Impact of the COVID-19 Pandemic on Pharmacy-based Immunization in Rural USA: a cross-sectional study of community pharmacists from five Southeastern States

by

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Abstract

Background: Immunization rates for seasonal and non-seasonal vaccines dropped during the COVID-19 pandemic. Little is known about the extent to which community pharmacies continue to serve as immunization sites during the pandemic.

Objective: To explore the impact of the COVID-19 pandemic on pharmacy-based immunization services in rural USA.

Methods: A cross-sectional design through self-administered web/paper questionnaires from May-August 2021. The 86 participants work at rural pharmacies from five Southeastern states.

Results and Implications: Vaccines available in 2019 were also offered in 2020 with no noticeable differences in vaccines average doses. 79.1% of pharmacists received a COVID-19 vaccine. 74.4% were willing to recommend a COVID-19 vaccine to family, and 76.6%, and 78.8% were willing to recommend and administer a vaccine to patients, respectively. Pharmacies adopted several measures to ensure safety and continuity of immunization services during the pandemic. Results highlight community pharmacies' role in immunization practice and pandemic response in rural areas.

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ACIP	Advisory Committee on Immunization Practices
CDC	Centers for Disease Control and Prevention
COVID-19	Coronavirus Disease 2019
FDA	Food and Drug Administration
HHS	U.S. Department of Health and Human Services
IIS	Immunization Information System
MSA	Metropolitan Statistical Area
NIS	National Immunization Survey
NRHA	National Rural Healthcare Association
RUCA	Rural-Urban Community Area
RURAL-CP	Rural Research Alliance of Community Pharmacies
SDGs	Sustainable Development Goals
WHO	World Health Organization

Chapter 1. Introduction

Immunization is one of the most significant achievements in public health. Since 1924, childhood vaccinations have prevented more than 100 million cases of life-threatening diseases.[1] As a product of successful immunization campaigns, the world was declared smallpox-free in 1980, with other diseases currently on the brink of eradication.[2] The World Health Organization (WHO) has reported 83 countries free of measles as of 2018 and 5 of 6 WHO regions – making 90% of the world's population – free of wild poliovirus as of 2020.[3]

Nonetheless, despite the availability of safe and effective vaccines in the United States, infectious diseases remain a major cause of morbidity and mortality, with 42,000 adults and 300 children are dying every year from diseases that could have been easily prevented by vaccines.[4] Furthermore, immunization coverages for some vaccines were below the desired targets of the 2020 Healthy People goals for immunization and infectious diseases, and disparities in immunization coverage also existed among minority populations.[5–9]

Progress toward control of vaccine-preventable diseases was threatened by the emergence of the novel virus SARS-CoV-2 and the declaration of the Coronavirus disease (COVID-19) pandemic in 2019, which has disrupted immunization efforts around the world.[10,11] Reasons for the disruption during the pandemic varied, including social distancing and stay-at-home orders, people's unwillingness to visit healthcare facilities due to fear of contracting the virus, disruptions in transportation, overshadowing routine care by prioritizing care for COVID-

19 patients, disruptions of vaccine supply chains, and fear of inadvertently contributing to the spread of COVID-19 during immunization campaigns.[10,11]

In the United States, a study from the Centers for Disease Control and Prevention (CDC) showed a significant decrease in Advisory Committee on Immunization Practices (ACIP) recommended non-influenza childhood vaccination coverage one week after the national emergency declaration in March 2020.[12] Immunization rates for other age groups were impacted by the pandemic as well.[13] Interruptions, due to the pandemic, to the efforts implemented to fill the gaps in immunization coverage can lead to increased risk of outbreaks from vaccine-preventable diseases, further exacerbating the strain on healthcare systems that are drained by the pandemic. If disruptions in immunization efforts continue, emergence of outbreaks of diseases that have been previously well-controlled or eliminated will be inevitable. For instance, in the past, outbreaks of measles were observed in the United States as a consequence of undervaccination.[14]

Immunization is one of the ways community pharmacists had greatly impacted public health.[15] As knowledgeable and trained healthcare providers who are known to have extensive experience in delivering immunization services during past pandemics, community pharmacists are in a good position to facilitate access to immunizations during the current unprecedented pandemic.[15–17] Community pharmacists' involvement in the provision of immunization services is illustrated by them being educators; educating and encouraging patients to receive needed vaccines, immunizers; administering vaccines consistent with state laws, and facilitators of

immunizations; being a source for vaccine distribution.[18] Community pharmacies have become widely accepted as immunization settings as evident by being ranked the second most common destination, after physician offices, for administration of the seasonal influenza vaccine.[19] Pharmacies are accessible to all Americans, especially those residing in rural areas where pharmacists may be the only healthcare provider offering healthcare services there.[16] Even during the current pandemic, pharmacies remained open to the public for vital services while other healthcare settings closed.[15]

The scope of their work as immunizers has evolved throughout the years. Earlier in 2020, the U.S. Department of Health and Human Services (HHS) issued an amendment to authorize state-licensed pharmacists along with pharmacy interns and pharmacy technicians ─ with oversight from a licensed pharmacist ─ to order and administer vaccines to children 3 to 18 years old given specific conditions are met.[20,21] Although some states had already permitted pharmacists to order and administer vaccines to this age group before, the new amendment expands this authorization to pharmacists across all states to ensure comprehensive and convenient care during the pandemic.[22] Capitalizing on community pharmacists' expertise in immunization could contribute to filling the gaps in childhood immunization coverage caused by the disruptions brought by the COVID-19 pandemic. Later in 2020, the HHS issued an emergency declaration allowing state-licensed pharmacists to order and administer, qualified pharmacy technicians, and state-licensed or authorized pharmacy interns to administer under the supervision of a qualified pharmacist, COVID-19 vaccines that have been authorized or

licensed by the U.S. Food and Drug Administration (FDA) to people aged 3 and older subject to several requirements.[23]

It is vital for children to receive recommended childhood vaccinations on time or catch up on doses missed due to the pandemic. This also applies to other ACIP-age and special-group recommended vaccines. Therefore, this study aspired to explore the impact the COVID-19 pandemic has had on the provision of routine and nonroutine non-COVID-19 vaccines in community pharmacies operating in non-urban areas.

Overview of Study Design and Specific Aims

The current study utilized a cross-sectional design through a self-administered questionnaire. Our target population was community pharmacies operating in non-urban areas and must have offered at least one vaccine in 2019. We used two sampling frames to recruit pharmacies. First, a list of community pharmacies from the Rural Research Alliance of Community Pharmacies (RURAL-CP) network was used. The RURAL-CP network is the first multi-state practice-based research network developed for community pharmacists in rural areas in 5 different southeastern states (Alabama, Arkansas, Mississippi, North Carolina, and South Carolina).[24] Second, the Hayes Directories was used to identify a list of community pharmacies located in non-urban areas from Alabama. The Hayes Directories is an online database that provides the name and contact information of community pharmacies in the United States and 1,198 community pharmacies in Alabama alone.[25] Pharmacy Zip code

provided by the Hayes Directories was used to identify pharmacies in non-urban areas for recruitment and to eliminate those part of the rural network to avoid duplications. The Zip code for each pharmacy was entered into the "Am I Rural?" tool, provided by Rural Health Information Hub Website, to identify rural pharmacies using Rural-Urban Community Area (RUCA) codes of 4-10.[26]

The questionnaire was supplied as a web survey and a mail survey; both versions were identical. The questionnaire had 4 sections: 1) COVID-19 vaccine acceptance, 2) provision of non-COVID-19 immunization services before and during the pandemic, 3) the types and doses of non-COVID-19 vaccines administered before and during the pandemic, and 4) pharmacist and pharmacy characteristics. This exploratory study has three distinct specific aims as described below.

Specific Aim 1:

To compare the types and doses of influenza and non-COVID-19 vaccines administered by community pharmacists before the COVID-19 pandemic in 2019 and during the pandemic in 2020.

Specific Aim 2:

To assess the impact of the COVID-19 pandemic on the delivery of influenza and non-COVID-19 immunization services in community pharmacies.

Specific Aim 3:

To explore the acceptance of COVID-19 vaccines among community pharmacists; their willingness to obtain, administer, and recommend COVID-19 vaccines at their practice site.

Study Significance and Implications

The study may contribute to research in pharmacy practice and public health. Our study provides an evaluation of the provision of non-COVID-19 immunization services in rural community pharmacies during the COVID-19 pandemic across 5 different states. To my knowledge, this is the first study evaluating the impact of the COVID-19 pandemic on pharmacy-based immunization activities in rural USA. Findings from our research are expected to identify best practices regarding successful provision of immunization services during the current and potentially subsequent pandemics. The study gives a glimpse of rural pharmacists' acceptance of the COVID-19 vaccines. Lastly, we expect that findings will highlight community pharmacists' role in public health crises, as immunizers in this context, and simultaneously improve collaboration with public health officials. Results add to the body of knowledge regarding community pharmacists' role in immunization practice and pandemic response.

Chapter 2. Literature Review

This chapter provides a literature review on the importance of immunizations, immunization coverage in the United States, barriers to immunizations, community-pharmacists contributions to immunizations, and the Coronavirus Disease 2019 (COVID-19) pandemic and its impact on pharmacy-based immunization practice. Finally, the last section will highlight the health disparity in rural communities in the United States.

Importance of Immunization

Immunization history

The history of immunization dates back to the 18th century when physician Edward Jenner realized a link between smallpox and cowpox. That is, milkmaids infected with cowpox did not develop smallpox infection after exposure to material from smallpox lesions.[2] He tested his hypothesis by taking pus from a blister of someone infected with cowpox and inoculating it into another person's skin who had never developed smallpox before.[2] Then, the person was exposed to smallpox several times later.[2] The results were positive as it did not cause infection with smallpox. In other words, the individual developed immunity to smallpox.[2]

Before the development of Jenner's method in 1796, eventually named vaccination, variolation was the standard approach to control smallpox.[27] Variolation involved purposefully infecting people who never contracted the infection with smallpox material, usually pus, inhaled through the nose or rubbed onto the skin.[2,27] Individuals would develop a mild form of

the disease and thus acquire immunity to severe illness.[28] Indeed, variolation had reduced mortality from the deadly smallpox, but it was not free from harm.[28] People died from the procedure, and there was a risk of smallpox outbreaks resulting from infected individuals disseminating the disease to others.[27,29] Moreover, concerns were raised regarding the possibility of spreading bloodborne diseases such as syphilis during virolation.[27] Jenner's discovery was safer and more effective than variolation and had gained popularity worldwide since then.[2,30] Subsequently, his work paved the path for more vaccines' discoveries and developments.[27]

Contribution of immunizations to public and global health

Since Jenner's work, vaccination has proved to be one of the safest and most cost-effective health measures to prevent, control, and eradicate life-threatening infectious diseases.[31] Worldwide, it is estimated that immunization prevents 2-3 million deaths from infectious but preventable diseases like measles, pertussis (whooping cough), and influenza every year.[32] There are several examples of successful initiatives that resulted in eradication of infectious diseases. For example, efforts to eradicate smallpox disease through immunization should be highlighted. Smallpox was a serious infection that caused death in 3 out of every 10 infected people, left many with permanent scars, and caused blindness in some cases.[2,33] Because of immunization efforts through the global smallpox eradication program, the world was declared smallpox-free in 1980.[2]

Another successful example is the polio vaccine. Polio is a crippling disease that causes irreversible paralysis in 1 out of 200 cases but can be prevented by safe and effective vaccines.[34] As for 2018, only 33 cases of polio were reported in 2 countries compared to 350,000 cases in 125 countries in 1988.[35] Immunization efforts against polio have saved more than 18 million people from paralysis and efforts are still underway to completely eradicate the disease from the world.[35] Next, the far-reaching use of the measles vaccine has drastically reduced global measles deaths from 2.6 million deaths per year in the pre-vaccination era (before 1963) to 142,000 deaths in 2018.[36] Influenzae type b (Hib) contributed to all bacterial meningitis and other infections in 1980s but the introduction of the Hib vaccine in 1990s resulted in a reduction in these infections by more than 90% in less than 10 years.[37,38]

Even more, vaccines are also used to reduce the risk of cancers caused by carcinogenic pathogens.[39] Chronic infection with the hepatitis B virus is a major cause of hepatocellular carcinoma (HCC) that is considered to be the most frequent primary liver cancer and the third cause of cancer-related deaths worldwide.[40] Chronic infection occurs in 90% of infants who acquire the infection at birth, in 30-50% of children infected at ages 1 to 5 years, and in 5% of healthy individuals who are infected as adults.[41] The ACIP recommends the hepatitis B (HepB) vaccines for children with a three-dose series starting at birth, for high-risk adults, for all children and adolescents who have not been vaccinated previously, and for travelers to countries where hepatitis B infection is common.[39] Another vaccine that was introduced to prevent cancer is the Human Papillomavirus (HPV) vaccines, which are recommended against

the oncogenic types of HPV that infect the human genital tract leading to cervical, valvular, vaginal, and anal cancers.[39] The ACIP recommends routine HPV vaccines at age 11-12 years (can start at age 9 years) before sexual activity begins and catch-up vaccinations for all persons unvaccinated through age 26 years.[39,42] And recently, the ACIP recommended HPV vaccines to individuals 27-45 years based on shared clinical decision-making.[43]

Reductions in morbidity and mortality of communicable diseases gained from the utilization of vaccines are translated into positive economic returns. Vaccines can provide means to lower health care costs by billions of US dollars globally.[44] Since 1994, immunization efforts have resulted in $406 billion savings in direct medical costs and $1.9 trillion in total costs.[45] It is estimated that for each dollar spent on childhood immunization, we attain more than $10 cost-saving in health care expenditures.[46]

Not only vaccines can protect vaccinated individuals from life-threatening infectious diseases, but widespread and well-implemented immunization programs can also provide indirect protection for people who are unable to receive immunization for different reasons.[47] The unvaccinated individuals including newborn babies who are too young to be vaccinated, elderly people, or those who can't receive certain vaccines for medical reasons, and they can receive protection through "herd immunity" or "herd protection".[47] Herd immunity is achieved when a very high proportion of the community get vaccinated preventing diseases from spreading to susceptible populations in the community.[47]

It is worth noting that the effect of immunization extends beyond improving the health and wellbeing of populations. Immunization is believed to indirectly contribute to attainment of 14 out of the 17 Sustainable Development Goals (SDGs) such as no poverty, zero hunger, quality education, and reduced health inequality.[48] To clarify, by protecting children from death and disability related to infectious diseases, immunization reduces burden of care on parents and allows them to focus on other life necessities such as nutrition and education.[49] Healthy and immunized children are more likely to attend schools regularly; this in turn impacts their cognitive development and physical strength positively.[48] Likewise, better health is associated with better equality. Specifically, immunization reduces the number of people forced into poverty and gives children an equal chance of a healthier and more productive future.[48]

Immunization Coverage in the United States

Recommended vaccines in the United States

In the United States, ACIP issues recommendations and guidelines for immunization targeting all age groups annually.[50] The recommended vaccines protect children, teens, and adults against 17 life-threatening diseases in addition to recommendations for non-routine vaccines for travelers and high-risk populations.[51,52]

The current guidelines include recommendations for hepatitis B (HepB) vaccine with the first dose administered at birth, rotavirus (RV), diphtheria, tetanus, & pertussis (DTaP: <7 yrs,

Tdap: ≥7 yrs), haemophilus influenzae type b (Hib), pneumococcal conjugate (PCV) and pneumococcal polysaccharide (PPSV23), poliovirus (IPV), influenza (IIV, RIV, and LAIV), measles, mumps, rubella (MMR), Varicella (VAR), hepatitis A (HepA), human papillomavirus (HPV), meningococcal (mengB, MenACWY-D: ≥9 mos, MenACWY-CRM: ≥2 mos), and herpes zoster or shingles (RZV).[53] Table 2.1 lists all ACIP age-specific recommended vaccines, and Table 2.2 displays names of available vaccines in the U.S. by disease state. Further, in December 2020 the FDA authorized two COVID-19 vaccines for emergency use during the COVID-19 pandemic; 1) Pfizer-BioNTech (2-shot regimen) for individuals 16 years and older and 2) Moderna (2-shot regimen) for individuals 18 years and older. Later in February 2021, the third vaccine; Johnson & Johnson's Janssen (1-shot regimen) received the FDA emergency use authorization for individuals 18 years and older. In August 2021, the Pfizer-BioNTech COVID-19 vaccine received full FDA-approval and was marketed as Comirnaty®, making it the only present vaccine that is fully-approved by the FDA for the prevention of COVID-19, as of November 1, 2021.[54] Moreover, a booster shot of the COVID-19 vaccines was approved in 2021 for certain populations.[54]

Table 2.1. Advisory Committee on Immunization Practices (ACIP) recommended vaccines from birth to 60 years or older, USA, 2020.[53,55]	
Age	**Recommended Vaccine**
Birth	HepB
1 month	HepB
2 months	DTaP, HepB, Hib, IPV, PCV13, RV
4 months	DTaP, Hib, IPV, PCV13, RV
6 months	DTaP, HepB, Hib, Influenza (yearly), IPV, PCV13, RV
9 months	HepB, Influenza (yearly), IPV <18 years
7-11 months	Influenza (yearly)
12-23 months	DTaP, HepA, HepB, Hib, Influenza (yearly), IPV, MMR, PCV13, VAR
2-3 years	Influenza (yearly)
4-6 years	DTaP, Influenza (yearly), IPV, MMR, VAR
7- 10 years	Influenza (yearly)
11-12 years	HPV, Influenza (yearly), Meningococcal conjugate, Tdap
13-18 years	Influenza (yearly), Meningococcal conjugate (at age 16 years)
19-26 years	HPV, Influenza (yearly), MenB (19 to 23 years), MMR** (if born in 1957 or later), PCV13, Tdap§ then Td or Tdap (every 10 years), VAR
27-60 years	Influenza (yearly), PCV13, MMR** (if born in 1957 or later), RZV (2 doses at age ≥ 50 years), Tdap§ then Td or Tdap (every 10 years), VAR (2 doses if born in 1980 or later)
60 years or older	Influenza (yearly), PPSV23 (≥ 65 years), MMR** (< 65 years if born in 1957 or later), Tdap§ then Td or Tdap (every 10 years), RZV

** 1 or 2 doses depending on the diagnosis.

§ (19-≥ 65 years): 1 dose Tdap, then Td or Tdap booster every 10 years.

Table 2.2. Available vaccines in the USA[55,56]		
Vaccines	**Abbreviations[a]**	**Trade names**
Adenovirus	None	Adenovirus Type 4 & Type 7
Anthrax	AVA	BioThrax
Cholera	None	Vaxchora
Coronavirus Disease 2019	COVID-19	Janssen COVID-19, Moderna COVID-19, Pfizer-BioNTech COVID-19
Diphtheria, tetanus vaccine	DT	Generic
Diphtheria, tetanus, and acellular pertussis	DTaP	Daptacel, Infanrix
Diphtheria, tetanus, and acellular pertussis, Polio	DTaP-IPV	Quadracel, Kinrix
Diphtheria, tetanus, and acellular pertussis, Polio, Haemophilus influenzae type b	DTaP-IPV/Hib	Pentacel
Diphtheria, tetanus, and acellular pertussis, Polio, Hepatitis B	DTaP-HepB-IPV	Pediarix
Haemophilus influenzae type b	Hib (PRP-T) Hib (PRP-T) Hib (PRP-OMP)	ActHIB Hiberix PedvaxHIB
Hepatitis A and hepatitis B vaccine	HepA-HepB	Twinrix
Hepatitis A vaccine	HepA	Havrix, Vaqta
Hepatitis B	HepB	Engerix, Recombivax HB, Heplisav-B
Herpes Zoster (recombinant)	RZV	Shingrix
Human papillomavirus	9vHPV	Gardasil 9
Influenza vaccine (inactivated)	IIV3, IIV4 IIV3 IIV4 ccIIV4IIV4 IIV3, IIV4 IIV3	Afluria Fluad Fluarix Flucelvax FluLaval Fluzone Fluzone High-Dose
Influenza vaccine (live attenuated)	LAIV4	FluMist

Influenza vaccine (recombinant)	RIV4	Flublok Quadrivalent
Japanese encephalitis	JE	Ixiaro
Measles, mumps, and rubella	MMR	M-M-R II
Measles, Mumps, Rubella, Varicella	MMRV	ProQuad
Meningococcal serogroup B vaccine	MenB-4C MenB-FHbp	Bexsero Trumenba
Meningococcal serogroups A, C, W, Y vaccine	MCV4, MenACWY-D MCV4, MenACWY-CRM	Menactra Menveo
Pneumococcal 13-valent conjugate vaccine	PCV13	Prevnar 13
Pneumococcal 23-valent polysaccharide vaccine	PPSV23	Pneumovax
Poliovirus vaccine (inactivated)	IPV	IPOL
Rabies	None	Imovax Rabies, RabAvert
Rotavirus vaccine	RV1 RV5	Rotarix RotaTeq
Tetanus, reduced diphtheria	Td	Tenivac, Generic
Tetanus, reduced diphtheria, and reduced pertussis	Tdap	Adacel, Boostrix
Typhoid	None	Typhim Vi, Vivotif
Vaccina (Smallpox)	None	ACAM2000
Varicella vaccine	VAR	Varivax
Yellow Fever	YF	YF-Vax

Types of vaccines in the United States

Vaccines are classified into five categories based on the processes or technologies used to produce them including: a) live attenuated vaccines, b) inactivated vaccines, c) subunit, recombinant, polysaccharide, and conjugate vaccines, d) toxoid vaccines, and RNA vaccines.[57,58] First, the live attenuated vaccines are developed from a weakened form of the pathogen (virus or bacteria) that causes the disease providing strong and lifelong protection such as the MMR and RV vaccines.[57] On the other hand, the inactivated vaccines deploy the killed version of the causative pathogen, and thus they provide a milder immunity compared to that of the first type, such as the HepA vaccine.[57] Parts of the pathogen, usually protein or sugar, are used to develop the third type of vaccines, known as subunit, recombinant, polysaccharide, and conjugate vaccines.[57] Examples include the HPV and HepB vaccines.[57]

On the contrary, toxoid vaccines are developed from bacterial toxins and are used to protect against diseases like tetanus and diphtheria.[57] Finally, RNA vaccines ─ which are a new type of vaccines─ use mRNA (messenger RNA) inside a fat membrane.[59] Once the mRNA is inside the cell it is translated by cell machinery into the antigen of interest triggering an immune response.[58,59] Then, the antigen is naturally broken and removed by the body.[58] Examples on human mRNA vaccines include Pfizer-BioNTech COVID-19 vaccines developed in 2020.[60,61]

