**How effective are governmental and university campaigns for increasing
meningitis vaccine uptake?**

Short title: Meningitis vaccine uptake

Ayushi Ramjee¹, Chloe Ogilvie¹, Africa Couto², Teresa Matini BSc², Claudia C. Anaele¹, Sylwia
Bujkiewicz³, Neil J. Oldfield², David P.J. Turner² and Christopher D. Bayliss^{1*}

¹Department of Genetics and Genome Biology, University of Leicester, Leicester, United Kingdom

²School of Life Sciences, University of Nottingham, Nottingham, United Kingdom

³Department of Health Sciences, University of Leicester, Leicester, United Kingdom

*Corresponding author.

E-mail: cdb12@le.ac.uk

24 **Abstract**

25 Objectives

26 University student cohorts have a potential for significant impacts on public health policies. Health
27 impacts arise from wide geographic catchment areas and behavioural patterns that enhance
28 infectious disease spread and occasional cases of meningococcal meningitis and septicaemia,
29 measles and mumps. Universities and the Department of Health and Social Care have tackled
30 these serious problems through advertising campaigns and by offering free MenACWY and MMR
31 vaccines to university students. Our study aimed to assess the engagement of universities with
32 these vaccine campaigns and student awareness of this information.

33 Study Design

34 Information was accrued by a combination of e-mail and telephone interactions with welfare
35 officers at universities. Student perceptions of meningitis vaccine campaigns were studied through
36 use of questionnaires with University of Leicester students.

37 Results

38 Information provided by 17 universities indicated that all universities run meningitis awareness
39 campaigns whereas on campus meningitis campaigns were infrequent and of variable penetration
40 into student cohorts. Assessment of 272 students from a 2019-2020 cohort found that 17.5% and
41 58% of students did not know or had not had the MMR and MenACWY vaccines. Only 37% of
42 students were aware that these vaccines were free and available from a university-linked GP
43 practice with lack of this knowledge being significantly associated with uncertainty or perceived
44 absence of immunisation. This latter group were significantly associated with a preference for on
45 campus immunisation.

46 Discussion

47 This information is important for understanding how to target a critical cohort with effective
48 campaigns for uptake of meningitis, MMR and COVID-19 vaccines.

49

50 Keywords: meningitis, MenACWY, vaccine, university students

51

52 Introduction

53 *Neisseria meningitidis*, the meningococcus, is the major cause of meningitis and septicaemia in the
54 UK with ~1 disease case per 100,000 individuals¹. A minor peak of invasive meningococcal disease
55 (IMD) incidence is found in teenagers and young adults and is associated with high levels of
56 asymptomatic carriage in this age group (~25% as compared to 5-11% for all adults²). Six
57 serogroups or polysaccharide capsule types (A, B, C, W, X and Y) account for the majority of IMD
58 worldwide with serogroup B (MenB) strains being the major cause of disease in the UK¹. A rapid 8-
59 fold rise in MenW cases was observed between epidemiological years 2008/9 and 2014/15 due to
60 a hypervirulent MenW strain of the sequence type 11 clonal complex³. In 2014/15, 26% (31/106)
61 of all IMD cases for the 15-24 age bracket were caused by these MenW strains⁴. To protect this
62 age group and, through herd protection, the wider community against these strains, conjugate
63 MenACWY vaccines were introduced into the UK immunisation schedule in 2015. In 2019, MenW
64 strains were responsible for 24% of all IMD cases (37/180) but with only 2 cases in the 15-24 age
65 bracket, indicative of effective direct protection by the vaccine⁵.

66
67 Starting in August 2015 following a recommendation by the Joint Committee on Vaccination and
68 Immunisation⁶, the MenACWY vaccine was offered to all university entrants and currently, there is
69 a free catch-up campaign for individuals up to the age of 25. The MenACWY vaccine also replaced
70 the MenC vaccine for immunisation of 13-14 year olds and the first cohort of immunised
71 teenagers entered the university population in 2018/19, the best scenario for a herd protective
72 effect. A loophole in this strategy is individuals who miss childhood vaccination and non-
73 vaccinated overseas students. This leaves a margin for ongoing MenW invasive meningococcal
74 disease cases and transmission. Universities are at the forefront of dealing with this loophole due

75 to their extensive reach into the late teenage/early adult population as a result of high rates of
76 university entrance.

