

1 **Syphilis screening in pregnancy in the United Kingdom, 2010-2011: a national**  
2 **surveillance study**

3

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13 **Running head:** Antenatal syphilis screening in the UK

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15 **Key words:** Syphilis; Pregnancy; Surveillance; Epidemiology; Congenital infection

16

17 **Abstract**

18 Objective. To evaluate the national antenatal syphilis screening programme and provide evidence  
19 for improving screening and management strategies.

20 Design. National population-based surveillance.

21 Setting. United Kingdom (UK).

22 Population. All pregnant women screening positive for syphilis, 2010-2011.

23 Methods. Demographic, laboratory and treatment details for each pregnancy were collected from  
24 UK antenatal units (~210), along with follow up information on all infants born to women requiring  
25 syphilis treatment in pregnancy.

26 Main outcome measures. Proportion of women with newly or previously diagnosed syphilis among  
27 those with positive screening tests in pregnancy; proportion requiring treatment.

28 Results. Overall 77% (1425/1840) of reported pregnancies were confirmed syphilis screen-positive.

29 Of these, 71% (1010/1425) were in women with previously diagnosed syphilis (155 requiring  
30 treatment), 26% (374/1425) with newly diagnosed syphilis (all requiring treatment) and 3%

31 (41/1425) required treatment but the reason was unclear. Thus 40% (570/1425) required treatment

32 overall; of these, 96% (516/537) were treated (missing data: 33/570), although for 18% (83/456),

33 this was not until the third trimester (missing data: 60/537). Follow up of infants born to treated

34 women was poor, with at least a third not followed. Six infants were diagnosed with congenital

35 syphilis; two mothers were untreated, three had delayed treatment and one incomplete treatment  
36 (first trimester).

37 Discussion. Over two years, among pregnant women with confirmed positive syphilis screening  
38 results in the UK, a quarter had newly diagnosed infections and two fifths required treatment.

39 Despite high uptake of treatment, antenatal syphilis management could be improved by earlier  
40 detection, earlier treatment, and stronger links between healthcare teams.

- 41 **Tweetable abstract.** 25% of pregnant women screening positive for syphilis in the UK were newly
- 42 diagnosed and 40% needed treatment.

## 43 **Surveillance of antenatal syphilis screening in the United Kingdom, 2010-2011**

### 44 **Introduction**

45 Syphilis in pregnancy remains a global public health problem, with approximately 1.36 million  
46 women (range: 1.16-1.56 million) worldwide estimated to have active syphilis in pregnancy in 2008.<sup>1</sup>  
47 Untreated syphilis infection is commonly associated with adverse pregnancy outcomes including  
48 miscarriage, stillbirth, preterm birth, hydrops and polyhydramnios,<sup>2</sup> and can be transmitted to the  
49 fetus, leading to growth restriction, low birth weight, and long-term sequelae including hearing loss,  
50 neurological impairment and bone deformities.<sup>3</sup> Congenital syphilis is almost entirely preventable,  
51 and the World Health Organization called for global elimination (less than 50 cases per 100 000 live  
52 births) by 2015, through testing of  $\geq 95\%$  of pregnant women and treatment of  $\geq 95\%$  of those  
53 identified.<sup>4</sup> In cases of early (primary, secondary, early latent) syphilis in pregnancy, treatment with a  
54 single intramuscular injection of benzathine penicillin G (2.4MU) is recommended, if administered in  
55 the first or second trimester of pregnancy, or two doses if administered later.<sup>5</sup> Current British  
56 guidelines also advise re-treatment if there is uncertainty over the efficacy of past treatment.<sup>6</sup> For  
57 late latent syphilis in pregnancy, three doses of benzathine penicillin are recommended.<sup>6</sup>

58 In the United Kingdom (UK), new diagnoses of infectious syphilis in women more than doubled  
59 between 1999 and 2007, and anecdotally sexual health clinics reported around 10 cases of  
60 congenital infection annually.<sup>7</sup> Since a peak of around 500 in 2005, new diagnoses in women  
61 subsequently declined to 265 in 2012, although infections in men remain 10-fold higher, mainly due  
62 to ongoing transmission in men who have sex with men.<sup>8</sup>

63 Screening is routinely offered and recommended to all pregnant women in England,<sup>9</sup> with uptake  
64 over 97%;<sup>10</sup> in 2014, 0.14% of pregnant women (971/709,204) screened positive.<sup>10</sup> However, a  
65 positive screening test can indicate current or past syphilis infection, or may be a false positive  
66 result, sometimes indicating a history of endemic treponemal infection such as yaws or pinta.  
67 Women screening positive for syphilis therefore need referral to an appropriate specialist (e.g. a

68 genitourinary (GU) physician) for clinical assessment based on a detailed medical history, physical  
69 examination, and laboratory results. Although uptake of screening is high, concerns have been  
70 raised about the subsequent investigation, treatment and follow up of screen-positive women and  
71 their babies.<sup>11</sup>

72 The aim of this study was to evaluate the UK antenatal syphilis screening programme and provide  
73 evidence for improving screening and management strategies, by reviewing screen-positive  
74 pregnancies over a two-year period and assessing their management and outcome.

