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ADVANCES IN PHARMACY PRACTICE

Pharmacist assessments and care to improve adult vaccination rates: A report from project IMPACT vaccine confidence

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ABSTRACT

Background: Neglect of vaccination needs among adults results in a needless burden of hospitalization, suffering, and death. America's community pharmacists deliver a substantial portion of adult vaccinations, yet many Americans still have unmet vaccination needs.
Objectives: This study evaluated rates of vaccine contraindications, acceptance, and willingness to be vaccinated among ambulatory adults.
Practice description: This was a prospective, multisite, multistate, observational study conducted in three waves between October 2021 and August 2023.
Practice innovation: Pharmacists conducted comprehensive vaccination need assessments.
Evaluation methods: The primary outcomes were numbers of vaccination needs per participant and vaccinations administered, scheduled, or declined.
Results: Pharmacists identified a mean of 1.8-2.2 unmet vaccination needs per adult assessed, more than in pilot studies. Participants had already received 61%-74% of vaccinations recommended for them hence 26%-39% of needs were unmet at baseline. The leading vaccination needs were COVID-19, influenza, zoster, tetanus-containing, and pneumococcal vaccines. From a baseline mean of 59.1% for these five vaccinations, pharmacists increased the mean percentage vaccinated to 73.2%. When an option for scheduling future vaccination was added to the process, declinations dropped from 46%-18%.
Conclusion: This study provides insight into adult vaccine acceptance, willingness, and declination behaviors not described elsewhere. Offering options for future vaccination reduced declination rates. Pharmacists resolved substantial proportions of adult vaccination needs. The signal that apportioning adult vaccines needed, but not received on day of assessment, across several months could help resolve unmet vaccination needs warrants additional research, especially with the rising number of vaccines recommended for adults.

Background

Tens of millions of American adults are vulnerable to serious preventable infections, yet are unvaccinated.[1,2] These vulnerabilities are largely unnecessary because vaccination can substantially reduce the burdens from COVID-19, influenza, pneumococcal disease, zoster, tetanus, pertussis, and more than a dozen other infectious diseases.[3]

Unfortunately, not enough health care providers proactively offer vaccination to their patients.[4] This lack of offering was compounded during the COVID-19 pandemic by issues of reluctance to seek care, lack of access to care when willing, vaccine hesitancy, and other factors.[5]

Prior studies showed pharmacists are effective at identifying unmet vaccination needs and resolving them at the patient's community pharmacy.[6,7] During the COVID-19 pandemic, pharmacists delivered more COVID-19 vaccinations than all other health care provider types combined.[8,9] Geomapping models showed that 48% of the U.S. population lived within 1 mile of a pharmacy, 89% within 5 miles, and 96%

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Key Points

Background:

- Pharmacists can identify unmet vaccination needs and resolve them in community pharmacies.
- Ready access to electronic vaccination records at pharmacy points of care enables vaccination delivery in pharmacies.

Findings:

- Adults assessed in spring-summer months needed more vaccinations to get up-to-date than adults presenting during "flu-shot season".
- Offering an option for scheduling future vaccination decreased the rate of vaccine declination.

within 10 miles.[10] In large metropolitan areas, 63% of pharmacies were chain pharmacies whereas, in rural areas, 76% of pharmacies were franchises or independent pharmacies.

Project IMPACT (IMProving America's Communities Together) immunizations,[6,7] building on earlier project IMPACT initiatives,[11-18] provided models to identify unmet vaccination needs, enable shared decision-making, and increase vaccination rates by improving processes that engage patients within community pharmacy practices. In the pilot project, pharmacists identified the need for 1.45 vaccinations per person assessed and increased vaccination rates by 41.4%.[6] In the follow-up scaled demonstration project, vaccination forecasts identified 11,789 unmet vaccination needs (1.9 per person), 54.3% of which were fulfilled during the study period.[7] Without the pharmacists' interventions, most of these patients likely would have remained vulnerable to serious infection.

Despite the success of these two studies, we recognized the need for process design improvements to make the workflow less dependent on custom-built interfaces with state immunization-information systems (IISs, i.e., vaccine registries). While the COVID-19 pandemic brought adult vaccination to public attention, much of the dialog was skeptical. Broad segments of the public hesitated before accepting vaccination. Thus, we sought to enhance the previous processes to be implementable more widely and to adjust messaging to address the pandemic circumstances.

