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## Impact of the abolition of copayments on the GP-centred coordination of care in Bavaria, Germany – analysis of routinely collected claims data

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53 24 **Keywords: copayment; primary care; gatekeeping; referral and consultation; healthcare**  
54 25 **administrative claims**

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**ABSTRACT****Objectives:**

In 2004, a copayment was introduced in the German healthcare system in order to strengthen the coordination function of general practitioners (GPs) and to reduce unnecessary physician contacts. The payment was abolished in 2012 due to a perceived lack of efficacy and a high administrative burden. The aim of this study was to investigate how this abolition affected the coordination of patients in Bavaria, Germany. A patient was defined as 'coordinated' if every regular specialist consultation within a quarter was conducted by referral from a GP

**Design:**

A retrospective routine data analysis of the Bavarian Association of Statutory Health Insurance Physicians, comparing the years 2011 and 2012, under influence of the copayment, with the period from 2013 to 2016, without copayment.

**Setting:**

Primary care in Bavaria, Germany.

**Participants:**

All statutorily insured patients in Bavaria, aged  $\geq 18$  years, with at least one ambulatory specialist contact between 2011 and 2016.

**Primary and secondary outcome measures:**

Primary outcome was the percentage of patients with GP-coordinated care. Secondary outcomes were the number of ambulatory emergency cases and apparent doctor shopping.

**Results:**

After the abolition of the copayment, the proportion of coordinated patients decreased markedly from 49.6% (2011) to 15.5% (2016). The decline was most acute among younger patients and those living in areas with lower levels of deprivation. Additionally, there were concomitant increases in the number of ambulatory emergency contacts and in the number of patients with apparent 'doctor shopping'.

**Conclusions:**

The abolition of the copayment was associated with a substantial decrease in the GP coordination of specialist care. This suggests that the copayment was an effective tool to support primary care. Future studies are required to investigate how the gatekeeping function

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3 61 of GPs in Germany can best be strengthened while minimising the associated administrative  
4 62 overhead.  
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## 11 **Article Summary**

### 12 **Strengths and limitations of this study:**

- 13 66
- 14 67 • Containing patients from all statutory health insurances, the results have a high
  - 15 68 generalisability.
  - 16 69 • This study uniquely observes a 6-year period immediately before and after abolition of the
  - 17 70 German copayment.
  - 18 71 • A limitation is that referrals do not represent an active coordination in every case.
  - 19 72 • No direct conclusion can be drawn concerning the quality of care.
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## 73 INTRODUCTION

74 Healthcare systems in industrialised countries are faced with conflicting demands with respect  
75 to the allocation of resources. This is driven largely by rising health expenditures due to medical  
76 progress accompanied by more complex and expensive procedures and medicine.  
77 Furthermore, these nations are faced with demographic change, leading to an age-related  
78 increase in costly and often comorbid chronic diseases, such as diabetes mellitus and coronary  
79 heart disease.[1] In this challenging setting, the main principles of primary care – namely the  
80 provision of effective, demand-oriented and efficient care – appear to be pertinent.[2]

81 A number of studies have shown that strong primary care can lead to lower healthcare costs,  
82 better health outcomes, especially for chronic diseases, and a reduction in mortality.[2-5] This  
83 is due to an improved coordination of patient pathways, better and more equitable access to  
84 health services, the reduction of unnecessary and multiple examinations, the avoidance of  
85 hospitalisations, and greater continuity of care.[4 ,6] Patient coordination can be achieved in  
86 several ways, such as gatekeeping systems, the introduction of copayments, provision of  
87 patient information or through discharge management.[7-10] Kringos et al. showed that  
88 Germany has a relatively weak primary care system with respect to the coordination of care  
89 [6]. In contrast with countries such as the United Kingdom, patients in Germany have direct  
90 access to specialist care and do not require a referral from a general practitioner (GP).  
91 However, Germany has very high physician contact rates, with an average of 14.7 practice  
92 contacts annually (2016).[11] In order to strengthen the coordination function of the GP and  
93 simultaneously reduce the rate of unnecessary contacts, a copayment was introduced in  
94 2004.[12] Patients had to pay a €10 fee for the first ambulatory visit in a quarter, regardless of  
95 whether this contact was with a GP or a specialist. If the patient consulted another physician  
96 within the quarter, the fee could be waived if on referral from the first physician. In 2012, the  
97 copayment was abolished, as the influence on the number of physician visits was considered  
98 too low in relation to the high bureaucratic efforts.[13]

99 Situated in the south of Germany, Bavaria is the largest German federal state by area and with  
100 13 million inhabitants the second most populous.[14] A retrospective routine data analysis of  
101 the Bavarian Association of Statutory Health Insurance Physicians (*Kassenärztliche*  
102 *Vereinigung Bayerns*, KVB) was performed, comparing the years 2011 and 2012, under  
103 influence of the copayment, with the period from 2013 to 2016, following the abolition of the  
104 copayment. Preceding analyses with a comparable method showed that patients living in rural  
105 areas and in highly deprived regions were more likely to exhibit coordination of specialist care  
106 than patients living in urban and less deprived regions.[15 ,16] The aim of the present study  
107 was to investigate the long-term abolition impact on the coordination of patients in Bavaria.  
108 Thus, our investigation significantly extends the previous analyses [15 ,16] by providing a  
109 longitudinal perspective.

## 110 **METHODS**

### 111 **Sources of data**

112 We conducted a time series analyses of anonymous claims data for the years 2011-2016, held  
113 by the Bavarian Association of Statutory Health Insurance Physicians (German:  
114 *Kassenärztliche Vereinigung Bayerns*, KVB). The KVB data cover all statutorily insured  
115 outpatients in the German federal state of Bavaria, which corresponds to approximately 85%  
116 of the Bavarian population (2015: 13 million people).[14] The patient-level data are submitted  
117 by approximately 9 000 GPs, 13 000 specialists in outpatient care and 4 000 psychotherapists  
118 for the purpose of remuneration. They detail the diagnostic and therapeutic procedures  
119 claimed along with the corresponding medical diagnoses, recorded on a quarterly basis using  
120 the German modification of the ICD-10 classification (International Classification of Diseases,  
121 10<sup>th</sup> Revision). Claims comprise an episode-based payment for each patient treated in a given  
122 quarter supplemented by additional claims for time-consuming or technical services (e.g.  
123 chronic disease management, lung function testing or emergency visits).

124 The Bavarian Index of Multiple Deprivation (BIMD) 2010, subdivided into quintiles, was used  
125 to account for socioeconomic area deprivation at the district level.[17] This index is based on  
126 an established British method for Indices of Multiple Deprivation[18] and combines official  
127 sociodemographic, socioeconomic and environmental data, divided in seven domains of  
128 deprivation.[17]

129 Diagnoses were aggregated using the KM87a\_2015 grouper.[19] This grouper was developed  
130 in the United States and modified for the healthcare system by an official organ of the German  
131 Ministry of Health, the Institute for Strategic Assessment of Reimbursement for Medical  
132 Services (German: *Institut des Bewertungsausschusses*, InBA), in order to measure morbidity  
133 within the German ambulatory system. The grouper specifies 72 aggregated medical condition  
134 categories, in order to provide a convenient and cost-based system for the analysis of the  
135 complex ICD-10 diagnoses. Specifically, the number of condition categories was used as a  
136 proxy for morbidity.

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### 138 **Population and study design**

139 The study included all patients aged  $\geq 18$  years and with a residential address in Bavaria. In  
140 the German healthcare system, some internists without specialisation are also licensed as  
141 family physicians and were thus included in the group of family physicians. In the following  
142 text, family physicians and internists in family practice were considered as general practitioners  
143 (GP). Besides the GPs, specialist physicians participate in the German primary care system.  
144 The investigated specialist groups are dermatologists, ear, nose and throat (ENT) specialists,  
145 gynaecologists, internists with and without specialisation (e.g. cardiology, gastroenterology,



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3 146 pulmonology and oncology), neurologists, ophthalmologists, orthopaedics, psychiatrists,  
4 147 psychotherapists, radiologists, surgeons, and urologists.

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6 148 One treatment episode, following named as 'case', is defined in the German statutory health  
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8 149 system as the consultation of a single practice within a 3-month period (quarter). If a patient  
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10 150 consults the same practice for different reasons within the quarterly period, both contacts are  
11 151 counted for remuneration purposes as a single case.

12 152 The investigation was performed as a retrospective routine data analysis. Similar to previous  
13 153 analyses, a patient was defined as 'coordinated' if every regular specialist consultation within  
14 154 a quarter was conducted by referral from a GP (coordinated patients, CP).[15 ,16] Patients  
15 155 consulting at least one specialist within a quarter without a referral were classified as  
16 156 uncoordinated (uncoordinated patients, UP). According to these previous analyses, we defined  
17 157 a regular specialist consultation as one in which a referral from a GP can be expected under a  
18 158 GP-centred system. Therefore, specialists billing for emergency treatment, pregnancy care or  
19 159 routine screening (e.g. mammography) were excluded. Similarly, consultations with  
20 160 radiologists, anaesthetists, surgeons, nuclear physicians and dialysis centres were not  
21 161 considered when determining the status of GP coordination, as these often occur on referral  
22 162 from a specialist. These patients were classified as 'Not relevant for coordinated care'.  
23 163 Additionally, patients who consulted only a GP within a quarter were classified as 'GP care  
24 164 only'.  
25 165

## 26 166 **Outcomes**

27 167 Of primary interest was the percentage of patients with GP-coordinated care and specifically  
28 168 how this changed after copayment abolition. In addition to the quarterly coordination status,  
29 169 we assessed the within-patient consistency of this measure over the course of each year. As  
30 170 secondary outcome measures, the developments in the number of ambulatory emergency  
31 171 cases and apparent 'doctor shopping' were analysed, again with respect to the abolition of the  
32 172 copayment. The analyses concerning 'doctor shopping' focussed on selected specialist groups  
33 173 in which more than 2.5% of patients consulted multiple practices within a quarter. To assess  
34 174 the consistency in coordination status during the course of a year, patients were divided into  
35 175 three subgroups: 1) patients with a GP referral for each specialist visit in each quarter of a  
36 176 specific year ('Always coordinated'), 2) patients for whom all specialist contacts occurred  
37 177 without GP referral ('Always uncoordinated'); and 3) patients whose coordination status was  
38 178 inconsistent over the course of a specific year ('Partially coordinated'). Apparent 'doctor  
39 179 shopping' was defined as the utilisation of multiple practices of the same specialist area within  
40 180 a single quarterly period.  
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## 182 **Statistical analysis**

183 To visualize the potential effect of the abolition of the consultation fee in 2012, a descriptive  
184 analysis of the patient population was conducted in tabular and graphical form. We aggregated  
185 the claims data to generate time series for the proportion of coordinated and uncoordinated  
186 patients over a six-year period, two years with and four years without influence of the  
187 copayment. In accordance with the analyses by Mehring et al.[15] and Schneider et al.[16] we  
188 stratified by age, sex, specialist groups, morbidity, and deprivation.

189 Time series are presented in graphical form. The effect of the abolition was quantified by  
190 means of interrupted time series regression models.[20] This method facilitates a simple  
191 decomposition of the time series into effects for the long-term trend and abolition of the  
192 copayment.

193

## 194 **Data protection**

195 The research project was performed in accordance with the German guideline 'Good Practice  
196 for Secondary Data Analysis' (German: *Gute Praxis Sekundärdatenanalyse*).[21] Data were  
197 anonymous and an approval was obtained from the data protection officer of the Bavarian  
198 Association of Statutory Health Insurance Physicians.

199

## 200 **Patient and public involvement**

201 Patients were not involved in setting the research question, in the outcome measures, in the  
202 design, or in the implementation of the study. No patients were asked to advice on  
203 interpretation or writing up of results. There are no plans to disseminate the results of the  
204 research to study participants or the relevant patient community, which is due to the nature of  
205 the cohort study using secondary data.

206

## 207 RESULTS

208 Baseline data of the study population are presented in Table 1. At the beginning of the  
209 investigation period (quarter 1/2011), 6 235 739 patients in Bavaria had at least one physician  
210 contact, with 3 401 779 (54.6%) consulting a specialist. Of these, 1 685 655 (49.6%) patients  
211 were GP-coordinated (coordinated patients, CPs) and 1 716 124 (50.4%) uncoordinated  
212 (uncoordinated patients, UPs) (Table 1). In the first quarter after the abolition of the copayment  
213 (quarter 1/2013), the number of CPs was 883 894 (25.2%) whereas the number of UPs was  
214 2 626 830 (74.8%). In 2016, this decrease continued, with 568 526 (15.5%) CPs and  
215 3 099 360 (84.5%) UPs. Both the CP and UP groups showed a slight increase in the average  
216 age, from 57.4 and 51.4 years (quarter 1/2011) to 59.3 and 53.9 years (quarter 1/2016),  
217 respectively. Greater differences were observed in gender distribution, with a decreasing  
218 proportion of women in the CP group (quarter 1/2011: 59.2%; quarter 1/2016: 51.5%).  
219 Additionally, the UP group exhibited an increased proportion of chronic (quarter 1/2011: 70.1%;  
220 quarter 1/2016: 77.8 %) and mental illness (quarter 1/2011: 39.2%; quarter 1/2016: 43.6%).  
221 The group 'GP care only' showed a slight increase in the number of patients and a decrease  
222 concerning the proportion of women, whereas other parameters remain stable.

**Table 1** Patient characteristics, classified according to coordination status (only the first quarter of respective years).

Quarter	Coordination status	Patients		Cases per patient (mean)	Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)	
		(n)	(%)							
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								

GP, general physician; n, number; SD, standard deviation.

Stratified by quintiles of the BIMD 2010 (Figure 1a), the proportion of patients whose specialist contacts were GP coordinated ranged between 42% and 54% under the copayment and decreased sharply for all quintiles to between 21% and 30% immediately following its abolition. Throughout the following observation period, a slow but steady decline is observable. By 2016, the proportion with coordinated care had decreased to below 20% in all BIMD categories. Differences between BIMD categories remained, with lower proportions of coordination in

233 areas with low deprivation ('20% lowest deprivation' and '21-40%') and higher rates of  
 234 coordination in areas with higher deprivation ('41-60%' and '61-80%'). Stratification by age  
 235 (Figure 1b) revealed a similar trend, with a low CP proportion among the young and a high  
 236 proportion in older groups. The difference in the CP proportion between age groups was twice  
 237 as large before copayment abolition, with a continued slow convergence of the groups until the  
 238 end of observation in 2016.

239  
 240 Focusing on the continuity of GP coordination over the course of the year, a change in patient  
 241 behaviour after copayment abolition was observable (Figure 2). After 2012, the proportion of  
 242 patients in the group 'Always coordinated' was greatly reduced, as was the group of patients  
 243 with inconsistent coordination behaviour ('Partially coordinated') (see also Supplement Table  
 244 1). Moreover, a correspondingly large increase was evident in the group of patients whose  
 245 specialist utilisation was 'Always uncoordinated'.

246 A complementary perspective was obtained by stratifying coordination by the number of  
 247 ambulatory emergency contacts (0, 1, 2 or  $\geq 3$  contacts annually). This suggests that the  
 248 reduced GP coordination was even stronger in categories with more emergency contacts. In  
 249 the category with three or more emergency treatment episodes, the proportion of 'Always  
 250 coordinated' patients decreased from 30% in 2011 to approximately 7% in 2016.

251 Table 2 shows the development in the number of ambulatory emergency treatment episodes.  
 252 Under the influence of the copayment in 2011 and 2012, the number amounted to  
 253 approximately 1.5 million cases. Throughout the observation period, an underlying yearly  
 254 increase of approximately 3% can be observed. Immediately after the abolition in 2013, the  
 255 number of emergency treatments episodes increased by additional 10% to 1.7 million cases  
 256 (Supplement Table 2).

257 **Table 2** Development of the number of ambulatory emergency cases in Bavaria, index year (100%)  
 258 2012.

Year	Emergency Episodes (n)	Index 2012 (%)
2011	1 484 119	97
2012	1 527 017	100
2013	1 726 868	113
2014	1 781 266	117
2015	1 817 742	119
2016	1 872 695	123

259  
 260 Analyses concerning multiple specialist visits within a quarter ('doctor shopping') focussed on  
 261 selected specialist groups in which  $\geq 2.5\%$  of patients consulted multiple practices within a  
 262 quarter. The resulting groups were dermatologists, gynaecologists, ENT specialists,

ophthalmologists, surgeons, and orthopaedics. Following abolition of the copayment, there were no changes observable among gynaecologists, whereas surgeons, ophthalmologists, dermatologists and ENT specialists showed a statistically significant increase in multiple utilisation, which increased by between 0.25% and 0.5%, representing approximately 1 500 (surgery) to 4 500 (orthopaedics) patients per specialist area per quarter (Figure 3a). Figure 3b shows the development of multiple visits in the selected groups from 2011 to 2016. Here, as well as in the interrupted time series, the greatest increase occurred in orthopaedics group. In 2011, 4% of orthopaedic patients had multiple visits, 4.5% in 2013 and 5% at the beginning of 2016.

## DISCUSSION

The abolition of the copayment was associated with a large decrease in primary care coordination. Additionally, we observe a concomitant increase in ambulatory emergency contacts and in apparent 'doctor shopping'.

A previous cross-sectional study by Schneider et al. showed that the ambulatory health care costs of coordinated patients were on average €9.65 lower than patients without coordination.[16] A further analysis, which based on the same data, found that the proportion of coordinated patients was significantly higher in rural and deprived areas, as well as among older patients and patients with chronic diseases.[15] The present investigation adds a longitudinal perspective by observing time periods with and without copayment. The previous studies[15 ,16] showed that the proportion of GP coordinated patients in the first quarter of 2011 (45.1%) corresponded approximately with those in the present study (49.6%). The differences can be arisen from the improved data quality (e.g. a more consistent patient identifier) and minor changes in the definition of a regular treatment episode (e.g. exclusion of pregnancy and birth control consultations, as these gynaecologic consultations usually occur without a referral). Consistent with the preceding investigation,[15 ,16] the present study found higher rates of coordination in areas with higher deprivation, as well as in older patient groups. These general tendencies are observed irrespective of the copayment. Additionally, the decrease of coordination appears to be similar over all deprivation categories and age groups.

Due to the unrestricted access to specialist care in Germany, a field of concern is the issue of 'doctor shopping', whereby a patient consults multiple physicians from the same specialist group for a second opinion without medical need. As gatekeeper, a family doctor has the potential to reduce such duplicate examinations. The abolition of the copayment led to only a small increase in such behaviour, whereas a substantial increase was observed in orthopaedic

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3 300 practices, with about 4 500 additional cases. Therefore, it is possible that the copayment had  
4 301 a coordinating influence on this specialist group.

5 302  
6 303 We found no noticeable effect of the copayment on the total number of specialist contacts. The  
7 304 overall number of physician contacts changed only slightly (quarter 1/2011: 6 235 739; quarter  
8 305 1/2013: 6 542 239; quarter 1/2016: 6 856 489), following a trend observed during the time of  
9 306 the copayment.[11] Similarly, several evaluations in Austria[22], Germany[23-25] and  
10 307 Sweden[26] showed that the introduction of a copayment had no significant influence on the  
11 308 number of physician contacts. Only Hafner et al. showed a decline concerning physician  
12 309 contacts when the copayment amounted to €50 in Austria. In this case, the decline resulted  
13 310 mainly from the decreased utilisation by lower-income patient groups.[22]

14 311  
15 312 In recent years, Germany has experienced steadily increasing contact numbers in ambulatory  
16 313 emergency departments.[27 ,28] The present study quantified this, finding an annual rate of  
17 314 increase of 3% and a one-off jump of 13% between 2012 and 2013. The abolition of the  
18 315 copayment may have contributed to this increase, as a €10 fee also had to be paid for  
19 316 ambulatory emergency contacts. Scherer et al. showed that 54.7% of emergency patients  
20 317 estimated the degree of their treatment urgency as low, implying that they did not fall into the  
21 318 category of a medical emergency.[28] Such cases, which are more appropriately treated by a  
22 319 GP, lower the concentration of truly urgent cases in emergency departments. This reduces the  
23 320 effectiveness of care and increases the likelihood of adverse effects, as specialists can no  
24 321 longer concentrate on their core competencies.[29] In this case, the copayment could have  
25 322 been a certain inhibition threshold. David et al. indicated that the behaviour controlling effect  
26 323 of the copayment might have led to a more appropriate utilisation of emergency department  
27 324 services.[30] Nevertheless, a causal inference between copayment abolition and the rising  
28 325 number of emergency cases is not possible. Concurrent changes in the provision and billing  
29 326 of out-of-hours services, in particular a gradual change to more structured weekday evening  
30 327 services, make it difficult to identify the pure effect of the copayment. National data show similar  
31 328 trends, although out-of-hours services are structured differently in each federal region.[31]

32 329  
33 330 In the light of recent findings of Gray et al.,[32] the general loss of coordinated care represents  
34 331 a matter of concern. They showed that an increased continuity of care, with respect to both  
35 332 GPs and specialists, leads to reductions in mortality. In our analysis, the pronounced decrease  
36 333 in coordinated care among older patient groups after the abolition is of special concern  
37 334 because such patients are particularly vulnerable, e.g. due to comorbid chronic diseases. This  
38 335 represents a weakening of the main benefits of strong primary care and consequently of a well-  
39 336 functioning healthcare system. The impact of a strong primary care, especially in the case of

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3 337 chronic diseases, was shown by a recently published study of Basu et al..[5] A higher primary  
4 338 care density was associated with longer life expectancy. Additionally, an increase of 10 primary  
5 339 care physicians per 100 000 inhabitants was associated with a lower mortality rate for  
6 340 cardiovascular and respiratory diseases as well as for cancer. The authors concluded that a  
7 341 solid primary care is the foundation of a well-functioning health care system.  
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### 14 344 **Strengths and limitations**

15 345 A major strength of the present study is the analysis of longitudinal claims data, covering 85%  
16 346 of the Bavarian population over six years. Including all statutory insured patients in Bavaria,  
17 347 Germany, a higher representativeness and generalisability of the results can be assumed than  
18 348 in studies that, for example, analyse the data of selected health insurance companies.  
19 349 Additionally, to the best of our knowledge, this represents the first published study assessing  
20 350 the long-term impact of the abolition of the copayment, as existing studies were either  
21 351 conducted after its introduction[23-25] or subsequent to its abolition.[15 ,16 ,33] Although one  
22 352 technical report published in German but without peer-review investigated the change in  
23 353 various time series, it did so without regard to the level of GP coordination or other structural  
24 354 factors such as regional deprivation.[31] Therefore, the present study is unique in observing a  
25 355 six-year period immediately before and after the abolition of the copayment.

26 356 However, the use of routine data has some limitations, as they were originally collected for  
27 357 billing purposes and not for research. In particular, we were unable to verify the extent to which  
28 358 a referral constituted an active coordination on the part of the GP. For example, referrals to a  
29 359 specialist could also be requested without a prior appointment with the GP.[34] Consequently,  
30 360 the proportion of patients with referrals might overestimate the proportion of patients with active  
31 361 GP-centred coordination. On the other hand, it is conceivable that some patients without  
32 362 administrative referral did in fact experience GP coordination. This could occur if, for example,  
33 363 the patient failed to deliver the referral form to the specialist.

34 364 Furthermore, no direct conclusion can be drawn concerning the quality of care. The outcomes  
35 365 'patient coordination', 'consistency', 'ambulatory emergency contacts' and 'doctor shopping'  
36 366 might, however, be viewed as surrogate parameters for effective primary care. Additionally,  
37 367 we did not consider outcome quality and had no access to mortality or hospitalisation data.  
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### 57 371 **Conclusion**

58 372 The present study shows that the abolition of the copayment in 2012 was followed by an  
59 373 immediate and a substantial decrease in GP-centred coordination of specialist care. This was  
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3 374 accompanied by an increase in emergency cases and apparent doctor shopping. These  
4 375 findings suggest that the copayment was an effective tool for supporting primary care.  
5 376 Nevertheless, the German copayment was associated with high bureaucratic efforts. Thus,  
6 377 alternative methods, such as a mandatory primary care system with referrals, might be more  
7 378 reasonable. Future studies are required to investigate how the gatekeeping function of GPs in  
8 379 Germany can best be strengthened while minimising the associated administrative overhead.

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For peer review only

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3 381 **Author Contributions**

4 382 MO, ED, MT, RG, KL, WM, LS, and AS designed the study. MO and ED performed the  
5 383 analysis. MO, ED, and AS wrote the initial version of the manuscript. MO, ED, MT, RG, KL,  
6 384 WM, LS, and AS revised the manuscript. All authors read and approved the final manuscript.  
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10 385

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12 387 The study was funded by the Central Research Institute for Ambulatory Health Care in  
13 388 Germany (Zentralinstitut für die Kassenärztliche Versorgung in Deutschland).  
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16 389

17 390 **Competing interests**

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19 391 ED, MT, and RG are employees of the Association of Statutory Health Insurance Physicians  
20 392 of Bavaria.  
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22 393

23 394 **Provenance and peer review**

24  
25 395 Not commissioned; externally peer reviewed.  
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29 397 **Data sharing statement**

30 398 The data that support the findings of this study are available from the Bavarian Association of  
31 399 Statutory Health Insurance Physicians but restrictions apply to the availability of these data,  
32 400 which were used under licence for the current study and are not publicly available. Data may  
33 401 be obtained from the authors upon reasonable request and with permission of the Bavarian  
34 402 Association of Statutory Health Insurance Physicians.  
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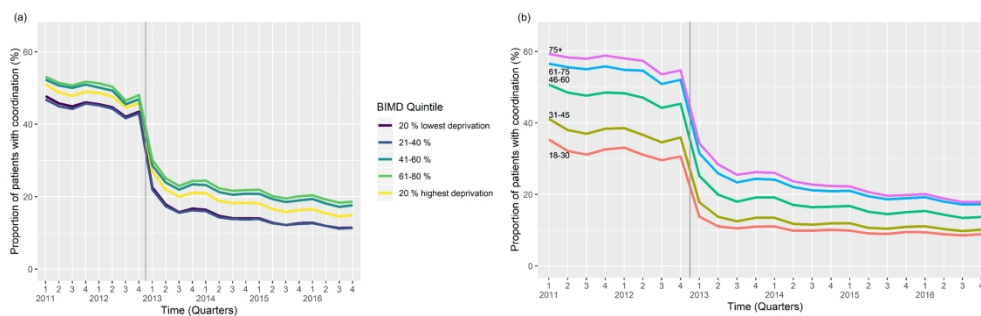
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3 484 **Summary of figures**

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5 485 **Figure 1** Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the  
6 486 BIMD 2010 (a) and age (b).

