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Just google it! Impact of media coverage of an outbreak of high-level azithromycin resistant Neisseria gonorrhoeae on online searches, and attendances, testing and diagnoses at sexual health clinics in England between 2015 and 2016: an interrupted time series analysis using surveillance data

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ABSTRACT

Objectives To determine if media coverage of an outbreak of high-level azithromycin resistant Neisseria gonorrhoeae (HL-AziR) impacted online search interest or was temporally associated with health-seeking behaviours in several English cities.

Methods A descriptive analysis of outbreak-related online media articles and relative search interest (RSI) using Google, and an interrupted time series analysis using routine surveillance data from sexual health clinics (SHCs) in England (GUMCAD STI surveillance system). The main outcomes were adjusted incidence rate ratios (IRR) of weekly attendances, gonorrhoea tests, and diagnoses of gonorrhoea or 'any STI' in selected cities after media coverage of the outbreak in 2015 and 2016

Results RSI for outbreak-related terms peaked during media coverage in September 2015 with smaller peaks coinciding with subsequent coverage. The greatest increase in RSI was in Leeds, which coincided with a 63% rise (n=1932; IRR 1.26, 95% CI 1.12 to 1.43) in SHC attendances by women. There was only a 7% (n=1358; IRR 1.01, 95% CI 0.91 to 1.11) increase in attendances by men. Modest increases in outcomes occurred in four other cities with a high RSI. There was no evidence of increases in outcomes in cities, other than Leeds, after subsequent media coverage of the outbreak.

Conclusions National and local media coverage of the HL-AziR outbreak coincided with peak RSI for related terms, and a transient increase in attendances, gonorrhoea

tests, and diagnoses of gonorrhoea or ‘any STI’ in some cities with a high RSI. Our analysis demonstrates the potential for media coverage to influence health-seeking behaviours during high profile STI outbreaks.

Key Messages

- After media coverage of the HL-AziR outbreak, the number of attendances at SHCs increased in some English cities with a high RSI for ‘gonorrhea’, particularly among women in Leeds, where the outbreak was first detected, and in cities near Leeds.

- Short periods of media coverage of high-profile STI outbreaks can impact health-seeking behaviours and highlights opportunities to improve targeting of health promotion information following online searches.

- There is a need for further research to optimise targeting and rapid delivery of health promotion information to those most at risk of infection.

INTRODUCTION

The ongoing emergence of resistance to antimicrobials used to treat gonorrhoea is a global public health concern [1]. Gonorrhoea is the second most commonly diagnosed bacterial sexually transmitted infection (STI) in England, and diagnoses have doubled in the past 10 years [2]. At the time of the outbreak, many countries, including the United Kingdom (UK), and the World Health Organization (WHO) recommended treatment using first-line dual therapy of ceftriaxone with azithromycin [3–6]. Resistance to azithromycin is increasing globally [1], which threatens the efficacy of dual therapy and could lead to the emergence of untreatable gonorrhoea [7].

An outbreak of sustained transmission of high-level azithromycin resistant Neisseria gonorrhoeae (HL-AziR; minimum inhibitory concentration (MIC) $\geq$ 256 mg/L) was identified in England in 2015 [8–11], stimulating widespread media interest. In England, isolates of HL-AziR were previously detected only sporadically or in small clusters [12].The outbreak was first identified among heterosexuals in Leeds, a large city in the North of England, but then spread to other parts of the country. Initially, the outbreak was relatively localized; there were 15 cases in Leeds, four in other parts of the North, and one in the South of England [8,9]. Widespread local and national media coverage started 17th September 2015 and dubbed it 'super gonorrhoea'. The media first reported cases in Leeds, Scunthorpe (near Leeds and Sheffield), Macclesfield and Oldham (near Manchester). Coverage of the outbreak appeared on television, in print, online, and made the front page of popular newspapers. A surveillance report released 15th April 2016 fuelled further media attention when it reported increased cases (n=34) nationally, including among men who have sex with

men (MSM)[9]. Media reported cases detected in the West Midlands (including Birmingham), London, and the South of England. There were growing concerns that HL-AziR could rapidly disseminate into wider sexual networks and become endemic. However, a subsequent surveillance report on 9th September 2016 [8] reported little change in the progression of the outbreak (n=48) and no evidence of rapid dissemination.

Previous research indicated that prolonged or intensive public health campaigns and media activity around health-related topics could influence health-seeking behaviours [13–19]. In this analysis, we used relative search interest (RSI) and interrupted time-series analysis to explore temporal associations between the effect of media coverage of the outbreak on online searches and health-seeking behaviour among people attending sexual health clinics (SHCs) in England. Online search engine data is increasingly utilized for understanding population health and health-related queries [20], including forecasting diseases and outbreak detection [21–23].

METHODS

Study design and setting

We used the Google search engine to quantify online media interest in the HL-AziR outbreak, and Google Trends (Alphabet Inc, Mountain View, California, USA) to determine RSI for outbreak-related search terms related. RSI is defined as the total number of people searching for a specified term divided by the total number of searches, providing a measure of the relative popularity (out of 100) of the term during a selected date range [24].

