



Research article

Understanding influenza vaccine perspectives and hesitancy in university students to promote increased vaccine uptake



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ABSTRACT

Introduction: Influenza vaccine hesitancy is a global barrier to controlling seasonal influenza. Influenza vaccination rates in university students lag behind current goals and pose a significant threat to the health of students on campuses. A broader understanding of the knowledge, attitudes and beliefs of university students are needed to develop targeted interventions to increase vaccination.

Methods: An anonymous cross-sectional survey was developed and distributed via REDCap to graduate and undergraduate students via individual college listservs at a large public university. Survey questions included demographic information and questions about vaccination history, preference for vaccine type (inactivated vaccine (IIV) or live attenuated vaccine (LAIV), knowledge of influenza vaccines, reasons for accepting or refusing vaccine and preference for receiving vaccine information and education.

Results: Students in 14 colleges received the survey and 1039 respondents were included in analysis. Sixty two percent reported having been vaccinated for influenza and of those vaccinated most were in health-related fields that require vaccination. Graduate and vaccinated students were more knowledgeable about influenza; undergraduates had lower vaccination rates. Students preferred IIV over LAIV and were more knowledgeable about IIV. Those with history of vaccination during childhood had higher rates of vaccination. Twenty six percent overall and 41.6% of the unvaccinated still believed you could get the flu from the flu vaccine. Fear of needles and inconvenience were cited as major reasons for not getting vaccinated. Incentives were cited as important motivators by only 20%. Students preferred to receive vaccine information from medical providers followed by online information and campus events.

Conclusions: A multipronged approach to increasing influenza vaccination of university students will be needed. Myths about influenza vaccine persist even in a relatively educated population. Programs will need to target undergraduate and students in non health-related fields, offer vaccine choices - IIV and LAIV and promote vaccination through medical providers and online information.

1. Introduction

Despite influenza's severity and the availability of safe vaccines, low influenza vaccination rates remain an international challenge and contribute to the burden of disease [1, 2]. Importantly, influenza vaccine coverage in university students lags behind other ages and remains well below the Healthy People 2020 goal of eighty percent [3]. Reported vaccination rates have ranged from 9–30% and annual influenza virus outbreaks cause serious and potentially fatal disease across college

campuses [4, 5, 6]. Influenza can spread easily on campuses due to crowded living quarters and frequent social activities, negatively affecting students' academic performance, class attendance and increasing health care utilization and prescription drug use [4]. College students interact with community members through their jobs, gym attendance and social events and therefore can be a source of community outbreaks and spread. In addition, travel during semester breaks increases transmission to vulnerable family members such as the elderly, very young and immunocompromised [7].

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The reasons for university students' influenza vaccine hesitancy are largely unknown and it is not known if their preferences for influenza vaccine type – inactivated vaccine (IIV) or live-attenuated vaccine (LAIV) may likewise influence immunization rates. Importantly, differences between undergraduate and graduate students as to vaccine perceptions and uptake have not been established. Documented barriers include vaccine accessibility, perceived lack of need for vaccination and lack of motivation to get vaccinated [7, 8, 9, 10, 11]. Convenience and incentives may also affect vaccine uptake [9]. Additionally, individual knowledge impacts vaccination. For example, a study at a large public university showed that when unvaccinated students learned how influenza vaccination protected young healthy people, most cited increased willingness to get vaccinated [8]. Likewise, a study of adults showed that those not knowledgeable about herd immunity were significantly less likely to report plans for vaccination [12].

In the United States, annual vaccination against seasonal influenza is recommended for all persons aged ≥ 6 months [13]. IIV is approved for use in individuals over 6 months of age and LAIV has been approved for use in healthy individuals 2–49 years of age since 2007 [14, 15]. Both IIV and LAIV vaccine effectiveness vary from year to year depending upon vaccine composition and match to circulating strains. Traditionally, university-based influenza vaccination programs have offered mainly or exclusively IIV. Offering a choice in vaccine could lead to higher vaccination rates, beginning with an understanding of the knowledge of LAIV and student preferences for receiving LAIV or IIV. The use of IIV or LAIV has been shown to increase vaccination rates especially in school-located vaccination programs [16, 17] and influenza vaccination in primary schools has been shown to decrease absenteeism [17, 18]. Larger scale immunization programs at universities offering a choice in vaccine, might also increase vaccination rates. Overcoming vaccine hesitancy in university students requires an understanding of the drivers and barriers to vaccine acceptance and preferences. This study aims to start the complex and multipronged approach to understanding how to tailor vaccine programming to specific college-aged groups.