Recommended vaccines for special groups

In addition to the age factor, certain groups of people are at higher risk of contracting infections due to their risk factors related to medical, occupational, and lifestyle. Therefore, people in this group are recommended additional vaccines besides routine vaccines that are recommended to all individuals within the same age group.[62] Healthcare providers (HCPS) are at high risk for developing vaccine-preventable diseases because they work in close proximity with patients or handle infectious materials putting them, their families, colleagues, and susceptible patients at risk for infections.[63] Furthermore, there is a concern about loss of productivity if HCPS get infected and become sick.[64] The ACIP recommends that HCPS receive vaccines against hepatitis B, influenzae, measles, mumps, rubella, varicella, tetanus, diphtheria, pertussis, and meningococcus as part of healthcare facilities' infection prevention and control programs.[63] Other high-risk populations requiring additional immunizations include pregnant women, adult patients with diabetes, liver disease, and heart disease, international travelers, men who have sex with men[65], female sex workers, and immigrants or refugees.[62,65] Immunization schedule tables from the CDC provide details regarding recommendations based on age, medical conditions and other indications as well as special situations.[66]

Immunization coverage for children in the United States

Immunization coverage for children, younger than 11 years old, is generally high, however, sociodemographic and geographic disparities in immunization coverage exist.[7] The National Immunization Survey-Child (NIS-Child) is a valuable source of information about immunization rates among children 19-35 months old in the United States.[7] Immunization rates from NIS-Child for the year 2017 for selected diseases were as follows: 91.5% for Measles, Mumps, Rubella (MMR) (1+ doses), 83.2% for Diphtheria, Tetanus, Pertussis (4+ doses DTP, DT, or DTaP), 91.0% for Chickenpox (Varicella) (1+ doses), 82.4% for Pneumococcal conjugate vaccine (PCV) (4+ doses), 80.7% for Haemophilus influenzae type b (Hib) (3+ or 4+ doses), 91.4% for Hepatitis B (Hep B) (3+ doses), and 92.7% for Polio (3+ doses).[7]

Immunization rates were noticeably low for 2+ doses of Hepatitis A (59.7%), the combined 7-vaccine series (70.4%), Rotavirus (73.2%), and the HepB birth dose (73.6%).[7] However, 1.1% of children received no immunization in 2017, a small but increasing percentage compared to 0.8% in the three preceding years.[7] In general, 2017 rates were similar to the previous year with disparities for race/ethnicity, poverty level, and geographical location.[7] Specifically, coverage was lower for most vaccines for children living in non-urban centers and those uninsured or receive their insurance through Medicaid.[7]

Immunization coverage for adolescents in the United States

The ACIP recommends routine vaccines for adolescents, identified as 11-18 years old, to protect them from diseases like pertussis, meningococcal disease, and cancers caused by HPV.[67] The 2019 NIS-Teens, provides vaccination coverage estimates for 18,788 adolescents aged 13-17 years and shows that 71.5% of adolescents received ≥ 1 dose of HVP vaccine, 54.2% completed the HPV immunization series, 88.9% received ≥ 1 dose of MenACWY, and 90.2% received ≥ 1 dose of Tdap.[67] Among adolescents aged 17 years old, 53.7% received a booster dose of MenACWY and 21.8% received ≥ 1 dose of MenB.[67]

Disparities in immunization coverage were observed in terms of locations, with lower coverages for most vaccines among adolescents residing in non-metropolitan statistical (MSA) areas compared to those living in MSA areas with differences ranging from 5.1 percentage points for MenACWY to 9.8 percentage points for those who completed the HPV vaccination full series.[67] Further, coverage was lower for all vaccines among uninsured adolescents compared to those with insurance.[8] In terms of data on vaccine coverage based on race/ethnicity, the coverage for ≥ 1 doses of HPV was higher for Hispanic adolescents compared with that for black and white adolescents. Conversely, the coverage was higher for white adolescents receiving ≥ 1 dose of Tdap compared to blacks and Hispanics. However, the coverage was comparable among these race/ethnic groups for the ≥ 1 dose of MenACWY.[8] In general, coverage for most vaccines was better compared to the previous year (2018).[67]

Immunization coverage for adults in the United States

Adults, aged 19 years or older, are specifically prone to morbidity and mortality from infectious diseases.[6] Influenza and pneumonia are among the 10 leading causes of death for adults.[68] However, it is well documented that the rate of adult vaccination is suboptimal. When compared with childhood vaccination rates, that exceed 90% for some vaccines, adult vaccination rates remain low for most ACIP-recommended vaccines, especially for influenza, pneumococcal disease, hepatitis B, tetanus, and diphtheria.[6,69,70] Data from the 2017 National Health Interview Survey (NHIS) indicate that smaller increases in influenza and Tdap immunization were observed for adults (>19 years old) compared to 2016. Influenza vaccination coverage among adults was 45.5%, 63.4% for Td and Tdap, 24.5% for pneumococcal vaccination (19-64 years) and 69.0% ($\geq$ 65 years), and 34.9% for herpes zoster for adults $\geq$ 60 years.[6] The coverage for 2017 was similar to that for 2016 with some increases for certain vaccines, but generally, coverage is still suboptimal.[6]

Looking at disparities across racial and ethnic groups, coverage was higher for most types of immunizations among white adults compared to non-white adults and this pattern is consistent throughout the previous several years.[6] Influenza immunization coverage among whites 19 years and older (48.2%) was higher than that for blacks (38.5%) and Hispanics (37.0%).[6] Influenza immunization coverage was also higher among white adults 19-49 years (35.3%) than in blacks (29.6%) but lower than that for Asian (42.6%).[6] Likewise, white adults had

higher coverage for tetanus immunization across all age groups compared with blacks, Asians, and Hispanics.[6] White adults had higher Tdap coverage across all age groups compared with blacks and Hispanics but higher coverage compared with Asians among adults 19 years and older and 19-64 years.[6] Furthermore, immunization coverage was affected by health insurance status of adults.[6] For instance, coverage for influenza and tetanus vaccines were lower for uninsured adults among all age groups compared to insured adults and lower for pneumococcal vaccines for uninsured adults aged 19-64 at increased risk.[6] The difference in coverage between insured and uninsured adults ranged from 4.1 percentage points for hepatitis A immunizations to 29.4 percentage points for influenza immunizations among adults aged 19 year and older.[6] Further, geographic disparities were observed throughout the years with rural adults getting vaccinated at lower rates compared to those residing in urban centers.[71,72]

Despite the availability of vaccines and immunization efforts in the United States, every year, 42,000 adults and 300 children die from diseases that could have been easily prevented by vaccines.[4] While improvement was seen in immunization coverage throughout the years, coverage is still low for many vaccines and suboptimal compared to the Healthy People 2020 goals for immunization and infectious diseases (Table 2.3) and vaccine disparity continues.

Table 2.3. Progress made toward Healthy People 2020 objectives for selected vaccines.[4]			
Vaccine	**Baseline (year)**	**Recent rate (year)**	**2020 Target**
HepB (1 dose) within 3 days of birth	70.6% (2010-2012)	73.5% (2016-2018)	85%
Hepb (3+) by age 19 to 35 months	89.7% (2012)	92.1% (2018)	90%
Hib (3+ or 4+ doses) by age 19–35 months	80.9% (2012)	82.3% (2018)	90%
MMR (1+ dose) by age 19 to 35 months	90.8% (2012)	92.1% (2018)	90%
MMR (2+ dose) by children kindergarten	95% (2009-2010)	94.3% (2017-2018)	95%
PCV (4+ doses) by age 19 to 35 months	81.9% (2012)	83.3% (2018)	90%
RV (1+ doses) by age 19 to 35 months	68.6% (2012)	74.7% (2018)	80%
HPV (2 or 3 doses) by female aged 13–15 years	45.1% (2016)	48.9% (2018)	80%
HPV (2 or 3 doses) by male aged 13–15 years	36.4% (2016)	47.1% (2018)	80%
Flu among noninstitutionalized adults 18+ years	38.1% (2010-2011)	45.2% (2016-2017)	70%

Barriers to Immunization

Barriers to immunization have led to inadequate immunization coverage and increased morbidity and mortality resulting from vaccine-preventable diseases.[73] These barriers can be categorized into different levels involving parent or patient barriers, health care provider barriers, and healthcare systems related barriers.[73]

Parent or patient barriers

Several parent or patient barriers contribute to immunization hesitancy, which is defined as delay in acceptance or complete refusal of immunizations.[74] The most frequently reported barriers at the parent/patient level are the lack of knowledge about vaccines and concerns about their safety.[73] For individuals to seek immunization services, first, they must be aware of the seriousness of vaccine-preventable diseases, the availability of effective and safe vaccines to control them, immunization schedules, and their need for these vaccines.[73,75] However, oftentimes, patients are unaware of the benefits of immunizations or they don't understand why a booster dose of a vaccine is sometimes needed.[76] In a study surveying over 2,000 adults regarding their attitudes and knowledge of 3 vaccines recommended for adults (tetanus, influenza, and pneumococcal vaccines), 90% of participants were aware of the availability of vaccines for tetanus, but only 36% knew that a tetanus booster is recommended for adults every 10 years.[77] The same study also showed that the majority of respondents (79% to 85% depending on the vaccine) reported that they were more likely to receive a vaccine if

their healthcare provider recommended it.[77] This highlights the important role of healthcare providers in educating and recommending needed vaccines to their patients, especially when patients/parents are not aware of the vaccine.

Another barrier contributing to vaccine hesitancy is lack of perceived susceptibility to infectious diseases and the perception that healthy people do not need vaccines.[75,77] Parents' reasons for choosing not to vaccinate their children include beliefs about the superiority of disease-induced immunity (natural immunity) to that acquired through immunization.[73] That is, some parents believe that if their child contracts a preventable disease, the child's immunity will grow stronger throughout adulthood.[78] Likewise, some adults believe that they are so old and thus disease prevention through immunizations is no longer a concern. [38,77] Others believe that healthy adults don't need vaccines.[77] Generally speaking, healthcare providers are a trusted vaccine-information source for parents and they can provide information to parents who want to know more information about the benefits and risks of vaccines.[79,80] However, when providers do not provide such information for parents, parents might consult other information sources that may spread misinformation and misconceptions about vaccines.[81] For example, some parents believe that after children reach age 2, they don't need to be seen by their provider as long as they look healthy.[37] This is especially true among socioeconomically disadvantaged families where a child is brought to see a healthcare provider only when he/she is sick or a prescription is needed, contributing to incomplete immunization requirements.[37,76]

Cost of vaccines is among the most common barriers to adult and childhood immunization, mostly if vaccines are not provided for free.[64,82] Such is the case for uninsured or underinsured individuals where insurance plans do not cover immunization services.[83,84] Next, unawareness about the location of immunization clinics and difficulty finding the appropriate transportation to reach them especially in non-urban or underserved areas are factors preventing individuals from seeking immunization services.[85] Other identified barriers are religious objections, language barriers, long waits in immunization clinics, inconvenient clinic hours, increased complexity of immunization schedules, overwhelming jobs deterring parents from keeping up with their children or teens immunization appointments, and delays due to child's frequent illness.[37,64,73,86]

To help address the cost concern, the Vaccines for Children Program (VFC) provides the ACIP recommended vaccines for uninsured and Medicaid-insured children for free in the United States.[73] Nevertheless, parents of eligible children for the program will still report other logistic barriers such as transportation problems.[73] This could be a legitimate concern since VFC providers may not be available in all communities. Parents who are unfamiliar with this program or unaware of how to access it will continue to report cost and other factors as barriers for immunization.[73]

Barriers to adult immunizations are quite similar to those pertaining to childhood immunizations as discussed above. There are, however, barriers that are unique to adult vaccinations. A factor specifically pertaining to adults' noncompliance to immunization stems

from the fact that the American healthcare system lacks an effective adult immunization delivery system.[38] When all immunization campaigns and programs target childhood immunizations, immunization remains a low priority for physicians and adults.[87] Employers, unlike schools, don't require proof of immunization as a condition for employment, so this motivator disappears among adult immunizations.[87] A frequently reported barrier to adult immunization is adults not showing up for their regular well-care visits where they miss out on receiving the required immunizations.[76] Fear of needles or concerns about vaccines side effects are also common reasons why adults avoid immunizations.[64,77]

Provider barriers

Strong immunization recommendation is key to increasing immunization uptake.[88] Therefore inadequate knowledge about vaccines among immunization providers can have a substantially negative impact on immunization coverage.[73] Such knowledge revolves around vaccine indications, side effects, and contraindications.[73] Providers find it challenging to stay up to date with immunization updates given the increasing number of vaccines recommended for routine use and the new specific recommendations for high-risk groups.[73] Many healthcare providers are unaware of the ACIP recommendations for adult immunizations and variations for different age groups and comorbidities.[87] In one survey, only 60% of physicians and 56% of nurse practitioners, registered nurses, and physician assistants stated they used official guidelines as a source of information about adults immunization.[77] Over 50% of those providers

stated they often don't communicate the consequences of missing recommended vaccines to their patients.[77] Providers often cite lack of time as big deterrent to vaccinating their patients.[77] Finally, missed opportunities, that is failure of providers to administer vaccines during clinic visits, where appropriate, can prevent the timely administration of immunizations.[73] When looking at the consequences of missed opportunities, about two-thirds of underimmunization in children younger than 2 years in the United States has been attributed to missed opportunities.[89] In a study regarding adolescents immunization practices, 90% of physicians stated they checked immunization status during child's well-visit but only 43% said they did that during sick-visits , and only 23% reported that they administered necessary vaccines.[90]

Healthcare system barriers

Healthcare system-related barriers are a major contribution to delayed or incomplete immunization. These could be logistical barriers and barriers pertaining to the organization of the healthcare system.[73] The most obvious barriers are those affecting vaccines supply and distribution.[83] Vaccine shortages can result from several reasons, including an imbalance in vaccine demand-supply, disruptions in vaccine supply or production, and financial constraints precluding the purchasing of vaccines.[91] Shortages of many vaccines in the recommended childhood immunization programs have occurred in the United States in the past.[83] For instance, the United States faced a shortage of Hib vaccine between 2007 and 2009, resulting in temporarily changing recommendations for using these vaccines as a strategy to avoid

underimmunization of children.[83] The recommendation included a temporary deferral of the booster dose for most children with no change on administration of the primary series dose, however, data from 2009 showed that not only booster dose coverage was low (consistent with the recommendation) but primary series coverage was also reduced nationwide.[83,92] This highlights the value of having sufficient supplies as well as having appropriate reminder-recall systems to ensure that all individuals receive the right number of vaccine doses once the vaccine under shortage is available again. A more recent shortage of Shingrix® (RZV) occurred in 2019 because of high demand.[93] It is, however, no longer on the CDC's shortage list.[94]

Poor access to individuals' previous immunization records poses an additional barrier for fulfilling immunization requirments.[73] Fragmentation of patient records is a major contributor to this issue.[73] Immunization registries or Immunization Information Systems (IISs) can provide access to individuals' records either at the region or state level. However, in cases where immunization registries are not used or are underutilized, it is difficult for providers to recommend vaccinations due to incomplete immunization records.[73,83] Often, this results in overimmunization and/or incomplete immunization.[73]

In addition, some vaccines including the RV vaccine, the MMR, live attenuated influenza vaccine, and the rotavirus vaccine require specific storage conditions and this can present a challenge to small or underequipped facilities which may result in not offering these vaccines in their facilities.[73,76] Lastly, immunizers report lack of fair reimbursement as barrier to administering vaccines that is when the fee of administering the vaccine is not covered.[83]

Strategies for addressing immunization hesitancy

Despite the many barriers discussed above, research identified some strategies that can be implemented to facilitate compliance with immunization and therefore maximize immunization coverage for all age groups. However, given the complexity of vaccine hesitancy, strategies should be tailored to the target population, considering their reasons for forgoing immunizations and the specific context. Strategies can be categorized into three categories; 1) strategies to enhance access to immunization services, 2) strategies to increase community demand for immunizations, and 3) provider-or-system-based interventions.

Strategies to enhance access to immunization services

The first strategy to improve access to immunizations includes "home visits,"; although it can be costly and resource-intensive when compared with other interventions.[95] During home visits, providers can assess the immunization status of individuals, explain the salience of recommended vaccines, and provide immunizations to people in their homes or refer them to other services outside their homes.[95]

The next strategy focuses on reducing out-of-pocket costs. Since the cost of vaccines is a fundamental reason for patients delaying or completely refusing uptake of vaccines, it is prudent to have interventions to reduce patients' out-of-pocket costs.[38,96] Such interventions should be intended to make vaccines or their provision more affordable.[96] Changes could

include paying for vaccines or administration fee, providing new or expanded insurance coverage, or lowering or completely eliminating patients' out-of-pocket expenses at the point of service (co-payments, coinsurance, and deductibles).[96] As per the Patient Protection and Affordable Care Act, private health insurance policies must provide full reimbursement for recommended vaccines with no out-of-pocket costs for patients.[69] Additionally, Medicare and Medicaid pay for some recommended vaccines depending on the plan.[69] But for uninsured patients, providers can refer those patients to free vaccination programs or explain to them that out-of-pocket payment from the patient is a cost-effective preventive measure.[69]

Another strongly proven effective intervention to maximize immunization rates is the adoption of child-care centers and schools based vaccination programs.[97] These programs can be most beneficial in improving immunization rates among children and adolescents for new vaccines and vaccines with new or expanded recommendations.[97] Services provided through such programs can include; immunization education, promotion of vaccines, immunization status tracking and assessment, administration of vaccines, and referral of underimmunized children/adolescents to vaccination providers.[97] Businesses are also encouraged to host vaccination clinics where vaccines can be administered on-site for their employees free of charge. [98]

Additionally, there is a recommendation for the implementation of immunization programs in Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) settings –combined with other strategies– to increase childhood immunization rates.[99] In WIC

settings, vaccination programs could provide services such as assessment of immunization status for infants and children, on-site vaccines administration or referral to other vaccination providers, reminder and recall systems, manual tracking and outreach efforts, or adoption of monthly voucher pickup schedules that require mothers to visit WIC settings more frequently encouraging them to have their children vaccinated on time.[99,100] Services could be provided in WIC clinics or through collaborations with other health care services.[99]

Strategies to increase community demand for immunizations

Providing incentive rewards (e.g., money, food vouchers, or gift cards) can motivate people to get recommended vaccines.[101] They can be given in exchange for keeping an appointment, receiving a vaccine, coming back to complete a vaccine series, or even producing documentation of vaccination status.[101] Increasing immunization awareness is one strategy to help improve immunization coverage. Because many parents are unaware of the vaccines required for their children and why they are recommended, providers should explain each vaccine and the infection it prevents.[37] For example, parents who may have concerns about immunizations agree to vaccinate their children when they hear that streptococcus pneumonia and Hib are the two leading causes of meningitis or that contracting rotavirus will likely cause their child to be admitted to the hospital.[37]

Another evidence-based intervention is the use of patient recall-reminder systems to remind parents/patients of vaccines that are due (reminder) or late (recall).[89,102] These

interventions can take the form of a letter, a text message, or a telephone call.[89] For parents who refuse or delay immunizations, providers might request them to sign an exemption form.[103]

This can give parents a chance to read about the benefits of immunizations and the subsequent risks of missing recommended vaccines.[103] Providers should emphasize to parents that there is no maximum interval between doses of any of the routine immunizations that would cause the vaccine series to be restarted.[104] Thus, providers should review immunization records every visit to check for any series that has begun years before but has never been completed.[104] This is particularly important for the HPV vaccines recommended for adolescents because adolescents do not often have regular well-visits as children do.[104]

Proof of vaccination or immunity as a requirement for daycare, school, or college attendance is another strongly recommended strategy to increase immunization rates and prevent disease outbreaks.[105] Other recommended strategies, however, with insufficient evidence, include imposing monetary sanctions on families receiving government assistance, interventions providing education for a target population (when used alone), clinic-based education (when used alone), and client-held paper immunization records.[106–109]

Finally, evidence suggests implementing a combination of community-based interventions collectively where organizations, local governments, and vaccination providers collaborate to implement two or more interventions that aim to increase community demand

for vaccines or enhance access to immunization services. [110] For example, the use of patient reminder-recall systems with home visits.