We used the GUMCAD STI surveillance system to investigate associations between online searches of the HL-AziR outbreak in England and health-seeking behaviour as a result of media coverage. GUMCAD is a mandatory, pseudonymised, electronic dataset covering all attendances and services provided at all SHCs in England and includes basic patient characteristics and demographics [25]. In the UK, SHCs are free, confidential, open-access services offering STI testing and treatment with many people attending [26]. This analysis was designed to detect exceedances in outcomes associated with defined periods of media coverage of the HL-AziR outbreak (described below), similar to previous studies [17,27].

Online media coverage of the HL-AziR outbreak

The study population was news outlets who published online articles in the UK on 'super gonorrhoea'. Online news articles were identified by performing an online search for the terms 'super gonorrh*' and 'super-gonorrh*' during defined periods of media interest (described below). The articles were counted (no duplicates identified) and categorised as related or unrelated to the outbreak to estimate media interest in the outbreak.

Online search interest for the HL-AziR outbreak

The study population was people in England searching for outbreak-related search terms. Separate analyses for RSI were conducted for 'gonorrhoea'/'super gonorrhoea' (British English) and 'gonorrhea'/'super gonorrhea' (American English) between 2014 and 2016 using Google Trends (wild card searches were not possible). Data reported are for the American English terms due to low search volumes for the British English terms. Google Trends generated a list of cities with

196 the highest RSI, and a list and percent increase in search frequency of other
197 common search-terms that users who searched for ‘gonorrhea’ also searched for.
198
199 **Associations between media coverage of the outbreak of HL-AziR and**
200 **exceedances in sexual health outcomes**
201 The study population included men and women attending SHCs in the six cities with
202 the highest RSI between 2014 and 2016: Leeds (number of SHCs [n]=7), Sheffield
203 (n=2), Manchester (n=9), Birmingham (n=3), London (n=94), and Liverpool (n=5).
204 Attendances by people with an unspecified gender (0.02%; n=694) and prisoners
205 (0.1%, n=2774) were excluded.
206
207 The outcomes were: new attendances, gonorrhoea tests, and diagnoses of
208 gonorrhoea or ‘any STI’ at SHCs in selected cities. Attendance analyses excluded
209 follow-up attendances (9.9%, n=396728) and unspecified attendance type (10.1%,
210 n=406791). We defined ‘any STI’ using the Public Health England surveillance
211 definition for a new STI diagnosis [28]. Multiple records of gonorrhoea tests per
212 patient attendance were de-duplicated; all other tests were retained to allow for
213 repeat testers and tests-of-cure. A 42 day episode of care was used for gonorrhoea
214 and ‘any STI’ diagnoses to prevent over-counting due to discrepancies in dates
215 reported to GUMCAD [29]. ‘Any STI’ diagnoses were included as a proxy for those
216 who may have attended a SHC due to perceived risk of ‘super gonorrhoea’ but were
217 also at risk of other STIs.
218
219 **Period of exposure to media coverage**

The HL-AziR outbreak was covered by the media on three separate occasions. The start date of each exposure period coincides with initial media coverage of the outbreak. The periods of exposure were defined as successive six-week periods directly before media coverage (pre-media: 2015 weeks 32-37; 2016 weeks 10-15; 2016 weeks 30 to 35), during and directly after media coverage (media: 2015 weeks 38-43; 2016 weeks 16-21; 2016 weeks 36 to 41), and a subsequent six-week period after media exposure (post-media: 2015 weeks 44-49; 2016 weeks 22-27; 2016 weeks 42 to 47)(Figure 1). The six-week period accounted for increased RSI over time, delays in making or obtaining SHC appointments, and was the same period used to prevent over-counting of STI diagnoses (described above).

Statistical analysis

We calculated the percent change in each outcome in the media and post-media period compared with the pre-media period as the baseline among men and women in selected cities to give an indication of the relative change in attendances compared to immediately prior to media coverage of the outbreak.

Next, we used interrupted time-series regression using a generalised linear model with a negative binomial distribution of weekly counts of outcomes modelled separately for men and women in each city. The hypothesis tested was that media coverage of the outbreak led to increased outcomes in each city. We examined the first two media exposure periods since they occurred in the absence of known outbreak interventions. Models accounted for the underlying time trend (continuous variable using weeks) and were adjusted for year to account for the increasing trend in SHC attendances in England (categorical variable)[30], seasonality (calendar

quarter as a categorical variable), bank holidays and major clinic closures (indicator variable). Time was divided into the previously defined exposure periods and compared to the baseline trend between 2014 and 2016. A total of 157 weeks were included in the analysis. Adjusted incidence rate ratios (IRRs) and 95% confidence intervals (CI) are reported. Data cleaning and analysis were performed using Stata v13.1 (StataCorp, College Station, TX, USA). P-values < 0.05 were considered statistically significant. Statistically significant increases in IRR in both the media and pre-media period were deemed to be unrelated to media coverage.