2. Methods

We developed a cross-sectional survey and study data were collected and managed using REDcap electronic data capture tools hosted at the University of Florida (UF) [19]. REDCap (Research Electronic Data Capture) is a secure web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources. The University of Florida is a public university comprised of 16 colleges which offers more than 100 undergraduate majors and graduate degrees [20]. Deans of the individual UF Colleges (e.g. College of the Arts, College of Medicine) were contacted by email inquiring about their willingness to participate. If they agreed, an email was sent via the individual college listserv to all enrolled students with an explanation of the research and a link to the REDCap survey. The emailed survey was distributed and remained active from March–May 2018. The University of Florida's (UF) Institutional Review Board approved the study under Exempt Category Guidelines.

Survey questions included demographic information and questions about vaccination history, preference for vaccine type, knowledge of influenza vaccines, reasons for accepting or refusing vaccine, perceived barriers to vaccination, and preference for receiving vaccine information and education. Questions and response options were selected from previous research, and a previously piloted iteration of this survey. The REDCap format allowed for online administration with radio-dial response options, making completion time only a few minutes.

For inclusion in analysis we required students provided a response to gender, age, their enrolled college and class standing. Primary questions of interest which we required responses to were: history of flu vaccine

receipt and past contraction of influenza, vaccination status for 2017–18 academic year, whether or not vaccine history influenced their current decision to vaccinate or not, preference between IIV and LAIV and lastly, a response to all 11 knowledge assessment questions. Missingness was otherwise permitted and considered a non-positive response grouped with 'no' or 'did not select', as students were permitted to skip questions.

Descriptive statistics (frequencies, percentages) were used for demographics and key outcomes; analyses were conducted using SAS 9.4. Knowledge differences regarding influenza vaccine were assessed between groups via Chi-Square testing, with $\alpha = 0.05$ as the predetermined level of significance.

3. Results

There were a total of 1,122 responses representing about 2% of the student population (34,554 undergraduate, 17,813 graduate) with a median age of 22, and mean age of 25. The approximate number of students in the 14 colleges that would have been reached by the emails sent out via the listservs is 48,984 representing about 93.5% of the student population. Among the 1,039 who met inclusion criteria, the characteristics of those who responded sufficiently to the survey did not differ substantially from the overall survey respondent characteristic distributions (Table 1). The majority were female (80.0%), Non-Hispanic White (69.7%) and U.S. citizens (94.2%). Compared to the overall demographics at UF, more of the survey respondents were female, white and U.S. citizens.

Fifty-five percent of students from the 14 colleges indicated that their area of study was health-related: Agricultural and Life Sciences (33.7%, including dietetics, food science, animal and nutritional sciences) and Public Health and Health Professions (PHHP) (16.4%, including health science, public health, clinical and health psychology, occupational and physical therapy, and biostatistics). Graduate students represented almost half of the sample (46.3%), representing about one third of the student body (Table 1). Among graduate students 63% were in health-related fields, and 49% of undergraduates reported their area of study was health-related.

3.1. Influenza vaccination and medical decision making

Overall, self-reported vaccination was 62.8% yet uptake varied by college, ranging from 0.0% in business administration to 37.0% from the College of Arts, 65.8% of Liberal Arts and Sciences, and 75.9% in PHHP students. All but one respondent from the Colleges of Medicine, Nursing and Pharmacy were vaccinated and there were three times as many students in PHHP vaccinated than unvaccinated. UF requires influenza vaccination for all programs of study where students come in direct contact with patients or school-aged children. Additionally, students participating in volunteer programs with direct patient contact would also be required to receive a vaccination. This includes but is not limited to the colleges of medicine, nursing, and pharmacy. Of the students who identified their field of study as being health-related, 76.0% were vaccinated compared to 62.8% overall. Among those students in health-related studies who were vaccinated, 77.8% reported that it was required they receive the vaccination. In the nonhealth-related fields, only about half the students (46.9%) were vaccinated (Table 1). Class year for undergraduates did not affect vaccination status. However, graduate students had higher vaccination uptake (72.1%) compared to undergraduates (54.7%).

Among undergraduates, 56.5% relied on their parents or close family members for medical decision-making; 35.8% relied on their medical provider. Among unvaccinated undergraduates 58.9% would rely on advice from parents or close family members for medical decisions. Among graduate students, far fewer relied on their parents or family members for medical advice (22.8%), and the majority would rely on a medical provider (66.5%). Only 67.4% of undergraduate students routinely made their own medical appointments whereas 87.5% of the

Table 1
Analytic sample demographics & influenza vaccination rates.