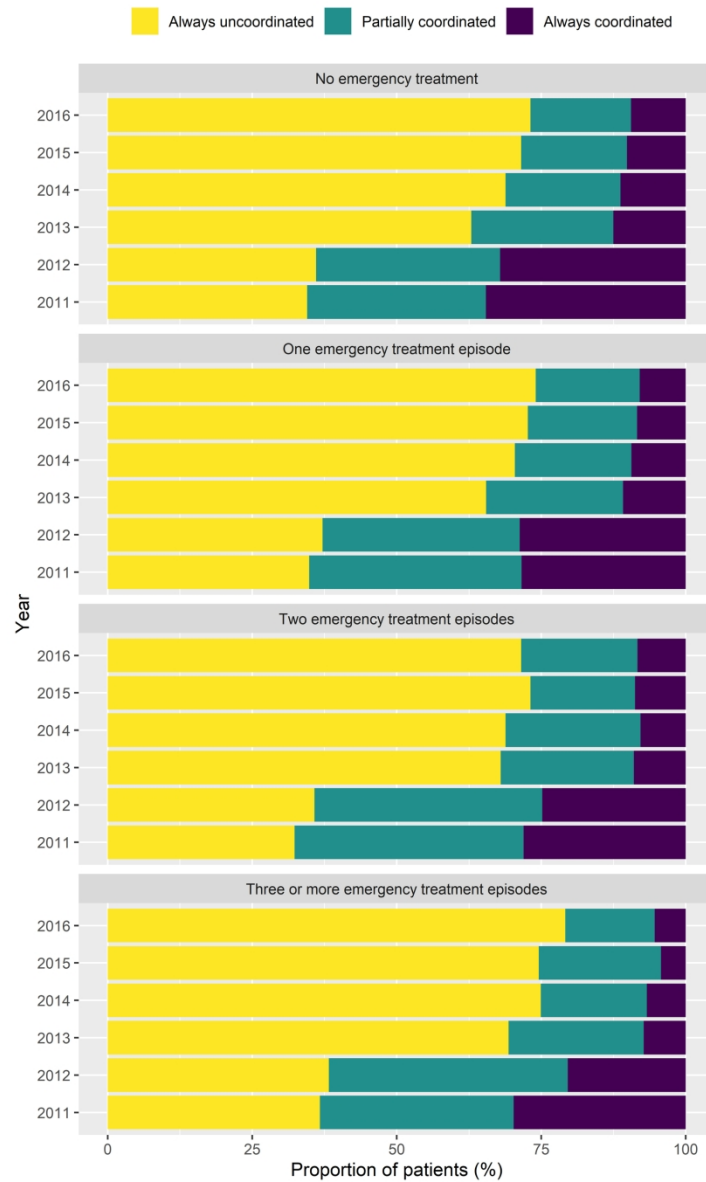
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9 487 **Figure 2** Continuity of coordination within one year according to the number of ambulatory  
10 488 emergency visits within one year. Yellow bars represent the proportion of patients that  
11 489 consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars  
12 490 represent patients that had a GP referral for every specialist visit ('Always coordinated'), and  
13 491 green bars represent patients with a switching coordination status ('Partially coordinated').

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17 492 **Figure 3** Effect of the abolition of the copayment on multiple specialist contacts of the same  
18 493 discipline as estimated by the interrupted time series regression model, with 95% confidence  
19 494 interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).



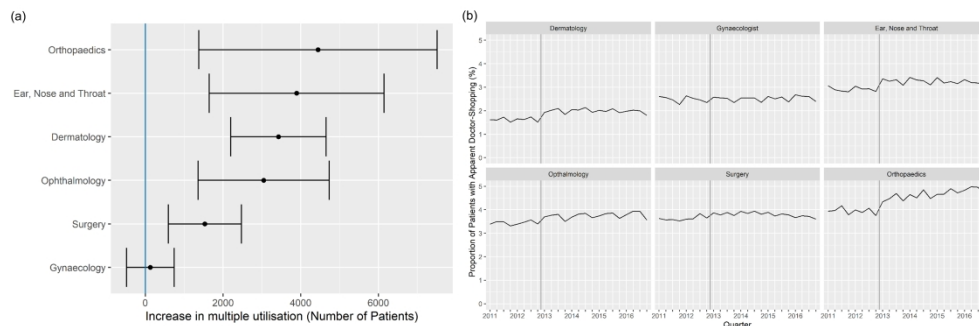
Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the BIMD 2010 (a) and age (b).

338x109mm (600 x 600 DPI)



Continuity of coordination within one year according to the number of ambulatory emergency visits within one year. Yellow bars represent the proportion of patients that consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars represent patients that had a GP referral for every specialist visit ('Always coordinated'), and green bars represent patients with a switching coordination status ('Partially coordinated').

149x249mm (300 x 300 DPI)



Effect of the abolition of the copayment on multiple specialist contacts of the same discipline as estimated by the interrupted time series regression model, with 95% confidence interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).

338x123mm (600 x 600 DPI)



## Supplementary Tables

**Supplement Table 1** Interrupted time series regression model concerning abolition of the co-payment, consistency of GP coordination and ambulatory emergency contacts. Outcome variable: Proportion of patients with coordination throughout the year (%).

<b>Coefficients</b>				
	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr (&gt; t )</b>
(Intercept)	32.0238	0.9474	33.802	< 0.001
<i>Number of emergency contacts (Ref.: 0)</i>				
1	-2.7420	1.0699	-2.563	0.01957
2	-3.8892	1.0699	-3.635	0.00189
3 or more	-6.0522	1.0699	-5.657	< 0.001
Trend year for year	-0.9937	0.3951	-2.515	0.02161
Absence of co-payment	-16.7683	1.4314	-11.715	< 0.001

**Supplement Table 2** Interrupted time series regression model concerning abolition of the co-payment and ambulatory emergency contacts. Outcome variable: Development of ambulatory emergency contacts (%) (Index: Emergency contacts in 2012).

<b>Coefficients</b>				
	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr (&gt; t )</b>
(Intercept)	97.0568	0.2427	399.97	< 0.001
Trend year for year	3.0770	0.1401	21.96	< 0.001
Absence of co-payment	10.0270	0.5076	19.75	< 0.001

**Supplement Table 3** Interrupted time series regression model concerning abolition of the co-payment and multiple specialist contacts of the same discipline ('doctor-shopping'). Outcome variable: Number of patients with multiple specialist utilisation.

<b>Specialist group</b>	<b>Coefficients</b>	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr (&gt; t )</b>
Dermatology	(Intercept)	10952.626309	310.76910	35.2436142	< 0.001
	Trend year for year	5.535340	40.12012	0.1379692	0.89158
	Absence of co-payment	3426.888416	589.13085	5.8168545	< 0.001
Orthopaedics	(Intercept)	34713.817408	777.81769	44.6297609	< 0.001
	Trend year for year	381.195026	100.41583	3.7961646	0.00106
	Absence of co-payment	4445.597186	1474.52366	3.0149378	0.00659
Surgery	(Intercept)	15345.746073	237.88726	64.5084833	< 0.001
	Trend year for year	-7.606021	30.71111	-0.2476635	0.80680
	Absence of co-payment	1532.772251	450.96736	3.3988541	0.00271
Ophthalmology	(Intercept)	34915.145288	427.84504	81.6069884	< 0.001
	Trend year for year	70.422775	55.23456	1.2749767	0.21624
	Absence of co-payment	3046.926702	811.07391	3.7566573	0.00116
Ear, Nose and Throat	(Intercept)	17381.999346	570.81974	30.4509427	< 0.001
	Trend year for year	-13.642670	73.69251	-0.1851297	0.85490
	Absence of co-payment	3895.399542	1082.11376	3.5998060	0.00168
Gynaecologist	(Intercept)	10847.602094	155.22381	69.8836205	< 0.001
	Trend year for year	40.506544	20.03931	2.0213544	0.05617
	Absence of co-payment	129.171466	294.26071	0.4389695	0.6651

**The RECORD statement: Checklist of items, extended from the STROBE statement, which should be reported in observational studies using routinely collected health data.**

	Item No.	STROBE items	Location in the manuscript where items are reported	RECORD items	Location in the manuscript where items are reported
<b>Title and Abstract</b>					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract. (b) Provide in the abstract an informative and balanced summary of what was done and what was found.	Done: Title and abstract	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Done: Title and abstract
<b>Introduction</b>					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported.	Done: Introduction		
Objectives	3	State specific objectives, including any pre-specified hypotheses.	Done: Objectives		
<b>Methods</b>					
Study Design	4	Present key elements of study design early in the paper.	Done: Section: Sources of data & Cohort and study design		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	Done: Methods, Section: Sources of data & Cohort and study design		

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Participants	6	(a) <i>Cohort study</i> : Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up. <i>Case-control study</i> : Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. <i>Cross-sectional study</i> : Give the eligibility criteria and the sources and methods of selection of participants. (b) <i>Cohort study</i> : For matched studies, give matching criteria and number of exposed and unexposed. <i>Case-control study</i> : For matched studies, give matching criteria and the number of controls per case.	Done: Methods, Section: Cohort & Study design  n/a	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.  RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.  RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request  See: Study Mehring et al. (2017)  n/a
21 22 23 24 25 26 27 28	Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Done: Methods / Supplement	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
29 30 31 32 33 34 35 36	Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	Done: Methods		
37 38	Bias	9	Describe any efforts to address potential sources of bias.	Done: Methods		
39 40	Study size	10	Explain how the study size was arrived at.	Done: Methods		
41 42 43	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	Done: Methods		

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		applicable, describe which groupings were chosen and why.			
Statistical methods	12	<p>(a) Describe all statistical methods, including those used to control for confounding.</p> <p>(b) Describe any methods used to examine subgroups and interactions.</p> <p>(c) Explain how missing data were addressed.</p> <p>(d) <i>Cohort study</i>: If applicable, explain how loss to follow-up was addressed. <i>Case-control study</i>: If applicable, explain how matching of cases and controls was addressed. <i>Cross-sectional study</i>: If applicable, describe analytical methods taking account of sampling strategy.</p> <p>(e) Describe any sensitivity analyses.</p>	Done: Methods		
Data access and cleaning methods		-		<p>RECORD 12.1: Authors should describe the extent to which the investigations had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>The author ED is an employee of the <i>Kassenärztliche Vereinigung Bayerns</i> hand has full access to the underlying database, the author MO has partial access. The authors have the permission of the <i>Kassenärztliche Vereinigung Bayerns</i> to conduct the study.</p>

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1 2 3 4 5 6	Linkage	-		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	No data linkage	
7	<b>Results</b>					
8 9 10 11 12 13 14 15 16 17 18	Participants	13	(a) Report the numbers of individuals at each stage of the study (e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed). (b) Give reasons for nonparticipation at each stage. (c) Consider use of a flow diagram.	Done: Methods, Table 1	RECORD 13.1: Describe in detail the selection of the persons included in the study (i.e., study population selection), including filtering based on data quality, data availability, and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Done: Methods, Section: Cohort and study design, Table 1
19 20 21 22 23 24 25 26 27 28 29	Descriptive data	14	(a) Give characteristics of study participants (e.g., demographic, clinical, and social) and information on exposures and potential confounders. (b) Indicate the number of participants with missing data for each variable of interest. (c) <i>Cohort study</i> : summarise follow-up time (e.g., average and total amount).	Done: Table 1  n/a		
30 31 32 33 34 35 36 37 38 39	Outcome data	15	<i>Cohort study</i> : Report numbers of outcome events or summary measures over time. <i>Case-control study</i> : Report numbers in each exposure category or summary measures of exposure. <i>Cross-sectional study</i> : Report numbers of outcome events or summary measures.	Done: Table 1		
40 41 42 43	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g.,	Done		

		95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.			
Other analyses	17	Report other analyses done – e.g., analyses of subgroups and interactions and sensitivity analyses.	Done: Supplement		
<b>Discussion</b>					
Key results	18	Summarise key results with reference to study objectives.	Done		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	Done	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Done (e.g. effects of different coding practices)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	Done		
Generalisability	21	Discuss the generalisability (external validity) of the study results.	Done		
<b>Other Information</b>					
Funding	22	Give the source of funding and the role of the funders	Done		
Accessibility of protocol, raw data, and programming code		n/a	Done	RECORD 22.1.: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Done. Raw data is subject to data protection concerns. See data sharing

					statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
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n/a, not applicable

Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 12.10 (2015): e1001885

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# BMJ Open

## Impact of the abolition of co-payments on the GP-centred coordination of care in Bavaria, Germany – analysis of routinely collected claims data

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4 1 Impact of the abolition of co-payments on the GP-centred  
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56 26 **Keywords: co-payment; primary care; gatekeeping; referral and consultation;**  
57 27 **healthcare administrative claims**

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60 29 **Word count: 4 380**

## 30 **ABSTRACT**

### 31 **Objectives:**

32 In 2012, Germany abolished a co-payment for consultations in ambulatory care. The aim of  
33 this study was to investigate how the removal of this co-payment affected the general  
34 practitioner-centred coordination of care in Bavaria, Germany. We assessed how the  
35 proportion with coordinated care changed over time and how consistent the coordination status  
36 of individual patients was. Furthermore, we investigated how the number of ambulatory  
37 emergency cases and apparent 'doctor shopping' changed in the years before and after the  
38 abolition.

### 39 **Design:**

40 A retrospective routine data analysis of the Bavarian Association of Statutory Health Insurance  
41 Physicians, comparing the years 2011 and 2012, under influence of the co-payment, with the  
42 period from 2013 to 2016, without co-payment. Therefore, time series analyses were  
43 performed.

### 44 **Setting:**

45 Primary care in Bavaria, Germany.

### 46 **Participants:**

47 All statutorily insured patients in Bavaria, aged  $\geq 18$  years, with at least one ambulatory  
48 specialist contact between 2011 and 2016.

### 49 **Primary and secondary outcome measures:**

50 Primary outcome was the percentage of patients with GP-coordinated care. Secondary  
51 outcomes were the number of ambulatory emergency cases and apparent 'doctor shopping'.

### 52 **Results:**

53 After the abolition of the co-payment, the proportion of coordinated patients decreased  
54 markedly from 49.6% (2011) to 15.5% (2016). The decline was most acute among younger  
55 patients and those living in areas with lower levels of deprivation. Additionally, there were  
56 concomitant increases in the number of ambulatory emergency contacts and to a lesser extent  
57 in the number of patients with apparent 'doctor shopping'.

### 59 **Conclusions:**

60 The abolition of the co-payment was associated with a substantial decrease in the GP  
61 coordination of specialist care. This suggests that the co-payment was a partly effective tool

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3 62 to support coordinated care. Future studies are required to investigate how the gatekeeping  
4 63 function of GPs in Germany can best be strengthened while minimising the associated  
5 64 administrative overhead.  
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## 67 **Article Summary**

### 68 **Strengths and limitations of this study:**

- 17 69 • Containing patients from all statutory health insurances, the results have a high  
18 70 generalisability.  
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20 71 • This study uniquely observes a 6-year period immediately before and after abolition of the  
21 72 German co-payment.  
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23 73 • A limitation is that referrals do not represent an active coordination in every case.  
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25 74 • No direct conclusion can be drawn concerning the quality of care.  
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## 75 INTRODUCTION

76 Healthcare systems in industrialised countries are faced with conflicting demands with respect  
77 to the allocation of resources. This is driven largely by rising health expenditures due to medical  
78 progress accompanied by more complex and expensive procedures and medicine.  
79 Furthermore, these nations are faced with demographic change, leading to an age-related  
80 increase in costly and often comorbid chronic diseases, such as diabetes mellitus and coronary  
81 heart disease.[1] In this challenging setting, the main principles of primary care – namely the  
82 provision of effective, demand-oriented and efficient care – appear to be pertinent.[2]  
83 A number of studies have shown that strong primary care can lead to lower healthcare costs,  
84 better health outcomes, especially for chronic diseases, and a reduction in mortality.[2-5] This  
85 is due to an improved coordination of patient pathways, better and more equitable access to  
86 health services, the reduction of unnecessary and multiple examinations, the avoidance of  
87 hospitalisations, and greater continuity of care.[4 ,6] Patient coordination can be achieved in  
88 several ways, such as gatekeeping systems, the introduction of co-payments, provision of  
89 patient information or through discharge management.[7-10] Kringos et al. showed that  
90 Germany has a relatively weak primary care system with respect to the coordination of care  
91 [6]. In contrast with countries such as the United Kingdom, patients in Germany have direct  
92 access to specialist care and do not require a referral from a general practitioner (GP).  
93 However, Germany has very high physician contact rates, with an average of 14.7 practice  
94 contacts annually (2016).[11] In order to strengthen the coordination function of the GP and  
95 simultaneously reduce the rate of unnecessary contacts, a co-payment was introduced in  
96 2004.[12] Patients paid a €10 fee for each ambulatory consultation made without referral in a  
97 given quarterly period, payable to the practice directly. This included consultations with general  
98 practitioners, specialists and walk-in emergency clinics. Once the first co-payment in a quarter  
99 had been made, the patient could avoid payment when consulting further practices if these  
100 were made on referral, thus saving €10 for each subsequent practice contact. In November  
101 2012, the German Federal Parliament ('Bundestag') voted unanimously to remove the co-  
102 payment effective 1 January 2013, as the influence on the number of physician visits was  
103 considered too low in relation to the high bureaucratic efforts.[13] This was reported widely by  
104 German news media, both at the time and at the beginning of 2013.  
105 Situated in the south of Germany, Bavaria is the largest German federal state by area and with  
106 13 million inhabitants the second most populous.[14] A retrospective routine data analysis of  
107 the Bavarian Association of Statutory Health Insurance Physicians (*Kassenärztliche*  
108 *Vereinigung Bayerns*, KVB) was performed, comparing the years 2011 and 2012, under  
109 influence of the co-payment, with the period from 2013 to 2016, following the abolition of the  
110 co-payment. Preceding analyses with a comparable method showed that patients living in rural  
111 areas and in highly deprived regions were more likely to exhibit coordination of specialist care

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3 112 than patients living in urban and less deprived regions.[15 ,16] It was the aim of the present  
4 113 study to investigate the effect of abolishing the co-payment for ambulatory consultations on  
5 114 the coordination of specialist care in Bavaria. Thus, our investigation extends previous  
6 115 analyses[15 ,16] by providing a longitudinal perspective.  
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## 11 117 **METHODS**

### 12 118 **Population and study design**

13 119 The study included all patients aged  $\geq 18$  years and with a residential address in Bavaria. In  
14 120 the German healthcare system, some internists without specialisation are also licensed as  
15 121 family physicians and were thus included in the group of family physicians. In the following  
16 122 text, family physicians and internists in family practice were considered as general practitioners  
17 123 (GP). Alongside GPs, specialist physicians participate in the German ambulatory care system.  
18 124 The investigated specialist groups are dermatologists, ear, nose and throat (ENT) specialists,  
19 125 gynaecologists, internists with and without specialisation (e.g. cardiology, gastroenterology,  
20 126 pulmonology and oncology), neurologists, ophthalmologists, orthopaedics, psychiatrists,  
21 127 psychotherapists (both physician and non-physician), radiologists, surgeons, and urologists.  
22 128 One treatment episode, in the following denoted as a 'case', is defined in the German statutory  
23 129 health system as the consultation of a single practice within a 3-month period (quarter). If a  
24 130 patient consults the same practice for different reasons within the quarterly period, both  
25 131 contacts are merged for administrative purposes to form a single case. The investigation was  
26 132 performed as a retrospective routine data analysis.  
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### 39 134 **Sources of data**

40 135 We conducted a time series analyses of anonymous claims data for the years 2011-2016, held  
41 136 by the Bavarian Association of Statutory Health Insurance Physicians (German:  
42 137 *Kassenärztliche Vereinigung Bayerns*, KVB). The KVB is the statutory organisation responsible  
43 138 for ambulatory physicians in Bavaria and is thus the primary source for such administrative  
44 139 routine data. The data have been used extensively for health services and medical  
45 140 research.[15-18] The data cover all statutorily insured outpatients in the German federal state  
46 141 of Bavaria, which corresponds to approximately 85% of the Bavarian population (2015: 13  
47 142 million people).[14] Approximately 15% of patients are privately insured, mostly civil servants  
48 143 and people with an income higher than €56 250 per year (2016). The patient-level data are  
49 144 submitted by approximately 9 000 GPs, 13 000 specialists in outpatient care and 4 000  
50 145 psychotherapists for the purpose of remuneration. They detail the diagnostic and therapeutic  
51 146 procedures claimed along with the corresponding medical diagnoses, recorded on a quarterly  
52 147 basis using the German modification of the ICD-10 classification (International Classification

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3 148 of Diseases, 10<sup>th</sup> Revision). Claims comprise an episode-based payment for each patient  
4 149 treated in a given quarter, supplemented by additional claims for time-consuming or technical  
5 150 services (e.g. chronic disease management, lung function testing or emergency visits).

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8 151 The Bavarian Index of Multiple Deprivation (BIMD) 2010, subdivided into quintiles, was used  
9 152 to account for socioeconomic area deprivation at the district level.[19] This index is based on  
10 153 an established British method for Indices of Multiple Deprivation[20] and combines official  
11 154 sociodemographic, socioeconomic and environmental data, divided in seven domains of  
12 155 deprivation.[19]

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15 156 Diagnoses were aggregated using the KM87a\_2015 grouper.[21] This grouper was developed  
16 157 in the United States and modified for the healthcare system by an official organ of the German  
17 158 Ministry of Health, the Institute for Strategic Assessment of Reimbursement for Medical  
18 159 Services (German: *Institut des Bewertungsausschusses*, InBA), in order to measure morbidity  
19 160 within the German ambulatory system. The grouper specifies 72 aggregated medical condition  
20 161 categories, in order to provide a convenient and cost-based system for the analysis of the  
21 162 complex ICD-10 diagnoses. Specifically, the number of condition categories was used as a  
22 163 proxy for morbidity.

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### 29 165 **Definition of Coordinated Care**

30 166 Similar to previous analyses, a patient was defined as 'coordinated' if every regular specialist  
31 167 consultation within a quarter was conducted on referral from a GP (coordinated patients,  
32 168 CP).[15 ,16] Patients consulting at least one specialist within a quarter without a referral were  
33 169 classified as uncoordinated (uncoordinated patients, UP). Following previous studies, we  
34 170 defined a regular specialist consultation as one in which a referral from a GP can be expected  
35 171 under a GP-centred system. Therefore, specialists billing for emergency treatment, pregnancy  
36 172 care or routine screening (e.g. mammography) were excluded. Similarly, consultations with  
37 173 radiologists, anaesthetists, surgeons, nuclear physicians and dialysis centres were not  
38 174 considered when determining the status of GP coordination, as these often occur on referral  
39 175 from a specialist. These patients were classified as 'Not relevant for coordinated care'.  
40 176 Additionally, patients who consulted only a GP within a quarter were classified as 'GP care  
41 177 only'.

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### 51 179 **Outcomes**

52 180 Of primary interest was the percentage of patients with GP-coordinated care and specifically  
53 181 how this changed after abolition of the co-payment. In addition to the quarterly coordination  
54 182 status, we assessed the within-patient consistency of this measure over the course of each  
55 183 year.



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3 184 As secondary outcome measures, the developments in the number of ambulatory emergency  
4 185 cases and apparent 'doctor shopping' were analysed, again with respect to the abolition of the  
5 186 co-payment. Ambulatory emergencies include both out-of-hours services and emergency care  
6 187 not leading to a hospital admission. In keeping with previous studies, apparent 'doctor  
7 188 shopping' was defined as the regular consultation (as defined for coordination of care) of two  
8 189 or more practices from the same specialism within a quarterly period. We focussed only on  
9 190 those specialist groups in which more than 2.5% of patients consult multiple physicians in the  
10 191 same quarter.  
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### 17 193 **Statistical analysis**

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19 194 To visualize the potential effect of the abolition of the consultation fee in 2012, a descriptive  
20 195 analysis of the patient population was conducted in tabular and graphical form. We aggregated  
21 196 the claims data to generate time series for the proportion of coordinated and uncoordinated  
22 197 patients over a six-year period, of which two years were under the influence of the co-payment  
23 198 and four years were without co-payment. In accordance with the analyses by Mehring et al.[15]  
24 199 and Schneider et al.[16] we stratified by age, sex, specialist groups, morbidity, and deprivation.  
25 200 Time series are presented in graphical form.

26  
27 201 To assess the consistency in coordination status during the course of a year, patients were  
28 202 divided into three subgroups: 1) patients with a GP referral for each specialist visit in each  
29 203 quarter of a specific year ('Always coordinated'), 2) patients for whom all specialist contacts  
30 204 occurred without GP referral ('Always uncoordinated'); and 3) patients whose coordination  
31 205 status was inconsistent over the course of a specific year ('Partially coordinated'). A  
32 206 complementary perspective was obtained by stratifying coordination by the number of  
33 207 ambulatory emergency contacts (0, 1, 2 or  $\geq 3$  contacts annually).

34  
35 208 The effect of the abolition on emergency cases and apparent 'doctor shopping' was quantified  
36 209 by means of interrupted time series regression models without adjustment for  
37 210 autocorrelation.[22] This method facilitates a simple decomposition of the time series into  
38 211 effects for the long-term trend (slope) and abolition of the co-payment ('step' at the time of  
39 212 abolition). As emergency cases vary considerably by quarter, and depend on the timing of  
40 213 holidays (e.g. Easter), we aggregate this outcome by year to provide a more interpretable  
41 214 measure.  
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### 52 216 **Data protection**

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54 217 The research project was performed in accordance with the German guideline 'Good Practice  
55 218 for Secondary Data Analysis' (German: *Gute Praxis Sekundärdatenanalyse*).[23] Data were  
56 219 anonymous and an approval was obtained from the data protection officer of the Bavarian  
57 220 Association of Statutory Health Insurance Physicians.

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5 222 **Patient and public involvement**  
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7 223 Patients were not involved in setting the research question, in the outcome measures, in the  
8 224 design, or in the implementation of the study. No patients were asked to advice on  
9 225 interpretation or writing up of results. There are no plans to disseminate the results of the  
10 226 research to study participants or the relevant patient community, which is due to the nature of  
11 227 the cohort study using secondary data.  
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## **Patient and public involvement**

Patients were not involved in setting the research question, in the outcome measures, in the design, or in the implementation of the study. No patients were asked to advice on interpretation or writing up of results. There are no plans to disseminate the results of the research to study participants or the relevant patient community, which is due to the nature of the cohort study using secondary data.

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## 229 RESULTS

230 Baseline data of the study population are presented in Table 1. In order to reduce the length  
231 of the table and highlight long-term trends, we focus on the first quarter of each year. At the  
232 beginning of the investigation period (quarter 1/2011), 6 235 739 patients in Bavaria had at  
233 least one physician contact, with 3 401 779 (54.6%) consulting a specialist.

