Institution: The University of Nottingham		
Unit of Assessment: UoA5		
Title of case study: Preventing meningococcal transmission and disease by promoting immunisation of university students in the UK.		
Period when the underpinning research was undertaken: 2008 - present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
David Turner	Associate Professor and Honorary Consultant Microbiologist	2002 - present
Neil Oldfield	Senior Research Fellow	2011 - present
Period when the claimed impact occurred: 2015- ongoing		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Epidemiological research programmes of meningococcal carriage by Dr Turner and Dr Oldfield in collaboration with the University of Nottingham (UoN) Health Service in 2008 highlighted the need to introduce early and comprehensive immunisation campaigns to incoming undergraduate students at the UoN. The success of the 2015 UoN immunisation campaign resulted in improvement from 31% to a 71% uptake of the MenACWY meningococcal vaccine. Public Health England highlighted this success by featuring the UoN immunisation campaign in their 2016 guidance document on the prevention and management of meningococcal disease in Higher Education Institutions. The Nottingham immunisation programme has been mirrored in other UK universities where vaccination is now routine in order to protect incoming students from invasive meningococcal disease.

2. Underpinning research

Neisseria meningitidis (meningococcus) is a gram-negative bacterium that causes both epidemic and endemic infections. Almost all meningococcal disease worldwide is caused by 5 groups: MenA, B, C, W and Y. Most cases of meningococcal disease occur in young children, with a second peak occurring in 15-19 year olds. Within this older group, it is well documented that undergraduate students at Higher Education Institutions (HEIs) are at higher risk of disease, with the highest risk for first year students living in university halls of residence during the first term. Effective current vaccines protect individuals directly against disease caused by these most prevalent meningococcal groups for at least 5 years and also provide community protection by interrupting carriage and transmission.

Dr David Turner and Dr Neil Oldfield (UoN) led an early longitudinal research study of meningococcal carriage in collaboration with Dr Christopher Bayliss (University of Leicester), investigating persistence and spread of strains in first year students of the 2008 cohort at the UoN. This epidemiological survey represented a detailed analysis of the temporal (over 6 months) and spatial (across 6 residential halls) distribution of distinct meningococcal strains, with a high rate of 47-62% meningococcal carriage detected at all time-points, rapid clonal expansion and prevalence of the disease-associated MenY clones **[1]**. In 2010 Dr Turner participated in a phase 3 randomised clinical trial involving 2,954 university students from 10 different UK locations sponsored by Novartis Vaccines and Diagnostics **[6].** The trial, published in *The Lancet*, concluded that both the MenACWY vaccine (glycoconjugate vaccine targeting MenA, C, W, Y strains) and the MenB subunit vaccine, *Bexsero*, reduced meningococcal carriage rates for at least 12 months after vaccination. Reduced carriage mainly resulted from reduction in acquisition by vaccinated individuals. Thus, vaccinations not only provided direct protection of vaccinated individuals, but also herd protection (which enhances the public health effect and cost-effectiveness of vaccination campaigns) through interruption of transmission **[2]**.
In response to the steady rise of MenW invasive meningococcal disease in England from 2009 (see Section 4), in August 2015 PHE introduced a national immunisation programme, where the MenACWY vaccine was offered to 14-18 year olds and new university students up to the age of 25 years. Dr Turner and Dr Oldfield, again in collaboration with Dr Bayliss, were able to report the uptake of the MenACWY vaccine by students during the 2015 immunisation campaign at UoN and found that vaccine coverage increased from 31 to 71% **[3]**. Concomitant with this

study, the team monitored carriage of meningococcus strains in a sample of UoN students of the same cohort over a period of 6 months. Despite 71% vaccine coverage amongst students, carriage of the MenW strain still increased from 14% in September 2015 to 46% in March 2016, with the authors inferring that spread of the MenW strain would have been even greater without the success of the immunisation campaign in increasing the vaccine coverage rate **[4].** Subsequently, the researchers analysed whole genome sequencing data to determine which specific lineages of meningococci were most prevalent in the UoN student carriers. This new study confirmed that it was the hypervirulent MenW ST-11c sub-lineage, the same as was spreading throughout the UK **[5].**

Overall, these studies highlighted the potential of university vaccination campaigns for incoming students during the enrolment process in increasing the uptake of vaccines, and therefore protecting students and their communities against potentially deadly meningococcal disease.