	Demographic Distributions			Vaccination Uptake Within Demographic Characteristics
	Overall	Among Vaccinated	Among Unvaccinated	
Total Sample Size:	1,039	652 (62.8)	387 (37.3)	652 (62.8)
Age	24.4 ± 6.5	24.8 ± 6.5	23.8 ± 6.6	
Gender				
Male	187 (18.0)	113 (17.3)	74 (19.1)	113 (60.4)
Female	847 (81.5)	534 (81.9)	313 (80.9)	534 (63.1)
Transgender	5 (0.5)	5 (0.8)	–	5 (100.0)
Race/Ethnicity				
Asian	63 (6.1)	48 (7.4)	15 (3.9)	48 (76.2)
Black/African American	40 (3.9)	24 (3.7)	16 (4.1)	24 (60.0)
Native American/Pacific Islander	3 (0.3)	2 (0.3)	1 (0.3)	2 (66.7)
Hispanic	179 (17.2)	103 (15.8)	76 (19.6)	103 (57.5)
White	726 (69.9)	458 (70.3)	268 (69.3)	458 (63.1)
Other	28 (2.7)	17 (2.6)	11 (2.8)	17 (60.7)
US Citizens	979 (94.2)	612 (93.9)	367 (94.8)	612 (62.5)
Non-US Citizens ¹	58 (5.6)	39 (6.0)	19 (4.9)	39 (67.2)
College				
Agricultural and Life Sciences	350 (33.7)	175 (26.8)	175 (45.2)	175 (50.0)
Arts	27 (2.6)	10 (1.5)	17 (4.4)	10 (37.0)
Business Administration	5 (0.5)	–	5 (1.3)	0 (0.0)
Health and Human Performance	19 (1.8)	12 (1.8)	7 (1.8)	12 (63.2)
Journalism and Communications	79 (7.6)	34 (5.2)	45 (11.6)	34 (43.0)
Liberal Arts and Sciences	73 (7.0)	48 (7.4)	25 (6.5)	48 (65.8)
Public Health and Health Professions	170 (16.4)	129 (19.8)	41 (10.6)	129 (75.9)
Veterinary Medicine	1 (0.1)	1 (0.2)	–	1 (100.0)
Education	88 (8.5)	47 (7.2)	41 (10.6)	47 (53.4)
Engineering	1 (0.1)	–	1 (0.3)	0 (0.0)
Medicine	72 (6.9)	72 (11.0)	–	72 (100.0)
Nursing	46 (4.4)	45 (6.9)	1 (0.3)	45 (97.8)
Pharmacy	61 (5.9)	61 (9.4)	–	61 (100.0)
Design, Construction and Planning	47 (4.5)	18 (2.8)	29 (7.5)	18 (38.3)
Health Sciences Field of Study	575 (55.3)	437 (67.0)	138 (35.7)	437 (76.0)
Non-Health Sciences Field of Study ²	464 (44.7)	215 (33.0)	249 (64.3)	215 (46.9)
Undergraduate Students				
Overall	558 (53.7)	305 (46.8)	253 (65.4)	305 (54.7)
Freshman	99 (17.7)	49 (16.1)	50 (19.8)	49 (49.5)
Sophomore	119 (21.3)	76 (24.9)	43 (17.0)	76 (63.9)
Junior	183 (32.8)	90 (29.5)	93 (36.8)	90 (49.2)
Senior	157 (28.1)	90 (29.5)	67 (26.5)	90 (57.3)
Age	20.9 ± 3.7	20.9 ± 3.8	20.9 ± 3.5	–
Routinely makes own appointments for medical care	376 (67.4)	222 (72.8)	154 (60.9)	222 (59.0)
Does not routinely make own appointments for medical care	182 (32.6)	83 (27.2)	99 (39.1)	83 (45.6)
Graduate Students				
Overall	481 (46.3)	347 (53.2)	134 (34.6)	347 (72.1)
Age	28.5 ± 6.8	28.2 ± 6.4	29.3 ± 7.5	–
Routinely makes own appointments for medical care	421 (87.5)	312 (89.9)	109 (81.3)	312 (74.1)
Does not routinely make own appointments for medical care	60 (12.5)	35 (10.1)	25 (18.7)	35 (58.3)

Demographic Distributions presented within Columns (Overall, and Among the Vaccinated and Unvaccinated); Vaccine Uptake/Rates are Row Percentages.

¹ Two students preferred not to answer regarding citizenship.

² Six students did not indicate of their field of study was health-sciences related, and were grouped with those who were not.

graduate students routinely made their own appointments.

3.2. Vaccination history and influences to vaccinate

Over half the students (59.3%) answered Yes to “Have you ever had the Flu?” (Table 2). The majority had received an influenza vaccine at some time in the past (82.4%), and among those, only 49.0% indicated they received influenza vaccines routinely growing up. The influence of lifetime receipt of vaccine was split: 48.9% said that having received (or not received) influenza vaccines influenced their decision regarding vaccination now. Only 41.0% said their parents received influenza vaccine.

