



Published in final edited form as:

Soc Sci Med. 2018 March ; 200: 238–248. doi:10.1016/j.socscimed.2017.09.030.

Unequal interactions: Examining the role of patient-centered care in reducing inequitable diffusion of a medical innovation, the human papillomavirus (HPV) vaccine

Anny T. Fenton^{a,*}, Marc N. Elliott^b, David C. Schwebel^c, Zahava Berkowitz^d, Nicole C. Liddon^e, Susan R. Tortolero^f, Paula M. Cuccaro^f, Suzy L. Davies^g, and Mark A. Schuster^{h,i}

^aDepartment of Sociology, Harvard University, 33 Kirkland Street, Cambridge, MA 02138, USA

^b1776 Main Street, RAND Corporation, Santa Monica, CA 90401, USA

^cDepartment of Psychology, University of Alabama at Birmingham, Campbell Hall 415, 1530 3rd Avenue South, Birmingham, AL 35294, USA

^dDivision of Cancer Prevention and Control, Epidemiology and Applied Research Branch, CDC, 1600 Clifton Road Atlanta, GA 30329, USA

^eDivision of Adolescent and School Health, CDC, 1600 Clifton Road Atlanta, GA 30329, USA

^fDepartment of Health Promotion and Behavioral Sciences, University of Texas School of Public Health, 1200 Pressler Street, Houston, TX 77030, USA

^gDepartment of Health Behavior, UAB Center for the Study of Community Health, 1665 University Boulevard, Birmingham, AL 35294, USA

^hDivision of General Pediatrics, Boston Children's Hospital and Department of Pediatrics, Harvard Medical School, Enders, 300 Longwood Avenue, Boston, MA 02115, USA

ⁱKaiser Permanente School of Medicine, 100 South Los Robles Avenue, Pasadena, CA 91106, USA

Abstract

Rationale: Studies of inequities in diffusion of medical innovations rarely consider the role of patient-centered care.

Objective: We used uptake of the human papillomavirus (HPV) vaccine shortly after its licensing to explore the role of patient-centered care.

Methods: Using a longitudinal multi-site survey of US parents and adolescents, we assessed whether patient-centered care ratings might shape racial/ethnic and socioeconomic gaps at two decision points in the HPV vaccination process: (1) Whether a medical provider recommends the vaccine and (2) whether a parent decides to vaccinate.

*Corresponding author. William James Hall, 574, 33 Kirkland Street, Cambridge, MA 02138, USA. afenton@fas.harvard.edu, (A.T. Fenton).

Disclaimer

The findings and conclusions are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Results: We did not find evidence that the association of patient-centeredness with vaccination varies by parent education. In contrast, parent ratings of providers' patient-centeredness were significantly associated with racial/ethnic disparities in parents' reports of receiving a HPV vaccine recommendation from a provider: Among parents who rate patient-centered care as low, white parents' odds of receiving such a recommendation are 2.6 times higher than black parents' odds, but the racial/ethnic gap nearly disappears when parents report high patient-centeredness. Moderated mediation analyses suggest that patient-centeredness is a major contributor underlying vaccination uptake disparities: Among parents who report low patient-centeredness, white parents' odds of vaccinating their child are 8.1 times higher than black parents' odds, while both groups are equally likely to vaccinate when patient-centeredness is high.

Conclusion: The results indicate that patient-centered care, which has been a relatively understudied factor in the unequal diffusion of medical innovations, deserves more attention. Efforts to raise HPV vaccination rates should explore why certain patient groups may be less likely to receive recommendations and should support providers to consistently inform all patient groups about vaccination.

Keywords

Medical innovations; Diffusion; Healthcare disparities; Patient-centered care; Race/ethnicity; US; Human papillomavirus (HPV); Vaccine

1. Introduction

Social, economic, and behavioral risk factors have long been linked to racial/ethnic and socioeconomic status (SES) disparities in healthcare and health outcomes (Berkman et al., 2014; Phelan and Link, 2005). The uptake of new and innovative medical technologies contributes to these disparities. Research indicates that racial/ethnic and SES disparities in health increase after medical innovations because racial/ethnic minorities and persons with low SES are less likely to have access to these innovations (Chang and Lauderdale, 2009; Ferris et al., 2006; Glied and Lleras-muney, 2008; Wang et al., 2012).

Fundamental cause theory, which emphasizes individuals' agency or ability to access a medical innovation, is a primary explanation for disadvantaged groups' and racial/ethnic minorities' low uptake rates of health innovations (Mackenbach, 2012). Fundamental cause theory's attention to individuals' resources, though, leads to less focus on how medical professionals and their interaction with patients may shape diffusion inequities. By examining odds of HPV vaccine initiation and medical providers' recommending the HPV vaccine shortly after the vaccine's 2006 US release, we assess whether patient-centered care (PCC) contributed to racial/ethnic and SES gaps at different stages of vaccine uptake. Using a three-site longitudinal survey of 5,147 adolescents and their parents, we examine whether PCC affects inequities at two decision-making points in a medical technology's adoption: (1) Whether a medical provider recommends the technology and (2) whether a patient/caregiver chooses to adopt it.

2. Background and theoretical motivation

2.1. Fundamental cause theory and medical innovation diffusion

Fundamental cause theory focuses on individuals' agency to be aware and take advantage of new medical information and innovations to mitigate health risks and improve and maintain health. One's ability to adopt new practices is a function of flexible resources e knowledge, money, power, prestige, and beneficial social connections e that typically vary by race/ethnicity and SES (Link and Phelan, 1995). Consequently, many studies use fundamental cause theory to explain why more advantaged groups are first to adopt new health behaviors or medical procedures (Hernandez, 2013; Korda et al., 2011; Link, 2008) and why SES and racial/ethnic health disparities grow after drug and other treatment advances (Chang and Lauderdale, 2009; Glied and Lleras-muney, 2008).

Theoretical emphasis on patient resources has led researchers to focus on factors that shape access to and awareness of medical innovations prior to clinical interactions. These studies typically investigate individuals' knowledge, attitudes, and understanding regarding the innovation (Link, 2008; Polonijo and Carpiano, 2013) and examine racism and stigma as mediating factors that affect SES, segregation, and psychological stress, which then shape health outcomes (Hatzenbuehler et al., 2013; Phelan and Link, 2015). Thus, studies of inequities in diffusion of new medical technologies have paid less attention to other actors' agency, for instance, the role of healthcare professionals and their interactions with patients. For exceptions, see Freese and Lutfey's (2011) discussion of fundamental causes' effects at an institutional level and Hernandez's (2013) study of how routine provider recommendations were associated with reduced SES disparities in use of prenatal supplements. Additionally, it is difficult to measure when individuals' resources are leveraged, so researchers rely on racial/ethnic and SES disparities (and their trends) as evidence that fundamental causes are at play, which obscures potential causal pathways (Mackenbach, 2012; Miech et al., 2011). Consequently, we focus on Freese and Lutfey's (2011) "metamechanism" concept, which refers to mechanisms that link disadvantaged groups and health outcomes. We explore PCC as a potential metamechanism through which healthcare professionals shape inequities in the adoption of medical innovations.

2.2. Patient-centered care

The relationship between medical provider and patient has received much attention since Talcott Parsons' (1951) initial investigations. Parsons theorized that typical patient-provider relations consisted of a paternalistic and authoritative doctor role and a complementary "sick" patient disavowed of responsibilities other than the desire to get well and obligation to follow doctor recommendations. Conceptions of effective patient-provider care have changed over time due to governmental policy emphasizing patient-centeredness, patients' increased access to information, medical reforms that empowered patients, and the pharmaceutical industry's emphasis on consumerism (Conrad and Leiter, 2004). Researchers have argued that these changes have led to a drastic shift from the traditional roles theorized by Parsons (Boyer and Lutfey, 2014; Heritage and Maynard, 2011), fostering a more patient-centered model that emphasizes power-sharing. While perspectives on how providers should facilitate patient-centeredness vary (Roter and McNeilis, 2003), core tenets center on

providers showing support and respect for patients during medical visits, facilitating patients' participation in decision-making, and providing information (Epstein et al., 2005; Schuster, 2015; Street et al., 2007).

