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ARTICLE DETAILS

TITLE (PROVISIONAL)	What school and area level factors influenced HPV and MenACWY vaccine coverage in England in 2016/17? An ecological study
AUTHORS	Tiley, Karen; White, Joanne; Andrews, Nick; Tessier, Elise; Ramsay, Mary; Edelstein, Michael

VERSION 1 - REVIEW

REVIEWER	Aurélie Bocquier (Sébastien Cortaredona for statistical issues) Regional Health Observatory Provence-Alpes-Côte d'Azur, Marseille, France Aix Marseille Univ, IRD, AP-HM, SSA, VITROME, Marseille, France
REVIEW RETURNED	07-Feb-2019

GENERAL COMMENTS	This is an interesting article exploring school and area-level factors associated with HPV and MenACWY vaccines uptake in England. Analysis are based on aggregated data collected at the school-level. Data were not exhaustive (voluntary submitted to PHE) but this limitation is discussed. Results stressed the need for using tailored approaches to promote vaccination that take into account the context (schools' and neighbourhoods' characteristics). However, this paper had some weaknesses that should be addressed.
	Title - As mentioned in the authors' instructions, the article title should include the study design (ecological study). Abstract - The abstract should be structured as mentioned in the authors' instructions (objectives, design, setting, etc.). - The Background section stated the existence of 3 adolescent school-based programmes in the UK (HPV, MenACWY and Td/IPV vaccine) but results were provided for the first 2 vaccines only; the reader could not understand the reason of this in the abstract. - Methods: the label "school type" is not very clear; the label "sex" may be replaced by "sex of school pupils". - Results: see remark below regarding the Results section of the main text. Introduction - Line 19: "LAs" is not explained. - The introduction focused mainly on how school-based vaccination programs are implemented in the UK. It would be

useful for the readers to have some additional information about the national (mean national vaccine coverage for the vaccines of interest?) and scientific context (what is already known about individual as well as area-level factors associated with vaccine uptake, in UK but also in other countries?).

-        At the end of the introduction, the objectives of the paper should be presented.

Methods

-        To improve the understanding of the reader, it would be useful to give more details about the source of the data used to measure vaccine coverage at the school level. Do data come from SITs' activity (i.e., only vaccines injected by these teams are taken into account) or from pupils' vaccination booklets reviewed by these teams (thus included vaccine injected by other healthcare professionals)?

-        Table 1. "Denomination": in the abstract, "religious affiliation" is used. This could be standardized.

-        Statistical analysis. The authors implemented linear regression models weighted by the "denominator" (i.e., the total number of pupils) of each school to examine school and area-level factors associated with vaccine coverage. As both numerators (i.e., numbers of vaccinated pupils) and denominators were available, why the authors did not study the number of vaccinated pupils as the dependant variable (e.g, using a Poisson regression model) using school size as an offset variable? Such analysis would allow estimation of relative risks.

-        Page 6, Lines 3-6: to my point of view, it would be more clear to say that these models were adjusted for… (and provide the list of variables).

Results

-        Page 6, Line 27: it would be useful to provide the total number of LAs here.

-        Page 6, Lines 29 and Line 35: could the authors indicate the percentage of schools included in the study, as they did for the percentage of LAs?

-        Page 6, Lines 37-40: it would be easier to read if both sentences were written in the same way.

-        Page 6, Lines 43-46: the authors stated that they could not compare the distribution of the sample with all schools in England because the Department of Education's school dataset does not report enough details on the type of school. But would it be possible to have comparisons for the other variables studied?

-        Section "Delivery model": I wonder whether these results were really essential.

-        Section "School type": why did the authors provide results from such bivariate analysis (which were not described in the Methods section) for the "school type" variable only? Results from bivariate analyses in Tables 2 and 3 are already interesting.

-        Figures 2 and 3. Titles indicated "[…] vaccine coverage distribution by school type" while, in fact, Figures presented the number of school by vaccine coverage and school type. Using two different scales for the y-axis (according to the school type) make the interpretation difficult.