The greatest influences indicated by those who were vaccinated implied an understanding and knowledge about influenza vaccines: Most had a past history of influenza vaccination (86.5%); most believed that vaccination is the best way to protect themselves and others (91.3%); and most cited they had been taught about flu vaccine, how it works, and its importance (87.9%). Other reasons reported by the majority of vaccine

recipients included its recommendation by a health professional (67.6%) and that it was required (57.7%). Of all influences offered, the fewest (20.0%) indicated that incentives influenced their decision to be vaccinated.

Among vaccine recipients, most (77.0%) received the vaccine early in the season yet 8.6% received it late in the season after hearing of the flu's severity, and 14.4% indicated the timing was simply a matter of convenience. Students were vaccinated at UF clinics (47.7%) and pharmacy settings (24.3%) most frequently, but other settings included private clinic/physician's office, health department and urgent care clinics.

The most commonly cited reasons for not getting vaccinated included “Getting an influenza vaccine has never been a priority for me” (77.0%) and “It is inconvenient for me to take the time and/or go out of my way to get the vaccine (61.2%) (Table 2). Also, 38.2% of the unvaccinated believed that flu vaccines are ineffective and 31.5% did not believe that flu is severe enough to need to receive a vaccine. Over half (55.0%) said they just did not want an influenza vaccine and 42.6% believed their natural immune system offered sufficient protection from the flu.

Table 2
Influenza vaccination history, current vaccination status, influences and beliefs.

	Overall	Vaccinated	Unvaccinated
Have Ever Had the Flu	1,039 616 (59.3)	652 371 (56.9)	387 245 (63.3)
Have Ever Been Vaccinated	856 (82.4)	647 (99.2)	209 (54.0)
Type: Flu Shot Only	658 (76.9)	507 (78.4)	151 (72.3)
Type: Flu Shot and Flu Mist	192 (22.4)	139 (21.5)	53 (25.4)
Type: Flu Mist Only	6 (0.7)	1 (0.2)	5 (2.4)
Received Influenza Vaccines Regularly Growing up	419 (49.0)	329 (50.9)	90 (43.1)
Parents Received Influenza Vaccines Regularly Growing Up	428 (41.2)	347 (53.2)	81 (20.9)
Has the experience of having received (or not) influenza vaccines growing up influenced your decision regarding whether or not to get a vaccine now? ('yes')	508 (48.9)	326 (50.0)	182 (47.0)
Intend to get a vaccination next Fall Flu Season (yes)	698 (67.2)	607 (93.1)	91 (23.5)
Influences and Beliefs Among Vaccinated (Check all that apply)		Vaccinated	
I have received a flu vaccine in the past		564 (86.5)	
I believe the vaccine is the best way to protect myself and others		595 (91.3)	
I was required to get a flu vaccine (for any reason) If the vaccination was NOT required, would NOT have gotten it		376 (57.7) 72 (19.1)	
Someone I know had the flu recently, and I want to protect myself		199 (30.5)	
I saw a news report on the importance of influenza vaccines		280 (42.9)	
It was recommended by a health professional		441 (67.6)	
A friend encouraged me		134 (20.6)	
A parent or relative encouraged me		283 (43.4)	
I got an incentive for getting a vaccination (i.e. Free T-shirt, coupon, movie pass etc.)		132 (20.0)	
I have been taught about the flu vaccine, how it works, and its importance		573 (87.9)	
Identification of Single Greatest Influence: I believe the vaccine is the best way to protect myself and others		237 (36.3)	
Timing of Vaccination¹			
Received it early in the season		501 (77.0)	
Late in the season		56 (8.6)	
Timing was not a factor		94 (14.4)	
Location of Vaccination			
UF Clinic		311 (47.7)	
Pharmacy Settings		158 (24.3)	
Private Clinic/Physician's Office		72 (11.1)	
Other		111 (17.0)	
Influences and Beliefs Among Unvaccinated (Check all that apply)		Unvaccinated	
I am concerned about an adverse reaction or side effects		147 (38.0)	
I believe I will contract the flu from the vaccine		70 (18.1)	
I do not believe that flu vaccines are effective		148 (38.2)	
It is inconvenient for me to take the time and/or go out of my way to get the vaccine		237 (61.2)	
Getting an influenza vaccine has never been a priority for me		298 (77.0)	
I do not believe the flu is severe enough for me to need to receive a vaccine		122 (31.5)	
I cannot receive the vaccine due to allergies or other contraindications		17 (4.4)	
I choose not to receive any vaccines		53 (13.7)	
I believe my natural immune system offers sufficient protection from the flu		165 (42.6)	
I don't want an influenza vaccine		213 (55.0)	
Identification of Single Greatest Reason Not to Vaccinate: It was inconvenient for me to take the time and/or go out of my way to get the vaccine		107 (28.4)	

¹ N Miss = 1.