Provider or System based interventions

First, provider assessment and feedback programs through which the delivery of vaccines by providers is assessed and feedback is provided based on their performance.[111] This could be individual-based or group-based feedback.[111] Next, another recommended intervention, either implemented alone or in combination with other interventions, is the use of standing orders.[112] This is to allow nurses, pharmacists, and other healthcare providers to administer vaccines independently from seeing the physician; this is particularly of benefit for children scheduled only for weight checks or a flu vaccine administered by a nurse. [37] Nurses can take advantage of this visit to check a child's immunization status and offer to administer any other needed vaccines.[37] The ACIP recommends the use of standing orders as means to improve immunization coverage among adults in hospitals, long-term-care-facilities, clinics, workplaces, and managed care organizations.[87] The Centers for Medicare and Medicaid Services doesn't require a physician order for adult vaccines (influenza and pneumococcal vaccines) any longer in participating health facilities.[87]

Furthermore, relying on provider reminders is a proven strategy that can help notify providers when patients are due to a particular vaccine.[113] Reminders can include leaving a note in patients' charts, alerts in electronic medical records (EMRs), or messages sent via email s or

the mail. [113] Specifically, preservation of EMRs can improve vaccination rates by providing means for long-term storage of medical records and easy retrieval of patients' immunization records.[69] They can be used to set alerts for needed immunizations and to contact patients accordingly.[69]

Evidence has shown the effectiveness of Immunization Information Systems (IISs) in increasing immunization rates and thus reducing vaccine-preventable diseases.[114,115] IISs facilitate the consolidation of vaccination histories for use by healthcare providers to determine appropriate vaccination needs for people.[110] They can be used to assess immunization status; remind/recall patients; provide provider assessment and feedback; provide reminders for providers; guide public health responses to outbreaks of vaccine-preventable diseases; assess vaccination coverage, missed opportunities, invalid administration, and disparities; and facilitate vaccine management and accountability.[114,115]

Provider education used alone with the aims to improve providers' immunization knowledge and to change their attitudes regarding immunizations can be beneficial but with insufficient evidence.[116] Education can be delivered through different formats; written materials, video, lectures, continuing medical education, computer-assisted instructions, or distance-based training.[116] Educational intervention should consider improving providers' communication strategies because communication with providers has been the most important factor influencing people's decisions regarding acceptance and uptake of immunizations. Strong provider recommendation resulted in better uptake of the flu vaccine among the adult

population and has been strongly linked to the initiation of the HPV vaccine series among male adolescents.[104,117,118] Some of the studied communication strategies have shown promising results, while others were of minimal impact or with mixed results.[104] Providers are, however, encouraged to individualize messages and recommendations for each individual they encounter, especially those with concerns.[64,119] Motivational interviewing is an example of proven communication strategies that providers can use when facing patients/parents who have concerns about vaccinations.[104]

Myths and misinformation about vaccines are abundant, causing many parents/patients to be fearful or skeptical about vaccines.[38,87] Providers should give patients/parents the time to express their concerns regarding the safety of vaccines and help address them with proven research.[103] In addition, providers are expected to respectfully correct any misconceptions parents/patients might have about vaccines with facts.[76,103] The CDC website offers numerous handouts and flyers with information about required vaccines that providers can download and distribute among parents and patients.[103]

Providers should take advantage of every clinical encounter, including visits for injuries or mild illness, to administer required vaccines for patients.[76,103] For instance, studies showed that administering childhood immunizations at sick visits is believed to reduce children's need for subsequent care.[89] Parents of children from disadvantaged socioeconomic groups can benefit the most from having their children's immunization status be evaluated during such a

visit.[37] Follow-up visits and postsurgical or posthospitalization visits can also be opportunities to administer needed immunizations.[37]

It is also highly recommended to use a combination of healthcare system-based interventions mainly implemented in healthcare settings but efforts to include interventions in the community are also welcomed.[120] It is suggested to use interventions that include the following; at least one intervention to increase client demand for vaccination and one or more interventions that address either one or both the following; interventions to enhance access to vaccinations and interventions directed at vaccination providers or systems.[120]

Community Pharmacists' contribution to immunization in the United States

Historically, the role of community pharmacists was limited to the dispensing and compounding of medications, but the scope of their work has expanded well beyond this role over the years.[16] Nowadays, pharmacists' practice extends to provision of patient-centered services such as immunizations, patient health monitoring, patient counseling, medication therapy management, and biometrics screenings.[16] Furthermore, they serve a vital role in care transitions from inpatient to outpatient settings with primary goals to optimize patient health outcomes and contain health care costs.[16] Depending on the jurisdictions and the scope of authority they grant pharmacists, pharmacists contribute to the practice of public health in a variety of ways, including health education on smoking cessation, obesity, sexual health, substance abuse treatment, and pain management, health promotion, screenings, point of care

testing, patient and medication counseling, and disease self-management training. In addition, one of the pivotal contribution pharmacists have made to public health was administering immunizations.[16]

Pharmacists' role as immunizers has evolved over the past two decades, starting from 1995, where only 9 states allowed pharmacists to administer vaccines, to today's world where pharmacists in all 50 states, District of Columbia, and Puerto Rico are authorized to administer immunizations.[16,22] The extent of authority granted to immunizing pharmacists varies by state, sometimes limiting the type of vaccines or the age group to whom the pharmacist can administer a vaccine.[16] However, laws and regulations have been changed, allowing pharmacists to expand the type of vaccines they administer from only the influenza vaccine as it was the case for many states initially to pharmacists administering all or nearly all ACIP age-specific recommended vaccines.[22] Depending on the state's law, pharmacists can administer vaccines under immunization protocols, with physician's prescription, or standing orders where pharmacists serve as a vaccine prescriber in some states.[16,22]

Pharmacists as trusted and highly accessible healthcare providers are well-positioned to facilitate access to immunizations for millions of individuals.[16] Adults who are often concerned about convenience when seeking heath care, can benefit from the convenience pharmacies offer.[16] On average, there are 2.11 pharmacists per 10 000 Americans and 8 out of 10 people live within 10 miles of a pharmacy.[121,122] Pharmacists' contribution is particularly evident in non-urban areas, where shortages of primary healthcare providers are common and pharmacists

may be the only healthcare provider in these settings.[16] Other unique advantages of community pharmacies over traditional immunization clinics include walk-in availability, no visit co-payments, and extended evening and weekend operating hours, particularly when other healthcare settings are closed.[16] Pharmacists contribute to raising immunization coverage by being engaging in IISs or immunization registries and other methods to document administered vaccines.[22] They use such means to assess individuals' need for vaccines as well.[123] Pharmacists in community settings send reminder messages for individuals who have immunizations that are due and recall messages for immunization that are overdue.[123] This is of particular importance for individuals receiving multiple-dose vaccine series.[123] Even when a state's law limits pharmacists from administering vaccines, they can still play an integral role in the delivery of other immunization services by strongly recommending vaccines when necessary, screening patients for ACIP-recommended vaccines, and referring patients to other healthcare providers as applicable.[16,124,125]

Even in times of emergencies and public health crises, pharmacists, like other medical professionals, continue to provide their expertise and services such as the provision of immunizations and ensuring access to medications, especially for the elderly and the disabled populations.[126] During the 2009H1N1 Pandemic, pharmacists proved to be vital to immunization campaigns by serving as mass immunizers across the country in addition to providing the public with education about the pandemic.[17] A CDC study showed that the inclusion of community pharmacists in the national H1N1 vaccination program reduced the time needed to achieve

80% vaccination coverage nationally by 7 weeks with 25 million doses of the vaccine administered every week.[127] Another study indicated that administering influenza vaccines through pharmacies in addition to the traditional sites in times of epidemics, can mitigate against 23.7 million symptomatic cases and results in cost savings of almost $100 billion to society.[128]

The H1N1 pandemic was a turning point in getting all 50 states to allow their pharmacists to administer influenza vaccine and since then many public health officials have strengthened their relationships with pharmacists and pharmacy associations and people started to consider pharmacies as their destination to get their annual flu vaccine.[129–131]

The Coronavirus Disease 2019 (COVID-19) Pandemic

The emergence of SARS-CoV-2 virus and impact of preventive public health measures

In December 2019, the novel virus SARS-CoV-2 has emerged in Wuhan, China, and rapidly spread to eventually result in an epidemic in China and a global pandemic 3 months later.[129] The virus causes an acute respiratory disease known as Coronavirus Disease 2019 (COVID-19).[133] The global impact of COVID-19 is profound; as of October 28, 2021, there were over 245 million confirmed cases and around 5 million deaths worldwide while the United States alone recorded over 44 million cases and over 722 thousand deaths.[134,135] Cases were reported in all age groups but mortality was seen more among older adults and people with comorbidities.[136,137] At the beginning of the pandemic, when there was no effective treatment or vaccine for COVID-19, the following measures were used to control spread of the virus including non-pharmaceutical interventions such as serious curfews in some countries, mandating social/physical distancing orders, mandating masks, canceling mass gatherings, closing schools and universities, and travel restrictions.[133,138] These measures were adopted by countries with the aim to reduce the utilization of healthcare facilities by decreasing the spread of the virus and minimizing morbidity and mortality caused by COVID-19.[139,140] Practicing these measures has impacted almost all aspects of our life, causing disruptions in trade, travels, education, and healthcare. In many healthcare settings, some measures have been taken during times of quarantine, such as stopping routine healthcare services and elective procedures.[133] In addition, changes to the workflow of healthcare professionals and facilities were implemented in a way to help prioritize

care for the increasing number of patients with COVID-19.[133] Many healthcare facilities have also adapted during the pandemic to provide telehealth services to replace in-person appointments.[141] The major challenge here is that these preventive measures still need to be maintained for a while even with the availability of vaccines or treatments for COVID-19 and/or when herd immunity is established.[142–144]

One important health service that has been negatively impacted by the pandemic is the delivery of immunizations. Immunization practices in all age groups but mostly routine childhood immunization programs, have been interrupted, delayed, reorganized, or completely stopped.[145] In the first 5 months of the pandemic, mass immunization campaigns against diseases like measles, polio, diphtheria, pertussis, tetanus, and meningitis were disrupted in at least 68 countries affecting around 80 million children.[11] The reasons for this disruption are social distancing and stay-at-home orders, parents' fear and reluctance to visit healthcare facilities, facility shifting priorities toward care of COVID-19 patients, vaccine transportation delays, and fear of unintentionally contributing to the spread of COVID-19 during immunization campaigns. [12,145–147] In countries where immunizations are usually delivered in school settings, school closures during the pandemic have led to immunization disruptions.[133] Disruptions to immunization practices are concerning because when immunization programs are interrupted for any reason, we may observe increases in vaccine-preventable disease and related deaths.[145] Susceptibility to diseases that were previously controlled or even eliminated might be seen as well among a fraction of the population.[145]

Reduction in childhood immunization rates

According to the Vaccines for Children Program (VFC) in the United States between January-April 2019 (first period) and January-April 2020 (second period), there was a notable decline in the administration of VFC-funded and ACIP-recommended measles-containing vaccines and non-influenza childhood vaccines during the second period.[12] Several states have reported a decrease in childhood immunizations. For example, in Michigan, 50% of infants aged 5 months were up to date on all recommended vaccines in May 2020 compared with 66-68% during the past 4 years (2016-2019).[148] Additionally, measles-containing immunization coverage has declined for children aged 16 months from 76.1% in May 2019 to 70.9% in May 2020.[148] In Ohio, childhood immunization coverage in April 2020 was 45% down from what is usually seen this time of the year; for example, usually 1000 shots of measles are given per month but in April 2020, only 32 shots were administered.[149] Furthermore, in the period from March 23 to May 9 in New York state, the number of childhood vaccine doses was down 63% overall and 91% for children older than 2 years compared to the same time the previous year.[150] In California childhood vaccines doses decreased by over 40% in April 2020 compared to April 2019.[150] Virginia reported that immunization rates dropped around 46% from March 15-April 23 in 2020 compared to the same period in 2019 and that a 83% drop was seen among children younger than 5 years.[151] Coverage for adolescents' vaccines has seen similar drops as well with 65% lower coverage for the HPV vaccine in 2020 compared with April 2019.[151]

This drop in immunization rates could have severe ramifications on the 90-95% immunization coverage that is needed to achieve herd immunity against diseases like measles, mumps, and pertussis putting unvaccinated children and vulnerable others at risk from outbreaks.[133,148] Measles, for example, is a deadly disease with a case fatality rate of 0.2% and it is highly contagious even when compared to COVID-19.[152] While measles was declared eliminated in 2000 in the United States, outbreaks were reported across the country recently.[153] Additionally, even before the pandemic many states have been struggling with parents' refusal of routine and voluntary immunizations like influenza vaccine for many reasons.[133] Thus, control measures implemented against COVID-19 are expected to lead to lower immunization coverage for routine immunizations, leaving millions of children vulnerable to vaccine-preventable diseases and their complications.[133] Similarly, adolescents missing booster doses during the pandemic are at risk of diseases and cancers that are prevented by the HPV vaccine.

Reduction in adult immunization rates

Similar to childhood immunizations, coverage for adult immunizations also display a similar pattern. In the week of April 6, 2020, declines in adult immunization rates for non-influenza vaccines were seen in the United States, with drops by 83.1% (65 years and older) and more than 70% (19-46 years).[13] Adults aged 65 years and older are chiefly at increased risk of serious complications from vaccine-preventable diseases, including influenza and pneumonia.[154]

Influenza is believed to increase the risk of heart attacks by 3-5 times and stroke by 2-3 times in the first two weeks of infection in this age group.[154]

A recent study of Medicare beneficiaries (aged ≥65 years) who are enrolled in a fee-for-service plan ─ representing 66% of the total Medicare population─ provides an analysis of the weekly administration rates for four adult vaccines (PCV13, PPSV23, RZV, and Td/Tdap) during the period of [January 5 to 18 July 2020] compared with [January 6 to July 20 in 2019].[155] In the period of January 4-March 15, 2020 ─ before the national emergency declaration in mid-March ─ immunization rates for PPSV23, RZV, and Td/Tdap vaccines among Medicare beneficiaries were higher than the rates for the same period in 2019.[155] However, the study provides evidence that during the first week following the declaration, weekly rates of receipt of the four studied vaccines dropped by 25% (PPSV23)-62% (RZV) compared to 2019 rates.[155] The largest declines were observed during week of [April 5-11, 2020] for PCV13, PPSV23, and Td/Tdap and week of [April 12-18, 2020] for RZV, with rates dropping by 70% for Td/Tdap to 89% for RZV.[155] Immunization rates started to improve gradually during the second to third weeks of April 2020, however, in the last week of the study [week of July 12, 2020], rates were still below those reported in 2019 except for the PPSV32 vaccine.[155] Compared with the corresponding period in 2019, rates were 8% higher for PPSV32, 24% and 43% lower for Td/Tdap and RZV, respectively.[155] Declines in adult immunization rates were sharp for all vaccines studied among all ethnic and racial groups.[155] Declines during the most recent week of the study [July 12-18, 2020] for PCV13 (42%) and Td/Tdap (23%) were the smallest among White adults but rate for

PPVS23 was 10% higher compared to the same week in 2019.[155] On the other hand, percentages of change in immunization rates were larger among Asian adults (-57% for PCV13 to -9% for PPSV23), Black adults (-44% for PCV13 to -2% for PPSV23), Hispanic adults (-62% for PCV13 to -22% for PPSV23), and among Other ethnic groups (-44% for RZV to 3% PPSV23).[155] In addition, the smallest decline in immunization rates for RZV (11%) was observed among Black adults.[155]

COVID-19 infection is especially severe among adults ≥65 years old, and as the pandemic continues, it is of high importance to maintain adult immunizations during the pandemic to reduce morbidity and mortality from infectious outbreaks and further strain on healthcare systems.[136,137,154]

Recommendations for provision of immunizations during the pandemic

Undoubtedly, another epidemic of a vaccine-preventable disease on top of the COVID-19 pandemic would be detrimental to healthcare systems. Therefore, WHO recommended that all routine vaccinations be administered as scheduled, even during the pandemic for infants, children, adolescents, pregnant women, high-risk groups, and adult heath care providers.[133] Priority should be given to primary series vaccines especially for the MMR, polio, and combination vaccines.[133] In the United States, the CDC recommends against delaying routine immunization schedules even during the COVID-19 pandemic; this is true for all vaccines for children, adolescents, and adults (pregnant women and healthcare workers).[156] The American Academy of Pediatrics (AAP) and the American Association of Family Physicians (AAFP) advised

continuing routine immunizations to maintain herd immunity for infections that have been previously eradicated.[157] Interrupted immunization services should be resumed, and catch-up immunizations should be offered as quickly as possible.[156]

During a vaccine administration session, control measures that guarantee protection for the vaccinators, vaccine recipients, and any individuals accompanying vaccine recipients should be followed.[133] Such measures include, hand wash hygiene, wearing masks and appropriate use of personal protective equipment (PPE), waiting in cars, when possible, until being called upon, keeping social distancing, and scheduling immunization visits in advance among others.[133]

Community pharmacist's expertise in immunization

Community pharmacists as knowledgeable and trained healthcare providers known to have extensive experience in provision of immunization services during past pandemics, are in well position to contribute to immunizations during this current pandemic. Pharmacies are accessible to all Americans and as an essential businesses on frontlines during the pandemic, they remained open to the public when other settings closed their doors. The scope of pharmacists' immunization authority continues to expand over the years with the recent guidance just issued in 2020. In August 2020, the U.S. Department of Health and Human Services (HHS) issued an order allowing pharmacists regardless of their state's law and pharmacy interns ─under supervision of pharmacists─ to order and administer all childhood vaccines during the COVID-19 pandemic.[20] This order is a step towards facilitating public's

access to vaccines and to prevent outbreaks of vaccine-preventable diseases during the pandemic.[20] This also translates into increasing the number of types of vaccines pharmacists can administer, decreasing the age of vaccine recipient to whom pharmacists can administer vaccines, and increasing pharmacists autonomy in this context. The HHS has also issued an order in the later part of 2020 authorizing pharmacists to order and administer, qualified pharmacy technicians, and state-licensed or authorized pharmacy interns to administer —under the supervision of qualified pharmacists— COVID-19 vaccines for people age 3 and older.[20,23]

Health Disparity in Rural Communities in the United States

Approximately 60 million Americans reside in rural areas accounting for nearly 19.3% of the U.S. population.[158] There is no precise definition of "rural area"; the Rural Development Act of 1972 defines "rural area" as an area with no more than 10,000 residents while the U.S. Census Bureau defines "rural area" as any geographic area that is not deemed urban (i.e. an urbanized area (UA) including 50,000 or more individuals or an urban cluster (UC) including at least 2,500 to less than 50,000 individuals).[159,160] Nevertheless, there is a consensus that rural areas face a unique combination of obstacles that are not found in urban areas.[161,162] Rural areas have poorly developed and fragile economic infrastructures and people there are more likely to have barriers to affordable and high-quality healthcare compared to their urban counterparts.[159,163] When compared to urban residents, rural residents have higher all-cause mortality, higher rates of premature morbidity and mortality from diseases like cancer and

heart disease, lower access and use of preventive healthcare services, and are less likely to engage in healthy behaviors.[162,164–168]

The reasons for this disparity are multifactorial including limited access to health insurance, lack of adequate transportation, and shortages of healthcare providers in rural areas (see Figure 2.1).[162] According to the National Rural Healthcare Association (NRHA), over 135 rural hospitals have closed since 2010; 20 of which closed in 2020 alone.[169,170] Rural hospital closures throughout the years had led to increased inpatient mortality whereas hospital closures in urban areas had no measurable impact on mortality.[169,171] Additionally, rural areas experience a high rate of primary health professional shortages with only 9% of physicians practicing in rural areas reflecting the challenge of recruitment and retention of healthcare providers in these settings.[159,169,172] Twenty million rural residents live in "Dental Professional Shortage Areas" leaving emergency rooms as the only source of dental care to this population.[169] Furthermore, rural areas are less likely to offer specialty and emergency care services which forces individuals seeking specialized care to travel significant distances for treatment and others to rely on general practitioners nearby to avoid long travel distances compromising the quality of care they attain.[159,173,174] Often, people in rural areas tend to be poorer and are more likely to live below the poverty level.[159,163,175] Evidence shows that people with limited income have a lower vaccination coverage than people living above the poverty levels.[176–179] Rural areas have more uninsured individuals than urban areas. Further, insurance coverage is often less comprehensive for rural populations; rural residents are less likely to

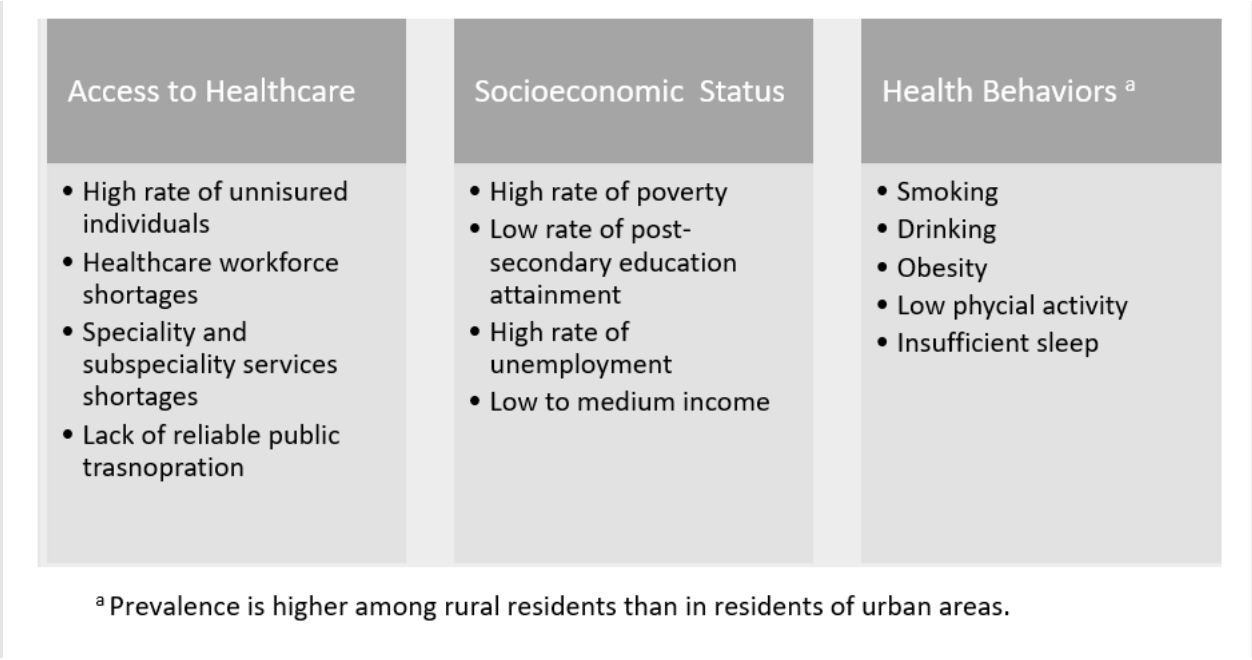
have employment-sponsored health insurance and are more likely to be covered by Medicaid or another form of public health insurance.[159,162,180–184] Rural residents tend to be unemployed, have less post-secondary education, and have low to moderate income.[162,181] Finally, limited access to high-speed internet is a barrier that people in some rural areas continuously face which hinders access to publicly available health information and adoption of digital health services such as telehealth.[185]

These factors also compromise vaccination uptake in rural areas. Data suggest that there are disparities in vaccination coverage in rural areas in the United States compared to urban areas. Vaccination rates are being reported for areas of residence in metropolitan statistical areas (MSAs) as MSA principal city, MSA nonprincipal city, and non-MSA city and MSAs contains at least one urbanized area of 50,000 people or more.[186] People across all age groups who live outside an MSA have lower immunization coverage than individuals living in an MSA.[177,186–188] Coverage disparity is more prominent in HPV vaccination rates among adolescents.[188] Notably, the most recent evidence on the rural-urban immunization divide comes from the CDC's Mortality and Morbidity Weekly Report (MMWR) on COVID-19 vaccination coverage. The report provides data on coverage among adults ─ 18 years or older who received the first dose of Moderna or Pfizer COVID-19 vaccines or the single dose of the Janssen COVID-19 vaccine during the period from December 14, 2020, to April 10, 2021. The report points out that, overall, coverage was lower in rural counties (38.9%) than in urban areas (45.7%) in most jurisdictions.[189] Disparities existed in terms of age and sex; (29.1%) for rural

adults aged 18-64 years versus (37.7%) for their counterparts in urban areas, (67.6%) for adults aged 65 years versus (76.1%) for urban counterparts, and women (41.7% rural versus 48.4% urban) and men (35.3% rural vs 41.9% urban).[189] In addition, people residing in rural areas traveled to nonadjacent counties for COVID-19 vaccination at a higher level than those residing in urban areas which may be attributable to limited access to vaccines and shortages of healthcare facilities in rural areas.[189,190]

Looking at the unique and inherent challenges of rural communities, the need to address these challenges is crucial to realize the full benefits of vaccines for everyone. As long as vaccine disparities persist, infectious disease outbreaks will continue to threaten rural residents at a higher rate.