### 234 Coordination:

235 Of these, 1 685 655 (49.6%) patients were GP-coordinated (coordinated patients, CPs) and  
236 1 716 124 (50.4%) uncoordinated (uncoordinated patients, UPs) (Table 1). In the first quarter  
237 after the abolition of the co-payment (quarter 1/2013), the number of CPs was 883 894 (25.2%)  
238 whereas the number of UPs was 2 626 830 (74.8%). In 2016, this decrease continued, with  
239 568 526 (15.5%) CPs and 3 099 360 (84.5%) UPs.

### 240 Age and gender distribution:

241 Both the CP and UP groups showed a slight increase in the average age, from 57.4 and 51.4  
242 years (quarter 1/2011) to 59.3 and 53.9 years (quarter 1/2016), respectively. Greater  
243 differences were observed in gender distribution, with a decreasing proportion of women in the  
244 CP group (quarter 1/2011: 59.2%; quarter 1/2016: 51.5%).

### 245 Chronical and mental illness:

246 Additionally, the UP group exhibited an increased proportion of chronic (quarter 1/2011: 70.1%;  
247 quarter 1/2016: 77.8 %) and mental illness (quarter 1/2011: 39.2%; quarter 1/2016: 43.6%).  
248 The group 'GP care only' showed a slight increase in the number of patients and a decrease  
249 concerning the proportion of women, whereas other parameters remain stable.

**Table 1** Patient characteristics, classified according to coordination status (only the first quarter of respective years).

Quarter	Coordination status	Patients		Cases per patient		Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)	(mean)	(SD)					
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								

GP, general practitioners; n, number; SD, standard deviation.

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### 254 Coordination of Care

255 Stratified by quintiles of the BIMD 2010 (Figure 1a), the proportion of patients whose specialist  
 256 contacts were GP coordinated ranged between 42% and 54% under the co-payment and  
 257 decreased sharply for all quintiles to between 21% and 30% immediately following its abolition.  
 258 Throughout the following observation period, a slow but steady decline is observable. By 2016,  
 259 the proportion with coordinated care had decreased to below 20% in all BIMD categories.

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260 Differences between BIMD categories remained, with lower proportions of coordination in  
 261 areas with low deprivation ('20% lowest deprivation' and '21-40%') and higher rates of  
 262 coordination in areas with higher deprivation ('41-60%' and '61-80%'). Stratification by age  
 263 (Figure 1b) revealed a similar trend, with a low CP proportion among the young and a high  
 264 proportion in older groups. The difference in the CP proportion between age groups was twice  
 265 as large before co-payment abolition, with a continued slow convergence of the groups until  
 266 the end of observation in 2016.

### 267 **Continuity of Coordination**

268 Focusing on the continuity of GP coordination over the course of the year, a change in patient  
 269 behaviour after co-payment abolition was observable (Figure 2). After 2012, the proportion of  
 270 patients in the group 'Always coordinated' was greatly reduced, as was the group of patients  
 271 with inconsistent coordination behaviour ('Partially coordinated') (see also Supplement  
 272 Table 1). Moreover, a correspondingly large increase was evident in the group of patients  
 273 whose specialist utilisation was 'Always uncoordinated'.

274 Stratification by the number of emergency treatment contacts suggests that the reduced GP  
 275 coordination was even stronger in categories with more emergency contacts. In the category  
 276 with three or more emergency treatment episodes, the proportion of 'Always coordinated'  
 277 patients decreased from 30% in 2011 to approximately 7% in 2016.

### 278 **Emergency Treatment**

279 Table 2 shows the development in the number of ambulatory emergency treatment episodes.  
 280 Under the influence of the co-payment in 2011 and 2012, the number amounted to  
 281 approximately 1.5 million cases. Throughout the observation period, an underlying yearly  
 282 increase of approximately 3% can be observed. Immediately after the abolition in 2013, the  
 283 number of emergency treatments episodes increased by additional 10% to 1.7 million cases  
 284 (Supplement Table 2).

285 **Table 2** Development of the number of ambulatory emergency cases in Bavaria, index year (100%)  
 286 2012.

Year	Emergency Episodes (n)	Index 2012 (%)
2011	1 484 119	97
2012	1 527 017	100
2013	1 726 868	113
2014	1 781 266	117
2015	1 817 742	119
2016	1 872 695	123

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### 288 **Apparent Doctor Shopping**

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3 289 The specialist groups in which at least 2.5% of patients consulted multiple practices were  
4 290 dermatology, gynaecology, ENT, ophthalmology, surgery, and orthopaedics. Following  
5 291 abolition of the co-payment, there were no changes observable among gynaecologists,  
6 292 whereas surgeons, ophthalmologists, dermatologists and ENT specialists showed a  
7 293 statistically significant increase in multiple utilisation, which increased by between 0.25% and  
8 294 0.5%, representing approximately 1 500 (surgery) to 4 500 (orthopaedics) patients per  
9 295 specialist area per quarter (Figure 3a and Supplement Table 3). Figure 3b shows the  
10 296 development of multiple visits in the selected groups from 2011 to 2016. Here, as well as in  
11 297 the interrupted time series, the greatest increase occurred in orthopaedics group. In 2011, 4%  
12 298 of orthopaedic patients had multiple visits, 4.5% in 2013 and 5% at the beginning of 2016.  
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## 22 301 **DISCUSSION**

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24 302 After the abolition of the co-payment, the proportion of coordinated patients decreased  
25 303 markedly from 49.6% (2011) to 15.5% (2016). The decline was most acute among younger  
26 304 patients and those living in areas with lower levels of deprivation. Additionally, there were  
27 305 concomitant increases in the number of ambulatory emergency contacts and to a lesser extent  
28 306 in the number of patients with apparent 'doctor shopping'.  
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34 308 A previous cross-sectional study by Schneider et al. showed that ambulatory health care costs  
35 309 of coordinated patients were on average €9.65 lower than patients without coordination.[16] A  
36 310 further analysis, which based on the same data, found that the proportion of coordinated  
37 311 patients was significantly higher in rural and deprived areas, e.g. due to a lower specialist  
38 312 density in rural areas, as well as among older patients and patients with chronic diseases.[15]  
39 313 The present investigation adds a longitudinal perspective by observing time periods with and  
40 314 without co-payment. The previous studies[15 ,16] showed that the proportion of GP  
41 315 coordinated patients in the first quarter of 2011 (45.1%) corresponded approximately with  
42 316 those in the present study (49.6%). The differences can be arisen from the improved data  
43 317 quality (e.g. a more consistent patient identifier) and minor changes in the definition of a regular  
44 318 treatment episode (e.g. exclusion of pregnancy and birth control consultations, as these  
45 319 gynaecologic consultations usually occur without a referral). Consistent with the preceding  
46 320 investigation,[15 ,16] the present study found higher rates of coordination in areas with higher  
47 321 deprivation, as well as in older patient groups. These general tendencies are observed  
48 322 irrespective of the co-payment. Additionally, the decrease of coordination appears to be similar  
49 323 over all deprivation categories and age groups.  
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3 325 Due to the unrestricted access to specialist care in Germany, a field of concern is the issue of  
4 326 'doctor shopping', whereby a patient consults multiple physicians from the same specialist  
5 327 group for a second opinion without medical need. As gatekeeper, a family doctor has the  
6 328 potential to reduce such duplicate examinations. The abolition of the co-payment led to only a  
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8 329 small increase in such behaviour, although a substantial increase was observed in orthopaedic  
9 330 practices, with about 4 500 additional cases. Therefore, it is possible that the co-payment had  
10 331 a coordinating influence on this specialist group. A review by Biernikiewicz et al. indicated that  
11 332 repeated consultations occur most often in patients with a chronic disease, multiple  
12 333 comorbidities, a drug addiction or the fact that their problem remains unresolved (persistent  
13 334 symptoms despite receiving treatment). It is unclear whether the concentration among  
14 335 orthopaedic physicians is due to drug abuse (e.g. repeated prescriptions of pain killers) or due  
15 336 to patient dissatisfaction with persisting symptoms. Further research is required to investigate  
16 337 the reasons.[24]  
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26 339 Increasing contact rates appear to occur also in ambulatory emergency departments. It was  
27 340 described recently, that Germany has experienced steadily increasing contact numbers in  
28 341 ambulatory emergency departments.[25 ,26] The present study quantified this, finding an  
29 342 annual rate of increase of 3% and a one-off jump of 13% between 2012 and 2013. The abolition  
30 343 of the co-payment may have contributed to this increase, as a €10 fee also had to be paid for  
31 344 ambulatory emergency contacts. Scherer et al. showed that 54.7% of emergency patients  
32 345 estimated the degree of their treatment urgency as low, implying that they did not fall into the  
33 346 category of a medical emergency. As motives, Patients stated 'convenience' or the expectation  
34 347 of better care than in the ambulatory sector. [26] Such cases, which are more appropriately  
35 348 treated by a GP, lower the concentration of truly urgent cases in emergency departments. This  
36 349 reduces the effectiveness of care and increases the likelihood of adverse effects, as specialists  
37 350 can no longer concentrate on their core competencies.[27] In this case, the co-payment could  
38 351 have been a certain inhibition threshold. David et al. indicated that the behaviour controlling  
39 352 effect of the co-payment might have led to a more appropriate utilisation of emergency  
40 353 department services.[28] Nevertheless, a causal inference between co-payment abolition and  
41 354 the rising number of emergency cases is not possible. Concurrent changes in the provision  
42 355 and billing of out-of-hours services, in particular a gradual change to more structured weekday  
43 356 evening services, make it difficult to identify the pure effect of the co-payment. National data  
44 357 show similar trends, although out-of-hours services are structured differently in each federal  
45 358 region.[29]  
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58 360 Generally, we found no noticeable effect of the co-payment on the total number of specialist  
59 361 contacts. The overall number of physician contacts changed only slightly (quarter 1/2011:

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3 362 6 235 739; quarter 1/2013: 6 542 239; quarter 1/2016: 6 856 489), following a trend observed  
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5 363 during the time of the co-payment.[11] Similarly, several evaluations in Austria[30],  
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7 364 Germany[31-33] and Sweden[34] showed that the introduction of a co-payment had no  
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9 365 significant influence on the number of physician contacts. Only Hafner et al. showed a decline  
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11 366 concerning physician contacts when the co-payment amounted to €50 in Austria. In this case,  
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13 367 the decline resulted mainly from the decreased utilisation by lower-income patient groups.[30]  
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15 368 In the context of the German co-payment, €10 per quarter is a low barrier to ambulatory care.  
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17 369 The additive impact of the co-payment was however an effective incentive for coordinated  
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19 370 care, as, for example, a patient consulting three practices without referral has to pay €30.  
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21 371 Nevertheless, it must be noted that co-payments have the potential to be a barrier for persons  
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23 372 with low socio-economic status, especially when the co-payment is income-independent.  
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25 373 Concerning the German co-payment, the evidence is inconsistent. A study by Rückert et al.[35]  
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27 374 showed that people with lower socio-economic status more often delayed or avoided physician  
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29 375 visits due to the co-payment. Grabka et al.[31] and Schreyögg et al.[36] did not find any socio-  
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31 376 economic differences. An alternative approach is to implement a mandatory primary care  
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33 377 system to strengthen coordination of care. In the current political discussion, there are  
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35 378 considerations to implement GP-centred care models,[37] perhaps in combination with  
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37 379 financial incentives for participating patients.[38]

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381 In the light of recent findings of Gray et al.,[39] the general loss of coordinated care represents  
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383 a matter of concern. They showed that an increased continuity of care, with respect to both  
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385 GPs and specialists, leads to reductions in mortality. In our analysis, the pronounced decrease  
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387 in coordinated care among older patient groups after the abolition is of special concern  
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389 because such patients are particularly vulnerable, e.g. due to comorbid chronic diseases. This  
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391 represents a weakening of the main benefits of strong primary care and consequently of a well-  
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393 functioning healthcare system. The impact of a strong primary care, especially in the case of  
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395 chronic diseases, was shown by a recently published study of Basu et al..[5] A higher primary  
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397 care density was associated with longer life expectancy. Additionally, an increase of 10 primary  
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399 care physicians per 100 000 inhabitants was associated with a lower mortality rate for  
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401 cardiovascular and respiratory diseases as well as for cancer. The authors concluded that a  
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403 solid primary care is the foundation of a well-functioning health care system. Despite the  
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405 difficulties inherent in making causal statements based on the observation of such  
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407 interdependent systems, the authors were able to conclude that a solid primary care is the  
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409 foundation of a well-functioning health system

### 410 **Strengths and limitations**

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412 397 A major strength of the present study is the analysis of longitudinal claims data, covering 85%  
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414 398 of the Bavarian population over six years. Including all statutory insured patients in Bavaria,



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3 399 Germany, a higher representativeness and generalisability of the results can be assumed than  
4 400 in studies that, for example, analyse the data of selected health insurance companies.  
5 401 Additionally, to the best of our knowledge, this represents the first published study assessing  
6 402 the impact of the abolition of the co-payment, as existing studies were either conducted after  
7 403 its introduction[31-33] or immediately before its abolition.[15 ,16 ,36] Although one technical  
8 404 report published in German investigated the change in various time series, it did so without  
9 405 regard to the level of GP coordination or other structural factors such as regional  
10 406 deprivation.[29] Therefore, the present study is unique in observing a six-year period  
11 407 immediately before and after the abolition of the co-payment.

12 408 However, the use of routine data has some limitations, as they were originally collected for  
13 409 billing purposes and not for research. In particular, we were unable to verify the extent to which  
14 410 a referral constituted an active coordination on the part of the GP. For example, referrals to a  
15 411 specialist could also be requested without a prior appointment with the GP.[40] Consequently,  
16 412 the proportion of patients with referrals might overestimate the proportion of patients with active  
17 413 GP-centred coordination. On the other hand, it is conceivable that some patients without  
18 414 administrative referral did in fact experience GP coordination. This could occur if, for example,  
19 415 the patient failed to deliver the referral form to the specialist.

20 416 Besides healthcare costs, distance to services and waiting time are two additionally relevant  
21 417 aspects concerning healthcare use. In case of distance, Figure 1 includes a breakdown by  
22 418 quintile of multiple deprivation. It was not possible to analyse waiting times as these data were  
23 419 not available in the claims data. However, waiting times for consultations with specialists are  
24 420 low in Germany if compared with international health care systems, due in large part to the  
25 421 high physician density of specialists in ambulatory care.[41 ,42]

26 422 Furthermore, no direct conclusion can be drawn concerning the quality of care. The outcomes  
27 423 'patient coordination', 'consistency', 'ambulatory emergency contacts' and 'doctor shopping'  
28 424 might, however, be viewed as surrogate parameters for effective primary care. Additionally,  
29 425 we did not consider outcome quality and had no access to mortality or hospitalisation data.

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## 33 429 **Conclusion**

34 430 The present study shows that the abolition of the co-payment in 2012 was followed by an  
35 431 immediate and a substantial decrease in GP-centred coordination of specialist care. This was  
36 432 accompanied by an increase in emergency cases and apparent 'doctor shopping'. These  
37 433 findings suggest that the co-payment was a partly effective tool for supporting coordinated  
38 434 care. Nevertheless, the German co-payment was associated with high bureaucratic efforts.  
39 435 Thus, alternative methods, such as a mandatory primary care system with referrals, might be  
40 436 more reasonable. Future studies are required to investigate how the gatekeeping function of

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436 GPs in Germany can best be strengthened while minimising the associated administrative  
437 overhead.

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For peer review only

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3 439 **Author Contributions**

4 440 MO, ED, MT, RG, KL, WM, LS, and AS designed the study. MO and ED performed the  
5 441 analysis. MO, ED, and AS wrote the initial version of the manuscript. MO, ED, MT, RG, KL,  
6 442 WM, LS, and AS revised the manuscript. All authors read and approved the final manuscript.  
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10 443

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13 446 Germany (Zentralinstitut für die Kassenärztliche Versorgung in Deutschland).  
14  
15

16 447

17 448 **Competing interests**

18 449 ED, MT, and RG are employees of the Association of Statutory Health Insurance Physicians  
19 450 of Bavaria.  
20  
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22 451

23 452 **Provenance and peer review**

24 453 Not commissioned; externally peer reviewed.  
25  
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27 454

28 455 **Data sharing statement**

29 456 The data that support the findings of this study are available from the Bavarian Association of  
30 457 Statutory Health Insurance Physicians but restrictions apply to the availability of these data,  
31 458 which were used under licence for the current study and are not publicly available. Data may  
32 459 be obtained from the authors upon reasonable request and with permission of the Bavarian  
33 460 Association of Statutory Health Insurance Physicians.  
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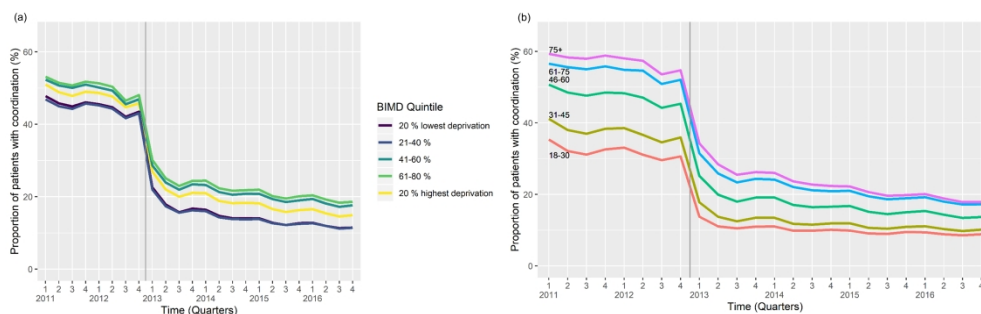
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3 560 **Summary of figures**  
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5 561 **Figure 1** Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the  
6 BIMD 2010 (a) and age (b).  
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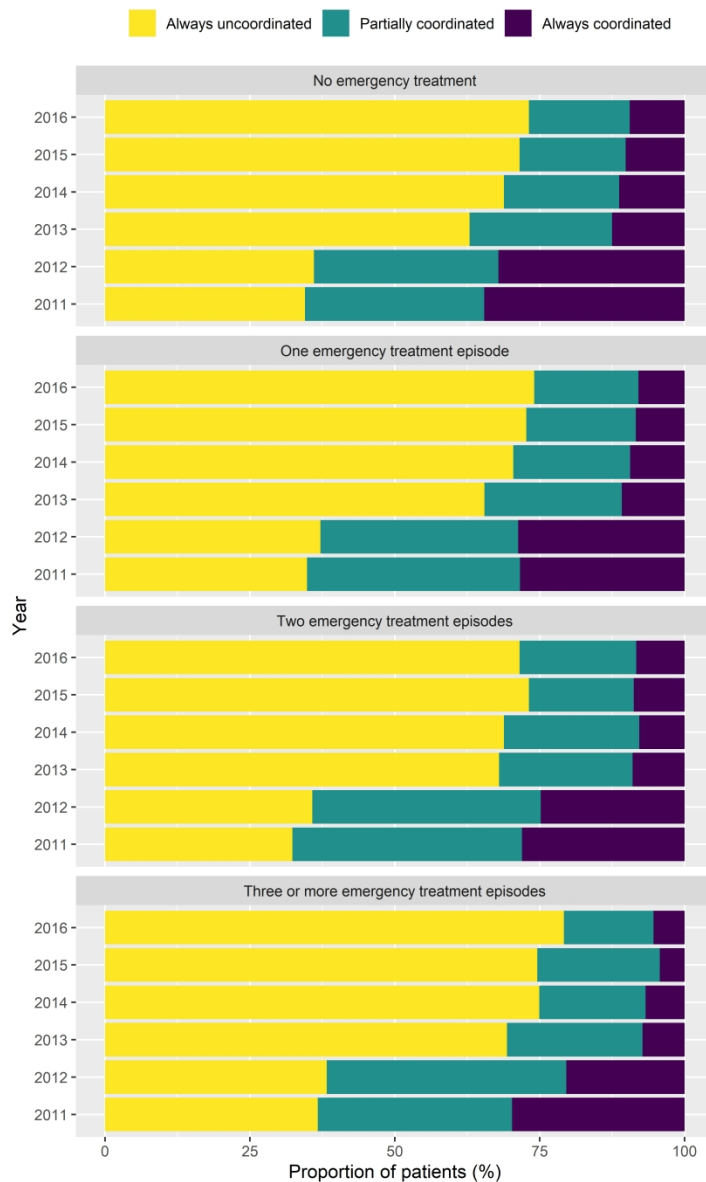
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9 563 **Figure 2** Continuity of coordination within one year according to the number of ambulatory  
10 emergency visits within one year. Yellow bars represent the proportion of patients that  
11 consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars  
12 represent patients that had a GP referral for every specialist visit ('Always coordinated'), and  
13 566 green bars represent patients with a switching coordination status ('Partially coordinated').  
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17 568 **Figure 3** Effect of the abolition of the co-payment on multiple specialist contacts of the same  
18 discipline as estimated by the interrupted time series regression model, with 95% confidence  
19 569 interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).  
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Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the BIMD 2010 (a) and age (b).

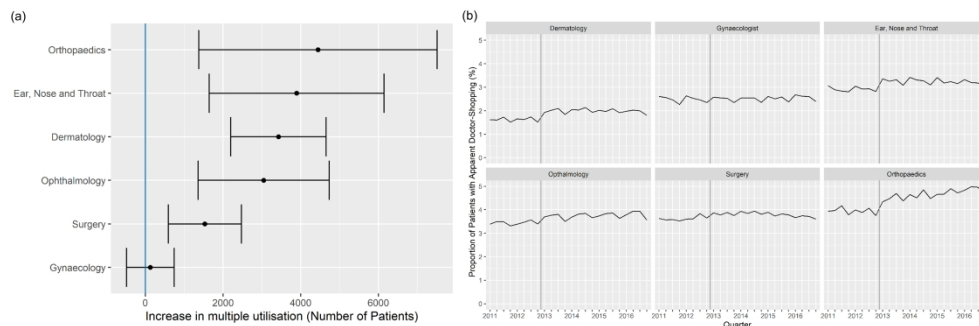
338x109mm (768 x 768 DPI)



Continuity of coordination within one year according to the number of ambulatory emergency visits within one year. Yellow bars represent the proportion of patients that consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars represent patients that had a GP referral for every specialist visit ('Always coordinated'), and green bars represent patients with a switching coordination status ('Partially coordinated').

149x249mm (600 x 600 DPI)





Effect of the abolition of the copayment on multiple specialist contacts of the same discipline as estimated by the interrupted time series regression model, with 95% confidence interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).

338x123mm (768 x 768 DPI)

## Supplementary Tables

**Supplement Table 1** Interrupted time series regression model concerning abolition of the co-payment, consistency of GP coordination and ambulatory emergency contacts. Outcome variable: Proportion of patients with coordination throughout the year (%).

<b>Coefficients</b>				
	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr (&gt; t )</b>
(Intercept)	32.0238	0.9474	33.802	< 0.001
<i>Number of emergency contacts (Ref.: 0)</i>				
1	-2.7420	1.0699	-2.563	0.01957
2	-3.8892	1.0699	-3.635	0.00189
3 or more	-6.0522	1.0699	-5.657	< 0.001
Trend year for year	-0.9937	0.3951	-2.515	0.02161
Absence of co-payment	-16.7683	1.4314	-11.715	< 0.001

**Supplement Table 2** Interrupted time series regression model concerning abolition of the co-payment and ambulatory emergency contacts. Outcome variable: Development of ambulatory emergency contacts (%) (Index: Emergency contacts in 2012).

<b>Coefficients</b>				
	<b>Estimate</b>	<b>Standard Error</b>	<b>t-value</b>	<b>Pr (&gt; t )</b>
(Intercept)	97.0568	0.2427	399.97	< 0.001
Trend year for year	3.0770	0.1401	21.96	< 0.001
Absence of co-payment	10.0270	0.5076	19.75	< 0.001

**Supplement Table 3** Interrupted time series regression model concerning abolition of the co-payment and multiple specialist contacts of the same discipline ('doctor shopping'). Outcome variable: Number of patients with multiple specialist utilisation.