Many studies find that PCC differs by race/ethnicity and SES. On average, providers are less patient-centered when interacting with racial/ethnic minorities: providers spend less time and communicate less with minority patients than white patients (Cooper et al., 2003; Stivers and Majid, 2007), express less warmth (Hausmann et al., 2012), offer less information (Gordon et al., 2006), are perceived as less respectful (Blanchard and Lurie, 2004), and are more verbally dominant (Johnson et al., 2004). Similar patterns are found for SES differences (Fiscella et al., 2002; Toomey et al., 2016). Patient behavior may also differ during visits: Some studies have found that, on average, racial/ethnic minorities and people with low SES participate less and express less warmth in visits compared to whites and higher SES persons (Gordon et al., 2006; Johnson et al., 2004), possibly due to discomfort or prior negative health-care experiences.

Others have similarly focused on how providers' interactions with patients may differ by patients' "cultural health capital." This type of capital is rooted in Bourdieu's (1977) theoretical construct of cultural capital whereby cultural skills, practices, and products such as style of speech, dress, eating habits, and scientific knowledge are non-financial forms of capital that connote levels of prestige and class membership. Cultural health capital focuses on cultural capital that is valuable to the medical encounter such as medical knowledge and terminology and the capabilities to convey medically relevant knowledge, change interactional styles, and convey self-discipline (Shim, 2010). Like cultural capital, valued cultural health capital is associated with high SES. Therefore, high SES patients may navigate the medical system more effectively and thus achieve better health outcomes than low SES patients. Many studies find that providers have higher PCC with patients with greater communication skills and health literacy, traits central to cultural health capital and associated with higher SES (Dubbin et al., 2013; Street et al., 2007). Providers may therefore engage more easily with and form more favorable opinions of patients with high cultural health capital, fostering better interactions and care.

Racial/ethnic and SES disparities in PCC suggest a potential metamechanism through which fundamental causes contribute to health inequities. The difference in access to high patient-centeredness is problematic because it has been linked to higher-quality medical care and improved health outcomes: Patient-centered interactions are associated with higher levels of patient understanding, trust in physicians, adherence (Beach et al., 2006; Blanchard and Lurie, 2004; Fiscella et al., 2004), treatment decision-making (see Arora (2003) for a review), emotional health (Heyland et al., 2006; Ong et al., 2000), reduced symptoms (Little et al., 2001), and more effective medical follow-up by providers (Epstein et al., 2005; Stewart et al., 2000). We therefore expect disparities in PCC to be linked to HPV vaccination.

2.3. HPV vaccine as an empirical case

The following study tests whether PCC contributes to racial/ ethnic and education disparities in a medical technology's diffusion. We use the HPV vaccine as an empirical case for

several reasons. First, it is a medical innovation because it is the first vaccine to prevent HPV-related cancers. Second, the vaccine's widespread availability and eligibility lets us explore a medical innovation's broad adoption. In 2007, the CDC recommended that all 11-year-old females initiate the three-dose HPV vaccine series and that the vaccine could be given from the ages of 9 to 26. The federal Vaccines for Children Program also began covering the HPV vaccine's cost for uninsured children. Third, adoption is measurable as whether a dose was received. Fourth, a medical innovation's uptake has several phases. The HPV vaccine allows us to explore inequities at two key decision points that we expect PCC to affect: (1) Whether a provider recommends the vaccine and (2) whether a child is vaccinated.

We believe our study can help illuminate underlying causes of disparities since our data capture information about the medical visit experience that could affect the uptake of medical innovations. Researchers are often unable to explore potential sources of disparities in uptake because they lack pertinent data. Consequently, these studies rely on disparities' presence as evidence of fundamental causes. For instance, by separating the vaccination process into several stages, Polonijo and Carpiano (2013) find evidence that fundamental causes contribute to disparities since minority and low SES parents are less likely to be aware of the HPV vaccine. However, while they theorized that fundamental causes contributed to disparities in provider vaccine recommendations and vaccination, they could not investigate these inequities' potential sources because the study's dataset, National Immunization Survey of Teens (NIS-Teen), has limited general medical visit and health-care access data.

We build on Polonijo and Carpiano's (2013) findings by assessing PCC's role in HPV vaccine decision-making using the Healthy Passages survey, which includes parents' reports of interactions with their child's medical provider. We hypothesized that PCC is associated with parents' odds of receiving a provider recommendation and of vaccinating, but that effects differ by race/ethnicity and education. Based on provider bias studies, we hypothesize that gaps between whites and minorities decline as PCC improves since meaningful interactions are theorized to reduce bias (Allport, 1979). Based on the cultural health capital literature, we expected parents' odds of receiving a provider recommendation and vaccinating to improve as PCC increases regardless of educational attainment. However, because more educated parents have higher levels of cultural health capital than less educated parents, we expect PCC's effect would be greater for more educated parents.

3. Method

This study uses Healthy Passages, a longitudinal survey about adolescent health-related behaviors that followed 5,147 students from fifth to tenth-grade and their primary caregivers from three metropolitan areas: Birmingham, Alabama, Los Angeles, California, and Houston, Texas. Fifth-grade data were collected from August 2004eSeptember 2006 (Wave 1), with follow-up two and five years later in seventh-grade and tenth-grade, respectively (Waves 2 and 3). For more information about Healthy Passages, see Schuster et al. (2012) and Windle et al. (2004).

Students and their parents were selected using a 2-stage probability sampling procedure, which sampled schools first. Schools' probability of selection was weighted based on size and minority population relative to racial/ethnic targets. In the second stage, all fifth-graders enrolled in public schools with fifth-grade class enrollments of at least 25 students were recruited. Among 11,532 students in the sampled schools, parents of 6663 children (58%) consented. Ultimately, 5,147 (77%) children and their parent participated in the study. Each parent-child dyad completed computer-assisted personal interviews and audio-computer-assisted self-interviews (for sensitive questions) in English or Spanish.

3.1. Dependent variables

3.1.1. Provider recommendation—Measured in Wave 3, parents indicated whether their child's healthcare provider recommended the HPV vaccine (coded "No" = 0; "Had not seen doctor since vaccine licensing" = 0 (less than 1%); "Yes" = 1). While studies find parents accurately recall HPV vaccination at a higher rate than other vaccines (over 95%) (Dorell et al., 2011) and recall ability does not differ by race/ethnicity or SES (Apte et al., 2015), no known study tests whether parents accurately report receiving a provider vaccine recommendation or whether patient characteristics affect recall. Therefore, studies of HPV vaccine recommendations have relied on parent surveys (Allen et al., 2010; Darden et al., 2013; Polonijo and Carpiano, 2013; Reiter et al., 2009).

Studies have validated patient recall as measures of visit components such as prescribing, procedures, and counseling (Brown and Adams, 1992; DiMatteo et al., 2003; Mangione-Smith et al., 2015). Additionally, studies find no racial/ethnic or SES differences in patients' ability to accurately recall visit communications comparable to a provider recommendation such as counseling, health discussions, and diagnosis (Flocke and Stange, 2004; Sciamanna et al., 2004). Furthermore, studies find patient recall more accurate than medical records (Shaikh et al., 2012; Stange et al., 1998). Additionally, studies of parent ability to recall healthcare experiences such as medications, number of healthcare visits, and illness demonstrated high accuracy and no differences by background (Kuriyan et al., 2014; Minkovitz and Strobino, 2005)

3.1.2. Adolescents' HPV vaccination status—Measured in Waves 2 and 3, parents could answer if their child received all three, one to two, or no shots. Parents' responses are categorized as "The adolescent receiving at least one dose of the HPV vaccine as of Wave 3" = 1 or "No doses" = 0.

3.2. Independent variables

3.2.1. Patient-centered care—Measured as parents' Wave 3 ratings of how often their child's provider spends enough time with the child, listens to the parent, respects their family's values, gives the parent wanted information, and treats the parent like a partner. Parents could respond 'Never,' 'Sometimes,' 'Usually,' or 'Always.'

We used principal component analysis to create a single component that explained 67% of the variance among the five items, suggesting that the measures primarily assess a single construct. Higher scores indicate better parent ratings and thus higher PCC. The component

is standardized so mean score equals zero and a one-unit change indicates a one standard deviation change in PCC.

Prior studies validate the use of patient reports of PCC based on comparison to third-party observations of provider behavior (see O’Keefe for a review of parent reports (2001) and “Patients Assessment of Their Care” (1988) for a review of patient reports) and find no racial/ethnic or SES differences in how patients assess PCC (Cooper et al., 2003; Fiscella et al., 2004; Weinick et al., 2011).