77

78 Herein, we assess current MenACWY immunisation levels and practices of UK Universities and the
79 awareness of students of meningococcal vaccine availability. We provide comparisons to
80 perceptions of new University-targeted MMR vaccine campaigns, as initiated in 2019, and
81 considerations for future community-wide vaccine campaigns.

82

83 **Materials and methods**

84 **Acquisition of information on university MenACWY immunisation campaigns.** Public Health
85 England (PHE) provided MenACWY vaccine usage figures for all university-linked general practices
86 (GP) and non-university-linked practices. Immunisation figures for the Universities of Nottingham
87 and Leicester were obtained from senior individuals in the University of Nottingham Health
88 Service and Victoria Park Health Centre, respectively.

89

90 **Acquisition of information on meningitis campaigns.** Information on practices in Universities was
91 obtained by sending an email (S1 Table) to universities with a Meningitis Aware Recognition Mark
92 (MARM) as awarded by Meningitis Now. Contact details for four additional Universities were
93 obtained at the 2019 Student Health Associations' annual conference. Information is provided as
94 an anonymised list (S2 Table).

95

96 **Assessment of student awareness of vaccines.** Student awareness questionnaire forms were
97 utilised within the University of Leicester in the 2017/2018 and 2019/2020 academic years (S3
98 Table for questions and S1 Appendix for raw data for 2019/2020 study). Questionnaires were
99 utilised as hard-copy forms and did not request any personal identifiers obviating the requirement

100 for written informed consent. The University Registrar approved usage of the forms on both
101 occasions and with ethical approval provided by the University of Leicester Medicine and
102 Biological Sciences Research Ethics Committee. Forms were targeted to first-year economic and
103 biomedical students during lectures or practical classes in both years ensuring that students were
104 not targeted on more than one occasion.

105

106 **Statistical analysis.** Univariable and multivariable logistic regression analyses were carried out to
107 investigate the association between the perceived status of MMR and MenACWY vaccines and
108 independent variables including students' university degree, knowledge that the vaccine was
109 freely available and knowledge of the location where vaccines were available. Multivariable
110 logistic regression models were selected using forward selection and analysis of deviance.
111 Variables were included in the model using a significance level of 5% or where significance was
112 borderline, and degree was included as the main explanatory variable. In addition, univariable
113 logistic regression analyses were carried out to investigate the association between perceptions of
114 vaccination status for the two vaccines. A chi-squared test, assuming an even distribution of
115 expected responses, was performed to investigate associations between perceived vaccine status
116 and ability to access vaccines and reasons for not accessing vaccines. Analyses were performed in
117 Stata 16.

118

119 **Results**

120 **Public Health England data on MenACWY vaccine uptake**

121 MenACWY usage figures were collected for three academic years for ~97% of 6,993 GPs in England
122 of which 80 were classified as university-linked based on evidence from University websites.
123 Average percentage uptake values were higher in University-linked GPs as compared to non-
124 university linked GPs for all three years (S4 Table). While some uptake is due to immunisations for

125 travel and for vulnerable older patients, this data indicates that MenACWY uptake is greater in
126 students after, rather than prior, to arrival at University.