75

## 76 **Methods**

77 The Surveillance of Antenatal Syphilis Screening (SASS) study was a comprehensive national  
78 surveillance study through which information on all syphilis-positive pregnancies was requested  
79 from designated respondents in all maternity units in the UK. It was modelled on the National Study  
80 of HIV in Pregnancy and Childhood,<sup>12</sup> and for 80% of units the respondent was the same individual.  
81 Study respondents were contacted every three months and asked to report all pregnancies in  
82 women attending for antenatal care in 2010-2011 with a positive syphilis screening test. Basic  
83 demographic, pregnancy and laboratory data were collected using a standard form. Respondents  
84 were asked to report whether screen-positive cases were classified as newly diagnosed or previously  
85 diagnosed syphilis infection (with or without history of adequate treatment), or false positive<sup>9</sup> (e.g.  
86 due to other treponemal infections, non-specific reactivity, or test errors), and to provide treatment  
87 details if it was required. Information on other positive screening tests in pregnancy (e.g. HIV,  
88 hepatitis B virus) was also collected. For pregnancies where treatment was required, outcome  
89 information was requested soon after the estimated date of delivery (EDD), along with details of the  
90 paediatrician responsible for infant follow-up; paediatricians were contacted between 2011 and  
91 2013, when infants were at least 6 months old, to identify cases of congenital syphilis. Duplicate  
92 reports were matched using maternal dates of birth and other identifiers (EDD, ethnicity, etc), as no

93 names were collected. A parallel paediatric study of congenital syphilis cases diagnosed between  
94 2010 and 2015 was carried out through the British Paediatric Surveillance Unit (BPSU) of the Royal  
95 College of Paediatrics and Child Health ([www.rcpch.ac.uk/what-we-do/bpsu/current-](http://www.rcpch.ac.uk/what-we-do/bpsu/current-studies/congenital-syphilis/congenital-syphilis)  
96 [studies/congenital-syphilis/congenital-syphilis](http://www.rcpch.ac.uk/what-we-do/bpsu/current-studies/congenital-syphilis/congenital-syphilis)). Cases of congenital syphilis reported through the  
97 two studies were matched using mothers' and babies' dates of birth and other identifiers, in order to  
98 ascertain any cases missed by either study.

99 Maternal country of birth was grouped by United Nations region  
100 (<http://unstats.un.org/unsd/methods/m49/m49regin.htm>). Hospitals were grouped by UK country  
101 and English region using the National Health Service (NHS) Strategic Health Authorities in place at  
102 the time of the study. Setting of previous syphilis diagnosis (if relevant) was recorded as "Antenatal"  
103 (i.e. in a previous pregnancy) or "Other / Not known". If date of booking for antenatal care (i.e. first  
104 antenatal appointment) was missing, the earliest syphilis test date was used as a proxy. Gestation at  
105 antenatal booking was calculated from booking date and EDD in most cases; where EDD was missing,  
106 it was estimated from delivery date and gestation at birth ( $n=59$ ). The interval between antenatal  
107 booking and treatment was calculated from treatment date and booking date, or first test date if  
108 booking date was missing. Time since arrival in the UK for women born abroad was calculated as the  
109 difference between year of arrival and year of booking.

110 Data were managed in Access 2010 (Microsoft Corp., Redmond, Washington, USA) and analysed  
111 using Stata version 12.1 (Stata Corp. LP, College Station, Texas, USA). Categorical variables were  
112 compared using  $\chi^2$  tests or Fisher's exact tests, and medians using Kruskal-Wallis tests. Analyses  
113 relate to pregnancies and some women (<3%) had more than one pregnancy reported during the  
114 study period. Preterm birth and low birthweight rates for the general population were obtained  
115 from Office for National Statistics data for the whole of England and Wales,<sup>13</sup> and comparisons made  
116 using the one-sample test of proportions.

