Title: Trends and patterns in antibiotic prescribing among out of hours primary care providers in England, 2010-2014

Running title: antibiotic prescribing in out of hours services

Authors: Michael EDELSTEIN[*], Adeola AGBEBIYI[1], Diane ASHIRU-OREDOPE[1], Susan HOPKINS[1]

Affiliation: 1. Antimicrobial Resistance Programme, Public Health England, 133-155 Waterloo Rd, Lambeth, London SE1 8UG London, UK

Corresponding author contact details:

Email: Michael.edelstein@phe.gov.uk

Telephone: 02083277508

Abstract

Objectives

Antimicrobial resistance (AMR) is a global threat, increasing morbidity and mortality. In England, publicly-funded clinical commissioning groups (CCGs)commission Out-of-Hours (OOH) primary care services outside daytime hours. OOH consultations represent 1% of in-hours general practice (GP) consultations. Antibiotic prescription increased 32% in non-GP community services between 2010- 2013. We described OOH antibiotic prescribing patterns and trends between 2010-2014.

Methods

We estimated the proportion of CCGs with OOH data available; described and compared antibiotic prescribing by volume of prescribed items, seasonality and trends in GP and OOH, using linear regression; and compared the proportion of broad-spectrum to total antibiotic prescriptions in OOHs with their respective CCGs in terms of seasonality and trends, using binomial regression.

Results

Data was available for 143/211 (68%) CCGs. OOH antibiotic prescription volume represented 4.5-5.2% of GP prescription volume and was stable over time (p=0.37). The proportion of broad-spectrum antibiotics prescriptions increased in OOH when it increased in the CCG they operated in (regression coefficient 0.98; 95%CI 0.96-0.99). Compared with GP, the proportion of broad-spectrum antibiotic prescriptions in OOH was higher but decreased both in GP and OOH (-0.57%, 95%CI -0.54;-0.6 and -0.76%, 95%CI -0.59;-0.93 per year respectively).

Conclusions

OOH proportionally prescribed more antibiotics than GPs although we could not comment on prescribing appropriateness. OOH prescribing volume was stable over time, and followed GP seasonal patterns. OOH antibiotic prescribing reflected the CCGs they operated in but with relatively more broad-spectrum antibiotics than in-hours GP. Understanding factors influencing prescribing in OOH will enable developing tailored interventions promoting optimal prescribing in this setting.

Introduction

Since 2004, the National Health Service (NHS) has commissioned out-of-hours services separately from in-hours (IH) primary care services. Out-of-hours primary care (OOH) services provide urgent primary care when general practice (GP) surgeries are typically closed, from 6.30 pm to 8.00 am on weekdays and all day at weekends and on bank holidays.[1] From April 2013, NHS England, delegated responsibility for commissioning such services to 211 clinical commissioning groups (CCG). CCGs are independent statutory bodies governed by members of local general practices with support from health professionals and direct input from people representing patients and members of the public.[2] The OOH services are provided by social enterprises (49%), private companies (31%) and NHS Trusts (20%).[1] An estimated 10 per cent of GPs have retained responsibility for OOH care; NHS England commissions these services (known as *opted-in* services) directly from GP practices.[1] The contractual arrangements at CCG level are complex: of the 175 (83%) CCGs that responded to a recent National Audit office (NAO) survey, 105 were taking the lead in managing an OOH contract; some contracts (42 per cent) covered several CCGs and other CCGs (6 per cent) received services under more than one contract.[1]

In 2013-2014, OOH GP services in England handled around 5.8 million cases in 2013-14, including 3.3 million face-to-face patient consultations, of which 800,000 were home visits. By comparison, in-hours GPs provide over 300 million consultations a year and 21.7 million people attend Accident and Emergency (A&E) departments.[1]

