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ORIGINAL ARTICLE

Increased registration of hypertension and cancer diagnoses after the introduction of a new reimbursement system

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Abstract

Objective. To investigate the impact on ICD coding behaviour of a new case-mix reimbursement system based on coded patient diagnoses. The main hypothesis was that after the introduction of the new system the coding of chronic diseases like hypertension and cancer would increase and the variance in propensity for coding would decrease on both physician and health care centre (HCC) levels. *Design*. Cross-sectional multilevel logistic regression analyses were performed in periods covering the time before and after the introduction of the new reimbursement system. *Setting*. Skaraborg primary care, Sweden. *Subjects*. All patients (n = 76 546 to 79 826) 50 years of age and older visiting 468 to 627 physicians at the 22 public HCCs in five consecutive time periods of one year each. *Main outcome measures*. Registered codes for hypertension and cancer diseases in Skaraborg primary care database (SPCD). *Results.* After the introduction of the new reimbursement system the adjusted prevalence of hypertension and cancer in SPCD increased from 17.4% to 32.2% and from 0.79% to 2.32%, respectively, probably partly due to an increased diagnosis coding of indirect patient contacts. The total variance in the propensity for coding declined simultaneously at the physician level for both diagnosis groups. *Conclusions*. Changes in the healthcare reimbursement system may directly influence the contents of a research database that retrieves data from clinical practice. This should be taken into account when using such a database for research purposes, and the data should be validated for each diagnosis.

Key Words: *Electronic health records, general practice, ICD codes, incentive, multilevel analysis, primary health care, reimbursement, Sweden*

Background

During the last decade, primary care in Sweden has been subject to considerable financial changes. In 2003 a decentralized drug budget was implemented in Skaraborg. In a previous study [1] we demonstrated that this change in economic prerequisites was associated with an increased adherence to prescribing recommendations.

In October 2009 the county authorities introduced the "Västra Götaland Primary Care" (VGPV) [2], involving a reform of the reimbursement system. In the new system resources are allocated according to a capitation formula based on the patient's age, gender, and a case-mix index inspired by the Johns Hopkins University Adjusted Clinical Groups (ACG) system [3]. This index is based on patient diagnoses coded according to the International Classification of Diseases (ICD). Codes for chronic diseases render higher reimbursement than codes for minor problems. Previous studies have shown that the method of payment affects the clinical practice behaviour of physicians [4]. The personal remuneration to the physician is not directly affected by the VGPV system. However, the general budget of the health care centres (HCCs) does depend on recorded ICD codes, and a decrease in the budget may lead to staff cuts. Consequently, the introduction of the VGPV system has introduced a strong economic incitement for coding, especially for chronic diseases.

Using the Skaraborg Primary Care Database (SPCD) [5] and multilevel regression analyses we investigated the impact of the new VGPV system on

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Introducing a new reimbursement system based on patient diagnoses at all consultations:

- increased registration of diagnoses of chronic diseases like hypertension and cancer;
- decreased the variation in diagnosis coding between physicians;
- seemed to be a powerful intervention for increasing the recording of diagnosis codes.

ICD coding behaviour. Our main hypothesis was that after the introduction of the new system the prevalence of coded chronic diseases like hypertension and cancer would increase in the SPCD. Furthermore, as all HCCs and physicians shared the same new incentives the variance in propensity for coding would be expected to decrease on both HCC and physician levels. We also investigated the levels of ICD code registration in the SPCD, a database that was previously used for research in primary health care [5–8].

Material and methods

Skaraborg is situated in the south-west of Sweden and populated by 250 000 inhabitants. Since 1998 it has administratively been part of the Västra Götaland Region with 1.6 million inhabitants. Before the new VGPV system, primary care in Skaraborg was supplied by 24 public HCCs and a few private general practitioners and after VGPV by 22 public and 11 private HCCs. Since 2000, all public HCCs in Skaraborg have shared the same computerized medical record system (Profdoc Journal III 1.82), allowing the construction of the SPCD containing information extracted from these records [5].