Figure 2.1 Causes of rural health disparities.[162]



Objectives of this study

Because community pharmacies remained open and accessible during the pandemic, pharmacies may serve as immunization sites for those who have otherwise gone elsewhere for vaccinations. Therefore, despite the reduction observed in immunization coverage for childhood and adult immunizations, it is possible that immunization activities remained stable or even increased when compared to the period prior to the pandemic. To date, and to the best of our knowledge, a clear image of how community pharmacies responded to the pandemic in terms of routine immunization services is lacking. This study explored the impact of the COVID-19 pandemic on pharmacy-based immunization practice. Specifically, we examined how the

pandemic affected the numbers and types of non-COVID-19 vaccines administered in rural community pharmacies, how rural pharmacies adapted their immunization services during the pandemic, and what innovative measures were implemented by pharmacists to continue to provide immunizations amidst the current pandemic. Further, this study aimed to explore rural pharmacists' willingness to obtain, administer, or recommend COVID-19 vaccines and their perceived benefits for providing COVID-19 immunization services at their practice site. Finally, we report on rural pharmacists' knowledge about the new guidance released by the U.S. Department of Health and Human Services (HHS) on pharmacy staff immunization authorization.

Findings from this study have the potential to contribute to the areas of pharmacy practice and public health. This study is expected to identify best practices regarding the successful provision of immunization services during the current and even future pandemics in non-urban settings. The study gives a glimpse of rural pharmacists' acceptance of COVID-19 vaccines. Further, findings can inform community pharmacists' role in public health crises and improve communication with public health officials. Results also add to the body of knowledge regarding community pharmacists' role in immunization practice and pandemic response in rural areas.

Chapter 3. Methods

The specific aims for this exploratory study are: (1) to compare the types and doses of seasonal and non-seasonal vaccines administered by rural community pharmacists before and during the COVID-19 pandemic, (2) to assess the impact of the COVID-19 pandemic on the provision of pharmacy-based immunization services in rural areas, and (3) to explore the willingness of rural community pharmacists to obtain, recommend, and administer the COVID-19 vaccines. This chapter provides a detailed description of the research method and the tool was used to address these specific aims including; research design, recruitment strategies, measures and data collection, and data analysis plan.

Study Design

This study utilized a cross-sectional design and recruited community pharmacists operating in non-urban areas in 5 different southeastern states. The unit of analysis was at the pharmacy level. Data was collected using a self-administered survey where both mail and web formats were used. The study protocol was reviewed by the Auburn University Institutional Review Board (IRB) as an expedited review.

Sample frames and Participants

A convenience sample of pharmacists from the Rural Research Alliance of Community Pharmacies (RURAL-CP) network, which is the first multi-state practice-based research network

developed for community pharmacies in rural settings, was used.[24] The RURAL-CP network consists of 110 community pharmacies, number changes, across 5 southeastern states including Alabama, Arkansas, Mississippi, North Carolina, and South Carolina where pharmacists collaborate with schools/colleges of pharmacy to identify and address questions related to medication use and pharmacy practice.[24] In addition, the Hayes Directories was used to recruit non-urban community pharmacies from Alabama. The Hayes Directories is an online database (Hayes Directories, 2020) that provides the name and contact information of a total of 57,855 community pharmacies across the U.S and 1,198 community pharmacies in Alabama alone (652 chain and 546 independent).[25] The Zip code provided by the Hayes Directories was used to identify pharmacies in non-urban areas in Alabama for recruitment. The "Am I Rural?" tool provided by the Rural Health Information Hub website (Am I Rural? Tool- Rural Health Information Hub, 2021) was used to identify rural pharmacies using RUCA codes of 4-10.[26] RURAL-CP pharmacies are also located in areas with RUCA codes of 4-10 so we eliminated RURAL-CP pharmacies from Alabama from the list to avoid duplication. Since RURAL-CP pharmacies are members of the RURAL-CP network and are regularly engaged in research projects about pharmacy practice in rural areas, they might be different from typical community pharmacies that do not usually engage in research, possibly, like pharmacies identified by the Hayes Directories.

Pharmacies were included in the study as long as they have provided immunization services for at least 1 vaccine at their practice site in 2019 and only one pharmacist per location

was allowed to participate including the pharmacy manager or any pharmacist who played a key role in the immunization services at the pharmacy in 2019 and 2020.

Due to the exploratory nature of this study and the small sampling frame, we invited all pharmacies from the RURAL-CP network and the eligible Alabama pharmacies identified through the Hayes directories to participate.

Data collection

Data was collected from May to August 2021, utilizing two different survey modes, as discussed below. The need to utilize two different modes was related to the type of contact information available for pharmacies. The questionnaires in both modes were identical in content and length and needed around 15 minutes to complete.

RURAL-CP network

RURAL-CP network has a list of network members and their contact information including pharmacy address, phone number, and email address. Pharmacies were invited to participate in our electronic questionnaire via an invitation email distributed through the network. The invitation email briefly described the study and included a link to the information letter and the online survey. The questionnaire was made available through Qualtrics online survey software (Qualtrics XM, Experience Management Software, 2021).[191] A week later, the initial invitation was followed by two follow-up "reminder/thank you" emails which were two weeks apart. The body of the email included a description of the study, a reminder message,

and the URL for the information letter and the survey. We had no access to pharmacies' contact information and all contacts were made through our partner from the RURAL-CP network at Eshelman School of Pharmacy at the University of North Carolina at Chapel Hill. In other words, our partner distributed the survey link among network pharmacies and sent reminders to pharmacies on our behalf per the approved IRB protocol. Qualtrics setting by UNC allows them to track responses so that only non-respondents get the reminder.

Hayes Directories group

Hayes Directories provides a list of community pharmacies and their contact information including their physical address, phone, and fax numbers but not their email addresses. Therefore, pharmacies identified through Hayes Directories were invited to participate in the paper version of the questionnaire which was sent via the United States Postal Service (USPS). First, a pre-notification postcard was sent to describe the study and to notify pharmacists of the incoming survey packet. The postcard also contained a URL for the electronic version of the questionnaire for pharmacists who would prefer to complete the survey in this mode. Two weeks later, the survey packet was sent to pharmacies including the letter of invitation, the paper questionnaire, and a return envelope with a first-class stamp. Three weeks later, a "reminder/thank you" postcard was sent to pharmacies including information about the study and a URL for completion via the electronic survey. Finally, two weeks later another survey packet was sent to pharmacies that did not complete the survey.

The packet consisted of a “reminder/thank you” letter with a URL for the online version of the questionnaire, an information letter, and a replacement paper survey. See Appendixes 1-8 for recruitment materials.

Data Management

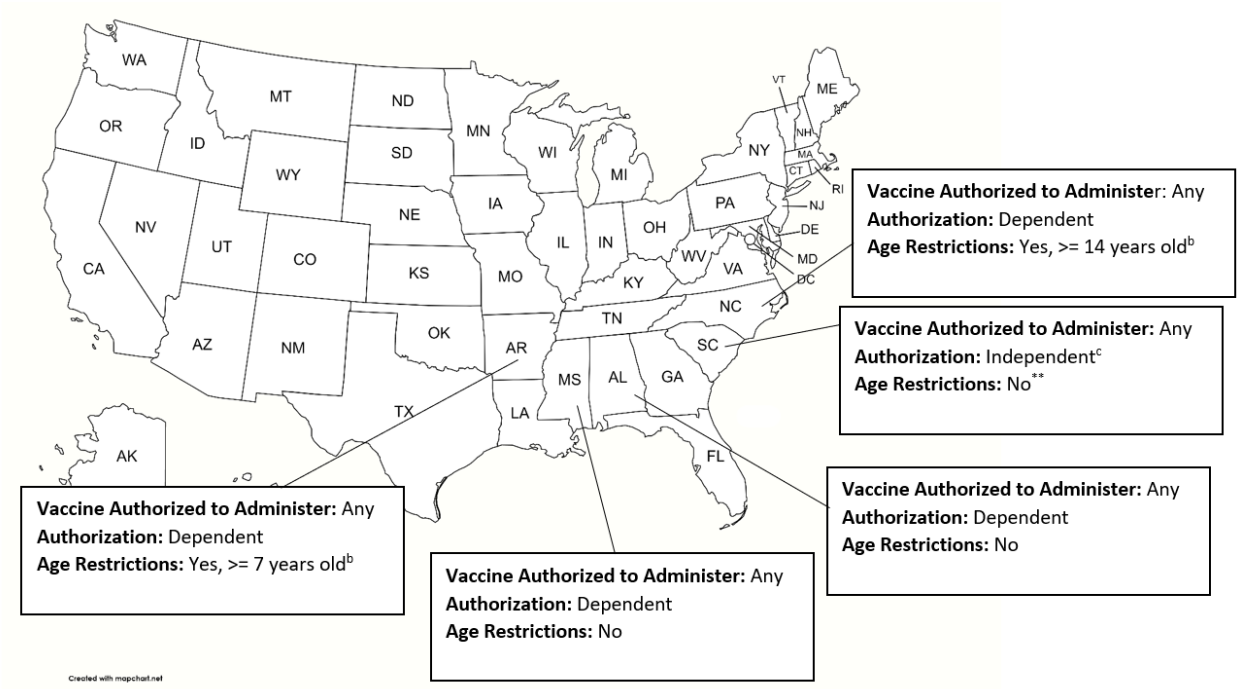
Each pharmacy was assigned a unique code which was provided in the invitation letter/postcard. The unique code was used to help monitor responses and for follow-up in case of any inquiries. All names associated with code numbers (code lists) were stored on an electronic file on the primary investigator’s (PI) Auburn University’s Box and kept separate from the data files. In addition, all returned mail questionnaires were kept in securely locked files inside a locked cabinet at the PI’s office in the Department of Health Outcomes Research and Policy. Data files contained participants’ responses (from both mail and online surveys) and code numbers but with no participants’ identifications and were kept in an electronic form on the PI’s Auburn University’s Box that is password protected and requires DUO authentication. Further, the incentive forms with participants’ email addresses and pharmacy unique code were detached from the completed questionnaires and kept in a different locked cabinet that is not shared with anyone at the PI’s office and were later discarded after payments were completed.

Pharmacist Immunization Authority by State

Pharmacist immunization authority varies widely by state and there are three main points to consider when looking at this scope of practice authority.[192] First, *which types of vaccines pharmacists can administer:* all FDA-approved vaccines, CDC/ACIP-recommended vaccines, or only vaccines listed in statute.[192] Second, *who prescribes the vaccine to patients:* if it is the pharmacist then this is considered "independent authority" whereas it is "dependent authority" if the vaccine is prescribed by another healthcare provider either via protocol or prescription. Finally, what age groups of vaccine-recipient are covered and does it vary depending on vaccine type.[192]

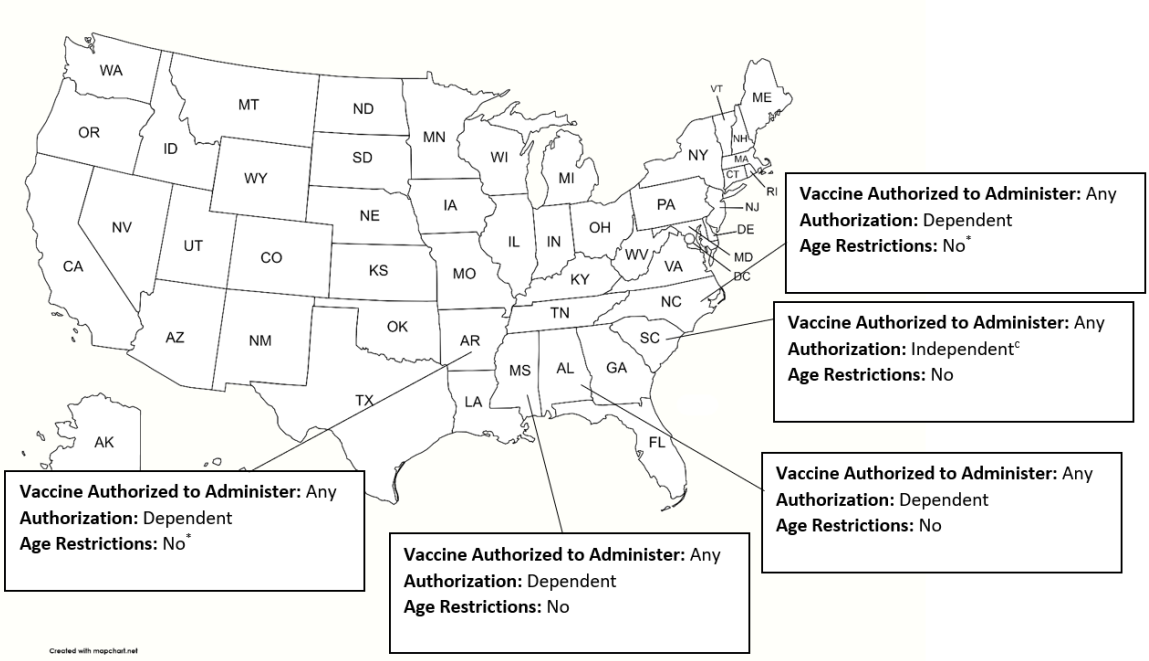
Figure 3.1 and Figure 3.2 provide a visual representation of pharmacist immunization authority in 2019 and 2020 in the five states that this thesis aimed to explore. The five states are Alabama (AL), Arkansas (AR), Mississippi (MS), North Carolina (NC), and South Carolina (SC). Compared to 2019, the age of vaccine-recipient has been expanded in 2020 to include all ages from 3 years and older for the 5 states. This expansion has come as a response to the COVID-19 pandemic in late 2020 where all state-authorized pharmacists and pharmacy interns and pharmacy technicians (under pharmacist's supervision) were granted authorization to order and administer childhood vaccines and COVID-19 vaccines for patients aged 3 years and older regardless of the laws in their state of practice.[20,21,23]

Figure 3.1 Pharmacist Immunization Authority in 2019.[193]



[b] Limited to certain vaccines.
** Via prescription. [c] Protocol/prescription or no prescriber/prescription needed.

Figure 3.2 Pharmacist Immunization Authority in 2020.[20,23,192]



[c] Protocol/prescription or no prescriber/prescription needed.
* Changed as a response to the new HHS guidance.

Consent

Consent was implied upon completion of the web questionnaire or returning the completed paper questionnaire. The information letter presented on page one of the online questionnaire included this message at the end: *"Having read the information above, you must decide if you want to participate in this research project. If you decide to participate, please click "yes'' and click on the "start" arrow on the bottom right of the screen. You may print a copy of this letter to keep.".* Pharmacists were explicitly informed that continuing with the survey indicates that they have provided their consent. This also applied to pharmacists who were invited to participate via mail but preferred to complete the online questionnaire. Likewise, consent was implied if respondents to the mail questionnaire sent us back their completed survey in the mail. A copy of the information letter was provided for them to keep.

The information letter indicated that the study's overall objective is to explore how pharmacies' provision of immunization services in non-urban areas has been affected by the COVID-19 pandemic. All potential respondents were guided to contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone or email if they had any inquiries about their rights as research participants. Finally, all potential participants were informed that they can withdraw from the study at any time.

Incentive

A $20 Amazon electronic gift card supported by the RURAL-CP grant and the Department of Health Outcomes Research and Policy at Auburn University was issued to pharmacists who completed the questionnaire and provided us with their contact information. The last section of the online questionnaire asked pharmacists to fill out an "incentive questionnaire" that asked pharmacists to provide their contact information (email address and pharmacy unique code provided in the invitation letter) if they wished to receive the gift card. The "incentive questionnaire" was separate from the main questionnaire to keep the identity of respondents anonymous. Likewise, those completing the mail questionnaire were asked to fill a separate card, enclosed in the survey packet, with their contact information (email address and pharmacy unique code provided in the invitation letter). Participants' contact information cards were kept separate from participants' responses to protect participants' identities.

Questionnaire Development

The questionnaire can be categorized into 4 main sections; 1) acceptance of COVID-19 vaccination, 2) administration of non-COVID-19 immunizations during the COVID-19 pandemic, 3) types and doses of administered non-COVID-19 vaccines before and during the pandemic, and 4) pharmacist demographics and pharmacy characteristics (Table 3.4). See Appendix 9 for the complete questionnaire.

The questionnaire development began with a literature review to identify existing relevant, valid, and reliable measures that could be adapted and used for this study along with brainstorming to identify new questions in line with the predefined specific aims. Some measures were adapted from previously published literature and an existing project funded by the Centers for Disease Control and Prevention. The following section in this chapter will describe the content of each survey section separately.

Section 1: COVID-19 immunizations

This section includes measures that address Aim 3 of the study. Specifically, they are pharmacist's willingness to receive, recommend, and administer a vaccine for COVID-19; pharmacists' personal motivators to get vaccinated against COVID-19; pharmacists' perceived benefits of providing COVID-19 immunization services at their practice sites; reimbursement for COVID-19 vaccines administration, and pharmacists knowledge of the HHS guidance on pharmacy-based immunization during the COVID-19 pandemic. Additionally, this section includes a question on previous vaccination against seasonal influenza in the past 12 months. This section has 8 questions, 6 of which are in a multiple-choice format and the other 2 are in a 5-point Likert scale format. The scores of the items in the 5-point Likert scales ranged from 1= strongly disagree to 5=strongly agree and from 1= no benefit to 5= extreme benefit, respectively. For example, "**Please indicate your level of agreement with the following statement**: *When my family member becomes eligible to receive a COVID-19 vaccine, I would*

recommend that they get it." The answer options are: Strongly disagree, Somewhat disagree, Neutral, Somewhat agree, or Strongly agree. Choosing the 5-point Likert scale was based on research recommending that the optimal number of response options for Likert scales is 5 to 7 which guarantees a more reliable and valid scale.[194] Choosing an odd number of options over an even number allows for the "neutral" option which eliminates forced response.

The questions in this section were created by the investigators informed by the current COVID-19 pandemic and adapted from previously published literature and published and ongoing work of authors (Dr. Westrick).[195–197] Table 3.1 displays the measures for aim 3 that were addressed by this section.

Table 3.1 Measures of pharmacist willingness to obtain, recommend, administer COVID-19 vaccines.				
Variables	**Source**	**Variable Scale**	**Analysis**	**Question number**
Previous influenza vaccination	Created by investigators and informed by previous research[195–197]	Multiple-choice question (Yes or No)	Descriptive statistics (frequency and percentage)	Q1.1
Previous COVID-19 vaccination	Created by investigators and informed by previous research[195–197]	Multiple-choice question (Yes or No)	Descriptive statistics (frequency and percentage)	Q1.2
Pharmacists' personal reasons for getting vaccinated against COVID-19	Created by investigators and informed by previous research[195–197]	Multiple-choice question	Descriptive statistics (frequency and percentage)	Q1.3
Pharmacist's willingness to receive, recommend, and administer a vaccine for COVID-19	Created by investigators and informed by previous research[195–197]	5-point Likert-scale	Descriptive statistics (frequency and percentage)	Q1 .4
Knowledge of the HHS guidance on pharmacy-based immunization during the COVID-19 pandemic	Created by investigators	Multiple-choice question	Descriptive Statistics (frequency and percentage)	Q1.6
COVID-19 Immunization Services	Created by investigators	Multiple-choice question	Descriptive Statistics (frequency and percentage)	Q1.7

Reimbursement for COVID-19 vaccine administration at the pharmacy	Created by investigators and informed by previous research[195–197]	Multiple-choice question	Descriptive Statistics (frequency and percentage)	Q 1.8

Section 2: Procedure for administering non-COVID-19 vaccines

This section includes measures that address Aim 2 of the study. It gathers information on the provision of non-COVID-19 vaccines during the COVID-19 pandemic with the aim to explore the effect of the pandemic on the provision of immunization services and to compare the delivery of immunization services during the pandemic (2020) to before the pandemic (2019). Questions gather information about all the steps undertaken during a vaccine administration procedure starting from assessing patients' immunization status all the way to documenting the administration of the vaccine. This section has 10 questions in a multiple-choice format where all but one question are followed with a sub-question asking pharmacist whether the delivery of the step mentioned in the question has changed compared to how it was carried out in 2019. A text box was provided to allow pharmacists to explain the change(s) as applicable. For example, *"***How did you provide immunization services at your pharmacy during the COVID-19 pandemic in 2020? Check all that apply.** Options: *By appointment - any time we are open, By appointment - during designated hours, By walk-in - any time we are open, By walk-in - during designated hours, Others".* Sub-question: *"***Has this changed compared to how you offered immunization services in 2019?** Options: ☐ *No* ☐ *Yes, please explain the change(s)* _____*".* The

questions were created by the investigators and adapted from authors' previously published and ongoing work.[198] See Table 3.2 for aim 2 measures that were addressed by this section.

Section 3: Types and doses of non-COVID-19 vaccines

Measures in this section address Aim 1 of the study. Pharmacists were asked to indicate whether they have provided routine non-COVID-19 vaccines recommended by ACIP for each age group in 2019 and 2020. Pharmacists were also asked to report the number of doses for each vaccine administered in 2020 and compare it with the number of doses administered in 2019.[66] Instead of asking pharmacists to indicate an estimated number of doses administered in 2019, pharmacists were asked to compare the number of doses provided in 2020 to 2019 by choosing one option from the following options: 1) increased, 2) remained about the same, or 3) decreased. Although it would be more prudent to ask pharmacists to provide dose estimates for 2019 as well but this can be inconvenient for busy pharmacists and likely impact survey response rate negatively. This section consists of 3 main questions in a multiple-choice format and sub-questions in a text-entry format that were created by the investigators and adapted from authors' previously published work.[198] See Table 3.3 for aim 1 measures that were addressed by this section.

Table 3.2 Measures for assessment of non-COVID-19 immunization activity in 2019 and 2020.

Variables	Source	Variable Scale	Analysis	Question number
Methods of provision of immunization services at practice site during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.1
Location of immunization administration at the pharmacy during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.2
Methods used for assessment of immunization status during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.3
Enrollment in a State or Regional Immunization Registry	Created by investigators and informed by previous research[198,199]	Multiple choice-question	Descriptive statistics (frequency and percentage)	Q2.4
Methods used for record-keeping during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.5
Frequency of immunization referrals sent/received	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.6, Q2.7

Methods used to remind patients of vaccination dates during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.8
Personnel administering vaccines during the pandemic	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.9
Role of pharmacy technicians in immunization services	Created by investigators and informed by previous research[198,199]	Multiple choice-question followed by an open-ended question	Descriptive statistics (frequency and percentage)	Q2.10

Table 3.3 Measures assessing the types and doses of non-COVID-19 vaccines administered in 2019 and 2020.