-        Section "Factors associated with HPV and MenACWY vaccine uptake": based on the results of the linear regression models, the authors stated that "Muslim and Jewish schools had significantly lower HPV coverage […] (24.0% and 20.5% lower respectively […]". I would suggest that results from such analysis must rather be interpreted in terms of percentage points(pp) (24.0 pp and 20.5pp lower respectively).

	Discussion
	- The section "Key findings" is not limited to a summary of main finding but also included a kind of "interpretation of the results" section.
	- Page 12, Lines 39-40: the last sentence of this paragraph seemed to be redundant with the previous one.
	- The section "comparison with previous studies" focused mainly on studies from the UK. The authors referred to the review from Kessels and colleagues about the factors associated with HPV vaccine uptake. Based on this review and other reviews on this topic (e.g., Fisher H, Int J Epidemiol, 2013; Holman DM, JAMA Pediatr, 2014; Jeudin P, Clin Ther, 2014), could the authors expend their discussion about the potential underlying reasons of the differences observed (even if these reasons are beyond the score of this study)?

REVIEWER	Jiangrong Wang
	Karolinska Institutet, Sweden
	I am currently involved in a study about effectiveness of HPV vaccination granted by Merck&Co.
REVIEW RETURNED	15-Feb-2019

GENERAL COMMENTS	In general, the study provide clear message on factors differentiating vaccination coverage among school-based vaccination programmes in England.
	Some parts may be revised to improve the comprehensibility and presentation:
	1. It would be appreciated if authors could provide more details about the adjusted models, especially which factors are adjusted for the figures in Table 2 and Table 3. Since not all schools have information about BME and deprivation as I understood, some factors may not be included in the adjusted model for the adjusted difference in some variables.
	2. I found figure 2 and 3 expressed similar information as the "type of school" in table 2 and 3. Authors may would like to motivate the main difference of the two channels of message if want to keep them all, or may consider focusing on one channel of the results.
	3. In MenACWY vaccine coverage, the Islam/Muslim school also exhibited a quite strong tendency of lower coverage although not statistically significant. Therefore in the second paragraph of the discussion, it might not be appropriate to state "there are no issue with vaccination acceptance or access in general". At least more evidence is needed for concluding. I found the influenza vaccine uptake among Muslim population discussed in the second last paragraph of the discussion is interesting for this issue. Authors may consider discussing them all together about the general acceptance of vaccine among religious groups.
	One minor suggestion:
	LA may need to be spelled out in introduction when it appears for the first time.

REVIEWER	Julia Brotherton
	VCS Population Health, VCS Foundation, Australia

	I have been an investigator on two HPV epidemiology studies where Merck and Seqirus funded laboratory testing through investigator initiated unrestricted grants. I have never received any personal financial benefits.
REVIEW RETURNED	24-Feb-2019

GENERAL COMMENTS	Thank you for asking me to review this interesting paper which I enjoyed reading. How to maximise vaccine coverage using school programs is a challenging policy question and these data can help inform further research studies to understand what is driving differences in coverage at the school and community level. The main weakness of the paper, that it is not an analysis covering the whole of England, is reasonably well addressed though I would like to see a bit more commentary about how the areas of England not included are different/similar to those that were (e.g. the map showing areas is valuable but not meaningful in terms of likely differences in populations/characteristics for those who are not English) and to understand when staff were asked to participate and submit data in what way the request was made - as optional to assist with a study with stated aim or as a more general request and what the resource implications of the request for the staff involved were. This will help understand whether there is likely to be a difference in the areas that did and did not respond in terms of resourcing (which could be related to program performance in schools also). Specific minor feedback Page 2 Abstract - line 9 papillomavirus is one word, line 10 suggest active voice 'we describe' LIne 30 suggest reword fro clarity 'had lower coverage in descending order then..' Line 32 add comma after sub-analysis Line 38 add comma after addition Line 47 reword 'variable collected allow determination of association between' Page 3 Intro Line 9 - papillomavirus is one word Line 19 - spell out what LA stands for (?local areas). Clarify if it is coverage by the end of start of Year 9 that is measured. Line 31 A previous not an previous Line 32 to 36 - long sentence. Add comma after England and located and beliefs Line 36 replace have been with are Methods Line 52 reword 'for HPV vaccine doses, some will have been scheduled for children targeted in the previous academic year..' Page 4 Line 11-12 - this is an assumption. Do you have any data supporting this statement (that parents who consent to meningococcal vaccine also consent to Td/IPV?) Line 15,16 Did you do any analysis of dose 1 coverage for HPV? Rates of initiation vs completion may be different and have different predictors. This may be highly relevant if one dose is protective. Line 23 add commas after Table 1 and school