Population

Datasets from five consecutive one-year time periods were extracted from the SPCD. The datasets contained all patients 50 years of age or older who had visited any of the 22 public HCCs. The first three periods represent the baseline (Figure 1). During the fourth period the forthcoming change in the reimbursement system became known (see Figure 1, A) but it was not officially introduced until the start of the last period, 1 October 2009 (see Figure 1, B).

Assessment of variables

All diagnoses are coded using the Swedish primary care version of ICD-10 [9]. We chose to study *hypertension* (ICD I10-, I13-P, I15-) since it is a well-defined chronic disease, and *cancer* (C00-C96-P) since it represents a group of diagnoses with low registration rates in primary care. The outcome was a dichotomous variable indicating whether a patient had a hypertension or cancer code registration in the diagnosis register or not, during each time period. Patients' sex (with women as reference) and age (centred at the mean of 68 years) were also included. For each patient and time period we identified the physician with the majority of patient contacts. Contacts were defined as direct (visits) or indirect (telephone consultations, prescription renewals, or administrative journal recordings). For comparison, the total number of registered tonsillitis (J03-) diagnoses was also determined in order to estimate

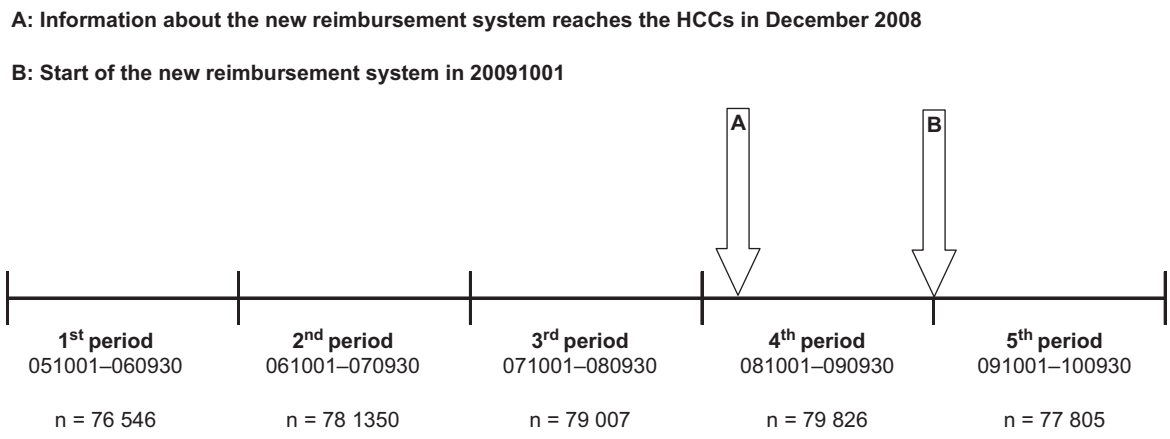


Figure 1. Relationship between the five consecutive data periods and the change in reimbursement system with numbers of patients included in each analysis. The first three periods represent the baseline, and were defined as 1 October 2005–30 September 2006 (1st period), 1 October 2006–30 September 2007 (2nd period) and 1 October 2007–30 September 2008 (3rd period). During the 4th period from 1 October 2008 the forthcoming change in reimbursement system became known but was not officially introduced until the start of the 5th period on 1 October 2009.

potential changes in the registration of an acute diagnosis with low reimbursement value.

Multilevel logistic regression analysis

Because of the hierarchical structure of the data we performed multilevel logistic regression analysis (MLA) [10,11] with patients nested within physicians who in turn were nested within HCCs. Like any regression analysis, MLA produces regression coefficients. However, because MLA also recognizes to which level the included variables belong, the total variance is partitioned to the relevant level. Thus, the relative importance of each level for ICD coding [12] could be quantified.

