

Developing a model to predict individualised treatment for  
gonorrhoea: a modelling study

**SUPPLEMENTARY MATERIAL: User guide for the model**

## Supplementary material: User guide for the spreadsheet model for predicting individualised treatment for gonorrhoea

INPUT	
Patient characteristics	
Gender & sexual orientation (F, HM, MSM)	F
Number of recent partners (>=2) (Y/ N)	N
Age (>=25) (Y/ N)	Y
Ethnicity (White/Other) (W/ O)	W

Figure 1: Snapshot of input parameters.

Input patient characteristics (green column):  
**Gender & sexual orientation:**  
 Female = F  
 Heterosexual male = HM  
 Men who have sex with men = MSM  
**Number of sexual partners in the last three months:**  
 Less than two = N  
 Two or more = Y  
**Age:**  
 Younger than 25 years old = N  
 Older than or aged 25 years old = Y  
**Ethnicity:**  
 White = W  
 Any other ethnicity = O

Figure 2: Snapshot of guide to inputting patient characteristics.

OUTPUT			
<b>Recommended treatment:</b>	Cefixime		
<i>Lowest risk old antibiotic</i>			
Cefixime	2.08		
<b>Antibiotic</b>	<b>Resistance (%)</b>	<b>Chance of success (%)</b>	<b>Recommendations</b>
Ciprofloxacin	22.86	77.14	X
Azithromycin	4.17	95.83	Azithromycin
Penicillin	8.33	91.67	X
Cefixime	2.08	97.92	Cefixime
<b>Chosen resistance threshold (%)</b>	5		

Figure 3: Snapshot of output table.

Output table explained:  
**Recommended initial treatment (yellow cell):**  
 The antibiotic with the lowest predicted risk of resistance below the threshold is recommended in this cell. If no antibiotic falls below the threshold, ceftriaxone will be recommended.  
**Lowest risk antibiotic:**  
 Provides the antibiotic with the lowest predicted risk of resistance.  
**Table:**  
 Provides the predicted risk of resistance (%); the chance of success (%); and lists all antibiotics below the resistance threshold.  
**Resistance threshold (orange cell):**  
 Modifiable: allows setting of the acceptable risk of resistance (%) for an antibiotic to be recommended. Default = 5%.

Figure 4: Snapshot of guide to output table.

This spreadsheet is a user-friendly tool to predict an individual's risk of resistance to multiple antibiotics used to treat gonorrhoea, based on their characteristics. This is to determine whether the individual is likely to be susceptible to previously recommended antibiotics for gonorrhoea (ciprofloxacin, azithromycin, penicillin, and cefixime) in order to avoid prescribing last-line ceftriaxone. The tool recommends the antibiotic with the lowest estimated of risk of resistance as the suggested treatment option. If the predicted risk of resistance to all of the previously recommended antibiotics is above a modifiable threshold of resistance, ceftriaxone will be recommended.

Individual characteristics should be filled in to the green column in the input table (Figure 1). This should be according to the guide included below (Figure 2). Data validation should restrict the entry of anything other than the correct codes shown in Figure 2. Press Enter after inputting the characteristics and the output table will be calculated automatically.

The output table (Figure 3) is explained in the guide below (Figure 4). This is where you'll find the estimated risk of resistance to ciprofloxacin, azithromycin, penicillin and azithromycin for the

individual based on their combination of characteristics. It also recommends the antibiotic with the lowest risk of resistance as the treatment option. The resistance threshold can be modified.

