Journal of Student-Run Clinics
Original Study

Overcoming Influenza Vaccination Barriers Through Community Outreach by a Student-Led Mobile Health Clinic

Ema V Karakoleva[1]; Katherine Spanos[1]; Hannah B Short[1]; Emma G Guare[1]; Erik B Lehman, MS[2]; Megan Mendez Miller, DO[3]

[1]Penn State College of Medicine, Hershey, Pennsylvania, USA
[2]Department of Public Health Sciences, Penn State College of Medicine, Hershey, Pennsylvania, USA
[3]Department of Family Medicine, Penn State Health, Hershey, Pennsylvania, USA

Corresponding Author: Ema V Karakoleva; email: ekarakoleva1@gmail.com

Published: August 17, 2024

Abstract

Background: Nearly half of United States adults were unvaccinated for influenza in 2022. Suboptimal vaccination rates remain a public health challenge affecting individual and community health. Influenza vaccination hesitancy (IVH) and limited access are especially prevalent among underserved communities. A promising way to combat IVH is through student-led community interventions. The organization Student-Run and Collaborative Outreach Program for Health Equity (SCOPE) at the Penn State College of Medicine (PSCOM) collaborated with community leaders to provide free influenza vaccinations in Central Pennsylvania (PA). We aim to analyze the impact of a student-led clinic on vaccination access and characterize vaccination-related community perceptions and behaviors.
Methods: This was a retrospective study. Two health fairs, "Family Wealth Through Health" (FWTH) and HANNA Pantry (HP), in rural PA and urban PA, respectively, were held at the beginning of the flu season (September-October 2022). Surveys assessing vaccine recipient demographics, vaccination status in the previous year, and motivation/intent to vaccinate, were administered. Results were analyzed using chi-square and t-tests.
Results: Of 51 respondents, 18 (35.3%) were from FWTH and 33 (64.7%) from HP. Race differed significantly ($p<0.001$) between sites but age ($p=0.203$) and sex ($p=0.754$) did not. One-fifth were unvaccinated the prior year, with reasons being "forgetting," "health," "cost," and "time." Six participants received vaccinations despite not planning to. Over half reported "doctor's office" as preferred location for vaccination, others being "pharmacy", "community health clinic", "work", and "store." Over 20% received earlier-than-planned vaccination at our clinic. Finally, coronavirus disease 2019 (COVID-19) impacted 13.3% of respondents' willingness to get vaccinated, significantly correlated with prior vaccination status ($p=0.011$) but not vaccination plans in the current season ($p=0.628$).
Conclusions: Direct influenza vaccination delivery by medical students in rural and urban Central PA improved vaccination uptake, access, and timeliness. Qualitative analysis revealed sociodemographic factors affecting IVH warranting consideration by student-led clinics.

Introduction

The seasonal influenza virus affects up to 20% of the United States (U.S.) population yearly. While most recover well, infection can lead to serious complications, hospitalizations, and death, especially in high-risk groups.[1,2] The Centers for Disease Control and Prevention (CDC) recommends annual influenza vaccinations starting at 6 months of age.[3] By 2030, the CDC aims to achieve a national vaccination coverage of 70%, with a current rate of 49.3%.[3,4] Effective influenza vaccine uptake is crucial for reducing individual mortality, establishing herd immunity, and alleviating financial burdens on the U.S. economy, as average influenza-related costs

surpass $11 billion annually.[5] The CDC recommends September or October vaccinations for optimal coverage against influenza, most prevalent from late fall to early spring.[6,7]

Factors affecting vaccination rates include public health campaigning, access, transportation, costs, and vaccine hesitancy.[8] Vaccine hesitancy, defined as the delay or refusal of vaccination against contagious disease despite vaccine availability, directly impacts country-wide vaccination rates. The 2018 National Internet Influenza Survey on Influenza Vaccination Hesitancy (IVH) revealed overall hesitancy rates of 36.9%.[9] Psychological factors include lack of perceived illness susceptibility, underestimation of disease severity, misunderstanding of recommendations, fear, and low trust in vaccine efficacy.[8,10,11] Therefore, special strategies must be undertaken to address healthcare barriers and IVH in high-risk areas.