For cancer and hypertension diagnoses separate analyses were performed for each time period in order to observe changes in prevalence and variance over time. To study associations in the fixed effects part of the MLA we calculated prevalences and ORs (odds ratios) and their 95% credible intervals (95% CIs).

In the random part of the model we used the variances to calculate the intra-class correlation (ICC) [11,13]. The ICC estimates the proportion of the total variance that can be attributed to a specific level. We calculated ICC as follows:

$$ICC_{PHY} = (VAR_{HCC} + VAR_{PHY}) / (VAR_{HCC} + VAR_{PHY} + VAR_P)$$

$$ICC_{HCC} = (VAR_{HCC}) / (VAR_{HCC} + VAR_{PHY} + VAR_P)$$

Where

VAR_{PHY} = Physician level variance
VAR_{HCC} = HCC level variance
VAR_P = Patient level variance
ICC_{PHY} = Physician level ICC
ICC_{HCC} = HCC level ICC

In the hypertension datasets the variances were calculated with the logit Link where the $VAR_P = 3.29$. However, because of the low prevalence in the Cancer datasets we used the probit link to calculate the variances, and the $VAR_P = 1$ [11].

Parameters were estimated using the MLwiN software [14].

Results

Descriptive analysis

The numbers of patients in each dataset from the five time periods were similar (between 76 546 and 79 826) with an overall mean age of 68 years (Table I). When comparing the mean of the first three time periods with the last time period, the prevalence of hypertension in SPCD increased from 17% to 33%, equally distributed between sexes. Prevalence of cancer diagnoses increased from 1.5% to 3.9% but with higher rates for men. Simultaneous rises in the total number of registered diagnoses (183 052 to 327 781) and in the proportion of coded indirect (13% to 24%) and direct contacts (81% to 93%) were also shown. The number of registered tonsillitis diagnoses remained approximately the same in all five time periods (data not shown).

Multilevel analysis

Table II shows that the adjusted prevalence of hypertension diagnoses increased from 17.4% to 32.2% between the mean of the first three and the last time period with no evident difference between sexes. In the same way, adjusted prevalence for cancer diagnoses increased from 0.79% to 2.32%. Here we can observe a clear and stable difference over time between sexes with ORs around 1.6 for men. Figure 2 shows the rise in age-adjusted prevalence of hypertension in the SPCD, and also the simultaneous decline in ICC on both HCC and physician level in the last two periods. For cancer diagnoses (Figure 3) there was a rise in prevalence and a decline in ICC at the physician level, but not at the HCC level.

Discussion

The main finding is that following the change of reimbursement system a clear rise in diagnosis prevalence of hypertension and cancer was observed, together with a simultaneous decline in the variation in diagnosis coding, especially at the physician level. The new practice behaviour was rather general since the clustering of possible practices habits (expressed by the ICC) were less important at the end of the study period. This study also shows that the change in diagnosis coding started when the forthcoming new reimbursement system became known, and accelerated after the implementation.

Even though we have previously shown a rather good registration rate of hypertension in the SPCD database [5], the current study demonstrates a nearly twofold rise in yearly hypertension diagnosis prevalence. This is probably due to the increased coding of indirect patient contacts. Similarly, the observed rise in cancer registration is probably also due to a shift in registration practice. Cancer diagnoses, usually established in hospital care, are most likely registered in the HCC records to a higher degree than before.