3.2.2. Race/ethnicity—Measured for parents as Hispanic, non-Hispanic white, non-Hispanic black, and non-Hispanic other. Other category includes Asians, American Indian/Alaska Native, Native Hawaiian/Pacific Islander, multiracial responses, and a write-in category.

3.2.3. Education—We dichotomized education as less than a high school degree versus at least high school degree because we hypothesized that parents without a high school degree might have different healthcare experiences compared to more educated parents. We created and tested several other education cutoffs, but found no differences in effect direction or significance (see online appendices). To test whether household income had an effect size in addition to parent’s education, we created a component term whereby each observation was assigned the difference between their income and their education level’s mean income. We found no difference (analyses not shown).

3.3. Control variables

We controlled for healthcare access, quality, and knowledge, important mechanisms that fundamental cause theory argues produce SES and race/ethnicity diffusion disparities. These included whether a child has health insurance including Medicaid, has a personal doctor, or received healthcare in the past year, and the place of care (“Doctor’s office/Hospital outpatient department” = 0, “Other” = 1). To gauge parents’ HPV vaccine knowledge and awareness, we controlled for parent’s Wave 2 vaccination intentions (Not likely at all/Not too likely = 0, Somewhat likely/Very likely = 1).

If providers and parents are uncomfortable discussing sex or do not believe the child is sexually active, they may be less likely to recommend the vaccine or to vaccinate (Gilkey et al., 2015). Therefore, we measured adolescents’ communications about sex with parents and providers. These included adolescents’ reports of whether their doctor discussed contraception, parents told them about sex (At least once = 1, Never 0) or to wait until marriage for sex (Never = 0, At least once 1), and closeness to parent (Not at all/Very little/Somewhat = 0, Quite a bit/Very much = 1).

Since older teens are eligible for vaccination for a longer period, we dichotomized adolescents’ age in seventh grade (10–12 years = 0; 13–15 years = 1). Sexual activity is measured prior to seventh grade (No sexual activity = 0, Kissing/Touching/Oral and genital sex = 1). We categorized sexual activity in several ways, but effect sizes did not differ (analyses not shown).

Because providers believe that time constraints limit opportunity to discuss the HPV vaccine (Perkins et al., 2014), we controlled for child health, a potential proxy for additional time providers need to discuss other health matters. Parents' Wave 3 responses "Excellent," "Very good," and "Good" are categorized as 'no serious health issues' = 0 and "Fair" and "Poor" as 'serious health issues' = 1. Parents' demographic characteristics included age, marital status, employment status, US born, and place of residence.

We controlled for place of residence because vaccine controversies that may shape the vaccination process vary by region. For instance, the anti-vaccine movement is strong in southern California (Gottlieb, 2010). Similarly, Texas Governor Perry issued an executive mandate in February 2007 that adolescent girls receive the HPV vaccine. The mandate was quickly overridden in April 2007 before implementation. However, the controversy (Colgrove, 2010) may have affected providers' and parents' vaccination choices in Houston during Healthy Passages' Wave 2 data collection (August 2006-September 2008).

3.4. Model samples

Our study is based on 2,190 girls and their parents who participated in all three waves and answered at least one question about HPV vaccination or about receiving a provider recommendation (84% of girls who completed the baseline survey and 99.9% of girls who completed all three waves). Boys were omitted because the HPV vaccine was not recommended for males until 2011, after the completion of Waves 1 and 2. Because 213 cases (9.7%) were missing one or more variables, we used Stata 14's 'mi' multiple imputation procedure to impute ten datasets for independent variables. There was no systematic non-response: No variable was missing in more than 4% of cases. We did not impute values for provider recommendation since it is a dependent variable.

We estimated two model sets. Model Set 1 tests whether PCC is associated with racial/ethnic and educational differences in parents' odds of receiving a HPV vaccine recommendation ($N = 1,384$). Model Set 2 tests whether provider recommendations are associated with racial/ethnic and educational differences in vaccination odds ($N = 1,778$). Model Set 1 is a subsample of Model Set 2 because Model Set 1 only estimates provider recommendation in Wave 3 since PCC is only measured in Wave 3.

3.5. Statistical analyses

We used logistic regression to estimate both model sets. Only variables of interest are reported. Full model results are available in online supplementary materials. We report log-odds with a p -value of 0.05 or less as statistically significant. We used Stata's 'svy' command to account for the complex survey design.

To test whether differences in PCC have an indirect association with vaccination odds that is mediated by a provider vaccine recommendation, we used moderated mediation analysis (see Fig. 1). Moderated mediation tests whether X indirectly affects Y through some mediator variable (M), allowing the indirect effect to vary by some moderator variable (W). In our case, race/ethnicity = X, parents' receipt of a provider recommendation = M, adolescents' vaccination odds = Y, and PCC=W. Based on results, we only test racial/ethnic differences in PCC.

To estimate indirect associations, we estimated a structural equation model (SEM) with logistic regression models 1.3 and 2.4. Because a SEM uses a single sample and Stata's 'sem' procedure does not support the 'mi' procedure, we used Model Set 1's non-imputed sample ($N = 1263$). To account for missing data, we estimated the SEM using full information maximum likelihood (Allison, 2003). To estimate standard errors, we used bootstrapping techniques ($b = 500$).

4. Results

Non-imputed Wave 3 vaccination and HPV vaccine provider recommendation frequencies were comparable to CDC's 2009 NIS-Teen's rates (National Center for Immunization and Respiratory Diseases, 2010). Note that NIS-Teen uses Census poverty thresholds for SES while we used parent education. Sample vaccination rates are similar to NIS-Teen's Houston and Los Angeles rates overall and by education/poverty threshold and race/ethnicity where available. We used Alabama rates since Birmingham rates were unavailable. The sample's Birmingham white and higher education vaccination rates are higher than NIS-Teen's Alabama rate. Nationally, the sample's vaccination rates for whites and more educated families were significantly higher than NIS-Teen's rates. White vaccination rates were greater than black and Asian/other while the NIS-Teen rates do not differ by race/ethnicity. Our sample showed no significant differences in vaccination rates by parental education while, in the NIS-Teen, vaccination rates of impoverished adolescents were greater than those living above poverty. NIS-Teen did not publish recommendation rates by locale or by race/ethnicity. The sample's HPV recommendation rate (63%) is greater than NIS-Teen's national rate (55%) (Darden et al., 2013).

Beyond comparing parent education to poverty threshold, dissimilarities may be due to age differences: Published NIS-Teen rates are calculated for 13 to 17-year-olds while 92% of Healthy Passages adolescents are 15 to 16-year-olds in Wave 3. Additionally, our data drew on metro areas while the NIS-Teen also captures rural areas.

Table 1 presents descriptive statistics by model set including imputed data. In both subsamples, most adolescents had health insurance, a personal provider, routinely visited a provider, spoke with their parents about sex, and had good to excellent health. Most parents had at least a high-school education, were married/ cohabiting, and were employed. Standardized PCC ranged from 3.42 to 1.73.

Table 2, based on the total sample, reveals large significant differences in PCC by racial/ethnic and educational groups. On average, Hispanic parents and less educated parents rated providers lowest. White parents, on average, rated providers highest. Differences between Hispanic and white parents (0.81 *SD*) are considered a large effect size (Cohen, 1992).

4.1. Provider recommendation

Model 1.1 in Table 3 estimates racial/ethnic and educational gaps in parents' odds of receiving a HPV vaccine recommendation. Black parents had significantly lower odds of receiving a recommendation than whites, and less educated parents had significantly lower odds than more educated parents.

Controlling for all variables except PCC in model 1.2, among healthcare access and knowledge variables, annual routine healthcare visits, having a personal doctor, and parent's vaccination intentions were significantly positively associated with recommendation odds.

Model 1.3 included the interactions of PCC with race/ethnicity and with education. There is a positive association between PCC and recommendation odds among non-white parents. As shown in Fig. 2, the racial/ethnic gaps were largest when PCC was low. Racial/ethnic gaps decreased as PCC increased; white parents' odds of receiving a recommendation decreased while non-white parents' odds increased. The interaction between PCC and education was not significant. There were no substantive changes in healthcare access and knowledge variables' associations from model 1.2.