RESULTS

Media and public interest in the HL-AziR outbreak

The HL-AziR outbreak in England was covered in both 2015 and 2016 by many popular news outlets [31–33] with a high readership among British adults (Figure 1A) [34]. The RSI for the term ‘gonorrhea’ peaked during initial media coverage in September 2015 (RSI 100) with smaller peaks in December 2015 (RSI 46) and April 2016 (RSI 72) related to subsequent media coverage (Fig. 1A). Peaks in RSI for ‘super gonorrhea’ coincided with peak searches for ‘gonorrhea’, although searches were less common. Increases in RSI for ‘gonorrhea’ were limited to two weeks (weeks 38-39) in September 2015 and one week (week 16) in April 2016. There were no peaks in RSI when the second surveillance report was published in September 2016, which received less online media attention (Fig. 1A).

The cities with the highest RSI were Leeds (RSI 100), Sheffield (RSI 90), Birmingham (RSI 88), Manchester (RSI 88), London (RSI 82), and Liverpool (RSI 74) (Fig. 1B). Searches related to ‘gonorrhea’ during this time-period were ‘super

gonorrhea' (% increase in search frequency 2100%), 'Leeds gonorrhea' (350%), 'super gonorrhea symptoms' (250%), 'dean street express' (190%), and 'how is gonorrhea treated' (100%).

Attendances at SHCs

After initial media coverage of the HL-AziR outbreak in 2015, there was a significant increase in attendances by women at SHCs in Leeds (Fig. 2, Tables 1A & 2), with no change in attendances by men (Tables 1B & 2). This translated to a 63% increase (n=1932; IRR 1.26, 95% confidence interval 1.12 to 1.43) in the media period, followed by a 103% increase (n=2412; IRR 1.51, 95% CI 1.34 to 1.71) in the subsequent post-media period compared to the pre-media period by women in Leeds. A smaller increase (14%, n=2809, IRR 1.25, 95% CI 1.10 to 1.43) in attendances by women at SHCs in Leeds occurred in 2016 during the media period, but not in the post-media period. Smaller increases in attendances by men and women at SHCs were detected in other cities in 2015. The second largest increase in attendances at SHCs was in Sheffield by both women (32%, n=2257, IRR 1.21, 95% CI 1.04 to 1.44) and men (media: 33%, n=1269, IRR 1.19, 95% CI 1.04 to 1.36; post-media: 31%, n=1254, IRR 1.15, 95% CI 1.01 to 1.32). In Manchester, there were increased attendances by both women (media 15%, n=5213, IRR 1.19, 95% CI 1.08 to 1.31; post-media 13%, n=5132, IRR 1.22, 95% CI 1.10 to 1.35) and men (media 17%, n=2835, IRR 1.13, 95% CI 1.04 to 1.24). In London, there was a 5% increase in attendances by men in the post-media period (n=47008, IRR 1.10, 95% CI 1.04 to 1.17). In Liverpool, there were increased attendances by men at SHCs (media 17%, n=2186, IRR 1.14, 95% CI 1.07 to 1.23; post-media 18%, n=2213, IRR

1.16, 95% CI 1.08 to 1.23). Although Birmingham was ranked third for highest RSI, there were no significant increases in attendances by men or women.

Gonorrhoea testing

Increases in the number of gonorrhoea tests, predominantly in 2015, were detected after media coverage in some cities (Tables 1 & 2). There were increased in gonorrhoea tests among women in Leeds and men in Sheffield, which coincided with increased SHC attendances, but was only statistically significant among women during the media (19%, n=1127, IRR 1.18, 95% CI 1.03 to 1.34) period in 2016 after adjusting for the underlying time trend. In Manchester, the number of gonorrhoea tests increased in the media (20%, n=2358, IRR 1.21, 95% CI 1.11 to 1.32) and post-media (17%, n=2287, IRR 1.19, 95% CI 1.08 to 1.31) periods among women and in the post-media period among men (10%, n=2107, IRR 1.13, 95% CI 1.04 to 1.23). In London, gonorrhoea tests increased by 4% in the post-media period among men (n=37121, IRR 1.08, 95% CI 1.02 to 1.15). An increase in gonorrhoea tests in the absence of a significant increase in SHC attendances occurred among women in Liverpool and men in Birmingham. In Liverpool, gonorrhoea tests among women increased in the media period (19%, n=2229, IRR 1.10, 95% CI 1.00 to 1.20) and among men during both periods (media 17%, n=1532, IRR 1.13, 95% CI 1.05 to 1.23; post-media 19%, n=1551, IRR 1.15, 95% CI 1.06 to 1.25). In Birmingham, gonorrhoea tests increased in both periods among men (media 8%, n=2319, IRR 1.11, 95% CI 1.02 to 1.22; post-media 15%, n=2480, IRR 1.15, 95% CI 1.06 to 1.25).

In Manchester, London, and Liverpool (men only), increased number of gonorrhoea tests coincided with simultaneous increased SHC attendances.

Diagnoses of gonorrhoea or any new STI

There were increased STI and gonorrhoea diagnoses detected among women in some cities in 2015 after media coverage (Tables 1 & 2). Diagnoses of 'any STI' increased among women in Manchester (media 37%, n=378, IRR 1.25, 95% CI 1.09 to 1.43), but not gonorrhoea. There were small increases in diagnoses of 'any STI' among women in London (media 6%, n=5099, IRR 1.09, 95% CI 1.03 to 1.16; post-media 5%, n=5052, IRR 1.11, 95% CI 1.04 to 1.18) in the absence of increases in gonorrhoea testing or SHC attendances. In Liverpool, diagnoses of 'any STI' increased in both periods (media 17%, n=279; IRR 1.21, 95% CI 1.04 to 1.41; post-media 27%, n=302; IRR 1.33, 95% CI 1.14 to 1.56), which coincided with increased gonorrhoea diagnoses (post-media 108%, n=27, IRR 1.76, 95% CI 1.05 to 2.95) but not SHC attendances. No increases in diagnoses were detected in any other cities.