Specialist group	Coefficients	Estimate	Standard Error	t-value	Pr (> t )
Dermatology	(Intercept)	10952.626309	310.76910	35.2436142	< 0.001
	Trend quarter by quarter	5.535340	40.12012	0.1379692	0.89158
	Absence of co-payment	3426.888416	589.13085	5.8168545	< 0.001
Orthopaedics	(Intercept)	34713.817408	777.81769	44.6297609	< 0.001
	Trend quarter by quarter	381.195026	100.41583	3.7961646	0.00106
	Absence of co-payment	4445.597186	1474.52366	3.0149378	0.00659
Surgery	(Intercept)	15345.746073	237.88726	64.5084833	< 0.001
	Trend quarter by quarter	-7.606021	30.71111	-0.2476635	0.80680
	Absence of co-payment	1532.772251	450.96736	3.3988541	0.00271
Ophthalmology	(Intercept)	34915.145288	427.84504	81.6069884	< 0.001
	Trend quarter by quarter	70.422775	55.23456	1.2749767	0.21624
	Absence of co-payment	3046.926702	811.07391	3.7566573	0.00116
Ear, Nose and Throat	(Intercept)	17381.999346	570.81974	30.4509427	< 0.001
	Trend quarter by quarter	-13.642670	73.69251	-0.1851297	0.85490
	Absence of co-payment	3895.399542	1082.11376	3.5998060	0.00168
Gynaecologist	(Intercept)	10847.602094	155.22381	69.8836205	< 0.001
	Trend quarter by quarter	40.506544	20.03931	2.0213544	0.05617
	Absence of co-payment	129.171466	294.26071	0.4389695	0.6651

**The RECORD statement: Checklist of items, extended from the STROBE statement, which should be reported in observational studies using routinely collected health data.**

	Item No.	STROBE items	Location in the manuscript where items are reported	RECORD items	Location in the manuscript where items are reported
<b>Title and Abstract</b>					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract. (b) Provide in the abstract an informative and balanced summary of what was done and what was found.	Done: Title and abstract	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Done: Title and abstract
<b>Introduction</b>					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported.	Done: Introduction		
Objectives	3	State specific objectives, including any pre-specified hypotheses.	Done: Objectives		
<b>Methods</b>					
Study Design	4	Present key elements of study design early in the paper.	Done: Section: Sources of data & Cohort and study design		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	Done: Methods, Section: Sources of data & Cohort and study design		

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Participants	6	(a) <i>Cohort study</i> : Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up. <i>Case-control study</i> : Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. <i>Cross-sectional study</i> : Give the eligibility criteria and the sources and methods of selection of participants. (b) <i>Cohort study</i> : For matched studies, give matching criteria and number of exposed and unexposed. <i>Case-control study</i> : For matched studies, give matching criteria and the number of controls per case.	Done: Methods, Section: Cohort & Study design  n/a	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.  RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.  RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request  See: Study Mehring et al. (2017)  n/a
21 22 23 24 25 26 27 28	Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Done: Methods / Supplement	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
29 30 31 32 33 34 35 36	Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	Done: Methods		
37 38	Bias	9	Describe any efforts to address potential sources of bias.	Done: Methods		
39 40	Study size	10	Explain how the study size was arrived at.	Done: Methods		
41 42 43	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	Done: Methods		

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		applicable, describe which groupings were chosen and why.			
Statistical methods	12	<p>(a) Describe all statistical methods, including those used to control for confounding.</p> <p>(b) Describe any methods used to examine subgroups and interactions.</p> <p>(c) Explain how missing data were addressed.</p> <p>(d) <i>Cohort study</i>: If applicable, explain how loss to follow-up was addressed. <i>Case-control study</i>: If applicable, explain how matching of cases and controls was addressed. <i>Cross-sectional study</i>: If applicable, describe analytical methods taking account of sampling strategy.</p> <p>(e) Describe any sensitivity analyses.</p>	Done: Methods		
Data access and cleaning methods		-		<p>RECORD 12.1: Authors should describe the extent to which the investigations had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>The author ED is an employee of the <i>Kassenärztliche Vereinigung Bayerns</i> hand has full access to the underlying database, the author MO has partial access. The authors have the permission of the <i>Kassenärztliche Vereinigung Bayerns</i> to conduct the study.</p>

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1 2 3 4 5 6	Linkage	-		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	No data linkage	
7	<b>Results</b>					
8 9 10 11 12 13 14 15 16 17 18	Participants	13	(a) Report the numbers of individuals at each stage of the study (e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed). (b) Give reasons for nonparticipation at each stage. (c) Consider use of a flow diagram.	Done: Methods, Table 1	RECORD 13.1: Describe in detail the selection of the persons included in the study (i.e., study population selection), including filtering based on data quality, data availability, and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Done: Methods, Section: Cohort and study design, Table 1
19 20 21 22 23 24 25 26 27 28 29	Descriptive data	14	(a) Give characteristics of study participants (e.g., demographic, clinical, and social) and information on exposures and potential confounders. (b) Indicate the number of participants with missing data for each variable of interest. (c) <i>Cohort study</i> : summarise follow-up time (e.g., average and total amount).	Done: Table 1  n/a		
30 31 32 33 34 35 36 37 38 39	Outcome data	15	<i>Cohort study</i> : Report numbers of outcome events or summary measures over time. <i>Case-control study</i> : Report numbers in each exposure category or summary measures of exposure. <i>Cross-sectional study</i> : Report numbers of outcome events or summary measures.	Done: Table 1		
40 41 42 43	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g.,	Done		

		95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.			
Other analyses	17	Report other analyses done – e.g., analyses of subgroups and interactions and sensitivity analyses.	Done: Supplement		
<b>Discussion</b>					
Key results	18	Summarise key results with reference to study objectives.	Done		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	Done	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Done (e.g. effects of different coding practices)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	Done		
Generalisability	21	Discuss the generalisability (external validity) of the study results.	Done		
<b>Other Information</b>					
Funding	22	Give the source of funding and the role of the funders	Done		
Accessibility of protocol, raw data, and programming code		n/a	Done	RECORD 22.1.: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Done. Raw data is subject to data protection concerns. See data sharing



					statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
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n/a, not applicable

Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 12.10 (2015): e1001885

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# BMJ Open

## Impact of the abolition of co-payments on the GP-centred coordination of care in Bavaria, Germany – analysis of routinely collected claims data

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Article Type:	Original research
Date Submitted by the Author:	01-Apr-2020
Complete List of Authors:	Olm, Michaela; Technical University of Munich School of Medicine, Institute of General Practice and Health Services Research Donnachie, Ewan; Bavarian Association of Statutory Health Insurance Physicians Tauscher, Martin; Association of Statutory Health Insurance Physicians of Bavaria Gerlach, Roman; Association of Statutory Health Insurance Physicians of Bavaria Linde, Klaus; Technical University of Munich School of Medicine, Institute of General Practice and Health Services Research Maier, Werner; German Research Center for Environmental Health (GmbH), Institute of Health Economics and Health Care Management, Helmholtz Zentrum München Schwettmann, Lars; German Research Center for Environmental Health (GmbH), Institute of Health Economics and Health Care Management, Helmholtz Zentrum München Schneider, Antonius; Technical University of Munich School of Medicine, Institute of General Practice and Health Services Research
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Health policy, Public health
Keywords:	PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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4 1 Impact of the abolition of co-payments on the GP-centred  
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6 2 coordination of care in Bavaria, Germany – analysis of routinely  
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13 5 Michaela Olm,<sup>1</sup> Ewan Donnachie,<sup>2</sup> Martin Tauscher,<sup>2</sup> Roman Gerlach,<sup>2</sup> Klaus Linde,<sup>1</sup> Werner  
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55 25 **Keywords: co-payment; primary care; gatekeeping; referral and consultation;**  
56 26 **healthcare administrative claims**

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58 27  
59 28 **Word count: 4 649**  
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## 29 **ABSTRACT**

### 30 **Objectives:**

31 In 2012, Germany abolished co-payment for consultations in ambulatory care. This study  
32 investigated the effect of the abolition on general practitioner (GP)-centred coordination of  
33 care. We assessed how the proportion of patients with coordinated specialist care changed  
34 over time when co-payment to all specialist services were removed. Furthermore, we studied  
35 how the number of ambulatory emergency cases and apparent 'doctor shopping' changed after  
36 the abolition.

### 37 **Design:**

38 A retrospective routine data analysis of the Bavarian Association of Statutory Health Insurance  
39 Physicians, comparing the years 2011 and 2012 (with co-payment), with the period from 2013  
40 to 2016 (without co-payment). Therefore, time series analyses covering 24 quarters were  
41 performed.

### 42 **Setting:**

43 Primary care in Bavaria, Germany.

### 44 **Participants:**

45 All statutorily insured patients in Bavaria, aged  $\geq 18$  years, with at least one ambulatory  
46 specialist contact between 2011 and 2016.

### 47 **Primary and secondary outcome measures:**

48 Primary outcome was the percentage of patients with GP-coordinated care (every regular  
49 specialist consultation within a quarter was preceded by a GP referral). Secondary outcomes  
50 were the number of ambulatory emergency cases and apparent 'doctor shopping'.

### 51 **Results:**

52 After the abolition, the proportion of coordinated patients decreased from 49.6% (2011) to  
53 15.5% (2016). Overall, younger patients and those living in areas with lower levels of  
54 deprivation showed the lowest proportions of coordination, which further decreased after  
55 abolition. Additionally, there were concomitant increases in the number of ambulatory  
56 emergency contacts and to a lesser extent in the number of patients with apparent 'doctor  
57 shopping'.

### 58 **Conclusions:**

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3 60 The abolition of co-payment in Germany was associated with a substantial decrease in GP  
4 61 coordination of specialist care. This suggests that the co-payment was a partly effective tool  
5 62 to support coordinated care. Future studies are required to investigate how the gatekeeping  
6 63 function of GPs in Germany can best be strengthened while minimising the associated  
7 64 administrative overhead.  
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## 67 **Article Summary**

### 68 **Strengths and limitations of this study:**

- 69 • Containing patients from all statutory health insurances, the results have a high  
70 generalisability.  
71 • This study uniquely observes a 6-year period immediately before and after abolition of the  
72 German co-payment.  
73 • A limitation is that referrals do not represent an active coordination in every case.  
74 • No direct conclusion can be drawn concerning the quality of care.
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## 75 INTRODUCTION

76 Medical progress and demographic change are leading to increased demand for health  
77 services. Although the beneficial impact of modern medicine on health outcomes is obvious, it  
78 is suspected that low coordination of care could harm patients. For example, Fenton et al. have  
79 demonstrated that discretionary care corresponds with higher drug prescription expenditures  
80 and mortality.[1] One potential way to increase the effectiveness of the healthcare system  
81 could be to strengthen patient coordination for example by general practitioners (GPs). A  
82 number of studies have shown that strong primary care has the potential to promote better  
83 health outcomes, especially for chronic diseases, to reduce mortality, and finally can lower  
84 healthcare costs.[2-6] This might be due to the continuity and coordination of care provided by  
85 general practitioners, which also leads to a better and more equitable access to health services  
86 and to a reduction of unnecessary examinations.[4 ,7]

87 Patient coordination can be achieved in several ways, such as gatekeeping systems, the  
88 introduction of co-payments, provision of patient information or through discharge  
89 management.[8-11] Germany has a relatively weak primary care system with respect to the  
90 coordination of care.[7] This is challenging, because GPs and specialists are both working in  
91 licensed private practices in ambulatory care. The specialists comprise mainly dermatologists,  
92 ear, nose and throat (ENT) specialists, gynaecologists, internists with and without  
93 specialisation (e.g. cardiology, gastroenterology, pulmonology and oncology), neurologists,  
94 ophthalmologists, orthopaedics, psychiatrists, psychotherapists (both physician and non-  
95 physician), radiologists, surgeons, and urologists. Internists without specialization are licensed  
96 as general practitioners.

97 Germany has a very high physician contact rate, with an average of 14.7 practice contacts  
98 annually (2016).[12] To strengthen the coordination function of the GP and simultaneously  
99 reduce the rate of unnecessary contacts, a co-payment was introduced in 2004.[13] In each  
100 quarter patients had to pay a €10 fee for the first ambulatory consultation made without referral,  
101 payable to the practice directly. Usually, these referrals are performed by general practitioners,  
102 but patients could also consult a specialist for initial contact. Once the first co-payment in a  
103 quarter had been made, the patient could avoid further payment when consulting other  
104 practices if these were made on referral.

105 In November 2012, the German Federal Parliament ('Bundestag') voted unanimously to  
106 remove the co-payment effective 1 January 2013, as the influence on the number of physician  
107 visits was considered too low in relation to the high bureaucratic efforts.[14] This was reported  
108 widely by German news media, both at the time of the decision and at the beginning of 2013.  
109 The aim of the present study was to investigate the effect of abolishing the co-payment for  
110 ambulatory consultations on the coordination of specialist care in Bavaria, the largest German  
111 federal state by area and the second most populous.[15]

## 112 **METHODS**

### 113 **Study design**

114 The investigation was performed as a retrospective routine data analysis. We conducted an  
115 ecological study with time series analyses of anonymous claims data. The data were provided  
116 by the Bavarian Association of Statutory Health Insurance Physicians (*Kassenärztliche*  
117 *Vereinigung Bayerns*, KVB) comparing the years 2011 and 2012, under influence of the co-  
118 payment, with the period from 2013 to 2016, following the abolition of the co-payment. As the  
119 KVB data are recorded quarterly, the investigation period is divided into 24 quarters (8 before  
120 and 16 after the abolition of co-payment), representing 24 successive sections that were each  
121 analysed in a cross-sectional way.

### 123 **Population and sources of data**

124 Situated in the south of Germany, Bavaria is the largest German federal state by area and with  
125 13 million inhabitants the second most populous.[15] The KVB is the statutory organisation  
126 responsible for ambulatory physicians in Bavaria and is thus the primary source for such  
127 administrative routine data. The data have been used extensively for health services and  
128 medical research.[16-19] They cover all statutorily insured outpatients in the German federal  
129 state of Bavaria, which corresponds to approximately 85% of the Bavarian population whereas  
130 15% of patients are privately insured, mostly civil servants and people with an income higher  
131 than €56 250 per year (2016). Furthermore, we only included patients aged  $\geq 18$  years, as  
132 children are mainly coordinated by paediatricians, and patients with residential address in  
133 Bavaria. Thus, the study population does not contain the entire Bavarian population.

135 The patient-level data are submitted by approximately 9 000 GPs, 13 000 specialists in  
136 outpatient care, and 4 000 psychotherapists for the purpose of remuneration. They detail the  
137 diagnostic and therapeutic procedures claimed along with the corresponding medical  
138 diagnoses, recorded on a quarterly basis using the German modification of the ICD-10  
139 classification (International Classification of Diseases, 10<sup>th</sup> Revision). Claims comprise an  
140 episode-based payment for each patient, which is documented quarterly including diagnoses  
141 and medical procedures, supplemented by additional claims for time-consuming or technical  
142 services (e.g. chronic disease management, lung function testing or emergency visits). One  
143 treatment episode, in the following denoted as a 'case', is defined in the German statutory  
144 health system as the consultation of a single practice within a 3-month period (quarter). If a  
145 patient consults the same practice for different reasons within the quarterly period, both  
146 contacts are merged for administrative purposes to form a single case.

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3 148 The Bavarian Index of Multiple Deprivation (BIMD) 2010, subdivided into quintiles, was used  
4 149 to account for socioeconomic area deprivation at the district level.[20] This index is based on  
5 150 an established British method for Indices of Multiple Deprivation[21] and combines official  
6 151 sociodemographic, socioeconomic and environmental data, divided in seven domains of  
7 152 deprivation.[20]  
8 153 Diagnoses were aggregated using the KM87a\_2015 grouper.[22] This grouper was developed  
9 154 in the United States and modified for the healthcare system by an official organ of the German  
10 155 Ministry of Health, the Institute for Strategic Assessment of Reimbursement for Medical  
11 156 Services (German: *Institut des Bewertungsausschusses*, InBA), in order to measure morbidity  
12 157 within the German ambulatory system. The grouper specifies 72 aggregated medical condition  
13 158 categories, in order to provide a convenient and cost-based system for the analysis of the  
14 159 complex ICD-10 diagnoses. Specifically, the number of condition categories was used as a  
15 160 proxy for morbidity.

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### 162 **Definition of Coordinated Care**

163 Similar to previous analyses, a patient was defined as 'coordinated' if every regular specialist  
164 164 consultation within a quarter was conducted on referral from a GP (coordinated patients,  
165 165 CP).[16 ,17] Patients consulting at least one specialist within a quarter without a referral were  
166 166 classified as uncoordinated (uncoordinated patients, UP). The referral status is present in the  
167 167 claims submitted by the receiving physician. In addition, following previous studies we defined  
168 168 a regular specialist consultation as one in which a referral from a GP can be expected under a  
169 169 GP-centred system. Therefore, specialists billing for emergency treatment, pregnancy care or  
170 170 routine screening (e.g. mammography) were excluded. Similarly, consultations with  
171 171 radiologists, anaesthetists, surgeons, nuclear physicians and dialysis centres were not  
172 172 considered when determining the status of GP coordination, as these often occur on referral  
173 173 from a specialist. These patients were classified as 'Not relevant for coordinated care'.  
174 174 Additionally, patients who consulted only a GP within a quarter were classified as 'GP care  
175 175 only'.

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### 177 **Outcomes**

178 178 Of primary interest was the percentage of patients with GP-coordinated care and specifically,  
179 179 how this changed after abolition of the co-payment. In addition to the quarterly coordination  
180 180 status, we assessed the within-patient consistency of this measure over the course of each  
181 181 year.

182 182 As secondary outcome measures, the developments in the number of ambulatory emergency  
183 183 cases and apparent 'doctor shopping' were analysed, again with respect to the abolition of the  
184 184 co-payment. Ambulatory emergencies include both out-of-hours services and emergency care

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3 185 not leading to a hospital admission. We included ambulatory emergency visits, as they  
4 186 represent alternative patient pathways that patients can freely choose, but which are not  
5 187 necessarily desirable from a health policy perspective. In this case, the abolition may also have  
6 188 had an effect, as the co-payment also has to be for ambulatory emergency services. In keeping  
7 189 with previous studies, apparent 'doctor shopping' was defined as the regular consultation (as  
8 190 defined for coordination of care) of two or more practices from the same specialism within a  
9 191 quarterly period. We focussed only on those specialist groups in which more than 2.5% of  
10 192 patients consult multiple physicians in the same quarter.  
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### 18 194 **Statistical analysis**

19 195 To visualize the potential effect of the abolition of the consultation fee on specialist contacts in  
20 196 2012, a descriptive analysis of the patient population was conducted in tabular form  
21 197 differentiated by age, sex and morbidity. Time series are presented in graphical form on a  
22 198 quarterly basis. Graphical analysis of specialist utilization was performed accounting for area-  
23 199 level deprivation and age. We aggregated the claims data to generate time series for the  
24 200 proportion of coordinated and uncoordinated patients over a six-year period, of which two years  
25 201 were under the influence of the co-payment and four years were without co-payment.

26 202 In order to analyse the impact of the abolition of the co-payment on ambulatory emergency  
27 203 care, we had to operationalise the consistency in coordination status during the course of a  
28 204 year. Therefore, patients were divided into three subgroups: 1) patients with a GP referral for  
29 205 each specialist visit in each quarter of a specific year ('Always coordinated'), 2) patients for  
30 206 whom all specialist contacts occurred without GP referral ('Always uncoordinated'); and 3)  
31 207 patients whose coordination status was inconsistent over the course of a specific year  
32 208 ('Partially coordinated'). A complementary perspective was obtained by stratifying coordination  
33 209 by the number of ambulatory emergency contacts (0, 1, 2 or  $\geq 3$  contacts annually).

34 210 The effect of the abolition on emergency cases and apparent 'doctor shopping' was quantified  
35 211 by means of interrupted time series regression models without adjustment for  
36 212 autocorrelation.[23] This method facilitates a simple decomposition of the time series into  
37 213 effects for the long-term trend (slope) and abolition of the co-payment ('step' at the time of  
38 214 abolition). As emergency cases vary considerably by quarter, and depend on the timing of  
39 215 holidays (e.g. Easter), we aggregate this outcome by year in the main manuscript to provide a  
40 216 more interpretable measure. A graphical presentation of all quarters can be found in the  
41 217 appendix (Supplement Figure 1).  
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### 57 219 **Data protection**

58 220 The research project was performed in accordance with the German guideline 'Good Practice  
59 221 for Secondary Data Analysis' (German: *Gute Praxis Sekundärdatenanalyse*).[24] Data were

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3 222 anonymous and an approval was obtained from the data protection officer of the Bavarian  
4 223 Association of Statutory Health Insurance Physicians.

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### 8 225 **Patient and public involvement**

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10 226 Patients were not involved in setting the research question, in the outcome measures, in the  
11 227 design, or in the implementation of the study. No patients were asked to advice on  
12  
13 228 interpretation or writing up of results. There are no plans to disseminate the results of the  
14  
15 229 research to study participants or the relevant patient community, which is due to the nature of  
16 230 the cohort study using secondary data.  
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## 231 RESULTS

232 Baseline data of the study population are presented in Table 1. In order to reduce the length  
233 of this table and highlight long-term trends, we report data from the first quarter of each year  
234 (all quarters are presented in Supplement Table 1). At the beginning of the investigation period  
235 (quarter 1/2011), 6 235 739 patients in Bavaria had at least one physician contact. Until 2016,  
236 this number increased up to 6 856 489 patients. Additionally, the number of patients that  
237 consulted a specialist, increased in absolute numbers from 3 401 779 (54.6%) (1/2011) to  
238 3 667 886 (53.5%) (1/2016).

### 239 Coordination of specialist visits:

240 Of these patients with specialist contacts, 1 685 655 (49.6%) patients were GP-coordinated  
241 (coordinated patients, CPs) and 1 716 124 (50.4%) uncoordinated (uncoordinated patients,  
242 UPs) (Table 1). In the first quarter after the abolition of the co-payment (quarter 1/2013), the  
243 number of CPs was 883 894 (25.2%) whereas the number of UPs was 2 626 830 (74.8%). In  
244 2016, this decrease continued, with 568 526 (15.5%) CPs and 3 099 360 (84.5%) UPs. The  
245 contact rate per patient (defined as cases per patient) increased in the UP group from 3.7 in  
246 2011 to 3.9 in 2016.

### 247 Age and gender distribution:

248 Both the CP and UP groups showed a slight increase in the average age, from 57.4 and 51.4  
249 years (quarter 1/2011) to 59.3 and 53.9 years (quarter 1/2016), respectively. Greater  
250 differences were observed in gender distribution, with a decreasing proportion of women only  
251 in the CP group (quarter 1/2011: 59.2%; quarter 1/2016: 51.5%).

### 252 Chronical and mental illness:

253 Additionally, the UP group exhibited an increased proportion of chronic (quarter 1/2011: 70.1%;  
254 quarter 1/2016: 77.8 %) and mental illness (quarter 1/2011: 39.2%; quarter 1/2016: 43.6%).  
255 The group 'GP care only' showed a slight increase in the number of patients and a decrease  
256 concerning the proportion of women, whereas other parameters remain stable.

**Table 1** Patient characteristics, classified according to coordination status (only the first quarter of respective years).

Quarter	Coordination status	Patients		Cases per patient		Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)	(mean)	(SD)					
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								

GP, general practitioners; n, number; SD, standard deviation.

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### 261 Coordination, Deprivation and Age

262 Stratified by quintiles of the BIMD 2010 (Figure 1a), the proportion of patients whose specialist  
 263 contacts were GP coordinated ranged between 42% and 54% under the co-payment and  
 264 decreased sharply for all quintiles to between 21% and 30% immediately following its abolition.  
 265 Throughout the following observation period, a slow but steady decline is observable. By 2016,  
 266 the proportion with coordinated care had decreased to below 20% in all BIMD categories.

10

267 Differences between BIMD categories remained, with lower proportions of coordination in  
 268 areas with low deprivation ('20% lowest deprivation' and '21-40%') and higher rates of  
 269 coordination in areas with higher deprivation ('41-60%' and '61-80%'). Stratification by age  
 270 (Figure 1b) revealed a similar trend, with a low CP proportion among the young and a high  
 271 proportion in older groups. The difference in the CP proportion between age groups was twice  
 272 as large before co-payment abolition, with a continued slow convergence of the groups until  
 273 the end of observation in 2016.

274

### 275 **Continuity of Coordination within a year**

276 Focusing on the continuity of GP coordination over the course of the year, a change in patient  
 277 behaviour after co-payment abolition was observable (Figure 2). After 2012, the proportion of  
 278 patients in the group 'Always coordinated' was greatly reduced, as was the group of patients  
 279 with inconsistent coordination behaviour ('Partially coordinated'). Moreover, a correspondingly  
 280 large increase was evident in the group of patients whose specialist utilisation was 'Always  
 281 uncoordinated'.

282 Stratification by the number of emergency treatment contacts suggests that the reduced GP  
 283 coordination was even stronger in categories with more emergency contacts (see also  
 284 interrupted time series analysis in Supplement Table 2). In the category with three or more  
 285 emergency treatment episodes, the proportion of 'Always coordinated' patients decreased  
 286 from 30% in 2011 to approximately 7% in 2016.

287

### 288 **Emergency Treatment**

289 Table 2 shows the development in the number of ambulatory emergency treatment episodes.  
 290 Under the influence of the co-payment in 2011 and 2012, the number amounted to  
 291 approximately 1.5 million cases. Throughout the observation period, an underlying yearly  
 292 increase of approximately 3% can be observed. However, immediately after the abolition in  
 293 2013, the number of emergency treatments episodes increased by additional 10% to 1.7 million  
 294 cases (see also interrupted time series analysis in Supplement Table 3 and a graphical  
 295 presentation of all quarters in Supplement Figure 1).

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298 **Table 2** Development of the number of ambulatory emergency cases in Bavaria, index year (100%)  
 299 2012.

Year	Emergency Episodes (n)	Index 2012 (%)
2011	1 484 119	97
2012	1 527 017	100

2013	1 726 868	113
2014	1 781 266	117
2015	1 817 742	119
2016	1 872 695	123

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### 301 **Apparent Doctor Shopping**

302 The specialist groups in which at least 2.5% of patients consulted multiple practices were  
 303 dermatology, gynaecology, ENT, ophthalmology, surgery, and orthopaedics. Following  
 304 abolition of the co-payment, there were no changes observable among gynaecologists,  
 305 whereas surgeons, ophthalmologists, dermatologists and ENT specialists showed a  
 306 statistically significant increase in multiple utilisation, which increased by between 0.25% and  
 307 0.5%, representing approximately 1 500 (surgery) to 4 500 (orthopaedics) patients per  
 308 specialist area per quarter (Figure 3a and interrupted time series analysis in Supplement Table  
 309 4). Figure 3b shows the development of multiple visits in the selected groups from 2011 to  
 310 2016. Here, as well as in the interrupted time series, the greatest increase occurred in  
 311 orthopaedics group. In 2011, 4% of orthopaedic patients had multiple visits, 4.5% in 2013 and  
 312 5% at the beginning of 2016.

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### 315 **DISCUSSION**

316 After the abolition of the co-payment, the proportion of coordinated patients decreased  
 317 markedly from 49.6% (2011) to 15.5% (2016). Younger patients and those living in areas with  
 318 lower levels of deprivation showed the lowest proportions of coordination, irrespective of the  
 319 co-payment. However, even in these 'low-coordinated' groups the coordination further  
 320 decreased after abolition. Additionally, there were concomitant increases in the number of  
 321 ambulatory emergency contacts and to a lesser extent in the number of patients with apparent  
 322 'doctor shopping'. The number of patients consulting any physician increased slightly over  
 323 time.

324

325 A previous cross-sectional study by Schneider et al. showed that ambulatory health care costs  
 326 of coordinated patients were on average €9.65 lower than patients without coordination.[16] A  
 327 further analysis, which based on the same data, found that the proportion of coordinated  
 328 patients was significantly higher in rural and deprived areas, e.g. due to a lower specialist  
 329 density in rural areas, as well as among older patients and patients with chronic diseases.[17]  
 330 The present investigation adds a longitudinal perspective by observing time periods with and  
 331 without co-payment. The previous studies[16 ,17] showed that the proportion of GP

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3 332 coordinated patients in the first quarter of 2011 (45.1%) corresponded approximately with  
4 333 those in the present study (49.6%). The differences can be arisen from the improved data  
5 334 quality (e.g. a more consistent patient identifier) and minor changes in the definition of a regular  
6 335 treatment episode (e.g. exclusion of pregnancy and birth control consultations, as these  
7 336 gynaecologic consultations usually occur without a referral). Consistent with the preceding  
8 337 investigation,[16 ,17] the present study found higher rates of coordination in areas with higher  
9 338 deprivation, as well as in older patient groups. These general tendencies are observed  
10 339 irrespective of the co-payment. Additionally, the decrease of coordination appears to be similar  
11 340 over all deprivation categories and age groups.