Variables	Source	Variable Scale	Analysis	Question number
Types and doses of vaccines administered for each age group in 2020 Types and doses of vaccines administered for each age group in 2020 compared to 2019	Created by investigators and informed by the previous research[198]	Multiple-choice questions and sub-questions in text-entry format	Descriptive statistics (frequency, percentage, mean, standard deviation)	Q3.1, Q3.2, Q3.3

Table 3.4 Measures for pharmacy and pharmacist characteristics.				
Variables	**Source**	**Variable Scale**	**Analysis**	**Section number**
Age, race, ethnicity, sex, education/training, pharmacy ownership, prescriptions volume, number of FTE licensed pharmacists and technicians, number of pharmacists, interns, and technicians trained to administer immunizations, and years of pharmacy immunization experience.	Informed by previous research [198,199]	Categorical multiple-choice questions and Open-ended questions	Descriptive statistics (frequency, percentage, mean, median, standard deviation)	Section 4

Reliability and Validity

The survey instrument was pre-tested with 3 pharmacists and 4 student pharmacists who provided their feedback on clarity, wording, and relevance of questions. The experience of committee members in pharmacy-based immunization research (Dr. Westrick and Dr. Ha) and survey methodology (Dr. Wang and Dr. Westrick) was consulted for content validity and the questionnaire was revised accordingly. Before wide-scale distribution, the questionnaire was piloted and modified with input from 20 urban community pharmacists from Alabama identified by the Hayes directories. These individuals were invited to the online questionnaire and were not included in the study. The survey instrument was piloted among urban pharmacists, not rural pharmacists, in order to save the small sample size we identified for the

study. However, we do not expect different response distribution for questions included in our survey between pharmacists working in rural areas and pharmacists working in urban areas. In addition, it is not uncommon for pharmacists to have work experience in both settings. The feedback we received from pilot-testing indicated that survey questions were readily understood by this group. Internal consistency reliability for both the willingness scale and benefit scale was assessed using Cronbach's alpha. The scale was considered reliable if the value of alpha was ≥ 0.70.

Estimation of Margin of Error

For RURAL-CP members, we estimated a 60% response rate based on a previous survey study of this population.[200] If the response rate is 60% of the 108 invited (65 pharmacies), with the Confidence Level of 95%, the margin of error is estimated to be 8% (Table 3.5). For Alabama community pharmacies identified by the Hayes Directories, if the response rate is 50% of the 285 invited pharmacies (143 pharmacies), with the Confidence Level of 95%, the margin of error is estimated to be 6% (Table 3.6).

Table 3.5 Estimation of Margin of Error for RURAL-CP Pharmacists.[201]			
Response Rate (%)	**Confidence Level (%)**	**Margin of Error (%)**	**N of pharmacies**
70	95	6	76
60	95	8	65
50	95	9	54
70	90	5	76
60	90	6	65
50	90	8	54

Table 3.6 Estimation of Margin of Error for Hayes Pharmacists.[201]			
Response Rate (%)	**Confidence Level (%)**	**Margin of Error (%)**	**N of pharmacies**
50	95	6	143
40	95	7	114
30	95	9	86
50	90	5	143
40	90	6	114
30	90	7	86

Nonresponse Bias Investigation

Potential nonresponse bias was investigated after completing the data collection process. We compared early respondents and late respondents in terms of several individual and pharmacy characteristics. According to the continuum of resistance model, late respondents can be used as a proxy for nonrespondents for nonresponse bias investigation purposes.[202,203] Late respondents are believed to have responded because of an additional stimulus, for

example, a follow-up postcard/email and are assumed to demonstrate similar characteristics to non-respondents because they would have been "non-respondents" had not that additional stimulus been made.[204] For this study, early respondents were defined as the first 15 participants to complete the survey and late respondents were defined as the last 15 to complete the survey. Chi-square test analysis was used to compare the differences between early and late respondents for categorical variables and independent t-test analysis for continuous variables. Fisher's exact test was used in lieu of the chi-square analysis test whenever more than 20% of cells had expected frequencies less than 5.[205] An alpha of 0.05 was used to test for statistical significance.

Data Analysis Plan

Data was analyzed using SAS software version 9.4 (SAS Institute Inc., Cary, NC) with a priori significance level of ≤ 0.05 for all tests. Descriptive statistics were used to describe the characteristics of pharmacists and pharmacies included in the analysis. Means and standard deviations were used to present continuous variables and percentages and frequencies were used to present categorical variables.

Moreover, descriptive statistics were used to present the total number of pharmacies providing immunization services in 2019 and 2020 and the average annual dose for 2020 for each vaccine type per pharmacy. Numbers and percentages of pharmacies offering vaccinations for each age group were also calculated. Answers to questions about immunization activities

during the pandemic and sub-questions comparing changes to 2019 were presented by percentages and frequencies. Further, bivariate exploratory tests were conducted to assess relationships between questionnaire items using the McNemar's test for paired data, Chi-square test, and Fisher's Exact test (when Chi-square test is invalid) for categorical variables and the Two-sample t-test and Mann-Whitney U test for continuous variables.[205] The Shapiro-Wilk test was used first to evaluate normality of distribution for continuous variables and depending on the result the Two-sample t-test or Mann-Whitney U test were used for variable comparisons. Bivariate analyses were also used to assess for the association between pharmacists' willingness to get vaccinated against COVID-19 (Yes or No) and some selected pharmacists' characteristics. Finally, bivariate analyses were used to assess for associations between pharmacists' willingness to recommend COVID-19 vaccines to patients and family (Willing or Unwilling) and some selected pharmacists' characteristics.

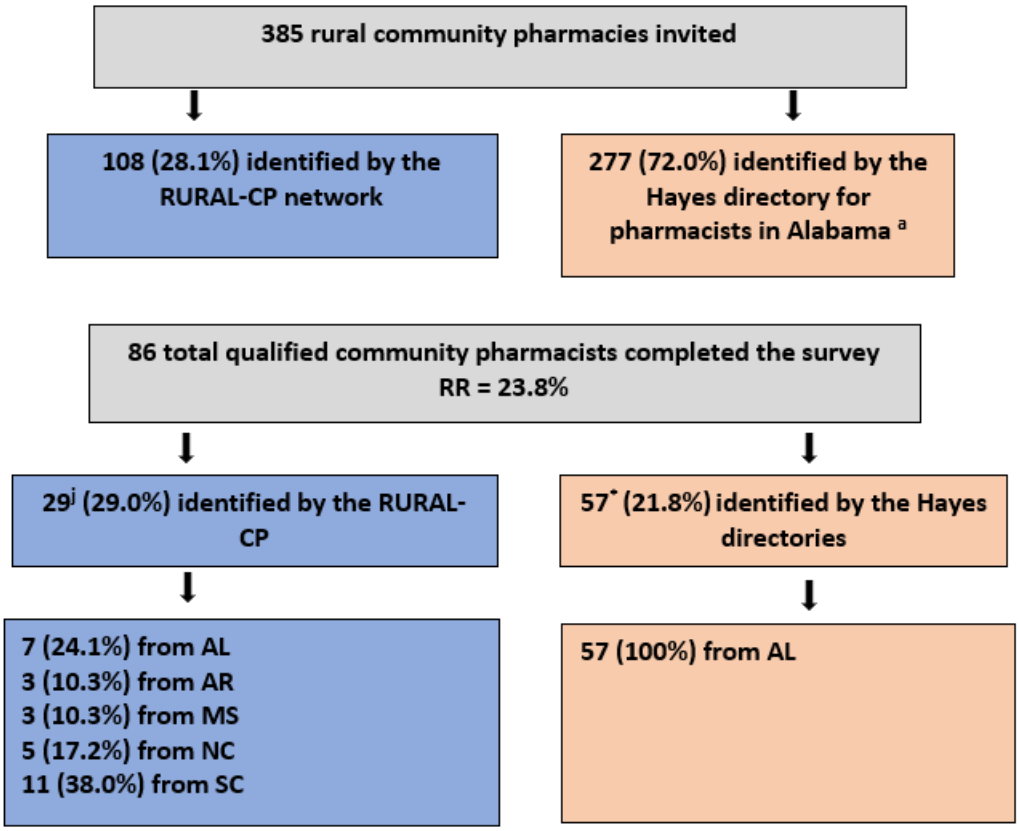
Chapter 4. Results

This chapter presents results separately for Aims 1, 2, and 3 along with results of potential nonresponse bias investigation and internal consistency reliability. In the context of this study, we used "pre-pandemic" to refer to the year 2019 and "during the pandemic" to refer to the year 2020. Further, "RURAL-CP Pharmacists" was used to refer to pharmacists identified through the RURAL-CP network and "Hayes Pharmacists" to refer to pharmacists identified through the Hayes Directories, when necessary. Results presented in this chapter are for both groups combined but Appendix 13 includes results for each group.

Response Rate

Of the 385 rural pharmacies invited, 102 responded. Of the 385 invited, 1 pharmacy had an outdated email address, and 1 had a mail address for a vacant building. Of the 102 pharmacies who responded, a total of 16 pharmacies were excluded because they were deemed ineligible as the pharmacies do not offer immunization services. The final sample consisted of 86 completed responses each representing a unique pharmacy. With a response rate (RR) of 23.8% and a confidence level of 95%, the margin of error was ± 9%. The majority of pharmacies 64 (74.4%) were from AL, followed by 11 (12.8%) from SC, 5 (5.8%) from NC, 3 (3.5%) from AR, and 3 (3.5%) from MS. Figure 4.1 illustrates survey response rate for each group and response distribution by state.

Figure 4.1 Survey response and distribution by state.



Eligible for the survey: Pharmacies operating in rural areas and had provided immunization services for at least 1 vaccine pre-pandemic.

[a] After removing duplicated pharmacies identified by the RURAL-CP network.
[j] 8 pharmacies were excluded [1 bounced email from SC; address not updated and 7 responses were excluded because pharmacy does not provide immunization services].
[*] 15 pharmacies were excluded [6 mails couldn't be delivered and 9 responses were excluded because they do not offer immunization services; 1 of which did not provide immunization services pre pandemic].
RURAL-CP, Rural Research Alliance of Community Pharmacies; RR, response rate; AL, Alabama; AR, Arkansas; MS, Mississippi; SC, South Carolina; NC, North Carolina.

Potential nonresponse bias investigation

A nonresponse investigation was conducted after closing the survey by comparing early respondents to late respondents in terms of pharmacist's age, sex, education, race, previous COVID-19 vaccination, influenza vaccination in the past 12 months, pharmacy's immunization experience, pharmacy's ownership, and enrollment in regional or state IIS.

Early respondents were defined as the first 15 participants to complete the survey and late respondents were defined as the last 15 to complete the survey. The results indicate that early respondents were different from late respondents in terms of age (p-value = 0.0080) where late respondents had a higher mean age. There were no other statistically significant differences between early and late respondents in the remaining variables, Appendix 10.

Internal Consistency Reliability

For our sample, the internal consistency of the "Pharmacist's acceptance of COVID-19 vaccination" scale, after removing one item that reduced the internal consistency, was high (Cronbach's alpha = 0.943). The item removed was "When a COVID-19 vaccine becomes available in my pharmacy, I or other staff would administer it to my patients". Additionally, the internal consistency of the "Perceived benefits of offering COVID-19 immunization services" scale was also high (Cronbach's alpha = 0.906). For both scales, response categories ranged from (1) for strongly disagree to (5) for strongly agree. For more details, see Appendix 11.

Pharmacist and pharmacy characteristics

Table 4.1 displays pharmacist and pharmacy characteristics. The age of respondents ranged between 24 and 81 years with a mean of 42.2 and SD 12.4 years, 58.8% were females, 94.1% were white, and 100% were not Hispanic or Latino. The majority of pharmacists (63.3%) held a Doctor of Pharmacy (Pharm.D.) degree.

In terms of the characteristics of the community pharmacy where respondent pharmacists work, about half of pharmacies (48.8%) have single-independent ownership, dispense 250 prescriptions daily, and employ 2 and 3 of pharmacist and pharmacy technician full-time equivalents, respectively. Furthermore, pharmacies reported a median immunization experience of 10.0 years. In respect of the number of personnel trained to administer vaccines at the pharmacy, pharmacies reported a median of 2 pharmacists, 0 pharmacy interns, and 0 pharmacy technicians. Finally, nearly 86% of pharmacies were enrolled in a state or regional IIS. Of those reporting the year of first enrollment in an IIS, over two-thirds (63.3%) have enrolled in or after 2018 of which 28.9% and 15.8% enrolled in 2020 and 2021, respectively.

Table 4.1 Respondent and Pharmacy Characteristics.	
Characteristics	**n** **Mean (SD)** **Median**
Respondent age (years)	**85** 42.2 (12.4) 40.0
Average prescription volume per day	**83** 278.7 (138.7) 250.0[Δ]
Number of FTEs of pharmacists	**84** 2 (1.3) 2[Δ]
Number of FTEs of technicians	**84** 3 (2.2) 3[Δ]
Number of pharmacists trained in immunization administration	**85** 2 (1.2) 2[Δ]
Number of technicians trained in immunization administration	**84** 0 (1.4) 0
Number of interns trained in immunization administration	**84** 0 (0.58) 0
Pharmacy immunization experience (years)	**83** 12.4 (8.7) 10.0[Δ]
	N **n (%)**
Sex Female Male	**85** **50 (58.8)** 35 (41.2)
Race White Black or African American Asia	**85** **80 (94.1)** 4 (4.7) 1 (1.2)

Ethnicity	**84**
Not Hispanic or Latino	84 (100)
Education/Training [a]	**79**
PharmD	**50 (63.3)**
B.S. Pharmacy	25 (31.6)
Pharmacy technician certification	6 (7.6)
Residency	2 (2.5)
Masters	1 (1.3)
Others	2 (2.5)
Pharmacy ownership	**84**
Single independent	**41 (48.8)**
Multiple independent	26 (31.0)
National chain	13 (15.5)
Grocery store chain	2 (2.4)
Others	2 (2.4)
State	**86**
AL	**64 (74.4)**
SC	11 (12.8)
NC	5 (5.8)
AR	3 (3.5)
MS	3 (3.5)
Enrolled in a State or Regional IIS	**83**
Yes	**71 (85.5)**
No	12 (14.5)
Year of first enrollment in IIS	**60**
Before 2018	22 (36.7)
2018 or after	**38 (63.3)**[b]

FTE, full-time equivalent; IIS, Immunization Information System; N, the total number of positive answers for a given category; SD, standard deviation.

[a] Participants were instructed to select all options that apply.

[Δ] Indicates that median was more appropriate to report than mean.

[b] Eleven pharmacies enrolled in 2020 and 6 enrolled in 2021.

Categories with the highest frequencies are in bold.

Types and Doses of non-COVID-19 vaccines administered in 2020 and 2019

Table 4.2 shows the number of pharmacies that offer vaccination services for adults, adolescents, and children. All pharmacies provided immunization services for adults; 19 years or older, and to a lesser extent for children aged 10 or younger (30.2%). In addition, pharmacies provided all those vaccines routinely recommended by ACIP for adults in 2020 and 2019. Table 4.3 displays the number of community pharmacies offering immunizations services in 2020 and 2019 and the average dose for each vaccine type per pharmacy per year. The most commonly offered vaccines to adults in 2020 were (percent of pharmacies offering the vaccine, average dose per year): influenza (100%, 340), Zoster (95.3%, 75), PCV13 (95.3%, 47), PPSV23 (89.5%, 50), with the least being the Hib B vaccine (19.8%, 7). The number of pharmacies reporting "yes" for giving a certain vaccine was higher for all vaccines in 2020 compared to 2019. When pharmacists were asked to compare vaccine doses administered during the pandemic to doses administered pre-pandemic, the majority indicated that doses remained about the same for all vaccines over the two years (Table 4.4).

Moreover, about 62.0% of pharmacies offer immunizations for adolescents; 11-18 years old. Likewise, pharmacists reported the provision of immunization services for all ACIP-recommended vaccines for adolescents in 2020 and 2019 as shown in Table 4.5. Table 4.5 provides the number of pharmacies offering vaccines in 2020 and the average dose for each vaccine type per pharmacy and shows that the Influenza vaccine (94.6%, 62) and DTaP vaccine (50.0%, 20) were the most frequently administered vaccines in 2020. For all vaccines, average

doses administered in 2020 were about the same when compared to doses administered pre-pandemic. Table 4.6 displays the comparison of vaccine doses administered pre-pandemic and during the pandemic.

Only 31.4% of surveyed pharmacists indicated providing immunization services for children (**<=** 10 years) at their practice site. All childhood vaccines that were administered pre-pandemic were also administered in 2020 except for the Polio vaccine (Table 4.7). Influenza vaccines were the most commonly administered vaccines to children (90.0%, 49) in 2020 as demonstrated in Table 4.7. Overall, pharmacists reported that vaccine doses administered in 2020 were about the same compared to 2019 doses for almost all vaccines (Table 4.8).

Furthermore, we examined the change in offering each vaccine between 2019 and 2020 for all age groups. Based on the results of the McNemar's test for all adults, adolescents, and children, only offering the MMR vaccines for adults was significantly different between 2019 and 2020. That is, more pharmacies indicated providing MMR vaccines to adults in 2020 compared to 2019.

Table 4.2 Age groups of vaccine recipients at rural community pharmacies pre pandemic and 2020.	
Age group	**N= 86 n (%)**
Adult (>= 19 years) Yes	86 (100)
Adolescence (11-18 years) Yes	53 (61.6)
Childhood (<= 10 years) Yes	27 (31.4)

Table 4.3 Types and Doses of Adult Non-COVID-19 Vaccines Offered at Rural Community Pharmacies pre pandemic and 2020.

Vaccine type	Administered the vaccine pre pandemic		Administered the vaccine in 2020		N*	Annual Average dose[a]	SD
	Yes n (%)	No n (%)	Yes n (%)	No n (%)			
Influenza	76 (98.7)	1 (1.3)	86 (100)	-	62	339.6	358.5
Zoster	68 (93.2)	5 (6.85)	81 (95.3)	4 (4.7)	57	75.2	84.3
PCV13	71 (94.7)	4 (5.33)	81 (95.3)	4 (4.7)	58	46.5	91.6
PPSV23	70 (90.9)	7 (9.09)	77 (89.5)	9 (10.5)	55	49.6	94.3
DTaP, Tdap, Td	67 (88.2)	9 (11.8)	75 (88.2)	10 (11.8)	52	28.9	48.1
HPV	21 (28.4)	53 (71.6)	25 (29.8)	59 (70.2)	20	4.4	11.3
MMR	22 (34.4)	42 (65.6)	36 (44.4)	45 (55.6)	22	20.5	34.3
Hib B	10 (14.9)	57 (85.1)	16 (19.8)	65 (80.3)	13	6.5	22.1

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Table 4.4 Doses of adult non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.	
Vaccine type	**N** **n (%)**
Influenza	**77**
Increased	32 (41.6)
Remained about the same	**34 (44.2)**
Decreased	11 (14.3)
Zoster	**69**
Increased	27 (39.1)
Remained about the same	**32 (46.4)**
Decreased	10 (14.5)
PCV13	**72**
Increased	16 (22.2)
Remained about the same	**45 (62.5)**
Decreased	11 (15.3)
PPSV23	**71**
Increased	18 (25.35)
Remained about the same	**42 (59.2)**
Decreased	11 (15.5)
DTaP, Tdap, or Td	**65**
Increased	11 (16.9)
Remained about the same	**46 (70.8)**
Decreased	8 (12.3)
HPV	**21**
Increased	2 (9.5)
Remained about the same	**16 (76.2**)
Decreased	3 (14.3)
MMR	**29**
Increased	6 (20.7)
Remained about the same	**17 (58.6)**
Decreased	6 (20.7)
Hib B	**10**
Increased	1 (10.0)
Remained about the same	**8 (80.0)**
Decreased	1 (10.0)

* Pharmacies provided dose data for 2020.

Categories with the highest frequencies are in bold.

Table 4.5 Types and Doses of Adolescent Non-COVID-19 Vaccines Offered at Rural Community Pharmacies pre pandemic and 2020.

Vaccine type	Administered the vaccine pre pandemic		Administered the vaccine in 2020		N*	Annual Average dose[a]	SD
	Yes n (%)	No n (%)	Yes n (%)	No n (%)			
Influenza	45 (90.0)	5 (10.0)	53 (94.6)	3 (5.4)	35	61.7	100.6
PCV13	20 (46.5)	23 (53.5)	22 (40.0)	33 (60.0)	13	55.0	137.7
DTaP, Tdap, or Td	24 (57.1)	18 (42.9)	27 (50.0)	27 (50.0)	14	19.5	28.7
MenACWY	17 (41.5)	24 (58.5)	19 (35.2)	35 (64.8)	13	18.2	30.3
HPV	15 (36.6)	26 (63.4)	18 (32.1)	38 (67.9)	12	21.8	39.2

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Table 4.6 Doses of Adolescent non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.	
Vaccine type	**N** **n (%)**
Influenza	**N= 40**
Increased	9 (22.50)
Remained about the same	**27 (67.50)**
Decreased	4 (10.00)
PCV13	**N= 17**
Increased	2 (11.76)
Remained about the same	**13 (76.47)**
Decreased	2 (11.76)
DTaP, Tdap, or Td	**N= 20**
Increased	1 (5.00)
Remained about the same	**15 (75.00)**
Decreased	4 (20.00)
MenACWY	**N= 15**
Increased	0
Remained about the same	**13 (86.67)**
Decreased	2 (13.33)
HPV	**N= 18**
Increased	0
Remained about the same	**15 (83.33)**
Decreased	3 (16.67)

* Pharmacies provided dose data for 2020.

Categories with the highest frequencies are in bold.