To improve access, several studies have leveraged direct and convenient vaccination delivery. One group found that walk-in vaccinations had a significantly positive impact on vaccine receptiveness.[12] Additionally, community-based influenza clinics provide a unique opportunity for medical profession students to exercise leadership and serve high-risk populations. Furthermore, studies show that vaccination barriers are geographically dependent. In 2023, vaccination rates were 3.4% lower in rural compared to urban areas and 6.4% lower compared to suburban regions.[13] Dauphin County, Pennsylvania (PA) encompasses both highly rural and well-populated areas with unique healthcare barriers and lower influenza vaccination rates than neighboring counties, translating to a higher number of influenza cases and greater healthcare burden.[14,15] Therefore, we sought to address the low influenza vaccine uptake in Dauphin County, PA by delivering influenza vaccinations directly to the communities around rural Elizabethville and urban Harrisburg.

We aim to assess the impact of our student-led mobile clinic on influenza vaccination uptake, access, and timeliness among underserved communities in Central PA. Additionally, we will characterize community behavior related to influenza vaccination, including preferred timing and location for vaccination and self-reported factors affecting vaccination status. Our results will inform student-led clinics on strategies to optimize vaccination uptake, access, and timeliness among high-risk groups.

Methods

Student-Run Free Clinic at Community Health Fairs

The Student-Run and Collaborative Outreach Program for Health Equity (SCOPE) is a student-run organization at the Penn State College of Medicine (PSCOM) aiming to deliver affordable, effective, and culturally responsible healthcare across Central PA. In the fall of 2022, SCOPE collaborated with local community partners to provide free influenza education and vaccinations obtained from the PSCOM Department of Public Health Sciences for the events "Family Wealth Through Health" (FWTH) in Elizabethville, PA and the HANNA Pantry (HP) in Harrisburg, PA.

FWTH took place on September 18, 2022, from 10AM to 1PM in a Walmart parking lot, organized by the Northern Dauphin Human Services Center. Forty-three vendors provided resources and health education on topics including responder training, health insurance, addiction medicine, and public transportation access. The event was family-oriented with raffles, games, and activities encouraging participation. Over 200 individuals from over 50 families were in attendance. Twenty medical student SCOPE volunteers provided verbal and printed education on influenza vaccination and administered 21 vaccinations. HP took place in a community high school parking lot on October 22, 2022, from 9AM to 12PM. Geared towards predominantly socioeconomically disadvantaged groups, volunteers distributed food and donated goods. SCOPE's influenza vaccination station was placed proximal to the drive-thru for attendees visiting on their way to and back from other stations. Sixteen medical students administered 46 vaccinations. Students were trained and supervised by a family physician.

Participants

The FWTH and HP events were advertised via email, local newspaper ads, and social media websites at least three months prior. Participants were selected using the convenience sampling

Table 1. Demographics of participants at the "Family Wealth Through Health" event at Elizabethville, PA and the HANNA Pantry event at Harrisburg, PA

Demographic	Overall (N=51)	FWTH (N=18)	HP (N=33)	P value*
Age				
N (%)	22 (29)	3 (15)	19 (14)	0.203
Mean ± SD	50.36 ± 19.26	37.00 ± 22.52	52.47 ± 18.50	-
Min - Max	22 - 85	24 - 63	22 - 85	-
Median (IQR)	47 (29)	24 (39)	48 (31)	-
Sex, n (%)				
Female	32 (69.6)	13 (72.2)	19 (67.9)	0.754
Male	14 (30.4)	5 (27.8)	9 (32.4)	-
Race				
White	21 (55.3)	14 (93.3)	7 (33.3)	-
Black	4 (10.5)	1 (6.0)	3 (14.3)	-
Asian	9 (23.7)	-	9 (42.9)	-
Other	4 (10.5)	-	2 (9.5)	-