To guide the present project, the American Pharmacists Association (APhA) Foundation (APhAF) sponsored a survey of pharmacy patients regarding beliefs and behaviors related to adult vaccination. From June through August 2021, 2019 patients at 32 community pharmacy practices in 13 states were queried (data not shown). Three-quarters of the respondents received influenza vaccination in recent years. Two-thirds reported receiving vaccinations at a pharmacy. Respondents visited a primary care provider a mean of 2.3 times per year and their pharmacy practice 7.7 times per year. Survey responses found strong concern about COVID-19 disease severity and vaccine efficacy. To increase their confidence in COVID-19 vaccination, respondents asked for more information about these vaccines, including long-term safety data.

In close-out discussions after the first two pilot projects,[6,7] participating pharmacists recommended more complete lists of options in the database interface (e.g., more detailed lists of patient choices and reasons for declination). They also recommended streamlined documentation processes and the ability to give patients documents describing their current vaccination status and what vaccines they still need.

Objectives

Building on the pilot projects, this study evaluated how implementing vaccination reviews by pharmacists with dedicated vaccination profile software would affect the pharmacist's ability to identify unmet vaccination needs and increase rates for routine adult vaccinations. We sought an efficient process respecting the pharmacists' clinical workload. Midstudy revisions added assessment of patient willingness to receive vaccines not administered on the day of assessment. These objectives were addressed in the context of the ongoing COVID-19 pandemic.

Methods

Safeguards: the study was approved by an institutional review board (IRB) and registered in a clinical trials database (NCT03372967). Data collection, use, and management procedures were compliant with the patient confidentiality provisions of the Health Insurance Portability and Accountability Act (HIPAA).

Setting, pharmacy eligibility: In brief, project IMPACT vaccine confidence was a prospective, multisite, multistate observational study, similar in design to those of project IMPACT immunization previously described,[6,7] adding key messaging related to COVID-19 disease and vaccine, as well as providing clinical decision support software. Pharmacy practices were selected to provide a mix of urban, suburban, and rural settings, resources, IIS capabilities, motivation to enroll participants, and project-management experience. Pharmacists were recruited and trained on the software and key messaging elements. Participating pharmacy practices were provided a stipend to offset costs of participation.

Messaging: the research team equipped the pharmacists with "Vaccine Confident" resources, both regarding COVID-19 as well as other vaccinations. These resources are among the many provided by the APhA at vaccineconfident.pharmacist.com. The messaging was designed to acknowledge patient questions about vaccination and communicate personally and responsibly with them, according to risk-communication principles.

Patient eligibility criteria: To be included in the evaluable population for data analysis, participants were at least 18 years of age, patients of a participating pharmacy, and with documentation of the pharmacist's review of the patient's vaccination records.

Implementation: patients were enrolled in three waves: wave 1 — October 2021-January 2022; wave 2 — February-August 2022; wave 3 — March-August 2023. Patients were selected by their pharmacist and based on 1 of several types of encounters. Starting with wave 1 and continuing throughout the study, patients were evaluated once if they had any of the following encounter types:

- Request for influenza or COVID-19 vaccination,
- Comprehensive medication therapy review, or
- Other clinical encounters where the pharmacist initiated a vaccine conversation.

During the course of their standard workflow, the pharmacists performed the need assessments and engaged the patient in dialog. Given the variety of settings, pharmacists had autonomy to determine how best to integrate the project into their daily operations.

During waves 2 and 3, a fourth encounter type was added, medication-refill synchronization, to gain specificity.

During wave 3, three more encounter types were added:

- Any other vaccination
- Any new prescription dispensed
- Any prescription refilled

Patients in wave 3 were asked for their reasoning if they declined vaccination. Responses were grouped by the pharmacist into 1 of four categories: lack of trust, disease indifference, cost, or other. Given the longer interval with waves 2 and 3, some pharmacists at their own discretion met with patients up to three times during the encounter period.

Vaccination status: A proprietary vaccination database (distinct from prescription management software) was built by the APhAF for a Microsoft Teams environment using the Microsoft Azure SQL Database. The data-input procedures followed what was termed "documentation by exception." The software started with default entries presuming that age-based vaccinations recommended by the Advisory Committee on Immunization Practices (ACIP) already had been given and documented in the jurisdiction's IIS. As the pharmacist identified needs (e.g., lack of an IIS record, a patient's own knowledge), the pharmacist revised the database fields accordingly, documenting actions, and decisions at time of patient consultation. If no IIS record was available, electronic health records, paper records, and dialog with the patient were used as the basis for determining prior vaccination.

