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Kyra Hester April 19th, 2018

Analysis of Dose-Specific Human Papillomavirus (HPV) Vaccination by Insurance Type Using the National Immunization Survey-Teen, 2015

By

Kyra A. Hester
Master of Public Health

Hubert Department of Global Health

_____

Robert A. Bednarczyk, PhD
Committee Chair

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By

Kyra A. Hester
Biocultural Anthropology
B.A., Western Washington University
2014

Thesis Committee Chair: Robert A. Bednarczyk, PhD

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2018

Abstract

Analysis of Dose-Specific Human Papillomavirus (HPV) Vaccination by Insurance Type Using the National Immunization Survey-Teen, 2015
By Kyra A. Hester

Objectives. Prior research on insurance coverage and human papillomavirus (HPV) vaccination has focused on overall insurance overage and evaluating the outcomes of initiation and completion. To address gaps in understanding of partial vaccination, we conducted a comprehensive analysis of dose- and insurance type-specific vaccine coverage among teens on private insurance, Medicaid, and military insurance to understand differences in HPV vaccine series initiation, non-series-completion, and series completion.

Methods. We analyzed the association between insurance type and HPV vaccination using 2015 National Immunization Survey-Teen (NIS-Teen) data. The main outcome variable was HPV vaccination, compared in two ways: initiation of HPV vaccine series to non-initiation of HPV vaccine series, and comparison of receipt of 1, 2, or 3 doses of HPV vaccine to those who did not initiate. The primary exposure variable was type of insurance coverage, defined as private, Medicaid, or military/other; with comparisons made to all adolescents without a given type of insurance. A secondary exposure compared insurance types (Medicaid, military, Medicaid and military, and none of the above) to private insurance.

Results. Male and female adolescents utilizing Medicaid were more likely to initiate vaccination compared to other male and female adolescents (adjusted Prevalence Ratio 1.16, 95% CI 1.07-1.25 for male; PR 1.19, 95% CI 1.08, 1.31 for females). Similarly, both male and female adolescents had a higher likelihood of vaccination at each dose level. Adolescents utilizing both Medicaid and military insurance were more likely to have received multiple doses without completing the HPV vaccine series compared to those with private insurance (PR for 2 doses compared to 0 doses 1.57, 95% CI 0.98-2.53).

Conclusions. HPV vaccine uptake remains suboptimal in the US. We have documented differences in dose-specific HPV vaccine uptake by insurance type that maintain consistent patterns by sex. With lower vaccine uptake among adolescents with private insurance, these findings highlight the importance of assessing both financial and non-financial barriers to HPV vaccination. Continued monitoring of HPV vaccine uptake patterns, particularly for younger adolescents who only need two vaccine doses, is important to tracking barriers to optimal vaccine coverage.

Analysis of Dose-Specific Human Papillomavirus (HPV) Vaccination by Insurance Type Using the National Immunization Survey-Teen, 2015

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INTRODUCTION:

Human Papillomavirus (HPV) vaccination coverage in the United States is still suboptimal twelve years after introduction. In 2016, HPV vaccine series completion coverage was 43% in females and 32% in males[1]. Previous analyses have looked at HPV vaccination and overall insurance coverage in the three recommended adolescent vaccines (tetanus, diphtheria, and pertussis; meningococcal conjugate; HPV), but only by evaluating outcomes of HPV vaccine series initiation of completion [2]. Little work has been done to assess associations with partial (e.g. only one or two doses received) vaccination. Studies have also analyzed insurance status and HPV vaccination, but have only compared insured and non-insured populations, without accounting for different types of insurance coverage (e.g. private, pubic, military) [3,4]

Understanding determinants of those who are incompletely vaccinated and those who are completely vaccinated can help with future targeted interventions regarding dose-specific HPV vaccination by insurance type. A more detailed analysis is to further understand these dose-specific and insurance-type specific vaccine coverage differences. We conducted a comprehensive analysis of dose- and insurance type-specific vaccine coverage to understand differences in HPV vaccine series initiation, non-series-completion, and series completion.