117

## 118 **Results**

### 119 ***Response rates***

120 Ninety-eight percent of reporting cards were returned (total 1662/1697; on average 208/212 per  
121 reporting period). There were 2162 reports of syphilis screen-positive pregnancies, of which 223  
122 were excluded (Figure 1), leaving 1939 reports. Of these, 92% (1781/1939) were from England, 4%  
123 (84/1939) from Scotland, 3% (51/1939) from Northern Ireland, and 1% (23/1939) from Wales.

### 124 ***Syphilis classification / diagnosis and baseline characteristics***

125 There was insufficient information to classify 5% of screen-positive pregnancies (99/1939) (Figure 1),  
126 mostly because they were lost to follow up (48/99), or resulted in miscarriage or termination  
127 (28/99), and no further details were available. Among 1840 classified pregnancies, 77% (1425) were  
128 confirmed positives (i.e. newly or previously diagnosed syphilis infection), the remainder being  
129 reported as “false positives” (Figure 1). Among confirmed positives, 26% (374/1425) of women were  
130 newly diagnosed with syphilis, and 71% (1010/1425) had a previous syphilis diagnosis; 3% (41/1425)  
131 were reported to require treatment but whether this was for a previously or newly diagnosed  
132 infection was unclear (Figure 1).

133 Over half of the 1425 confirmed positive pregnancies were in European-born women (Table 1), of  
134 whom 39% (268/687) were born in Eastern Europe. Most women had previously been pregnant  
135 (Table 1), 88% (927/1058) of whom had previous live or still births. About 6% (81/1271) had their  
136 first antenatal appointment in the third trimester (at 27 weeks gestation or later), and 9% were  
137 reported to have screened positive for HIV, hepatitis B, and/or hepatitis C virus in pregnancy (Table  
138 1). In about 5% of confirmed positive pregnancies (76/1425), respondents spontaneously reported  
139 that women did not attend antenatal or genitourinary medicine (GUM) appointments, had poor  
140 adherence to syphilis treatment, and/or had complex or adverse social circumstances (e.g. drug or  
141 alcohol use, immigration or housing problems, domestic violence, prison); often these factors were

142 reported as reasons for problems with referral or follow up, or to explain why information was not  
143 available.

144 There was wide variation by region in the proportion of false positives (23% overall, Figure 1), from  
145 less than 10% in about half of UK countries or regions, to 32% in London (270/849) and 56% in  
146 Scotland (46/82). Few false positives were reported as due to other treponemal infections ( $n<15$ ).

#### 147 *Previously diagnosed syphilis infection*

148 Among 1010 pregnancies in women with previously diagnosed syphilis, 31% (313/1010) overall and  
149 36% (290/816) of those with previous pregnancies were reported to have been diagnosed during an  
150 earlier pregnancy, a median of three years prior to the current booking (interquartile range (IQR): 2,  
151 5 years;  $n=283$  overall). Most women with previously diagnosed syphilis (85%, 855/1010) were  
152 reported not to require treatment in the current pregnancy; however, treatment was advised for  
153 15% (Figure 1), mainly because of inadequate documentation of previous treatment (other reasons  
154 included: previous treatment incomplete, loss to follow-up or miscarriage before treatment could be  
155 offered in a previous pregnancy, and possible reinfection and/or positive EIA IgM test in the current  
156 pregnancy). Among women with previously diagnosed syphilis, 79% (711/898) were referred to a  
157 GUM clinic for assessment (information missing for 112/1010). Among 187 women who were not  
158 referred, possible reasons included miscarriage or termination ( $n=9$ ), loss to follow up or lack of  
159 engagement with care ( $n=7$ ) and multiple care providers ( $n=7$ ). However, for most, no reason was  
160 given for lack of referral.

#### 161 *Newly diagnosed syphilis infection*

162 All 374 women with newly diagnosed syphilis required treatment in pregnancy, and virtually all were  
163 referred to a GU physician (two women were not referred owing to difficult circumstances). Syphilis  
164 disease stage was reported for 73% (273/374) of these women: 14% (39/273) were reported to have



165 primary, 4% (12/273) secondary, 14% (38/273) early latent, 66% (181/273) late latent, and 1%  
166 (3/273) late symptomatic/tertiary infection.