127

128 **Evaluation UK universities practices for raising awareness of meningitis and meningococcal** 129 **vaccines**

130 Meningitis NOW aims to enhance meningitis awareness by awarding MARM status to universities
131 with significant awareness campaigns ([https://www.meningitisnow.org/meningitis-](https://www.meningitisnow.org/meningitis-explained/marm)
132 [explained/marm](https://www.meningitisnow.org/meningitis-explained/marm)). Information was requested by email from all 41 MARM accredited Universities
133 on their strategies for enhancing awareness and uptake of MenACWY vaccines and following
134 contacts at a university engagement program or from study author contacts. Detailed information
135 was provided by 41% (17/41; S2 Table) of universities while two others only provided
136 immunisation numbers. Among these universities, a diverse range of awareness strategies were
137 implemented (e.g. emails, information in welcome packs, freshers' fair stands, Meningitis NOW
138 merchandise, posters etc). Additional awareness approaches included organisation of meningitis
139 talks by guest speakers and having staff in university halls of residence with training on meningitis.

140

141 Responses on meningitis vaccine availability indicated that eleven universities have statements in
142 their literature that meningitis vaccines are free. Six respondents indicated that their universities
143 do not have on campus vaccination programme. The other eleven Universities provide on-campus
144 meningococcal vaccination programmes at least during the first month of the academic year, with
145 three offering vaccinations throughout the year. One university also participated in the University
146 Management Information System (UMIS) with text alerts sent to students who have not received
147 the MenACWY vaccine.

148

149 Five respondents stated that information was specifically targeted to overseas students. Two
150 provided examples: Universities 1 and 8 offered bespoke induction talks to incoming international
151 students. Four institutions explicitly stated that no targeted information is provided to
152 international students while the remainder provided no response to this question.

153

154 **Assessment of on-campus meningitis campaigns**

155 The University of Nottingham runs an on-campus vaccination programme. during the first week of
156 term. During registration with the University of Nottingham Health Service (UNHS), new students
157 are asked about their vaccine status and are offered the opportunity to immediately receive any
158 missing vaccines. An assessment of uptake of MenACWY vaccines in September 2015 among the
159 7,049 first-year University of Nottingham students, found that coverage rose from 31% to 71% as
160 a result of the on-campus vaccine campaign⁷. Crucially, coverage rose from 1% to 72% among 804
161 international students. Revisiting this programme for the September-to-December 2019 period
162 found that 2,760 MenACWY vaccine doses were delivered among 9,850 newly-registered patients
163 for an overall uptake rate of 28%, this is probably due to high uptake among overseas students
164 who form ~25% of this population. The UNHS Chief Operating Officer also runs the University of
165 Lincoln Health service and implementation of similar service at the University of Lincoln in 2019
166 resulted in immunisation of 168 first year students (i.e. 5.3%), raising overall MenACWY
167 immunisation rates to 66%.

168

169 In 2017, the University of Leicester Welfare Team collaborated with the Victoria Park Health
170 Centre (VPHC) and a public health team of NHS England to deliver an on campus MenACWY
171 vaccination campaign. Delivered in during Fresher's week within the Student's Union, MenACWY
172 vaccines were provided to 491 students (a 24% uptake rate for 2,001 newly-registered patients).
173 This was a significant increase on the 291 vaccine doses (11% uptake for 2,726 new registrants)

174 provided in VHPC off-campus practice in the previous year. Hampered by a slow throughput and
175 out-of-the-way location, the campaign was not repeated due to losses incurred because PHE
176 payments for vaccine doses did not cover all the staff costs.

177

178 Five Universities reported provision of 250 to 900 MenACWY doses per year with estimated
179 uptake rates of ~10% for two universities. Other universities provided <200 vaccine doses due to
180 vaccines only being offered to sub-sets of students. These lower levels of uptake indicated that the
181 immediacy of providing vaccines during registration is critical for high vaccine uptake.

182

183 The Radford Medical Practice, allied with Nottingham Trent University, uses text messages for
184 advising students about vaccine provision. Post-arrival vaccine uptake among eligible non-
185 vaccinated students over three academic years fluctuated between 8% and 12%. A “NO” response
186 was introduced in 2018/19 and these apparent refusals of the vaccine were given by 6-16% of
187 students while 74-86% of students did not reply (S5 Table).