12 341  
13 342 Due to the unrestricted access to specialist care in Germany, a field of concern is the issue of  
14 343 'doctor shopping', whereby a patient consults multiple physicians from the same specialist  
15 344 group for a second opinion without medical need. As gatekeeper, a family doctor has the  
16 345 potential to reduce such duplicate examinations. The abolition of the co-payment led to only a  
17 346 small increase in such behaviour, although a substantial increase was observed in orthopaedic  
18 347 practices, with about 4 500 additional cases. Therefore, it is possible that the co-payment had  
19 348 a coordinating influence on this specialist group. A review by Biernikiewicz et al. indicated that  
20 349 repeated consultations occur most often in patients with a chronic disease, multiple  
21 350 comorbidities, a drug addiction or the fact that their problem remains unresolved (persistent  
22 351 symptoms despite receiving treatment). It is unclear whether the concentration among  
23 352 orthopaedic physicians is due to drug abuse (e.g. repeated prescriptions of pain killers) or due  
24 353 to patient dissatisfaction with persisting symptoms. Further research is required to investigate  
25 354 the reasons.[25]

26 355  
27 356 Increasing contact rates appear to occur also in ambulatory emergency departments. It was  
28 357 described recently, that Germany has experienced steadily increasing contact numbers in  
29 358 ambulatory emergency departments.[26 ,27] The present study quantified this, finding an  
30 359 annual rate of increase of 3% and a one-off jump of 13% between 2012 and 2013. The abolition  
31 360 of the co-payment may have contributed to this increase, as a €10 fee also had to be paid for  
32 361 ambulatory emergency contacts. Scherer et al. showed that 54.7% of emergency patients  
33 362 estimated the degree of their treatment urgency as low, implying that they did not fall into the  
34 363 category of a medical emergency. As motives, Patients stated 'convenience' or the expectation  
35 364 of better care than in the ambulatory sector.[27] Such cases, which are more appropriately  
36 365 treated by a GP, lower the concentration of truly urgent cases in emergency departments. This  
37 366 reduces the effectiveness of care and increases the likelihood of adverse effects, as specialists  
38 367 can no longer concentrate on their core competencies.[28] In this case, the co-payment could  
39 368 have been a certain inhibition threshold. David et al. indicated that the behaviour controlling



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3 369 effect of the co-payment might have led to a more appropriate utilisation of emergency  
4 370 department services.[29] Nevertheless, a causal inference between co-payment abolition and  
5 371 the rising number of emergency cases is not possible. Concurrent changes in the provision  
6 372 and billing of out-of-hours services, in particular a gradual change to more structured weekday  
7 373 evening services, make it difficult to identify the pure effect of the co-payment. National data  
8 374 show similar trends, although out-of-hours services are structured differently in each federal  
9 375 region.[30]

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14 377 Generally, we found no strong effect of the co-payment on the total number of specialist  
15 378 contacts. The overall number of physician contacts changed slightly (quarter 1/2011:  
16 379 6 235 739; quarter 1/2013: 6 542 239; quarter 1/2016: 6 856 489), following a trend observed  
17 380 during the time of the co-payment.[12] However, the proportion of uncoordinated specialist  
18 381 contact rates increased remarkably. Similarly, evaluations in Austria[31] and Germany[32-34]  
19 382 showed that the introduction of a co-payment had no significant influence on the number of  
20 383 physician contacts, while a study from Belgium[35] identified a negative effect on the number  
21 384 of contacts. More specifically, Hafner et al. showed in a survey with 90 patients in Austria, that  
22 385 patients would reduce the number of consultations if a co-payment of €50 was imposed; this  
23 386 decline was mainly driven by lower-income patient groups.[31] In the context of the German  
24 387 co-payment, €10 per quarter is a low barrier to ambulatory care. However, the additive impact  
25 388 of the co-payment was an effective incentive for coordinated care, as, for example, a patient  
26 389 that has consulted three practices without referral had to pay €30. Nevertheless, it must be  
27 390 noted that co-payments have the potential to be a barrier for persons with low socio-economic  
28 391 status, especially when the co-payment is income-independent. Concerning the German co-  
29 392 payment, the evidence is inconsistent. A study by Rückert et al.[36] showed that people with  
30 393 lower socio-economic status more often delayed or avoided physician visits due to the co-  
31 394 payment. Grabka et al.[32] and Schreyögg et al.[37] did not find any socio-economic  
32 395 differences. An alternative approach is to implement a mandatory primary care system to  
33 396 strengthen coordination of care. In the current political discussion, there are considerations to  
34 397 implement GP-centred care models,[6] perhaps in combination with financial incentives for  
35 398 participating patients.[38]

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38 400 In the light of recent findings of Gray et al.,[39] the general loss of coordinated care represents  
39 401 a matter of concern. They showed that an increased continuity of care, with respect to both  
40 402 GPs and specialists, leads to reductions in mortality. In our analysis, the pronounced decrease  
41 403 in coordinated care among older patient groups after the abolition is of special concern  
42 404 because such patients are particularly vulnerable, e.g. due to comorbid chronic diseases. This  
43 405 represents a weakening of the main benefits of strong primary care and consequently of a well-

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3 406 functioning healthcare system. The impact of a strong primary care, especially in the case of  
4 407 chronic diseases, was shown by a recently published study of Basu et al..[5] A higher primary  
5 408 care density was associated with longer life expectancy. Additionally, an increase of 10 primary  
6 409 care physicians per 100 000 inhabitants was associated with a lower mortality rate for  
7 410 cardiovascular and respiratory diseases as well as for cancer. The authors concluded that a  
8 411 solid primary care is the foundation of a well-functioning health care system. Despite the  
9 412 difficulties inherent in making causal statements based on the observation of such  
10 413 interdependent systems, the authors were able to conclude that a solid primary care is the  
11 414 foundation of a well-functioning health system.  
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### 19 416 **Strengths and limitations**

20 417 A major strength of the present study is the analysis of longitudinal claims data, covering 85%  
21 418 of the Bavarian population over six years. Including all statutory insured patients in Bavaria,  
22 419 Germany, a higher representativeness and generalisability of the results can be assumed than  
23 420 in studies that, for example, analyse the data of selected health insurance companies.  
24 421 Additionally, to the best of our knowledge, this represents the first published study assessing  
25 422 the impact of the abolition of the co-payment, as existing studies were either conducted after  
26 423 its introduction[32-34] or immediately before its abolition.[16 ,17 ,37] Although one technical  
27 424 report published in German investigated the change in various time series, it did so without  
28 425 regard to the level of GP coordination or other structural factors such as regional  
29 426 deprivation.[30] Therefore, the present study is unique in observing a six-year period  
30 427 immediately before and after the abolition of the co-payment.  
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38 428 However, the use of routine data has some limitations, as they were originally collected for  
39 429 billing purposes and not for research. In particular, we were unable to verify the extent to which  
40 430 a referral constituted an active coordination on the part of the GP. For example, referrals to a  
41 431 specialist could also be requested without a prior appointment with the GP.[40] Consequently,  
42 432 the proportion of patients with referrals might overestimate the proportion of patients with active  
43 433 GP-centred coordination. On the other hand, it is conceivable that some patients without  
44 434 administrative referral did in fact experience GP coordination. This could occur if, for example,  
45 435 the patient failed to deliver the referral form to the specialist. Additionally, the mentioned  
46 436 change in out-of-hours services could be partly responsible for the increase in emergency  
47 437 contacts. Further, we are unaware of any other administrative changes. However, we cannot  
48 438 exclude that there have been changes that may have influenced the coordination of care.  
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55 439 Besides healthcare costs, distance to services and waiting time are two additionally relevant  
56 440 aspects concerning healthcare use. In case of distance, Figure 1 includes a breakdown by  
57 441 quintile of multiple deprivation. It was not possible to analyse waiting times as these data were  
58 442 not available in the claims data. However, waiting times for consultations with specialists are  
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3 443 low in Germany if compared with international health care systems, due in large part to the  
4 444 high physician density of specialists in ambulatory care.[41 ,42]  
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6 445 Furthermore, no direct conclusion can be drawn concerning the quality of care. The outcomes  
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8 446 'patient coordination', 'consistency', 'ambulatory emergency contacts' and 'doctor shopping'  
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10 447 might, however, be viewed as surrogate parameters for effective primary care. Additionally,  
11 448 we did not consider outcome quality and had no access to mortality or hospitalisation data.  
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## 15 451 **Conclusion**

16 452 The present study shows that the abolition of the German co-payment in 2012 was followed  
17 453 by an immediate and a substantial decrease in GP-centred coordination of specialist care.  
18 454 Thus, the abolition of co-payment led to a change only between coordinated vs. uncoordinated  
19 455 care, whereas the impact on the number of specialist contacts and on the 'GP only' group was  
20 456 comparatively low. This effect was accompanied by an increase in emergency cases and to a  
21 457 lesser extent in apparent 'doctor shopping'. These findings suggest that the co-payment was  
22 458 a partly effective tool for supporting coordinated care. Nevertheless, the German co-payment  
23 459 was associated with high bureaucratic efforts. Thus, alternative methods, such as a mandatory  
24 460 primary care system with referrals, might be more reasonable. Future studies are required to  
25 461 investigate how the gatekeeping function of GPs in Germany can best be strengthened while  
26 462 minimising the associated administrative overhead.  
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3 464 **Author Contributions**

4 465 MO, ED, MT, RG, KL, WM, LS, and AS designed the study. MO and ED performed the  
5 466 analysis. MO, ED, and AS wrote the initial version of the manuscript. MO, ED, MT, RG, KL,  
6 467 WM, LS, and AS revised the manuscript. All authors read and approved the final manuscript.  
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10 468

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13 471 Germany (Zentralinstitut für die Kassenärztliche Versorgung in Deutschland).  
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16 472

17 473 **Competing interests**

18 474 ED, MT, and RG are employees of the Association of Statutory Health Insurance Physicians  
19 475 of Bavaria.  
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22 476

23 477 **Provenance and peer review**

24 478 Not commissioned; externally peer reviewed.  
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27 479

28 480 **Data sharing statement**

29 481 The data that support the findings of this study are available from the Bavarian Association of  
30 482 Statutory Health Insurance Physicians but restrictions apply to the availability of these data,  
31 483 which were used under licence for the current study and are not publicly available. Data may  
32 484 be obtained from the authors upon reasonable request and with permission of the Bavarian  
33 485 Association of Statutory Health Insurance Physicians.  
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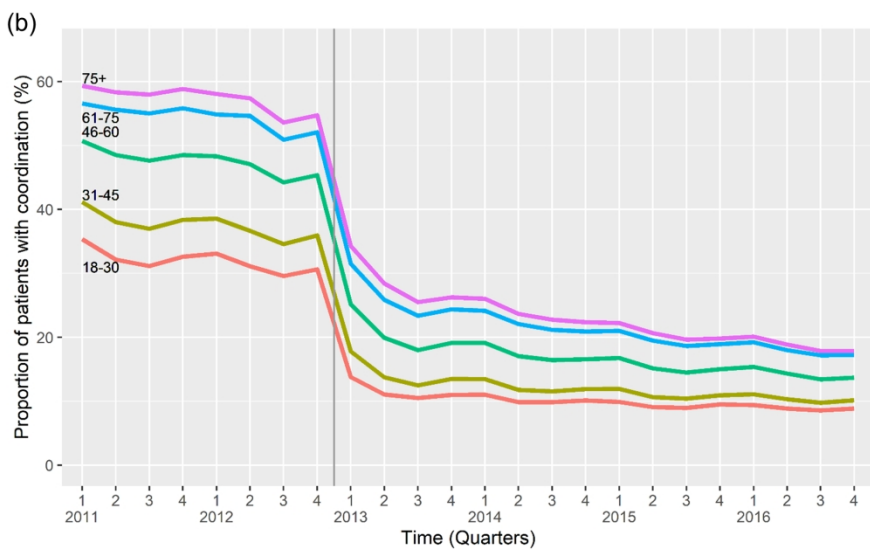
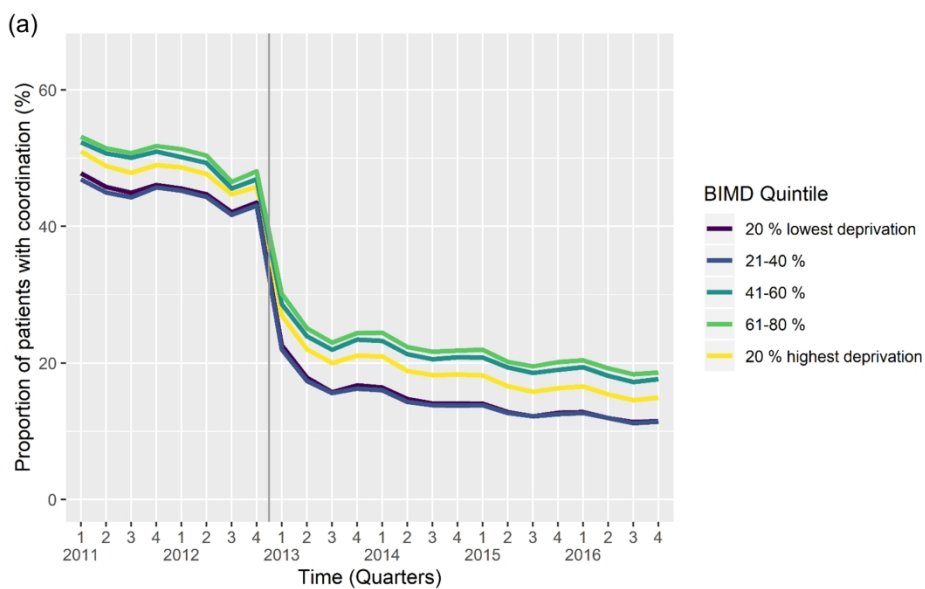
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3 584 **Summary of figures**

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5 585 **Figure 1** Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the  
6 586 BIMD 2010 (a) and age (b).

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9 587 **Figure 2** Continuity of coordination within one year according to the number of ambulatory  
10 588 emergency visits within one year. Yellow bars represent the proportion of patients that  
11 589 consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars  
12 590 represent patients that had a GP referral for every specialist visit ('Always coordinated'), and  
13 591 green bars represent patients with a switching coordination status ('Partially coordinated').

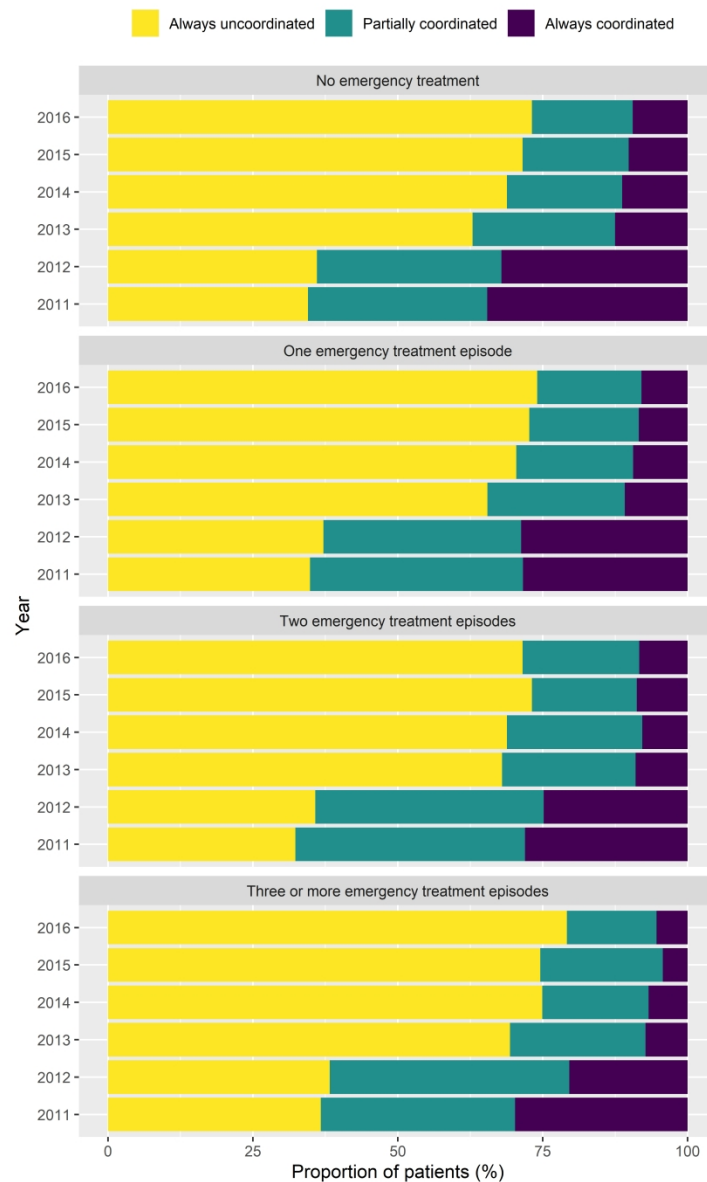
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17 592 **Figure 3** Effect of the abolition of the co-payment on multiple specialist contacts of the same  
18 593 discipline as estimated by the interrupted time series regression model, with 95% confidence  
19 594 interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).



Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the BIMD 2010 (a) and age (b).

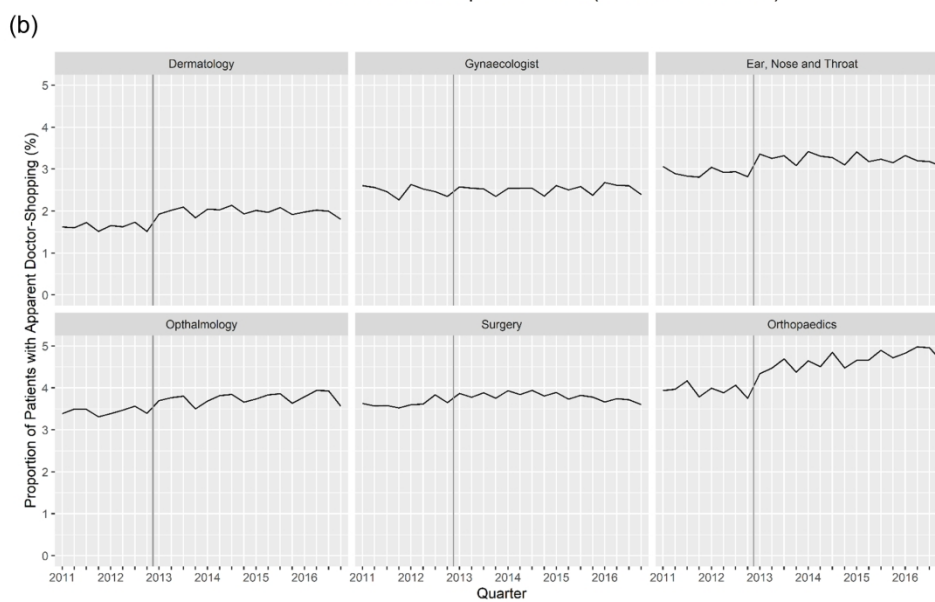
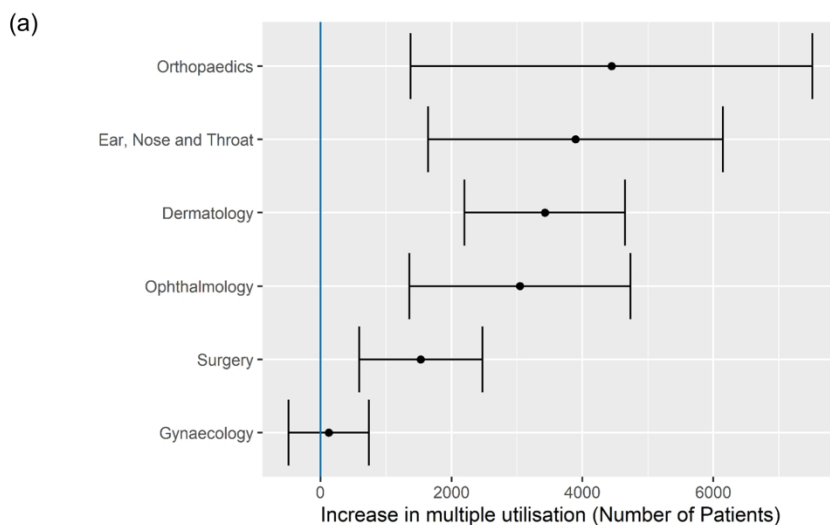
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45 Continuity of coordination within one year according to the number of ambulatory emergency visits within  
 46 one year. Yellow bars represent the proportion of patients that consistently contacted a specialist without a  
 47 GP referral ('Always uncoordinated'), blue bars represent patients that had a GP referral for every specialist  
 48 visit ('Always coordinated'), and green bars represent patients with a switching coordination status ('Partially  
 49 coordinated').

50 149x249mm (600 x 600 DPI)



Effect of the abolition of the co-payment on multiple specialist contacts of the same discipline as estimated by the interrupted time series regression model, with 95% confidence interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).

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## Supplementary Tables

**Supplement Table 1** Patient characteristics, classified according to coordination status.

Quarter	Coordination status	Patients		Cases per patient (mean)	Age		Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)		(mean)	(SD)				
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
2/2011	Coordinated care	1 580 662	26.0	3.8	58.2	17.7	59.7	88.3	43.4	9.0
	Uncoordinated care	1 735 990	28.5	3.6	51.5	18.7	59.3	71.4	39.5	7.6
	GP care only	1 619 287	26.6	1.1	50.0	19.8	50.1	68.2	26.4	5.5
	Not relevant for coordinated care	1 151 214	19.0	2.6	48.2	19.9	71.8	63.0	29.6	6.2
	Total	6 087 153								
3/2011	Coordinated care	1 552 705	25.6	3.9	58.4	17.7	59.6	88.3	43.5	9.0
	Uncoordinated care	1 759 789	29.0	3.7	51.4	18.7	59.1	70.9	39.3	7.6
	GP care only	1 597 252	26.3	1.1	50.2	19.8	50.3	68.6	26.5	5.5
	Not relevant for coordinated care	1 161 260	19.1	2.6	47.9	19.9	72.2	62.2	29.6	6.1
	Total	6 071 006								
4/2011	Coordinated care	1 628 179	26.1	3.9	58.4	17.6	59.5	86.6	42.8	8.9
	Uncoordinated care	1 761 055	28.2	3.7	51.7	18.5	59.2	70.3	39.3	7.6
	GP care only	1 677 964	26.9	1.1	49.8	19.9	49.6	66.1	25.6	5.4
	Not relevant for coordinated care	1 178 683	18.9	2.6	47.9	19.8	72.1	61.0	29.0	6.0
	Total	6 245 881								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
2/2012	Coordinated care	1 562 731	25.5	3.9	58.6	17.6	59.6	88.5	44.1	9.1
	Uncoordinated care	1 788 677	29.2	3.6	51.8	18.7	59.1	71.6	40.1	7.7
	GP care only	1 600 505	26.1	1.1	49.9	19.9	49.9	67.7	26.9	5.5
	Not relevant for coordinated care	1 177 067	19.2	2.6	48.3	19.9	71.8	62.6	30.0	6.2
	Total	6 128 980								
3/2012	Coordinated care	1 456 069	24.1	3.9	58.3	17.8	59.1	87.9	43.9	9.0
	Uncoordinated care	1 883 960	31.1	3.6	51.9	18.8	59.0	71.7	40.2	7.7
	GP care only	1 535 559	25.4	1.1	50.1	19.9	49.7	68.1	26.8	5.5
	Not relevant for coordinated care	1 176 532	19.4	2.6	47.9	19.9	72.1	61.7	29.9	6.1
	Total	6 052 120								

Quarter	Coordination status	Patients		Cases per patient (mean)	Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)	
		(n)	(%)							
4/2012	Coordinated care	1 526 191	24.5	3.8	58.4	17.6	59.0	86.3	43.3	8.9
	Uncoordinated care	1 870 570	30.0	3.6	52.3	18.6	59.3	71.1	40.1	7.7
	GP care only	1 637 222	26.3	1.1	49.5	19.9	48.9	64.7	25.8	5.3
	Not relevant for coordinated care	1 193 379	19.2	2.6	47.9	19.7	72.1	60.2	29.3	6.0
	Total	6 227 362								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
2/2013	Coordinated care	715 492	11.2	3.8	60.3	17.2	54.9	89.2	40.9	9.0
	Uncoordinated care	2 790 655	43.6	3.7	53.3	18.6	60.2	75.8	42.2	8.1
	GP care only	1 667 506	26.0	1.1	49.6	19.7	48.7	67.0	26.4	5.4
	Not relevant for coordinated care	1 227 680	19.2	3.6	48.0	19.8	72.0	61.8	29.8	6.1
	Total	6 401 333								
3/2013	Coordinated care	639 323	10.0	3.8	60.0	17.4	54.0	88.3	40.1	9.0
	Uncoordinated care	2 827 789	44.3	3.6	53.3	18.7	59.9	75.6	42.2	8.1
	GP care only	1 691 144	26.5	1.1	50.1	19.7	49.1	67.8	26.6	5.5
	Not relevant for coordinated care	1 221 995	19.2	2.6	47.7	19.9	72.3	61.1	29.8	6.1
	Total	6 380 251								
4/2013	Coordinated care	685 699	10.4	3.7	60.0	17.2	53.8	85.2	39.2	8.8
	Uncoordinated care	2 837 061	43.1	3.7	53.6	18.6	60.3	75.3	42.2	8.1
	GP care only	1 813 341	27.6	1.1	50.1	19.7	48.6	64.7	25.9	5.3
	Not relevant for coordinated care	1 245 121	18.9	2.6	47.8	19.8	71.9	60.0	29.3	6.0
	Total	6 581 222								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
2/2014	Coordinated care	614 868	9.4	3.7	60.0	17.3	53.4	88.9	40.4	9.0
	Uncoordinated care	2 916 939	44.5	3.7	53.6	18.7	60.1	77.8	43.4	8.3
	GP care only	1 788 918	27.3	1.1	50.3	19.6	48.8	68.6	27.4	5.5
	Not relevant for coordinated care	1 235 298	18.8	2.6	48.1	19.9	71.6	63.7	30.7	6.2
	Total	6 556 023								
3/2014	Coordinated care	599 391	9.1	3.8	59.8	17.5	53.2	88.1	39.9	8.9
	Uncoordinated care	2 968 314	45.1	3.7	53.6	18.7	59.9	77.3	43.2	8.2
	GP care only	1 766 847	26.8	1.2	50.5	19.7	48.6	68.7	27.2	5.5

Quarter	Coordination status	Patients		Cases per patient (mean)	Age		Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)		(mean)	(SD)				
	Not relevant for coordinated care	1 248 495	19.0	2.6	47.7	19.9	71.8	62.4	30.4	6.1
	Total	6 583 047								
4/2014	Coordinated care	610 445	9.1	3.8	59.6	17.4	52.6	85.9	39.2	8.8
	Uncoordinated care	3 007 717	44.7	3.8	53.9	18.6	60.1	76.8	43.0	8.2
	GP care only	1 839 683	27.3	1.1	50.0	19.6	48.0	66.6	26.6	5.3
	Not relevant for coordinated care	1 271 794	18.9	2.6	47.8	19.8	71.5	61.0	29.8	6.0
	Total	6 729 639								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
2/2015	Coordinated care	554 975	8.4	3.8	59.9	17.4	52.6	88.7	40.0	9.0
	Uncoordinated care	3 029 301	45.7	3.7	53.9	18.7	59.9	78.4	43.5	8.3
	GP care only	1 774 779	26.8	1.1	50.3	19.6	48.3	69.0	27.7	5.5
	Not relevant for coordinated care	1 273 946	19.2	2.6	48.1	20.0	71.5	63.5	30.4	6.2
	Total	6 633 001								
3/2015	Coordinated care	529 977	8.0	3.8	59.6	17.6	52.2	87.8	39.6	8.9
	Uncoordinated care	3 044 692	45.8	3.7	53.8	18.8	59.5	77.9	43.3	8.3
	GP care only	1 793 325	27.0	1.2	50.5	19.6	48.5	69.1	27.6	5.5
	Not relevant for coordinated care	1 273 049	19.2	2.7	47.8	20.0	71.9	62.7	30.3	6.2
	Total	6 641 043								
4/2015	Coordinated care	562 112	8.3	3.8	59.5	17.4	51.9	85.7	39.0	8.8
	Uncoordinated care	3 112 307	45.7	3.8	54.1	18.6	59.9	77.4	43.1	8.3
	GP care only	1 835 257	26.9	1.1	49.9	19.6	47.5	66.8	26.7	5.3
	Not relevant for coordinated care	1 300 370	19.1	2.7	47.7	19.8	71.5	61.0	29.6	6.0
	Total	6 810 046								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								
2/2016	Coordinated care	543 658	8.0	3.8	59.5	17.5	52.0	88.2	39.5	8.9
	Uncoordinated care	3 202 755	47.0	3.8	54.1	18.7	59.9	78.6	43.5	8.3
	GP care only	1 762 914	25.9	1.1	49.9	19.6	47.3	67.9	27.3	5.4
	Not relevant for coordinated care	1 304 098	19.1	2.7	47.9	19.9	71.0	63.2	29.9	6.1
	Total	6 813 425								

Quarter	Coordination status	Patients		Cases per patient (mean)	Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)	
		(n)	(%)							
3/2016	Coordinated care	497 527	7.4	3.8	59.5	17.6	51.9	87.7	39.3	8.9
	Uncoordinated care	3 121 810	46.4	3.8	54.1	18.8	59.5	78.5	43.5	8.3
	GP care only	1 813 330	27.0	1.2	50.5	19.7	48.1	69.2	27.8	5.5
	Not relevant for coordinated care	1 291 769	19.0	2.7	47.7	20.0	71.3	62.9	30.2	6.2
	Total	6 724 436								
4/2016	Coordinated care	516 249	7.4	3.8	59.5	17.5	51.3	85.8	38.8	8.8
	Uncoordinated care	3 170 525	46.0	3.8	54.4	18.6	59.7	78.0	43.4	8.3
	GP care only	1 937 562	28.0	1.1	49.5	19.6	47.0	65.7	26.6	5.3
	Not relevant for coordinated care	1 312 583	19.0	2.7	47.7	19.8	71.0	61.4	29.6	6.1
	Total	6 936 919								

GP, general practitioners; n, number; SD, standard deviation.