DISCUSSION

Extensive local and national media coverage of an outbreak of HL-AziR was temporally associated with a high RSI for outbreak-related search terms, and increased attendances, gonorrhoea tests, and gonorrhoea or 'any STI' diagnoses at SHCs in several English cities. After media coverage of the outbreak, people in the initial outbreak city, Leeds, or nearby cities, were more likely to attend SHCs, suggesting that they were modifying their health-seeking behaviour as a result.

We quantified online media coverage of the outbreak as a proxy for media interest. However, we did not assess news articles in print, article placement (e.g. front page), or differences in local media exposure between cities (e.g. dose-response), which may have influenced outcomes. RSI for ‘gonorrhea’ coincided with peak search interest for ‘super gonorrhea’ suggesting that both peaks were related to outbreak media coverage. GUMCAD is a large, comprehensive surveillance dataset with complete coverage of attendances, testing, and diagnoses of STIs at SHCs in England. This provided a unique opportunity to quantify attendance-based changes for multiple outcomes in different cities. We could not analyse reason for attendance, the sequence of events (i.e. did a person attend a SHC because they searched online, or vice versa) or associated risk factors because data were not available. Since the interrupted time series analysis was ecological, we can only infer temporal associations not causation, but there were no known national or local health promotion campaigns which may have impacted this analysis. To our knowledge, this is the first time associations between a relatively short-period of media interest of a high-profile STI outbreak and changes in health-seeking behaviour were demonstrated. Recent evidence suggests that media coverage could impact the progression of epidemics [16], and impact health-seeking behaviour [14,17–19,35,36].

Dean Street Express is a large SHC in central London providing asymptomatic STI screening, so the increase in the search query could imply people were seeking SHC appointments. Increased SHC attendances did not always coincide with increased gonorrhoea tests or diagnoses, which may reflect an increase in attendances by low risk individuals. However, media coverage may have encouraged clinicians to offer

tests to more patients or improved test uptake by patients, which could explain the increased gonorrhoea tests in the absence of increased attendances in Birmingham. Proximity to the initial outbreak area might influence risk perception among local populations. Sheffield and Manchester and Birmingham had similar RSIs, but no increased attendances occurred in Birmingham (located further from Leeds). Major campaigns for AIDS in the UK were associated with a surge in HIV testing by heterosexuals with no identified risk factors [37] and a decline in HIV positivity rates [38]. In contrast, media campaigns aimed at increasing chlamydia screening reported improved uptake by high risk individuals, but not total tests [15].

Other factors could have contributed to increased SHCs attendances by women in Leeds. All known outbreak interventions were implemented after March 2016, so were unlikely to have impacted outcomes in 2015 (described elsewhere) [10]. Leeds SHCs increased their opening hours from July 2015 and began delivering an integrated sexual health and reproductive health service from a new main hub with satellite clinics from December 2015; however, there were no specific changes to the service in mid-September 2015 when attendances peaked (Appendix Fig. 1). The increase in opening hours at SHCs may have placed Leeds in a unique position to accommodate more appointments after media coverage of the outbreak while other SHCs may have already been operating at full capacity.

Our findings demonstrate that media stories can result in an increase in both online searches and health-seeking behaviours. Public health agencies should make better use of national and local media outlets to promote testing, treatment and healthier

behaviour. For example, the release of STI statistics or reports can often attract media attention which can provide an important opportunity to reinforce key public health messages on safer sexual and health-seeking behaviours. Public health agencies need to have good internal coordination and strong communication capacity (potentially supplemented by partnerships with media agencies) to be able to respond rapidly and take full advantage of such media opportunities. When media stories do occur, public health agencies should promote social media interventions [39] and deliver major sexual health campaigns in order to reinforce key public health message and disseminate accurate and evidence-based information.

This study also highlights that continued “click-bait” may desensitize people over time. Most of the increases in our study were transient and limited to 2015, and online RSI also declined over time. Awareness of people’s online search interest and the impact it can have on health-seeking behaviour may aid in planning by health professionals and identifying the optimal window for public health engagement and education.

The HL-AziR outbreak in England persists and clinicians have reported difficulties in getting partners of cases to attend SHCs for screening [39]. Therefore, more research is needed to understand risk perceptions, health-seeking behaviours, and barriers to accessing healthcare to improve infection control. Although this study focused on a high-profile STI outbreak, understanding the relationship between media health stories, the internet and social media, and subsequent health behaviours is an area of increasing public health importance, especially for controversial issues [40].