Antimicrobial resistance (AMR), linked to increased antibiotic use (both appropriate and inappropriate), is a growing threat to the effective treatment of an ever-increasing range of infections. The current lack of new antimicrobials on the horizon brings added urgency to the need to protect the efficacy of existing drugs: a post-antibiotic era—in which common infections and minor injuries can kill—is a very real possibility in the 21st century.[3] In Europe,

resistant infections in hospitals kill 25,000 people and cost €1.5 billion in extra hospital, treatment and societal costs every year.[4] It is estimated that by 2050 antimicrobial resistance could be responsible for 10 million deaths globally and could cost up to US$ 100 trillion in lost output to the global economy.[5] For these reasons, several strategies are being pursued to decrease the emergence of antimicrobial resistance, with antimicrobial stewardship, defined as "an organisational or healthcare-system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness",[6] a key intervention. Stewardship requires an understanding of the patterns of antibiotic utilisation and resistance. In England, Public Health England (PHE) has monitored these since 2014 through the English Surveillance programme for antimicrobial utilisation and resistance (ESPAUR). The 2014 ESPAUR report noted a 32% increase in antibiotic prescription in community services other than general practice between 2010 and 2013, in particular in community health services, hospital based community services and urgent care settings. This highlights the need to explore whether general practice prescribing is being displaced to other settings such as OOH primary care services.[7] The little evidence available around antibiotic prescribing patterns in this specific setting suggests that antibiotic prescription OOH is high[8] and that compared with patients' own GPs, commercial companies providing OOH services prescribe more antibiotics.[9] A study conducted in Oxfordshire, England showed an increase in the number of antibiotic prescriptions in OOH between 2010 and 2014, against a trend of decreasing number of consultations.[10] There is however no published description of the trends and patterns of antibiotic prescribing among OOH providers in England. We aimed to describe these between 2010 and 2014, in order to inform potential future stewardship interventions.

Methods

PHE obtains prescribing data for primary care from the NHS Business Services Authority[11] and merges this using NHS Digital classification of prescribing cost centres.[12] The merged database contains the number of prescribed antibiotic items each month, by antibiotic and by prescribing centre. We retained all GP and OOH prescribing centres excluding prescribing centres issuing less than 100 antibiotic items in a year. We calculated the proportion of CCGs with OOH data available in the ESPAUR database and estimated the volume of antibiotics these OOH providers prescribed and compared it with the prescription volume among GPs in CCGs with OOH data between 2010-2014. We described the overall prescribing volume among IH and OOH providers assessing for seasonality and calculated trends over time, using linear regression.

We further focussed our comparative analysis of IH and OOH prescribing on broad spectrum antibiotics, for two reasons: first, there is particular focus around broad spectrum antibiotic stewardship as they can be used to treat a range of infection and their use can increase the risk of MRSA, *Clostridium difficile* and resistant urinary tract infections[13] and their use in primary care should be restricted to situations when narrow spectrum antibiotics are ineffective;[14] second, as no denominator data was available for OOH prescriptions that would allow comparison with IH prescribing, comparing the proportion of broad spectrum antibiotics prescribed out of the total antibiotic prescription volume provided an element of direct comparison between OOH and IH providers. Cephalosporins, quinolones and co-amoxiclav were defined as broad-spectrum, consistent with the England Department of Health advisory committee for antimicrobial resistance prescribing and healthcare associated infections (ARPHAI).[15]

The proportion of broad-spectrum to total antibiotic prescriptions in OOHs with their respective CCGs were compared using linear regression. We described and cross correlated the seasonality of broad-spectrum antibiotic prescribing among OOH and GP providers, and compared the two in terms of trends in broad spectrum antibiotic prescribing using binomial regression. All statistical analyses were done in STATA 13 (SataCorp, Texas)

Results

In 2014, data were available for 188 OOH providers, in 143/211 (68%) CCGs. Graphically, the distribution of CCGs with no OOH data seem to cluster in London and the South East, East Anglia and the Midlands (Figure 1), suggesting that CCGs in these areas may contract their out-of-hours to NHS Trusts or to an OOH from another CCG. These 188 OOH providers prescribed between 1,055,000 and 1,205,000 antibiotic items each year between 2010 and 2014 (table 1). Between 2010 and 2013, this represented 5-5.2% of the GP antibiotic prescription volume in those CCGs with OOH data, decreasing to 4.5% in 2014.

