td>
<td>8</td>
<td>909</td>
<td>92.74</td>
</tr>
<tr>
<td>aAdjusted for: age, gender, diabetes, nutritional deficiencies, current admission (CA), blood disorders (BD), dementia (DA), Parkinson’s disease (PD), cerebrovascular disease (CVD), vascular disease (VD), rheumatoid arthritis (RA).</td>
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public disclosure of results could reduce the socioeconomic differential in health care through a general improvement in the quality of care.

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Authors’ contributions

C.P.: study conception and design, data analysis, interpretation of data; A.N.: study conception and design, interpretation of data; E.D.: study design, data analysis, interpretation of data; P.L.: study design, interpretation of data; S.C.: data analysis; P.C.A.: study conception and design, interpretation of data; D.M.: study conception and design, interpretation of data and all the authors read and approved the final manuscript.

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References


### Appendix 1  List of comorbidities used for risk adjustment

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<th>Risk factor</th>
<th>ICD-9-CM code</th>
<th>Previous hospital or ED admissions</th>
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<tr>
<td>Diabetes</td>
<td>250.1–250.9</td>
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<tr>
<td>Nutritional deficiencies</td>
<td>260–263, 783.2, 799.4</td>
<td>260–263, 783.2, 799.4</td>
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<tr>
<td>Obesity</td>
<td>278.0</td>
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<tr>
<td>Dementias including</td>
<td>290.0–290.4, 294.1, 331.0</td>
<td>290.0–290.4, 294.1, 331.0</td>
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<tr>
<td>Alzheimer's disease</td>
<td>332</td>
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<tr>
<td>Hemiplegia and other paralytic syndromes</td>
<td>342, 344</td>
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<tr>
<td>Hypertension</td>
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<tr>
<td>Previous myocardial infarction</td>
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<td>410, 412</td>
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<td>Other forms of chronic ischaemic heart disease</td>
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<tr>
<td>Heart failure</td>
<td>428</td>
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<tr>
<td>Ill-defined descriptions and complications of heart disease</td>
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<td>Rheumatic heart disease</td>
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<td>Cardiomyopathy</td>
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<tr>
<td>Acute endocarditis and myocarditis</td>
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<td>Other heart conditions</td>
<td>745, V15.1, V42.2, V43.2, V43.3, V45.0</td>
<td>745, V15.1, V42.2, V43.2, V43.3, V45.0</td>
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<td>COPD</td>
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<td>Chronic renal disease</td>
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<td>Other chronic disease (liver, pancreas and intestine)</td>
<td>571–572, 577.1–577.9, 555, 556</td>
<td>571–572, 577.1–577.9, 555, 556</td>
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<td>Rheumatoid arthritis and other inflammatory polyarthropathies</td>
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<td>714</td>
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<tr>
<td>Osteoporosis and other disorders of bone and cartilage</td>
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