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# Effectiveness of a Vaccination Education Module for College Freshman

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ABSTRACT

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The purpose of this thesis is to evaluate a vaccination education module and evaluate its effectiveness to improve vaccine beliefs and behaviors among college freshmen. The participants included 177 college freshmen at one Utah university. Participants were eligible for this study if admitted as a new freshman during the 2019-2020 school year. The study was a cross-sectional pre- and post-education evaluation assessing vaccine beliefs and behaviors using a Likert-type scale. After completing the vaccination education module, participants' vaccine beliefs and behavioral intentions improved. Participants reported they were more likely to be up-to-date on personal vaccines and more likely to expect other students to be up-to-date on their vaccinations. Participants were more likely to ask other students to vaccinate and were also more likely to ask their family members to be vaccinated. In conclusion this online vaccination education module effectively improved participants' vaccine beliefs and behavioral intentions.

Keywords: vaccine, college, communicable disease, freshman, vaccine knowledge

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# Effectiveness of a Vaccination Education Module for College Freshman

Since the beginning of the 19th Century, vaccines have saved millions of lives. For example, before the measles vaccine, the measles virus killed, on average, 440 people in the United States every year between 1953 and 1962. Similarly, pertussis was responsible for the deaths of 4,034 people each year between 1934-1943 (Roush, 2007). Comparatively, in the post-vaccine era, the United States (US) had zero measles-related deaths in 2019 (Patel et al., 2019) and nine deaths from pertussis in 2019 (Centers for Disease Control and Prevention [CDC], 2019). Consequently, vaccines are regarded as one of the most significant life-saving measures of all time (Rémy et al., 2015).

Despite the well-documented, vaccine-related achievements in combating communicable diseases, vaccination rates in the US continue to fall below national recommendations. For example, human papillomavirus (HPV) vaccination rates continuously fall below the national target goal of 80% (Healthy People 2030, 2020). In fact, the national HPV vaccination rate of young adults aged 18-26 is only 21.5% (Boersma & Black, 2020). Other vaccines that fall below national recommendations include the quadrivalent meningococcal conjugate vaccine (MenACWY) and the serogroup B meningococcal vaccine (MenB). For example, in adolescents aged 13-17, the MenACWY national vaccination rate average 44.3% for two or more doses. The MenB national vaccination rate for the same age group averages a shocking 14.5% (Walker et al., 2018).

Moreover, the World Health Organization (WHO) (2019) listed vaccine hesitancy as a top ten threat to global health. Vaccine hesitancy leads to decreasing vaccination rates resulting in increases in communicable disease outbreaks and case counts. In addition, geographical areas with lower vaccination rates have higher occurrences of disease outbreaks (Cole & Swendiman,

2015). For example, in 2019 the US reported 22 measles outbreaks, which resulted in 1,282 cases, the most measles cases reported since 1992; approximately 71% of these cases were in unvaccinated persons (CDC, 2021). Thus, while vaccines are highly effective, those who are unvaccinated are still capable of circulating communicable diseases in the general population.

School environments, especially those in low-vaccination areas, are ideal settings for spreading communicable diseases (Czumbel et al., 2018). However, the quick spread of communicable diseases in school settings is not exclusive to K-12 grades. In fact, college campuses are also highly vulnerable to communicable disease outbreaks (Bernitz et al., 2020). The most common disease outbreaks on college campuses include pertussis, mumps, and meningitis (Soeters et al., 2019). Low pertussis vaccination rates among college students have led to severe pertussis outbreaks on university campuses (Matthews et al., 2008). In 2019, an outbreak of 18 confirmed and over 90 probable cases of mumps occurred on the Temple University campus. Additionally, outbreaks of more than 420 mumps cases at the University of Missouri and more than 450 cases at the University of Iowa were noted in 2016 (Bauer-Wolf, 2019). Furthermore, ten university-based outbreaks of meningococcal meningitis resulted in 39 cases and two deaths between 2013 and 2018 (Soeters et al., 2019).