3. References to the research

Key Publications (University of Nottingham UoA5 researchers, at the time of publication, are highlighted in bold)

1 Bidmos FA, Neal KR, **Oldfield NJ**, **Turner DPJ**, **Ala'Aldeen DAA** and Bayliss CD (2011) Persistence, replacement, and rapid clonal expansion of meningococcal carriage isolates in a 2008 university student cohort, *Journal of Clinical Microbiology*, 49: 506-512. doi: 10.1128/JCM.01322-10

2 Read RC, Baxter D, Chadwick DR, Faust SN, Finn A, Gordon SB, Heath PT, Lewis DJM, Pollard AJ, **Turner DPJ**, et al. (2014) Effect of a quadrivalent meningococcal ACWY glycoconjugate or a serogroup B meningococcal vaccine on meningococcal carriage: an observer-blind, phase 3 randomised clinical trial. *Lancet* 13: 2123-2131. doi: 10.1016/S0140-6736(14)60842-4.

3 **Turner DPJ**, **Oldfield NJ**, Bayliss CD (2017). University vaccine campaign increases meningococcal ACWY vaccine coverage. *Public Health* 145: 1-3. doi: 10.1016/j.puhe.2016.12.010

4 **Oldfield NJ**, Cayrou C, **AlJannat MAK**, Al-Rubaiawi AAA, Green LR, Dada S, **Steels OD**, **Stirrup C**, Wanford J, **Atwah BAY**, Bayliss CD and **Turner DPJ** (2017) Rise in group W meningococcal carriage in university students, United Kingdom. *Emerging Infectious Diseases*, 23:1009-1011. doi: 10.3201/eid2306.161768

5 **Oldfield NJ**, Green LR, Parkhill J, Bayliss CD, **Turner DPJ** (2018). Limited impact of adolescent meningococcal ACWY vaccination on *Neisseria meningitidis* serogroup W carriage in university students. *Journal of Infectious Diseases* 217: 608-616. doi: 10.1093/infdis/jix596

Key Grants:

6 2010-11, Unicom Healthcare Ltd, 'Phase 3, RCT to evaluate the effect of Novartis Vaccine's MenB and MenACWY meningococcal vaccines on pharyngeal carriage of *N. meningitidis*', **Turner** PI, partnership developed between UoN, UNHS, Trent Comprehensive Local Research Network (NIHR), NUH, GBP56,299

4. Details of the impact

Increased protection against meningococcal disease at the **University of Nottingham**:

Recorded total cases of invasive meningococcal disease in England due to MenW increased from 19 in 2008/09 to 176 in 2014/15 [*Figure 1*, showing data for 15-24 age group], prompting PHE to introduce the MenACWY vaccine for 14-18 year olds and new university students up to the age of 25 years in August 2015 and replacing the routine teenage MenC school-based programme. As a direct result of Dr Turner and Dr Oldfield's 2008 longitudinal study of carriage of meningococcal strains by UoN Students **[1]**, the University of Nottingham Health service (UNHS) already recognised the critical importance of comprehensive and early immunisation of incoming students, fully embracing and adopting this vaccination programme. The Chief Operating Officer at UNHS states *"This study highlighted the speed at which meningococcal carriage spreads amongst freshers in halls and helped the UNHS understand the importance of early vaccination within the academic year. As a result, the UNHS substantially increased its efforts in ensuring the majority of the unvaccinated student intake were able to take up the*

options for vaccination… by: offering vaccinations over an extended period of time to ensure most students can access them; ensuring the vaccine recommendations and information was available to students and their families prior to arrival, including our large international cohort; working alongside volunteers from Meningitis UK to talk to students about the importance of vaccination during the heath registration process; and making vaccine information available in a number of languages… Dr Turner and Dr Oldfield have been hugely influential in highlighting the importance of early vaccination" **[S1]**.