Lookup table for model	
<b>Table of input codes</b> (feeding from Input table of Model)	
Patient characteristics	<i>Input codes</i>
Gender & sexual orientation (F, HM, MSM)	SO & gender code 0
Number of recent partners (>=2) (Y/ N)	Partner code 0
Age (>=25) (Y/ N)	Age code 1
Ethnicity (White/Other) (W/ O)	Ethnicity code 1
	Lookup code 0011

  

LOOKUP TABLE									
Code	Gender & SO	No partners	Age group	Ethnicity	Description	Resistance prevalence (%)			
						Ciprofloxacin	Azithromycin	Penicillin	Cefixime
0000		0	0	0	0 Female, <2 partners, <25 yo, Other	20	4.08	8.16	0
0001		0	0	0	1 Female, <2 partners, < 25 yo, White	18.75	8.86	8.86	2.53
0010		0	0	1	0 Female, <2 partners, >= 25 yo, Other	31.25	0	19.44	0
0011		0	0	1	1 Female, <2 partners, >= 25 yo, White	22.86	4.17	8.33	2.08
0100		0	1	0	0 Female, >= 2 partners, < 25 yo, Other	27.27	0	17.24	3.45
0101		0	1	0	1 Female, >= 2 partners, < 25 yo, White	23.68	1.92	5.77	0
0110		0	1	1	0 Female, >= 2 partners, >= 25 yo, Other	11.11	0	6.67	13.33
0111		0	1	1	1 Female, >= 2 partners, >= 25 yo, White	32	6.45	9.68	0
1000		1	0	0	0 Heterosexual male, <2 partners, < 25 yo, Other	11.54	7.5	7.5	0
1001		1	0	0	1 Heterosexual male, <2 partners, < 25 yo, White	42.86	4.76	14.29	2.38
1010		1	0	1	0 Heterosexual male, <2 partners, >= 25 yo, Other	35.71	7.69	17.95	2.56
1011		1	0	1	1 Heterosexual male, <2 partners, >= 25 yo, White	35	12.7	12.7	7.94
1100		1	1	0	0 Heterosexual male, >= 2 partners, < 25 yo, Other	27.78	0	10	1.67
1101		1	1	0	1 Heterosexual male, >= 2 partners, < 25 yo, White	29.27	8.93	17.86	3.57
1110		1	1	1	0 Heterosexual male, >= 2 partners, >= 25 yo, Other	39.34	2.94	17.31	0
1111		1	1	1	1 Heterosexual male, >= 2 partners, >= 25 yo, White	51.35	6.84	22.03	2.54
2000		2	0	0	0 MSM, <2 partners, < 25 yo, Other	28.57	0	33.33	8.33
2001		2	0	0	1 MSM, <2 partners, < 25 yo, White	54.17	11.43	21.43	4.29
2010		2	0	1	0 MSM, <2 partners, >= 25 yo, Other	39.58	7.81	12.5	0
2011		2	0	1	1 MSM, <2 partners, >= 25 yo, White	43.16	9.82	16	0
2100		2	1	0	0 MSM, >= 2 partners, < 25 yo, Other	25.81	7.5	20	5
2101		2	1	0	1 MSM, >= 2 partners, < 25 yo, White	43.97	5.88	10.59	0
2110		2	1	1	0 MSM, >= 2 partners, >= 25 yo, Other	48.15	5.66	11.95	0.63
2111		2	1	1	1 MSM, >= 2 partners, >= 25 yo, White	41.02	8.34	15.42	0.4

Figure 5: Snapshot of lookup table.

The sheet named 'Lookup table' was included in the model to provide detail on where the estimated risks of resistance come from, and it does not need to be edited (Figure 5). Estimates of the prevalence of resistance in different participant subgroups were calculated from data from the Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP), from between 2015 and 2017.<sup>1</sup> These estimates were fed into a lookup table included in the model to match individual characteristics to resistance prevalence.

## References

- Public Health England. Surveillance of antimicrobial resistance in *Neisseria gonorrhoeae* in England and Wales. Key findings from the Gonococcal Resistance to Antimicrobials Surveillance Programme (GRASP). Data to May 2018. (Accessed 26/08/19).  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/746261/GRASP\\_2017\\_report.pdf?\\_ga=2.69271190.789226432.1566843835-240657835.1543998438](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/746261/GRASP_2017_report.pdf?_ga=2.69271190.789226432.1566843835-240657835.1543998438)