Table 4.7 Types and Doses of Childhood Non-COVID-19 Vaccines Offered at Rural community Pharmacies pre pandemic and 2020.							
Vaccine type	**Administered the vaccine pre pandemic**		**Administered the vaccine in 2020**		**N***	**Annual Average dose[a]**	**SD**
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**			
Influenza	23 (88.5)	3 (11.5)	27 (90.0)	3 (10.0)	21	49.0	76.4
PCV13	9 (47.4)	10 (52.6)	10 (34.5)	19 (65.5)	8	10.0	20.9
DTaP, Tdap, or Td	10 (52.6)	9 (47.4)	11 (37.9)	18 (62.1)	9	10.6	16.5
Hepatitis B	7 (38.9)	11 (61.1)	8 (27.6)	21 (72.4)	7	8.1	18.6
Hepatitis A	7 (38.9)	11 (61.1)	8 (27.6)	21 (72.4)	7	8.1	18.6
MMR	5 (27.8)	13 (72.2)	6 (20.7)	23 (79.3)	6	1.2	2.0
Hib B	3 (16.7)	15 (83.3)	3 (10.3)	26 (89.7)	6	0.3	0.8
Polio	1 (5.6)	17 (94.4)	0	28 (100)	0	0	0
Varicella	5 (27.8)	13 (72.2)	6 (20.7)	23 (79.3)	6	0.8	2.0
Rotavirus	1 (5.6)	17 (94.4)	1 (3.6)	27 (96.4)	1	0	0

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Table 4.8 Doses of Childhood non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.	
Vaccine type	**N n (%)**
Influenza	**N= 22**
Increased	5 (22.7)
Remained about the same	**14 (63.6)**
Decreased	3 (13.6)
PCV13	**N= 9**
Increased	1 (11.1)
Remained about the same	**7 (77.8)**
Decreased	1 (11.1)
DTaP, Tdap, or Td	**N= 10**
Increased	1 (10.0)
Remained about the same	**8 (80.0)**
Decreased	1 (10.0)
Hepatitis B	**N= 7**
Increased	0
Remained about the same	**6 (85.7)**
Decreased	1 (14.3)
Hepatitis A	**N= 7**
Increased	0
Remained about the same	**6 (85.7)**
Decreased	1 (14.3)
MMR	N=5
Increased	0
Remained about the same	**4 (80.0)**
Decreased	1 (20.0)
Hib B	**N= 3**
Increased	0
Remained about the same	**2 (66.7)**
Decreased	1 (14.3)

Polio	N=1
Increased	0
Remained about the same	0
Decreased	**1 (100)**
Varicella	N=5
Increased	0
Remained about the same	**4 (80.0)**
Decreased	1 (20.0)
Rotavirus	N=1
Increased	0
Remained about the same	0
Decreased	**1 (100)**

* Pharmacies provided dose data for 2020.

Categories with the highest frequencies are in bold.

Non-COVID-19 immunization activities during the pandemic

Pharmacy based-immunization activities during the pandemic - in 2020 are described in Table 4.9 while Appendix 12 provides an overview of the reported changes, if any, in the delivery of these activities compared to their delivery during pre-pandemic.

1. Provision of immunization services

The majority of pharmacists (78.2%) reported providing immunization services during the pandemic for patients presenting to the pharmacy any time the pharmacy was open and only 16.5% reported providing immunization services for walk-in patients during designated hours. Other reported modalities were offering immunizations through an onsite clinic, onsite at workplaces, and scheduling drive-thru appointments. About 78% of pharmacists indicated that the way immunization services were made available to patients during the pandemic was not different compared to pre-pandemic. On the contrary, 21.7% of pharmacists reported that differences existed in response to the pandemic. Some changes mentioned by those pharmacists include immunization appointments in the pharmacy and drive-through appointments. All comments provided by pharmacists in this context are found in Appendix 12.

2. Assessment of patient immunization status

Almost all pharmacists (98.8%) reported that they assess patients' immunization status at the pharmacy. The majority (80.0%) verbally discussed this with patients presenting to the pharmacy and 40.0% reported contacting patients' physician or provider as the least used method. One pharmacist reported discussing immunization status with patients on the phone, at a drive-through site, or in the parking lot. Only 5.9 % of pharmacists reported that the way they used to assess patients' immunization status during the pandemic has changed compared to their practice pre-pandemic. Some of the cited changes were "consulting state IIS" and "we added face-to-face discussions with patients inside the pharmacy during the pandemic to the mentioned options" (Appendix 12).

3. Location of vaccine administration

When asked about the location where vaccines administration takes place at the pharmacy, 56.6% of pharmacists reported administering vaccines in a separate room inside the pharmacy, 39.5% inside the pharmacy but not inside a separate room, and half of them administered vaccines outdoors (e.g., parking lot, curbside site, drive-through). Others reported that they administer vaccines anywhere the patient feels comfortable, at the patient's home for home-bound patients, and shot booth/clinic in stores. Only 14.5% of pharmacists answered "yes" when asked whether the location of vaccine administration has changed compared to

where it took place pre-pandemic. Some of those pharmacists commented that administering vaccines outside the pharmacy building is a new practice that was adopted as a response to the pandemic; it either replaced or supplemented indoor vaccines administration. All comments provided by respondents are displayed in Appendix 12.

4. Vaccine administration record-keeping

Almost all pharmacists (92.5%) documented vaccine administration in the pharmacy software and 91.3% gave patients the receipt and the Vaccine Information Statement (VIS), while 46.3% documented vaccine receipt on patients' personal immunization records. The majority of respondents (89.4%) indicated that the method of keeping vaccine records followed during the pandemic was not different than that followed pre-pandemic. Some of those who indicated there was a difference, commented that they started to report to state IIS or enrolled in state IIS for COVID-19 immunization (Appendix 12).

5. Immunization's referrals sent or received

When pharmacists were asked about the frequency of immunization referrals they made to other healthcare providers during the pandemic, over one-third (37.2%) answered with "sometimes", 36.1% selected "never", and none selected "always". All pharmacists (100%) indicated that the frequency of referrals was not different compared to the pre-pandemic. Further, when pharmacists were asked about the frequency of receiving referrals from other

healthcare providers for immunizations, 47.7% answered “very often”, while 3.5% answered “never” and “always”. Fourteen percent indicated that the frequency of referrals was different from the frequency of referrals pre-pandemic, however, with no consensus regarding the nature of the difference (increase vs decrease) among these pharmacists as shown in Appendix 12. Some reported a decrease in referrals for all or one vaccine in particular (e.g., shingles), and others reported receiving referrals at an increased level for all or specific vaccine types (e.g., Hep A and Hep B from gastrointestinal associates).

6. Vaccine reminder/recall strategies

The majority of pharmacies (71.3%) used phone calls to remind patients when vaccines are due/overdue but 5.0% sent them postcards or letters. Another 5.0% reported not sending any reminders to patients. However, around 10% reported that this practice has changed compared to 2019. Specifically, sending reminders is a practice that was not followed pre-pandemic. For others, reminders were part of practice prior to 2020 but the method of sending reminders differed (e.g., pharmacy scheduling software, acuity scheduling software, calling patients by phone, notifying patient primary provider, patients personal record cards).

7. Personnel administering vaccines at the pharmacy

For all pharmacies, regarding personnel who administered vaccines, participants reported that pharmacists administered vaccines at the pharmacy (100.0%) followed by

pharmacy interns/students (29.1%), and pharmacy technicians (11.4%). About 11% of respondents indicated that this was not always the case prior to the pandemic, that is having technicians administer vaccines is a new role, they did not administer vaccines prior to the pandemic (Appendix 12).

8. Role of pharmacy technicians in immunization services

When asked about pharmacy technicians' involvement in the delivery of immunization services during the pandemic, respondents reported that technicians were involved in asking patients about their interest in vaccines (87.5%), billing (78.8%), documenting receipt of vaccines (78.8%), identifying potential vaccine recipients (58.8%), administration (26.3%), and to a lesser extent, vaccine preparation for administration (23.8%). But 5.0% of respondents reported that technicians had no role in the delivery of immunization services at all. Nearly 19% of respondents indicated that technicians' involvement in the delivery of immunization services has expanded as a response to the current pandemic emphasizing the new role of "vaccine administrator" with some describing their role as "more active" or "stepped up role".

Table 4.9 Non-COVID-19 immunization activities during the COVID-19 pandemic.	
Activity	**N** **n (%)**
Provision of immunization services [a]	**85**
By walk-in - anytime we are open	**58 (78.2**)
By appointment - any time the pharmacy is open	24 (28.2)
By appointment - during designated hours only	17 (20.0))
By walk-in - during designated hours	14 (16.5)
Others	2 (2.4)
Activity changed compared to 2019	**83**
No	65 (78.3)
Yes	18 (21.7)
Assessment of patient immunization status [a]	**85**
Verbally discuss with patients walking into the pharmacy	**68 (80.0)**
Administer paper or electronic questionnaire	44 (51.8)
Consult state or local immunization information system (IIS)	43 (50.6)
Contact patients' physician/provider	34 (40.0)
Review pharmacy immunization records	58 (68.2)
Other	1 (1.2)
Activity changed compared to 2019	**85**
No	80 (94.1)
Yes	5 (5.9)
Location of vaccine administration [a]	**77**
Separate room inside the pharmacy	**43 (56.6)**
Outdoors (e.g., parking lot, curbside site, drive-through)	38 (50.0)
Inside the pharmacy but not inside a separate room	30 (39.5)
Other	3 (2.6)
Activity changed compared to 2019	**83**
No	71 (85.5)
Yes	12 (14.5)

Vaccine administration record-keeping [a]	**80**
Documenting in the pharmacy software	**74 (92.5)**
Giving the receipt and the VIS to the patient	73 (91.3)
Documenting in the State or Regional Immunization Registry	62 (77.5)
Manually reporting to the patient's primary care provider by fax or hard copy	41 (51.3)
Documenting on the patient's immunization record	37 (46.3)
Other	1 (1.3)
Activity changed compared to 2019	**85**
No	76 (89.4)
Yes	9 (10.6)
Immunization referrals sent	**86**
Never	31 (36.1)
Seldom	19 (22.1)
Sometimes	**32 (37.2)**
Very often	4 (4.7)
Always	-
Activity changed compared to 2019	**83**
No	83 (100)
Yes	0
Immunization referrals received	**86**
Never	3 (3.5)
Seldom	18 (20.9)
Sometimes	21 (24.4)
Very often	**41 (47.7)**
Always	3 (3.5)
Activity changed compared to 2019	**86**
No	74 (86.1)
Yes	12 (14.0)

Vaccine reminder/recall strategies [a]	**80**
Telephone call	**57 (71.3)**
A record card given to patients	43 (53.8)
Pharmacy sets up the next appointment in the system	36 (45.0)
Text/Email	25 (31.3)
Postcard/Letter	4 (5.0)
None	4 (5.0)
Activity changed compared to 2019	**83**
No	75 (90.4)
Yes	8 (9.6)
Personnel administering vaccines at the pharmacy [a]	**79**
Pharmacists	**79 (100)**
Pharmacy students/interns	23 (29.1)
Pharmacy technicians	9 (11.4)
Activity changed compared to 2019	**86**
No	77 (89.5)
Yes	9 (10.5)
Role of pharmacy technicians in immunization services [a]	**80**
Asking patients if they are interested in immunizations	**70 (87.5)**
Documentation	63 (78.8)
Billing	63 (78.8)
Identifying potential vaccine recipients	47 (58.8)
Vaccine administration	21 (26.3)
Preparing vaccines for administration	19 (23.8)
Others	0
None	4 (5.0)
Activity changed compared to 2019	**85**
No	69 (81.2)
Yes	16 (18.8)

[a] Participants were instructed to select all options that apply.
VIS: Vaccine Information Statement.

Acceptance of COVID-19 vaccines among rural community pharmacists

1. ***Personal experience with vaccines***

The majority of pharmacists (84.9%) reported that they have received immunization against seasonal influenza in the past 12 months whereas (79.1%) reported they have received COVID-19 immunization. On the contrary, 17.4% (15/86) of respondents indicated they have no plan to get vaccinated against COVID-19. A pharmacist justified the rejection by having concerns about "the lack of research on COVID-19 vaccines" and another justified it by having concerns about "vaccine impact on pregnancy". A summary of pharmacists' answers to questions related to personal vaccine experience is shown in Table 4.10 and Table 4.11.

Further, we conducted bivariate analyses to assess associations between various demographic variables and pharmacists' acceptance of COVID-19 immunization or "previous COVID-19 vaccination". Results from bivariate analyses indicated that "previous seasonal influenza vaccination" was the only variable significantly associated with COVID-19 immunization acceptance. Pharmacists who received influenza vaccines were more likely to also have received a COVID-19 vaccine (Fisher's exact test; P-value = 0.0006).

Table 4.10 Pharmacist personal experience with immunization.	
Question	**n (%) N= 86**
Have you been vaccinated against Influenza in the past 12 months?	
Yes	73 (84.9)
No	13 (15.1)
Have you been vaccinated against COVID-19?	
Yes	68 (79.1)
No	18 (20.9)

2. ***Reasons given for choosing to get vaccinated against COVID-19***

The most frequent reasons for receiving COVID-19 immunization cited by pharmacists were “concerns about transmitting COVID-19 to family members and co-workers” and “concerns about high-risk exposure”, 71.8% each. Furthermore, pharmacists had “intentions to set an example for others to get vaccinated” (69.2%), “concerns about transmitting COVID-19 to patients” (67.9%), and to a lesser extent “intentions to contribute to herd immunity” by receiving COVID-19 immunizations (60.3%). Over half of respondents (51.3%) had “concerns about becoming ill with COVID-19”. Reasons for choosing to receive vaccination against COVID-19 are shown in Table 4.11.

Table 4.11 Reasons for receiving vaccination against COVID-19.	
Reasons [a]	**n (%) N=78**
Concerns about high-risk exposure.	**56 (71.8)**
Concerns about transmitting COVID-19 to family members and co-workers.	**56 (71.8)**
Intention to set an example for others to get vaccinated.	54 (69.2)
Concerns about transmitting COVID-19 to patients.	53 (67.9)
Intention to contribute to herd immunity.	47 (60.3)
Concerns about becoming ill with COVID-19.	40 (51.3)
Other	3 (3.8)
Not willing to get a COVID-19 vaccine.	15 (19.2)

[a] Participants were instructed to select all options that apply.
Categories with the highest frequencies are in bold.

3. ***Pharmacists' willingness to recommend and administer COVID-19 vaccines***

As Table 4.12 shows, nearly 59.0% strongly agreed that they will recommend COVID-19 vaccination to their family, while 60.0% strongly agreed that when a COVID-19 vaccine becomes available to their patients, they would recommend that they get it. Further, an overwhelming percentage of pharmacists (78.8%) strongly agreed that they or another staff member would administer COVID-19 vaccines to patients once available.

To assess the associations of pharmacists' demographic factors with pharmacists' willingness to recommend COVID-19 immunization to their *families,* we used bivariate analyses as conducting multiple logistic regression analysis, as proposed initially, was not feasible due to

small sample size. Based on bivariate analyses, only the following variables were significantly associated with “pharmacists’ willingness to recommend COVID-19 vaccines to family”; previous influenza vaccination (Fisher’s exact test; P-value = 0.0044) and previous COVID-19 vaccination (Fisher’s exact test; P-value = 0.0002).

Likewise, bivariate analyses were conducted to assess for associations between pharmacists’ willingness to recommend COVID-19 immunization to their *patients* and some demographic variables. The only significantly associated variables with “pharmacists’ willingness to recommend COVID-19 vaccines to patients were; previous influenza vaccination (Fisher’s exact test; P-value = 0.0419) and previous COVID-19 vaccination (Fisher’s exact test; P-value = 0.0058).

Knowledge of the new HHS guidance on pharmacists’ immunization practice

Table 4.13 demonstrates that the majority of pharmacists (88.2%) knew that all state-authorized pharmacy interns are allowed to administer routine and influenza childhood vaccines under the new HHS guidance and over two-thirds (57.9%) knew that qualified pharmacy technicians are allowed to do so. Over one-half (52.6%) of pharmacists, however, correctly identified that both interns and technicians are now allowed to administer childhood vaccines. Likewise, the majority (86.8%) knew that state-authorized pharmacy interns are now allowed to administer COVID-19 vaccines under this guidance and 82.9% knew that qualified pharmacy technicians are allowed to do so. Of the 76 respondents to this question, 77.6%

correctly identified that both pharmacy interns and pharmacy technicians received authorization to administer COVID-19 vaccines. When asked about the age of vaccine recipient covered under the new guidance, 6.5% of pharmacists selected “< 3 years”, 36.4% selected “3-10 years”, 64.9% selected “11-18 years” and 84.4% selected “> 18 years”. Nevertheless, only 14 (18.2%) pharmacists correctly identified that this guidance targets individuals 3 years and older.

Table 4.12 Pharmacist's willingness to recommend a COVID-19 vaccine to family and patients, and to administer a COVID-19 vaccine to patients.	
Item	**n (%) N= 85**
Pharmacists' willingness to RECOMMEND a COVID-19 vaccine to family	
Strongly disagree	9 (10.6)
Somewhat disagree	8 (9.4)
Undecided	**4 (4.7)**
Somewhat agree	14 (16.5)
Strongly agree	**50 (58.8)**
Somewhat agree or Strongly agree	64 (74.4)
Somewhat disagree or Strongly disagree	17 (20.0)
Pharmacists' willingness to RECOMMEND a COVID-19 vaccine to patients	
Strongly disagree	7 (8.2)
Somewhat disagree	5 (5.9)
Undecided	**7 (8.2)**
Somewhat agree	15 (17.7)
Strongly agree	**51 (60.0)**
Somewhat agree or Strongly agree	66 (76.7)
Somewhat disagree or Strongly disagree	12 (14.1)
Pharmacists' willingness to ADMINISTER a COVID-19 vaccine to patients	
Strongly disagree	8 (9.4)
Somewhat disagree	3 (3.5)
Undecided	**2 (2.4)**
Somewhat agree	5 (5.9)
Strongly agree	**67 (78.8)**
Somewhat agree or Strongly agree	72 (83.7)
Somewhat disagree or Strongly disagree	11 (12.9)

Table 4.13 Knowledge of the department of health and human services (HHS) new guidance on pharmacists' immunization practice.[¤]	
Item	**N n (%)**
Personnel authorized to administer routine and influenza childhood vaccines under this guidance[a]	**N= 76**
State-authorized pharmacy interns	67 (88.2)
Qualified pharmacy technicians	44 (57.9)
Correct answer (both)	40 (52.6)
Personnel authorized to administer COVID-19 vaccines under this guidance	**N= 76**
State-authorized pharmacy interns	66 (86.8)
Qualified pharmacy technicians	63 (82.9)
Correct answer (both)	59 (77.6)
Age of vaccine recipients covered under this guidance [a]	**N= 77**
< 3 years	5 (6.5)
3-10 years	28 (36.4)
11-18 years	50 (64.9)
> 18 years	65 (84.4)
Correct answer (>= 3 years)	14 (18.2)

[a] Participants were instructed to select all options that apply.

COVID-19 immunization Services

1) Reimbursement for COVID-19 vaccines administration

The majority of pharmacists (84.7%) indicated that their pharmacy is offering COVID-19 immunization services, around 6.0% reported that they are waiting to receive the vaccines at the pharmacy, whereas 9.4% reported they do not plan to offer any COVID-19 immunization services in their pharmacy (Table 4.14). Moreover, when asked about whether they receive reimbursement for COVID-19 vaccines administration, 80.8% of pharmacists who provide COVID-19 vaccines responded that they file claims to Medicaid, 82.1% to Medicare, 82.1% to Commercial Plans, and 60.1% to Provider Relief Fund for the uninsured patients. On the other hand, 11.5% indicated that they plan to file claims to Provider Relief Fund or for the uninsured patients, 9.0% to Medicaid, 6.4% Medicare, and 5.1% plans to file claims to Commercial plans (Table 4.15).

Table 4.14 Pharmacy Offering a COVID-19 Vaccination Service.	
Does your pharmacy currently offer a COVID-19 immunization service?	**n (%)** **N= 85**
Yes	72 (84.7)
No, we do not plan to offer any COVID-19 vaccination services	8 (9.4)
No, we are waiting to receive the vaccines	5 (5.9)

Table 4.15 Reimbursement for Administration of COVID-19 Vaccination. [a]	
Item	**N =78 n (%)**
Pharmacy currently files claims to:	
Medicare	**64 (82.1)**
Commercial plans	**64 (82.1)**
Medicaid	63 (80.8)
Provider Relief Fund for the uninsured	47 (60.1)
Pharmacy plans to file claims to	
Provider Relief Fund for the uninsured	9 (11.5)
Medicaid	7 (9.0)
Medicare	5 (6.4)
Commercial plans	4 (5.1)
Pharmacy does not plan to offer a COVID-19 vaccination service	7 (9.0)
Pharmacy not planning to file claims to receive any administration fee	0

2) Perceived benefits from offering COVID-19 immunization services

About half of pharmacists (44.7%) somewhat agreed that offering COVID-19 vaccination services at their site of practice would result in generating additional revenue to the pharmacy and another 41.2% of pharmacists strongly agreed that it will bring more patients into the pharmacy. Additionally, 36.5% of pharmacists somewhat agreed that this would increase their ability to compete with other pharmacies and 44.7% strongly agreed that it would help pharmacy/pharmacist be a role model for other pharmacies/pharmacists. Finally, less than half of the respondents (40.0%) somewhat agreed that offering COVID-19 vaccination services at their practice site is beneficial as to enhancing relationships with local clinics or public health agencies. Table 4.16 displays summary statistics of responses.

Table 4.16 Pharmacist perceived benefits from offering COVID-19 vaccination services.	
Item	**n (%) N= 85**
Generating additional revenue	
Strongly disagree	5 (5.9)
Somewhat disagree	4 (4.7)
Undecided	12 (14.1)
Somewhat agree	**38 (44.7)**
Strongly agree	26 (30.6)
Somewhat agree or Strongly agree	64 (75.3)
Bringing more patients into the pharmacy	
Strongly disagree	6 (7.1)
Somewhat disagree	2 (2.4)
Undecided	8 (9.4)
Somewhat agree	34 (40.0)
Strongly agree	**35 (41.2)**
Somewhat agree or Strongly agree	69 (81.2)
Increasing ability to compete with other pharmacies	
Strongly disagree	10 (11.8)
Somewhat disagree	7 (8.2)
Undecided	12 (14.1)
Somewhat agree	**31 (36.5)**
Strongly agree	25 (29.4)
Somewhat agree or Strongly agree	56 (65.9)
Being a role model for other pharmacies/pharmacists	
Strongly disagree	10 (11.8)
Somewhat disagree	4 (4.7)
Undecided	10 (11.8)
Somewhat agree	23 (27.1)
Strongly agree	**38 (44.7)**
Somewhat agree or Strongly agree	61 (71.8)

Enhancing relationship with local clinics or public health agencies	
Strongly disagree	8 (9.4)
Somewhat disagree	5 (5.9)
Undecided	9 (10.6)
Somewhat agree	**34 (40.0)**
Strongly agree	29 (34.1)
Somewhat agree or Strongly agree	63 (74.1)

Chapter 5. Discussion

This chapter presents a summary and interpretation of the results, implications, and conclusions for each aim of the three specific aims examined by this study.