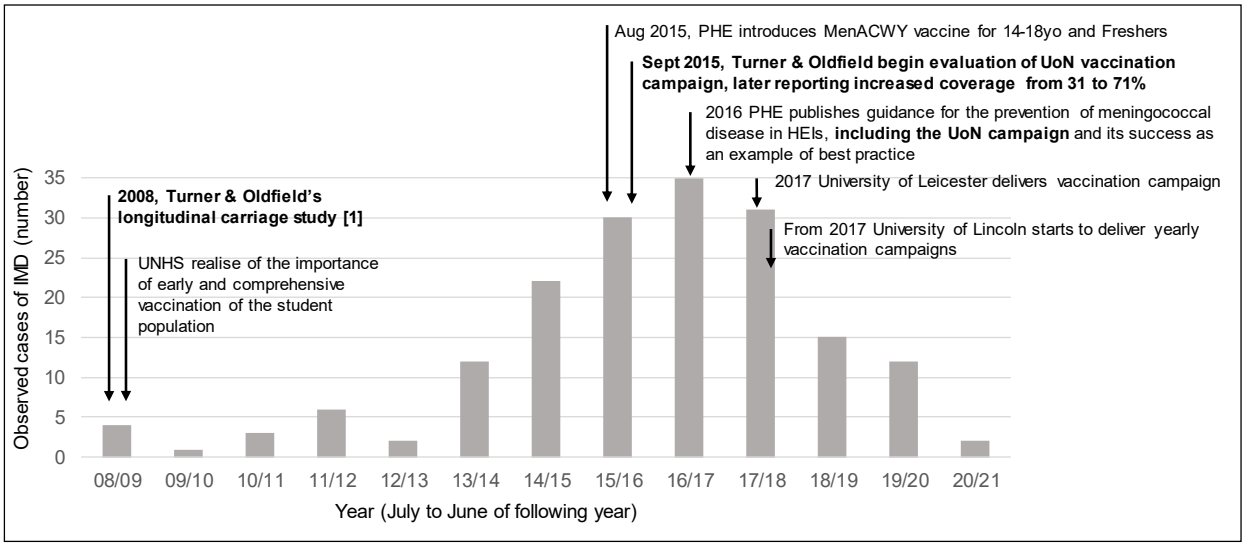

Figure 1. Number of cases of Invasive Meningococcal Disease (IMD) due to MenW in England from 2008 to 2020 in the 15-24 age-group [S10]. Important milestones of the research and impact are highlighted alongside the timeline.

Following the introduction of the national MenACWY vaccination programme in August 2015, Dr Turner and Dr Oldfield, in collaboration with Dr Bayliss and the UNHS led a new research study where uptake during the 2015/16 vaccination campaign of the UoN student body was evaluated. From all first-year students who attended the registration event, 2,809 UK students were newly immunised, increasing MenACWY coverage from 31% to 71% in this cohort. International student immunisations rose from 1% to 72%, protecting 572 additional students and confirming the feasibility of mass vaccination of vulnerable cohorts. In total, **3,381 students** were immunised during the 2015 immunisation campaign at the UoN **[3]**. Individual students who were vaccinated were protected against MenA, MenC, MenY and the hypervirulent MenW meningococcal strains for at least 5 years, with the University and wider community benefiting from the herd protection effect arising from >70% vaccination uptake.