**Supplement Table 2** Interrupted time series regression model concerning abolition of the co-payment, consistency of GP coordination and ambulatory emergency contacts. Outcome variable: Proportion of patients with coordination throughout the year (%).

Coefficients	Standard		t-value	Pr (> t )
	Estimate	Error		
(Intercept)	32.0238	0.9474	33.802	< 0.001
<i>Number of emergency contacts (Ref.: 0)</i>				
1	-2.7420	1.0699	-2.563	0.01957
2	-3.8892	1.0699	-3.635	0.00189
3 or more	-6.0522	1.0699	-5.657	< 0.001
Trend year for year	-0.9937	0.3951	-2.515	0.02161
Absence of co-payment	-16.7683	1.4314	-11.715	< 0.001

Supplement Table 2 shows how the consistency of GP coordination (%) is pronounced in groups with different ambulatory emergency contacts. The numbers of "Estimate" refer to the category "always coordinated" (see also Figure 2 in the main text). "Trend year for year" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.

**Supplement Table 3** Interrupted time series regression model concerning abolition of the co-payment and ambulatory emergency contacts. Outcome variable: Development of ambulatory emergency contacts (%) (Index: Emergency contacts in 2012).

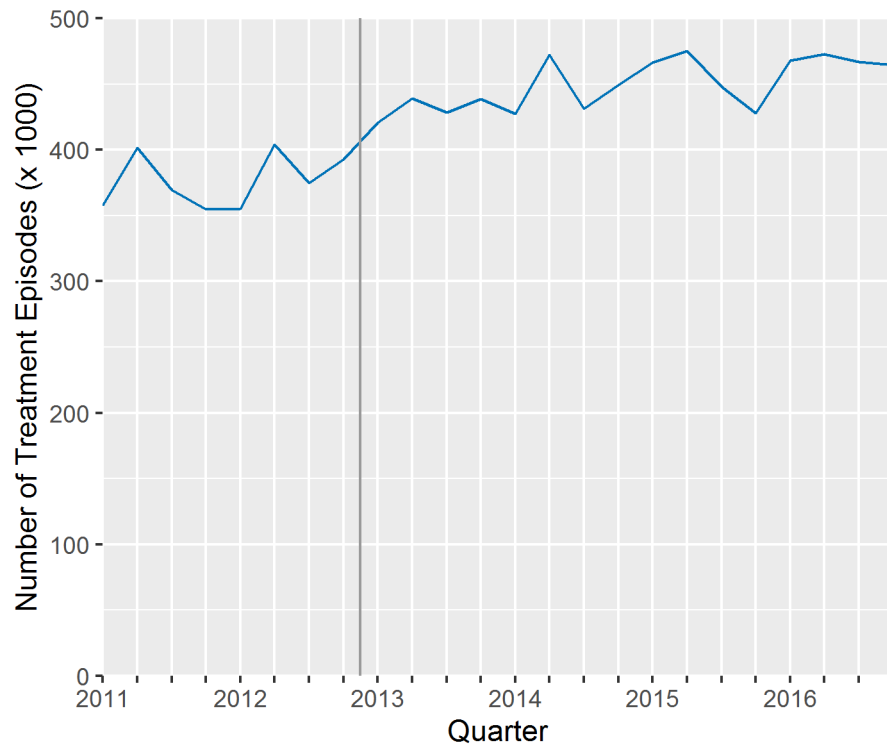
Coefficients	Estimate	Standard Error	t-value	Pr (> t )
(Intercept)	97.0568	0.2427	399.97	< 0.001
Trend year for year	3.0770	0.1401	21.96	< 0.001
Absence of co-payment	10.0270	0.5076	19.75	< 0.001

Supplement Table 3 shows how changes in ambulatory emergency contact numbers (%) are pronounced over time (see also Table 2 in the main text). Again, "Trend year for year" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.

**Supplement Table 4** Interrupted time series regression model concerning abolition of the co-payment and multiple specialist contacts of the same discipline ('doctor shopping'). Outcome variable: Number of patients with multiple specialist utilisation.

Specialist group	Coefficients	Estimate	Standard Error	t-value	Pr (> t )
Dermatology	(Intercept)	10952.626309	310.76910	35.2436142	< 0.001
	Trend quarter by quarter	5.535340	40.12012	0.1379692	0.89158
	Absence of co-payment	3426.888416	589.13085	5.8168545	< 0.001
Orthopaedics	(Intercept)	34713.817408	777.81769	44.6297609	< 0.001
	Trend quarter by quarter	381.195026	100.41583	3.7961646	0.00106
	Absence of co-payment	4445.597186	1474.52366	3.0149378	0.00659
Surgery	(Intercept)	15345.746073	237.88726	64.5084833	< 0.001
	Trend quarter by quarter	-7.606021	30.71111	-0.2476635	0.80680
	Absence of co-payment	1532.772251	450.96736	3.3988541	0.00271
Ophthalmology	(Intercept)	34915.145288	427.84504	81.6069884	< 0.001
	Trend quarter by quarter	70.422775	55.23456	1.2749767	0.21624
	Absence of co-payment	3046.926702	811.07391	3.7566573	0.00116
Ear, Nose and Throat	(Intercept)	17381.999346	570.81974	30.4509427	< 0.001
	Trend quarter by quarter	-13.642670	73.69251	-0.1851297	0.85490
	Absence of co-payment	3895.399542	1082.11376	3.5998060	0.00168
Gynaecologist	(Intercept)	10847.602094	155.22381	69.8836205	< 0.001
	Trend quarter by quarter	40.506544	20.03931	2.0213544	0.05617
	Absence of co-payment	129.171466	294.26071	0.4389695	0.6651

Supplement Table 4 shows the changes in apparent 'doctor shopping' (contact numbers) concerning dermatology, orthopaedics, surgery, ophthalmology, ENT, and gynaecologists. The numbers of "Estimate" refer to the number of multiple contacts within a specialist group. Again, "Trend quarter by quarter" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.



**Supplement Figure 1** Development of the number of ambulatory emergency cases in Bavaria between 2011 and 2016, quarterly.

review only



**The RECORD statement: Checklist of items, extended from the STROBE statement, which should be reported in observational studies using routinely collected health data.**

	Item No.	STROBE items	Location in the manuscript where items are reported	RECORD items	Location in the manuscript where items are reported
<b>Title and Abstract</b>					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract. (b) Provide in the abstract an informative and balanced summary of what was done and what was found.	Done: Title and abstract	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Done: Title and abstract
<b>Introduction</b>					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported.	Done: Introduction		
Objectives	3	State specific objectives, including any pre-specified hypotheses.	Done: Objectives		
<b>Methods</b>					
Study Design	4	Present key elements of study design early in the paper.	Done: Section: Sources of data & Cohort and study design		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	Done: Methods, Section: Sources of data & Cohort and study design		

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Participants	6	(a) <i>Cohort study</i> : Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up. <i>Case-control study</i> : Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. <i>Cross-sectional study</i> : Give the eligibility criteria and the sources and methods of selection of participants. (b) <i>Cohort study</i> : For matched studies, give matching criteria and number of exposed and unexposed. <i>Case-control study</i> : For matched studies, give matching criteria and the number of controls per case.	Done: Methods, Section: Cohort & Study design  n/a	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.  RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.  RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request  See: Study Mehring et al. (2017)  n/a
21 22 23 24 25 26 27 28	Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Done: Methods / Supplement	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
29 30 31 32 33 34 35 36	Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	Done: Methods		
37 38	Bias	9	Describe any efforts to address potential sources of bias.	Done: Methods		
39 40	Study size	10	Explain how the study size was arrived at.	Done: Methods		
41 42 43 44 45 46	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	Done: Methods		

		applicable, describe which groupings were chosen and why.			
Statistical methods	12	<p>(a) Describe all statistical methods, including those used to control for confounding.</p> <p>(b) Describe any methods used to examine subgroups and interactions.</p> <p>(c) Explain how missing data were addressed.</p> <p>(d) <i>Cohort study</i>: If applicable, explain how loss to follow-up was addressed. <i>Case-control study</i>: If applicable, explain how matching of cases and controls was addressed. <i>Cross-sectional study</i>: If applicable, describe analytical methods taking account of sampling strategy.</p> <p>(e) Describe any sensitivity analyses.</p>	Done: Methods		
Data access and cleaning methods		-		<p>RECORD 12.1: Authors should describe the extent to which the investigations had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>The author ED is an employee of the <i>Kassenärztliche Vereinigung Bayerns</i> hand has full access to the underlying database, the author MO has partial access. The authors have the permission of the <i>Kassenärztliche Vereinigung Bayerns</i> to conduct the study.</p>

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1 2 3 4 5 6	Linkage	-		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	No data linkage	
7	<b>Results</b>					
8 9 10 11 12 13 14 15 16 17 18	Participants	13	(a) Report the numbers of individuals at each stage of the study (e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed). (b) Give reasons for nonparticipation at each stage. (c) Consider use of a flow diagram.	Done: Methods, Table 1	RECORD 13.1: Describe in detail the selection of the persons included in the study (i.e., study population selection), including filtering based on data quality, data availability, and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Done: Methods, Section: Cohort and study design, Table 1
19 20 21 22 23 24 25 26 27 28 29	Descriptive data	14	(a) Give characteristics of study participants (e.g., demographic, clinical, and social) and information on exposures and potential confounders. (b) Indicate the number of participants with missing data for each variable of interest. (c) <i>Cohort study</i> : summarise follow-up time (e.g., average and total amount).	Done: Table 1  n/a		
30 31 32 33 34 35 36 37 38 39	Outcome data	15	<i>Cohort study</i> : Report numbers of outcome events or summary measures over time. <i>Case-control study</i> : Report numbers in each exposure category or summary measures of exposure. <i>Cross-sectional study</i> : Report numbers of outcome events or summary measures.	Done: Table 1		
40 41 42 43	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g.,	Done		

		95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.			
Other analyses	17	Report other analyses done – e.g., analyses of subgroups and interactions and sensitivity analyses.	Done: Supplement		
<b>Discussion</b>					
Key results	18	Summarise key results with reference to study objectives.	Done		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	Done	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Done (e.g. effects of different coding practices)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	Done		
Generalisability	21	Discuss the generalisability (external validity) of the study results.	Done		
<b>Other Information</b>					
Funding	22	Give the source of funding and the role of the funders	Done		
Accessibility of protocol, raw data, and programming code		n/a	Done	RECORD 22.1.: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Done. Raw data is subject to data protection concerns. See data sharing

					statement Kassenärztliche Vereinigung Bayerns; codes are available on request
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n/a, not applicable

Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 12.10 (2015): e1001885

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# BMJ Open

## Impact of the abolition of co-payments on the GP-centred coordination of care in Bavaria, Germany: analysis of routinely collected claims data

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<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Health policy, Public health
Keywords:	PRIMARY CARE, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, PUBLIC HEALTH

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13 5 Michaela Olm,<sup>1</sup> Ewan Donnachie,<sup>2</sup> Martin Tauscher,<sup>2</sup> Roman Gerlach,<sup>2</sup> Klaus Linde,<sup>1</sup> Werner  
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25 25 **Keywords: co-payment; primary care; gatekeeping; referral and consultation;**  
26 26 **healthcare administrative claims**

27  
28 28 **Word count: 4 606**

## 29 **ABSTRACT**

### 30 **Objectives:**

31 In 2012, Germany abolished co-payment for consultations in ambulatory care. This study  
32 investigated the effect of the abolition on general practitioner (GP)-centred coordination of  
33 care. We assessed how the proportion of patients with coordinated specialist care changed  
34 over time when co-payment to all specialist services were removed. Furthermore, we studied  
35 how the number of ambulatory emergency cases and apparent 'doctor shopping' changed after  
36 the abolition.

### 37 **Design:**

38 A retrospective routine data analysis of the Bavarian Association of Statutory Health Insurance  
39 Physicians, comparing the years 2011 and 2012 (with co-payment), with the period from 2013  
40 to 2016 (without co-payment). Therefore, time series analyses covering 24 quarters were  
41 performed.

### 42 **Setting:**

43 Primary care in Bavaria, Germany.

### 44 **Participants:**

45 All statutorily insured patients in Bavaria, aged  $\geq 18$  years, with at least one ambulatory  
46 specialist contact between 2011 and 2016.

### 47 **Primary and secondary outcome measures:**

48 Primary outcome was the percentage of patients with GP-coordinated care (every regular  
49 specialist consultation within a quarter was preceded by a GP referral). Secondary outcomes  
50 were the number of ambulatory emergency cases and apparent 'doctor shopping'.

### 51 **Results:**

52 After the abolition, the proportion of coordinated patients decreased from 49.6% (2011) to  
53 15.5% (2016). Overall, younger patients and those living in areas with lower levels of  
54 deprivation showed the lowest proportions of coordination, which further decreased after  
55 abolition. Additionally, there were concomitant increases in the number of ambulatory  
56 emergency contacts and to a lesser extent in the number of patients with apparent 'doctor  
57 shopping'.

### 58 **Conclusions:**

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2  
3 60 The abolition of co-payment in Germany was associated with a substantial decrease in GP  
4 61 coordination of specialist care. This suggests that the co-payment was a partly effective tool  
5 62 to support coordinated care. Future studies are required to investigate how the gatekeeping  
6 63 function of GPs in Germany can best be strengthened while minimising the associated  
7 64 administrative overhead.  
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## 67 **Article Summary**

### 68 **Strengths and limitations of this study:**

- 69 • Containing patients from all statutory health insurances, the results have a high  
70 generalisability.  
71 • This study uniquely observes a 6-year period immediately before and after abolition of the  
72 German co-payment.  
73 • A limitation is that referrals do not represent an active coordination in every case.  
74 • No direct conclusion can be drawn concerning the quality of care.
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## 75 INTRODUCTION

76 Medical progress and demographic change are leading to increased demand for health  
77 services. Although the beneficial impact of modern medicine on health outcomes is obvious, it  
78 is suspected that low coordination of care could harm patients. For example, Fenton et al. have  
79 demonstrated that discretionary care corresponds with higher drug prescription expenditures  
80 and mortality.[1] One potential way to increase the effectiveness of the healthcare system  
81 could be to strengthen patient coordination for example by general practitioners (GPs). A  
82 number of studies have shown that strong primary care has the potential to promote better  
83 health outcomes, especially for chronic diseases, to reduce mortality, and finally can lower  
84 healthcare costs.[2-6] This might be due to the continuity and coordination of care provided by  
85 general practitioners, which also leads to a better and more equitable access to health services  
86 and to a reduction of unnecessary examinations.[4 ,7]

87 Patient coordination can be achieved in several ways, such as gatekeeping systems, the  
88 introduction of co-payments, provision of patient information or through discharge  
89 management.[8-11] Germany has a relatively weak primary care system with respect to the  
90 coordination of care.[7] This is challenging, because GPs and specialists are both working in  
91 licensed private practices in ambulatory care. The specialists comprise mainly dermatologists,  
92 ear, nose and throat (ENT) specialists, gynaecologists, internists with and without  
93 specialisation (e.g. cardiology, gastroenterology, pulmonology and oncology), neurologists,  
94 ophthalmologists, orthopaedics, psychiatrists, psychotherapists (both physician and non-  
95 physician), radiologists, surgeons, and urologists. Internists without specialization are licensed  
96 as general practitioners.

97 Germany has a very high physician contact rate, with an average of 14.7 practice contacts  
98 annually (2016).[12] To strengthen the coordination function of the GP and simultaneously  
99 reduce the rate of unnecessary contacts, a co-payment was introduced in 2004.[13] In each  
100 quarter patients had to pay a €10 fee for the first ambulatory consultation made without referral,  
101 payable to the practice directly. Usually, these referrals are performed by general practitioners,  
102 but patients could also consult a specialist for initial contact. Once the first co-payment in a  
103 quarter had been made, the patient could avoid further payment when consulting other  
104 practices if these were made on referral.

105 In November 2012, the German Federal Parliament ('Bundestag') voted unanimously to  
106 remove the co-payment effective 1 January 2013, as the influence on the number of physician  
107 visits was considered too low in relation to the high bureaucratic efforts.[14] This was reported  
108 widely by German news media, both at the time of the decision and at the beginning of 2013.  
109 The aim of the present study was to investigate the effect of abolishing the co-payment for  
110 ambulatory consultations on the coordination of specialist care in Bavaria, the largest German  
111 federal state by area and the second most populous.[15]

## 112 **METHODS**

### 113 **Study design**

114 The investigation was performed as a retrospective routine data analysis. We conducted an  
115 ecological study with time series analyses of anonymous claims data. The data were provided  
116 by the Bavarian Association of Statutory Health Insurance Physicians (*Kassenärztliche*  
117 *Vereinigung Bayerns*, KVB) comparing the years 2011 and 2012, under influence of the co-  
118 payment, with the period from 2013 to 2016, following the abolition of the co-payment. As the  
119 KVB data are recorded quarterly, the investigation period is divided into 24 quarters (8 before  
120 and 16 after the abolition of co-payment), representing 24 successive sections that were each  
121 analysed in a cross-sectional way.

### 123 **Population and sources of data**

124 Situated in the south of Germany, Bavaria is the largest German federal state by area and with  
125 13 million inhabitants the second most populous.[15] The KVB is the statutory organisation  
126 responsible for ambulatory physicians in Bavaria and is thus the primary source for such  
127 administrative routine data. The data have been used extensively for health services and  
128 medical research.[16-20] They cover all statutorily insured outpatients in the German federal  
129 state of Bavaria, which corresponds to approximately 85% of the Bavarian population whereas  
130 15% of patients are privately insured, mostly civil servants and people with an income higher  
131 than €56 250 per year (2016). Furthermore, we only included patients aged  $\geq 18$  years, as  
132 children are mainly coordinated by paediatricians, and patients with residential address in  
133 Bavaria. Thus, the study population does not contain the entire Bavarian population.

135 The patient-level data are submitted by approximately 9 000 GPs, 13 000 specialists in  
136 outpatient care, and 4 000 psychotherapists for the purpose of remuneration. They detail the  
137 diagnostic and therapeutic procedures claimed along with the corresponding medical  
138 diagnoses, recorded on a quarterly basis using the German modification of the ICD-10  
139 classification (International Classification of Diseases, 10<sup>th</sup> Revision). Claims comprise an  
140 episode-based payment for each patient, which is documented quarterly including diagnoses  
141 and medical procedures, supplemented by additional claims for time-consuming or technical  
142 services (e.g. chronic disease management, lung function testing or emergency visits). One  
143 treatment episode, in the following denoted as a 'case', is defined in the German statutory  
144 health system as the consultation of a single practice within a 3-month period (quarter). If a  
145 patient consults the same practice for different reasons within the quarterly period, both  
146 contacts are merged for administrative purposes to form a single case.

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3 148 The Bavarian Index of Multiple Deprivation (BIMD) 2010, subdivided into quintiles, was used  
4 149 to account for socioeconomic area deprivation at the district level.[21] This index is based on  
5 150 an established British method for Indices of Multiple Deprivation[22] and combines official  
6 151 sociodemographic, socioeconomic and environmental data, divided in seven domains of  
7 152 deprivation.[21]  
8 153 Diagnoses were aggregated using the KM87a\_2015 grouper.[23] This grouper was developed  
9 154 in the United States and modified for the healthcare system by an official organ of the German  
10 155 Ministry of Health, the Institute for Strategic Assessment of Reimbursement for Medical  
11 156 Services (German: *Institut des Bewertungsausschusses*, InBA), in order to measure morbidity  
12 157 within the German ambulatory system. The grouper specifies 72 aggregated medical condition  
13 158 categories, in order to provide a convenient and cost-based system for the analysis of the  
14 159 complex ICD-10 diagnoses. Specifically, the number of condition categories was used as a  
15 160 proxy for morbidity.

### 161 162 **Definition of Coordinated Care**

163 Similar to previous analyses, a patient was defined as 'coordinated' if every regular specialist  
164 164 consultation within a quarter was conducted on referral from a GP (coordinated patients,  
165 165 CP).[16 ,17] Patients consulting at least one specialist within a quarter without a referral were  
166 166 classified as uncoordinated (uncoordinated patients, UP). The referral status is present in the  
167 167 claims submitted by the receiving physician. In addition, following previous studies we defined  
168 168 a regular specialist consultation as one in which a referral from a GP can be expected under a  
169 169 GP-centred system. Therefore, specialists billing for emergency treatment, pregnancy care or  
170 170 routine screening (e.g. mammography) were excluded. Similarly, consultations with  
171 171 radiologists, anaesthetists, surgeons, nuclear physicians and dialysis centres were not  
172 172 considered when determining the status of GP coordination, as these often occur on referral  
173 173 from a specialist. These patients were classified as 'Not relevant for coordinated care'.  
174 174 Additionally, patients who consulted only a GP within a quarter were classified as 'GP care  
175 175 only'.

### 176 177 **Outcomes**

178 178 Of primary interest was the percentage of patients with GP-coordinated care and specifically,  
179 179 how this changed after abolition of the co-payment. In addition to the quarterly coordination  
180 180 status, we assessed the within-patient consistency of this measure over the course of each  
181 181 year.

182 182 As secondary outcome measures, the developments in the number of ambulatory emergency  
183 183 cases and apparent 'doctor shopping' were analysed, again with respect to the abolition of the  
184 184 co-payment. Ambulatory emergencies include both out-of-hours services and emergency care

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3 185 not leading to a hospital admission. We included ambulatory emergency visits, as they  
4 186 represent alternative patient pathways that patients can freely choose, but which are not  
5 187 necessarily desirable from a health policy perspective. In this case, the abolition may also have  
6 188 had an effect, as the co-payment also has to be for ambulatory emergency services. In keeping  
7 189 with previous studies, apparent 'doctor shopping' was defined as the regular consultation (as  
8 190 defined for coordination of care) of two or more practices from the same specialism within a  
9 191 quarterly period. We focussed only on those specialist groups in which more than 2.5% of  
10 192 patients consult multiple physicians in the same quarter.  
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### 18 194 **Statistical analysis**

19 195 To visualize the potential effect of the abolition of the consultation fee on specialist contacts in  
20 196 2012, a descriptive analysis of the patient population was conducted in tabular form  
21 197 differentiated by age, sex and morbidity. Time series are presented in graphical form on a  
22 198 quarterly basis. Graphical analysis of specialist utilization was performed accounting for area-  
23 199 level deprivation and age. We aggregated the claims data to generate time series for the  
24 200 proportion of coordinated and uncoordinated patients over a six-year period, of which two years  
25 201 were under the influence of the co-payment and four years were without co-payment.

26 202 In order to analyse the impact of the abolition of the co-payment on ambulatory emergency  
27 203 care, we had to operationalise the consistency in coordination status during the course of a  
28 204 year. Therefore, patients were divided into three subgroups: 1) patients with a GP referral for  
29 205 each specialist visit in each quarter of a specific year ('Always coordinated'), 2) patients for  
30 206 whom all specialist contacts occurred without GP referral ('Always uncoordinated'); and 3)  
31 207 patients whose coordination status was inconsistent over the course of a specific year  
32 208 ('Partially coordinated'). A complementary perspective was obtained by stratifying coordination  
33 209 by the number of ambulatory emergency contacts (0, 1, 2 or  $\geq 3$  contacts annually).