Sixty seven percent of respondents indicated they intended to get an influenza vaccination for next season, mirroring the 62.8% that reported vaccination this season. Thirteen percent of those who intend to get vaccinated next fall were not vaccinated this season. A few who received a vaccination this year did not intend to vaccinate next year (6.9%).

3.3. Knowledge of influenza

Overall, the student population was knowledgeable about influenza illness, vaccines and understood the concept of herd immunity (Table 3). The majority (92.8%) of respondents knew that all persons 6 months and older should get vaccinated annually, that complications from flu can lead to time away from work, school, hospitalization and even death (97.3%) and that healthy young people can die from influenza (93.8%). In addition, most (87.3%) understood that getting an influenza vaccine helped protect others from getting the flu, and that there are vulnerable populations who cannot receive influenza vaccination that would benefit if they get vaccinated (95.6%). Most students correctly answered 'False' to the statements describing common misconceptions: "The influenza vaccine is only minimally effective and thus not necessary if you are young and healthy" and "if I already got the flu there is no point in getting the influenza vaccine anymore" (89.0%, 91.8%).

However, there were some gaps in general knowledge. Surprisingly, 26.2% of the respondents still believed that you can "get the flu" from the vaccine, and a similar number (21.7%) did not know that getting an influenza vaccine reduces the severity and duration of influenza if they were to catch a strain not covered in the vaccine. Knowledge of IIV was better than for LAIV – 86.7% knew that the shot contains inactivated virus while only 59.3% knew that the intranasal spray contained live-attenuated virus.

The knowledge gaps were largest when comparing vaccinated to unvaccinated students. Unvaccinated students had fewer correct responses to all 11 knowledge-based questions with statistically significant differences on 10 of 11 of the knowledge questions. Graduate students were generally more knowledgeable about influenza than undergraduates with statistically significant differences in the proportion of correct responses observed in about half of the questions. Undergraduate students were less knowledgeable about both IIV and LAIV. More unvaccinated students (41.7%) believed you can get the flu from the vaccine.

3.4. Vaccine preferences

Among those who had ever been vaccinated (82.4%), 76.9% indicated they had only received IIV, with few (0.7%) receiving only LAIV and 22.3% receiving either IIV or LAIV on separate occasions (Table 2).

Among all surveyed, 72.7% indicated a preference for IIV over LAIV. Reasons for choosing IIV or LAIV are listed in Table 4. Among those who would choose IIV, 69.5% cited that they had always received IIV, 55.5% believed it provided better immunity and 52.7% were not familiar with LAIV. Reasons for LAIV preference were predominantly a dislike of needles (69.9%) but also the belief that it provides better immunity (21.9%). Of the students who prefer neither vaccine form (indicating they would opt not to vaccinate regardless of administration method), 50.0% said they had never been vaccinated, 76.1% said they would make this choice regardless of administration method and 79.1% said they felt they were making an informed decision (Table 4). Among those who indicated they prefer LAIV or Neither administration method (n = 284), when asked if a dislike of needles was among the reasons, the proportion who indicated YES was nearly identical between vaccinated and unvaccinated students (58% and 59% respectively). Students who preferred IIV (n = 755) were not asked if a dislike of needles was a contributing factor in their preference of vaccine administration.

Table 3

Knowledge of flu vaccines (True-False Statements) Overall, and between Vaccinated/Unvaccinated and Undergraduate/Graduate Students.