**P<0.05 represents significance.*
PA: Pennsylvania; FWTH: Family Wealth Through Health; HP: HANNA Pantry; SD: standard deviation; IQR: interquartile range.

method. Inclusion criteria included being 18 or older, receiving influenza vaccination directly prior by our group, and verbally consenting. Participants were recruited face-to-face at the SCOPE booth, where they received a flu vaccine. Study objectives were explained, and survey questions were administered to voluntarily consented individuals. Spanish and Nepali translators were available in Harrisburg. Collected data did not include identifiable personal health information, therefore the PSCOM institutional review board exempted this study.

Study Design

This was a retrospective study involving two participant groups at the FWTH and HP events who verbally answered the same survey after receiving an influenza vaccine (Appendix A). Volunteers administering surveys were blinded and responses were transferred and randomized in Excel (v2407, Microsoft, Redmond, WA) to minimize bias. Survey questions included demographic information, influenza vaccination status from the previous year, coronavirus disease 2019 (COVID-19) impact on participant intent or ability to receive influenza vaccination the previous year, and plans for receiving influenza vaccination the current influenza season prior to attending our event. Using open-ended question format, participants reported reasons for prior season unvaccinated status, COVID-19 impact, lacking plans for vaccination the current season, and preferred location and anticipated month to receive vaccination.

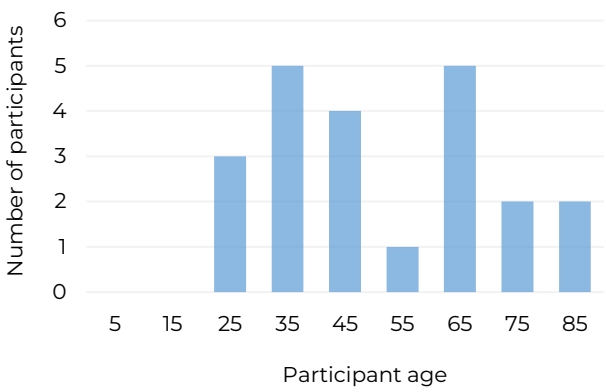
Statistical Analysis

The minimal sample size required to detect a medium effect was 32 using the formula G*Power 3.1, with power set at .80 and alpha at .05 with 1 degree of freedom. Statistical analysis was performed using SAS statistical software (v9.4, SAS Institute, Cary, NC). Percentage of participants who were vaccinated the prior year, whether and where they were planning to get vaccinated during the current season, and the mean time between the planned and actual dates of vaccination, were calculated. Data analysis included chi-square tests comparing differences in proportions of survey responses between the two sites and 2-tailed t-tests comparing mean differences between the two sites with significance level of 0.05. Numerical proportions of categorical variables were illustrated via pie charts and bar graphs.

Results

Of 51 eligible survey responses, 18 (35.3%) were from FWTH and 33 (64.7%) from HP (Table 1) with a mean age of 50.36 years and a majority of

Figure 1. Age distribution of all surveyed participants



N = 22, including 3 from the "Family Wealth Through Health" event at Elizabethville, PA and 19 from the HANNA Pantry event at Harrisburg, PA. Mean = 50.36 ± 19.26.
PA: Pennsylvania.

female respondents (69.6%) (Figure 1). There were no significant differences in age (p=0.203) or sex (p=0.754) between the two locations (p=0.203). Race differed significantly (p<0.001), with a White-to-non-White ratio of 1.4 overall, 14 in Elizabethville, and 0.5 in Harrisburg where Asian was the predominant race.