### 167 **Treatment**

168 Overall, 40% of confirmed positive pregnancies (570/1425) were in women who required treatment  
169 for syphilis in pregnancy (Figure 1); 96% were reported to have received treatment but 21 women  
170 were not treated (Table 2). Most treated women (89%) were prescribed benzathine penicillin, and  
171 median gestation at treatment initiation was 17.4 weeks (IQR: 14.2, 23.8 weeks;  $n=456$ ). Treatment  
172 occurred in the third trimester in 18% of pregnancies (Table 2), and was more likely to be delayed in  
173 women born in European countries outside the UK (26%, 32/124) than in UK-born women (12%,  
174 15/130,  $p=0.006$ ). Median time since arrival in the UK among women born abroad was significantly  
175 shorter for those treated in the third trimester than for those treated in the first or second trimester  
176 (1 year, IQR: 0, 3 years,  $n=35$ , versus 3 years, IQR: 1, 7 years,  $n=113$ ,  $p<0.001$ ), but year of arrival was  
177 poorly reported (see Table 1). Among women treated in the third trimester, first antenatal  
178 appointment occurred at a median of 22.4 weeks (IQR: 13.0, 31.0 weeks,  $n=82$ ), a median of 9.6  
179 weeks prior to treatment initiation (IQR: 2.7, 19.0 weeks).

180 Among women receiving benzathine penicillin, 73% received at least three doses (Table 2), most of  
181 whom had late latent infection (66%, 209/318) or unreported disease stage (19%, 61/318). Eighty-  
182 eight percent of women with late latent syphilis (209/238) received three doses of benzathine  
183 penicillin, and 10 of 11 women with early syphilis treated in the third trimester received two or more  
184 doses. Among women with early syphilis infection who received benzathine penicillin before the  
185 third trimester, 81% (54/67) received more than one dose, even though guidelines suggest that one  
186 dose is sufficient. Seven of these were specifically reported to require additional doses (e.g. due to  
187 reinfection or treatment failure); half of the remainder (23/47) were classified as having early latent  
188 syphilis, which may be difficult to distinguish from late latent infection.

189 An additional five women were reported as having been treated during pregnancy although they did  
190 not require it (e.g. as a precaution due to late presentation or at patient request).

191 According to routine data sources, 691,494 women were screened for syphilis antenatally in 2011 in  
192 England<sup>14</sup>; in our study, 851 women had confirmed syphilis and 244 of these required treatment  
193 during pregnancy (figures restricted to pregnancies in England in 2011). In other words, for each  
194 woman requiring treatment who was identified through the screening programme, approximately  
195 2800 women were screened for syphilis.

### 196 ***Pregnancy outcomes among women requiring treatment***

197 Outcome details were sought for all 570 pregnancies in women reported to require treatment  
198 (Figure S1). There were 10 stillbirths; no evidence of congenital syphilis was found at post-mortem in  
199 five, including three where other causes were identified (e.g. congenital anomalies); for the other  
200 five no further details were available.

201 Deliveries occurred between July 2010 and March 2012. Among the 477 pregnancies with  
202 information on delivery (including five twin births) (Figure S1), 10% were delivered by elective  
203 caesarean section (45/454), 21% (97/454) by emergency caesarean section, and 69% (312/454)  
204 vaginally. For singleton live births, the preterm delivery rate (<37 weeks gestation) was 8% (32/419;  
205 95% confidence interval (CI), 5-11%), similar to that in the general population (6.2% in England in  
206 2005,  $t$ -test  $p=0.22$ )<sup>13</sup>. Median birth weight was 3.3 kg (IQR: 3.0, 3.6 kg), and 10% of infants weighed  
207 <2.5 kg (41/431, 95% CI: 7%-13%), significantly higher than the general population (6.1% in England  
208 in 2005,  $t$ -test  $p=0.004$ )<sup>13</sup>.

209 For 26% (125/482) of live born infants (including the five sets of twins), paediatric follow up forms  
210 were not returned. Furthermore, where forms were received, 18% (64/357) of infants were lost to  
211 follow up (e.g. moved away, failed to attend appointments, family declined follow up, etc), and  
212 another 15% (53/357) had no paediatric follow up, 20 reportedly because the mother had been

213 adequately treated. Among infants whose mothers had newly diagnosed syphilis in pregnancy, 15%  
214 (36/240) were lost to follow up and 8% (19/240) were reported not to have been followed up.

215 Six infants born to women who required treatment in pregnancy were diagnosed with congenital  
216 syphilis: four of the mothers received incomplete and/or delayed treatment (one received partial  
217 treatment in the first trimester, and three were treated in the third trimester only), but two were  
218 untreated; four of the six infants were preterm. One additional infant, whose mother was reported  
219 to this study as previously diagnosed and adequately treated (therefore not followed up further) was  
220 subsequently reported to the BPSU study as having congenital syphilis, likely as a result of maternal  
221 reinfection.