188

189 **Evaluation of student awareness of meningitis and MMR vaccines**

190 From 2019, governmental recommendations are that all new UK university entrants have had both
191 a MenACWY vaccine and two doses of the MMR vaccine prior to arrival at University. The latter
192 was as a result of outbreaks of measles and mumps among students. To assess the impact of
193 national and local vaccination awareness campaigns, we conducted self-reporting studies with
194 University of Leicester students in February 2017/18 and February 2019/20. Students in the
195 biological sciences and economics degree streams were targeted during large-group teaching
196 sessions in a convenience sampling approach. The overall self-reporting rate for MenACWY
197 immunisation in the 2017/18 questionnaire was 73% with an uptake of 66% prior to arrival at the
198 University (Table 1). Among non-vaccinated students, 77% indicated that on-campus

199 immunisation would have increased their likelihood of obtaining the MenACWY vaccine (S6 Table)
 200 with registration as the preferred location. The majority (64%) of unvaccinated students were not
 201 aware the MenACWY was available at the university-linked GP practice.

202

203 **Table 1.** Student Responses to Vaccine Questionnaires in 2017/18 and 2019/20

Vaccine/ Year Group	Size	Not vaccinated		Don't Know		Vaccinated Prior		Vaccinated After	
		No.	%	No.	%	No.	%	No.	%
MenACWY/ 2017-18	297	81	27	NR ¹	NR ¹	196	66	20	7
MenACWY/ 2019-20	271	12	4	147	54	111	41	1	<1
MMR/ 2019-20	272	4	1.5	44	16	224	82	0	0

213 ¹The 2017/18 questionnaire had only a Yes or No response option whereas the 2019/20 had a Yes, No or Don't Know
 214 response options (see S3 Table)

215

216 The 2019/20 questionnaire assessed both MMR and MenACWY immunisation status with 'Yes',
 217 'No' or 'Don't Know' as three possible responses (Table 1). Perceived uptake was 82% and 41% for
 218 the MMR and MenACWY vaccines, respectively, with high levels of uncertainty (54% of
 219 respondents) for MenACWY vaccine status. Only two students reported not having received either
 220 vaccine and only one student indicated having had one of these vaccines after arrival on campus.

221

222 A weak but significant association was detected between degree stream and MMR vaccine status
 223 in a univariable analysis with biology students being 2.34 times more likely to report a positive
 224 MMR vaccination status compared to economics students. This association was absent in a
 225 multivariable analysis (S7 Table). Strong, significant associations were detected between perceived

status for both vaccines indicating that students are often uncertain about their status for both vaccines (S7 Table). Intriguingly, strong, significant associations were detected in both univariable and multivariable analyses between a 'Yes' vaccine status response and knowing that both vaccines were free and between a positive MenACWY status and knowing where vaccines were available (S7 Table and Table 2). Only 37% of students were aware that these vaccines were both free and attainable at the local GP practice while 23% were unaware of both pieces of information (S1 Appendix). Most students (78%) learnt these facts from a non-University source while pre-arrival information was selected as the main University-linked information source (S1 Appendix).

Table 2. Multivariable analysis for 2019/20 Questionnaire for associations between a no or don't know perceived MMR or MenACWY vaccine status, with degree or vaccine availability

Variable	Odds Ratio	95% CI	P value
MMR Vaccine			
Free	3.05	1.58-5.87	0.001
Degree	2.15	0.95-4.86	0.066
MenACWY Vaccine			
Free	2.12	1.21-4.01	0.021
Location	1.85	1.08-3.14	0.023
Degree	1.82	0.82-4.02	0.143

Analysis of factors influencing vaccine uptake by students

Analyses of students with a no or don't know vaccine status response found that indicated that on-campus immunisation would have increased their likelihood of accessing these vaccines with halls of residence being a popular location (Table 3). The vast majority of students reported being 'unaware' or 'busy schedule' as their reasons for not taking up vaccines (Table 3).