4.2. HPV vaccination uptake wave 3

In models 2.1 through 2.4, we estimated Wave 3 vaccination odds. In model 2.1, white children's vaccination odds are higher than black and Asian/other children's, but not significantly greater than Hispanics'. More educated parents' children have 1.5 times greater vaccination odds than less educated parents' children. In model 2.2, after controlling for all variables except PCC and provider recommendation, only black children's vaccination odds were significantly lower than whites'. Among healthcare access and knowledge variables, health insurance, healthcare visits in the last year, having a personal doctor, and parent vaccination intention had significant associations with vaccination odds. In model 2.3, we found no racial/ethnic or educational differences in the association between PCC and vaccination odds. Other variables' significance did not change from model 2.2.

Because studies indicate that a provider recommendation has the largest positive effect on a child's HPV vaccination odds (Darden et al., 2013; Reiter et al., 2009), we controlled for provider recommendation in our last model, 2.4, to avoid masking other effects. We found a large effect size: Education and the black-white gaps disappear and many other controls become non-significant. Among healthcare access and knowledge variables, only receiving care routinely and parental vaccination intention remain significant. Receiving a provider recommendation is so highly related to disparities in parents' odds of vaccinating that, when we only controlled for receiving a recommendation, education, and race/ethnicity, the racial/ethnic and educational gaps disappeared (analyses not shown).

4.3. Moderated mediation

Table 4 indicates that black children have significantly lower vaccination odds compared to whites when PCC is at its mean or below, while Asian/other children's odds are higher when PCC is one standard deviation above the mean. The conditional indirect effect when PCC is low accounts for a large proportion of the combined total effect of race/ethnicity on black children's vaccination odds; when PCC is low, race/ethnicity's indirect effect on vaccination odds accounts for 75% of black children's total effects.

To estimate the indirect effects of PCC racial/ethnic differences on minority versus white adolescents' vaccination odds, we use covariate-adjusted probabilities ("recycled predictions") (Graubard and Korn, 1999). Using parents' predicted probability of receiving a recommendation from model 1.3 (shown in Fig. 2), we calculated an adolescent's predicted

probability of vaccine initiation given their parents' odds of receiving a provider recommendation. As shown in Fig. 3, racial/ethnic disparities in adolescents' vaccination odds nearly disappear when PCC is high. Since white parents' predicted probability of receiving a recommendation is higher than black parents', when parents report low PCC (0.89 vs. 0.34), white adolescents' predicted probability of vaccination is 8.1 times higher than blacks' (0.67 vs. 0.08). When PCC is high and parents' odds of receiving a recommendation regardless of race/ethnicity are nearly equivalent, racial/ethnic gaps in vaccination odds are not significant.

5. Discussion

Prior studies focus on identifying racial/ethnic and SES disparities in the diffusion of new medical technologies (Chang and Lauderdale, 2009; Glied and Lleras-muney, 2008; Polonijo and Carpiano, 2013; Wang et al., 2012). Our study builds on this research by investigating potential mechanisms that contribute to disparities. In addition to mechanisms that fundamental cause theory argues shape individuals' access to resources, our results suggest that providers' ability to interact effectively with patients may affect racial/ethnic inequities in the adoption of medical innovations. Racial/ethnic differences in PCC were directly or indirectly associated with HPV vaccine recommendations and decisions. Minority parents reported lower PCC compared to whites. This is problematic since, when PCC is low, minority parents were less likely than whites to receive a HPV vaccine recommendation. Similarly, the moderated mediation results suggest that, when PCC is low, race/ethnicity has an outsized, indirect effect on black children's vaccination odds. This suggests that black children's vaccination odds are significantly lower than whites' if their parent does not receive a provider recommendation. These disparities are particularly concerning for adolescent girls given that black and Hispanic women are more likely than whites to develop and die of cervical cancer (Siegel et al., 2012).

While our results suggest that providers may be more likely to recommend vaccination to more educated parents, PCC's impact on HPV vaccine recommendations and decisions may not vary by parents' education. This latter finding was unexpected, given cultural health capital and patient-centeredness research findings that lower SES persons have worse care experiences (Dubbin et al., 2013; Street et al., 2007). Our results suggest that, while improving PCC among less educated persons could reduce SES disparities in the adoption of medical innovations, other factors not revealed by these analyses must also be addressed.

Lastly, like most HPV vaccine uptake studies, we find evidence that receiving a vaccine recommendation from a provider is central to parents' vaccination decisions (Darden et al., 2013; Reiter et al., 2009); controlling for receiving a recommendation alone eliminates racial/ethnic and SES gaps in vaccination odds.

5.1. Limitations

There are several potential limitations to our results. First, we use parents' reports of provider HPV vaccine recommendations and PCC, which may not reflect actual visit interactions. Studies validate patient reports of providers' recommendations and patient-centeredness as measures (Brown and Adams, 1992; DiMatteo et al., 2003; Mangione-Smith

et al., 2015) and indicate that race/ ethnicity and SES do not differentially shape how patients recall simple recommendations or evaluate providers (Cooper et al., 2003; Fiscella et al., 2004; Flocke and Stange, 2004; Weinick et al., 2011). Additionally, PCC and provider recommendations have little utility if they are not recognized by the patient, thus we argue for valuing patient reports (Beckett et al., 2009). Readers should interpret this study's findings as based on parents' experiences. Alleviating disparities may therefore require improving provider behavior in ways that all patients can recognize.

Additionally, while we expected cultural health capital to contribute to education differences in PCC's effect on provider recommendation and vaccination odds, our results suggest PCC's effect does not vary by education (see online appendices for results for alternative parameterizations of education). Controlling for income may have revealed alternate results, however, several studies find education is more predictive of health than income (Herd et al., 2016).

Second, we can only hypothesize potential explanations for racial/ethnic gaps in recommendation odds when PCC is low. Regarding patient factors, since black children often have worse health than white children (Mulye et al., 2009), they may have more complex health visits, potentially reducing time for providers to recommend the HPV vaccine. We attempt to mitigate this factor by controlling for parents' rating of child's health. Regarding providers, the results pattern suggests provider biases may contribute to recommendation odds disparities. White parents' recommendation odds are highest when they rated PCC low while minority parents' odds are lowest, suggesting preferential treatment of whites. If white parents' odds remained stable or increased as PCC ratings improved, high PCC could potentially ease cultural differences or be a proxy for better care. Similarly, if high PCC was significantly associated with increased recommendation odds for more educated parents, we could point to cultural health capital differences like parents' abilities to communicate with, navigate, and negotiate the medical system (Shim, 2010). Many studies investigating providers' bias and visit behaviors find similar patterns (Dovidio et al., 2002; Hagiwara et al., 2013). Again, we cannot assess these explanations without data on how providers engage with minority versus white patients. Similarly, while literature suggests that authoritative vaccine recommendation styles lead to higher vaccination odds than more patient-centered styles (Brewer et al., 2016; Opel et al., 2012), our data cannot speak to this question.

Lastly, our data drew on public schools in three metropolitan areas. Consequently, our sample has higher percentages of people who have minority backgrounds, are unemployed, and have lower educational attainment compared to national averages. Therefore, our findings may differ from national patterns.

6. Conclusion

If the patterns identified here apply to adoption of other medical innovations, educational efforts related to patient-centeredness should focus on educating providers regarding how influential discretionary recommendations and styles (Moss et al., 2016) may vary by patients' race/ethnicity. Cultural competency interventions have experienced success training

medical professionals to engage effectively with minority and disadvantaged patients (Lie et al., 2011). Finally, social sciences' focus on fundamental causes encourages support for programs that increase access to healthcare by improving individuals' knowledge, money, power, networks, and status. Our findings indicate that these improvements are important but insufficient. Future research should explore how medical professionals decide to recommend medical innovations to patients and if these decisions vary by race/ethnicity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We thank the Healthy Passages team, staff, and participants for making the study possible. We thank Ari Coopersmith for his assistance with the manuscript.

Appendix A.: Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.socscimed.2017.09.030>.