	Correct Response	Overall	Vaccinated	Unvaccinated	% Diff	CHISQ p-value
It is recommended by the Advisory Committee on Immunization Practices that all persons 6 months and older get the influenza vaccine annually	T	1,039 964 (92.8)	652 623 (95.6)	387 341 (88.1)	7.5	<.0001
You can get 'the flu' from an influenza vaccine	F	767 (73.8)	541 (83.0)	226 (58.4)	24.6	<.0001
Influenza illness complications can be severe, leading to extended time away from work or school, hospitalization and even death	T	1,011 (97.3)	636 (97.6)	375 (96.9)	0.7	0.5337
Getting an influenza vaccine helps protect others that I may come into contact with from influenza	T	907 (87.3)	590 (90.5)	317 (81.9)	8.6	<.0001
Getting an influenza vaccine reduces the severity and duration of influenza if I do catch a strain not covered in the vaccine	T	814 (78.3)	553 (84.8)	261 (67.4)	17.4	<.0001
Young and healthy people can die from influenza	T	975 (93.8)	625 (95.9)	350 (90.4)	5.5	0.0004
There are populations such as infants, and the immuno-compromised who cannot receive an influenza vaccination, and by receiving a vaccination myself, I am helping limit transmission throughout a community	T	99. (95.6)	636 (97.6)	357 (92.3)	5.3	<.0001
The influenza vaccine is only minimally effective, and thus not necessary if you are young and healthy	F	925 (89.0)	628 (96.3)	297 (76.7)	19.6	<.0001
If I already got the flu, there is no point in getting the influenza vaccine anymore, because I had the flu	F	954 (91.8)	619 (94.9)	335 (86.6)	8.3	<.0001
The intramuscular influenza "shot" vaccine contains inactivated (killed) virus	T	901 (86.7)	583 (89.4)	318 (82.2)	7.2	0.0009
The intranasal influenza "spray" vaccine (FluMist) contains live attenuated virus	T	616 (59.3)	419 (64.3)	197 (50.9)	13.4	<.0001
	Correct Response	Overall	Undergraduate	Graduate	% Diff	CHISQ p-value
Rate of Vaccination		1,039 652 (62.8)	558 (53.7) 305 (54.7)	481 (46.3) 347 (72.1)	– 17.4	–
It is recommended by the Advisory Committee on Immunization Practices that all persons 6 months and older get the influenza vaccine annually	T	964 (92.8)	509 (91.2)	455 (94.6)	3.4	0.0360
You can get 'the flu' from an influenza vaccine	F	767 (73.8)	363 (65.1)	404 (84.0)	18.9	<0.0001
Influenza illness complications can be severe, leading to extended time away from work or school, hospitalization and even death	T	1,011 (97.3)	540 (96.8)	471 (97.9)	1.1	0.2550
Getting an influenza vaccine helps protect others that I may come into contact with from influenza	T	907 (87.3)	471 (84.4)	436 (90.6)	6.2	0.0026
Getting an influenza vaccine reduces the severity and duration of influenza if I do catch a strain not covered in the vaccine	T	814 (78.3)	432 (77.4)	382 (79.4)	2.0	0.4355
Young and healthy people can die from influenza	T	975 (93.8)	521 (93.4)	454 (94.4)	1.0	0.4964
There are populations such as infants, and the immuno-compromised who cannot receive an influenza vaccination, and by receiving a vaccination myself, I am helping limit transmission throughout a community	T	99. (95.6)	529 (94.8)	464 (96.5)	1.7	0.1939
The influenza vaccine is only minimally effective, and thus not necessary if you are young and healthy	F	925 (89.0)	490 (87.8)	435 (90.4)	2.6	0.1774
If I already got the flu, there is no point in getting the influenza vaccine anymore, because I had the flu	F	954 (91.8)	504 (90.3)	450 (93.6)	3.3	0.0580
The intramuscular influenza "shot" vaccine contains inactivated (killed) virus	T	901 (86.7)	470 (84.2)	431 (89.6)	5.4	0.0109
The intranasal influenza "spray" vaccine (FluMist) contains live attenuated virus	T	616 (59.3)	288 (51.6)	328 (68.2)	16.6	<0.0001

Presented: % answered correctly within column group.

3.5. Education material preferences

Receiving information about influenza from a healthcare provider was the preferred source among all groups (34.6%) (Table 5). The next most popular sources were informational content received via university email and campus-wide educational events followed by online resources. Among those who selected they preferred their health care provider as first choice ($n = 360$), the top 3 next choice options to receive information included online resources (33.3%), campus-wide educational events (23.3%), and informational content via university email (20.6%) (data not shown). The unvaccinated and graduate students had a slight preference for online resources/emails over campus-wide events, yet overall, one in five (19.3%) did not wish to receive additional information about influenza vaccination.

4. Discussion

Increasing university-wide influenza vaccination requires coordinated and targeted public health interventions. This study provides relevant and actionable information regarding campus-wide differences in influenza vaccine knowledge levels between vaccinated and unvaccinated students, preferences for IIV or LAIV, differences in vaccine receipt between graduate and undergraduates, and preferences for vaccine education. This study also provides evidence that targeted messages within campus populations will be necessary and that a "one size fits all" approach will not be effective. Importantly, students in this cohort are receptive to influenza vaccination with higher vaccination rates than reported in other studies [4, 5, 6]. It is notable that of the students surveyed at this single yet diverse public university, 62% reported vaccination during the current season and a similar two-thirds indicated they

Table 4
Choice of vaccination type preferences and justification.