To protect students from communicable diseases while in the school environment, many states have implemented compulsory vaccination laws (CDC, 2016). School vaccination laws differ from state to state and are primarily aimed at the K-12 school population (Cardenas-Comfort & Majumder, 2019; National Conference of State Legislatures, 2021). In contrast, college-aged students are only sometimes required to provide proof of vaccinations prior to attending school, even for the most common vaccine-preventable communicable diseases on college campuses (Sandler et al., 2019). Currently, only 32 states have laws requiring one or

more vaccines for college entry (Noesekabel & Fenick, 2017). Although, all 50 states ideally would have vaccine laws for college students, it is essential to identify other means by which college students are encouraged to receive vaccinations, especially while awaiting such laws (Noesekabel & Fenick, 2017). A potentially effective method to improve vaccination rates is to provide vaccination education about 1) the importance of vaccines and 2) the communicable diseases prevented by vaccines (Johnson et al., 2019).

There are currently no laws in Utah that require students to be vaccinated before attending classes on a college campus. While the Utah Department of Health (UDOH) (2018) recommends vaccinations prior to college entry, many Utah colleges and universities require few, if any, vaccines upon registration and attendance on campus. However, in 2018, the Utah State Board of Regents (SBOR) updated a policy regarding vaccine education of college students (Buhler, 2018). In this revised policy, the SBOR clarifies that all students living on campus should receive education about vaccines. The purpose of this research was to evaluate the efficacy of an online vaccination education module by assessing freshmen students' vaccination beliefs and behavioral intent.

## Research Questions

1- How likely are college freshmen to be up-to-date on vaccinations?

2- How likely are college freshmen to expect other students on campus to be up-to-date on their vaccinations?

3- How likely are college freshmen to ask other students on campus to be vaccinated?

4- How likely are college freshmen to ask their family members to be vaccinated?

# Methods

## Participants

All participants were incoming freshmen at one private university in Utah. The university is a traditional brick-and-mortar school with a focus on undergraduate programs. Students were eligible for this study if admitted as a new freshman during the 2019-2020 school year. Age was neither an inclusion nor exclusion criterion. Transfer students, meaning those who attended another college and transferred credits, were excluded from participation.

## Measures

Pre- and post-education module questionnaires were adapted from Luthy et al. (2017). Participants were asked three demographic questions: 1) age; 2) intended major; and 3) highest level of parents' education. Participants answered four Likert-type questions on both the pre- and post-education questionnaires. Participants rated their beliefs and behavioral intentions on a scale of 0 to 10 by sliding a visual scale cursor (0 = not at all and 10 = definitely). Two questions asked about student vaccine beliefs: 1) How likely are you to be up-to-date on your vaccinations? and 2) How likely are you to expect other students to be up-to-date on their vaccinations? Two questions asked about student vaccine behavioral intentions: 1) How likely are you to ask other students to be up-to-date on their vaccinations? and 2) How likely are you to ask your family members to be up-to-date on their vaccinations?

There were also four open-ended questions. One open-ended question was included in both the pre- and post-education questionnaire. Three open-ended questions were only included on the post-education questionnaire. The open-ended questions included: 1) What concerns do you have about immunizations? (pre- and post-education); 2) What new information did you learn from the module? (post-education); and 3) What questions do you have about

immunizations that were not covered in the module? (post-education); and 4) What questions do you have about communicable diseases that were not covered in the module? (post-education). Luthy et al. (2017) also asked the participants, "What concerns do you have about immunizations?" and "What new information did you learn from the module?" Qualitative data, however, will be published separately.

**Procedures**

The study was a cross-sectional pre- and post-education evaluation that received Institutional Review Board approval prior to data collection. Online survey administration is successful for data collection in college-aged populations (Park et al., 2019). Hence pre- and post-education questionnaires were administered online. Additionally, an online vaccination education module was created to educate incoming freshmen about the importance of vaccines for college-aged students.

The education module was created in collaboration with individual vaccine experts, student healthcare providers, researchers, public health experts, and several vaccine-focused coalitions in the state (referred collectively to hereafter as stakeholders). The module went through several iterations, each time returning to the stakeholders for recommendations. The researchers then collaborated with a professional marketing and advertising firm to refine the aesthetics of the module.