References

- Allen JD, Othus MKD, Shelton RC, Li Y, Norman N, Tom L, del Carmen MG, 2010 Parental decision making about the HPV vaccine. *Canc. Epidemiol. Bio-markers Prev* 19, 2187–2198.
- Allison PD, 2003 Missing data techniques for structural equation modeling. *J. Abnorm. Psychol. J. Abnorm. Psychol* 112, 545. [PubMed: 14674868]
- Allport GW, 1979 *The Nature of Prejudice* Basic Books.
- Apte G, Pierre-Joseph N, Vercruyse JL, Perkins RB, 2015 Could poor parental recall of HPV vaccination contribute to low vaccination rates? *Clin. Pediatr. (Phila)* 54, 987–991. [PubMed: 26045587]
- Arora NK, 2003 Interacting with cancer patients: the significance of physicians' communication behavior. *Soc. Sci. Med* 57, 791–806. [PubMed: 12850107]
- Beach MC, Keruly J, Moore RD, 2006 Is the quality of the patient-provider relationship associated with better adherence and health outcomes for patients with HIV? *J. Gen. Intern. Med* 21, 661–665. [PubMed: 16808754]
- Beckett MK, Elliott MN, Richardson A, Mangione-Smith R, 2009 Outpatient satisfaction: the role of nominal versus perceived communication. *Health Serv. Res* 44, 1735–1749. [PubMed: 19656231]
- Berkman LF, Kawachi I, Glymour M, 2014 *Social Epidemiology* Oxford University Press.
- Blanchard J, Lurie N, 2004 R-E-S-P-E-C-T: patient reports of disrespect in health care setting and its impact on care. *J. Fam. Pract* 53.
- Bourdieu P, 1977 *Outline of a Theory of Practice* Cambridge University Press.
- Boyer CA, Lutfey KE, 2014 Examining critical health policy issues within and beyond the Clinical Encounter: patient-provider relationships and help-seeking Behaviors. *J. Health Soc. Behav* 51.
- Brewer NT, Hall ME, Malo TL, Gilkey MB, Quinn B, Lathren C, 2016 Announcements versus conversations to improve HPV vaccination coverage: a randomized trial. *Pediatrics* 139.
- Brown JB, Adams ME, 1992 Patients as reliable reporters of medical care process: recall of ambulatory encounter events. *Med. Care* 30, 400–411. [PubMed: 1583918]
- Chang VW, Lauderdale DS, 2009 Fundamental cause theory, technological innovation, and health disparities: the case of cholesterol in the era of statins. *J. Health Soc. Behav* 50, 245–260. [PubMed: 19711804]

- Cohen J, 1992 A power primer. *Psychol. Bull* 112, 155e159.
- Colgrove J, 2010 The Coercive Hand, the Beneficent Hand, in: *Three Shots at Prevention: the HPV Vaccine and the Politics of Medicine's Simple Solutions*, pp. 2–20.
- Conrad P, Leiter V, 2004 Medicalization, markets and consumers. *J. Health Soc. Behav* 158–176. [PubMed: 15779472]
- Cooper LA, Roter DL, Johnson RL, Ford DE, Steinwachs DM, Powe NR, 2003 Patient-centered communication, ratings of care, and concordance of patient and physician race. *Ann. Intern. Med* 139, 907–915+I34. [PubMed: 14644893]
- Darden PM, Thompson DM, Roberts JR, Hale JJ, Pope C, Naifeh M, Jacobson RM, 2013 Reasons for not vaccinating adolescents: national immunization survey of teens, 2008e2010. *Pediatrics* 131, 645–651. [PubMed: 23509163]
- DiMatteo MR, Robinson JD, Heritage J, Tabbarah M, Tabbarah M, Fox SA, 2003 Correspondence among patients' self-reports, chart records, and audio/ videotapes of medical visits. *Health Commun* 15, 393–413. 10.1207/S15327027HC1504_02. [PubMed: 14527865]
- Dorell CG, Jain N, Yankey D, 2011 Validity of parent-reported vaccination status for adolescents aged 13–17 years: national Immunization Survey-Teen, 2008. *Public Health Rep* 126, 60.
- Dovidio JF, Kawakami K, Gaertner SL, 2002 Implicit and explicit prejudice and interracial interaction. *J. Pers. Soc. Psychol* 82, 62–68. [PubMed: 11811635]
- Dubbin LA, Chang JS, Shim JK, 2013 Cultural health capital and the interactional dynamics of patient-centered care. *Soc. Sci. Med* 93, 1–16. [PubMed: 23906115]
- Epstein RM, Franks P, Shields CG, Meldrum SC, Miller KN, Campbell TL, Fiscella K, 2005 Patient-centered communication and diagnostic testing. *Ann. Fam. Med* 3, 415–421. [PubMed: 16189057]
- Ferris TG, Kuhlthau K, Ausiello J, Perrin J, Kahn R, 2006 Are minority children the last to benefit from a new Technology? Diffusion and inhaled corticosteroids for asthma technology. *Med. Care* 44, 81–86. [PubMed: 16365616]
- Fiscella K, Goodwin MA, Stange KC, 2002 Does patient educational level affect office visits to family physicians? *J. Natl. Med. Assoc* 94, 157–165. [PubMed: 11918385]
- Fiscella K, Meldrum S, Franks P, Shields CG, Duberstein P, McDaniel SH, Epstein RM, 2004 Patient trust: is it related to patient-centered behavior of primary care physicians? *Med. Care* 42, 1049–1055. [PubMed: 15586831]
- Flocke SA, Stange KC, 2004 Direct observation and patient recall of health behavior advice. *Prev. Med. (Baltim)* 38, 343–349.
- Freese J, Lutfey K, 2011 Fundamental causality: challenges of an animating concept for medical sociology. In: *Handbook of the Sociology of Health, Illness, and Healing* Springer, pp. 67–81.
- Gilkey MB, Moss JL, Coyne-Beasley T, Hall ME, Shah PD, Brewer NT, 2015 Physician communication about adolescent vaccination: how is human papillomavirus vaccine different? *Prev. Med. (Baltim)* 77, 181–185.
- Glied S, Lleras-muney A, 2008 Technological innovation and inequality in health. *Demography* 45, 741–761. [PubMed: 18939670]
- Gordon HS, Street RL, Sharf BF, Soucek J, 2006 Racial differences in doctors' information-giving and patients' participation. *Cancer* 107, 1313–1320. [PubMed: 16909424]
- Gottlieb SD, 2010 *Manufactured Uncertainty: the Human Papillomavirus (HPV) Vaccine and the Object Multiple* John Hopkins University.
- Graubard BI, Korn EL, 1999 Predictive margins with survey data. *Biometrics* 55, 652–659. [PubMed: 11318229]
- Hagiwara N, Penner LA, Gonzalez R, Eggly S, Dovidio JF, Gaertner SL, West T, Albrecht TL, 2013 Racial attitudes, physician-patient talk time ratio, and adherence in racially discordant medical interactions. *Soc. Sci. Med* 87, 123–131. [PubMed: 23631787]
- Hatzenbuehler ML, Phelan JC, Link BG, 2013 Stigma as a fundamental cause of population health inequalities. *Am. J. Public Health* 103, 813–821. [PubMed: 23488505]
- Hausmann LR, Hannon MJ, Kresevic DM, Hanusa BH, Kwok CK, Ibrahim SA, 2012 In: *Impact of Perceived Discrimination in Health Care on Patient- Provider Communication*, vol. 49, pp. 626–633.