Prescription volume peaked each year in December and was at its lowest each year in July for both GP and OOH (figure 2). There were no statistically significant changes in the overall number of items prescribed yearly in either GP or OOH over the study period (p=0.37).Out of hours broad spectrum antibiotic prescribing increased with CCG prescribing: The higher the broad spectrum prescribing in the CCG, the higher the broad spectrum prescribing in OOH (figure 3, regression coefficient 0.98, 95%CI 0.96- 0.99)

The relative contribution of broad spectrum antibiotics to total prescription volume was highest each year in July both among GPs and OOH. Broad spectrum prescribing in OOH correlated with GP prescribing in terms of trends and seasonality (figure 4, cross-correlation coefficient=0.95). Compared with GPs, the contribution of broad spectrum antibiotics to total antibiotic prescribing in OOH was consistently higher (table 2, $p<0.001$ each year). However, this contribution was decreasing both among GPs (-0.57% per year on average, 95% CI -

0.54 to -0.6) and to an even greater extent OOH (-0.76% per year on average, 95%CI -0.59 to -0.93).

Discussion

This study is, to our knowledge, the first to focus specifically on national level prescribing in the primary care OOH setting in England. OOH consultations represent around 1% of the volume of IH GP consultations, but up to 5% of the volume of antibiotic prescriptions. Compared with IH GP, OOH antibiotic prescribing was out of proportion to the volume of consultations, suggesting that more OOH consultations are related to acute infection presentations, a finding consistent with the published literature.[16] The disproportionality reduced in 2014 compared with previous years, mainly due to increased coding of IH prescription volume between 2013 and 2014; while this may reflect a true difference in focus, it may also reflect increased IH practices taking on OOH workload at the same practice code. OOH prescribing volume was stable over time, and followed similar seasonal patterns to IH GP prescriptions; with traditional increases in prescribing in the winter months related to increased prevalence of respiratory tract infections. The relative contribution of broad spectrum antibiotics was consistently higher among OOH providers compared with GP providers over the time period, although that proportion was decreasing on both settings, and decreasing faster in OOH settings, narrowing the gap between the two. Qualitative work is required to understand the factors that drive broader-spectrum prescribing in OOH care; To our knowledge there is no published literature on factors contributing to increased likelihood of prescribing antibiotics in OOH settings.

It is possible that increased awareness of AMR as a global issue among healthcare professionals, reinforced by several high profile publications including a Chief Medical Officer report focused on AMR,[6] combined with specific prescribing guidance on reducing broad spectrum antibiotic prescribing in primary care[13,14] and primary care focused antibiotic

stewardship programmes[17] have contributed to this decrease in broad spectrum antibiotic prescribing.

This study offers new insights into OOH prescribing. However, limitations to the data and organisational features of OOH services have limited the scope of the analysis. First, OOH prescribing data was linked geographically to two thirds of CCGs. However, increasingly, the same OOH provider cover several CCGs and some CCGs commission more than one provider, it was not possible to estimate the size of the population covered by each OOH provider or calculate prescription volume by population to compare with GP prescription. We were not able to ascertain the representativeness of our sample because of the heterogeneous nature of OOH providers, rapid turnover of OOH providers and no reliable data on who provides OOH services where. For these reasons we analysed the data at a national level; and did not perform a multi-level analysis including CCGs as a random variable. Finally, clinical indications for prescriptions were not available, making it difficult to ascertain appropriateness of prescriptions: it is plausible that a higher proportion of OOH consultations are for acute conditions including infections. Similarly, broad spectrum antibiotic prescribing may reflect illness spectrum or failure of first line treatments.