	Page 5 Add heading so table stands alone (e.g. number of schools, year , country) Under denomination there is no Jewish category yet that is a main finding of the analysis. Please explain how this was assigned to schools.
	Line 45 spell out LSOA in the table footnote
	Line 55 going the weighting for size did you also analyse whether school size was an independent predictor of coverage? It would be worth assessing this as school size may relate to level of resourcing within the school available to support vaccination program operation and this may be different for Independent vs state schools.
	Page 6
	Results
	line 46. Is it possible to analyse the representativeness of the state schools?
	Page 7
	line 11and line 17 add comma after dataset
	Page 8/9
	Table 2/3 add reference category 1.0 to each reference category in last column for clarity
	Page 11
	Discussion
	LIne 7 remove capital from This
	Line 22 add comma after instances
	Line 23 suggest although rather than however
	ine 27 as previously suggest analyse school size independently to determine if it is a predictor and if its effect varies by school type
	LIne 56-58 unclear - reword.
	Page12 line 10 add comma after programme

VERSION 1 – AUTHOR RESPONSE

Reviewer(s)' Comments to Author:

Reviewer: 1

This is an interesting article exploring school and area-level factors associated with HPV and MenACWY vaccines uptake in England. Analysis are based on aggregated data collected at the school-level. Data were not exhaustive (voluntary submitted to PHE) but this limitation is discussed. Results stressed the need for using tailored approaches to promote vaccination that take into account the context (schools' and neighbourhoods' characteristics). However, this paper had some weaknesses that should be addressed.

Title
- As mentioned in the authors' instructions, the article title should include the study design (ecological study).

The title has been changed to What school and area level factors influenced HPV and MenACWY vaccine coverage in England in 2016/17? An ecological study

Abstract
- The abstract should be structured as mentioned in the authors' instructions (objectives, design, setting, etc.)

We have restructured the abstract according to the author's instructions

- The Background section stated the existence of 3 adolescent school-based programmes in the UK (HPV, MenACWY and Td/IPV vaccine) but results were provided for the first 2 vaccines only; the reader could not understand the reason of this in the abstract.

The new format of the abstract doe snot include a background, but the main text explains that Td/IPV is administered concurrently with MenACWY

- Methods: the label "school type" is not very clear; the label "sex" may be replaced by "sex of school pupils".

We replaced sex with "single sex/mixed". We agree that school type is not entirely descriptive, but the results and main manuscript elaborate on what this means

- Results: see remark below regarding the Results section of the main text.
Introduction
- Line 19: "LAs" is not explained.

We spelled LAs out (local authorities)

- The introduction focused mainly on how school-based vaccination programs are implemented in the UK. It would be useful for the readers to have some additional information about the national (mean national vaccine coverage for the vaccines of interest?) and scientific context (what is already known about individual as well as area-level factors associated with vaccine uptake, in UK but also in other countries?)

We have added the following sentence to the introduction (with references): Previous studies of the national immunisation programme in England have identified inequalities in terms of geography, ethnicity and deprivation for vaccines delivered in primary care. The introduction also describes studies conducted on the influenza programme. International comparisons are made in the discussion.

We have added national coverage for the vaccines of interest for the study period

- At the end of the introduction, the objectives of the paper should be presented.

The following sentence has been added: "This study aims to determine whether school-level and other local area factors Are associated with vaccine coverage for those adolescent programmes."