Consultations: pharmacists reviewed the patient's vaccination history in their respective IIS system (or other records) and compared that data to ACIP guidelines to identify unmet needs based on patient age. Pharmacists could apply ACIP recommendations based on their knowledge of patient health conditions and other risk factors. Following an in-person consultation with each patient, pharmacists documented:

- Unmet vaccination needs,
- Contraindications to vaccination,
- Vaccinations delivered on day of assessment,
- Vaccinations scheduled for a specific date as a follow-up visit within a few weeks,
- Vaccinations intended to be sought some unspecified time in the future, or
- Declinations of vaccination (including rationale for declinations, with an expanding degree of detail of declination types recorded in successive waves of the study).

Data analysis: vaccination needs were defined as the sum of each vaccination recommended by the ACIP for each specific patient. Met needs were those needs already fulfilled before the pharmacist encounter. Unmet needs were those needs that patients had not yet obtained at baseline. Proportions were calculated using the corresponding number of needs or number of applicable patients as the denominators. Data collected were analyzed with descriptive statistics. To compare age strata for patients' vaccination status, proportions were compared with Fisher's exact tests. Analyses of needs per person and their disposition were stratified by age cohort and by vaccine type.

Results

Table 1 describes characteristics of the pharmacy practices, time interval of the encounters, and varying elements of the interventions in each wave. The pharmacy practices reflected a diverse range of rural, urban, and suburban settings across multiple states. Wave 1 occurred during high-volume "flu-shot season," whereas waves 2 and 3 occurred during spring and summer months.

Table 2 describes the demographics of the patients enrolled and the basis that triggered evaluation. Seven pharmacies participated in all three waves. Eight of the 21 pharmacies in wave 2 also participated in wave 1. All of the pharmacies in wave 3 participated in wave 2.

Table 3 reflects the frequency of vaccinations identified as needed. Patient enrollment per pharmacy increased slightly as the waves progressed. Unmet vaccination needs per patient enrolled was relatively constant across the waves. The spring and summer months of waves 2 and 3 reduced the need for influenza vaccination. During wave 1, pharmacists enrolled 1214 patients (mean 101 patients per pharmacy). They had already been vaccinated to meet 7113 of their personal vaccination needs at time of consultation. In aggregate, these patients had 2446 unmet vaccination needs (mean 2.0 unmet needs per patient; 25.6% of vaccinations they needed).

During wave 2, pharmacists enrolled 2877 patients (mean 115 patients per pharmacy). At baseline, these patients had 8204 met and 5318 unmet vaccination needs (mean 1.8 unmet needs per patient; 39.3% of vaccinations they needed).

During wave 3, pharmacists enrolled 1977 patients (mean 152 patients per pharmacy). In aggregate, these patients had 7075 met and 4346 unmet vaccination needs (mean 2.2 unmet needs per patient; 38.1% of vaccinations they needed).

Table 4 provides detail on the numbers of contraindications identified, vaccinations delivered on day of assessment, vaccinations scheduled for a specific date within the next few weeks, vaccinations identified for later delivery, and declinations. The 50.3% administered value in wave 1 included many influenza vaccinations, which were not pertinent in the other two waves. Notably, a drop in the declination rate was evident when patients were offered the opportunity to return at a later date to resolve unmet vaccination need. Waves 2 and 3 documented drops in declinations from 46% to ~18%.