222

223

## 224 **Discussion**

### 225 *Main findings*

226 Over 1900 pregnancies in women screening positive for syphilis in pregnancy in 2010-2011 were  
227 reported in this UK study. Among the 1425 pregnancies with confirmed syphilis, about a quarter  
228 were in women with newly diagnosed infection, and over two thirds (71%) had a previous syphilis  
229 diagnosis; of the latter, most were seen by a GU physician, and about 15% were reported to have  
230 required treatment in pregnancy. Our findings suggested that among women with a previous syphilis  
231 diagnosis, about a third had been diagnosed in a previous pregnancy, reflecting the high uptake of  
232 antenatal screening over previous years.<sup>15</sup> About 40% of confirmed syphilis-positive pregnancies  
233 were in women requiring treatment, two thirds due to a newly diagnosed infection, and 96% were  
234 treated. Most women with late latent syphilis infection (88%) received three doses of benzathine  
235 penicillin, in line with UK guidelines.

236

237 *Strengths and limitations*

238 This study was the first national evaluation of the antenatal syphilis screening programme in the UK.  
239 High response rates were achieved, and the number of pregnancies reported corresponded closely  
240 with the number expected for 2010-2011 based on routine data (~1000/year).<sup>10, 14</sup> Despite good case  
241 ascertainment, miscarriages and pregnancy terminations in syphilis-positive women were probably  
242 under-ascertained, as the study only included women accessing antenatal care. In order to avoid  
243 missing cases, we invited respondents to report all syphilis screen-positive pregnancies including  
244 false positives; these accounted for almost a quarter of reports, with wide variation across the  
245 country, partly due to an incident involving IgM test kits used in some laboratories.<sup>16</sup> We were also  
246 aware of differential reporting of false positive results by unit, with some respondents providing  
247 these figures and others not, an issue that may also arise in routine data sources.

248

249 *Interpretation*

250 This study suggested that for every case of syphilis identified and treated, about 2800 women were  
251 screened. Although this number may seem high, antenatal syphilis screening combined with  
252 treatment has been shown to be cost-effective even in low-to-moderate prevalence settings<sup>17</sup> and  
253 its high uptake (>97%) suggests that it is acceptable to pregnant women. Furthermore, the UK  
254 antenatal syphilis screening programme was reviewed in 2013, with a recommendation that  
255 screening should continue in light of ongoing transmission among women of reproductive age, and  
256 the balance of benefits to harm.<sup>18</sup>

257 We identified 570 women requiring treatment for syphilis in pregnancy over two years (~285/year),  
258 at least two thirds with undiagnosed infection who would likely have remained untreated in the  
259 absence of screening, with a risk of onward transmission to their babies and sexual partners. In a  
260 previous survey among GU physicians, 139 similar cases were identified over three years (1994-  
261 1997, ~46/year), with 70% response rate (lower than in our study).<sup>19</sup> Although methods differed (the

262 previous survey excluded women seen only by their obstetricians), the increase is in line with the  
263 rise in infectious syphilis in women observed since 1999. Although diagnostic and treatment  
264 information was obtained for most pregnancies, it was clear that links between maternity and GUM  
265 services were not always satisfactory. Contrary to national standards,<sup>9</sup> key information on diagnosis  
266 and treatment was not always known to maternity teams, even after delivery, and despite repeated  
267 requests for information, 5% of confirmed screen-positive pregnancies remained unclassified.  
268 Although women with newly diagnosed infections were almost all referred to a specialist, about 20%  
269 of previously-diagnosed women were not, even though all screen-positive women should be  
270 evaluated by a GU physician;<sup>6,9</sup> in addition, basic information on whether referral had occurred was  
271 missing for 11%.

272 Current UK management guidelines also recommend that infants born to women treated for syphilis  
273 during or before pregnancy should be monitored.<sup>6</sup> This study showed that even infants with newly-  
274 diagnosed mothers were not always followed up. Where further appointments were planned, these  
275 were not always attended, suggesting issues around retention in care. Despite improvements in  
276 follow up of mothers and infants since earlier audits,<sup>11</sup> our findings highlighted some inadequacies  
277 and inconsistencies in the management and follow up of pregnancies in syphilis-positive women,  
278 which could potentially lead to avoidable cases of congenital infection. Nevertheless, with routine  
279 screening in place and high uptake of testing (>97%) and treatment (96%), few cases of congenital  
280 syphilis were reported. The timely diagnosis and treatment of several hundred maternal infections  
281 will also have prevented other adverse pregnancy outcomes (reported to occur in approximately  
282 two-thirds of untreated pregnancies<sup>1</sup>) and transmission to sexual partners, neither of which were  
283 measured here.