Methods
- To improve the understanding of the reader, it would be useful to give more details about the source of the data used to measure vaccine coverage at the school level. Do data come from SITs' activity (i.e., only vaccines injected by these teams are taken into account) or from pupils' vaccination booklets reviewed by these teams (thus included vaccine injected by other healthcare professionals)?

the following sentence was added: In England, school-based vaccination is delivered by a variety of public and private healthcare providers and commissioned and coordinated through Screening and Immunisation Teams (SITs). Data are routinely collected in each school through tally sheets, aggregated at local LA level and submitted to PHE. Therefore prior to 2016/17 school-level data, although collected, were not routinely available at national level

- Table 1. "Denomination": in the abstract, "religious affiliation" is used. This could be standardized.

Changed to "religious affiliation" in table 1

- Statistical analysis. The authors implemented linear regression models weighted by the "denominator" (i.e., the total number of pupils) of each school to examine school and area-level factors associated with vaccine coverage. As both numerators (i.e., numbers of vaccinated pupils) and denominators were available, why the authors did not study the number of vaccinated pupils as the dependant variable (e.g, using a Poisson regression model) using school size as an offset variable? Such analysis would allow estimation of relative risks.

We did consider this approach but preferred the linear regression analysis with weighting approach for a number of reasons. First we think that risk differences (i.e. coverage differences) which are obtained from the linear regression are a more interpretable output than relative risks as this directly relates to the quantity of interest. Secondly the normality assumptions when using linear regression and coverage for each school are reasonable as the coverage values are not getting close to 0 or close to 100%. Thirdly if Poisson regression was used then to get a risk difference output and allow for potential over dispersion would make the model quite complex and essentially be producing a similar analysis to the more simple one presented.

- Page 6, Lines 3-6: to my point of view, it would be more clear to say that these models were adjusted for… (and provide the list of variables).

The paragraph was amended as follows: Unadjusted regression models were used for each school-level factors (except school size, which was adjusted for by weighting) and region to explore differences in coverage from the baseline for each factor (religious affiliation, school type, urban/rural, single sex/mixed . In addition to school-level factors, the association between ethnicity and deprivation LSOA level factors (proportion of BME in school LSOA, deprivation) and vaccine coverage were explored for mixed-sex state-funded secondary schools, using the same model. To ascertain the effect of school size, we opted to include school size as a variable, rather than weighting, in the mixed-sex state funded only sub-analysis. We restricted the analysis of school size to this subanalysis because all pupil referral units and special schools were small and had less than 400 pupils. An adjusted linear regression model was then used, presenting differences in coverage from the baseline for each factor, adjusting for all other factors.

Results
- Page 6, Line 27: it would be useful to provide the total number of LAs here.

Added out of 152 LAs

- Page 6, Lines 29 and Line 35: could the authors indicate the percentage of schools included in the study, as they did for the percentage of LAs?

Unfortunately it is not possible because the dataset used from the Department of Education does not differentiate between primary and secondary schools

- Page 6, Lines 37-40: it would be easier to read if both sentences were written in the same way.

We have changed the sentences to give then the same structure

- Page 6, Lines 43-46: the authors stated that they could not compare the distribution of the sample with all schools in England because the Department of Education's school dataset does not report enough details on the type of school. But would it be possible to have comparisons for the other variables studied?

Unfortunately it is not possible because the dataset used from the Department of Education does not differentiate between primary and secondary schools

- Section "Delivery model": I wonder whether these results were really essential.

This section has been removed as we agree it does not fit the study's objectives

- Section "School type": why did the authors provide results from such bivariate analysis (which were not described in the Methods section) for the "school type" variable only? Results from bivariate analyses in Tables 2 and 3 are already interesting.

This analysis provides information beyond the risk difference as it provides insight into how performance is distributed among those different school types. This variable was selected for this analysis because school type is significantly associated with performance, and it is a factor that is operationally relevant to those delivering the programme

- Figures 2 and 3. Titles indicated "[…] vaccine coverage distribution by school type" while, in fact, Figures presented the number of school by vaccine coverage and school type. Using two different scales for the y-axis (according to the school type) make the interpretation difficult.