To assess age-based differences in vaccine acceptance (e.g., pneumococcal vaccine recommendations become routine at age 65), these data are stratified in Supplemental Table S1. The breakpoint at age 65 was based on previous literature on vaccine-seeking behaviors and Medicare reimbursement for vaccines. Several of the differences, although small in magnitude, were statistically significantly different. Notably, the data for waves 2 and 3 show that patients > 65

Table 1
Description of study waves and pharmacy practices

Study wave	No. of pharmacy practices participating	States (number of pharmacy practices)	Encounter period	Consults per patient
Wave 1	12	Iowa (5), Ohio (2), Georgia (1), Hawaii (1), Missouri (1), Virginia (1), Washington (1)	Oct 2021-Jan 2022	1
Wave 2	21	Ohio (11), Iowa (8), Virginia (1), Washington (1)	Feb-Aug 2022	1 to 3
Wave 3	13	Iowa (7), Ohio (4), Virginia (1), Washington (1)	Mar-Aug 2023	1 to 3

Table 2
Demographics of patients assessed for vaccination needs

Study wave	No. of pharmacy practices	Encounter period	Patients enrolled	% female	Mean age (y) ± SD	% nonWhite	% Hispanic	Basis of identification[a]				
								COVID-19 vaccination	Influenza vaccination	Comprehensive medication review	Medication refill synchronization	Other
Wave 1	12	Oct 2021-Jan 2022	1214	57.9%	62.1 ± 19.5	3.8%	0.4%	573 (47.2%)	305 (25.1%)	140 (11.5%)	NC	209 (17.2%)
Wave 2	21	Feb-Aug 2022	2877	56.7%	63.8 ± 16.6	13.0%	0.7%	1146 (39.8%)	7 (0.2%)	80 (2.8%)	727 (25.3%)	1098 (38.2%)
Wave 3	13	Mar-Aug 2023	1977	59.3%	64.9 ± 16.4	8.1%	0.5%	244 (12.3%)	8 (0.4%)	80 (4.0%)	498 (25.2%)	1318 (8.9%) Note A

Note A – these 1318 patients included 67 whose evaluation was triggered by a new prescription, 710 triggered by a refill prescription, 424 triggered by some other vaccination request, and 117 others initiated at the pharmacist's clinical discretion.

[a] Multiple entries per patient were allowed.

year old were more likely to be vaccinated on day of assessment, whereas younger adults were somewhat more likely either to decline vaccination (0.7 and 5.5 percentage point differences) or express intention to be vaccinated at a later date (4.7 and 13.3 percentage point differences).

During wave 3, the most frequently cited reason for declination involved disease indifference ('not at risk') (200 of 368 patients, 54%). The second most common reason cited was lack of trust (41, 11%), which the pharmacists had been instructed to interpret broadly (e.g., vaccine itself, government, manufacturing process).

Table 5 shows data from Table 4 stratified for the five most commonly administered vaccines: COVID-19, influenza, zoster, Tdap, and pneumococcal. Of these five, COVID-19 and zoster were the least likely to have already been administered at baseline (37.6% to 41.0%). The mean percentage of vaccination for specific vaccines at baseline ranged from 37.6% to 88.0%. Baseline values were similar to national statistics.[2,19,20] Among the three vaccines that had been available for more than 10 years (i.e., pneumococcal, zoster, Tdap), baseline values were consistently higher in wave 1 (mean 77.3%) than during waves 2 or 3 (mean 58.1%, a 19.2 percentage point difference).

From a baseline mean of 59.1% vaccinated (i.e., 40.9% unmet needs), pharmacists increased the mean percentage vaccinated after day of assessment to 73.2%, an improvement of 14.1 percentage points. Resolution of vaccination needs after engaging with the pharmacist generally achieved vaccination values in the 65%-90% range, although zoster vaccination fell below this range in two of the study waves. If the patients fulfilled their stated intentions to be vaccinated in the near future, then 70%-94% (mean 88%) of needs eventually would be fulfilled.

Discussion

The pharmacists in each pharmacy practice conducted comprehensive vaccination reviews with means ranging from 101 to 152 patients per pharmacy during these pandemic periods, consistent or somewhat lower than in previous studies in this series (135 to 283).[6,7] While some pharmacy practices were challenged by pandemic workload and well-being issues, especially during 2021, and activity varied among participating pharmacy practices (data not shown), the high number of enrollments and the increase in mean vaccination rates by 14 percentage points shows that the project was a success for both pharmacists and patients alike.

Previous studies in this series required special efforts to integrate with the Washington and Iowa IISs.[6,7] In this study, each pharmacy directly queried the state's IIS through its standard IIS interface. The documentation-by-exception approach simplified this process, allowing pharmacists to click once to indicate contraindication, administration, scheduled, intended, or declined, requiring an average of less than 2 minutes per patient to document.

