Vaccine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Immunization requirements of the top 200 universities: Implications for vaccine-hesitant families

Allison Noesekabel [a], Ada M. Fenick [b,*]

[a] Wayne State University School of Medicine, United States
[b] Yale School of Medicine, United States

ARTICLE INFO

Article history:
Received 5 April 2017
Received in revised form 11 May 2017
Accepted 12 May 2017
Available online xxxx

Keywords:
Student immunization
College immunization requirements
Immunization law
Immunization exemption

ABSTRACT

Background: The majority of pediatricians encounter vaccine hesitancy in their practices. As part of a broad discussion about vaccination, school requirements arise as a topic yet providers may lack information about the effects of immunization on university matriculation.
Methods: We surveyed the top-ranked 200 universities regarding required immunizations, medical, religious, and philosophical exemptions, and noncompliance policies. We examined the legal requirements for involved jurisdictions.
Results: Of 129 responding universities (64%), 94% had ≥1 pre-matriculation immunization requirement (PIR), with a mean of 3.53 (95%CI 3.17–3.89) requirements. In unadjusted analyses, funding, region, jurisdictional requirements, undergraduate size, and tuition were significant predictors of the number of PIRs. In multivariate modeling, jurisdictional requirements outperformed all other university demographics, but excluding these, Northeast and South region and smaller undergraduate size persisted. The most common PIR was measles (93%). 67% of involved jurisdictions have laws mandating ≥1 university PIR, and 45% of universities surpassed their jurisdiction's law. With respect to medical, religious, and philosophical exemptions, 24%, 40%, and 60% of universities with PIRs had the highest hardship category, and 2%, 2%, and 46% disallowed these outright. Frequent responses to student noncompliance were: hold on classes (89%), additional registration fees (13%), and hold on housing (11%).
Conclusions: Requirements for pre-matriculation immunizations in top universities are common and exemptions are difficult to obtain. Conversations between providers and vaccine-hesitant families may be enriched by discussion of these future effects of their decision on immunization.

1. Introduction

Epidemic levels of pertussis in California in 2014, 23 measles outbreaks across the US in 2014, and mumps outbreaks involving several hundred university students in Iowa and Illinois in 2015–16 incite further examination into how parents make decisions about their children's immunizations [1,2,3]. Among others, the perception of a low risk of contracting the target disease and the fear of negative side effects from the vaccine influence a parent's action on immunizations [4]. The number of school-age students in the United States with non-medical exemptions to vaccines has increased by 19% from 2009 to 2013, with a wide variability across states [5,6]. Up to 85% of pediatricians have reported encountering partial vaccine refusal during a 12-month period, and 54% have reported encountering total refusal [7]. Encouragingly, parents have cited their child's health care provider as a trusted, 'most important' source for information about vaccines [8,9]. Therefore, it is important for providers to have knowledge of the many ways vaccination may affect their patients in order to facilitate this discussion.

Parents choosing whether to vaccinate and actively seeking information on vaccines and vaccination policies do consider school requirements; in particular school requirements were reported as a factor when considering vaccination by 46.4% of surveyed parents of adolescents [10]. Vaccine-hesitant parents tend to have higher educational achievement and be more affluent [11,12]. Families from this demographic are likely to groom their children for an elite university [13,14,15]. Therefore, providers counseling these families may include in their armamentarium an understanding of the effect of vaccination status as the child transitions between educational systems.

* Corresponding author at: Yale School of Medicine, Department of Pediatrics, 333 Cedar Street, PO Box 208064, New Haven, CT 06520-8064, United States.
E-mail address: ada.fenick@yale.edu (A.M. Fenick).

http://dx.doi.org/10.1016/j.vaccine.2017.05.038
0264-410X/

The aim of this study is to delineate the current vaccination requirements and policies of the 200 most highly ranked universities in the United States. We describe to what extent these universities currently require their matriculating students to provide proof of immunizations, and what their policies are regarding exemptions due to medical, religious, or philosophical beliefs, and noncompliance. We further investigate the association between state immunization laws and requirements of universities in their states.

2. Methods

2.1. Demographic data

We identified the 200 top-ranked universities in the US using the US News and World Report 2014 National University rankings [16]. The College Board and College Tool Kit websites were accessed for demographic identifiers of each school, including such as location, funding source, and tuition [17,18]. If this information were unavailable, the university's admissions office was contacted.

The Department of Health website and Immunization Program Manager of each state and of the District of Columbia was consulted to identify the 7 immunization categories as required by any jurisdictional law for attendance at universities (hepatitis B, meningococcus, measles, mumps & rubella, pertussis, tetanus & diphtheria, and varicella).