- Herd P, Goesling B, House JS, Herd P, Goesling B, 2016 Socioeconomic position and health: the differential effects of education versus income on the onset versus progression of health problems. *J. Health Soc. Behav* 48, 223–238.
- Heritage J, Maynard DW, 2011 After 30 Years, Problems and Prospects in the Study of Doctorepatient Interaction, in: *Handbook of the Sociology of Health, Illness, and Healing* Springer, pp. 323–342.
- Hernandez EM, 2013 Provider and patient influences on the formation of socio-economic health behavior disparities among pregnant women. *Soc. Sci. Med* 18, 1199–1216.
- Heyland DK, Dodek P, Rocker G, Groll D, Gafni A, Pichora D, Shortt S, Tranmer J, Lazar N, Kutsogiannis J, Lam M, 2006 What matters most in end-of-life care: perceptions of seriously ill patients and their family members. *Cmaj* 174, 627–633. [PubMed: 16505458]
- Johnson RL, Roter D, Powe NR, Cooper LA, 2004 Patient race/ethnicity and quality of patient-physician communication during medical visits. *Am. J. Public Health* 94, 2084–2090. [PubMed: 15569958]
- Korda RJ, Clements MS, Dixon J, 2011 Socioeconomic inequalities in the diffusion of health technology: uptake of coronary procedures as an example. *Soc. Sci. Med* 72, 224–229. [PubMed: 21147510]
- Kuriyan AB, Pelham WE, Molina BSG, Waschbusch DA, Sibley MH, Gnagy EM, 2014 Concordance between parent and physician medication histories for children and adolescents with attention-deficit/hyperactivity disorder. *J. Child. Adolesc. Psychopharmacol* 24, 269–274. [PubMed: 24945086]
- Lie DA, Lee-Rey E, Gomez A, Bereksnyi S, Braddock CH, 2011 Does cultural competency training of health professionals improve patient outcomes? A systematic review and proposed algorithm for future research. *J. Gen. Intern. Med* 26, 317–325. [PubMed: 20953728]
- Link BG, 2008 Epidemiological sociology and the social shaping of population health. *J. Health Soc. Behav* 49, 367–384. [PubMed: 19181044]
- Link BG, Phelan J, 1995 Social conditions as fundamental causes of disease. *J. Health Soc. Behav* 80–94. [PubMed: 7560851]
- Little P, Everitt H, Williamson I, Warner G, Moore M, Gould C, Ferrier K, Payne S, 2001 Observational study of effect of patient centredness and positive approach on outcomes of general practice consultations. *Bmj* 323, 908–911. [PubMed: 11668137]
- Mackenbach JP, 2012 The persistence of health inequalities in modern welfare states: the explanation of a paradox. *Soc. Sci. Med* 75, 761–769. [PubMed: 22475407]
- Mangione-Smith RM, Zhou C, Robinson JD, Taylor JA, Elliott MN, 2015 Communication practices and antibiotic use for acute respiratory tract infections in children. *Ann. Fam. Med* 13, 221e228. 10.1370/afm.1785.
- Miech R, Pampel F, Kim J, Rogers RG, 2011 The enduring association between education and mortality: the role of widening and narrowing disparities. *Am. Sociol. Rev* 76, 913–934. [PubMed: 26937041]
- Minkovitz CS, Strobino DM, 2005 Validity of maternal report of acute health care use for children younger than 3 years. *Arch. Pediatr. Adolesc. Med* 159, 167–172. [PubMed: 15699311]
- Moss JL, Gilkey MB, Rimer BK, Brewer NT, 2016 Disparities in collaborative patient-provider communication about human papillomavirus (HPV) vaccination. *Hum. Vaccin Immunother* 12, 1476–1483. [PubMed: 26786888]
- Mulye TP, Park MJ, Nelson CD, Adams SH, Irwin CE, Brindis CD, 2009 Trends in adolescent and young adult health in the United States. *J. Adolesc. Heal* 45, 8–24.
- National Center for Immunization and Respiratory Diseases, 2010 2009 NIS-Teen Vaccination Coverage Table Data
- O’Keefe M, 2001 Should parents assess the interpersonal skills of doctors who treat their children? A literature review. *J. Paediatr. Child. Health* 37, 531–538. [PubMed: 11903829]
- Ong LML, Visser MRM, Lammes FB, De Haes JCJM, 2000 Doctor-patient communication and cancer patients’ quality of life and satisfaction. *Patient Educ. Couns* 41, 145–156. [PubMed: 12024540]
- Opel DJ, Robinson JD, Heritage J, Korfiatis C, Taylor JA, Mangione-Smith R, 2012 Characterizing providers’ immunization communication practices during health supervision visits with vaccine-hesitant parents: a pilot study. *Vaccine* 30, 1269–1275. [PubMed: 22230593]

- Parsons T, 1951 *The Social System*
- Patients Assessment of Their Care, 1988 *The quality of medical care: information for consumers*, pp. 231e250. Washington, DC.
- Perkins RB, Clark JA, Apte G, Vercruyse JL, Sumner JJ, Wall-Haas CL, Rosenquist AW, Pierre-Joseph N, 2014 Missed opportunities for HPV vaccination in adolescent girls: a qualitative study. *Pediatrics* 134 e666–e674. [PubMed: 25136036]
- Phelan JC, Link BG, 2015 Is racism a fundamental cause of inequalities in health? *Annu. Rev. Sociol* 41, 311–330.
- Phelan JC, Link BG, 2005 Controlling disease and creating disparities: a fundamental cause perspective. *J. Gerontol. B. Psychol. Sci. Soc. Sci* 60, 27–33. Spec No. [PubMed: 16251587]
- Polonijo AN, Carpiano RM, 2013 Social inequalities in adolescent human papillomavirus (HPV) vaccination: a test of fundamental cause theory. *Soc. Sci. Med* 82, 115–125. [PubMed: 23337830]
- Preacher KJ, Kelley K, 2011 Effect size measures for mediation models: quantitative strategies for communicating indirect effects. *Psychol. Methods* 16, 93–115. [PubMed: 21500915]
- Reiter PL, Brewer NT, Gottlieb SL, McRee AL, Smith JS, 2009 Parents' health beliefs and HPV vaccination of their adolescent daughters. *Soc. Sci. Med* 69, 475–480. [PubMed: 19540642]
- Roter D, McNeilis KS, 2003 The nature of the therapeutic relationship and the assessment of its discourse in routine medical visits. *Handb. Heal. Commun* 121–140.
- Schuster MA, 2015 Pediatric clinicians and parents: working together for the benefit of the child. *Acad. Pediatr* 15, 469–473. [PubMed: 26189584]
- Schuster MA, Elliott MN, Kanouse DE, Wallander JL, Tortolero SR, Ratner JA, Klein DJ, Cuccaro PM, Davies SL, Banspach SW, 2012 Racial and ethnic health disparities among fifth-graders in three cities. *N. Engl. J. Med* 367, 735–745. [PubMed: 22913683]
- Sciamanna CN, Goldstein MG, Marcus BH, Lawrence K, Pinto BM, 2004 Accuracy of recall of exercise counseling among primary care patients. *Prev. Med. (Baltim)* 39, 1063–1067.
- Shaikh U, Nettiksimmons J, Bell RA, Tancredi DJ, Romano PS, 2012 Accuracy of parental report and electronic health record documentation as measures of diet and physical activity counseling. *Acad. Pediatr* 12, 81–87. [PubMed: 22209035]
- Shim JK, 2010 Cultural health capital: a theoretical approach to understanding health care interactions and the dynamics of unequal treatment. *J. Health Soc. Behav* 51, 1–15. [PubMed: 20420291]
- Siegel R, Naishadham D, Jemal A, 2012 Cancer statistics, 2012. *Ca. Cancer J. Clin* 62, 10–29. [PubMed: 22237781]
- Stange KC, Zyzanski SJ, Smith TF, Kelly R, Langa M, Flocke SA, Jae'n CR, Fedirko T, Kelly R, 1998 How valid are medical records and patient questionnaires for and health services Research? Physician profiling observation visits. *Med. Care* 36, 851–867. [PubMed: 9630127]
- Stewart M, Brown JB, Donner A, Oates J, Weston WW, Jordan J, 2000 The impact of patient-centered care on outcomes. *J. Fam. Pract* 49, 796–804. [PubMed: 11032203]
- Stivers T, Majid A, 2007 Questioning children: interactional evidence of implicit bias in medical interviews. *Soc. Psychol. Q* 70, 424–441.
- Street RL, Gordon H, Haidet P, 2007 Physicians' communication and perceptions of patients: is it how they look, how they talk, or is it just the doctor? *Soc. Sci. Med* 65, 586–598. [PubMed: 17462801]
- Toomey S, Elliott MN, Schwebel D, Tortolero S, Cuccaro P, Davies S, Kampalath V, Schuster M, 2016 The relationship between adolescent-report of patient-centered care and of the quality of primary care. *Acad. Pediatr* 16, 770–776. [PubMed: 26802684]
- Wang A, Clouston SAP, Rubin MS, Colen CG, Link BG, 2012 Fundamental causes of colorectal cancer mortality: the implications of informational diffusion. *Milbank Q* 90, 592–618. [PubMed: 22985282]
- Weinick RM, Elliott MN, Volandes AE, Lopez L, Burkhart Q, Schlesinger M, 2011 Using standardized encounters to understand reported racial/ethnic disparities in patient experiences with care. *Health Serv. Res* 46, 491–509. [PubMed: 21143475]
- Windle M, Grunbaum JA, Elliott M, Tortolero SR, Berry S, Gilliland J, Kanouse DE, Parcel GS, Wallander J, Kelder S, Collins J, Kolbe L, Schuster M, 2004 Healthy passages: a multilevel,

multimethod longitudinal study of adolescent health. *Am. J. Prev. Med* 27, 164–172. [PubMed: 15261905]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