	IIV	LAIV	Neither
	755 (72.7)	196 (18.9)	88 (8.5)
Among those who prefer the shot:			
I have always received the shot	525 (69.5)	–	–
I believe the shot provides better immunity	419 (55.5)	–	–
I am not familiar with the intranasal spray vaccine, or its effectiveness	398 (52.7)	–	–
Among those who prefer FluMist:			
I believe the intranasal spray would provide better protection	–	43 (21.9)	–
I have never had a flu shot immunization	–	32 (16.3)	–
Among those who prefer FluMist or Neither:			
I do not like needles	–	137 (69.9)	30 (34.0)
<i>If a shot vaccine was the only type offered, would still opt</i>	–	56 (40.9)	23 (76.7)
<i>NOT to get one</i>			
Among those who prefer Neither:			
I have never had a flu shot, or intranasal spray immunization	–	–	44 (50.0)
I don't know enough about either vaccine to make an informed decision	–	–	23 (26.1)
I have made the choice that I will not receive a flu vaccine, regardless of administration method	–	–	67 (76.1)
<i>Do you feel you have enough information about the influenza vaccine and/or FluMist that your decision to receive neither is an informed one?</i>	–	–	53 (79.1)

planned to be vaccinated in the upcoming season. The higher vaccination rates at this university may reflect the vaccine requirement in health-related fields, the strong support of influenza vaccination by the university student health center as well as a strong local school-located influenza vaccination program. Graduate students may be more aware of these community programs because they have lived in the community longer and possibly have their own children enrolled in school, which could partially explain their higher vaccination rates.

Aside from emergencies during outbreaks, students will need to choose into vaccination, and this study clarifies how understanding decision-making skills, barriers and facilitators to vaccination and information delivery could be incorporated into any campus promotional vaccination campaign. Choosing an influenza vaccination may represent a younger students' first independent medical decision making opportunity and little evidence exists about how young adults develop into medical decision-makers. Most data come from studies of adolescents with chronic diseases and their transition to adult care [21, 22, 23].

Themes of anxiety about moving to unfamiliar environments, changing important medical professional relationships and fear of making the wrong medical decisions have surfaced in these studies [24]. Graduate students, naturally older than the undergraduates, had significantly higher vaccination rates, had a higher frequency of making their own medical appointments and relied less on parents for medical decision making. This likely reflects their increased comfort with navigating the medical arena independently, more experience with making their own medical decisions and also may reflect an emerging independent interest in their own personal health. This study identifies an opportunity to create messaging and education focused on developing decision-making skills of younger undergraduate students.

Decision-making requires accurate knowledge, which varied greatly in this cohort. Unvaccinated students were significantly less knowledgeable about influenza, vaccine recommendations and effectiveness than vaccinated students and graduate students were significantly more knowledgeable than undergraduates. More graduate students were in health-related fields which could explain the difference in knowledge. Surprisingly, a quarter (26.2%) overall still believed that you can "get the flu" from the influenza vaccine, with unvaccinated respondents nearly twice as likely to believe this. Education campaigns will need to directly address these myths and will need to target their efforts to the unvaccinated and undergraduate students especially those in nonhealth-related fields.

In addition to decision-making and knowledge, understanding barriers or hesitancy to vaccination provides further educational opportunities. For example, the relative lack of students' knowledge about LAIV possibly explains their higher preference for IIV. With a significant proportion of students preferring LAIV simply because of needle-aversion, choice in vaccine type may be important. The relative efficacy of LAIV and IIV appear to vary depending on the specific population studied, the type of study, and the degree of match to the circulating strains. LAIV was found to be more effective than IIV in children 6 months to 17 years with no decline in efficacy with increasing age [25, 26]. Most comparative studies in individuals 18–49 years of age have demonstrated that LAIV and IIV were similarly effective or that IIV was more effective [27, 28, 29, 30]. In US military studies, LAIV was more protective than IIV in new recruits of all ages, as effective in older non-recruits but less effective in younger non-recruits [31, 32]. Studies have not looked at the comparative effectiveness of LAIV and IIV specifically in the university age group. The immune response to influenza in these young adults might more closely mimic the response in older teens (15–17 year olds) than in somewhat older adults (ie. 30–49 year olds) and thus represent a "bridge" population between older and younger individuals. Additional studies will be needed to clarify this. The first priority should be to vaccinate as many individuals as possible with safe, available and approved vaccines. Increased awareness and education around vaccine options could lead to improved vaccination rates by having a choice

Table 5
Where/how students would like to receive more information about influenza.