The vaccination education module utilized a read-only (no voiceover) PowerPoint-style modality. Information on several slides included URLs as references and links to additional news articles or resources. Information on bacterial meningitis, influenza, and HPV included embedded videos with stories from survivors. Videos came from news outlets or the American Cancer Society. In addition, the module included three pop quizzes to enhance participant

engagement. The pop quizzes were multiple-choice with only one correct response and required a response to advance to the next slide. After a response was chosen, correct and incorrect answers were displayed. Before proceeding in the module, participants needed to select the correct response.

The vaccination education module also included: 1) a congratulatory message, welcoming the freshman students to the university; 2) data regarding how many students were enrolled at the university and how many students live in dormitories; 3) college students' risk for contracting communicable diseases; 4) information regarding communicable diseases; 5) strategies for preventing communicable disease spread, including the role of vaccines; 6) information on community immunity; 7) general vaccine facts; 8) recommended vaccines for college-aged students; 9) symptoms, duration, and adverse side effects associated with tetanus, diphtheria, pertussis, measles, mumps, rubella, and bacterial meningitis, HPV, and influenza; and 10) resources to confirm vaccination status and where to receive vaccines.

Once the vaccination module was completed, an email was sent out to all incoming freshmen via the Office of First-Year Experience, inviting them to view the vaccine education module and participate in the study. A total of 7,775 emails were sent to the incoming freshman class – one email per student. Non-responders were sent a second and third reminder email at the 3-week and 6-week mark, respectively. Students could opt to 1) view the module and participate in the study; 2) neither view the module nor participate in the study; or 3) begin the module and participation in the study without completing either. The vaccine education module was completely accessible online. All email invitations contained a link to the vaccine education module, the estimated time required to complete the module (20 minutes), and a reminder that completing the module was completely voluntary. No incentive, monetary or otherwise, was

offered to participants. Consent was implied if the students completed the vaccination module and answer the pre- and post-test questions.

**Analysis**

Quantitative analysis was performed using Jamovi version 2.1 (The Jamovi Project, 2020) and R Core Team 4.0 (R Core Team, 2020). Descriptive statistics were calculated for study variables. Comparisons between pre-test and post-test responses were made using paired *t*-tests. Effect size for significant pairwise comparisons was calculated using Cohen's *d*.

## Results

A convenience sample of incoming college freshmen (n = 177) at one private university in Utah participated in this study; all 177 participants completed both pre- and post-test questions. Participants reported being an average of 18.1 years of age (*Mo = 18; Mdn = 18; SD* = 1.8) with a range of 16 – 36 years of age. The top five majors reported by participants were undecided (n = 40), nursing (n = 22), art (n = 11), biology (n = 10), and engineering (n = 9). Participants also reported their parents' highest level of education. The three most common responses were college graduate (n = 62), master's degree (n = 60), and doctorate degree (n = 39).

**Pre-test and Post-test**

There were two student vaccine belief questions and two student vaccine behavioral intention questions. Highest scores for both pre- and post-test were on belief questions, while behavioral intention question scores were lower, both pre- and post-test. All means and standard deviations for pre-test and post-test scores are reported in Table 1.

## Student Vaccine Beliefs

***Likelihood of vaccinating self.*** All 177 participants reported during the pre-test, on a Likert-type scale of 0-10, how likely they were to be up-to-date on their own vaccinations. The mean score at baseline (pre-test) was 8.3 and increased to a mean score of 8.7 after completing the vaccination education module (post-test). Participants were already likely to be vaccinated according to the pre-test score and, after receiving vaccine education, they were even more confident they were up-to-date on their own vaccinations (See Table 1).

***Expectation of other students being vaccinated.*** Participants (n = 177) also reported how likely they were to expect other students on campus to be up-to-date on vaccinations using a Likert-type scale from 0-10. The mean score at baseline (pre-test) was 7.1 and the mean score at post-test was 7.7. After completing the vaccination education module, participants reported they were more likely to expect other students on campus to be up-to-date on vaccinations (See Table 1).