Table I. Characteristics of patients 50 years of age and older with hypertension and/or cancer diagnoses, contacts and HCCs in the Skaraborg Primary Care Database (SPCD) for the different time periods.[1]

Time period	051001–060930	061001–070930	071001–080930	081001–090930	091001–100930
Characteristics of the 22 HCCs:					
Patients (n)	76 546	78 350	79 007	79 826	77 805
Median	3186	3456	3535	3470	3310
Range	1226–7699	1241–7687	1207–7789	1242–7962	1276–7319
Physicians (n)	554	489	589	627	468
Median	19	17	23	23	20
Range	3–77	4–71	5–87	5–81	8–42
Characteristics of patients:					
Age (years)					
Mean	68.0	68.0	68.1	68.1	68.3
Range	50–106	50–107	50–108	50–108	50–109
Sex					
Female	42 266 (55%)	43 181 (55%)	43 327 (55%)	43 632 (55%)	42 436 (55%)
Male	34 264 (45%)	35 156 (45%)	35 664 (45%)	36 182 (45%)	35 355 (45%)
Hypertension	12 752 (17%)	12 876 (16%)	14 290 (18%)	20 387 (26%)	25 478 (33%)
Age (years)					
Mean	70.6	70.6	70.8	71.1	71.6
Range	50–102	50–99	50–101	50–102	50–104
Sex					
Female	7256 (17%)	7293 (17%)	7975 (18%)	11 318 (26%)	13 975 (33%)
Male	5496 (16%)	5583 (16%)	6313 (18%)	9067 (25%)	11 502 (33%)
Cancer	1082 (1.4%)	1007 (1.3%)	1203 (1.5%)	2030 (2.5%)	3061 (3.9%)
Age (years)					
Mean	74.8	74.9	75.5	75.6	75.5
Range	50–100	50–101	50–101	50–103	50–101
Sex					
Female	490 (1.2%)	451 (1.0%)	556 (1.3%)	917 (2.1%)	1346 (3.2%)
Male	592 (1.7%)	556 (1.6%)	647 (1.8%)	1113 (3.1%)	1715 (4.9%)
Characteristics of contacts:					
Direct (n)	125 346	121 802	125 196	126 066	123 900
Diagnosed (%)	77%	80%	86%	89%	93%
Indirect (n)	276 740	293 661	316 462	319 891	313 162
Diagnosed (%)	13%	13%	13%	17%	24%
Diagnoses (n)	173 783	178 608	196 764	246 341	327 781

[1]Values are number of patients/physicians/contacts (percentage) if not otherwise indicated.

A plausible explanation for the observed increase in hypertension and cancer diagnoses in SPCD is that the increase is largely driven by the new reimbursement system, which introduced an increased economic incentive for the coding of chronic diseases. The observation that tonsillitis, which represents a diagnosis with low reimbursement value, remained constant supports this notion. Diagnoses with low reimbursement values may be less likely to increase as a consequence of the new system, simply because of the lack of an economic incentive. Furthermore, an acute diagnosis like tonsillitis may not be likely to increase over time, while chronic diseases, like hypertension and cancer, may also be coded when the reason for the visit was an acute disease.

The rise in diagnosis prevalence could also potentially be explained by upcoding, i.e. deliberate miscoding to receive higher reimbursement. Upcoding is a well-known phenomenon in other case-mix reimbursement systems, especially the US Medicare system [15,16] where 7.5% of the fees were estimated to depend on upcoding in 2009 [17]. In a comparison of three case-mix systems Steinbusch et al. [18] conclude that fewer opportunities for upcoding occur in systems where, similar to the VGPV system, the coder's salary does not directly depend on the coding. Furthermore, the observed adjusted prevalence of hypertension (33%) in the last period in our study is similar to that found in previous prevalence studies [19], indicating that the observed prevalence reflects the real burden of hypertension in the population. However, in order to exclude possible upcoding, validation of the registered ICD codes is required. The risk of upcoding will probably differ between diagnoses, with lower risks for diagnoses with more clear diagnostic criteria [18].

Even though several new private HCCs were established, the number of patients visiting the public HCCs did not change much between the time

Table II. Adjusted prevalences of hypertension and cancer diagnoses, association between patient sex and these diagnoses as well as analysis of variances obtained from the multilevel regression analysis in the Skaraborg Primary care database for the five time periods.