34 210 The effect of the abolition on emergency cases and apparent 'doctor shopping' was quantified  
35 211 by means of interrupted time series regression models without adjustment for  
36 212 autocorrelation.[24] This method facilitates a simple decomposition of the time series into  
37 213 effects for the long-term trend (slope) and abolition of the co-payment ('step' at the time of  
38 214 abolition). As emergency cases vary considerably by quarter, and depend on the timing of  
39 215 holidays (e.g. Easter), we aggregate this outcome by year in the main manuscript to provide a  
40 216 more interpretable measure. A graphical presentation of all quarters can be found in the  
41 217 appendix (Supplement Figure 1).  
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### 57 219 **Data protection**

58 220 The research project was performed in accordance with the German guideline 'Good Practice  
59 221 for Secondary Data Analysis' (German: *Gute Praxis Sekundärdatenanalyse*).[25] Data were

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3 222 anonymous and an approval was obtained from the data protection officer of the Bavarian  
4 223 Association of Statutory Health Insurance Physicians.

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8 225 **Patient and public involvement**

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10 226 Patients were not involved in setting the research question, in the outcome measures, in the  
11 227 design, or in the implementation of the study. No patients were asked to advice on  
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13 228 interpretation or writing up of results. There are no plans to disseminate the results of the  
14  
15 229 research to study participants or the relevant patient community, which is due to the nature of  
16 230 the cohort study using secondary data.

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## 231 RESULTS

232 Baseline data of the study population are presented in Table 1. In order to reduce the length  
233 of this table and highlight long-term trends, we report data from the first quarter of each year  
234 (all quarters are presented in Supplement Table 1). At the beginning of the investigation period  
235 (quarter 1/2011), 6 235 739 patients in Bavaria had at least one physician contact. Until 2016,  
236 this number increased up to 6 856 489 patients.

### 237 Coordination of specialist visits:

238 Of all patients with specialist contacts in 1/2011 (3 401 779), 1 685 655 (49.6%) patients were  
239 GP-coordinated (coordinated patients, CPs) and 1 716 124 (50.4%) uncoordinated  
240 (uncoordinated patients, UPs) (Table 1). In the first quarter after the abolition of the co-payment  
241 (quarter 1/2013; 3 510 724 specialist contacts), the number of CPs was 883 894 (25.2%)  
242 whereas the number of UPs was 2 626 830 (74.8%). In 1/2016 (3 667 886 specialist contacts),  
243 this decrease continued, with 568 526 (15.5%) CPs and 3 099 360 (84.5%) UPs. The contact  
244 rate per patient (defined as cases per patient) increased in the UP group from 3.7 in 2011 to  
245 3.9 in 2016.

### 246 Age and gender distribution:

247 Both the CP and UP groups showed a slight increase in the average age, from 57.4 and 51.4  
248 years (quarter 1/2011) to 59.3 and 53.9 years (quarter 1/2016), respectively. Greater  
249 differences were observed in gender distribution, with a decreasing proportion of women only  
250 in the CP group (quarter 1/2011: 59.2%; quarter 1/2016: 51.5%).

### 251 Chronical and mental illness:

252 Additionally, the UP group exhibited an increased proportion of chronic (quarter 1/2011: 70.1%;  
253 quarter 1/2016: 77.8 %) and mental illness (quarter 1/2011: 39.2%; quarter 1/2016: 43.6%).  
254 The group 'GP care only' showed a slight increase in the number of patients and a decrease  
255 concerning the proportion of women, whereas other parameters remain stable.

256 **Table 1** Patient characteristics, classified according to coordination status (only the first quarter of  
257 respective years).

Quarter	Coordination status	Patients		Cases per patient		Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)	(mean)	(SD)					
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								

258 GP, general practitioners; n, number; SD, standard deviation.

259

## 260 Coordination, Deprivation and Age

261 Stratified by quintiles of the BIMD 2010 (Figure 1a), the proportion of patients whose specialist  
262 contacts were GP coordinated ranged between 42% and 54% under the co-payment and  
263 decreased sharply for all quintiles to between 21% and 30% immediately following its abolition.  
264 Throughout the following observation period, a slow but steady decline is observable. By 2016,  
265 the proportion with coordinated care had decreased to below 20% in all BIMD categories.

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266 Differences between BIMD categories remained, with lower proportions of coordination in  
 267 areas with low deprivation ('20% lowest deprivation' and '21-40%') and higher rates of  
 268 coordination in areas with higher deprivation ('41-60%' and '61-80%'). Stratification by age  
 269 (Figure 1b) revealed a similar trend, with a low CP proportion among the young and a high  
 270 proportion in older groups. The difference in the CP proportion between age groups was twice  
 271 as large before co-payment abolition, with a continued slow convergence of the groups until  
 272 the end of observation in 2016.

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### 274 **Continuity of Coordination within a year**

275 Focusing on the continuity of GP coordination over the course of the year, a change in patient  
 276 behaviour after co-payment abolition was observable (Figure 2). After 2012, the proportion of  
 277 patients in the group 'Always coordinated' was greatly reduced, as was the group of patients  
 278 with inconsistent coordination behaviour ('Partially coordinated'). Moreover, a correspondingly  
 279 large increase was evident in the group of patients whose specialist utilisation was 'Always  
 280 uncoordinated'.

281 Stratification by the number of emergency treatment contacts suggests that the reduced GP  
 282 coordination was even stronger in categories with more emergency contacts (see also  
 283 interrupted time series analysis in Supplement Table 2). In the category with three or more  
 284 emergency treatment episodes, the proportion of 'Always coordinated' patients decreased  
 285 from 30% in 2011 to approximately 7% in 2016.

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### 287 **Emergency Treatment**

288 Table 2 shows the development in the number of ambulatory emergency treatment episodes.  
 289 Under the influence of the co-payment in 2011 and 2012, the number amounted to  
 290 approximately 1.5 million cases. Throughout the observation period, an underlying yearly  
 291 increase of approximately 3% can be observed. However, immediately after the abolition in  
 292 2013, the number of emergency treatments episodes increased by additional 10% to 1.7 million  
 293 cases (see also interrupted time series analysis in Supplement Table 3 and a graphical  
 294 presentation of all quarters in Supplement Figure 1).

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296

297 **Table 2** Development of the number of ambulatory emergency cases in Bavaria, index year (100%)  
 298 2012.

Year	Emergency Episodes (n)	Index 2012 (%)
2011	1 484 119	97
2012	1 527 017	100

2013	1 726 868	113
2014	1 781 266	117
2015	1 817 742	119
2016	1 872 695	123

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### 300 **Apparent Doctor Shopping**

301 The specialist groups in which at least 2.5% of patients consulted multiple practices were  
 302 dermatology, gynaecology, ENT, ophthalmology, surgery, and orthopaedics. Following  
 303 abolition of the co-payment, there were no changes observable among gynaecologists,  
 304 whereas surgeons, ophthalmologists, dermatologists and ENT specialists showed a  
 305 statistically significant increase in multiple utilisation, which increased by between 0.25% and  
 306 0.5%, representing approximately 1 500 (surgery) to 4 500 (orthopaedics) patients per  
 307 specialist area per quarter (Figure 3a and interrupted time series analysis in Supplement Table  
 308 4). Figure 3b shows the development of multiple visits in the selected groups from 2011 to  
 309 2016. Here, as well as in the interrupted time series, the greatest increase occurred in  
 310 orthopaedics group. In 2011, 4% of orthopaedic patients had multiple visits, 4.5% in 2013 and  
 311 5% at the beginning of 2016.

### 314 **DISCUSSION**

315 After the abolition of the co-payment, the proportion of coordinated patients decreased  
 316 markedly from 49.6% (2011) to 15.5% (2016). Younger patients and those living in areas with  
 317 lower levels of deprivation showed the lowest proportions of coordination, irrespective of the  
 318 co-payment. However, even in these 'low-coordinated' groups the coordination further  
 319 decreased after abolition. Additionally, there were concomitant increases in the number of  
 320 ambulatory emergency contacts and to a lesser extent in the number of patients with apparent  
 321 'doctor shopping'. The number of patients consulting any physician increased slightly over  
 322 time.

323  
 324 A previous cross-sectional study by Schneider et al. showed that ambulatory healthcare costs  
 325 of coordinated patients were on average €9.65 lower than patients without coordination.[16] A  
 326 further analysis, which based on the same data, found that the proportion of coordinated  
 327 patients was significantly higher in rural and deprived areas, e.g. due to a lower specialist  
 328 density in rural areas, as well as among older patients and patients with chronic diseases.[17]  
 329 The present investigation adds a longitudinal perspective by observing time periods with and  
 330 without co-payment. The previous studies[16 ,17] showed that the proportion of GP

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3 331 coordinated patients in the first quarter of 2011 (45.1%) corresponded approximately with  
4 332 those in the present study (49.6%). The differences can be arisen from the improved data  
5 333 quality (e.g. a more consistent patient identifier) and minor changes in the definition of a regular  
6 334 treatment episode (e.g. exclusion of pregnancy and birth control consultations, as these  
7 335 gynaecologic consultations usually occur without a referral). Consistent with the preceding  
8 336 investigation,[16 ,17] the present study found higher rates of coordination in areas with higher  
9 337 deprivation, as well as in older patient groups. These general tendencies are observed  
10 338 irrespective of the co-payment. Additionally, the decrease of coordination appears to be similar  
11 339 over all deprivation categories and age groups.  
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19 341 Due to the unrestricted access to specialist care in Germany, a field of concern is the issue of  
20 342 'doctor shopping', whereby a patient consults multiple physicians from the same specialist  
21 343 group for a second opinion without medical need. As gatekeeper, a family doctor has the  
22 344 potential to reduce such duplicate examinations. The abolition of the co-payment was  
23 345 accompanied by only small increases in doctor shopping, although a substantial increase was  
24 346 observed in orthopaedic practices, with about 4 500 additional cases. Therefore, it is possible  
25 347 that the co-payment had a coordinating influence on this specialist group. A review by  
26 348 Biernikiewicz et al. indicated that repeated consultations occur most often in patients with a  
27 349 chronic disease, multiple comorbidities, a drug addiction or the fact that their problem remains  
28 350 unresolved (persistent symptoms despite receiving treatment). It is unclear whether the  
29 351 concentration among orthopaedic physicians is due to drug abuse (e.g. repeated prescriptions  
30 352 of pain killers) or due to patient dissatisfaction with persisting symptoms. Further research is  
31 353 required to investigate the reasons.[26]  
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41 355 Increasing contact rates appear to occur also in ambulatory emergency departments. It was  
42 356 described recently, that Germany has experienced steadily increasing contact numbers in  
43 357 ambulatory emergency departments.[27 ,28] The present study quantified this, finding an  
44 358 annual rate of increase of 3% and a one-off jump of 13% between 2012 and 2013. The abolition  
45 359 of the co-payment may have contributed to this increase, as a €10 fee also had to be paid for  
46 360 ambulatory emergency contacts. Scherer et al. showed that 54.7% of emergency patients  
47 361 estimated the degree of their treatment urgency as low, implying that they did not fall into the  
48 362 category of a medical emergency. As motives, Patients stated 'convenience' or the expectation  
49 363 of better care than in the ambulatory sector.[28] Such cases, which are more appropriately  
50 364 treated by a GP, lower the concentration of truly urgent cases in emergency departments. This  
51 365 reduces the effectiveness of care and increases the likelihood of adverse effects, as specialists  
52 366 can no longer concentrate on their core competencies.[29] In this case, the co-payment could  
53 367 have been a certain inhibition threshold. David et al. indicated that the behaviour controlling  
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3 368 effect of the co-payment might have led to a more appropriate utilisation of emergency  
4 369 department services.[30] Nevertheless, a causal inference between co-payment abolition and  
5 370 the rising number of emergency cases is not possible. Concurrent changes in the provision  
6 371 and billing of out-of-hours services, in particular a gradual change to more structured weekday  
7 372 evening services, make it difficult to identify the pure effect of the co-payment. National data  
8 373 show similar trends, although out-of-hours services are structured differently in each federal  
9 374 region.[31]

14 375

15 376 Generally, we found no strong association of the co-payment on the total number of specialist  
16 377 contacts. The overall number of physician contacts changed slightly (quarter 1/2011:  
17 378 6 235 739; quarter 1/2013: 6 542 239; quarter 1/2016: 6 856 489), following a trend observed  
18 379 during the time of the co-payment.[12] However, the proportion of uncoordinated specialist  
19 380 contact rates increased remarkably. Similarly, evaluations in Austria[32] and Germany[33-35]  
20 381 showed that the introduction of a co-payment had no significant influence on the number of  
21 382 physician contacts, while a systematic review, considering demand effects in different types of  
22 383 healthcare systems, identified reduced GP and specialist use due to co-payments in the  
23 384 majority of the studies included.[36] In the context of the German co-payment, €10 per quarter  
24 385 is a low barrier to ambulatory care. However, the additive impact of the co-payment was an  
25 386 effective incentive for coordinated care, as, for example, a patient that has consulted three  
26 387 practices without referral had to pay €30. Nevertheless, it must be noted that co-payments  
27 388 have the potential to be a barrier for persons with low socio-economic status, especially when  
28 389 the co-payment is income-independent. Concerning the German co-payment, the evidence is  
29 390 inconsistent. A study by Rückert et al.[37] showed that people with lower socio-economic  
30 391 status more often delayed or avoided physician visits due to the co-payment. Grabka et al.[33]  
31 392 and Schreyögg et al.[38] did not find any socio-economic differences. An alternative approach  
32 393 is to implement a mandatory primary care system to strengthen coordination of care. In the  
33 394 current political discussion, there are considerations to implement GP-centred care models,[6]  
34 395 perhaps in combination with financial incentives for participating patients.[39]

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48 397 In the light of recent findings of Gray et al.,[40] the general loss of coordinated care represents  
49 398 a matter of concern. They showed that an increased continuity of care, with respect to both  
50 399 GPs and specialists, leads to reductions in mortality. In our analysis, the pronounced decrease  
51 400 in coordinated care among older patient groups after the abolition is of special concern  
52 401 because such patients are particularly vulnerable, e.g. due to comorbid chronic diseases. This  
53 402 represents a weakening of the main benefits of strong primary care and consequently of a well-  
54 403 functioning healthcare system. The impact of a strong primary care, especially in the case of  
55 404 chronic diseases, was shown by a recently published study of Basu et al..[5] A higher primary

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3 405 care density was associated with longer life expectancy. Additionally, an increase of 10 primary  
4 406 care physicians per 100 000 inhabitants was associated with a lower mortality rate for  
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6 407 cardiovascular and respiratory diseases as well as for cancer. The authors concluded that a  
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8 408 solid primary care is the foundation of a well-functioning healthcare system. Despite the  
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10 409 difficulties inherent in making causal statements based on the observation of such  
11 410 interdependent systems, the authors were able to conclude that a solid primary care is the  
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13 411 foundation of a well-functioning health system.

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### 15 413 **Strengths and limitations**

16 414 A major strength of the present study is the analysis of longitudinal claims data, covering 85%  
17 415 of the Bavarian population over six years. Including all statutory insured patients in Bavaria,  
18 416 Germany, a higher representativeness and generalisability of the results can be assumed than  
19 417 in studies that, for example, analyse the data of selected health insurance companies.  
20 418 Additionally, to the best of our knowledge, this represents the first published study assessing  
21 419 the impact of the abolition of the co-payment, as existing studies were either conducted after  
22 420 its introduction[33-35] or immediately before its abolition.[16 ,17 ,38] Although one technical  
23 421 report published in German investigated the change in various time series, it did so without  
24 422 regard to the level of GP coordination or other structural factors such as regional  
25 423 deprivation.[31] Therefore, the present study is unique in observing a six-year period  
26 424 immediately before and after the abolition of the co-payment.

27 425 However, the use of routine data has some limitations, as they were originally collected for  
28 426 billing purposes and not for research. In particular, we were unable to verify the extent to which  
29 427 a referral constituted an active coordination on the part of the GP. For example, referrals to a  
30 428 specialist could also be requested without a prior appointment with the GP.[41] Consequently,  
31 429 the proportion of patients with referrals might overestimate the proportion of patients with active  
32 430 GP-centred coordination. On the other hand, it is conceivable that some patients without  
33 431 administrative referral did in fact experience GP coordination. This could occur if, for example,  
34 432 the patient failed to deliver the referral form to the specialist. Additionally, the mentioned  
35 433 change in out-of-hours services could be partly responsible for the increase in emergency  
36 434 contacts. Further, we are unaware of any other administrative changes. However, we cannot  
37 435 exclude that there have been changes that may have influenced the coordination of care.

38 436 Besides healthcare costs, distance to services and waiting time are two additionally relevant  
39 437 aspects concerning healthcare use. As these data were not available in the claims data,  
40 438 analyses were not possible. However, waiting times for consultations with specialists are low  
41 439 in Germany if compared with international healthcare systems, due in large part to the high  
42 440 physician density of specialists in ambulatory care.[42 ,43]

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3 441 Furthermore, no direct conclusion can be drawn concerning the quality of care. The outcomes  
4 442 'patient coordination', 'consistency', 'ambulatory emergency contacts' and 'doctor shopping'  
5 443 might, however, be viewed as surrogate parameters for effective primary care. Additionally,  
6 444 we did not consider outcome quality and had no access to mortality or hospitalisation data.  
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8 445 Since the present study is an ecological study, no causal relationships can be drawn, but only  
9 446 indications of possible associations.  
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## 15 449 **Conclusion**

16 450 The present study shows that the abolition of the German co-payment in 2012 was followed  
17 451 by an immediate and a substantial decrease in GP-centred coordination of specialist care. The  
18 452 abolition was associated with a change between coordinated vs. uncoordinated care, whereas  
19 453 the number of specialist contacts and 'GP only' contacts remained almost stable. Concomitant  
20 454 to these trends, an increase in emergency cases and to a lesser extent in apparent 'doctor  
21 455 shopping' was observable. These findings suggest that the co-payment was a partly effective  
22 456 tool for supporting coordinated care. Nevertheless, the German co-payment was associated  
23 457 with high bureaucratic efforts. Thus, alternative methods, such as a mandatory primary care  
24 458 system with referrals, might be more reasonable. Future studies are required to investigate  
25 459 how the gatekeeping function of GPs in Germany can best be strengthened while minimising  
26 460 the associated administrative overhead.  
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3 462 **Author Contributions**

4 463 MO, ED, MT, RG, KL, WM, LS, and AS designed the study. MO and ED performed the  
5 464 analysis. MO, ED, and AS wrote the initial version of the manuscript. MO, ED, MT, RG, KL,  
6 465 WM, LS, and AS revised the manuscript. All authors read and approved the final manuscript.  
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10 466

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13 469 Germany (Zentralinstitut für die Kassenärztliche Versorgung in Deutschland).  
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16 470

17 471 **Competing interests**

18 472 ED, MT, and RG are employees of the Association of Statutory Health Insurance Physicians  
19 473 of Bavaria.  
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23 475 **Provenance and peer review**

24 476 Not commissioned; externally peer reviewed.  
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28 478 **Data sharing statement**

29 479 The data that support the findings of this study are available from the Bavarian Association of  
30 480 Statutory Health Insurance Physicians but restrictions apply to the availability of these data,  
31 481 which were used under licence for the current study and are not publicly available. Data may  
32 482 be obtained from the authors upon reasonable request and with permission of the Bavarian  
33 483 Association of Statutory Health Insurance Physicians.  
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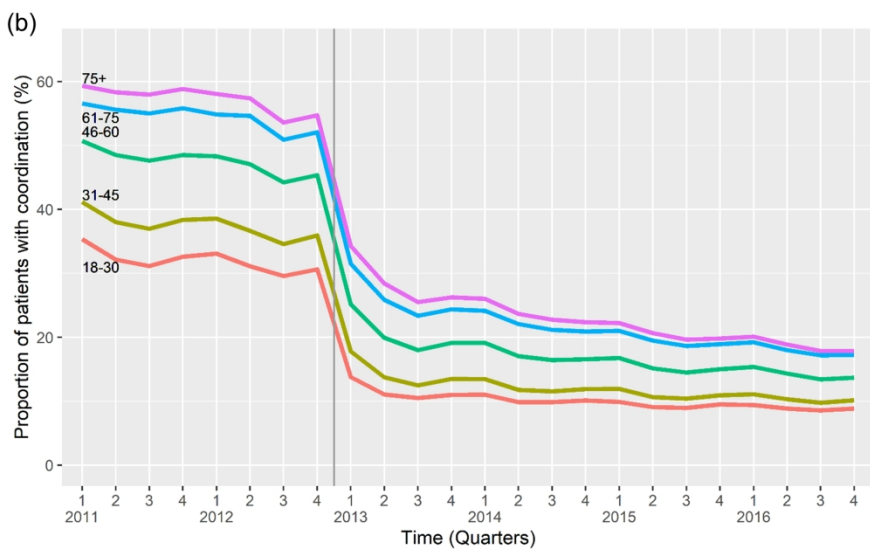
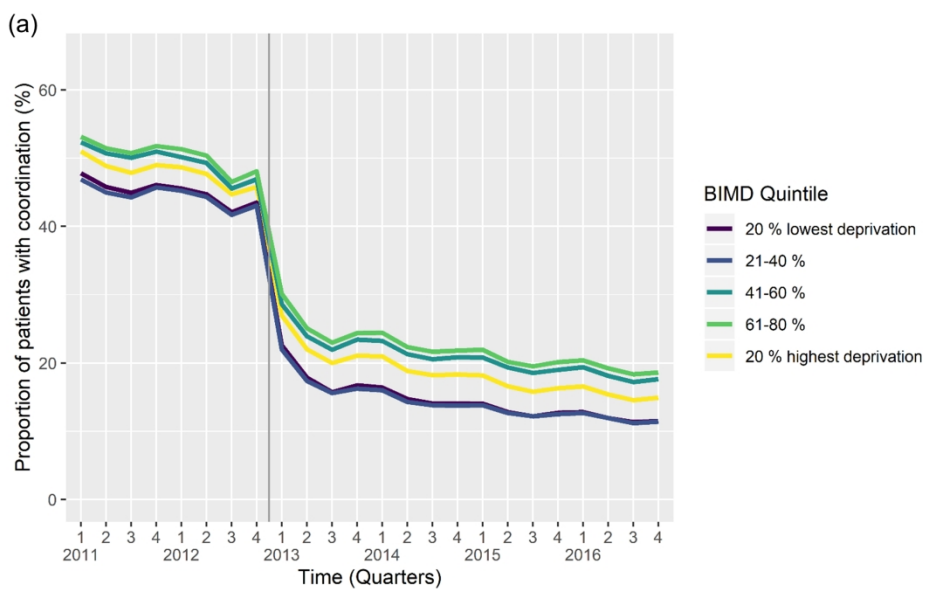
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3 587 **Summary of figures**  
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5 588 **Figure 1** Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the  
6 BIMD 2010 (a) and age (b).  
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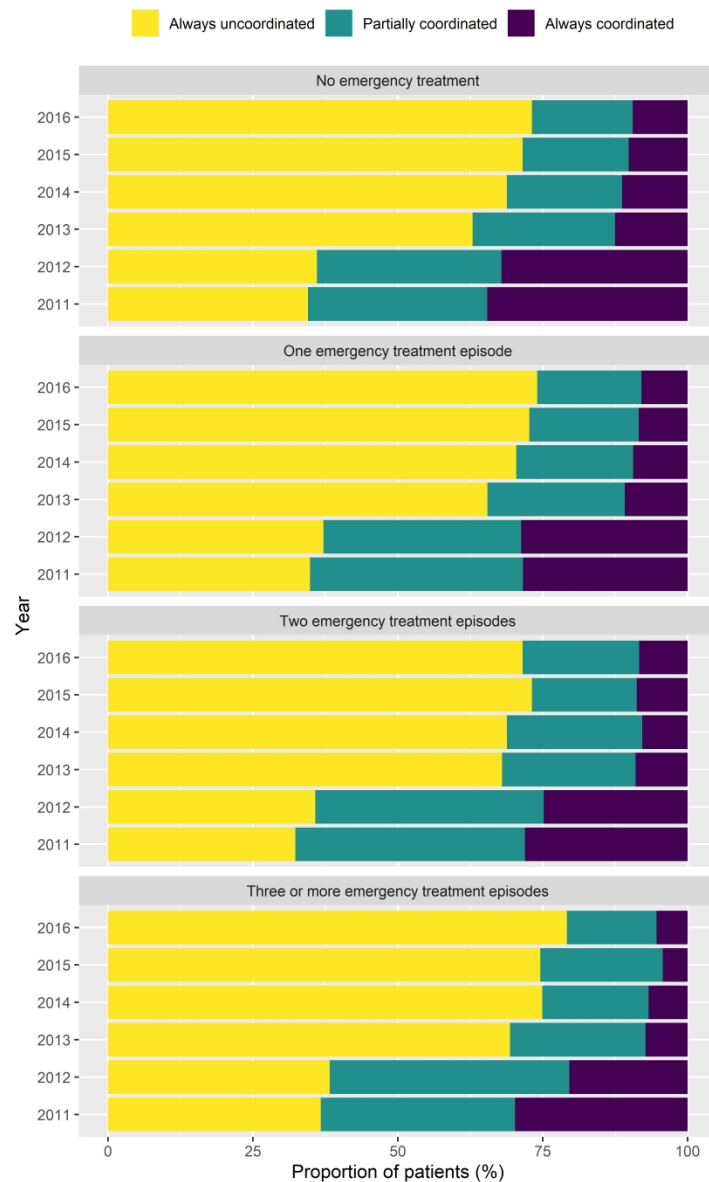
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9 590 **Figure 2** Continuity of coordination within one year according to the number of ambulatory  
10 emergency visits within one year. Yellow bars represent the proportion of patients that  
11 consistently contacted a specialist without a GP referral ('Always uncoordinated'), blue bars  
12 represent patients that had a GP referral for every specialist visit ('Always coordinated'), and  
13 green bars represent patients with a switching coordination status ('Partially coordinated').  
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17 595 **Figure 3** Effect of the abolition of the co-payment on multiple specialist contacts of the same  
18 discipline as estimated by the interrupted time series regression model, with 95% confidence  
19 interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).  
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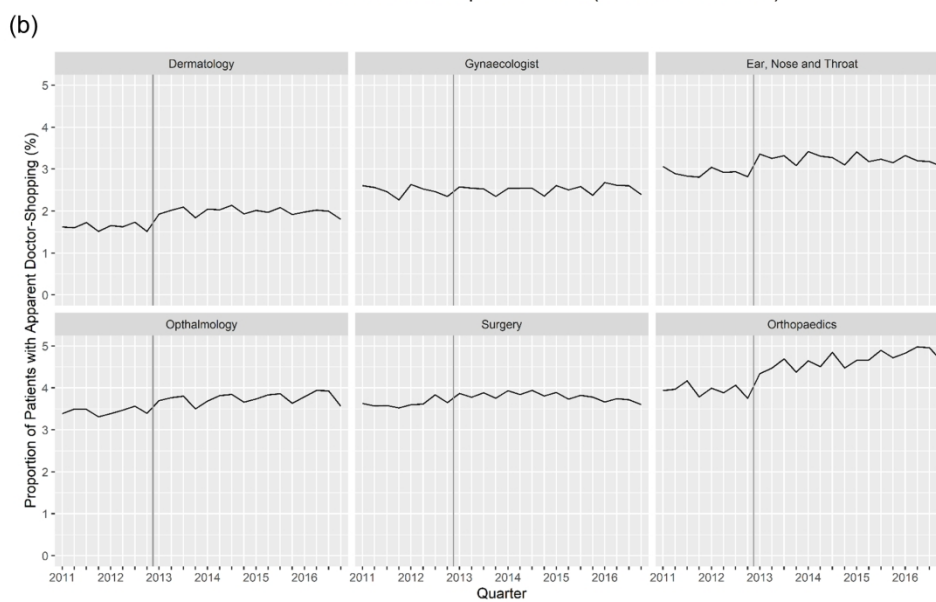
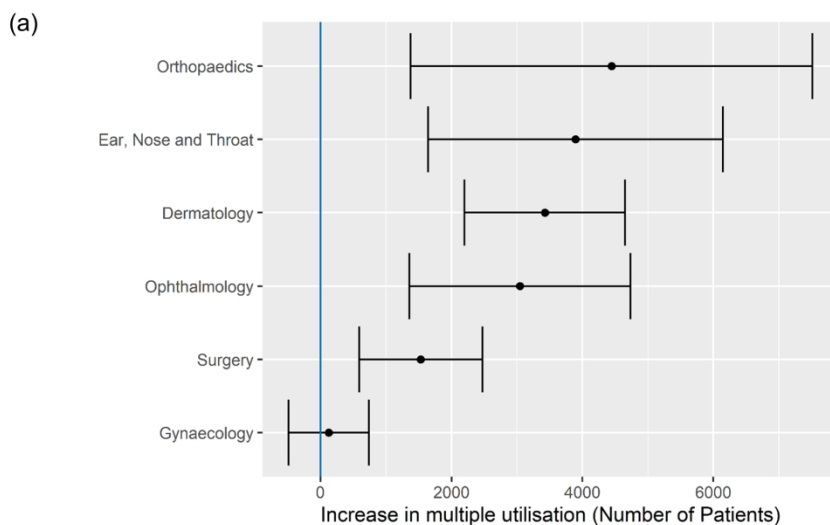
Proportion of patients using GP-coordinated healthcare, stratified by quintiles of the BIMD 2010 (a) and age (b).