Nearly one-fifth of respondents (n=10, 19.6%) reported not receiving influenza vaccination the prior year (Table 2). Additionally, 6 participants (12%) were not planning to get vaccinated in the current 2022 influenza season. Between the two sites, there was no statistically significant difference in percentages of vaccinated individuals the prior year (p=0.305) or those planning to get vaccinated (p=0.646) (Table 2). Previously unvaccinated participants stated reasons such as "not getting the vaccine every year," "forgot," "no health insurance," "being in a mental hospital," "money," "scared," and "time."

Over half (n=20, 52.6%) were originally planning to visit a "doctor's office," and others reported "pharmacy" (n=9, 23.7%), "community health clinic" (n=4, 11%), "work," (n= 2, 5%) "store," (n=2, 5%) and "anywhere else but a store." (n=1, 3%) (Figure 2) The reported likelihood to receive vaccination at our clinic was not significantly different between sites (p=0.615) (Table 2). Roughly 20% (n=8) reported that vaccination at our clinic was occurring at least a month earlier than planned (Figure 3).

Finally, 13.3% of respondents reported that the COVID-19 pandemic impacted their willingness to get an influenza vaccine. Responses were not statistically different between the two sites (p=0.667). COVID-19 impact was significantly correlated with vaccination status the prior influenza season (p=0.011) but not with participants' plans to get vaccinated in the current season (p=0.628). Participants further reported that COVID-19 impacted them because they were "sick," "had no time last year," and "would rather get flu vaccine than COVID."

Discussion

Our events made influenza vaccination directly available in the community, resulting in a cumulative 12% of participants receiving vaccination that otherwise would have not. Vaccination barriers were mitigated through strategic intervention within easily accessible and centralized locations in the community. For example, the FWTH event was at a Walmart parking lot, facilitating the gathering of otherwise widely dispersed rural communities. Similarly, the HP site was located at a local high school with high population density, increasing chances of engaging passersby and citizens with limited mobility. Our intervention increased accessibility for participants ages 18-49 which represented 55% of completed surveys (Figure 1). This is important given this age group typically has the lowest vaccination rates nationally.[9,16,17] While age was similar, race differed across sites with mostly Asian subjects in Harrisburg, emphasizing the importance of providing culturally responsive site-specific delivery of healthcare services.

Our student-led events provided earlier-than-planned vaccination to approximately one-fifth of participants through improved access to up-to-date vaccinations against the current season's influenza strains. Data shows that delaying vaccination from August/September to October by a significant proportion of the community increases the overall complication-related hospitalization rates and may increase the risk of avoiding vaccination altogether.[7] It is, however, important to acknowledge the possibility of waning immunity later in the season that may make early

Table 2. Survey responses of participants at the "Family Wealth Through Health" event at Elizabethville, PA and the HANNA Pantry event at Harrisburg, PA.

Survey question, n (%)	Overall	FWTH	HP	P-value*
Vaccinated the prior year	41 (80.4)	16 (31.4)	25 (49.0)	0.305
Planning to get vaccinated during the current season	44 (88.0)	15 (30.0)	29 (58.0)	0.646
Planning to receive vaccination at our community health clinic	4 (10.5)	2 (5.3)	2 (5.3)	0.615
COVID-19 pandemic on willingness to get an influenza vaccine	6 (13.3)	1 (2.2)	6 (13.3)	0.667

**P<0.05 represents significance.*
PA: Pennsylvania; FWTH: Family Wealth Through Health; HP: HANNA Pantry; COVID-19: coronavirus disease 2019.