<u>The UoN 2015 immunisation campaign was featured by PHE in its 2016 guidance for HEIs:</u>
The success of the 2015 immunisation campaign at the UoN was such that it was highlighted as an **example of best practice by PHE** in their 2016 report *'Guidance on the prevention and management of meningococcal meningitis and septicaemia in Higher Education Institutions'*. The report states *"efforts of Higher Education Institutions in collaboration with their student health partners can and have made a difference when MenACWY vaccine has been offered opportunistically to their freshers…The following case study [refers to UoN immunisation campaign] may be helpful in identifying some ways in which higher education institutions can play an active role in improving awareness and promoting vaccination uptake amongst its students"* **[S2].** This guidance paper was developed by PHE and Universities UK, together with the national charities Meningitis Research Foundation and Meningitis Now, NHS National Services Scotland, Public Health Wales and Public Health Agency in Northern Ireland. These organisations all publicised the PHE guidelines on their websites to raise awareness and promote vaccine uptake amongst university students across the UK **[S3]**. A Senior Clinical Scientist at the Immunisation and Countermeasures Department at PHE said *"Colleagues at PHE were aware of the work undertaken by Dr Turner and Dr Oldfield at the University of Nottingham and how successful they had been in targeting their incoming student population for MenACWY vaccination thereby markedly improving coverage... The UoN 2015 immunisation*

campaign was therefore featured as example of best practice in the [PHE] 2016 report… The aim was to illustrate to other Higher Education Institutions (HEI) how one HEI had successfully improved MenACWY vaccination coverage in their new student population as an achievable goal that could be emulated" **[S4]**. The UoN immunisation campaign was also cited as an example of a HEI that achieved high vaccine uptakes in a 2017 paper from PHE, reporting uptake rates during the first 12 months of the emergency MenACWY vaccination programme. The resulting article is published in *Emerging Infectious Diseases*, a peer-reviewed journal of the USA's health protection agency CDC (Centers for Disease Control and Prevention) **[S5].**

Encouraging other UK Universities to offer MenACWY immunisations:
As a result of the success of the immunisation campaigns at the UoN, Dr Bayliss liaised with the University of Leicester Welfare Team, the Victoria Park Health Centre and a public health team from NHS England to organise and deliver a comparable mass-MenACWY vaccination campaign for **University of Leicester** students **[S6]**. The campaign was delivered during three days of 'freshers' week in October 2017 at the Student's Union on campus, and resulted in the immunisation against MenA, C, W and Y strains of **491** students. This represented a 24% uptake rate for 2,001 newly-registered patients, which was more than double the 291 vaccinations (11% uptake for 2,726 new registrants) provided in the previous year. The Chief Operating Officer of UNHS, which coordinates the mass-immunisation campaigns at UoN, also leads the University of Lincoln health service. Due to the success of the UoN campaigns, the **University of Lincoln** implemented an equivalent campaign from 2017. Here, immunisation uptakes have been high, although records are limited; as an example, the 2019/20 campaign resulted in the immunisation of **168** 'fresher' students, representing a 5.3% increase in immunisations from a base of 60.5% **[S7]**.

The research team at the UoN also recognised that the success of their vaccination campaign could be used to promote implementation of PHE best practice and encourage other UK universities to deliver similar campaigns. Specifically, they collaborated with the communications department of Meningitis Now on additional initiatives to support the mirroring of the UoN immunisation campaign. Meningitis Now, UoN and University of Leicester's representatives shared an information stand and Dr Turner delivered a talk promoting the results of the UoN campaign at the 2019 Student Health Association Conference [Sheffield, July 2019]. Additionally, Meningitis Now sent two newsletters highlighting the UoN immunisation campaign to all universities in their network in April 2019. These newsletters reached both MARM (Meningitis Aware Recognition Mark)-accredited universities that already have in place initiatives to increase MenACWY vaccination coverage amongst their students, but also universities that were not yet accredited **[S8].** Overall MenACWY vaccination rates achieved in university-linked GP surgeries have been higher compared to non-university GP surgeries across England in four consecutive academic years **[S5, S9,** *Table 1***]**, likely linked to easier adoption of PHE guidelines for the prevention of meningococcal disease in HEIs, where the UoN immunisation campaign was highlighted as an example of good practice **[S2].**