Pharmacists identified a mean of 1.8-2.2 vaccination needs per patient assessed, higher than in previous studies in this series (1.2-1.9).[6,7] The range of needs per patient ranged from 0 to 6 or more. This finding matches the iteratively broader set of entry criteria adopted over time, ever-changing ACIP recommendations, and the addition of COVID-19 vaccine in 2021. The leading vaccination needs in the previous studies as well as the present 1 were influenza, zoster, pneumococcal, and Tdap,[6,7] with COVID-19 added in the present study.

Waves 2 and 3 occurred outside of influenza-vaccination season. All three waves assessed needs for COVID-19

Table 3
Frequency of met and unmet vaccination needs at baseline

Study wave, patients	Needs already met at baseline	Total unmet needs	COVID-19 Needed	Influenza Needed	Pneumo-coccal Needed	Zoster Needed	Tdap or Td Needed	HepA Needed	HepB Needed	HPV Needed	MMR Needed	Varicella Needed	Meningococcal Needed	Hib needed
Wave 1[a] 1214	7113 (5.9 pp)	2446 (2.0 pp) % of patients: % of needs	757 62.4% 30.9%	714 58.8% 29.2%	251 20.7% 10.3%	354 29.2% 14.5%	290 23.9% 11.9%	5 0.4% 0.2%	19 1.6% 0.8%	15 1.2% 0.6%	6 0.5% 0.2%	32 2.6% 1.3%	2 0.2% 0.1%	1 0.1% 0.0%
Wave 2 2877	8204 (2.9 pp)	5318 (1.8 pp) % of patients: % of needs	1561 54.3% 29.4%	578 20.1% 10.9%	640 22.2% 12.0%	1229 42.7% 23.1%	1015 35.3% 19.1%	NC	NC	37 1.3% 0.7%	238 8.3% 4.5%	NC	20 0.7% 0.4%	NC
Wave 3 1977	7075 (3.6 pp)	4346 (2.2 pp) % of patients: % of needs	1110 56.1% 25.5%	365 18.5% 8.4%	672 34.0% 15.5%	975 49.3% 22.4%	710 35.9% 16.3%	42 2.1% 1.0%	268 13.6% 6.2%	59 3.0% 1.4%	129 6.5% 3.0%	2 0.1% 0.1%	14 0.7% 0.3%	NC

Abbreviations used: HepA, hepatitis A vaccine; HepB, hepatitis B vaccine; Hib, haemophilus influenzae type b vaccine; HPV, human papillomavirus vaccine; MMR, measles-mumps-rubella vaccine; Td, tetanus and diphtheria toxoids; Tdap, tetanus and diphtheria toxoids with acellular pertussis vaccine.
[a] Wave 1 encompassed an influenza vaccination season, whereas waves 2 and 3 did not.

Table 4
Disposition of unmet vaccination needs

Study wave, patients	Unmet needs at baseline	Contra-indicated (row %)	Administered on day of assess-ment (row %)	Scheduled for specific date (row %)	Intended for later vaccination (row %)	Administered, scheduled, or intended (row %)	Declined (row %)
Wave 1 1214	2446	58 2.4%	1260 51.5% 1.0 pp	NC	NC	1260 51.5%	1128 46.1%
Wave 2 2877	5318	46 0.9%	1416 26.6% 0.5 pp	119 2.2%	2807 52.8%	4342 81.6%	930 17.5%
Wave 3 1977	4346	22 0.5%	628 14.5% 0.3 pp	135 3.1%	2762 63.6%	3525 81.1%	799 18.4%

vaccinations. Same-day resolution of unmet vaccination needs was 51.5% in autumn wave 1 and 14.5%-26.6% in spring-summer waves 2 and 3, respectively. We hypothesize that pharmacists were more likely to identify patients during wave 1 who routinely received influenza vaccination in autumn and so were more likely to have had their vaccination needs assessed within the last few years. In contrast, pharmacists holding vaccine conversations during the spring-summer waves may have engaged people less vaccine aware or with less vaccine confidence. If so, this highlights the importance of assessing patients' vaccination status year-round, not just in autumn.

The declination rate was 46.1% at the point of care during wave 1. The study pharmacists told the study team about the workload demands of resolving all unmet needs at the same visit and that many patients were intimidated by the number of vaccinations they personally needed. Indeed, the declination rates observed in waves 2 and 3 (~18%) when vaccine planning was an option were far lower than observed in wave 1. Clearly, a patient statement of intent to be vaccinated may or may not be fulfilled in the future. Nonetheless, frank rejection of future vaccination was lower when the option for planned, spaced-out vaccinations was offered. These observations highlight the need for a means of planning future vaccination.