CONCLUSION

Our analysis demonstrates the potential for media coverage to have a beneficial impact on health-seeking behaviour during high profile STI outbreaks. In England, Google searches related to gonorrhoea direct people to the National Health Services (NHS) Choices website; however, top results for ‘super gonorrhoea’ searches only refer to media coverage of the outbreak. Opportunities to improve targeting of health promotion information following online searches clearly exist, and further research is needed to optimise targeting and rapid delivery of health promotion information to those most at risk of infection. Partnerships between public health agencies and media agencies, or the use of social media platforms could facilitate this process, support infection control initiatives, and thereby achieve control of outbreaks.

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Declaration of interests All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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Transparency statement CS, as guarantor, affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as originally planned have been explained.

Patient consent and ethics statement

As GUMCAD is a routine public health surveillance activity which collects de-identified data, no specific consent was required from the patients whose data were used in this analysis. In its role providing infectious disease surveillance, Public Health England has permission to process data obtained by GUMCAD under Regulation 3 of the Health Service (Control of Patient Information) Regulations 2002. No patients were recruited for this study, or involved in the development of the research question, outcome measures, or study design.

Data sharing Data from Google Trends are publicly available. GUMCAD STI Surveillance System is the mandatory surveillance system for sexually transmitted infections (STIs) in England. PHE collects pseudo-anonymised, electronic data on all STI tests and diagnoses from all commissioned sexual health services in England. Some data are publicly available, and the principles for accessing, storing, and sharing data are given in PHE's HIV and STI data sharing policy found here: https://www.gov.uk/government/publications/hiv-and-sti-data-sharing-policy

Figures and Table Legends

Figure 1 A) Relative search interest (RSI) for the search terms ‘gonorrhea’ and ‘super gonorrhea’ from Google Trends compared with the number of news articles published online related to ‘super gonorrhoea’ during different exposure periods by week, and B) cities with the highest RSI for the search term ‘gonorrhea’ in England from 2015 to 2016.

Footnote1: The periods of exposure were defined as successive six-week periods directly before media coverage (pre-media: 2015 weeks 32-37; 2016 weeks 10-15; 2016 weeks 30 to 35), during and directly after media coverage (media: 2015 weeks 38-43; 2016 weeks 16-21; 2016 weeks 36 to 41), and a subsequent six-week period after media exposure (post-media: 2015 weeks 44-49; 2016 weeks 22-27; 2016 weeks 42 to 47).

Figure 2 Attendances at sexual health clinics by A) women and B) men in Leeds by year, week and attendance type from 2014 to 2016. Incidence rate ratios (IRRs) and 95% confidence intervals for new attendances during the media and post-media periods are displayed from interrupted time series regression using a negative binomial regression after two periods of major media coverages of an outbreak of high-level azithromycin resistant Neisseria gonorrhoeae in England. The vertical, solid lines in 2015 and 2016 indicates the start of media coverage of the high-level azithromycin resistant N. gonorrhoeae outbreak in England during that period, and the dashed lines separate the pre-media, media and post-media periods.

Footnote1: The periods of exposure were defined as successive six-week periods directly before media coverage (pre-media: 2015 weeks 32-37; 2016 weeks 10-15; 2016 weeks 30 to 35), during and directly after media coverage (media: 2015 weeks 38-43; 2016 weeks 16-21; 2016 weeks 36 to 41), and a subsequent six-week period after media exposure (post-media: 2015 weeks 44-49; 2016 weeks 22-27; 2016 weeks 42 to 47).

Footnote2: Significance was defined as $p < 0.05$ and indicated by an asterisk.

Table 1 Incidence rate ratios (IRRs) for A) women and B) men from interrupted time series regression using a negative binomial distribution for sexual health clinic attendances, gonorrhoea tests, and gonorrhoea or 'any STI' diagnoses after major media coverage of the high-level azithromycin resistant Neisseria gonorrhoeae outbreak in England for cities with the highest relative search interest (RSI) based on Google Trends. Separate models were run stratified by city, and gender. Pre-media (2015 weeks 32 to 37; 2016 weeks 10 to 15), media (2015 weeks 38 to 43; 2016 weeks 16 to 20) and post-media (2015 weeks 44 to 49; 2016 weeks 22 to 27) periods were compared to the baseline trend from 2014 to 2016 after controlling for year, seasonality, bank holidays, and clinic closures. Text highlighted in grey represent statistically significant increases and text highlighted in black represent statistically significant decreases in outcomes where no statistically significant increase occurred in the pre-media period.

Footnote1: Significance was defined as $p < 0.05$ and indicated by an asterisk.

Table 2 Percent change in number of sexual health clinic attendances, gonorrhoea tests, and gonorrhoea or 'any STI' diagnoses among men or women after major media coverage of an outbreak of high-level azithromycin resistant Neisseria gonorrhoeae in England for cities with the highest relative search interest (RSI) based on Google Trends. Percent changes in the media (2015 weeks 38 to 43; 2016 weeks 16 to 20) and post-media (2015 weeks 44 to 49; 2016 weeks 22 to 27) periods were compared to the pre-media (2015 weeks 32 to 37; 2016 weeks 10 to 15) for each year. Text highlighted in grey represent statistically significant increases and text highlighted in black represent statistically significant decreases in outcomes

where no statistically significant increases occurred in the pre-media period. Statistical significance is based on separate analyses using interrupted time series and is only highlighted in this figure for comparison purposes to Table 1.