5.1 Aim 1

Through aim 1 of this study, we compared the types and doses of vaccines administered at community pharmacies during the pandemic to pre-pandemic. There were no noticeable differences between the types or doses of vaccines between the two periods of time. For all ages, all the vaccines given at community pharmacies pre-pandemic were also given during the pandemic. There was a consensus that the number of vaccine doses administered per pharmacy per year remained relatively about the same for all vaccines during the pandemic.

There is relatively plenty of evidence from all over the world on the impact of the COVID-19 pandemic on routine and non-routine vaccination at different settings (hospitals, independent physician offices), utilizing different data sources (electronic medical records, immunization registries, surveys of parents, caregivers, or providers), using different timeframes over the pandemic, and mainly evaluating the impact of the pandemic on childhood immunizations.[206–213] Conversely, our study sought to compare the doses and types of vaccines administered at rural community pharmacies in the United States throughout the two years (2019 and 2020) and without restricting the analysis to a specific age group. To the best of our

knowledge and as of writing, evidence on the impact of the pandemic on the doses and types of vaccines administered at community pharmacies in rural areas is lacking.

In terms of the age of vaccine recipients, our findings show that adults were the most vaccinated group in community pharmacies during and pre-pandemic, followed by adolescents, and children to the lowest extent. The small percentage of pharmacies offering childhood immunizations is to be expected. It is uncommon for community pharmacists to administer childhood vaccines unlike adults and adolescents' vaccines as most childhood vaccines are usually administered at doctor's offices during well-child visits.[214–219] Nonetheless, in August 2020 the HHS authorized all pharmacists across the country regardless of state's law to administer vaccines to individuals ages 3 through 18 years during the COVID-19 pandemic.[20] Given that we asked pharmacists about their immunization activities during the years 2019 and 2020, it is possible that the percentage of community pharmacies offering childhood vaccines would be higher in 2021 and possibly would continue to rise further in the future contingent on the expansion of the authorization's scope beyond the COVID-19 pandemic. The authorization is critical and came with the potential to boost childhood vaccination coverage that dropped during the first months of the pandemic by offering catch-up vaccines to those not vaccinated or not fully vaccinated.

Concerning the types of vaccines administered by community pharmacists in this study, the Influenza vaccine was the most commonly administered vaccine during and pre-pandemic, followed by Pneumococcal 13-valent conjugate, Pneumococcal-polysaccharide, Herpes Zoster,

and Diphtheria, tetanus, and pertussis vaccines; this finding was consistent with previous research[220]. Notably, for all adult vaccines, our results show that the percentage of pharmacies offering a certain vaccine in 2020 was slightly higher than its correspondent percentage in 2019. For instance, 41.6% of pharmacies reported that they administered Influenza vaccines in 2019 compared to 44.2% in 2020, and 39.2% administered Herpes Zoster vaccines in 2019 vs 46.4% in 2020. The difference was only significant for all the MMR vaccines, (McNemar's test, P-value = 0.0253). Possibly, this could be attributed to the state of panic people experienced following the declaration of COVID-19 as a national emergency in March 2020.[221] For example, people rushed to pharmacies to stock up on medications and personal protective equipment (PPE), and for the influenza vaccine especially with the heightened concerns at that time about the possibility of concurrent circulation of the flu viruses and the virus causing COVID-19 and the expected severity of the coinfection.[217,222–226] At the beginning of the pandemic, pharmacists had to deal with an unprecedented high demand on medications; specifically, certain medications which were initially proposed or thought to be effective in treating COVID-19 but this eventually led to many prescription drug shortages during the first quarter of the pandemic.[223–225,227–229] Further, community pharmacists had to respond to these drug shortages to conserve drug supplies by changing local policies, restricting antibiotic dispensing, and limiting quantity for medication refills.[230] Community pharmacists have also had to deal with the large amounts of information around COVID-19 since the emergence of the disease in 2020. They continue to provide accurate information to the general public about the disease and the

safety and efficacy of the present vaccines and they address misinformation about COVID-19 fake treatments and the approved vaccines.[231,232] Also, they have been heavily involved in testing for COVID-19 and administering vaccines primarily the seasonal influenza vaccines followed by the COVID-19 vaccines.[232] Additionally, from the beginning of the pandemic, there were copious recommendations emphasizing the importance of protecting older adults from COVID-19 as they were prone to a higher risk of severe illness, hospitalization, and even death from COVID-19.[233] In parallel, there were recommendations to prioritize routine vaccinations for older adults because they are at high risk of disease complications if their vaccines were deferred or completely neglected.[233,234] Needless to say, community pharmacies were open during the pandemic while other vaccination sites were closed, and given that pharmacies are one of the most preferred vaccination sites to adults this can partly explain the patterns observed in our study.

Finally, there is a decrease in vaccination rates across all age groups during the pandemic.[13] Our research shows that community pharmacists in rural areas continued to serve as immunization providers.

5.2 Aim 2

With aim 2 of this study we intended to assess the impact, if any, the COVID-19 pandemic has had on how routine immunization services were being delivered and to compare the delivery of these activities during the pandemic to pre-pandemic. We also aimed to

compare the frequency of immunization referrals to or from the pharmacy and the involvement of pharmacy technicians in vaccine administration during the pandemic to pre-pandemic.

There was relatively no difference in the delivery of immunization services at the community pharmacy during and pre-pandemic based on our findings. The dimensions of the vaccine administration process we evaluated were 1) mode of delivery (appointment only vs. walk-in mode), 2) immunization status assessment, 3) location of vaccine administration, 4) method of vaccine reminder/recall, 5) documentation of vaccine administration, and 6) the personnel administering the vaccine.

Pharmacies in our study provided multiple modalities for patients to access vaccination services. About 95% of pharmacies administered vaccines to walk-in patients during the pandemic while about half (48.2%) made them available through appointments. Although the majority (78.3%) agreed that the mode through which vaccines were made available to patients during the pandemic was not different from pre-pandemic, the remainder (21.7%) indicated it was different and that the "by-appointment" mode was only adopted because of the pandemic. Some respondents said that appointments helped in organizing patients' flow into the pharmacy.

A CDC study was conducted in September 2020 aimed to gauge influenza vaccination intention and uptake among U.S. adults during the 2020-2021 influenza season and to examine the place of vaccine administration.[226] The study found that the percentage of adults who have already received their influenza vaccine during the 2020-2021 season at stores including retail

pharmacies (53.8%), was significantly higher than that in the 2019-2020 season (34.9%).[226] In contrast, the percentage of adults who received their vaccine at doctors' offices during the 2020-2021 season (29.7%) was significantly lower than that during the 2019-2020 season (37.3%).[226] Community pharmacies are the second most trusted influenza vaccination destination for adults after physicians' offices but according to the results from the CDC's study, community pharmacies were the first destination for adults during the study period from September 1 to October 10, 2020.[19] This can be explained by the fact that despite sate-lockdowns and stay-at-home orders issued to mitigate COVID-19 spread in communities earlier in 2020, pharmacies as an essential business remained open to the public providing usual healthcare services and yet acting as an ideal site for COVID-19 testing.[235]

Moreover, some other healthcare facilities closed during the first months of the pandemic (before any COVID-19 vaccine was available) or had to restructure their workflow by implementing triage systems, or telemedicine, or prioritizing COVID-19 care which in addition to the disruptions in transportation have arguably limited patients' access to regular healthcare services at these sites.[221] But even on normal days, community pharmacies offer unique advantages over other traditional vaccination clinics. Community pharmacies are open for extended hours, open during weekends and on holidays, and unlike other healthcare settings, community pharmacies do not require visit fees making them ideal sites for people with limited income who are seeking health care. Additionally, they are highly accessible to everyone as nearly 90% of the U.S. population resides 5 miles away from a community pharmacy.[15] This can

also explain the high percentage of pharmacies in our sample that kept offering immunization services for walk-in patients during the pandemic.[236] For the same reasons discussed above, through community pharmacies, H1N1 influenza vaccines were made more accessible at the community level during the 2009 H1N1 influenza pandemic in the United States which accelerated the mass vaccination campaign.[236]

Furthermore, a national survey from Australia conducted in June 2020 examined community pharmacists' documentation and reporting of vaccine administration to the national Immunization Register in Australia and whether the provision of immunization services was impacted by the pandemic.[237] The study indicates that 27% (61/228) of community pharmacies were negatively affected by the challenges brought by the pandemic and that pharmacies operating in regional areas were more negatively impacted compared to those operating in major cities.[237] Additionally, about half of affected pharmacies implemented new measures as a response to the pandemic which hindered the delivery of services on site such as additional cleaning and social distancing requirements.[237] These measures required extra time with patients on the pharmacy staff's end and limited the number of people (staff or patients) presented in the pharmacy at the same time.[237] Another adopted measure reported by authors was the adoption of new appointment systems by pharmacies that couldn't accept walk-in patients. This is pursuant to our findings, although with a percentage that is smaller than what we found. Authors also reported that pharmacies faced difficulties related to staff shortage and rostering which meant pharmacies had less enough qualified staff to administer vaccines and

results show that only 2 pharmacies had to discontinue immunization services because of the challenges mentioned above.[237] Nevertheless, it is important to note that unlike the situation in the US, the experience of Australian community pharmacists with administering vaccines is in its infancy; community pharmacists in Australia administer a small proportion of vaccines only.

In regard to the location of vaccine administration, our findings show that the majority of pharmacies administered vaccines inside the pharmacy during the pandemic (inside/outside a separate room) as was the case previously pre-pandemic. About half of the pharmacies, however, administered vaccines outside the pharmacy at a curbside, in a parking lot, or at a drive-through location. Administering vaccines outdoors was reported as a "new" modality that pharmacies had to adopt as a response to the pandemic. This seems to go in accordance with the CDC guidance released in June 2020 for pharmacists and pharmacy technicians in community pharmacies during the COVID-19 response which includes recommendations to reduce their risk of exposure to SARS-CoV-2 virus; the virus causing COVID-19 and to reduce the risk for patients.[234] The recommendations revolved around following infection prevention and control measures and social distancing at the pharmacy including implementing universal use of face coverings, advising staff who are sick to stay home, filling prescriptions in a manner that maintains social distancing, offering home delivery of medications, offering curbside pickup, offering drive-through services, implementing strategies to minimize close contact between pharmacy staff and patients and between patients (engineering controls, administrative controls), and reducing risk during COVID-19 testing and other close-contact pharmacy care

services. The guidance has also advised pharmacy staff to provide adult vaccinations based on local conditions and to prioritize vaccinating older adults or adults with pre-existing conditions because they are more prone to disease risks and complications if their vaccination was deferred. While we acknowledge that capabilities and resources vary from one pharmacy to another and that dictates the degree to which a change can be adopted or accepted, apparently, pharmacies in our sample have adhered to these recommendations to certain extents.

In terms of immunization referrals, seemingly participating community pharmacies rarely referred patients to other immunization providers during the pandemic and this was not different from pre-pandemic. In contrast, pharmacies frequently received immunization referrals from other providers during the pandemic and only 14.0% indicated that this was different from 2019 with some reporting increases in referrals and others reporting decreases in referrals. The quite stable pattern of immunization referrals received and sent implies that pharmacies acted as an independent vaccination destination and were sufficiently stocked with the needed vaccines which made vaccines administration during the current crisis possible. The result also shows that community pharmacies were highly trusted by other immunization providers. Future research can further examine the pattern of referrals for preventive health services including immunizations and possibly look at reasons for referrals received and sent during the pandemic.

Equally important, in the current study pharmacy technicians were involved in the delivery of immunization services during the pandemic at various levels; they assessed patients' interest in vaccines, carried out documentation and billing, identified potential vaccine recipients, prepared vaccines for administration, and in fact, they have administered vaccines to patients. While pharmacy technicians were involved in immunization services in the same manner pre-pandemic, respondents emphasized that having technicians administering vaccines during the pandemic was a prominent change compared to pre-pandemic.

Historically, the involvement of pharmacy technicians in vaccination services was merely limited to roles where they helped pharmacists in documentation and billing and they were not allowed to administer vaccines.[238,239] However, this role has changed in 2017 when pharmacy technicians in Idaho were granted authorization to administer vaccines.[239,240] Idaho was the first state to allow technicians to administer vaccines, but other states including Washington, Utah, Rhode Island, Michigan, and Nevada subsequently followed its steps.[239,241] Surely, the most recent advancement in this context dates to October 2020, when the Department of Health and Human Services issued an order to the Public Readiness Emergency Preparedness (PREP) Act which allowed pharmacy technicians to administer childhood vaccines and COVID-19 vaccines in all states regardless of state-specific laws given specific requirements are met.[21] This order was issued a few months prior to the release of any COVID-19 vaccine in the American market and came to reduce the increased demand on healthcare providers forced by the pandemic. This explains the reports of pharmacists in our sample referring to the

administration of vaccines by technicians as a new practice compared to pre-pandemic. The order was further expanded in August 2021 to allow technicians to administer the seasonal flu vaccine to adults given some conditions are met.[242] Because many people are still unvaccinated against COVID-19, pharmacy technicians alongside pharmacists and pharmacy interns can help accelerate the COVID-19 mass vaccination efforts in the country and contribute to achieving herd immunity. Additionally, with the 2021-2022 influenza season approaching and the concerns about the possibility of coinfection with COVID-19 and influenza, it is plausible to involve technicians in administering the annual influenza vaccine.

At this stage, it is uncertain whether this authorization will translate into a permanent role in the future as it is currently time-bound to the COVID-19 public health emergency and it is unclear whether pharmacy technicians might be granted an independent role where they can administer vaccines without pharmacist' supervision. Nevertheless, if it turns to be the case in the future, we anticipate that this will free pharmacists' time up to focus on the delivery of other clinical services that are usually overlooked due to time constraints such as patient counseling. Either way, the implementation of this advanced technician role during the COVID-19 pandemic serves in a way or so as a step towards preparedness for the upcoming influenza seasons and the other potential infectious threats that we may encounter in the future.

One theme that can be inferred from our results is an ability to adapt among community pharmacies. Adaptability is the individual's or system's ability to change or modify programs, services, or interventions to align them with the context in which they are implemented.[243] As a

construct of the Consolidated Framework Implementation Research (CFIR), adaptability is defined as the "degree to which an intervention can be adapted, tailored, refined, or intervened to meet local needs".[244] Adaptability can be proactive/planned, reactive, or activated upon an anticipated condition but regardless, adaptability serves to ameliorate the expected negative ramifications arising from undesired conditions.[245,246] Notably, businesses that are adaptable and embrace change are more likely to succeed and survive compared to the rigid and resisting ones.[247–250]

As a matter of fact, when organizations are faced with unprecedented circumstances or emergencies such as natural disasters, manmade disasters, or public health pandemics disrupting social and organizational practices, adaptability becomes very crucial to maintain services.[251–253] The current pandemic is a living example as it has forced organizations worldwide, including healthcare systems, to adapt rapidly to new realities. In our study, adaptability was evident on multiple occasions reflecting that pharmacists continued to offer immunization services at the pharmacy. Doing so allows pharmacies to continue to meet patient needs during the pandemic. Pharmacists reported adopting a "by-appointment" model, accepting vaccines administration outdoors (e.g., drive-through), implementing strict social distancing measures, and accepting technicians' administration of vaccines, which all can arguably explain the relatively steady number of doses and types of vaccines administered despite the pandemic. Similarly, not from our study though, adaptability of community pharmacies was also evident by them becoming a site for COVID-19 testing immediately

following the authorization granted to them by the HHS, offering home delivering of medications, and offering curbside pickup services.[221,254,235]

After all, a wealth of literature exists about healthcare systems adaptability and responses to the current crisis coming from a wide range of professions and health settings including emergency departments, psychiatric clinics, children hospitals, and pathology departments.[255–264] Current literature discusses examples of modifications adopted in these settings as a response to the current pandemic pertaining to triage, workflow, staffing, communication and information dissemination, using technological approaches to provide telehealth services (remote monitoring, virtual visits), canceling elective procedures or elective admissions, and the increased use of PPE. Nonetheless, there is a dearth of research on how pharmacy-based immunization practice in rural communities has adapted to the pandemic. As such, this study has made a contribution by describing how pharmacies adapted their immunization services to fit with the local demands during the state of the pandemic.

5.3 Aim 3

Aim 3 of this study examined three themes: 1) the acceptance of COVID-19 vaccines among rural community pharmacists including pharmacists' willingness to personally receive, administer, and recommend a COVID-19 vaccine, personal experience with seasonal influenza and COVID-19 vaccines, and reasons for choosing to receive a COVID-19 vaccine, 2) knowledge of the HHS new guidance on pharmacy-based immunization, and 3) provision of COVID-19

immunization services at the pharmacy including reimbursement for vaccine administration and pharmacists' perceived benefits from offering COVID-19 immunization services.

In the current study, the majority of pharmacists (84.9%) reported that they have been vaccinated against seasonal influenza in the past 12 months. Research showed that previous vaccination with seasonal influenza is associated with uptake intention of other vaccines including H1N1 influenza and COVID-19 vaccines.[265–268] A survey that aimed to assess predictors of American adults' intention to receive the novel 2009 H1N1 influenza vaccine found that history of seasonal flu vaccination was among the significant predictors of intention to receive the H1N1 vaccine.[265] Another survey of community nurses in Hong Kong reported that having been vaccinated with seasonal influenza last year was significantly independently associated with nurses' willingness to accept H1N1 influenza vaccination.[266] In addition, a survey predicting intention to receive COVID-19 vaccination among Israeli adults showed that vaccination with a seasonal influenza vaccine in the past year was a powerful predictor of adults' intention to receive COVID-19 vaccination.[267] A study of healthcare workers from France demonstrated the same patterns with a strong correlation between seasonal influenza vaccination and COVID-19 vaccination.[269] Finally, a systematic review of 24 cross-sectional studies from different countries evaluated attitudes of healthcare workers towards COVID-19 immunization showed a positive attitude towards COVID-19 immunization among healthcare workers who received seasonal influenza vaccination previously.[268] In agreement with previous research findings, our results showed that previous seasonal influenza vaccination was statistically significantly associated

with pharmacists' vaccination against COVID-19 (Fisher's Exact test; p-value = 0.0006). However, it is noteworthy that the current pandemic might have affected pharmacists' seasonal influenza vaccination attitude, that is, pharmacists were more inclined than before to get vaccinated against seasonal influenza in 2020 because of concerns about coinfection with COVID-19 and the possible severe symptoms of the coinfection.[222,226]

The current study found a fairly high willingness among rural community pharmacists to recommend COVID-19 vaccination to eligible family members (74.4%, who answered strongly agree or somewhat agree) and to patients (76.7%, who answered strongly agree or somewhat agree). Further, an overwhelming percentage of rural community pharmacists (83.7%, who answered strongly agree or somewhat agree) reported willingness to administer COVID-19 vaccination to patients once a vaccine is available at their practice site. Furthermore, almost 80% (79.1%, who answered yes) reported having already received a COVID-19 vaccine. Our results are consistent with findings from a nationwide survey of 400 pharmacists conducted by the American Pharmacists Association (APhA) which found that 78% of pharmacists were ready to receive a COVID-19 vaccine and 60% were willing to vaccinate patients immediately.[270] In this APhA survey that was conducted from November 21-28, 2020, shortly before the release of any COVID-19 vaccines, pharmacists were asked to report their readiness to get COVID-19 vaccination and vaccinate patients "as soon as possible", "after 6 months experience with the COVID-19 vaccines", and "after 1 year of experience with the COVID-19 vaccines". Our survey, however, was launched on May 27, 2021, that is about 5 months after the U.S. Food and Drug

Administration issued the first emergency use authorization (EUA) for vaccines for the prevention of COVID-19 on December 11 and 18, 2020. Because we examined pharmacists' acceptance after vaccines were already made available we believe that we have more likely captured the actual acceptance of COVID-19 vaccines among community pharmacists participating in our study. In addition, in our study, we asked pharmacists whether they have received a COVID-19 vaccine, whilst in the APhA survey, pharmacists were asked about their readiness to receive a COVID-19 vaccine. We acknowledge that while capturing the intention is useful, there could be an intention-behavior gap. That is, intending to take an action does not always translate into actual uptake of the action.[271] Therefore, given the timing of our data collection, we were able to provide a more accurate picture of the uptake of COVID-19 vaccines among pharmacists. Data from a meta-analysis by Webb TL and Sheeran P on intention-behavior relations found that a medium-large change in intention only predicts a small-to-medium percentage of the variation in health behavior.[272] The meta-analysis consisted of 47 reports derived from 45 experimental studies exploring different behaviors such as physical exercise, use of dental tablets, and smoking.[272] Further, our target population was community pharmacists operating in rural centers across 5 Southeastern states whilst the APhA survey included pharmacists from different practice settings including community-based, institutional, and hospital pharmacies across the United States.

Another study by Jacob et al. explored pharmacists' acceptance of COVID-19 vaccines at two points of time; at ≤ 1 year from the time of COVID-19 vaccine approval and at >1 year after

vaccine approval. The study surveyed 632 American pharmacists from September to November 2020 and found that 67.1% and 63.4% of participating pharmacists were somewhat likely or extremely likely to receive and recommend a COVID-19 vaccine at ≤ 1 year from the time of COVID-19 vaccines approval, respectively.[273] But pharmacists were significantly more willing to receive (78%) and recommend (81.2%) a COVID-19 vaccine at >1 year after vaccine approval.[273] Our results are similar to Jacob et al.'s results in terms of vaccine acceptance, however, their sample consisted of pharmacists who work at a broad range of practice settings including community pharmacies. Community pharmacists accounted for about 14% of their total sample coming right after the largest group; hospital pharmacists (44%). Furthermore, respondents in their sample represented all regions in the United States contrary to our coverage but nearly 20% of pharmacists in their sample represented the southeastern region. Notably, a major difference between our study and Jacob et al.'s study is that we collected data on pharmacists' acceptance of COVID-19 immunization when COVID-19 vaccines were already approved and made available to healthcare workers and the general public.

Moreover, another nationwide APhA survey of pharmacists on COVID-19 vaccine confidence, launched in May 2021, showed that 88% of participating pharmacists indicated they are fully vaccinated against COVID-19 and that 92% said they plan or have already been vaccinated.[274] The 366 surveyed pharmacists work in various practice settings but nearly half of them work in community-based settings.[274] This survey is relatively similar to ours in terms of the timeframe of data collection.

The overall high acceptance of COVID-19 vaccination among community pharmacists should be capitalized on by stakeholders and policymakers to prepare and respond for future pandemics/epidemics. Future research should focus on vaccine acceptance among rural pharmacists nationwide and possibly compare their acceptance of COVID-19 vaccination to pharmacists in urban settings. This could be done through the APhA for example or other national pharmacist associations, to ensure high reachability.