Figure 2. Preferred location to receive influenza vaccination for the 2022 influenza season as reported by study participants (N=38)

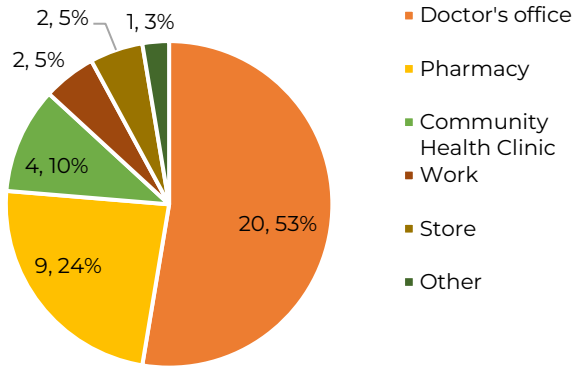
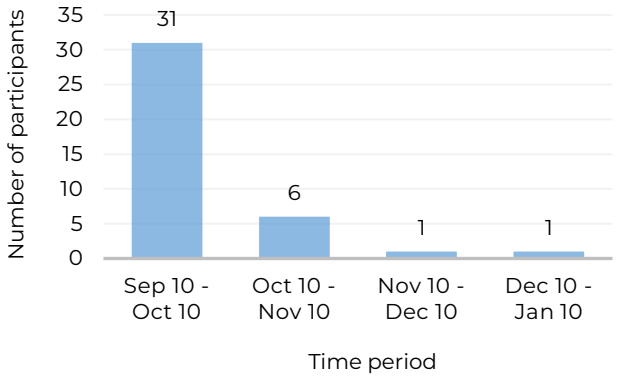


Figure 3. Preferred time for receiving Influenza vaccination as self-reported by participants in both studies



Each bar shows the number of participants who were planning to receive a vaccine within the same month of the clinic (Sept 10 - Oct 10), 1 month later (Oct 10 - Nov 10), 2 months later (Nov 10 - Dec 10), or 3 months later (Dec 10 - Jan 10). N = 38.

vaccinated individuals less protected during later peaks in the season, especially since predicting seasonal peaks can be challenging.[18,19] Nevertheless, the Advisory Committee on Immunization Practices (ACIP) recommends influenza vaccination in September or October, with equal health benefits observed for people vaccinated in either month.[7] Therefore, our group is encouraged by our ability to offer timely vaccination in the community in line with ACIP recommendations.

Finally, the majority (90%) of community members who received vaccination at our free clinic were planning to do so at alternative locations such as a "doctor's office" (53%). National 2022-2023 statistics showed an increase of 2 million vaccinations administered in pharmacies and a reduction of 3.5 million in physician offices compared to the previous year.[4] Although it remains unknown if and where patients received vaccinations instead, community efforts like ours may play an important role in filling this gap in coverage. More data on location of vaccine administration and factors affecting such decisions is needed to understand vaccination-related public perceptions and behaviors.

Roughly half of Pennsylvanians (45%) and Dauphin County residents (51%) do not receive vaccination annually;[3] therefore, additional efforts are necessary to target vaccination barriers reported by participants. Reasons identified through survey responses included "time," "forgot," "health," "money," and "does not get it every year," with "time" being the most common. Additionally, our findings showed that those whose receptiveness to influenza vaccination was impacted by COVID-19 did get vaccinated, implying that COVID-19 helped to mitigate vaccination barriers. This may be explained by increased

public health efforts to combat IVH during the COVID-19 pandemic. Future work addressing vaccination barriers highlighted in our results including lack of time or personal health problems is needed.

The success of our intervention rests on the unique combination of previously reported methods found to improve healthcare access. Mobile health clinics have been of increasing importance in reaching vulnerable populations, particularly through curbside delivery of health services in underserved communities.[20] For example, a mobile clinic in rural southern Minnesota successfully brought lab testing and primary care exams directly to patients, significantly reducing travel time and costs.[21] Non-medical methods of increasing vaccination uptake such as retail, mobile clinics, door-to-door, or street-based approaches, have been successfully applied even before the COVID-19 pandemic,[22,23] but have been especially impactful in recent times due to increased patient hesitancy to risk exposure in healthcare settings.[24] Reports on student-led mobile clinics have shown successful delivery of COVID-19, Tetanus, Diphtheria, Pertussis (Tdap), and pneumococcal vaccinations in the community, even exceeding national averages.[25,26] By integrating mobile health, non-traditional vaccination delivery, and student-led clinics into one model, we delivered convenient, easily accessible influenza vaccination in two different underserved communities facing multiple healthcare barriers and low influenza vaccination rates.