284 It was reassuring that over 95% of women reported to require treatment were treated, in line with  
285 WHO targets,<sup>4</sup> but the fact that almost one in five women were treated in the third trimester was  
286 concerning, given the increased risk of adverse outcomes.<sup>20</sup> Furthermore, three of the cases of

287 congenital syphilis were associated with delayed maternal treatment and two with lack of  
288 treatment. Treatment in the third trimester was associated with being born abroad and more recent  
289 arrival in the UK. However, over half of women treated in the third trimester experienced a delay of  
290 almost 10 weeks between first antenatal appointment and treatment initiation, and about a quarter  
291 had been in contact with antenatal services in the first trimester. These observations suggest that  
292 issues around both access to and engagement with care contributed to treatment delays. The  
293 finding that one in 11 syphilis-positive women screened positive for another blood-borne infection  
294 and one in 20 (a minimum estimate) had social issues or problems taking up care or treatment  
295 highlights the complex healthcare needs of this population. Furthermore, the prevalence of HIV in  
296 this population was high, at 4%, compared with 0.22% among all pregnant women in the UK in  
297 2011.<sup>21</sup> The majority of syphilis-positive women in this study were from Eastern Europe, Africa or  
298 Asia, areas where historically the prevalence of syphilis has been much higher than in Western  
299 Europe, and coverage of antenatal testing and treatment much lower.<sup>1, 22</sup>

300 Most women in this study should also have been tested for other sexually transmitted infections at  
301 their GUM appointment, but full details were not collected here. Although this study was carried out  
302 through antenatal clinics and therefore included few miscarriages and terminations, efforts should  
303 be made to follow up all pregnant women screening positive for syphilis regardless of pregnancy  
304 outcome, particularly as many women will have subsequent pregnancies. It was reassuring that the  
305 preterm delivery rate among women treated in pregnancy (8%) was not substantially higher than  
306 the general population, although infant birth weight was significantly lower,<sup>13</sup> probably due to socio-  
307 demographic and other factors. For syphilis treatment before the third trimester, UK guidelines  
308 recommend a single dose of benzathine penicillin for women with early syphilis;<sup>6</sup> however over  
309 three quarters of women with early syphilis in this study received two or more doses, possibly  
310 reflecting a precautionary approach to treatment.

311

312 *Conclusions*

313 Despite high uptake of antenatal syphilis screening and treatment in the UK, this study has  
314 highlighted areas where management of syphilis could be improved, including earlier diagnosis and  
315 treatment of pregnant women, better communication between maternity and GUM services, and  
316 more consistent follow-up of exposed infants. Optimal care and management of syphilis-positive  
317 women in pregnancy requires a coordinated multidisciplinary approach involving antenatal, GUM  
318 and paediatric teams, to ensure that guidelines are followed, and testing, referral and treatment are  
319 not delayed.

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342

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344 coordinated the study, carried out the statistical analyses and drafted the paper. CLT and KF



345 collected the data. PAT and CLT contributed to developing the concept of the paper. All authors  
346 contributed to interpreting the results and critically revising the paper, and saw and approved the  
347 final version. PAT is the guarantor.