## Student Vaccine Behaviors

***Asking other students to vaccinate.*** When asked how likely they were to ask other students on campus to be vaccinated, participants (n = 177) reported responses on a Likert-type scale from 0-10. Prior to receiving vaccination education, the mean score was 3.7 at pre-test and increased to 5.0 at post-test. Thus, after completing a vaccination education module, participants were more likely to ask other students on campus to be vaccinated (See Table 1).

***Asking family members to vaccinate.*** All 177 participants reported how likely they were to ask their family members to be vaccinated on a Likert-type scale from 0-10. The mean pre-test score was 6.7. After completing the vaccination education module, the mean post-test score increased to 7.4 indicating the participants were more likely to ask family members to be vaccinated after receiving vaccination education (See Table 2).

**Comparison Between Pre-test and Post-test Responses**

Comparisons between pre-test and post-test responses were conducted using paired *t*-tests. Results for paired *t*-tests are reported in Table 2. There were significant differences between pre-test and post-test responses for all four questions. Participant scores were higher on average at post-test, indicating participants felt they were more likely to get vaccinated, expect other students to be vaccinated, ask other students to be vaccinated, and ask family members to be vaccinated after completing the vaccination education module. Effect size (Cohen's *d*) for differences in probability of self-vaccination ($d$= .29) indicated a small effect, expecting other students to be vaccinated ($d$ = .40), and asking family members to vaccinate ($d$ = .42) indicated a medium effect. Asking other students to vaccinate ($d$ = .74) indicated a large effect.

## Discussion

Every participant scored higher on the post-test than the pre-test, indicating the vaccination education module effectively improved vaccine beliefs and behavioral intentions in college freshmen. Effect size was calculated to identify the size of the difference between pre-test and post-test scores. There was a medium effect in the expectation of other students being fully vaccinated and in asking family members to vaccinate. The likelihood of being up-to-date on personal vaccinations had a small effect, which can be attributed to participants scoring high on the pre-test question.

While most Americans support vaccinations (Zogby, 2018), they are commonly referred to as the silent majority compared to the amplified voices of vaccine-critical activists (World Health Organization, 2016). There is growing concern that the vocal anti-vaccine minority effectively spreads misinformation that negatively influences the beliefs and behavioral intentions of those who have traditionally accepted vaccines as safe and effective (Arede et al., 2018; Germani & Biller-Andorno, 2021). Vaccine misinformation gains credibility when it is frequently and socially reinforced, especially through social media outlets (Sabin-Aspen Vaccine Science & Policy Group, 2020).

Interestingly, the largest effect size in this study was among college freshmen who intended to ask other college students to get vaccinated after completing a vaccination education module. While the majority of individuals who are supportive of vaccinations do not openly share pro-vaccine messages with others (Altay & Mercier, 2020), these data indicate that with targeted vaccination education, college freshmen reported they were more likely to engage in pro-vaccine dialogue (i.e., asking other college students to get vaccinated) rather than remaining silent when the topic of vaccinations arise.

Given the effectiveness of the vaccination education module, universities that do not have student vaccination requirements may want to offer a vaccination education module for incoming freshmen. In 2019, 2.89 million freshmen enrolled in American universities, which is only expected to rise (National Center for Educational Statistics, 2019). Therefore, a vaccination education module can positively influence vaccine beliefs and behavioral intentions for millions of college freshmen every year.

While the vaccination education module utilized for this study did not include education on the COVID-19 vaccine, such content could be added. In fact, the American College Health

Association (2020) recommends educating students about the importance, efficacy, and safety of the COVID-19 vaccine, although traditional higher education institutions are usually slower to enact policy changes than the private sector (Rosowsky, 2020). Still, the number of colleges and universities requiring students to be fully vaccinated against COVID-19 before attending fall semester 2021 is rapidly growing (Stuart, 2021). Mandating COVID-19 vaccines for college students would undoubtedly decrease the number of COVID-19 cases among student bodies; however, universities could also positively influence student vaccination beliefs and behavioral intentions with a vaccination education module until a vaccine policy is in place.