243

244 **Table 3.** Analysis of associations between a no or don't know perceived vaccine status with ability
245 to access vaccines and reasons for not accessing vaccines

Question/Response	MMR		MenACWY	
	No/Don't Know	P value ¹	No/Don't Know	P value ¹
<i>If both vaccines were offered on campus, would this increase your decision to be vaccinated?</i>				
No Difference	12 (25.5)		38 (24.1)	
Yes	34 (72.3)	<0.0001	116 (73.4)	<0.0001
No	1 (2.1)		4 (2.5)	
<i>Which location would have been best for accessing the vaccines?</i>				
Health Centre	10 (22.7)		31 (20.8)	
Registration	11 (25.0)		35 (23.5)	
Fresher's fair	4 (9.1)	0.011	18 (12.1)	<0.0001
Hall	16 (36.4)		58 (38.9)	
Other	3 (6.8)		7 (4.7)	
<i>If you have not had the vaccination, why?</i>				
Safety	3 (9%)		3 (3%)	
Not Easy to Access	0		3 (3%)	
Busy Schedule	7 (21%)	<0.0001	17 (16%)	<0.0001
Unaware	18 (53%)		69 (66%)	
Other	6 (18%)		13 (12%)	

246 ¹Chi-square test for equi-probability model

247

248 **Discussion**

249 Our study focussed on university approaches to increasing uptake of the MenACWY vaccine
250 among first-year university students but is relevant to requirements for delivery of MMR and
251 COVID-19 vaccines to this young, mobile population.

252

253 Our snapshot of universities found a wide variability in methods for raising awareness of
254 MenACWY vaccine availability and in university-linked delivery frequencies for these vaccines. The
255 13-24% higher rate of MenACWY immunisation among university-linked GP practices suggests that
256 the awareness programmes are working. This conclusion is tempered by the observation of only
257 37% of University of Leicester students being aware that MenACWY and MMR vaccines are both
258 free and accessible through university-linked GP practices. Data from other studies also indicates
259 that current approaches are insufficient for breaking down barriers to increasing vaccine uptake
260 among university students, adolescents and parents of these groups⁸⁻¹¹. Improvements could be
261 achieved by more widespread implementation of 'best-practice strategies' such as guest speakers,
262 early distribution of pre-arrival information, providing information in all university-linked
263 residential halls and targeting of information to international student groups. Text message alerts
264 to individual students are effective for obtaining some vaccine uptake among students but are
265 inefficient. A thorough evaluation of the differing approaches is required in order to inform
266 general recommendations for the university-sector.

267

268 Our study found that on-campus vaccination programmes were common but not universal or
269 equally effective. Although eleven of 17 universities offered MenACWY vaccinations on campus,
270 the numbers of vaccine doses were low particularly when compared to the University of
271 Nottingham programme, which was highlighted by PHE in 2016 as an exemplar of best practice¹⁴.

272 One potential reason for not implementing on-campus programmes is the perception that
273 university entrants will be immunised through national vaccine campaigns. However, there are

274 wide disparities in MenACWY vaccine uptake with two studies reporting coverage rates of 32.7%
275 and 90.7% among students in universities in Liverpool and Northern Ireland, respectively¹¹⁻¹².

276 Another barrier is the lack of available resources to coordinate and fund on campus vaccine
277 programmes despite support by the Department of Health and Social Care for these
278 immunisations. On-campus vaccination programmes during registration removes barriers to
279 student uptake of vaccines, such as going to a GP-practice or booking appointments, while
280 automatically fitting into busy student schedules. Registration is popular among students
281 alongside availability of vaccines in halls of residence.

282

283 Another potential barrier to effective meningococcal immunisation campaigns is vaccine
284 hesitancy. Blagden *et al.*¹¹ explored multiple aspects of vaccine hesitancy (e.g. vaccine side effects
285 and pain from vaccination) and found that inconvenience was the only significant barrier to
286 vaccine uptake. This matches our observation that only a small percentage of students cited safety
287 as a reason for not taking up the MenACWY (3%) and MMR (9%) vaccines. A meta-analysis of
288 meningitis vaccine hesitancy concluded that the major effect was from perceived risks of
289 meningococcal disease, which were associated with higher odds of being vaccinated¹³. These
290 findings suggest that awareness of risks and ease of access, but not vaccine hesitancy, are the
291 major limiters on the reach of meningococcal immunisation programmes into student
292 populations.