METHODS:

We analyzed the association between HPV vaccination and type of insurance coverage to assess differences between (a) receipt of any HPV vaccination compared to no HPV vaccination and (b) dose-specific receipt of HPV vaccine compared to receipt of 0 doses. We analyzed data from the 2015 National Immunization Survey-Teen (NIS-Teen)- a telephone survey utilizing random digit dialing to identify and survey households of teens aged 13-17, with follow-up

verification of immunization status through provider query[5]. NIS-Teen methods have been described in detail previously[6]

The primary outcome was receipt of HPV vaccination. We conducted 4 separate analyses. First, we compared initiation of HPV vaccine (receipt of one or more doses) to non-initiation of HPV vaccine (receipt of 0 doses). Next, we compared receipt of 1, 2, or 3 doses of HPV vaccine to non-initiation of HPV vaccine (receipt of 0 doses). These two models were both conducted across two different exposure classification systems (see below). At the time of data collection, the ACIP recommendations were for a 3-dose series[7]. Receipt of three doses was used to indicate series completion. Individuals with 3+ doses of vaccine were included in the 3-dose category.

The primary exposure variable was insurance coverage type, defined as private, Medicaid, or military/other. Individuals who were not enrolled in the above insurance types were recoded as having none of the identified insurance types. Private insurance was defined as coverage through an employer or union, and Medicaid was recoded to combine coverage by S-CHIP (currently referred to as CHIP) or any Medicaid plan. Military insurance includes Indian Health Service, Military Health Care, Tricare, Champus or Champ-VA[6]. No insurance was defined as not having private, Medicaid or Military/other insurance types. The two levels of exposure classification for analyses were compared (a) individuals with a given insurance type to all other adolescents who did not have that specific type and (b) individuals with a given insurance type (Medicaid, military, Medicaid and military, and none of the above) compared to those with private insurance (Table 1).

All analyses were conducted using SAS v.9.4 (The SAS Institute, Cary North Carolina) and the procedures PROC FREQ, for vaccine uptake, and PROC GENMOD for prevalence

ratios. PROC GENMOD calculated a subset weighted analysis, as outlined by Hale et al[8]. Multivariate log-binomial regression analyses were conducted with adjustments for sociodemographic characteristics (i.e. mother's education, income to poverty ratio, race and ethnicity of teen, census region, and if the teen had an 11 or 12-year-old well check. The analyses as indicated in the NIS-Teen Data Users Guide, and sex-stratified estimates were obtained the ESTIMATE statement in PROC GENMOD. All analyses were restricted to observations with provider-verified immunization data. Teens with no insurance and other types of insurance were excluded. Responses of "don't know" or refused to answer were set to missing, and all missing responses were removed from the analysis.

The Emory IRB considered this study to be nonhuman subject research and exempt, as it used existing, public data with no health identifiers or personally identifiable information.

RESULTS:

The NIS-Teen 2015 survey consisted of 44,773 total observations, of which 22,214 observations contained provider-verified immunization data. Self-reported insurance status among those with provider-verified immunization data showed 60% of teens had private insurance, 34% had Medicaid/S-CHIP, and 6% had military/other insurance.

Prevalence of HPV vaccination in females:

Among female adolescents, most received either 3 doses of HPV vaccine (43%) or 0 HPV vaccine doses (36%). Partial vaccination- receipt of 1 or 2 doses- was documented for 10% and 11% of female adolescents, respectively. While the highest coverage of 3 doses was seen in females with Medicaid coverage (45%), this group also had a high proportion that did not initiate

(29%). In contrast, females with military coverage were less likely to have received 3 + doses (34%), while private insurance showed those most likely to have not initiated vaccination (40%; Table 2).

Prevalence of any dose of HPV vaccine in females:

Females on Medicaid were 19% more likely to receive at least 1 dose of HPV vaccine than all other female adolescents (adjusted Prevalence Ratio 1.19, 95% CI 1.08-1.31). No other significant associations were seen when comparing HPV vaccine initiation for other insurance types, nor for any insurance types among female adolescents (Table 2).

Dose-specific prevalence of HPV vaccination in females:

Adolescent females with private or military insurances were less likely to have received only one dose of vaccine compared to non-initiation of HPV vaccine (Table 2). Adolescents with Medicaid coverage had the highest dose-specific vaccination coverage at 1, 2, and 3 doses of vaccine (Table 2). There was only a minor difference between the prevalence of females on private and military insurance, with both showing little difference from those who do not initiate. Females on military insurance had the lowest amount of vaccine uptake among all dose levels of HPV vaccine (Table 2).