This study provides a first insight into antibiotic prescribing among OOH providers. It highlights that compared with General Practice, antibiotic prescribing, both overall and in terms of broad spectrum antibiotics, is more common. Little is known about the appropriateness of this prescribing, and our data did not allow evaluating the appropriateness of OOH prescribing due to lack of information on the spectrum of illness presenting OOH. This setting therefore warrants further attention with regards to antibiotic stewardship. Understanding the factors driving prescribing behaviour among OOH practitioners and how they relate to presenting complaints will help inform tailored interventions to promote prudent antibiotic use in this setting.

Acknowledgements: none

Funding: This study was carried out as part of our routine work

Transparency declaration:

SH and DAO are affiliated with the National Institute for Health Research Health Protection Research Units (NIHR HPRU) in Healthcare Associated Infection and Antimicrobial Resistance at Imperial College London in partnership with Public Health England and SH is also affiliated with the NIHR HPRU in Healthcare Associated Infection and Antimicrobial Resistance at University of Oxford in partnership with Public Health England.
All other authors: none to declare

References

1. National Audit office. *Out-of-hours GP services in England*. 2014. http://www.nao.org.uk/wp-content/uploads/2014/09/Out-of-hours-GP-services-in-England1.pdf
2. NHS England. *Understanding the new NHS*. 2014 https://www.england.nhs.uk/wp-content/uploads/2014/06/simple-nhs-guide.pdf

3. World Health Organization. *Antimicrobial Resistance: Global Report .on Surveillance*. 2014. http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf
4. Rodier G. *European strategic action plan on antibiotic resistance 2011–2016*. . 2011. http://www.euro.who.int/__data/assets/pdf_file/0011/148988/RC61_Pres_Rodier_antibiotic_resistance.pdf
5. O'Neill J. *Antimicrobial Resistance: Tackling a crisis for the health and wealth of nations. Review on antimicrobial resistance.* 2014. http://amr-review.org/sites/default/files/AMR%20Review%20Paper%20-%20Tackling%20a%20crisis%20for%20the%20health%20and%20wealth%20of%20nations_1.pdf
6. Davies S*. Annual Report of the Chief Medical Officer Volume Two, 2011. Infections and the rise of antimicrobial resistance*. 2013. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/138331/CMO_Annual_Report_Volume_2_2011.pdf
7. Public health England*. English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) Report 2014*.https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/362374/ESPAUR_Report_2014__3_.pdf
8. Huibers L, Moth G, Christensen MB, *et al*. Antibiotic prescribing patterns in out-of-hours primary care: a population-based descriptive study. *Scand J Prim Health Care*. 2014;**32**:200-7.
9. Cragg DK, McKinley RK, Roland MO, *et al*. Comparison of out of hours care provided by patients' own general practitioners and commercial deputising services: a randomised controlled trial. I: The process of care. *BMJ*. 1997 18;**314**:187-9
10. Hayward GN, Fisher RF, Spence GT *et al*. Increase in antibiotic prescriptions in out-of-hours primary care in contrast to in-hours primary care prescriptions: service evaluation in a population of 600000 patients. *J Antimicrob Chemother*. 2016;**71**2612-9.

11. NHS Business Services Authorities. *Electronic prescribing and cost*. http://www.nhsbsa.nhs.uk/3230.aspx
12. NHS Digital. *GPs, GP Practices, Nurses and Pharmacies*. http://systems.digital.nhs.uk/data/ods/datadownloads/gppractice
13. National Institute for Clinical Excellence. *Antibiotic prescribing – especially broad spectrum antibiotics*. 2015. https://www.nice.org.uk/advice/ktt9/chapter/evidence-context
14. Public Health England. *Managing common infections: guidance for primary care*. 2010. https://www.gov.uk/government/publications/managing-common-infections-guidance-for-primary-care
15. Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection (ARHAI)- *5th Annual Report, April 2013-March 2014* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/405295/ARHAI_annual_report.pdf
16. de Bont EG, Peetoom KK, Moser A, *et al*. Childhood fever: a qualitative study on GPs' experiences during out-of-hours care. *Fam Pract*. 2015;**32**:449-55.
17. Moore M. McNulty C. European Antibiotic Awareness Day 2012: TARGET antibiotics through guidance, education, and tools. *Br J Gen Pract*. 2012; **62**: 621–622