Other student-led clinics can derive valuable insights by examining our methods, participant recruitment, the support network from medical and community institutions, and the logistical framework of our events. These aspects serve as focal points for community intervention planning. Moreover, our study has elucidated several distinctions between rural and urban areas including the selection of service locations, demographic considerations, and encountered challenges. The provision of education by medical profession students to mitigate IVH, the necessity for translators and culturally competent care pronounced in urban settings, and the strategic timing of influenza vaccination to align with recommended guidelines are key areas identified for attention and action.

Strengths

Our public intervention achieved a twofold goal of analyzing the impact of a student-led mobile health clinic on vaccination uptake in underserved areas of Central PA and qualitatively characterizing the factors affecting IVH. The outcomes rely on an extensive planning process including a Penn State Health 2021 Community Health Needs Assessment (CHNA) needs assessment, organizational support by faculty, local government community grants, close collaboration with community leaders and vendors for delivery of comprehensive services, and successful engagement of family units. The direct availability of influenza vaccination in a public setting further allowed informal discussion and education on vaccination benefits and safety for those likely to face barriers to information due to limited time and insurance coverage. Our study confirms prior findings of increased interest in vaccination following community-based interventions in underserved neighborhoods.

Finally, the open-ended question format allowed qualitative exploration of self-reported reasons contributing to IVH and barriers to care, while the inclusion of two demographically and geographically different participant groups increased the generalizability of this study.

Limitations

Limitations include participant selection bias, as our intervention targeted individuals who may be more likely or able to attend vaccination events and those more likely or able to answer survey questions. Regarding survey design, utilizing broad language for survey questions offered qualitative benefits, though it may have enabled response bias or failed to characterize positive vs. negative impact of external factors (e.g. COVID-19 pandemic). Additionally, surveys and vaccinations were oftentimes administered by the same volunteer which may have introduced social desirability bias. Finally, the small sample size and attrition rate of demographic questions limited the scope of our understanding of the sociodemographic effects that drive decision-making and create obstacles to vaccination access.

Future Directions

Further investigation on the factors contributing to vaccine hesitancy is needed. For future student-led healthcare delivery events, we recommend special consideration of sociodemographic factors such as age, sex, race, geographic location, and accessibility, to understand the disproportional rates of IVH and healthcare barriers impacting underserved communities. Our findings can be utilized in conjunction with other aspects of IVH such as immigration status, health insurance coverage, education level, and household income, which have been shown to correlate with willingness to receive vaccination.[27] Characterizing the relationship between sociodemographic factors and influenza vaccination rates will ultimately optimize delivery of healthcare services to communities in need.

Conclusion

By utilizing a non-traditional approach to influenza vaccination through direct community engagement, our student-led healthcare clinic improved vaccination uptake and convenience of location and timing and identified factors affecting vaccination hesitancy and barriers to care.

Acknowledgements

We would like to thank Bonnie Kent (Operations Manager, Northern Dauphin County Human Services) for her guidance and partnership, the volunteers at the health fairs in Elizabethville, PA and Harrisburg, PA, and the SCOPE student leaders and volunteers affiliated with the Penn State College of Medicine in Hershey, PA.

Disclosures

This work was supported by a grant from the Dauphin County Commissioners [IO#400001004755].