Prevalence of HPV vaccination in males:

Among male adolescents, most received 3 doses of HPV vaccine (31%), or 0 doses of vaccine (48%). Partial vaccination- receipt of 1 or 2 doses- was documented for 10% and 11% of the population, respectively. Those with private insurance had the largest number of individuals

with 0 doses of vaccine (53%), followed by those with military insurance (51%). Medicaid coverage had the highest level of male teens with 3 doses of vaccine (31%; Table 2).

Prevalence of any dose of HPV vaccination in males:

Males with Medicaid coverage were 16% more likely to receive at least 1 dose of vaccine than all other male adolescents (aPR 1.16, 95% CI 1.07-1.25; Table 2). There were no other significant associations seen when comparing HPV vaccine initiation to insurance type (Table 2).

Dose-specific prevalence of HPV vaccination in males:

Males utilizing Medicaid had the highest prevalence of vaccination at all doses at 34%, with those receiving 1 dose of vaccine the highest overall (aPR 1.34, 95% CI 1.11-1.62; Table 2). Males who received one dose of vaccine on private insurance or military insurance have the lowest uptake among males. Receipt of 3 doses has low coverage among military and private insurances, while 2 doses of vaccine had a higher prevalence among all insurance types (Table 2).

Prevalence of HPV vaccination when compared to private insurance:

Adolescents on both Medicaid and military insurance were 12% more likely to initiate HPV vaccination compared to those on private insurance (aPR 1.12, 95% CI 0.95-1.32; Table 3) Adolescents without documented coverage of any of the specified insurance types (Medicaid, military, or Medicaid and military insurance), were less likely to initiate HPV vaccination compared to those with private insurance (aPR 0.83, 95% CI 0.73-0.93; Table 3).

When looking at each dose-specific vaccination, adolescents with Medicaid coverage were more likely to initiate, but not receive more than 1 dose of, HPV vaccine compared to those with private insurance (Table 4). While adolescents with both Medicaid and military insurance were more likely to have received only 2 doses of HPV vaccine but not completing the series than those with private insurance, this result was not statistically significant (aPR 1.57, 95% CI 0.98-2.53; Table 4).

DISCUSSION:

While other analyses have been conducted to compare HPV vaccine uptake by uninsured/insured status[2], this analysis is the only one that has focused on dose-specific HPV vaccine uptake by insurance type. This analysis shows that an increase in HPV vaccination in adolescents on Medicaid holds for all dose levels and both sexes. These differences may indicate the presence of other systemic, non-financial issues with HPV vaccine insurance coverage, particularly for adolescents not utilizing Medicaid, which highlights the need to tailor interventions by socioeconomic status, where we can use insurance status as a marker.

In this analysis, we found that adolescents with Medicaid and military insurance were the most likely to receive at least one dose of HPV vaccine. Adolescents only with Medicaid coverage consistently had better coverage than those on private or military insurance. This underscores the successes in preventative care with Medicaid, and highlights the importance of this program in promoting and providing preventative care. Continued work is needed to evaluate the impact of Medicaid expansion and identify populations that would be served through additional Medicaid expansion[9, 10]. While vaccine coverage was lower for males, the associations between insurance type and vaccine uptake were similar between males and

females. HPV vaccine coverage was lower among males, as HPV vaccine was not recommended for regular use in this group until 2011. This gap in male and female vaccine uptake is narrowing, but has not yet closed. The similarity between the sexes in this analysis highlights structural barriers (e.g. access, cost, transportation) that may be more constant regardless of sex, affecting both sexes similarly[11, 12.]