Table 1. Volume and proportion of antibiotic items prescribe d in Out of Hour settings, England, 2010-2014

Year	Prescribed antibiotic items in GP*	Prescribed antibiotic items in OOH	Proportion of GP prescription volume prescribed in OOH (%)
2010	21,029,000	1,055,000	5.0
2011	21,799,000	1,102,000	5.1
2012	22,228,000	1,205,000	5.2
2013	21,559,000	1,121,000	5.2
2014	26,239,000	1,170,000	4.5

*in CCGs with OOH data

Figure 1. CCGs in England, by availability of OOH prescribing data (2014)

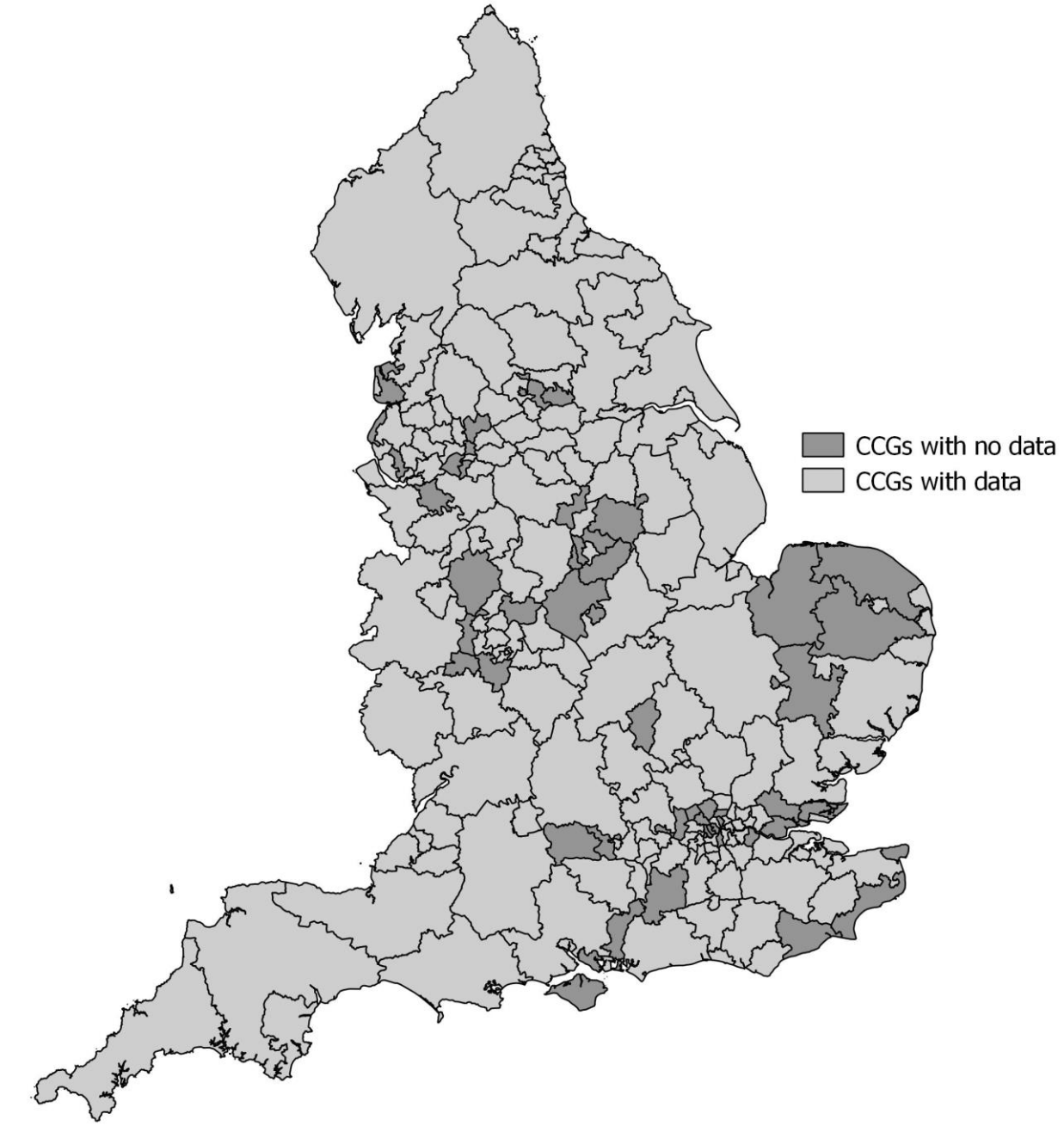
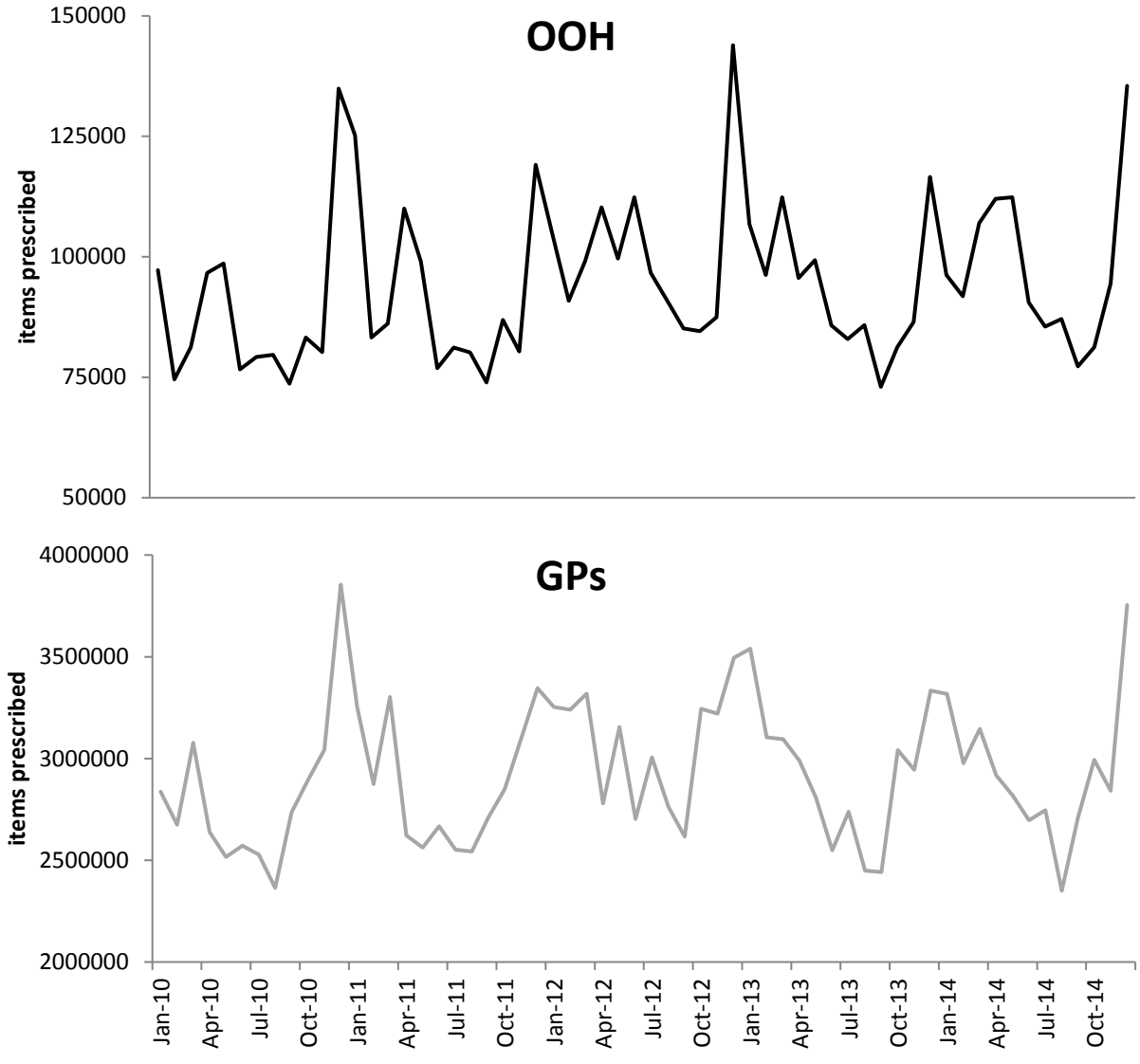