Time period	051001–060930	061001–070930	071001–080930	081001–090930	091001–100930
Diagnosis:					
Cancer					
Fixed effects:					
Adjusted prevalence,% (95% CI)	0.79 (0.6–1.02)	0.74 (0.58–0.93)	0.84 (0.67–1.03)	1.43 (1.18–1.78)	2.32 (1.92–2.74)
Patient sex, OR (95% CI)					
Female	REF	REF	REF	REF	REF
Male	1.6 (1.46–1.81)	1.63 (1.43–1.85)	1.56 (1.38–1.74)	1.64 (1.5–1.79)	1.71 (1.59–1.84)
Random effects:					
HCC variance (95% CI)	0.036 (0.014–0.088)	0.027 (0.011–0.064)	0.019 (0.06–0.049)	0.03 (0.014–0.065)	0.036 (0.019–0.076)
ICC	3.3	2.5	1.8	2.8	3.4
Physician variance (95% CI)	0.057 (0.039–0.081)	0.051 (0.034–0.074)	0.056 (0.038–0.08)	0.038 (0.027–0.054)	0.021 (0.014–0.03)
ICC	8.5	7.2	7.0	6.4	5.4
Hypertension					
Fixed effects:					
Adjusted prevalence,% (95%CI)	17.0 (14.8–19.7)	16.7 (14.4–19.2)	18.6 (16.1–22.0)	24.9 (21.6–28.9)	32.2 (29.8–35.4)
Patient sex, OR (95% CI)					
Female	REF	REF	REF	REF	REF
Male	0.91 (0.88–0.95)	0.93 (0.89–0.96)	0.96 (0.92–0.99)	0.97 (0.93–1.0)	1.01 (0.98–1.05)
Random effects:					
HCC variance (95% CI)	0.19 (0.1–0.4)	0.22 (0.11–0.46)	0.26 (0.14–0.52)	0.14 (0.07–0.28)	0.05 (0.02–0.12)
ICC	5.0	5.8	6.9	3.7	1.4
Physician variance (95% CI)	0.22 (0.17–0.28)	0.24 (0.19–0.31)	0.20 (0.16–0.25)	0.20 (0.16–0.25)	0.15 (0.12–0.20)
ICC	10.9	12.3	12.1	9.3	5.8

Notes: OR = odds ratio; CI = credible interval; HCC = health care centre; ICC = intra-class correlation.

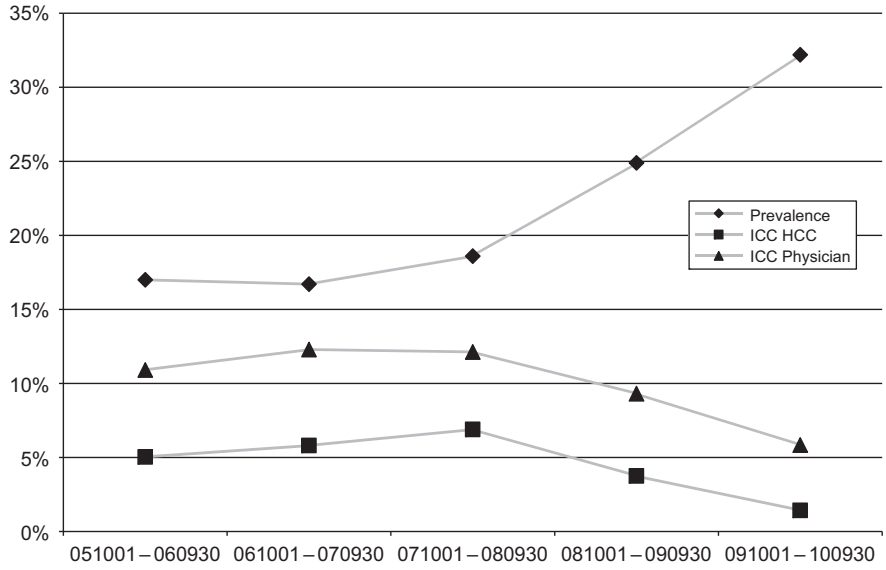


Figure 2. Adjusted prevalences and intra-class correlations (ICC) for patients 50 years of age and older with registered hypertension diagnosis in SPCD during the five time periods.

periods. An explanation for this may be that patients were automatically listed with their previous HCC unless they actively selected another HCC. Furthermore, high age and comorbidity level has previously been shown to be associated with choosing a public HCC [20].