Low HPV vaccination uptake is seen among individuals on private insurance, even after the implementation of the Affordable Care Act (ACA), which mandates that well-child visits be covered without copay[8]. While HPV vaccination has increased overall after the ACA, the multiple visits needed to complete the series may be a barrier to vaccination[11]. Parents will need to schedule multiple appointments, possibly around their child's school and extracurricular activity schedule, and may need to take time off of work. All insurance types may be affected by provider messaging- which may not follow ACIP guidelines- and parental vaccine confidence and lack of knowledge [15-17]. Access to healthcare, whether through lack of transportation or available providers, may also affect HPV vaccine uptake. When compared to private insurance and all other insurance types, teens with Medicaid had a higher prevalence of HPV vaccination at all dose levels. While individuals with this insurance type have more teens initiating vaccination, they are not always completing the series. This could be affected by the Medicaid expansion under the ACA. In states that chose to expand coverage of Medicaid, individuals on Medicaid reported their cost of care to be more affordable[17]. As HPV-related cancers disproportionately impact underserved communities, it is possible that the higher prevalence of HPV immunization among adolescents utilizing Medicaid may be due to greater awareness of the disease due to family or community members who have been impacted by cervical cancer. Lower socioeconomic status is associated with a higher risk of cervical cancer and overall higher cancer

mortality [19, 20]. The 2015 NIS-Teen data show teens who report a minority, non-white, race/ethnicity and income at or below the federal poverty level have a higher percent of HPV vaccine uptake by both sexes and at all dose levels[1]. This trend has been seen consistently over the last 10 years [21].

HPV vaccine coverage was lowest among adolescents with military insurance when compared to both all other insurance types and private insurance, which may be due to the mobility of the population. This may impact tracking of immunization status. Adolescents with military insurance consistently have the lowest prevalence, with the only distinguishable dose-specific difference in males who receive 2 doses. However, when combined with Medicaid, HPV vaccination coverage becomes the highest among both 2 and 3 doses of vaccine. At the time of data collection, parents had to keep track of their child's vaccination status. A new electronic medical record system for military dependents is currently in the process of being deployed across the country, but has not yet reached all members[21]. Whether due to the previously mentioned problems, or possible cultural differences of the military population, dependents are overall less likely to be vaccinated[23].

The schedule for HPV vaccination has changed in the time since the data for this study was collected, and as of 2016 two doses are recommended by the ACIP for adolescents under the age of 15[1]. Under the new recommendations, the two doses are to be administered at 0 and 6-12 months. With these new guidelines for adolescents, some of these barriers, both financial and non-financial, may be mitigated. Continued evaluation in an era of a two-dose schedule is needed to determine if this schedule can increase HPV vaccine initiation and ultimately completion. It is possible that rates of completion may increase with these recommendations, as parents may opt

to vaccinate their adolescents at their yearly well-check visits to decrease non-financial, logistic barriers to accessing healthcare. While this report is not directly transferable because of the new recommendations, these findings are still indicative of any difficulties faced by individuals on private, Medicaid or military insurance.

LIMITATIONS:

This analysis was conducted using only 'yes' responses for all insurance type variables and may not provide an accurate representation of the data. All missing, refused, and "don't know" responses were removed from the analysis. Individuals that know they have insurance, but get confused by the type, may also impact this analysis. This was mitigated through pairwise deletion of the data, which removes missing information from a respondent, but keeps the rest of the observations for other analyses[24]. Additionally, insurance status was self-reported and not verified, like vaccination status. However, studies indicate that self-reporting of insurance information is accurate at a population level[25].

The NIS-Teen is a large survey, but some subgroups of insurance coverage were small-limiting precision in estimates. Continued monitoring of insurance coverage, and vaccination status by insurance coverage, will help put these estimates into context over time.

CONCLUSION:

HPV vaccine uptake remains suboptimal in the US. We have documented differences in dose-specific HPV vaccine uptake that maintain consistent patterns by sex. These findings highlight the importance of assessing both financial and non-financial barriers to HPV vaccination. Continued monitoring of HPV vaccine uptake patterns, particularly for younger

adolescents who only need two vaccine doses, is important to tracking barriers to optimal vaccine coverage.

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APPENDIX:

Table 1. Analyses conducted.

Model #	HPV Doses of Vaccine	Insurance Type
1	Initiation of HPV vaccination (1, 2, or 3+ doses) compared to non initiation (0 doses)	Private, Medicaid, and military insurance compared to all others without the given insurance type
2	Vaccination of 1, 2, and 3 + doses compared to non initiation (0 doses)	Private, Medicaid, and military insurance compared to all others without the given insurance type
3	Initiation of HPV vaccination (1, 2, or 3+ doses) compared to non initiation (0 doses)	Medicaid, Military, Medicaid + military, and None of the above compared to private
4	Vaccination of 1, 2, and 3 + doses compared to non initiation (0 doses)	Medicaid, Military, Medicaid + military, and None of the above compared to private

Table 2. Dose-specific receipt of HPV vaccine by sex and insurance type.