CCGs with no data
CCGs with data

Figure 2. Total number of antibiotic items prescribed*, by type of provider and month, England, 2010-2014



*the y-axis scale is different for GPs and OOH

Figure 3. Contribution of broad spectrum antibiotics to prescribing volume among OOH providers and their CCGs, England, 2010-2014

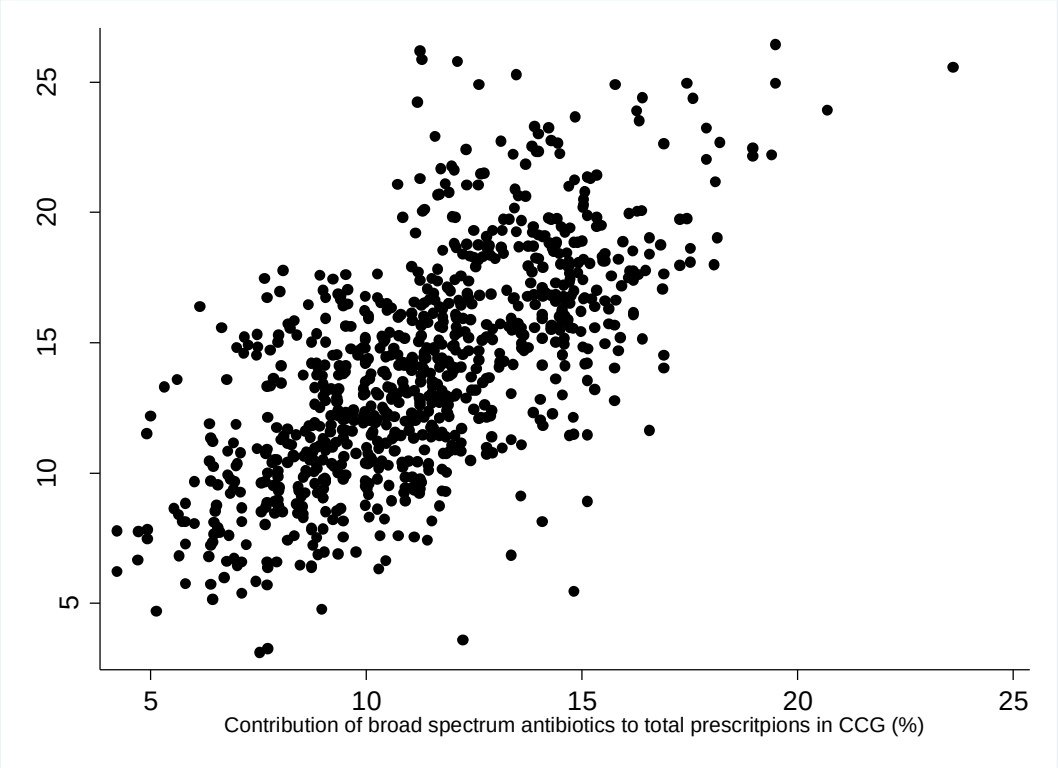

25
20
15
10
5
5
10
15
20
25
Contribution of broad spectrum antibiotics to total prescritpions in CCG (%)