348

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360

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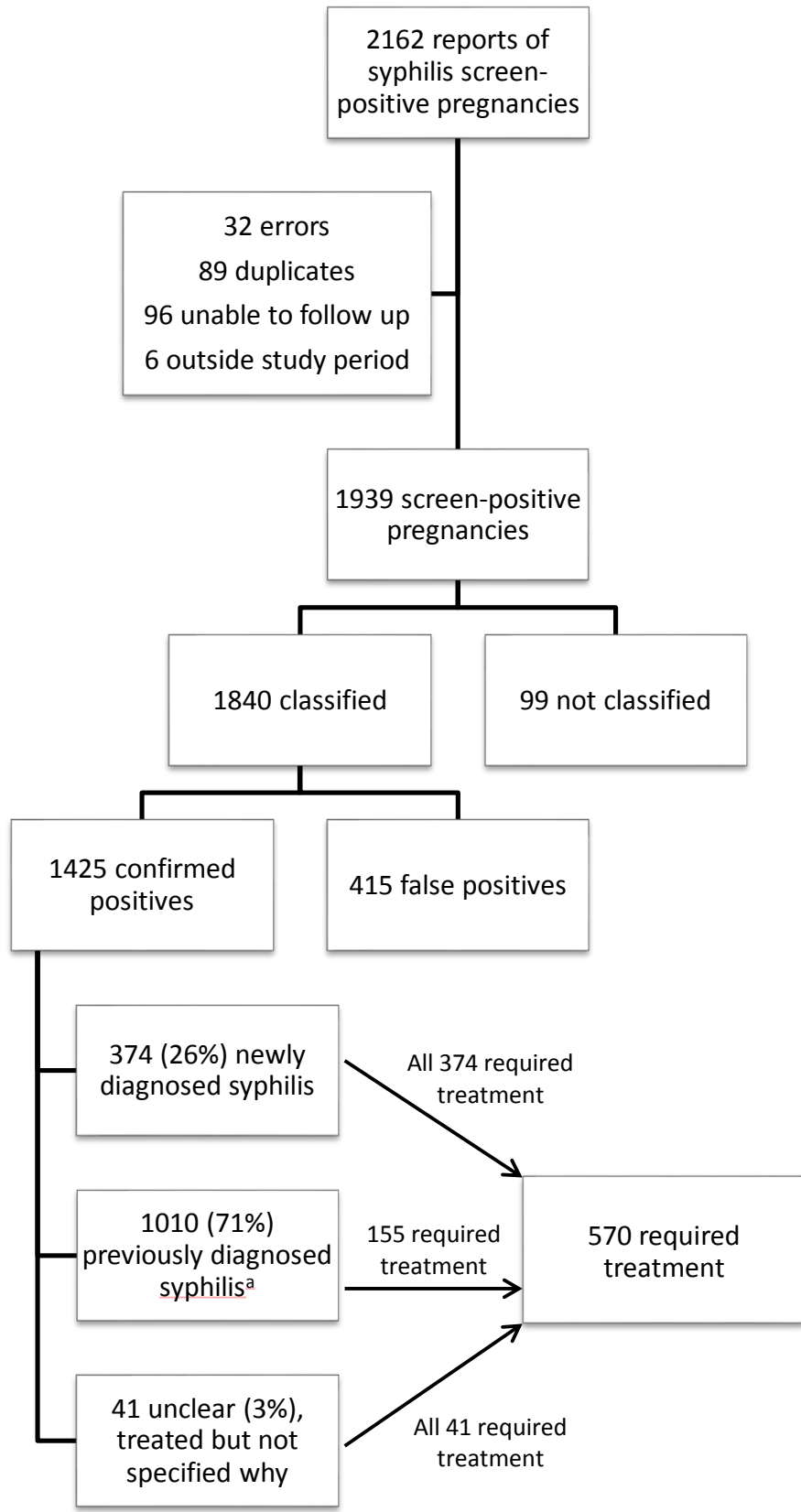


Figure 1. Reports of syphilis screen-positive pregnancies in the UK, 2010-2011.<sup>a</sup> Includes those adequately treated requiring no further treatment, and those requiring treatment due to inadequate documentation of previous treatment (e.g. no previous treatment, incomplete or uncertain treatment) or suspected re-infection.