We have redone these graphs presenting by proportion of schools rather than number of schools, which enable to have a single y axis

- Section "Factors associated with HPV and MenACWY vaccine uptake": based on the results of the linear regression models, the authors stated that "Muslim and Jewish schools had significantly lower HPV coverage […] (24.0% and 20.5% lower respectively […]". I would suggest that results from such analysis must rather be interpreted in terms of percentage points(pp) (24.0 pp and 20.5pp lower respectively).
Indeed- this has been changed to percentage points

Discussion
- The section "Key findings" is not limited to a summary of main finding but also included a kind of "interpretation of the results" section.

The section has been renamed "interpretation of key findings

- Page 12, Lines 39-40: the last sentence of this paragraph seemed to be redundant with the previous one.

The last sentence was removed

- The section "comparison with previous studies" focused mainly on studies from the UK. The authors referred to the review from Kessels and colleagues about the factors associated with HPV vaccine uptake. Based on this review and other reviews on this topic (e.g., Fisher H, Int J Epidemiol, 2013; Holman DM, JAMA Pediatr, 2014; Jeudin P, Clin Ther, 2014), could the authors expend their discussion about the potential underlying reasons of the differences observed (even if these reasons

are beyond the score of this study)?

We have expanded this section to include further comparisons in light of some of the papers highlighted. However it is worth noting that international comparisons with countries where the healthcare system is very different (e.g. USA) have limitations.

Reviewer: 2

In general, the study provides clear message on factors differentiating vaccination coverage among school-based vaccination programmes in England.

Some parts may be revised to improve the comprehensibility and presentation:
1. It would be appreciated if authors could provide more details about the adjusted models, especially which factors are adjusted for the figures in Table 2 and Table 3. Since not all schools have information about BME and deprivation as I understood, some factors may not be included in the adjusted model for the adjusted difference in some variables.

This paragraph was revised as follows: Unadjusted regression models were used for each school-level factors (except school size, which was adjusted for by weighting) and region to explore differences in coverage from the baseline for each factor (religious affiliation, school type, urban/rural, single sex/mixed . In addition to school-level factors, the association between ethnicity and deprivation LSOA level factors (proportion of BME in school LSOA, deprivation) and vaccine coverage were explored for mixed-sex state-funded secondary schools, using the same model. To ascertain the effect of school size, we opted to include school size as a variable, rather than weighting, in the mixed-sex state funded only sub-analysis. We restricted the analysis of school size to this subanalysis because all pupil referral units and special schools were small and had less than 400 pupils. An adjusted linear regression model was then used, presenting differences in coverage from the baseline for each factor, adjusting for all other factors.

2. I found figure 2 and 3 expressed similar information as the "type of school" in table 2 and 3. Authors may would like to motivate the main difference of the two channels of message if want to keep them all, or may consider focusing on one channel of the results.

This analysis provides information beyond the risk difference as it provides insight into how performance is distributed among those different school types. This variable was selected for this analysis because school type is significantly associated with performance, and it is a factor that is operationally relevant to those delivering the programme

3. In MenACWY vaccine coverage, the Islam/Muslim school also exhibited a quite strong tendency of lower coverage although not statistically significant. Therefore in the second paragraph of the discussion, it might not be appropriate to state "there are no issue with vaccination acceptance or access in general". At least more evidence is needed for concluding. I found the influenza vaccine uptake among Muslim population discussed in the second last paragraph of the discussion is interesting for this issue. Authors may consider discussing them all together about the general acceptance of vaccine among religious groups.

The paragraph was changed to: The lower coverage in Jewish schools for HPV but not for MenACWY suggests that there are no issues with vaccination acceptance or access in general, but there may be less acceptance of the need for HPV vaccine in particular within this religious community. In Muslim schools, coverage was lower for MenACWY and HPV, the difference was only significantly lower for HPV. In contrast, coverage for both vaccines in Roman Catholic schools was similar or higher than coverage in schools of no religious character. These findings suggest that issues around vaccination

may be specific to each religious community and that different vaccines may be perceived differently within a given community. Factors underlying these differences require further investigation.