Women

City	Outcome	2015			2016		
		pre-media	media	post-media	pre-media	media	post-media
		Incidence rate ratio (95% confidence interval)					
Leeds	Attendances	0.91 (0.80-1.03)	1.26 (1.12-1.43)*	1.51 (1.34-1.71)*	1.04 (0.92-1.17)	1.25 (1.10-1.43)*	1.11 (0.97-1.26)
	Gonorrhoea testing	0.87 (0.77-0.99)*	1.06 (0.95-1.20)	0.96 (0.85-1.08)	0.95 (0.84-1.08)	1.18 (1.03-1.34)*	1.08 (0.95-1.23)
	Gonorrhoea diagnoses	0.71 (0.42-1.19)	0.91 (0.59-1.41)	0.91 (0.58-1.43)	1.34 (0.89-2.03)	0.84 (0.51-1.40)	0.62 (0.35-1.11)
	'Any STI' diagnoses	0.75 (0.63-0.89)*	0.86 (0.74-1.00)*	0.87 (0.75-1.01)	0.94 (0.81-1.08)	1.14 (0.99-1.33)	0.93 (0.80-1.09)
Sheffield	Attendances	1.09 (0.92-1.29)	1.21 (1.04-1.44)*	1.11 (0.94-1.32)	0.71 (0.60-0.84)*	0.82 (0.68-0.99)*	0.87 (0.73-1.05)
	Gonorrhoea testing	0.64 (0.53-0.79)*	0.78 (0.65-0.95)*	0.69 (0.57-0.85)*	1.00 (0.82-1.22)	0.94 (0.76-1.16)	0.88 (0.72-1.09)
	Gonorrhoea diagnoses	0.86 (0.45-1.64)	0.91 (0.49-1.69)	0.62 (0.29-1.35)	0.64 (0.34-1.19)	0.34 (0.10-1.15)	0.52 (0.23-1.17)
	'Any STI' diagnoses	0.94 (0.76-1.17)	1.11 (0.91-1.34)	0.99 (0.81-1.22)	0.92 (0.75-1.15)	0.74 (0.58-0.96)*	0.86 (0.68-1.08)
Manchester	Attendances	1.06 (0.96-1.17)	1.19 (1.08-1.31)*	1.22 (1.10-1.35)*	1.16 (1.05-1.28)*	1.21 (1.09-1.35)*	1.10 (0.99-1.23)
	Gonorrhoea testing	1.07 (0.97-1.17)	1.21 (1.11-1.32)*	1.19 (1.09-1.31)*	1.02 (0.93-1.12)	1.07 (0.97-1.18)	0.98 (0.88-1.08)
	Gonorrhoea diagnoses	1.04 (0.61-1.77)	0.87 (0.49-1.55)	1.15 (0.66-1.99)	0.89 (0.53-1.52)	1.28 (0.76-2.17)	1.04 (0.61-1.79)
	'Any STI' diagnoses	0.98 (0.84-1.14)	1.25 (1.09-1.43)*	1.13 (0.98-1.31)	0.89 (0.76-1.03)	1.15 (0.98-1.34)	1.02 (0.87-1.19)
London	Attendances	1.07 (1.01-1.13)*	1.10 (1.04-1.17)*	1.13 (1.06-1.20)*	1.00 (0.94-1.06)	1.00 (0.94-1.07)	1.01 (0.95-1.07)
	Gonorrhoea testing	1.06 (1.00-1.13)*	1.09 (1.03-1.15)*	1.12 (1.05-1.19)*	0.99 (0.93-1.05)	1.00 (0.94-1.07)	1.01 (0.95-1.08)
	Gonorrhoea diagnoses	1.19 (1.04-1.35)*	1.27 (1.13-1.44)*	1.22 (1.08-1.39)*	0.81 (0.71-0.94)*	0.87 (0.75-1.01)	0.82 (0.71-0.95)*
	'Any STI' diagnoses	1.07 (1.00-1.14)	1.09 (1.03-1.16)*	1.11 (1.04-1.18)*	0.95 (0.89-1.01)	0.92 (0.86-0.99)*	0.91 (0.85-0.98)*
Liverpool	Attendances	0.97 (0.89-1.05)	1.00 (0.92-1.08)	0.97 (0.89-1.05)	1.04 (0.96-1.13)	1.01 (0.93-1.10)	0.93 (0.85-1.01)
	Gonorrhoea testing	1.00 (0.92-1.11)	1.10 (1.00-1.20)*	1.09 (0.99-1.20)	0.99 (0.90-1.09)	1.02 (0.92-1.13)	0.95 (0.86-1.05)
	Gonorrhoea diagnoses	0.93 (0.49-1.76)	1.36 (0.81-2.31)	1.76 (1.05-2.95)*	0.87 (0.51-1.49)	0.99 (0.56-1.77)	1.02 (0.59-1.77)
	'Any STI' diagnoses	1.08 (0.92-1.27)	1.21 (1.04-1.41)*	1.33 (1.14-1.56)*	0.81 (0.68-0.96)*	1.06 (0.89-1.26)	0.79 (0.66-0.95)*
Birmingham	Attendances	0.99 (0.87-1.13)	0.95 (0.84-1.08)	1.03 (0.91-1.17)	0.92 (0.81-1.04)	0.96 (0.84-1.10)	0.89 (0.77-1.01)
	Gonorrhoea testing	1.17 (1.06-1.30)*	1.17 (1.06-1.30)*	1.34 (1.20-1.48)*	0.94 (0.85-1.04)	0.98 (0.88-1.10)	0.90 (0.81-1.01)
	Gonorrhoea diagnoses	1.21 (0.90-1.63)	1.08 (0.79-1.46)	1.28 (0.94-1.75)	0.70 (0.52-0.95)*	0.51 (0.36-0.73)*	0.73 (0.54-1.00)*
	'Any STI' diagnoses	1.31 (1.16-1.47)*	1.21 (1.08-1.35)*	1.25 (1.11-1.41)*	0.87 (0.77-0.97)*	0.91 (0.80-1.03)	0.87 (0.77-0.99)*