References

1. Coleman BL, Fadel SA, Fitzpatrick T, Thomas SM. Risk factors for serious outcomes associated with influenza illness in high- versus low- and middle-income countries: Systematic literature review and meta-analysis. Influenza Other Respir Viruses. 2018;12(1):22-9. https://doi.org/10.1111/irv.12504 LINK
2. Chaves SS, Naeger S, Lounaci K, et al. High-dose influenza vaccine is associated with reduced mortality among older adults with breakthrough influenza even when there is poor vaccine-strain match. Clin Infect Dis. 2023;77(7):1032-42. https://doi.org/10.1093/cid/ciad322 LINK
3. Centers for Disease Control and Prevention. Influenza vaccination coverage for persons 6 months and older [Internet]. Atlanta (GA): CDC; 2021 May 28 [accessed 2022 Dec 18]. Available from: https://www.cdc.gov/flu/fluvaxview/interactive-general-population.htm?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fflu%2Ffluvaxview%2Freportshtml%2Freporti1920%2Freportii%2Findex.htmldult-coverage.html LINK
4. Centers for Disease Control and Prevention. Flu vaccination coverage, United States, 2022-2023 influenza season [Internet]. Atlanta (GA): CDC; [updated 2023 Oct 10; accessed 2022 Dec 18]. Available from: www.cdc.gov/flu/fluvaxview/coverage-2223estimates.htm#:~:text=In%20the%202022%E2%80%9323%20flu,the%20prior%20season%20(49.4%25 LINK
5. Putri W, Muscatello DJ, Stockwell MS, Newall AT. Economic burden of seasonal influenza in the United States. Vaccine. 2018;36(27):3960-6. https://doi.org/10.1016/j.vaccine.2018.05.057 LINK
6. Belongia EA, Sundaram ME, McClure DL, et al. Waning vaccine protection against influenza A (H3N2) illness in children and older adults during a single season. Vaccine. 2015;33(1):246-51. https://doi.org/10.1016/j.vaccine.2014.06.052 LINK
7. Grohskopf LA, Blanton LH, Ferdinands JM, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the advisory committee on immunization practices - United States, 2022-23 influenza season. MMWR Recomm Rep. 2022;71(1):1-28. https://doi.org/10.15585/mmwr.rr7101a1 LINK
8. Schmid P, Rauber D, Betsch C, Lidolt G, Denker ML. Barriers of influenza vaccination intention and behavior - a systematic review of influenza vaccine hesitancy, 2005 - 2016. PLoS One. 2017;12(1):e0170550. https://doi.org/10.1371/journal.pone.0170550 LINK
9. Srivastav A, Lu PJ, Amaya A, et al. Prevalence of influenza-specific vaccination hesitancy among adults in the United States, 2018. Vaccine. 2023;41(15):2572-81. https://doi.org/10.1016/j.vaccine.2023.03.008 LINK
10. Nowak GJ, Sheedy K, Bursey K, Smith TM, Basket M. Promoting influenza vaccination: insights from a qualitative meta-analysis of 14 years of influenza-related communications research by U.S. Centers for Disease Control and Prevention (CDC). Vaccine. 2015;33(24):2741-56. https://doi.org/10.1016/j.vaccine.2015.04.064 LINK
11. Bekkat-Berkani R, Romano-Mazzotti L. Understanding the unique characteristics of seasonal influenza illness to improve vaccine uptake in the US. Vaccine 2018;36(48):7276-85. https://doi.org/10.1016/j.vaccine.2018.10.027 LINK
12. Bonner KE, Chyderiotis S, Sicsic J, et al. What motivates adults to accept influenza vaccine? An assessment of incentives, ease of access, messaging, and sources of information using a discrete choice experiment. SSM Popul Health. 2023;22:101384. https://doi.org/10.1016/j.ssmph.2023.101384 LINK
13. Centers for Disease Control and Prevention. Influenza vaccination coverage, adults [Internet]. Atlanta (GA): CDC; [updated 2024 Apr 12; accessed 2022 Dec 18]. Available from: https://www.cdc.gov/flu/fluvaxview/dashboard/vaccination-adult-coverage.html LINK
14. Center for Rural Pennsylvania. Rural-Urban Maps [Internet]. Harrisburg (PA): Center for Rural Pennsylvania; 2020. [accessed 2022 Dec 18]. Available from: https://www.rural.pa.gov/data/rural-urban-definitions LINK