One minor suggestion:
LA may need to be spelled out in introduction when it appears for the first time.

This is now spelled out

Reviewer: 3

Thank you for asking me to review this interesting paper which I enjoyed reading. How to maximise vaccine coverage using school programs is a challenging policy question and these data can help inform further research studies to understand what is driving differences in coverage at the school and community level. The main weakness of the paper, that it is not an analysis covering the whole of England, is reasonably well addressed though I would like to see a bit more commentary about how the areas of England not included are different/similar to those that were (e.g. the map showing areas is valuable but not meaningful in terms of likely differences in populations/characteristics for those who are not English) and to understand when staff were asked to participate and submit data in what way the request was made - as optional to assist with a study with stated aim or as a more general request and what the resource implications of the request for the staff involved were. This will help understand whether there is likely to be a difference in the areas that did and did not respond in terms of resourcing (which could be related to program performance in schools also).

The data was not collected specifically for this study. It is collected routinely at school level but was never nationally collected at that level. Thus the voluntary nature refers to the submission, rather than the collection. Hope fully this is clearer with this new paragraph:

In England, school-based vaccination is delivered by a variety of public and private healthcare providers and commissioned and coordinated through screening and immunisation team. Data are routinely collected in each school through tally sheets, aggregated at local LA level and submitted to PHE. Therefore prior to 2016/17 school-level data, although collected, were not routinely available at national level.

We have added further representativeness analyses which hopefully will help the reader assess how similar/different the schools included are to those who are not.

Specific minor feedback
Page 2
Abstract - line 9 papillomavirus is one word, line 10 suggest active voice 'we describe'
Corrected- the active voice is already used

Line 30 suggest reword for clarity 'had lower coverage in descending order then..'
We felt the current wording was not ambiguous and left as is
Line 32 add comma after sub-analysis
added

Line 38 add comma after addition
added

Line 47 reword 'variable collected allow determination of association between'
reworded
Page 3

Intro
Line 9 - papillomavirus is one word
corrected

Line 19 - spell out what LA stands for (?local areas). Clarify if it is coverage by the end of start of Year 9 that is measured.

LA is spelled out and we have specified that it is by the end of year 9
Line 31 A previous not an previous
corrected
?
Line 32 to 36 - long sentence. Add comma after England and located and beliefs Line 36 replace have been with are

Added a comma and replaced "have been" with "were"

Methods Line 52 reword 'for HPV vaccine doses, some will have been scheduled for children targeted in the previous academic year..'

We agree that the wording is unclear. We have reworded to "For HPV the data will have included some doses given in the previous academic year (2015/16))"

Page 4
Line 11-12 - this is an assumption. Do you have any data supporting this statement (that parents who consent to meningococcal vaccine also consent to Td/IPV?)

Programmatically the 2 vaccines are given at the same time. There may be rare instances where an individual receives one but not the other but it would be unusual. Hence the use of the word "generally". We have rephrased to make it clearer:

School delivery of the MenACWY and Td/IPV vaccines are generally organised concurrently and given on the same day, so only MenACWY data were used and the findings relating to MenACWY should be generalisable to Td/IPV.

Line 15,16 Did you do any analysis of dose 1 coverage for HPV? Rates of initiation vs completion may be different and have different predictors. This may be highly relevant if one dose is protective.

While we agree that there may be different predictors to HPV initiation vs completion, this analysis was not part of this study's objectives, which focused on completed courses; although it is something that merits attention and that we will consider for future studies.

Line 23 add commas after Table 1 and school Page 5 Add heading so table stands alone (e.g. number of schools, year , country) Under denomination there is no Jewish category yet that is a main finding of the analysis. Please explain how this was assigned to schools.

We added the Jewish category, which was an omission. The numbers are available in table 2 so we feel there is no need to duplicate the information. The methods section specifies that "School characteristics (table 1) were obtained from the Department for Education 2017 school census"

Line 45 spell out LSOA in the table footnote
LSOA is now spelled out

Line 55 going the weighting for size did you also analyse whether school size was an independent predictor of coverage? It would be worth assessing this as school size may relate to level of resourcing within the school available to support vaccination program operation and this may be different for Independent vs state schools.