	2015/16	2016/17	2017/18	2018/19
University-linked GPs	56.1%	56.5%	57.1%	53.6%
Non-university-linked GPs	33.8%	32.8%	36%	40.9%

Table 1. *Comparison of the uptake of the MenACWY vaccine among young people for university-linked and non-linked GP practices. PHE provided average MenACWY immunisation figures for 6,993 GPs in England, 80 of which are university-linked.*

Further evidencing ongoing impact from promotion of the successful UoN vaccination campaign, other UK universities in addition to Nottingham, Leicester and Lincoln have reported vaccination of high numbers of incoming students. The accessibility of comprehensive information from different university health services is challenging, but we present here some examples where data was forthcoming (*Table 2*). Five universities provided between 300 and 900 MenACWY immunisations per year in two or more of the last three academic years. For Bristol and Nottingham Trent Universities, where records allowed calculation of uptake rates, approximately 10% of incoming students received vaccination **[S7]**

University	2017/18	2018/19	2019/20
University of Essex	824	854	655
University of Leeds	1,588	747	496
UCL		830	614
University of Bristol	492	411	128
Nottingham Trent University	300	300	250
Bath Spa University		3,572	

Table 2. *MenACWY uptake results provided by selected UK universities. Figures indicate total number of vaccinations delivered to students during a particular academic year.*

Summary:
Since the introduction in August 2015 of the MenACWY conjugate vaccine to the national immunisation programme, including in UK secondary schools, cases of invasive meningococcal disease that had been rising since 2008 started to fall. In 2020, the number of cases amongst the 15-24 age group has fallen to a level comparable to pre-2008 [**S10**, *Figure 1*]. Immunisation campaigns in university settings, including the UoN, have contributed to this decline in IMD. The first cohort of year 9 teenagers immunised in schools and GPs in 2015 arrived at university in the 2018/19 academic year. This relieved pressure in university health services to provide immunisation for incoming students, allowing then to focus on other areas of need, the exception being international students who typically have a lower proportion immunised upon arrival in the UK. The Chief Operating Officer at UNHS said *"It is clear that a mass vaccination campaign is much more efficient than immunisation on a one-to-one basis in terms of time and being accessible to the patient… our campaigns are very effective at reaching adult students who may not otherwise access healthcare. This is particularly so for international students, minority ethnic groups and more vulnerable students such as those with mental health issues"* **[S1]**.

5. Sources to corroborate the impact (websites were last accessed on 18/01/2021)

S1 Corroborative letter from the Chief Operating Officer at UNHS.
S2 2016 PHE guidance document on the prevention and management of meningococcal disease in HEIs; see p18 for mention of the UoN vaccination campaign, web link
S3 PDF of combined documents: 2019 PHE report 'Guidance for public health management of meningococcal disease in the UK', mentions S2 (reference 31) in page 12; PHE News Release, 2017; Universities UK published PHE's report on their website, June 5th 2017; Meningitis Now News Stories, May 25th 2019 mentions [3] and its highlight in PHE's report [S2]; Meningitis Now publishes 'Promoting MenACWY vaccination', with a link to PHE's report [S2] and UoN vaccination campaign [3] as an example of success.
S4 Corroborative letter from Senior Clinical Scientist of PHE Immunisation and Countermeasures Department.
S5 Campbell H, Edelstein M, Andrews N, et al. Emergency Meningococcal ACWY Vaccination Program for Teenagers to Control Group W Meningococcal Disease, England, 2015–2016. *Emerging Infectious Diseases*. 2017;23(7):1184-1187. doi:10.3201/eid2307.170236.
S6 Announcement of University of Leicester immunisation campaign, web link
S7 Collated emails from UK Universities with information on MenACWY immunisations.
S8 Meningitis Now newsletter sent to non-MARM and MARM-accredited Universities
S9 Personal communication from PHE of figures of MenACWY immunisations in university-linked versus non-university linked GP surgeries.
S10 PHE Annual Report 2018/19 supp. data tables: Invasive Meningococcal Disease in England, web link