15. Pennsylvania Department of Health. Pennsylvania Weekly Influenza Report [Internet]. Harrisburg (PA): Pennsylvania Department of Health; 2020 Sep 29 [accessed 2022 Dec 18]. Available from: https://www.health.pa.gov/topics/Documents/Diseases%20and%20Conditions/Flu/2019-2020%20influenza%20season%20summary.pdf LINK
16. Kini A, Morgan R, Kuo H, et al. Differences and disparities in seasonal influenza vaccine, acceptance, adverse reactions, and coverage by age, sex, gender, and race. Vaccine. 2022;40(11):1643-54. https://doi.org/10.1016/j.vaccine.2021.04.013 LINK
17. Centers for Disease Control and Prevention. Flu vaccination coverage, United States, 2021–22 influenza season [Internet]. Atlanta (GA): CDC; [updated 2022 Oct 18; accessed 2023 Oct 12] Available from: https://www.cdc.gov/flu/fluvaxview/coverage-2022estimates.htm#print LINK
18. Ferdinands JM, Alyanak E, Reed C, Fry AM. Waning of influenza vaccine protection: exploring the trade-offs of changes in vaccination timing among older adults. Clin Infect Dis. 2020;70(8):1550-9. https://doi.org/10.1093/cid/ciz452 LINK
19. Ferdinands JM, Gaglani M, Martin ET, et al. Waning vaccine effectiveness against influenza-associated hospitalizations among adults, 2015-2016 to 2018-2019, United States hospitalized adult influenza vaccine effectiveness network. Clin Infect Dis. 2021;73(4):726-9. https://doi.org/10.1093/cid/ciab045 LINK
20. Yu SWY, Hill C, Ricks ML, Bennet J, Oriol NE. The scope and impact of mobile health clinics in the United States: a literature review. Int J Equity Health. 2017;16(1):178. https://doi.org/10.1186/s12939-017-0671-2 LINK
21. Iqbal A, Anil G, Bhandari P, et al. A digitally capable mobile health clinic to improve rural health care in America: a pilot quality improvement study. Mayo Clin Proc Innov Qual Outcomes. 2022;6(5):475-83. https://doi.org/10.1016/j.mayocpiqo.2022.08.002 LINK
22. Uscher-Pines L, Harris KM, Burns RM, Mehrotra A. The growth of retail clinics in vaccination delivery in the U.S. Am J Prev Med. 2012;43(1):63-6. https://doi.org/10.1016/j.amepre.2012.02.024 LINK
23. Coady MH, Weiss L, Galea S, et al. Rapid vaccine distribution in nontraditional settings: lessons learned from project VIVA. J Community Health Nurs 2007;24(2):79-85. https://doi.org/10.1080/07370010701316163 LINK
24. Leibowitz A, Livaditis L, Daftary G, et al. Using mobile clinics to deliver care to difficult-to-reach populations: A COVID-19 practice we should keep. Prev Med Rep. 2021;24:101551. https://doi.org/10.1016/j.pmedr.2021.101551 LINK
25. Fisher EL, Sack DE, Gonzalez Pena T, et al. COVID-19 vaccination program at a student-run free clinic: A descriptive study. Prev Med Rep. 2022;30:101992. https://doi.org/10.1016/j.pmedr.2022.101992 LINK
26. Abuelenen T, Khalil S, Simoneit E, et al. Prevent and protect: a vaccination initiative for uninsured patients at a student-run free clinic. J Community Health 2020;45(5):910-5. https://doi.org/10.1007/s10900-020-00808-w LINK
27. Agency for Healthcare Research and Quality. 2022 national healthcare quality and disparities report. Rockville (MD): AQHR; Oct 2022 [updated Jul 2023; accessed 2023 Jan 7]. Available from: https://www.ahrq.gov/research/findings/ nhqrdr/nhqdr22/index.html LINK