We have added school size as a variable for the subanalysis restricted to state schools adjusting for other factors, and discussed the findings related to school size in the results and discussion. We have also amended the tables accordingly.

Page 6
Results
line 46. Is it possible to analyse the representativeness of the state schools?

We have added further representativeness analyses which hopefully will help the reader assess how similar/different the schools included are to those who are not.

Page 7

line 11and line 17 add comma after dataset

added

Page 8/9 Table 2/3 add reference category 1.0 to each reference category in last column for clarity

We are presenting risk difference rather than risk ratios so the baseline is not one (it would be 0). However for clarity we have added "baseline" in the last column for each category

Page 11 Discussion Line 7 remove capital from This
corrected

Line 22 add comma after instances
Added

Line 23 suggest although rather than however
We replaced however with although

Line 27 as previously suggest analyse school size independently to determine if it is a predictor and if its effect varies by school type

We have added school size as a variable for the subanalysis restricted to state schools adjusting for other factors, and discussed the findings related to school size in the results and discussion. We have also amended the tables accordingly. We could not do it for all school types because all special schools and pupil referral units are very small. Because state funded schools were the only ones for which we had all variable available including deprivation and ethnic make-up of the catchment are we thought it would be most meaningful to restrict the size analysis to these schools, so confounding could be better controlled.

Line 56-58 unclear - reword.
Rephrased as follows: "Coverage was lower for London compared with other areas, as seen across other childhood immunisation programmes (19). Participation from London was low in this study particularly for HPV. Lack of statistical power with the London HPV sample may partly explain why

HPV coverage for London was not lower than the baseline after adjusting for other factors. "

Page12 line 10 add comma after programme

added

VERSION 2 – REVIEW

REVIEWER	Aurélie Bocquier Observatoire Régional de la Santé Provence-Alpes-Côte d'Azur, France
REVIEW RETURNED	28-Apr-2019

GENERAL COMMENTS	The authors have answered all comments and improved the manuscript.

REVIEWER	Jiangrong Wang Karolinska Institutet, Sweden I am involved in a study about HPV vaccination effectiveness funded by the Gardasil and Gardasil 9 manufacturer Merck &Co.
REVIEW RETURNED	01-May-2019

GENERAL COMMENTS	Thank you for addressing my previous comments. Regarding the description of adjusted models in text and in Table 2 and Table 3, I would still prefer more clarified information. For example, the estimates in the last column of Table 2 and Table 3 for "independent school" or school types other than state-funded school, I suppose that BME and deprivation variables were not adjusted for. But from the description that "estimates were adjusted for all variables" in the text and in the title of Table 2 and Table 3, it seems BME and deprivation variables were also adjusted for, as they were part of "all variables". Authors may consider giving particular markers and legends for the estimates in the last column in Table 2 and Table 3 to clarify it.

VERSION 2 – AUTHOR RESPONSE

Thank you for addressing my previous comments. Regarding the description of adjusted models in text and in Table 2 and Table 3, I would still prefer more clarified information. For example, the estimates in the last column of Table 2 and Table 3 for "independent school" or school types other than state-funded school, I suppose that BME and deprivation variables were not adjusted for. But from the description that "estimates were adjusted for all variables" in the text and in the title of Table 2 and Table 3, it seems BME and deprivation variables were also adjusted for, as they were part of

"all variables". Authors may consider giving particular markers and legends for the estimates in the last column in Table 2 and Table 3 to clarify it.

ANSWER: We have modified the methods section as follows: "An adjusted linear regression model was then used, presenting differences in coverage from the baseline for each factor, adjusting for all other school-level factors. Area level factors (proportion of BME in school LSOA, deprivation) were adjusted for all other factors in the subanalysis restricted to mixed-sex state-funded secondary schools"

We have also added the following mention in the tables: "School-level factors (denomination, type of school, urban/rural, sex of school pupils, region) are adjusted for other school-level factors only"