Men

City	Outcome	2015			2016		
		pre-media	media	post-media	pre-media	media	post-media
		Incidence rate ratio (95% confidence interval)					
Leeds	Attendances	1.03 (0.92-1.14)	1.01 (0.91-1.11)	0.94 (0.85-1.05)	0.87 (0.78-0.97)*	1.09 (0.97-1.22)	1.04 (0.93-1.17)
	Gonorrhoea testing	1.03 (0.93-1.15)	1.01 (0.91-1.12)	0.92 (0.82-1.03)	0.86 (0.77-0.97)*	1.10 (0.97-1.24)	1.02 (0.91-1.15)
	Gonorrhoea diagnoses	1.15 (0.80-1.66)	1.23 (0.87-1.74)	0.88 (0.59-1.31)	0.89 (0.59-1.34)	0.84 (0.55-1.31)	0.79 (0.51-1.23)
	'Any STI' diagnoses	1.00 (0.86-1.17)	0.87 (0.75-1.02)	0.88 (0.75-1.03)	0.88 (0.75-1.03)	1.12 (0.95-1.32)	0.97 (0.82-1.14)
Sheffield	Attendances	0.96 (0.83-1.09)	1.19 (1.04-1.36)*	1.15 (1.01-1.32)*	0.92 (0.80-1.06)	0.96 (0.82-1.11)	0.86 (0.75-1.00)
	Gonorrhoea testing	0.86 (0.75-0.99)*	1.05 (0.92-1.20)	1.02 (0.89-1.17)	0.97 (0.84-1.12)	0.91 (0.78-1.06)	0.81 (0.70-0.95)*
	Gonorrhoea diagnoses	0.60 (0.36-0.99)*	0.70 (0.46-1.05)	0.66 (0.44-1.00)	0.67 (0.37-1.21)	0.90 (0.51-1.58)	0.85 (0.50-1.46)
	'Any STI' diagnoses	0.83 (0.67-1.02)	1.05 (0.87-1.26)	1.10 (0.91-1.33)	0.80 (0.65-0.99)*	0.95 (0.77-1.18)	0.88 (0.71-1.09)
Manchester	Attendances	1.01 (0.92-1.10)	0.99 (0.91-1.08)	1.13 (1.04-1.24)*	1.09 (0.99-1.19)	1.05 (0.96-1.16)	1.02 (0.93-1.12)
	Gonorrhoea testing	1.07 (0.99-1.17)	1.06 (0.97-1.15)	1.13 (1.04-1.23)*	1.08 (1.00-1.18)	1.06 (0.97-1.16)	1.02 (0.94-1.12)
	Gonorrhoea diagnoses	1.24 (1.00-1.55)	1.17 (0.94-1.45)	1.00 (0.79-1.27)	1.08 (0.85-1.38)	0.78 (0.60-1.04)	0.81 (0.63-1.07)
	'Any STI' diagnoses	1.11 (0.97-1.26)	1.09 (0.96-1.24)	1.12 (0.98-1.28)	1.08 (0.94-1.23)	0.95 (0.82-1.10)	0.96 (0.83-1.10)
London	Attendances	1.04 (0.99-1.11)	1.04 (0.98-1.10)	1.10 (1.04-1.17)*	0.99 (0.94-1.05)	1.00 (0.93-1.06)	0.98 (0.93-1.06)
	Gonorrhoea testing	1.04 (0.98-1.10)	1.04 (0.98-1.10)	1.08 (1.02-1.15)*	0.99 (0.93-1.05)	0.99 (0.92-1.05)	0.98 (0.93-1.05)
	Gonorrhoea diagnoses	1.11 (1.01-1.22)*	0.95 (0.86-1.03)	0.94 (0.85-1.03)	0.95 (0.86-1.05)	0.82 (0.74-0.91)*	0.87 (0.78-0.97)*
	'Any STI' diagnoses	1.04 (0.98-1.12)	1.00 (0.94-1.07)	1.04 (0.97-1.11)	0.97 (0.91-1.04)	0.94 (0.88-1.01)	0.95 (0.88-1.02)
Liverpool	Attendances	1.04 (0.96-1.11)	1.14 (1.07-1.23)*	1.16 (1.08-1.23)*	1.05 (0.98-1.13)	1.05 (0.97-1.13)	1.01 (0.94-1.10)
	Gonorrhoea testing	1.03 (0.94-1.12)	1.13 (1.05-1.23)*	1.15 (1.06-1.25)*	1.04 (0.96-1.13)	1.06 (0.97-1.16)	1.05 (0.96-1.15)
	Gonorrhoea diagnoses	1.02 (0.73-1.44)	0.98 (0.71-1.36)	0.92 (0.66-1.30)	1.08 (0.75-1.55)	1.14 (0.79-1.65)	1.08 (0.75-1.56)
	'Any STI' diagnoses	0.97 (0.85-1.11)	1.09 (0.96-1.24)	1.07 (0.94-1.22)	1.15 (1.01-1.32)*	1.24 (1.08-1.43)*	1.09 (0.95-1.26)
Birmingham	Attendances	1.10 (0.99-1.23)	1.08 (0.98-1.19)	1.10 (0.99-1.22)	0.89 (0.81-0.99)	0.93 (0.83-1.04)	0.98 (0.88-1.09)
	Gonorrhoea testing	1.09 (1.00-1.20)	1.11 (1.02-1.22)*	1.15 (1.05-1.26)*	0.94 (0.86-1.02)	0.94 (0.85-1.03)	0.94 (0.86-1.04)
	Gonorrhoea diagnoses	1.09 (0.86-1.39)	0.99 (0.79-1.26)	0.81 (0.63-1.06)	0.69 (0.53-0.90)*	0.70 (0.53-0.91)*	0.59 (0.44-0.78)*
	'Any STI' diagnoses	1.13 (1.01-1.27)*	1.19 (1.07-1.32)*	1.10 (0.98-1.23)	0.93 (0.83-1.04)	0.89 (0.78-1.00)*	0.80 (0.71-0.91)*