Participating pharmacists expressed positive sentiments about the effect of their interventions:

- "We were able to help address vaccine hesitancy and promote vaccine awareness as many patients did not know they were due for a vaccine."
- "This project demonstrates the importance of pharmacist involvement in primary care, specifically with the vaccination of patients."
- "Many patients are not aware that they do not have all the vaccines recommended for them. They are also not aware of how to find this information outside of their prescriber or pharmacy. This project with APhA has highlighted this deficiency in the health care system. It has also allowed us to focus on being this immunization resource and educate our patients on the vaccines they need for disease prevention."
- "This vaccine project has allowed our pharmacy to have a quick discussion with patients about vaccines they may be eligible for upon pick up of their medication refills, which

Table 5
Disposition of vaccination needs, stratified by wave and vaccine

Study wave	Vaccine	Previously met needs	Total unmet needs	Contra-indicated	Administered on day of assessment	Scheduled for specific date	Intended for later vaccination	Administered, scheduled, or intended	Declined	Needs met after encounter (previous + newly administered)	Needs met if plans fulfilled[b]
Wave 1	COVID-19	456 37.6%	757 62.4%	9 0.7%	671 55.3%			671 55.3%	77 6.3%	92.9%	92.9%
Wave 2	COVID-19	1260 44.7%	1561 55.3%	3 0.1%	913 32.4%	26 0.9%	467 16.6%	1406 49.8%	152 5.4%	77.0%	94.5%
Wave 3	COVID-19	1933 63.5%	1110 36.5%	3 0.1%	256 8.4%	16 0.5%	622 20.4%	894 29.4%	213 7.0%	71.9%	92.9%
Wave 1[a]	Influenza[a]	497 41.0%	714 59.0%	10 0.8%	439 36.3%			439 36.3%	265 21.9%	77.3%	77.3%
Wave 1	Pneumococcal	1082 81.2%	251 18.8%	9 0.7%	27 2.0%			27 2.0%	265 19.9%	83.2%	83.2%
Wave 2	Pneumococcal	2020 75.9%	640 24.1%	26 1.0%	88 3.3%	11 0.4%	383 14.4%	482 18.1%	169 6.4%	79.2%	94.1%
Wave 3	Pneumococcal	1443 68.2%	672 31.8%	7 0.3%	63 3.0%	0 0.0%	268 12.7%	331 15.7%	88 4.2%	71.2%	83.9%
Wave 1	Zoster	599 62.9%	354 37.1%	11 1.2%	66 6.9%			66 6.9%	277 29.1%	69.8%	69.8%
Wave 2	Zoster	895 42.1%	1229 57.9%	6 0.3%	256 12.1%	49 2.3%	701 33.0%	1006 47.4%	217 10.2%	54.2%	89.5%
Wave 3	Zoster	658 40.3%	975 59.7%	6 0.4%	210 12.9%	46 2.8%	552 33.8%	808 49.5%	161 9.9%	53.2%	89.8%
Wave 1	Tdap or Td	2119 88.0%	290 12.0%	13 0.5%	41 1.7%			41 1.7%	236 9.8%	89.7%	89.7%
Wave 2	Tdap or Td	1545 60.4%	1015 39.6%	4 0.2%	135 5.3%	10 0.4%	654 25.5%	799 31.2%	212 8.3%	65.6%	91.6%
Wave 3	Tdap or Td	1155 61.9%	710 38.1%	2 0.1%	81 4.3%	45 2.4%	483 25.9%	609 32.7%	99 5.3%	66.3%	94.6%
Mean of proportions, all rows		59.1%	40.9%							73.2%	88.0%
Mean of proportions for pneumococcal, zoster, and Tdap/Td rows		64.5%	35.5%							70.3%	87.3%

Abbreviation used: Td, tetanus and diphtheria toxoids; Tdap, tetanus and diphtheria toxoids with acellular pertussis vaccine.
[a] Wave 1 encompassed an influenza vaccination season, whereas waves 2 and 3 did not.
[b] Sum of previously vaccinated + newly administered + scheduled + intended.

then leads to them making an appointment for needed vaccines or even getting them that same day."