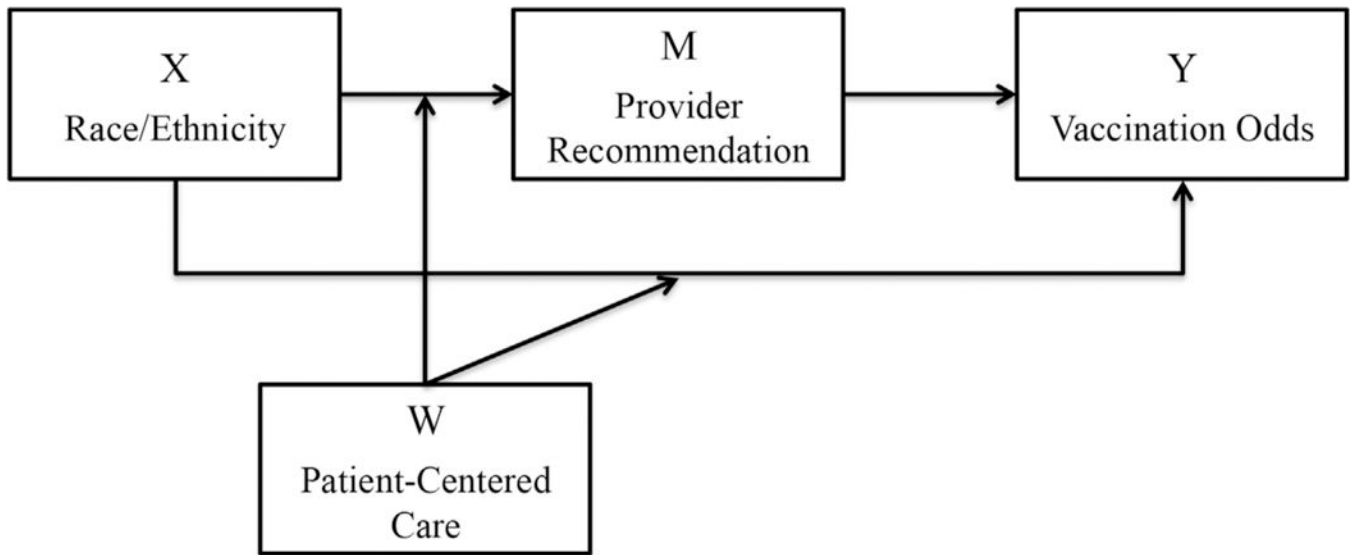


Fig. 1. Path analysis of a provider recommendation’s mediating effect on the race/ethnicity-vaccination odds relationship, moderated by patient-centered care.

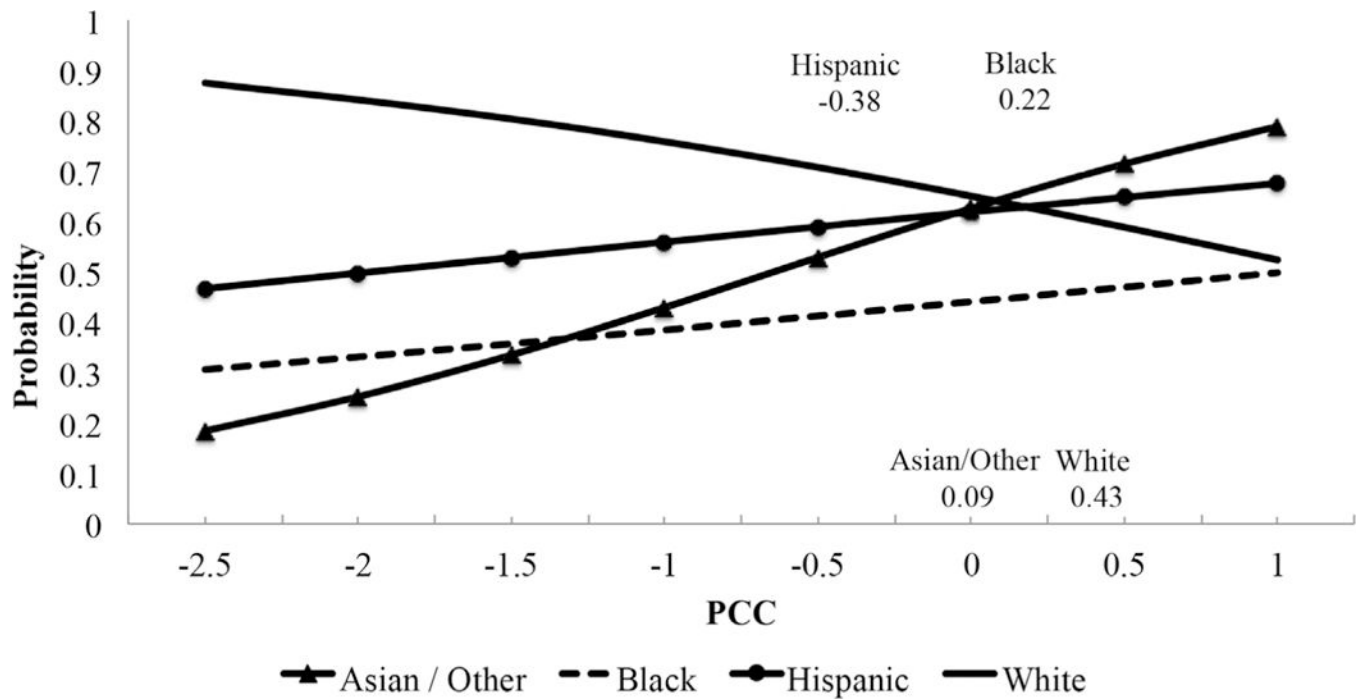


Fig. 2. Predicted probabilities of parent receiving provider HPV vaccine recommendation, by parent’s race/ethnicity and patient-centered care.*
 *All other predictors set at their means. Vertical bars indicate racial/ethnic groups’ mean patient-centered care (PCC) score. PCC is measured in standard deviations.