2.2. Survey procedures

To formulate a survey on university pre-matriculation immunization requirements (PIRs) and policies, we examined the websites of twenty randomly selected top universities to determine what information would be available to an incoming freshman regarding PIRs, including immunization forms, health center guidance, and the university's responses to noncompliance. The authors individually examined this information thematically and came to a consensus on common PIRs (simplified from the legal categories), requirements for exemptions, and responses to noncompliance. Questions regarding the PIRs, exemption requirements for medical, religious, or philosophical beliefs, and actions taken if a student were noncompliant were created, tested, and, finally, formatted for electronic transmission (Appendix A). The survey was emailed to the registrar of each university in November 2014, and non-responders were re-emailed in January 2015. When this approach was unsuccessful, an email was sent to the health center at each institution. Responses were accepted from November 2014 until April 2015. If a university responded that it had fewer PIRs than mandated by law, the university's freshman immunization form was consulted to verify requirements.

Survey questions dealing with exemptions allowed for categorical choices or open-ended statements. After receipt of data, the open-ended responses were assigned to the closest matching category. The difficulty of obtaining each type of exemption was categorized into three levels of hardship based on the method outlined by Rota et al. [19] in which the answer choices were given a hardship score (1. Lowest 2. Medium 3. Highest). For example, those in the highest category had requirements such as notarization of parent statements, letters from religious leaders, Dean/committee approval, while the lowest level allowed students to check a box on a form. This method was also applied to rank the hardship of the answer choices regarding university action as response to student noncompliance, from highest to lowest stringency, with highest including students being withdrawn from the university, and lowest including additional registration fees.

2.3. Data analysis

Descriptive statistics were used to characterize the universities. Demographic identifiers of responding and non-responding institutions were compared using *t*-tests and chi-square tests for continuous and categorical characteristics respectively. Tuition and undergraduate size were transformed using the natural log prior to being included in all analyses. Unadjusted associations between the mean number of PIRs and demographic characteristics of participating universities were examined with *t*-tests and chi-square tests. Adjusted analyses included Poisson regression modeling of the number of PIRs in the presence of multiple university demographic characteristics. Multiple logistic regression was used to examine the adjusted associations between demographics of universities and whether or not a university went above jurisdictional requirements. Results were summarized using model-obtained estimates of mean PIRs, regression parameter estimates (B), Odds Ratios (OR) and associated 95% Confidence Intervals (95%CI). Models were constructed manually in a step-wise fashion, starting with bivariate associations and adding additional predictors one at a time. Prior to including predictors in the same model, we tested for possible multiple collinearity and confounding using Pearson correlation coefficients for continuous predictors, chi-square tests for categorical variables and *t*-tests for the differences in means for combinations of categorical and continuous predictors. Variables with a Pearson correlation coefficient of >0.90 or significant associations for the other two tests were not included in the same model.

We examined geographic groupings by the 4 US census regions [20]. Poisson loglinear correlations were used to identify strength of relationships among hardship levels of obtaining exemptions at a given university.

Analyses were performed using SPSS (IBM SPSS Statistics for Macintosh, Version 22.0). Alpha of 0.05 was used to establish statistical significance, with the exception of using alpha of 0.10 for selection of predictors to be included in the adjusted models so as to not unduly eliminate appropriate predictors.

3. Results

3.1. Demographics

The responding 129 universities (64% response rate) spanned 45 jurisdictions (44 States and the District of Columbia) and represented institutions from all ranked quartiles. We compared the demographic identifiers of responding institutions with non-responding institutions and found that the responders and non-responders were similar in all demographics, although for undergraduate size, there was a trend to a larger undergraduate body for responders compared with non-responders (Table 1).

3.2. Pre-matriculation immunization requirements

Overall, 94% of responding top universities had $\geq$1 PIR, with 84% having $\geq$2, 63% having $\geq$3, and 16% requiring all 7 vaccines. Only 6% of universities had no vaccination requirements. Across all responding institutions, the mean number of required immunizations was 3.53 (95% CI 3.17–3.89).

Funding (private/public), region, jurisdictional requirements, undergraduate size, and tuition were highly significant predictors of the number of PIRs in the unadjusted analyses (Table 2). In the multivariate model including all of these, the jurisdictional requirements outperformed all other university demographics ($p < 0.001$). In a model with all significant demographics but excluding jurisdictional requirements, Northeast and South region

Please cite this article in press as: Noesekabel A, Fenick AM. Immunization requirements of the top 200 universities: Implications for vaccine-hesitant families. Vaccine (2017), http://dx.doi.org/10.1016/j.vaccine.2017.05.038