Unlike studies based solely on electronic vaccine administration recordkeeping, this study provides insight into adult vaccine acceptance or declination behavior not available elsewhere. This study provides detail on rates of contraindications, willingness to schedule vaccination in the future, and declination. Scaling of the model described here could offer greater insights into vaccine confidence and vaccine-acceptance behavior.

This short-duration observational study had limited ability to follow individual patients over time. There was limited enrollment of diverse racial and ethnic populations, likely related to the patient mix of pharmacy practices volunteering to participate. The analyses were not able to fully control for differences associated with the pharmacy's patients in each wave during the COVID-19 public health emergency, nor which patients were invited to be enrolled. When the same pharmacy practices were included in successive waves, individuals vaccinated during earlier waves may not have presented again or could have been included and assessed as up-to-date in later waves. The waves had differences in time of year for data collection, making the influence of influenza variable across waves.

Future studies should follow-up on this study's findings regarding willingness to be vaccinated against the unmet needs remaining after the clinical encounter. Longitudinal cohort designs with follow-up of 1 year or more with the same enrolled individuals would permit assessment of factors affecting whether scheduled or intended responses can be converted into actual vaccinations delivered. It may be worthwhile to quantify a patient's strength of intention for future vaccination at time of consultation. Greater geographic and demographic diversity in adult populations studied is needed. Addition of adolescent patients should be considered. Health care providers and vaccine stakeholders should work together toward a common format to convey plans for follow-up vaccination of adults for residual vaccine needs.

Conclusion

Pharmacists raised adult vaccination rates from 59% at baseline to 73% and potentially higher (if patients fulfill their stated intentions), with some vaccine needs remaining unmet. Offering options for future vaccination reduced vaccine declination rates. With the rising number of vaccines routinely recommended for adults, specifically scheduling return visits to resolve vaccine needs not resolved on the day

of care could be an important tool to further increase vaccination rates.

Disclosure

Benjamin M. Bluml and Jonathan B. Little are employed by the APhA Foundation. Scott A. Hamstra and Lisa L. Tonrey are consultants to the APhA Foundation. Aaron J. Bonham is an employee of the University of Michigan. John D. Grabenstein serves as a volunteer board member for the APhA Foundation. He serves as consultant to the APhA Foundation for this manuscript. He reports receiving honoraria for consulting with CSL Seqirus, Takeda, Valneva, and VBI Vaccines. The authors have no other disclosures to declare and no conflicts of interest or financial interests in any product or service mentioned in this article, including grants, gifts, stock holdings or honoraria.

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Supplementary Data

Supplemental Table S1
Disposition of unmet vaccination needs, stratified by age

Study wave	Age cohort (y)	Needs already met at baseline	Total unmet needs	Contra-indicated (row %)	Administered on day of assess-ment (row %)	Scheduled for specific date (row %)	Intended for later vaccination (row %)	Administered, scheduled, or intended (row %)	Declined (row %)
Wave 1	< 65	3148	992	28 (2.8%)	525 (52.9%)	NC	NC	525 (52.9%)	439 (44.3%)
	> 65	3965	1454	30 (2.1%)	735 (50.6%)			735 (50.6%)	689 (47.4%)
				$P = 0.23$	$P = 0.27$			$P = 0.27$	$P = 0.14$
Wave 2	< 65	2870	2256	11 (0.5%)	470 (20.8%)	56 (2.5%)	1253 (55.5%)	1779 (78.9%)	466 (20.7%)
	> 65	5334	3062	35 (1.1%)	946 (30.9%)	63 (2.1%)	1554 (50.8%)	2563 (83.7%)	464 (15.2%)
				$P = 0.01$	$P < 0.001$	$P = 0.30$	$P < 0.001$	$P < 0.001$	$P < 0.001$
Wave 3	< 65	2388	1884	8 (0.4%)	164 (8.7%)	34 (1.8%)	1339 (71.1%)	1537 (81.6%)	339 (18.0%)
	> 65	4687	2462	14 (0.6%)	464 (18.8%)	101 (4.1%)	1423 (57.8%)	1988 (80.7%)	460 (18.7%)
				$P = 0.67$	$P < 0.001$	$P < 0.001$	$P < 0.001$	$P = 0.51$	$P = 0.58$