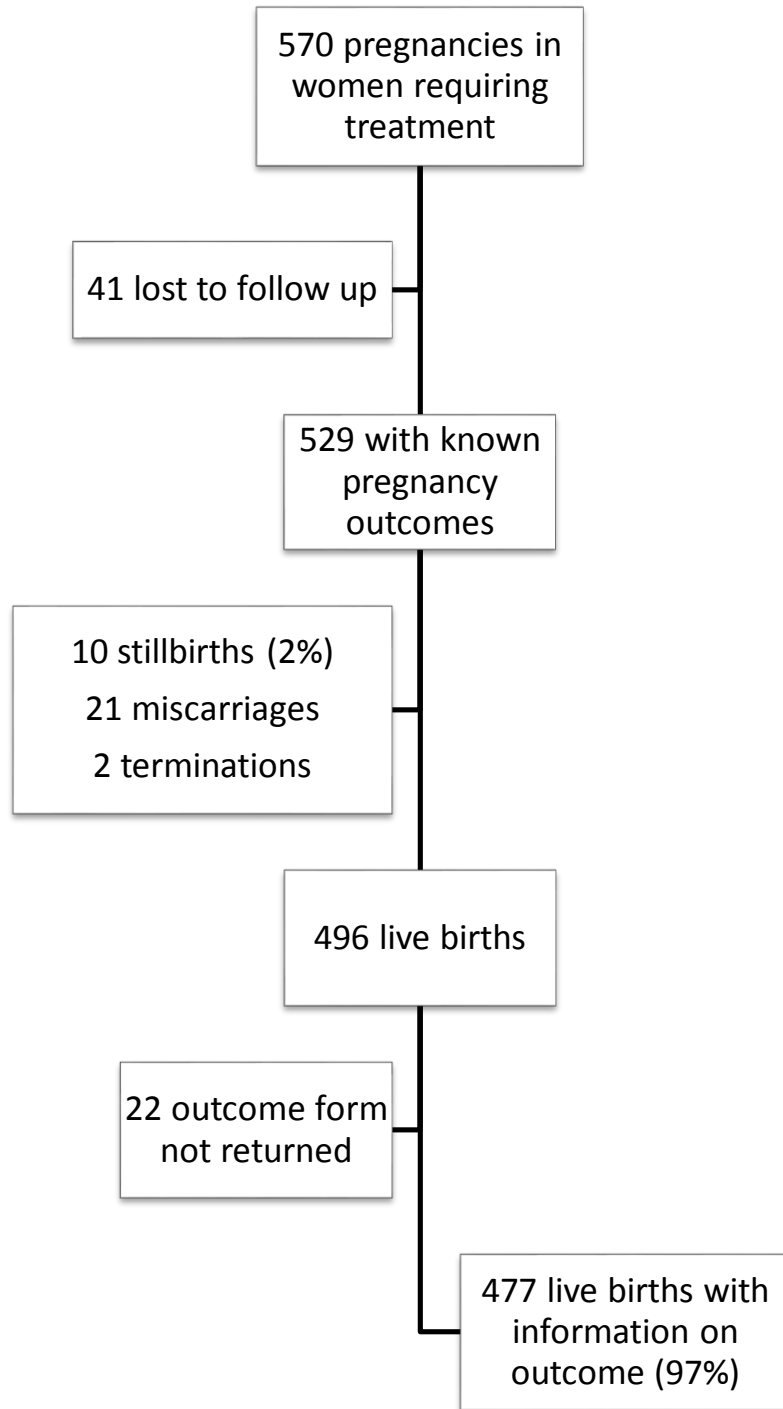


Figure S1. Follow up of women requiring treatment for syphilis in pregnancy, 2010-2011.



**Table 1. Baseline characteristics of 1425 pregnancies in 1394 women with newly or previously diagnosed syphilis infection in the UK, 2010-2011**

	<i>n</i>	%
<b>Maternal ethnic group (n=1348)</b>		
White	667	49
Black	436	32
Asian	188	14
Other	28	2
Mixed	29	2
<b>Maternal region of birth (n=1266)</b>		
Europe	687	54
<i>British Isles</i>	377	30
<i>Eastern Europe</i>	268	21
<i>Elsewhere in Europe</i>	42	3
Africa	310	24
Asia	164	13
Other	105	8
<b>Previous pregnancies (n=1292)</b>		
None	234	18
One	331	26
Two or more	727	56
<b>Previous syphilis diagnosis (n=1384) <sup>a</sup></b>		
No	374	27
Yes	1010	73
<b>Other positive screening tests in pregnancy (n=1248) <sup>b</sup></b>		
HIV	51	4
Hepatitis B virus	52	4
Hepatitis C virus	24	2
At least one of the above	115	9
	<b>Median (IQR)</b>	
<b>Maternal age (n=1419)</b>	31.4 (27.0, 35.5)	
<b>Years since arrival in the UK <sup>c</sup> (n=373)</b>	5 (1, 9)	
<b>Years since previous syphilis diagnosis <sup>d</sup> (n=722)</b>	4 (2, 7)	
<b>Gestation at antenatal booking (n=1271)</b>	11.7 (9.9, 15.1)	

<sup>a</sup> 41 women required treatment for syphilis in pregnancy, but it was unclear whether they had been previously diagnosed (see Figure 1).

<sup>b</sup> Categories are not mutually exclusive; 12 women were reported to have two of the three specified co-infections.

<sup>c</sup> At first antenatal appointment; year of arrival in the UK was only reported for 42% (373/889) of women born abroad.

<sup>d</sup> At first antenatal appointment; year of diagnosis was only reported for 71% (722/1010) of women with a previous syphilis diagnosis.

**Table 2. Treatment details for 570 women requiring treatment for syphilis in pregnancy, 2010-2011**

	<i>n</i>	%
<b>Treated in pregnancy (<i>n</i>=537)</b>		
Yes	516	96
No <sup>a</sup>	21	4
<b>Drugs (<i>n</i>=494)</b>		
Benzathine penicillin	439	89
Procaine penicillin	17	3
Erythromycin	15	3
Doxycycline	10	2
Unspecified/other drugs	13	3
<b>Timing of treatment in pregnancy (<i>n</i>=456)</b>		
First or second trimester	373	82
Third trimester	83	18
<b>Doses of benzathine penicillin (<i>n</i>=433)</b>		
One	66	15
Two	49	11
Three or more	318	73

<sup>a</sup> 10 women declined treatment, three delivered before their GUM appointment and three were diagnosed at or after delivery; for the remaining four, no further information was given.