Another potential explanation for the observed increase in hypertension and cancer diagnoses could be that incidence rates in fact increased. Unfortunately we were not able to compare the observed changes in prevalence rates with those from other health care areas. However, the observed simultaneous rise in the total number of registered diagnoses further strengthens our belief that this reflects the changing incentives for coding rather than a true change in morbidity.

A drawback of the SPCD is that patient and physician identity are not available. Therefore, it is not possible to follow physicians and patients across different HCCs. This is a minor problem when studying patients since the number of patients changing HCC is rather low (e.g. only 3.4% of patients with hypertension in Skaraborg visited more than one HCC during a 10-year period, personal communication). However, it might lead to an underestimation of the physician-level variance when studying practice variation.

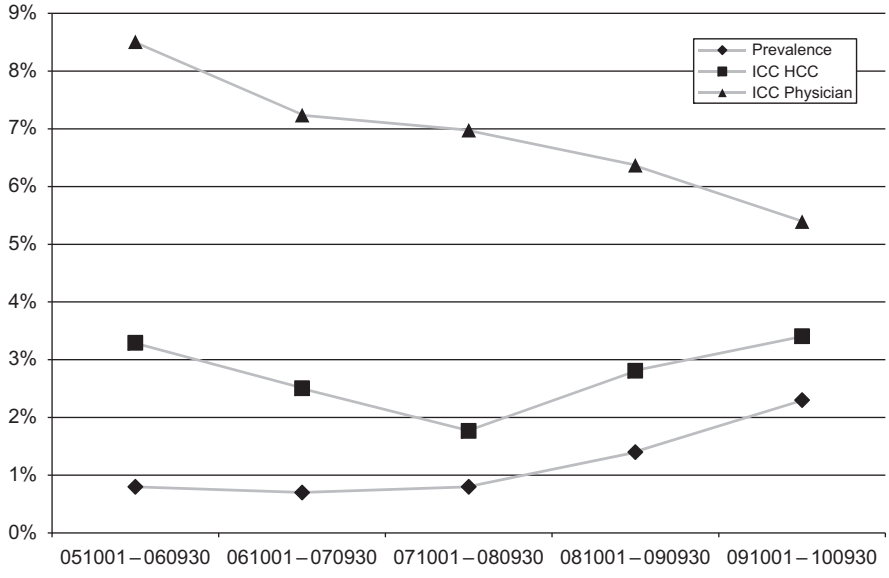


Figure 3. Adjusted prevalences and intra-class correlations (ICC) for patients 50 years of age and older with registered cancer diagnosis in SPCD during the five time periods.

A strength of our study is that it is population based and includes all patients, physicians, and HCCs in the public primary care of Skaraborg, thus minimizing the risk of selection bias. The combined study of prevalence and variance allowed us to study not only overall changes in coding prevalence but also how the coding behaviour changed at different levels.

Conclusions

This study indicates that the change of reimbursement system has had a substantial effect on the coding of chronic diseases. Part of the observed increase is probably due to an increased coding of indirect patient contacts. Thus, changes in the healthcare reimbursement system may directly influence the contents of a research database that retrieves data from clinical practice. This should be taken into account when using such a database for research purposes, and the data should be validated for each diagnosis.

Ethical approval

The study was approved by The Regional Ethical Review Board in Gothenburg

Declaration of interest

The authors report no conflict of interest. The authors alone are responsible for the content and writing of the paper

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