293

294 International students are a critical group as immunisation campaigns in other countries are
295 usually divergent from the UK immunisation programme. A meta-study detected evidence of
296 lower meningococcal vaccine uptake among non-white ethnic groups and international students¹³.
297 Blagden *et al.*¹¹ found that 27% (7/26) of overseas students in 2015/16 reported receiving a
298 MenACWY vaccine whereas Turner *et al.*⁷ found that MenACWY immunisation rates increased

299 from a low of 1% among incoming international students to 70% when the vaccine was offered
300 during registration. These contrasting findings indicate that overseas students are likely to find
301 access to vaccines more difficult in the absence of large-scale on campus vaccine campaigns.
302 Targeting of literature to overseas students in different languages, small-scale events and through
303 liaison with international student societies, are strategies that may increase outreach to this
304 group.

305

306 Universities are likely to have a role in COVID-19 vaccine programmes. Delivery of a university
307 COVID-19 immunisation will require funding and close coordination with local GPs and Public
308 Health England to ensure effective delivery to the maximum number of students. Immunisation
309 during registration and within halls of residence are likely to be the most effective delivery
310 locations. These are crucial issues as transmission by University students may be widespread due
311 to their high mobility both within the UK and to other countries.

312

313 The limitations of this study are: poor response rate to assessments of University meningitis
314 policies; an inherent bias due to targeting of Universities registered with Meningitis NOW;
315 convenience sampling of first year students and absence of demographic data resulting in
316 selection biases (e.g. from academic year group, gender, ethnicity or socioeconomic status) that
317 have not been accounted for and may confound the generalisability of findings; and introduction
318 of bias by combining 'no' and 'don't know' responders.

319

320 In summary, high levels of variability were found in the meningitis immunisation approaches of UK
321 Universities. There was also significant uncertainty among students about their MenACWY vaccine
322 status. These issues may need to be addressed to achieve further reductions in cases and

323 outbreaks of meningitis and other vaccine-preventable diseases within the close-contact
324 environments of the university-sector.

325

326 **Supporting information**

327 (Link to supporting information:- <https://figshare.com/s/464cbedbfd5b2b3e0c7f>)

328 **S1 Table.** Text of email and questionnaire sent to MARM-list universities.

329 **S2 Table.** Survey of Meningitis Awareness and MenACWY Immunisation Policies and Procedures in
330 the UK.

331 **S3 Table.** Text of 2017/18 and 2019/20 Questionnaires.

332 **S4 Table.** Comparison of the uptake of the MenACWY vaccine for University-linked and non-linked
333 GP practices

334 **S5 Table.** Text responses from first year students at the Nottingham Trent University regarding
335 uptake of the MenACWY vaccine

336 **S6 Table.** Collated Results of 2017/18 Questionnaire for a University of Leicester Student Cohort.

337 **S7 Table.** Univariable analysis of 2019/20 questionnaire for association between perceived vaccine
338 status and degree programme, status for the two vaccines and vaccine availability.

339 **S1 Appendix.** Excel file with vaccine questionnaire 2019/20 raw data.

340

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Competing interests

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Author contributions

Conceptualization: Chris Bayliss, Teresa Matini, David Turner, Neil Oldfield. **Data collection and curation:** Ayushi Ramjee, Chloe Ogilvie, Africa Couto, Teresa Matini, Claudia Anaele. **Formal analysis:** Sylwia Bujkiewicz. **Project administration and supervision:** Chris Bayliss. **Writing – original draft:** Ayushi Ramjee, Chloe Ogilvie, Chris Bayliss. **Writing – review and editing:** Chris Bayliss, Africa Couto, David Turner, Neil Oldfield.

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