## Limitations

This study does have limitations. First, data were left-skewed, probably due to most students giving high responses to the questions. This resulted in violation of the assumption of normality. However, a *t*-test was still appropriate due to sample size.

Second, there was a very low response rate (177 out of 7,775 or 2.2%). One strategy to increase response rates is to offer an incentive to participants (Smith et al., 2019), although the researchers would also need to obtain funding to purchase incentives. Another potential explanation for the low response rate includes potential issues with email. For example, it is possible that some of the college freshman email addresses were incorrect. Additionally, the number of emails sent at the same time could have alerted the email system that the incoming message was spam, thus automatically filtering the email to the recipients' spam folders. Finally, the emails inviting college freshman to complete the online vaccination education module were sent around the same time the freshman would have received many emails from the university. It is possible the college freshman simply prioritized responding to emails from the university and

the email inviting the college freshman to complete an optional online vaccination education module was a lower priority.

Third, there is limited generalizability due to little diversity in participants at one Utah university. Additionally, no gender demographics were collected, so it is difficult to discern if gender influenced the results. The majority of participants were 18 years old and, as a result, are categorized as Generation Z (born between 1995 – 2010). A study of Generation Z reveals they are comfortable obtaining and cross-referencing many sources of information. Additionally, Generation Z is progressive, pro-government, and on track to become the highest educated group compared to other generational groups (Parker & Igielnik, 2020). Generation Z characteristics could have influenced the results and explain why the participants scored high on the pre-education module questionnaire. This generation is influential on people of all ages and incomes and are driven by a search for the truth (Francis & Hoefel, 2018).

Finally, despite the participants reporting that they are more likely to vaccinate themselves and ask others to vaccinate, the researchers did not collect data on whether the improved vaccine beliefs and behavioral intentions translated to increased vaccination rates. Additionally, no data were collected on knowledge retention over time.

## Recommendations

While the results of this study show promise in improving college freshman beliefs and behavioral intentions regarding vaccines, the study should be replicated in several university populations to obtain generalizability. Because each new school year yields a new group of college freshmen, universities could also replicate the study among freshman on an annual basis to identify belief and behavioral intention trends. Furthermore, it would be beneficial to extend

the research for a longer time and evaluate whether education translates into action and increases vaccination rates.

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Table 1

*Pre- and Post-test Results*

| Question | | Pre-test | | Post-test | |
|---|---|---|---|---|---|
| | *n* | M | SD | M | SD |
| 1. How likely are you to be up-to-date on vaccinations? | 177 | 8.3 | 2.2 | 8.7 | 1.94 |
| 2. How likely are you to expect other students on campus to be up-to-date on their vaccinations? | 177 | 7.1 | 2.1 | 7.7 | 2.1 |
| 3. How likely are you to ask other students on campus to be vaccinated? | 177 | 3.7 | 3.2 | 5.0 | 3.2 |
| 4. How likely are you to ask your family members to be vaccinated? | 177 | 6.7 | 3.2 | 7.4 | 2.8 |

Table 2

*Comparison Between Pre- and Post-test Responses*

| | | | 95% CI | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | | Mean | Diff | | | | |
| Question | Diff | SD | LB* | UB** | *t* | df | *p* | d*** |
| 1. How likely are you to be up-to-date on vaccinations? | -.38 | .09 | -.57 | -.19 | -3.9 | 176 | <.001 | -.29 |
| 2. How likely are you to expect other students on campus to be up-to-date on their vaccinations? | -.68 | .12 | -.93 | -.43 | -5.4 | 176 | <.001 | -.41 |
| 3. How likely are you to ask other students on campus to be vaccinated? | -1.4 | .13 | -1.64 | -1.09 | -9.9 | 176 | <.001 | -.74 |
| 4. How likely are you to ask your family members to be vaccinated? | -.73 | .12 | -.98 | -.48 | -5.7 | 176 | <.001 | -.43 |

*LB represents the lower bounds.
**UB represents the upper bounds.
***Represents Cohen's d.