	Doses of vaccine			Doses of vaccine						
	1+	0	aPR* 1+ (95% CI)	3+	2	1	0	aPR* 3+ (95% CI)	aPR* 2 (95% CI)	aPR* 1 95% CI)
FEMALES										
Private	61%	39%	0.95 (0.88, 1.04)	41%	5%	9%	40%	0.97 (0.86, 1.09)	1.01 (0.81, 1.27)	0.86 (0.67, 1.11)
All Non-Private	66%	34%	-	42%	5%	13%	34%	-	-	-
Medicaid	71%	29%	1.19 (1.08, 1.31)	45%	13%	14%	29%	1.25 (1.10, 1.42)	1.35 (1.04, 1.76)	1.28 (0.99, 1.65)
All Non-Medicaid	58%	42%	-	40%	9%	9%	42%	-	-	-
Military	58%	42%	0.92 (0.76, 1.10)	34%	14%	10%	42%	0.87 (0.67, 1.12)	0.97 (0.60, 1.55)	0.88 (0.55, 1.41)
All Non-Medicaid	63%	37%	-	42%	10%	11%	37%	-	-	-
MALES										
Private	47%	53%	0.99 (0.93, 1.05)	27%	10%	10%	53%	1 (0.92, 1.09)	1.04 (0.88, 1.23)	0.88 (0.73, 1.06)
All Non-Private	53%	47%	-	29%	12%	13%	47%	-	-	-
Medicaid	57%	43%	1.16 (1.07, 1.25)	31%	13%	13%	43%	1.21 (1.10, 1.34)	1.30 (1.06, 1.60)	1.34 (1.11, 1.62)
All Non-Medicaid	45%	55%	-	26%	10%	10%	55%	-	-	-
Military	49%	50%	0.94 (0.84, 1.05)	25%	14%	10%	51%	0.88 (0.75, 1.03)	1.13 (0.84, 1.52)	0.86 (0.62, 1.21)
All Non-Military	49%	51%	-	28%	11%	11%	51%	-	-	-

* Prevalence ratio adjusted for mother's education, income to poverty ratio, race and ethnicity of teen, census region, and if the teen had an 11 or 12-year-old well check

† Percentages are weighted and may not equal 100%

Table 3. Adjusted prevalence ratio comparing the population of those who initiated HPV vaccination (any dose of vaccine) to those who did not initiate HPV vaccination (0 doses of vaccine), by insurance type. Private insurance is used as the exposure comparison group.

	1+ dose (%)	0 dose (%)	aPR* (95% CI)
Medicaid	64%	36%	1.08 (1.01, 1.17)
Military	53%	47%	0.87 (0.75, 1.01)
Medicaid + military	68%	32%	1.12 (0.95, 1.32)
None of the above	44%	56%	0.83 (0.73, 0.93)
Private	54%	46%	REF

* Prevalence ratio adjusted for mother's education, income to poverty ratio, race and ethnicity of teen, census region, and if the teen had an 11 or 12-year-old well check

Table 4. Adjusted prevalence ratio comparing dose-specific HPV vaccination (by 1, 2 and 3+ doses of vaccine) to those who have not initiated (0 doses) the HPV vaccine, by insurance type. Private insurance is used as the exposure comparison group.

	Medicaid aPR	Military aPR	Medicaid + Military	None of the following
1 Dose	1.25 (1.00, 1.56)	0.96 (0.63, 1.45)	0.81 (0.45, 1.43)	0.82 (0.58, 1.15)
2 Doses	1.12 (0.96, 1.47)	1.00 (0.68, 1.49)	1.57 (0.98, 2.53)	0.77 (0.55, 1.08)
3 Doses	1.09 (0.99, 1.21)	0.76 (0.62, 0.92)	1.16 (0.93, 1.45)	0.76 (0.64, 0.90)