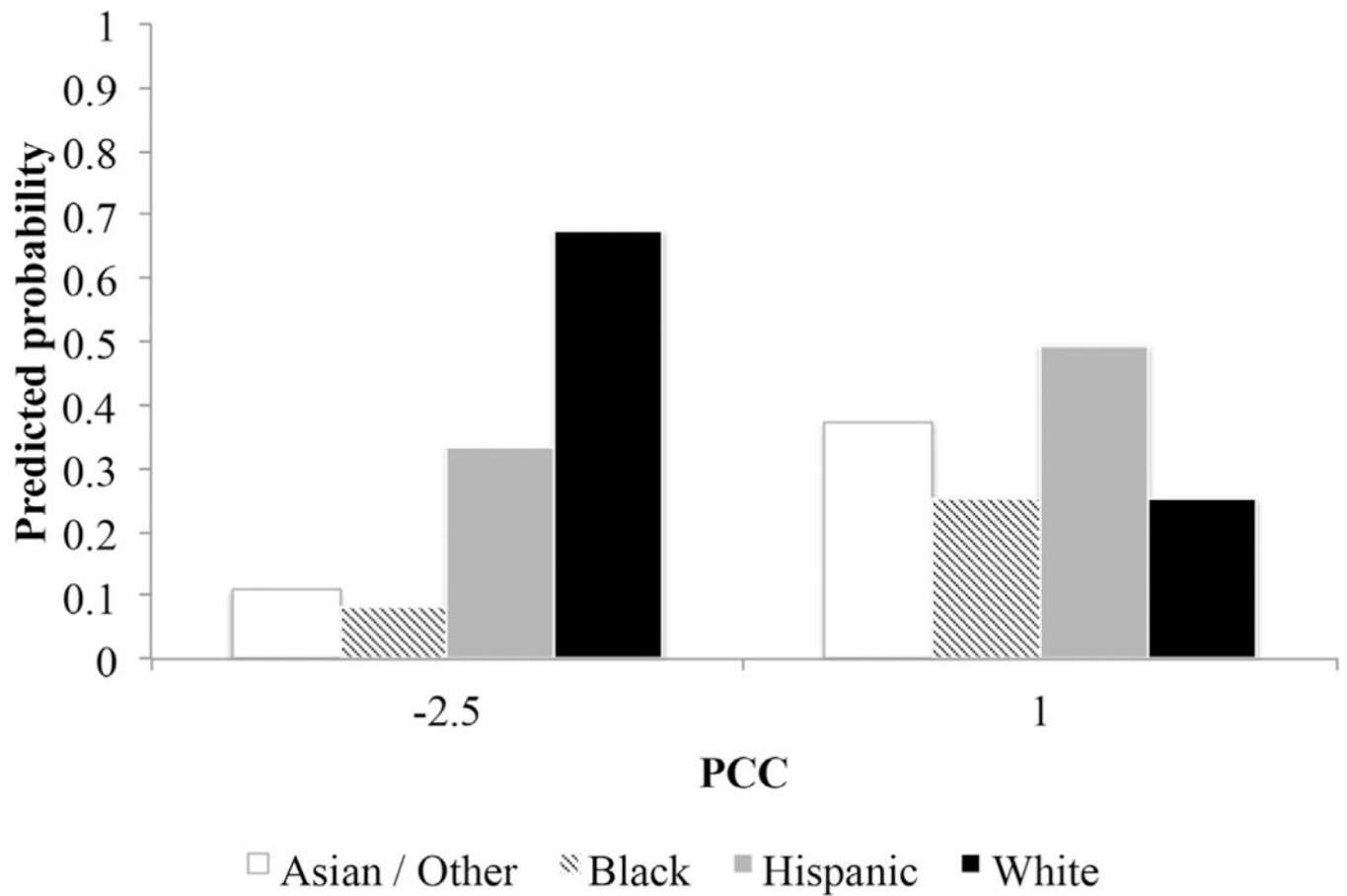


Fig. 3. Adolescent’s predicted probability of vaccine initiation by 10th grade given parent’s predicted probability of receiving a provider recommendation, by parent’s race/ethnicity at minimum and maximum patient-centered care scores.*

*All other predictors are set at their means. PCC is measured in standard deviations.

Table 1Descriptive statistics for model sets' subsamples including imputed data.^a

Variables	Model Set 1 (<i>n</i> = 1,384)	Model Set 2 (<i>n</i> = 1,778)
Received at least one HPV vaccine dose	46.6% ^c	47.9% ^c
Parent received provider HPV vaccine recommendation	60.4% ^c	62.9% ^d
Parent's race/ethnicity		
White	18.0%	21.3%
Black	31.0%	29.1%
Hispanic	46.2%	45.1%
Asian/Other	4.8%	4.5%
Parent's Education		
Less than high school	32.8%	31.5%
High school, GED, or higher	67.2%	68.5%
Child's age		
10–12	48.7%	50.4%
13–15	51.3%	49.6%
Parent's age		
Less than 45	75.8%	74.1%
45 and older	24.2%	25.9%
Parent's marital status		
Married or cohabiting	62.3%	63.8%
Divorced, separated, or widowed	37.7%	36.2%
Parent's employment status		
Employed outside the home	69.2%	69.4%
Unemployed	30.8%	30.6%
Parent born outside the US	41.1%	40.4%
Residence		
Birmingham	27.6%	27.9%
Houston	38.8%	37.6%
Los Angeles	33.6%	34.5%

Variables	Model Set 1 (n = 1,384)	Model Set 2 (n = 1,778)
Child's sexual experience		
No sexual behavior	64.6%	65.9%
Kissing, touching, or oral or vaginal sex	35.4%	34.1%
Times parent has spoken to child about what sex is		
At least once	71.3%	70.8%
Never	28.7%	29.2%
Times parent has spoken to child about waiting until marriage for sex		
At least once	78.7%	77.6%
Never	21.3%	22.4%
Provider has spoken to child about contraceptives at least once	38.5% ^c	
Child's closeness to mother		
Not close/Very little/Somewhat	8.1%	9.8%
Very/Quite a bit	90.2%	90.2%
Child has health insurance	86.1% ^b	86.0% ^b
Child's place of healthcare		
Doctor's office or hospital outpatient	77.4%	78.1%
Clinic, ER or other non-routine care facility	22.6%	21.9%
Child's last routine health visit		
Over one year	32.0% ^c	30.1% ^c
Less than one year	68.0% ^c	69.9% ^c
Parent's sense of child's general health		
Excellent/Very good/Good	91.7%	91.7%
Fair/Poor	8.3%	8.3%
Child has personal provider	72.5% ^c	73.4% ^c
Parent's vaccination intention		
Somewhat/Very likely	51.4%	51.4%
Not likely/Not too likely	48.4%	48.6%
PCC	Mean: -0.01 ^c	Mean: -0.04 ^c
	Range: -2.55, 1.73	Range: -3.42, 1.73

Variables	Model Set 1 (<i>n</i> = 1,384)	Model Set 2 (<i>n</i> = 1,778)
	St. Error: 0.04	St. Error: 0.05

^aVariables from W2 unless indicated.

^bVariables from W1.

^cVariables from W3.

^dVariables from W2 and W3.

Table 2Patient-centered care, by parents' race/ethnicity and education ($N = 2192$).^a

	Mean	95% Confidence Interval	
Parent's race/ethnicity			
White	0.43	0.35	0.52
Black	0.22	0.15	0.28
Hispanic	-0.38	-0.48	-0.29
Asian/Other	0.09	-0.09	0.29
Parent's education			
High school, GED, or higher	0.20	0.14	0.26
Less than high school	-0.46	-0.59	-0.34

^aPatient-centered care (PCC) is standardized. Mean score is 0.0 and standard deviation is 1.0.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Adjusted log-odds of a parent receiving a provider HPV vaccine recommendation ($N = 1,384$) and adolescent's HPV vaccine initiation as of Wave 3 ($N = 1,778$).^a

	Model Set 1—Provider Vaccine Recommendation			Model Set 2—Vaccine Initiation			
	1.1 ^a	1.2	1.3	2.1 ^a	2.2	2.3	2.4
Parent's Race (White Omitted)							
Black	-0.727 *** [0.144]	-0.581 ** [0.173]	-0.858 *** [0.163]	-0.474 *** [0.127]	-0.419 * [0.162]	-0.552 ** [0.173]	-0.277 [0.221]
Hispanic	-0.247 [0.158]	0.116 [0.212]	-0.135 [0.200]	-0.151 [0.147]	0.257 [0.182]	0.166 [0.189]	0.375 [0.264]
Asian/Other	-0.175 [0.323]	0.130 [0.332]	-0.105 [0.354]	-0.441 * [0.221]	-0.192 [0.252]	-0.316 [0.252]	-0.333 [0.294]
Parent's Education (Less than HS Omitted)							
HS or Higher	0.520 ** [0.171]	0.413 * [0.199]	0.398 * [0.199]	0.306 * [0.134]	0.304 * [0.144]	0.305 * [0.151]	0.0681 [0.181]
PCC			-0.655 [0.333]			-0.208 [0.261]	-0.272 [0.245]
Black × PCC			0.757 * [0.296]			0.391 [0.241]	0.362 [0.268]
Hispanic × PCC			0.772 * [0.311]			0.237 [0.247]	0.165 [0.249]
Asian/Other × PCC			1.325 *** [0.439]			0.454 [0.334]	0.0219 [0.325]
HS or Higher × PCC			0.194 [0.190]			0.0593 [0.151]	0.124 [0.165]
Provider recommendation (No = 0)							3.574 *** [0.181]

Note. Standard errors appear in brackets. PCC=Patient-centered care.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$.

^a All models except 1.1 and 2.1 control for healthcare access and knowledge, sex communications, and demographics.

Table 4

Bootstrapped conditional indirect effects at different values of patient-centered care, by race/ethnicity.

Race/ethnicity	PCC	Indirect effect (XW→M→Y)	SE	Proportion of total effect
Black	-1 SD	-0.1947***	0.0461	0.7485*
	Mean	-0.0991**	0.0300	0.9787 ^a
	+1 SD	-0.0036	0.0406	-0.0620 ^a
Hispanic	-1 SD	-0.0701	0.0494	1.1805 ^a
	Mean	-0.0114	0.0376	0.1799 ^a
	+1 SD	0.0929	0.0474	0.4993 ^a
Asian/Other	-1 SD	-0.1274	0.0703	0.6482 ^a
	Mean	0.0135	0.1151	-0.2840 ^a
	+1 SD	0.1544**	0.0580	1.5176 ^a

Note. See Fig. 1 to understand terms (X, Y, M, W). PCC=Patient-centered care.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$.

^aUnstable proportions because total effect size is smaller than ± 0.2 and/or 'inconsistent mediation' created by opposite direct and indirect effects (Preacher and Kelley, 2011).