	Overall	Undergraduate	Graduate	Vaccinated	Unvaccinated
FIRST CHOICE	1,039	558	481	652	387
Campus-Wide Educational Event (health fair etc.)	122 (11.7)	77 (13.8)	45 (9.4)	91 (14.0)	31 (8.0)
Media News (local television, radio, newspapers etc.)	59 (5.7)	27 (4.8)	32 (6.7)	43 (6.6)	16 (4.1)
Online Resources	107 (10.3)	54 (9.7)	53 (11.0)	57 (8.7)	50 (12.9)
Campus Flyers	7 (0.7)	5 (0.9)	2 (0.4)	3 (0.5)	4 (1.0)
My physician or healthcare provider	360 (34.6)	206 (36.9)	154 (32.0)	222 (34.0)	138 (35.7)
Informational Content sent to my University Email	143 (13.8)	76 (13.6)	67 (13.9)	95 (14.6)	48 (12.4)
Informational booths in dormitories or campus buildings	13 (1.3)	9 (1.6)	4 (0.8)	10 (1.5)	3 (0.8)
I do not wish to receive any additional information	201 (19.3)	90 (16.1)	111 (23.1)	116 (17.8)	85 (22.0)
SECOND CHOICE: Among those who reported their Physician or healthcare provider as top-choice (n=360)					
Online Resources	120 (33.3)				
Campus-wide Educational Events	84 (23.3)				
Informational Content sent to my university email	74 (20.6)				

Did not require non-missingness, as they were only able to select one for First-Second-Third out of the full list of options.

between a needle and a nasal mist.

Other significant barriers to vaccination included that vaccination was not a priority, it was inconvenient and respondents simply not wanting to be vaccinated. Having vaccine clinics in convenient, high traffic areas of campus, in dormitories, dining halls and at student unions after classes could increase access to vaccination. Nearly half of students who were vaccinated got their vaccine on campus and, over one quarter of the vaccinated received them at local pharmacies, emphasizing the need for robust on campus events and campus pharmacies to stock and promote vaccination. All of these barriers provide opportunity for educational initiatives. This study did not assess the barrier of cost. The justification for this conscious decision not to address the issue of cost is that all UF students are required to have health insurance either through their parents or a university plan, and a flu vaccination would be covered at no cost to the student. Flu vaccines are offered at multiple times and locations on campus to address access. However, cost should not be negated as a potential barrier to vaccine receipt on other university campuses.

There were also facilitators that could be maximized when planning campus vaccination campaigns. Students who choose vaccination for themselves overwhelmingly cited that vaccination satisfied a desire to protect themselves and others, required knowledge of flu vaccines and their importance, and relied on a history of being vaccinated. Additionally, a large majority stated that they got vaccinated because it was recommended by a professional.

Surprisingly, incentives (e.g. T shirts, food, coupons) were not a significant motivator in this student cohort. While incentives might energize the hesitant student or those that are unmotivated, they should not be overemphasized in vaccine campaigns. Those that got vaccinated were motivated by community-level benefits and a sense of altruism that should be promoted similar to older, successful campaigns like "Get yourself tested" that expand by a sense of duty to others.

Information delivery about influenza vaccination, the final piece needed for a vaccination campaign, showed uniformity between vaccinated, unvaccinated, graduate and undergraduate students. All groups primarily prefer to receive information from healthcare professionals. However, this choice hinges on students physically going to the doctor and seeking out information. With only 67% of undergraduates and 61% among the unvaccinated undergraduates making their own medical appointments, this may not be sufficient. Students cited emails, campus-wide educational events and online resources as preferential strategies for receiving information. Novel or hybrid methods such as campus-wide events and university emails that highlight the recommendations from healthcare providers, or infographics which encompass knowledge about the vaccine and links to other online resources may provide the broadest reach to all students, potentially translating to increased vaccination. This merits future study.

Limitations of this study deserve mention. This survey was performed only at a single, albeit large public university with a diverse student population from states all across the U.S. Additionally, students anonymously self-reported their vaccination status precluding any verification by health records. Due to the nature of this voluntary survey, the risk of ascertainment bias exists; the population who replied represent those who may be more inclined to vaccinate than the general college-age population as many were in health-related fields of study. Finally, the population surveyed included both graduate and undergraduate students and represents an older population than most college-based studies.

A sample of about 1,000 provides precise estimates, with a small margin of error, though generalizability is a function of those who responded. Our sample was comprised of both graduate and undergraduate students, was skewed toward females, and predominantly white. Results may not be generalizable to all university student populations.

Given the findings of this study where younger and less knowledgeable populations are less likely to choose influenza vaccination, universities need to plan for targeted campaigns surrounding annual influenza

vaccination using knowledge of the developing skills of decision-making, barriers and facilitators and information delivery. We believe that policies such as health students being required to receive vaccination are significant and that other groups need targeted interventions to persuade vaccine-hesitant populations to receive either LAIV or IIV vaccination. In conclusion, this survey encourages future cross-university interventional studies aimed at increasing accurate knowledge about influenza vaccination and provides evidence towards the scaffolding for the development of personal decision making in the emerging adult population.

Declarations

Author contribution statement

Kathleen A. Ryan, Stephanie L. Filipp: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Matthew J. Gurka, Lindsay A. Thompson: Analyzed and interpreted the data; Wrote the paper.

Alexander Zirulnik: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

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