



## Corruption and use of antibiotics in regions of Europe



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### ABSTRACT

The aim of this article is to investigate the association between corruption and antibiotic use at sub-national level. We explore the correlation between, on the one hand, two measures of corruption (prevalence of corruption in the health sector and prevalence of bribes in the society) at regional level from the European Quality of Government Index; and, on the other, the consumption of antibiotics in those European regions from a 2009 Special Euro Barometer. In a multivariate regression model, we control for potential confounders: purchasing power of standardized regional gross domestic product, inhabitants per medical doctor and age-standardized all-cause mortality rates. We find that there is a strong positive association between both measures of corruption (i.e. in the health sector, and in the society at large) and antibiotics use; and that this association is robust to the introduction of the control variables. These results support previous findings in the literature linking corruption to higher antibiotic use at cross-national level. We show that corruption does seem to account for some of the remarkable between-region variation in antibiotic consumption in Europe.

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## 1. Background

Antibiotic resistance – an unavoidable side effect of the consumption of antibiotics – is one of the greatest global challenges to public health. Increasing bacterial resistance to existing antibiotics causes substantial morbidity and mortality and increases health care and societal costs. As the World Health Organization (WHO) points out, “a post-antibiotic era—in which common infections and minor injuries can kill—far from being an apocalyptic fantasy, is instead a very real possibility for the 21st century” [1]. In Europe alone, antimicrobial resistance is estimated to cause 25,000 deaths each year and result in related costs of over €1.5 billion in healthcare expenses and reduced produc-

tivity [2] while, in the US, it is estimated to cause 2 million illnesses and 23,000 deaths per year [3]. If resistance is left unchecked, a conservative estimate is that by 2050 an additional 10 million people are expected to die every year and the cumulative cost – among other, increased complications, waste, lengthier hospital stays and the development of more expensive drugs – will be more than one and a half times annual world Gross Domestic Product today (GDP) [4]. In other words, “rarely has modern medicine faced such a grave threat” [5].

There is a recognition that limiting antibacterial resistance is far from just a medical concern but rather a behavioural and social problem. Since consumption of antibiotics is considered to be the main driver of the development of antibacterial resistance [6], large-scale behavioural change in relation to antibiotic consumption is urgently called upon.

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In a European perspective, there is a huge variation in outpatient antibiotic consumption, variation in the class of antibiotics, dosage and treatment duration, and variation in the quality of outpatient antibiotic consumption between European countries [6–11]. This variation is unlikely to be the result of differences in the frequency of bacterial infections [6]. Take for instance Belgium and the Netherlands, which exhibit remarkable differences in antibiotic use, with the former using them to a much larger extent than the latter.

What could possibly account for this heterogeneity? Some researchers emphasize differences in regulatory practices and healthcare systems [6,7,12] while for others it is ineffective healthcare systems and poor enforcement of regulations what might explain the widespread non-prescription sales of antibiotics that are prevalent in many European countries [6]. There is also a growing literature exploring the effects of corruption on health care [13,14]. A pioneering analysis of a panel data set including 28 European countries found that “corruption is the main socioeconomic factor that explains antibiotics resistance” [15], leading the authors to conclude that addressing corruption and improving governance will lead to a reduction in resistance to antibiotics. Moreover, a report from the European Commission (2013, p. 146) explicitly brings up increased antimicrobial resistance as possibly being the result of improper market relations, since promotion of pharmaceutical products create loyalty and may trigger over-medicalization [16].

However, the literature linking corruption and antibiotics abuse has not taken into consideration sub-national differences. And we know from other studies that there are both very large within-state variations in levels of corruption [17] and consumption of antibiotics [11,18]. For example, there are pronounced differences across regions within the same country, such as the very high levels of antibiotic consumption in Spain’s Catalonia (or Italy’s Lazio) and the moderate levels in Spain’s Basque Country (or Italy’s Tuscany). The picture emerging from these findings is thus more nuanced than the conventional view that the rates of antibiotic use and resistance “remain low in northern European countries” while “reaching alarming levels in Southern and Central Europe” [6].

In general, the aim of this paper is to provide a more detailed map of the relationship between corruption and antibiotic consumption—by examining over 100 European regions instead of countries. Despite causality cannot be established in a cross-sectional study like the one presented here, our findings do indeed question the validity of national-level explanations of both corruption and antibiotics use, either institutional (e.g. the national health care system) or cultural (e.g. the national language).

In particular, the goal of this paper is to investigate the association between two regional measures of corruption – prevalence of corruption in the health sector and prevalence of bribes in the society – and consumptions of antibiotics in the European regions. This paper uses novel data from the European Quality of Government Index [17] that collect perceptions of the prevalence of bribes in the public sector in general and the prevalence of corruption in the health sector in regions of Europe. The data

shows a strong bivariate association between these measures of corruption at the regional level and consumption of antibiotics in European regions—with data from a special 2009 Euro-Barometer survey on antibiotic consumption. When controlling in multivariate regression models for multiple confounders – e.g. purchasing-power standardized regional GDP per capita, inhabitants per medical doctor, age-standardized mortality rates – the associations between regional corruption and antibiotic consumption remain persistent and strong.

## 2. Methods

### 2.1. Independent variables

We test proxies for both indicators of corruption: the perception of corruption in the healthcare sector; and citizens’ reported experience of bribery. Data come from a survey data of about 85,000 EU citizens distributed in all the 206 NUTS-1 and NUTS-2 (Nomenclature des Unités Territoriales Statistiques) regions in Europe. Making use of telephone interviews in the local language of each region, randomly drawn respondents 18 years of age or older were asked questions relating to Quality of Government on the one hand and questions about demographics on the other. The survey was administered beginning in February 2013 and sampled 400 or more respondents in each region. The robustness and external validity of the data have been verified thoroughly [17].

To measure the perception of corruption in the healthcare sector, respondents were asked to rate on a 10-point scale the extent to which they agreed or disagreed with the following statement: ‘Corruption is prevalent in the public healthcare system in my area’ (agree/disagree 0–10). In the empirical analysis, higher scores indicate lower levels of healthcare sector corruption. To measure citizens’ reported experience with bribery, the following question was asked: ‘In your opinion, how often do you think other citizens in your area use bribery to obtain public services?’ Respondents were asked to answer on a 10-point scale (never/often 0–10). In the empirical analysis, higher scores indicate higher levels of bribery. The indicators of perceptions of corruption in the healthcare sector and perceptions of the prevalence of bribes in the society were aggregated from the individual level to the regional level as the mean score. The indicators are highly but far from perfectly correlated (Pearson’s  $R$  0.7430). This signifies that, although related, the indicators seem to measure different aspects of corruption. To increase comparability, the measures were also standardized so that the mean is 0 and the standard deviation is 1.

The measure of corruption in the healthcare sector ranges from the Hovedstaden region in Denmark (1.825, very low levels of healthcare sector corruption) to the region of Yugozapaden in Bulgaria (–2.268, very high levels of healthcare sector corruption). The measure of bribery in society ranges from the region of Midtjylland in Denmark (0.926, very low levels of bribery) to the region of Bucuresti-Ilfov in Romania (4.624, very high levels of bribery).

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