Figure 4. Contribution of broad spectrum antibiotics to prescribing volume among OOH providers and GPs, by month, England, 2010-2014

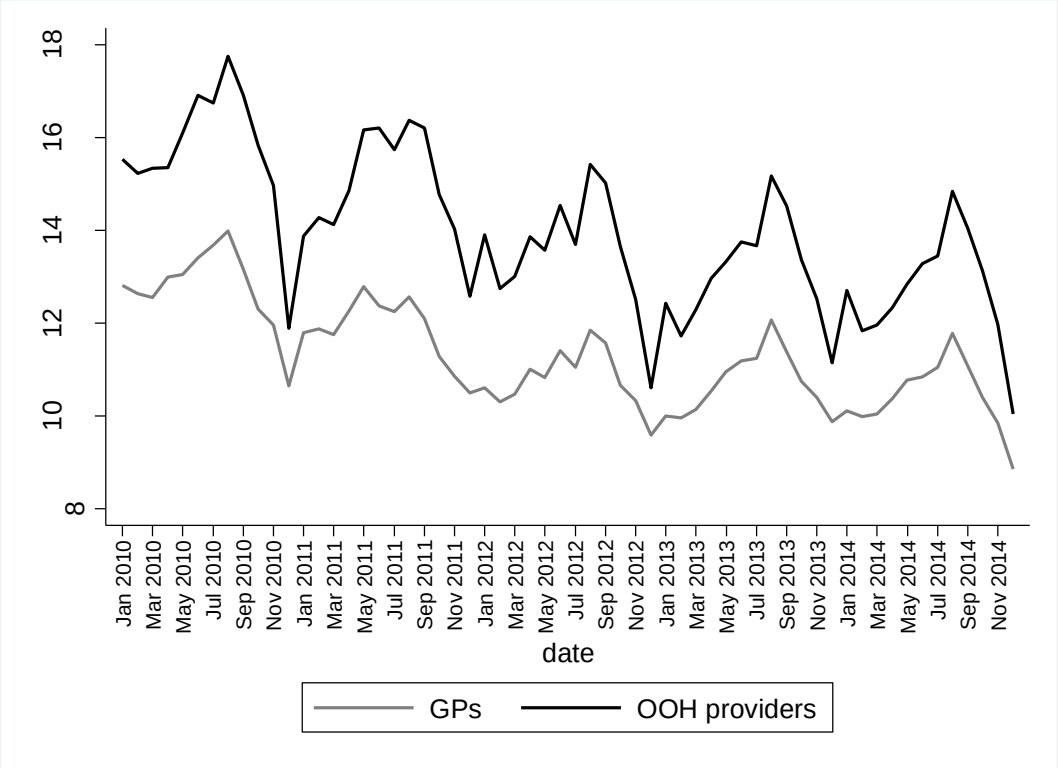


Table 2. Proportion of broad spectrum antibiotics out of total antibiotic prescriptions, by year and type of practice, England, 2010-2014										
Type of practice	Year									
	2010		2011		2012		2013		2014	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI
GP	12.7	12.5-12.8	11.8	11.7-11.9	10.7	10.7-10.8	10.6	10.5-10.7	10.3	10.3-10.4
OOH	15.5	14.9-16	14.8	14.3-15.3	13.4	12.9-13.9	13.0	12.4-13.5	12.5	12-13.1