City	Outcome	Women						Men					
		2015			2016			2015			2016		
		pre-media	media	post-media	pre-media	media	post-media	pre-media	media	post-media	pre-media	media	post-media
		(n)	% increase		(n)	% increase		(n)	% increase		(n)	% increase	
Leeds	Attendances	1,187	63%	103%	2,458	14%	0%	1,271	7%	1%	1,155	25%	17%
	Gonorrhoea testing	823	35%	24%	946	19%	5%	1,079	6%	-5%	820	26%	14%
	Gonorrhoea diagnoses	19	47%	53%	36	-31%	-58%	54	6%	-24%	38	-3%	-5%
	'Any STI' diagnoses	191	31%	39%	297	19%	-4%	323	-7%	-6%	293	28%	8%
Sheffield	Attendances	1,711	32%	29%	1,647	7%	11%	954	33%	31%	1,139	2%	-9%
	Gonorrhoea testing	807	32%	20%	808	4%	-1%	877	29%	29%	1,034	2%	-9%
	Gonorrhoea diagnoses	13	8%	-38%	13	-77%	-38%	20	55%	65%	14	29%	43%
	'Any STI' diagnoses	160	29%	21%	158	-23%	-11%	181	30%	40%	166	19%	13%
Manchester	Attendances	4,544	15%	13%	4,759	5%	-10%	2,431	3%	17%	2,689	1%	-4%
	Gonorrhoea testing	1,957	20%	17%	2,118	4%	-9%	1,918	3%	10%	2,117	2%	-4%
	Gonorrhoea diagnoses	20	-25%	-5%	20	40%	20%	128	-3%	-16%	104	-21%	-16%
	'Any STI' diagnoses	276	37%	24%	288	24%	7%	577	4%	6%	592	-6%	-7%
London	Attendances	53,009	5%	5%	51,506	5%	4%	44,763	1%	5%	41,604	6%	4%
	Gonorrhoea testing	35,992	5%	5%	34,426	5%	5%	35,713	1%	4%	33,020	5%	4%
	Gonorrhoea diagnoses	369	19%	16%	288	10%	1%	2,415	-15%	-19%	1,556	-5%	-2%
	'Any STI' diagnoses	4,790	6%	5%	4,456	1%	-3%	9,236	-4%	-4%	7,591	3%	2%
Liverpool	Attendances	5,268	9%	6%	5,478	2%	-8%	1,869	17%	18%	1,965	2%	-3%
	Gonorrhoea testing	1,874	19%	18%	2,036	4%	-7%	1,305	17%	19%	1,401	3%	0%
	Gonorrhoea diagnoses	13	62%	108%	19	11%	21%	49	10%	6%	43	23%	16%
	'Any STI' diagnoses	238	17%	27%	207	30%	-7%	345	24%	23%	378	10%	-5%
Birmingham	Attendances	3,911	8%	26%	4,635	5%	-3%	2,497	5%	11%	2,698	4%	9%
	Gonorrhoea testing	2,870	9%	29%	3,557	3%	-5%	2,148	8%	15%	2,410	1%	1%
	Gonorrhoea diagnoses	64	-16%	-8%	59	-20%	5%	103	-1%	-19%	77	18%	-6%

	‘Any STI’ diagnoses	626	-2%	4%	601	7%	1%	581	11%	4%	584	1%	-11%

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