190x236mm (300 x 300 DPI)



45 Continuity of coordination within one year according to the number of ambulatory emergency visits within  
 46 one year. Yellow bars represent the proportion of patients that consistently contacted a specialist without a  
 47 GP referral ('Always uncoordinated'), blue bars represent patients that had a GP referral for every specialist  
 48 visit ('Always coordinated'), and green bars represent patients with a switching coordination status ('Partially  
 49 coordinated').

50 149x249mm (600 x 600 DPI)



Effect of the abolition of the co-payment on multiple specialist contacts of the same discipline as estimated by the interrupted time series regression model, with 95% confidence interval (a) and the proportional development between 2011 and 2016 (quarterly) (b).

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## Supplementary Tables

**Supplement Table 1** Patient characteristics, classified according to coordination status.

Quarter	Coordination status	Patients		Cases per patient (mean)	Age		Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)		(mean)	(SD)				
1/2011	Coordinated care	1 685 655	27.0	3.8	57.4	17.7	59.2	86.5	43.1	8.9
	Uncoordinated care	1 716 124	27.5	3.7	51.4	18.5	59.2	70.1	39.2	7.6
	GP care only	1 649 237	26.5	1.1	49.0	19.9	49.3	64.4	25.6	5.4
	Not relevant for coordinated care	1 184 723	19.0	2.6	48.2	19.9	71.1	61.9	29.0	6.1
	Total	6 235 739								
2/2011	Coordinated care	1 580 662	26.0	3.8	58.2	17.7	59.7	88.3	43.4	9.0
	Uncoordinated care	1 735 990	28.5	3.6	51.5	18.7	59.3	71.4	39.5	7.6
	GP care only	1 619 287	26.6	1.1	50.0	19.8	50.1	68.2	26.4	5.5
	Not relevant for coordinated care	1 151 214	19.0	2.6	48.2	19.9	71.8	63.0	29.6	6.2
	Total	6 087 153								
3/2011	Coordinated care	1 552 705	25.6	3.9	58.4	17.7	59.6	88.3	43.5	9.0
	Uncoordinated care	1 759 789	29.0	3.7	51.4	18.7	59.1	70.9	39.3	7.6
	GP care only	1 597 252	26.3	1.1	50.2	19.8	50.3	68.6	26.5	5.5
	Not relevant for coordinated care	1 161 260	19.1	2.6	47.9	19.9	72.2	62.2	29.6	6.1
	Total	6 071 006								
4/2011	Coordinated care	1 628 179	26.1	3.9	58.4	17.6	59.5	86.6	42.8	8.9
	Uncoordinated care	1 761 055	28.2	3.7	51.7	18.5	59.2	70.3	39.3	7.6
	GP care only	1 677 964	26.9	1.1	49.8	19.9	49.6	66.1	25.6	5.4
	Not relevant for coordinated care	1 178 683	18.9	2.6	47.9	19.8	72.1	61.0	29.0	6.0
	Total	6 245 881								
1/2012	Coordinated care	1 641 263	26.2	3.9	57.8	17.7	59.0	86.7	43.7	8.9
	Uncoordinated care	1 811 769	28.9	3.8	51.5	18.5	58.8	70.1	39.6	7.6
	GP care only	1 623 530	25.9	1.1	49.1	19.9	49.2	64.2	26.1	5.4
	Not relevant for coordinated care	1 196 061	19.1	2.7	48.3	20.0	71.3	62.1	29.5	6.1
	Total	6 272 623								
2/2012	Coordinated care	1 562 731	25.5	3.9	58.6	17.6	59.6	88.5	44.1	9.1
	Uncoordinated care	1 788 677	29.2	3.6	51.8	18.7	59.1	71.6	40.1	7.7
	GP care only	1 600 505	26.1	1.1	49.9	19.9	49.9	67.7	26.9	5.5
	Not relevant for coordinated care	1 177 067	19.2	2.6	48.3	19.9	71.8	62.6	30.0	6.2
	Total	6 128 980								
3/2012	Coordinated care	1 456 069	24.1	3.9	58.3	17.8	59.1	87.9	43.9	9.0
	Uncoordinated care	1 883 960	31.1	3.6	51.9	18.8	59.0	71.7	40.2	7.7
	GP care only	1 535 559	25.4	1.1	50.1	19.9	49.7	68.1	26.8	5.5
	Not relevant for coordinated care	1 176 532	19.4	2.6	47.9	19.9	72.1	61.7	29.9	6.1
	Total	6 052 120								



Quarter	Coordination status	Patients		Cases per patient (mean)	Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)	
		(n)	(%)							
4/2012	Coordinated care	1 526 191	24.5	3.8	58.4	17.6	59.0	86.3	43.3	8.9
	Uncoordinated care	1 870 570	30.0	3.6	52.3	18.6	59.3	71.1	40.1	7.7
	GP care only	1 637 222	26.3	1.1	49.5	19.9	48.9	64.7	25.8	5.3
	Not relevant for coordinated care	1 193 379	19.2	2.6	47.9	19.7	72.1	60.2	29.3	6.0
	Total	6 227 362								
1/2013	Coordinated care	883 894	13.5	3.8	59.6	17.1	55.5	88.1	42.1	9.1
	Uncoordinated care	2 626 830	40.2	3.7	52.7	18.5	59.6	73.7	41.6	8.0
	GP care only	1 786 331	27.3	1.1	48.9	19.6	48.5	63.2	25.6	5.3
	Not relevant for coordinated care	1 245 184	19.0	2.6	48.1	19.8	71.0	61.3	29.5	6.1
	Total	6 542 239								
2/2013	Coordinated care	715 492	11.2	3.8	60.3	17.2	54.9	89.2	40.9	9.0
	Uncoordinated care	2 790 655	43.6	3.7	53.3	18.6	60.2	75.8	42.2	8.1
	GP care only	1 667 506	26.0	1.1	49.6	19.7	48.7	67.0	26.4	5.4
	Not relevant for coordinated care	1 227 680	19.2	3.6	48.0	19.8	72.0	61.8	29.8	6.1
	Total	6 401 333								
3/2013	Coordinated care	639 323	10.0	3.8	60.0	17.4	54.0	88.3	40.1	9.0
	Uncoordinated care	2 827 789	44.3	3.6	53.3	18.7	59.9	75.6	42.2	8.1
	GP care only	1 691 144	26.5	1.1	50.1	19.7	49.1	67.8	26.6	5.5
	Not relevant for coordinated care	1 221 995	19.2	2.6	47.7	19.9	72.3	61.1	29.8	6.1
	Total	6 380 251								
4/2013	Coordinated care	685 699	10.4	3.7	60.0	17.2	53.8	85.2	39.2	8.8
	Uncoordinated care	2 837 061	43.1	3.7	53.6	18.6	60.3	75.3	42.2	8.1
	GP care only	1 813 341	27.6	1.1	50.1	19.7	48.6	64.7	25.9	5.3
	Not relevant for coordinated care	1 245 121	18.9	2.6	47.8	19.8	71.9	60.0	29.3	6.0
	Total	6 581 222								
1/2014	Coordinated care	703 377	10.5	3.8	59.6	17.2	53.2	87.8	40.5	9.0
	Uncoordinated care	2 944 931	44.1	3.8	53.3	18.6	60.0	76.4	43.1	8.2
	GP care only	1 762 164	26.4	1.1	49.6	19.7	48.2	65.8	26.8	5.4
	Not relevant for coordinated care	1 271 288	19.0	2.7	48.0	19.9	71.0	62.9	30.2	6.1
	Total	6 681 760								
2/2014	Coordinated care	614 868	9.4	3.7	60.0	17.3	53.4	88.9	40.4	9.0
	Uncoordinated care	2 916 939	44.5	3.7	53.6	18.7	60.1	77.8	43.4	8.3
	GP care only	1 788 918	27.3	1.1	50.3	19.6	48.8	68.6	27.4	5.5
	Not relevant for coordinated care	1 235 298	18.8	2.6	48.1	19.9	71.6	63.7	30.7	6.2
	Total	6 556 023								
3/2014	Coordinated care	599 391	9.1	3.8	59.8	17.5	53.2	88.1	39.9	8.9
	Uncoordinated care	2 968 314	45.1	3.7	53.6	18.7	59.9	77.3	43.2	8.2
	GP care only	1 766 847	26.8	1.2	50.5	19.7	48.6	68.7	27.2	5.5

Quarter	Coordination status	Patients		Cases per patient (mean)	Age		Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)
		(n)	(%)		(mean)	(SD)				
	Not relevant for coordinated care	1 248 495	19.0	2.6	47.7	19.9	71.8	62.4	30.4	6.1
	Total	6 583 047								
4/2014	Coordinated care	610 445	9.1	3.8	59.6	17.4	52.6	85.9	39.2	8.8
	Uncoordinated care	3 007 717	44.7	3.8	53.9	18.6	60.1	76.8	43.0	8.2
	GP care only	1 839 683	27.3	1.1	50.0	19.6	48.0	66.6	26.6	5.3
	Not relevant for coordinated care	1 271 794	18.9	2.6	47.8	19.8	71.5	61.0	29.8	6.0
	Total	6 729 639								
1/2015	Coordinated care	614 518	8.9	3.8	59.4	17.3	52.0	87.5	40.1	9.0
	Uncoordinated care	3 032 169	44.1	3.9	53.6	18.6	59.8	77.1	43.3	8.3
	GP care only	1 937 232	28.1	1.1	49.2	19.5	47.3	63.9	26.3	5.3
	Not relevant for coordinated care	1 298 528	18.9	2.7	48.1	19.9	70.6	62.9	30.0	6.2
	Total	6 882 447								
2/2015	Coordinated care	554 975	8.4	3.8	59.9	17.4	52.6	88.7	40.0	9.0
	Uncoordinated care	3 029 301	45.7	3.7	53.9	18.7	59.9	78.4	43.5	8.3
	GP care only	1 774 779	26.8	1.1	50.3	19.6	48.3	69.0	27.7	5.5
	Not relevant for coordinated care	1 273 946	19.2	2.6	48.1	20.0	71.5	63.5	30.4	6.2
	Total	6 633 001								
3/2015	Coordinated care	529 977	8.0	3.8	59.6	17.6	52.2	87.8	39.6	8.9
	Uncoordinated care	3 044 692	45.8	3.7	53.8	18.8	59.5	77.9	43.3	8.3
	GP care only	1 793 325	27.0	1.2	50.5	19.6	48.5	69.1	27.6	5.5
	Not relevant for coordinated care	1 273 049	19.2	2.7	47.8	20.0	71.9	62.7	30.3	6.2
	Total	6 641 043								
4/2015	Coordinated care	562 112	8.3	3.8	59.5	17.4	51.9	85.7	39.0	8.8
	Uncoordinated care	3 112 307	45.7	3.8	54.1	18.6	59.9	77.4	43.1	8.3
	GP care only	1 835 257	26.9	1.1	49.9	19.6	47.5	66.8	26.7	5.3
	Not relevant for coordinated care	1 300 370	19.1	2.7	47.7	19.8	71.5	61.0	29.6	6.0
	Total	6 810 046								
1/2016	Coordinated care	568 526	8.3	3.8	59.3	17.4	51.5	87.5	39.9	9.0
	Uncoordinated care	3 099 360	45.2	3.9	53.9	18.6	59.6	77.8	43.6	8.3
	GP care only	1 868 128	27.2	1.1	49.4	19.6	47.6	65.8	27.2	5.4
	Not relevant for coordinated care	1 320 475	19.3	2.7	48.1	20.0	70.4	63.3	29.9	6.2
	Total	6 856 489								
2/2016	Coordinated care	543 658	8.0	3.8	59.5	17.5	52.0	88.2	39.5	8.9
	Uncoordinated care	3 202 755	47.0	3.8	54.1	18.7	59.9	78.6	43.5	8.3
	GP care only	1 762 914	25.9	1.1	49.9	19.6	47.3	67.9	27.3	5.4
	Not relevant for coordinated care	1 304 098	19.1	2.7	47.9	19.9	71.0	63.2	29.9	6.1
	Total	6 813 425								

Quarter	Coordination status	Patients		Cases per patient (mean)	Age (mean) (SD)	Sex: female (%)	With chronic illness (%)	With mental illness (%)	Number of medical condition categories (mean)	
		(n)	(%)							
3/2016	Coordinated care	497 527	7.4	3.8	59.5	17.6	51.9	87.7	39.3	8.9
	Uncoordinated care	3 121 810	46.4	3.8	54.1	18.8	59.5	78.5	43.5	8.3
	GP care only	1 813 330	27.0	1.2	50.5	19.7	48.1	69.2	27.8	5.5
	Not relevant for coordinated care	1 291 769	19.0	2.7	47.7	20.0	71.3	62.9	30.2	6.2
	Total	6 724 436								
4/2016	Coordinated care	516 249	7.4	3.8	59.5	17.5	51.3	85.8	38.8	8.8
	Uncoordinated care	3 170 525	46.0	3.8	54.4	18.6	59.7	78.0	43.4	8.3
	GP care only	1 937 562	28.0	1.1	49.5	19.6	47.0	65.7	26.6	5.3
	Not relevant for coordinated care	1 312 583	19.0	2.7	47.7	19.8	71.0	61.4	29.6	6.1
	Total	6 936 919								

GP, general practitioners; n, number; SD, standard deviation.

**Supplement Table 2** Interrupted time series regression model concerning abolition of the co-payment, consistency of GP coordination and ambulatory emergency contacts. Outcome variable: Proportion of patients with coordination throughout the year (%).

Coefficients				
	Estimate	Standard Error	t-value	Pr (> t )
(Intercept)	32.0238	0.9474	33.802	< 0.001
<i>Number of emergency contacts (Ref.: 0)</i>				
1	-2.7420	1.0699	-2.563	0.01957
2	-3.8892	1.0699	-3.635	0.00189
3 or more	-6.0522	1.0699	-5.657	< 0.001
Trend year for year	-0.9937	0.3951	-2.515	0.02161
Absence of co-payment	-16.7683	1.4314	-11.715	< 0.001

Supplement Table 2 shows how the consistency of GP coordination (%) is pronounced in groups with different ambulatory emergency contacts. The numbers of "Estimate" refer to the category "always coordinated" (see also Figure 2 in the main text). "Trend year for year" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.

**Supplement Table 3** Interrupted time series regression model concerning abolition of the co-payment and ambulatory emergency contacts. Outcome variable: Development of ambulatory emergency contacts (%) (Index: Emergency contacts in 2012).

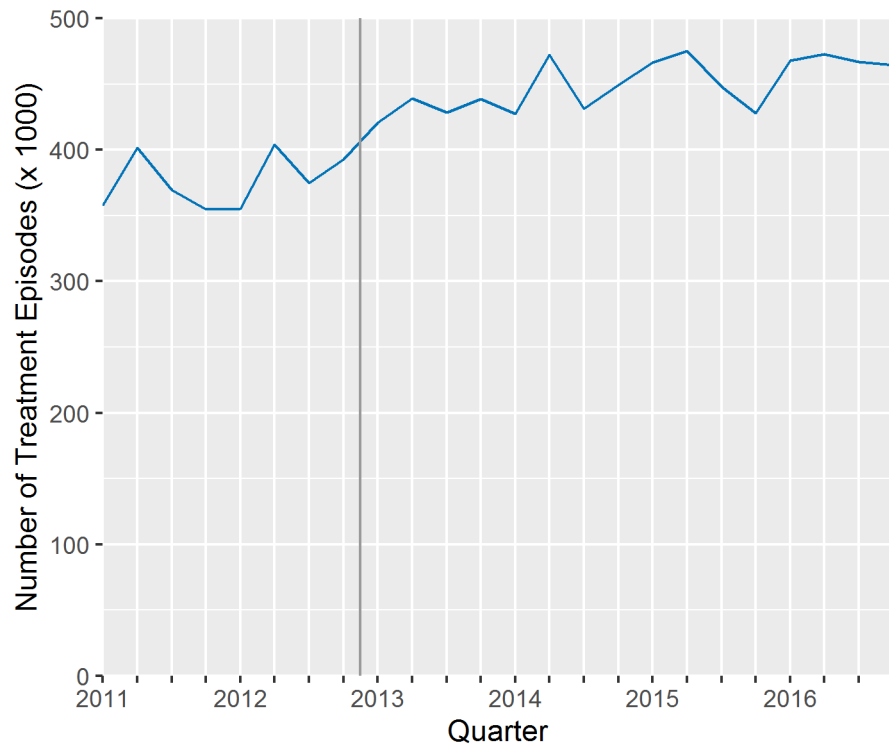
Coefficients				
	Estimate	Standard Error	t-value	Pr (> t )
(Intercept)	97.0568	0.2427	399.97	< 0.001
Trend year for year	3.0770	0.1401	21.96	< 0.001
Absence of co-payment	10.0270	0.5076	19.75	< 0.001

Supplement Table 3 shows how changes in ambulatory emergency contact numbers (%) are pronounced over time (see also Table 2 in the main text). Again, "Trend year for year" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.

**Supplement Table 4** Interrupted time series regression model concerning abolition of the co-payment and multiple specialist contacts of the same discipline ('doctor shopping'). Outcome variable: Number of patients with multiple specialist utilisation.

Specialist group	Coefficients	Estimate	Standard Error	t-value	Pr (> t )
Dermatology	(Intercept)	10952.626309	310.76910	35.2436142	< 0.001
	Trend quarter by quarter	5.535340	40.12012	0.1379692	0.89158
	Absence of co-payment	3426.888416	589.13085	5.8168545	< 0.001
Orthopaedics	(Intercept)	34713.817408	777.81769	44.6297609	< 0.001
	Trend quarter by quarter	381.195026	100.41583	3.7961646	0.00106
	Absence of co-payment	4445.597186	1474.52366	3.0149378	0.00659
Surgery	(Intercept)	15345.746073	237.88726	64.5084833	< 0.001
	Trend quarter by quarter	-7.606021	30.71111	-0.2476635	0.80680
	Absence of co-payment	1532.772251	450.96736	3.3988541	0.00271
Ophthalmology	(Intercept)	34915.145288	427.84504	81.6069884	< 0.001
	Trend quarter by quarter	70.422775	55.23456	1.2749767	0.21624
	Absence of co-payment	3046.926702	811.07391	3.7566573	0.00116
Ear, Nose and Throat	(Intercept)	17381.999346	570.81974	30.4509427	< 0.001
	Trend quarter by quarter	-13.642670	73.69251	-0.1851297	0.85490
	Absence of co-payment	3895.399542	1082.11376	3.5998060	0.00168
Gynaecologist	(Intercept)	10847.602094	155.22381	69.8836205	< 0.001
	Trend quarter by quarter	40.506544	20.03931	2.0213544	0.05617
	Absence of co-payment	129.171466	294.26071	0.4389695	0.6651

Supplement Table 4 shows the changes in apparent 'doctor shopping' (contact numbers) concerning dermatology, orthopaedics, surgery, ophthalmology, ENT, and gynaecologists. The numbers of "Estimate" refer to the number of multiple contacts within a specialist group. Again, "Trend quarter by quarter" represents the long-term trend (slope) from 2011 to 2016. "Absence of co-payment" indicates the abolition effect.



**Supplement Figure 1** Development of the number of ambulatory emergency cases in Bavaria between 2011 and 2016, quarterly.

review only

**The RECORD statement: Checklist of items, extended from the STROBE statement, which should be reported in observational studies using routinely collected health data.**

	Item No.	STROBE items	Location in the manuscript where items are reported	RECORD items	Location in the manuscript where items are reported
<b>Title and Abstract</b>					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract. (b) Provide in the abstract an informative and balanced summary of what was done and what was found.	Done: Title and abstract	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and time frame within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	Done: Title and abstract
<b>Introduction</b>					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported.	Done: Introduction		
Objectives	3	State specific objectives, including any pre-specified hypotheses.	Done: Objectives		
<b>Methods</b>					
Study Design	4	Present key elements of study design early in the paper.	Done: Section: Sources of data & Cohort and study design		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	Done: Methods, Section: Sources of data & Cohort and study design		

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Participants	6	(a) <i>Cohort study</i> : Give the eligibility criteria and the sources and methods of selection of participants. Describe methods of follow-up. <i>Case-control study</i> : Give the eligibility criteria and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. <i>Cross-sectional study</i> : Give the eligibility criteria and the sources and methods of selection of participants. (b) <i>Cohort study</i> : For matched studies, give matching criteria and number of exposed and unexposed. <i>Case-control study</i> : For matched studies, give matching criteria and the number of controls per case.	Done: Methods, Section: Cohort & Study design  n/a	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided.  RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.  RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request  See: Study Mehring et al. (2017)  n/a
21 22 23 24 25 26 27 28	Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Done: Methods / Supplement	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	See data sharing statement <i>Kassenärztliche Vereinigung Bayerns</i> ; codes are available on request
29 30 31 32 33 34 35 36	Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	Done: Methods		
37 38	Bias	9	Describe any efforts to address potential sources of bias.	Done: Methods		
39 40	Study size	10	Explain how the study size was arrived at.	Done: Methods		
41 42 43	Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If	Done: Methods		

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		applicable, describe which groupings were chosen and why.			
Statistical methods	12	<p>(a) Describe all statistical methods, including those used to control for confounding.</p> <p>(b) Describe any methods used to examine subgroups and interactions.</p> <p>(c) Explain how missing data were addressed.</p> <p>(d) <i>Cohort study</i>: If applicable, explain how loss to follow-up was addressed. <i>Case-control study</i>: If applicable, explain how matching of cases and controls was addressed. <i>Cross-sectional study</i>: If applicable, describe analytical methods taking account of sampling strategy.</p> <p>(e) Describe any sensitivity analyses.</p>	Done: Methods		
Data access and cleaning methods		-		<p>RECORD 12.1: Authors should describe the extent to which the investigations had access to the database population used to create the study population.</p> <p>RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>The author ED is an employee of the <i>Kassenärztliche Vereinigung Bayerns</i> hand has full access to the underlying database, the author MO has partial access. The authors have the permission of the <i>Kassenärztliche Vereinigung Bayerns</i> to conduct the study.</p>

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1 2 3 4 5 6	Linkage	-		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	No data linkage	
7	<b>Results</b>					
8 9 10 11 12 13 14 15 16 17 18	Participants	13	(a) Report the numbers of individuals at each stage of the study (e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed). (b) Give reasons for nonparticipation at each stage. (c) Consider use of a flow diagram.	Done: Methods, Table 1	RECORD 13.1: Describe in detail the selection of the persons included in the study (i.e., study population selection), including filtering based on data quality, data availability, and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Done: Methods, Section: Cohort and study design, Table 1
19 20 21 22 23 24 25 26 27 28 29	Descriptive data	14	(a) Give characteristics of study participants (e.g., demographic, clinical, and social) and information on exposures and potential confounders. (b) Indicate the number of participants with missing data for each variable of interest. (c) <i>Cohort study</i> : summarise follow-up time (e.g., average and total amount).	Done: Table 1  n/a		
30 31 32 33 34 35 36 37 38 39	Outcome data	15	<i>Cohort study</i> : Report numbers of outcome events or summary measures over time. <i>Case-control study</i> : Report numbers in each exposure category or summary measures of exposure. <i>Cross-sectional study</i> : Report numbers of outcome events or summary measures.	Done: Table 1		
40 41 42 43	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g.,	Done		

		95% confidence interval). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables were categorized. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.			
Other analyses	17	Report other analyses done – e.g., analyses of subgroups and interactions and sensitivity analyses.	Done: Supplement		
<b>Discussion</b>					
Key results	18	Summarise key results with reference to study objectives.	Done		
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	Done	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Done (e.g. effects of different coding practices)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	Done		
Generalisability	21	Discuss the generalisability (external validity) of the study results.	Done		
<b>Other Information</b>					
Funding	22	Give the source of funding and the role of the funders	Done		
Accessibility of protocol, raw data, and programming code		n/a	Done	RECORD 22.1.: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	Done. Raw data is subject to data protection concerns. See data sharing

					statement Kassenärztliche Vereinigung Bayerns; codes are available on request
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n/a, not applicable

Reference: Benchimol EI, Smeeth L, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 12.10 (2015): e1001885

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