In the present study, the major reasons identified by pharmacists for choosing to receive a COVID-19 vaccine were to avoid transmitting COVID-19 to family members and co-workers, being at high-risk exposure, to set an example for others to get vaccinated, and to void transmitting COVID-19 to patients. To a lesser extent, pharmacists reported intention to contribute to herd immunity and to avoid becoming ill with COVID-19. Our results are similar to results found by Jacob et al.[273] In their survey, the 565 pharmacists who favored COVID-19 vaccination for themselves selected the following reasons for their willingness to receive a COVID-19 vaccine; to avoid transmitting COVID-19 to their family (91.9%), to reduce the risk of contracting COVID-19 for personal protection (87.6%), being a healthcare worker (80%), and to avoid transmitting the disease to community or patients (64.1%).[273] Results are also similar to findings from the previous H1N1 influenza pandemic. To illustrate, a survey by Alsaleem on the acceptance of H1N1 influenza vaccination among healthcare workers at primary healthcare centers in Abha, Saudi Arabia showed that the main reasons for receiving the H1N1 vaccine given by healthcare workers who reported having had received the H1N1 vaccine included

personal protection (51%), fear of transmitting the disease to their family and relatives (49%), and fear of transmitting the disease to their patients (43.9%).[195] Notably, our study is consistent with findings from the two studies by Jacob et al. and Alsaleem as there is an agreement that the avoidance of transmitting diseases to others and the realization of being at high-risk exposure are major motivators for healthcare providers to get vaccinated against a communicable disease during a pandemic.

Although the majority of pharmacists in our study reported having had received a COVID-19 vaccine, yet hesitancy remains as 17.4% (15/86) of pharmacists reported having no plans to receive immunization against COVID-19. Additionally, while we have not asked pharmacists about the reasons they do/would choose to not get vaccinated against COVID-19, a small percentage (3.8%) provided their comments about this under “other” when asked about reasons they do/would choose to get vaccinated. These comments were “I am concerned about the lack of research on COVID-19 vaccines” and “My spouse is concerned about vaccine impact on pregnancy”. While this represents a small percentage, but vaccine hesitancy among healthcare providers is not new. Findings from several studies evaluating vaccines acceptance among different healthcare workers including acceptance of COVID-19 vaccines showed healthcare workers' refusal of vaccines and provided reasons for the refusal. Among reported reasons were fear of side effects, doubts about the safety of the vaccines, vaccines not being tested clinically, and rapidly changing real-world data during the pandemic.[195,273,275,276]

The percentage of COVID-19 vaccine refusal in our sample is alarming for many reasons. First, it is much higher than percentages reported by the few available studies capturing actual uptake of the COVID-19 vaccines by healthcare providers who hold various job roles such as nurses, clinicians, doctors, dentists, and pharmacists.[276–278] The percentages reported by these studies were 8.0%, 9.0%, and 10.0%.[276–278] It is noteworthy to mention here that the current research on COVID-19 vaccine acceptance among healthcare professionals is generally limited to studies of vaccination intention rather than the actualized uptake of the vaccines and studies are mostly conducted prior to the release of any COVID-19 vaccine.[268,279–282] Second, participating pharmacists in our study work in four states ranking the lowest in COVID-19 vaccination rates in the U.S. with less than 50% of the state's population fully-vaccinated against COVID-19 as of the week of October 15th,2021; AL (43.9%), MS (44.9%), AR (46.8%), and SC (48.9%).[283,284] Third, our sample comprises community pharmacists working in rural areas only. Rural areas commonly have poor healthcare infrastructure including shortages of healthcare providers and lack of specialized facilities, but community pharmacists are often the first healthcare providers patients reach in these areas.[285,286]

To explain, provider confidence in the vaccines is paramount and often translates into a better ability to discuss with patients, any safety and efficacy-related concerns. The latest of a series of surveys conducted by the APhA from May 1-8, 2021 on vaccine confidence which reported a very high percentage (88%) of pharmacists already fully vaccinated against COVID-19, also found that 98% of respondents reported being comfortable with addressing vaccine

confidence and vaccine hesitancy concerns with patients and other individuals.[274] Furthermore, high confidence in COVID-19 immunization among healthcare workers was found to be associated with higher willingness and actual uptake of the COVID-19 vaccines as reported by a national survey of 2,386 healthcare workers (doctors, nurses, public health employees, medical technicians, and hospital administrators) from China.[287] In similar fashion, another study from Kuwait surveyed 1019 healthcare workers of which 20.2% were pharmacists showed a positive association between healthcare workers' confidence in the effectiveness of the COVID-19 vaccines and public authorities and their acceptance of the vaccines.[278] Additionally, research has demonstrated that vaccine recommendations made by a healthcare worker can help overcome vaccine hesitancy and improve vaccine uptake.[265,288–295] For example, a survey of 2006 U.S. adults conducted in May 2020, shows that adults were more likely to be willing to receive a COVID-19 vaccine if they thought it would be recommended by their healthcare provider and that doctor recommendation was a major factor in vaccination decision for the majority of participants.[289]

Equally important, community pharmacists are on the frontline of COVID-19 care and they come into direct contact with patients on a daily basis being among the first professionals to be at high-risk exposure to COVID-19. [273,296] Thus, they need to get vaccinated to protect themselves which would also indirectly protect patients presenting to the pharmacy, pharmacists' co-workers, and family, and reduce absenteeism and loss of productivity due to sickness. Further, with the new CDC's recommendation for a booster shot of the FDA-approved

COVID-19 vaccines for certain populations including healthcare workers at increased exposure risk in September and October 2021, community pharmacists' confidence in the vaccines becomes invaluable.[297–300] As of writing, only 5.9% of Americans have received a booster dose for COVID-19.[301] However, community pharmacies can be focal points for promoting the booster shots, identifying eligible patients, along with administering the shots.[302]

To conclude, improving community pharmacists' acceptance and confidence in COVID-19 vaccines is crucial if we aim to build public confidence in vaccines, achieve herd immunity, and reduce morbidity and mortality from COVID-19 in rural areas. The concerns around the safety and efficacy of vaccines that pharmacists might have can be addressed by educational interventions, by sharing information material with pharmacists, or by guiding pharmacists to reliable information sources.[276] However, we believe research is still needed to specifically understand COVID-19 vaccine hesitancy among rural community pharmacists.

Implications

Results hold positive implications for pharmacy practice, public health practice, and future research related to pharmacy-based immunization during the COVID-19 pandemic and other possible pandemics.

Vaccination rates declined across all age groups during the current pandemic but community pharmacies in the rural United States from our study succeeded in maintaining delivery of routine immunization services despite the pandemic with almost no noticeable disruption in the types or doses of vaccines they administered compared to pre-pandemic and continued to meet patients' needs during such unprecedented circumstances demonstrating the integral public health role that community pharmacists are playing during a global pandemic.[13] To further help address the decline in vaccination rates in the pandemic, future research may focus on examining effective strategies used by community pharmacies to keep patients protected from vaccine-preventable diseases during the pandemic. These activities may include screening for potential vaccine recipients through reviewing pharmacy immunization records or IIS, reaching out to patients' physicians/providers, or verbally asking patients presenting to the pharmacy or drive-through for other services, or sending reminders to adults whose vaccines are due or overdue. Future research can examine which strategies are effective in increasing the uptake of vaccines at the pharmacy.

Furthermore, our results hold positive implications for rural communities in particular since community pharmacists are one of the few primary healthcare providers operating in

rural areas. Making vaccines available at community pharmacies operating in rural areas can resolve the immunization coverage disparities in these settings.

Additionally, public health officials and public health communities have the opportunity to learn from community pharmacies' response to the COVID-19 pandemic and take the lessons pertaining to immunization services to prepare for the coming influenza season (2021-2022 flu season) and any future public health or pandemic emergencies. Also, policymakers in other countries where community pharmacies' involvement in vaccination is limited or almost absent can learn from the findings of the current study and the experience of the American community pharmacies, in general, to improve the practice of immunization in their regions.

Finally, while the present study gives a glimpse of rural pharmacists' acceptance of the COVID-19 vaccines, future in-depth qualitative research may focus on evaluating COVID-19 vaccine hesitancy in this population and supplement it with evidence-based tailored interventions to address components of hesitancy thereafter. Possibly, researchers design an intervention addressing factors affecting pharmacists' drive towards COVID-19 vaccines. For example, we recommend that researchers can utilize and adapt the 5C scale which is a validated and robust tool used to evaluate five psychological antecedents (reasons or determinants) related to one's behavior towards vaccination.[303] The five determinants that are assessed through the 5C scale are: 1) confidence ("trust in the effectiveness and safety of vaccines, the system that delivers them, and the motivations of policy-makers who decide on the needed vaccines"), 2) complacency ("perceived risks of vaccine-preventable diseases are

low and vaccination is not deemed a necessary preventive action"), 3) constraints ("physical availability, affordability and willingness to pay, geographical accessibility, ability to understand (language and health literacy) and appeal of immunization services affect uptake" or the structural and psychological barriers precluding intention from turning into actual behavior), 4) calculation ("individual's engagement in extensive information searching; deliberate comparison of the risks of infections and vaccination from which to derive an informed decision"), and 5) collective responsibility ("willingness to protect others by one's own vaccination by means of herd immunity (flip side: willingness to have a free ride when a sufficient number of other people are vaccinated)").[303,304] The 5C scale is believed to be superior to other similar scales in explaining an individual's vaccination behavior as most existing validated measures only consider the confidence determinant of vaccine hesitancy.[278,303] Researchers can tailor these five components to respective pharmacists, depending on individual reasons for not getting vaccinated.

In conclusion, the findings highlight the importance of engaging community pharmacists in decision-making for emergency preparedness planning along with public health departments.

Limitations

This study has limitations that should be considered. First, the design implemented is a cross-sectional design thus we cannot make causal inferences based on the findings. Second, the convenience sampling procedure imposes a bias itself. Results may not be generalizable to a wider population of community pharmacies in rural areas across the nation other than the 5 states studied in this study nor to a wider population of community pharmacies in urban areas. Pharmacists' involvement in immunization services, the scope of authority, and awareness of immunization-related activities may differ across different states. Further, we limited inclusion to pharmacies that offered immunization services during 2019 and 2020, this might have resulted in the small sample size and in excluding pharmacies that only stopped providing immunizations during the pandemic. About 34.0% of participating pharmacists in this study come from the RURAL-CP network. As such, they may be more familiar with responding to surveys or other research modalities or they may have better access to information compared to pharmacists who are not part of research networks. Additionally, a sampling frame error arises from using the Hayes Directories to identify Alabama pharmacies. The contact list might have omitted eligible pharmacies, included ineligible pharmacies, or included inaccurate contact information of pharmacies. Self-selection to participate in the study could be an issue since those who choose to participate might differ from those who did not respond. Furthermore, this study relies on self-reported responses, and thus it is prone to the

disadvantages of recall and social desirability biases. Our survey was released in 2021 but we asked pharmacists about their immunization activities in 2020 and 2019 therefore, it is possible that some pharmacists reported their current activities in 2021 instead of 2020. Lastly, policies around COVID-19 are rapidly changing so changes to the current findings are expected specifically in terms of pharmacists' acceptance of the COVID-19 vaccines.

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Appendixes

Appendix 1: Information Letter

DEPARTMENT OF
HEALTH
OUTCOMES
RESEARCH AND
POLICY

AUBURN UNIVERSITY
HARRISON SCHOOL OF
PHARMACY

Information Letter
For a Research Study entitled
"Impact of the COVID-19 pandemic on pharmacy-based immunization practice in non-urban settings"

Your pharmacy is invited to participate in a research study exploring the impact of the COVID-19 pandemic on pharmacy-based immunization practice in rural areas. The study is being conducted by Sura AlMahasis, a graduate student under the direction of Dr. Salisa Westrick, professor at the Auburn University Department of Health Outcomes Research and Policy. Your pharmacy was selected because it is located in a non-urban area and had provided immunization services for at least 1 vaccine in 2019. Please pass this request on to a pharmacist who played a key role in the immunization services at your pharmacy in 2019 and 2020.

What will be involved if you participate? Your participation is completely voluntary. If you decide to participate, you will be asked to fill out the questionnaire, which should take approximately 20 minutes. You can find the online survey at (https://aub.ie/immunizstudy). Please enter the code number that was given to you to access the survey.

Are there any risks or discomforts? The risks associated with participating in this study are minimal. Data included in study reports will be presented in aggregate form, and therefore neither you nor your pharmacy's identity will ever be disclosed in any publications and presentations. The code number allows us to monitor responses for follow up. Files contain codes and contact information will be kept separate from the survey responses to ensure your response cannot be linked to you or your pharmacy and will be destroyed upon the completion of the study.

Are there any benefits to yourself or others? There are no direct benefits from participating. With this study, we aim to add to the body of knowledge regarding community pharmacists' role in immunization practice and pandemic response. Findings from our study are expected to identify factors affecting successful provision of immunizations during the current and future pandemics. We cannot guarantee that you will receive any or all of the mentioned benefits.

Will you receive compensation for participating? To thank you for your time you will be offered a $20 Amazon gift card. Gift cards will be sent via email.

Are there any costs? Aside from 20 minutes of your time, you can expect no other costs for your participation.

The Auburn University
Institutional Review Board has
approved this Document for use
from
02/09/2021 to

4316 Walker Building, Auburn, AL 36849; Telephone: 334-844-5152; Fax: 334-844-8307
www.auburn.edu

If you change your mind about participating, you can withdraw at any time as long as your response is identifiable. Your decision about whether or not to participate or to withdraw from participating will not jeopardize your future relations with Auburn University nor the Department of Health Outcomes Research and Policy.

Any data obtained in connection with this study will remain anonymous. In the event of any publication of presentation resulting from this research, no personally identifiable information will be shared because your name is no way linked to your responses. Your identity and your pharmacy's identity will remain confidential.

If you have questions about this study, please contact Dr. Salisa Westrick at (334) 750-3352. If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334) 844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@aubuedu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, THE DATA YOU PROVIDE WILL SERVE AS YOUR AGREEMENT TO DO SO. YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

Signature

Salisa C. Westrick, PhD, FAPhA Sterling
Professor & Department Head
Advisor

Sura AlMahasis

Signature

Sura AlMahasis, PharmD
Master's Student
Principal Investigator

The Auburn University
Institutional Review Board has
approved this Document for use
from
02/09/2021 to ----------

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Appendix 2: **Invitation Email to Pharmacies Identified by the RURAL-CP Network**

Dear RURAL-CP pharmacist,

You are invited to participate in a research study seeking to explore the **impact of the COVID-19 pandemic on pharmacy-based immunization practice, including influenza, routine, and COVID-19 vaccines**. The study is conducted by Sura AlMahasis, a graduate student in the Department of Health Outcomes Research and Policy at Harrison School of Pharmacy under the advisement of Dr. Salisa Westrick. You are invited because your pharmacy operates in a non-urban area and had provided immunization services for at least 1 vaccine in 2019.

We need your help!!! Your responses help us estimate the impact the COVID-19 pandemic has had on pharmacy based-immunization practice in non-urban settings in the United States, where immunization rates are normally below the urban areas, and inform us of how to further advance the profession in this area.

Please go to https://aub.ie/immunisstudy2 to review the study description. To participate, please use this code, unique to your pharmacy,_____ , when prompted. The questionnaire should take ~20 minutes and may be completed by any pharmacist who played a key role in the immunization services at your pharmacy in 2019 and 2020.

A $20 Amazon gift card will be issued as a token of appreciation for completing the survey. Thank you in advance for your participation!

Sincerely,
Salisa Westrick, PhD
Health Outcomes Research and Policy Auburn University
Harrison School of Pharmacy
westrsc@auburn.edu

Appendix 3: Reminder Email 1 to Pharmacies Identified by RURAL-CP Network

Dear RURAL-CP pharmacist,

Last week, we sent you an invitation to our research project regarding **pharmacy based-immunization practice during the COVID-19 pandemic.** Your responses are important because they represent the views of many pharmacists like yourself.

Our records show that we have not yet heard from you. If you have not yet completed the questionnaire we hope that you will take ~ 20 minutes of your time within the next couple of days to complete the questionnaire. The questionnaire may be completed by any pharmacist who played a key role in the immunization services at your pharmacy in 2019 and 2020.

You can reach the questionnaire at https://aub.ie/immunisstudy2. When prompted, please use this code _____ that is specific to your pharmacy.

Thank you in advance for your participation in this study. If you have any questions do not hesitate to contact Dr. Salisa Westrick at westrsc@auburn.edu or 334-844-8314.

Sincerely,

Salisa Westrick, PhD
Health Outcomes Research and Policy
Auburn University, Harrison School of Pharmacy

Appendix 4: Reminder Email 2 to Pharmacies identified by RURAL-CP Network

Dear RURAL-CP pharmacist,

Last month, we sent you an invitation to our research project regarding **pharmacy based-immunization practice during the COVID-19 pandemic.** Your responses are important because they represent the views of many pharmacists like yourself!

Our records show that we have not yet heard from you. If you have not yet completed the questionnaire we hope that you will take ~ 20 minutes of your time **within the next 7 days** to complete the questionnaire. The questionnaire may be completed by any pharmacist who played a key role in providing immunization services at your pharmacy in 2019 and 2020.
You can reach the questionnaire at https://aub.ie/immunisstudy2.

When prompted, please use code _____ that is specific to your pharmacy.

Thank you in advance for your participation in this study. If you have any questions do not hesitate to contact Dr. Salisa Westrick at westrsc@auburn.edu or 334-844-8314.

Sincerely,

Salisa Westrick, PhD
Health Outcomes Research and Policy
Auburn University, Harrison School of Pharmacy

Appendix 5: Pre-notification Postcard to Pharmacies Identified by Hayes Directories

DEPARTMENT OF
HEALTH
OUTCOMES
RESEARCH AND
POLICY

AUBURN UNIVERSITY
HARRISON SCHOOL OF
PHARMACY

Dear Pharmacy Manager,

You are invited to participate in a research study entitled "**Impact of the COVID-19 Pandemic on Pharmacy-based Immunization Practice in Non-urban Settings".** The study is being conducted by Sura AlMahasis, a graduate student under the advisement of Dr. Salisa Westrick from the Health Outcomes Research and Policy Department at Auburn University. You are invited because your pharmacy operates in a non-urban area and had provided immunization services for at least 1 vaccine in 2019. Information learned from this study may help us estimate the impact the COVID-19 pandemic has had on provision of immunization services and inform us of how to further advance the profession in this area.

You will soon receive a questionnaire packet in the mail. Please go to (https://aub.ie/immunizstudy) to review the study description. To participate now, please use this code, unique to your pharmacy, ____ when prompted. The questionnaire should take ~20 minutes and may be completed by any pharmacist who played a key role in the immunization services at your pharmacy in 2019 and 2020. To thank you for your time, we will send you a $20 Amazon gift card. **Thank you in advance for your participation!**

Sincerely,
Salisa Westrick, PhD
westrsc@auburn.edu

Appendix 6: Invitation Letter to Pharmacies Identified by Hayes Directories

DEPARTMENT OF
HEALTH
OUTCOMES
RESEARCH AND
POLICY

AUBURN UNIVERSITY

HARRISON SCHOOL OF
PHARMACY

Dear Pharmacy Manager,

You are invited to participate in a research study seeking to explore the impact of the COVID-19 pandemic on pharmacy-based immunization services including seasonal and routine vaccines. The study is conducted by Sura AlMahasis, a graduate student in the Department of Health outcomes Research and Policy at Harrison School of Pharmacy under the advisement of Dr. Salisa Westrick. You are invited because your pharmacy operates in a non-urban area. Your pharmacy must provide immunization services to be eligible to participate.

We need your help!!! Your responses help us estimate the impact the COVID-19 pandemic has had on pharmacy based-immunization practice in non-urban settings in the United States, where immunization rates are normally below the urban areas, and inform us of how to further advance the profession in this area.

We have enclosed the information letter to help answer any questions that you may have about the study or your participation in it. You also have the option to pass this request to a pharmacist at your practice site who plays a key role in immunization services. The questionnaire should take around 15 minutes and may be completed by any pharmacist who played a key role in the immunization services at your pharmacy in 2019 and 2020.Should you decide to participate, please complete, and return the enclosed questionnaire within 10 days of receipt. A $20 Amazon gift card will be issued as a token of appreciation for completing the survey.

If you prefer, you can complete the web-version of this survey at (https://aub.ie/immunizstudy). Please use this code, unique to your pharmacy, _____ when prompted.

Thank you in advance for your participation in this study. If you have any questions do not hesitate to contact Dr. Salisa Westrick at westrsc@auburn.edu or 334-844-8314.

Sincerely,

Salisa Westrick, PhD
Health Outcomes Research and Policy
Auburn University, Harrison School of Pharmacy
westrsc@auburn.edu

4316 Walker Building, Auburn, AL 36849; Telephone: 334-844-5152; Fax: 334-844-8307
www.auburn.edu

Appendix 7: Reminder Postcard to Pharmacies Identified by Hayes Directories

DEPARTMENT OF HEALTH OUTCOMES RESEARCH AND POLICY

AUBURN UNIVERSITY
HARRISON SCHOOL OF PHARMACY

Dear Pharmacy Manager,

Last month we sent you a questionnaire for our research study regarding **pharmacy based-immunization during the COVID-19 pandemic.**

Our records show that we have not yet heard from you. If you have not yet completed the questionnaire we hope that you will take ~20 minutes of your time within the **NEXT 7 DAYS** to complete and return the questionnaire. The questionnaire may be completed by any pharmacist who played a key role in the immunization services at your pharmacy in *2019 and 2020*.

If you prefer, you can complete the web-version of this survey at (**https://aub.ie/immunizstudy**). Please use this unique code _____ when prompted. If you completed and mailed your questionnaire within the past few days, please accept our sincere thanks for doing so. If you mailed your questionnaire more than a week ago, we would appreciate if you let us know that you sent it so we can work on locating it. **Thank you in advance for your participation in this study!**

Sincerely,

Salisa Westrick, PhD
westrsc@auburn.edu

Appendix 8: Invitation Letter to Pharmacies Identified by Hayes Directories (Second survey packet)

DEPARTMENT OF
HEALTH
OUTCOMES
RESEARCH AND
POLICY

AUBURN UNIVERSITY
HARRISON SCHOOL OF
PHARMACY

Dear Pharmacy Manager,

Last month, we sent you a questionnaire regarding **pharmacy based-immunization during the COVID-19 pandemic**. Your pharmacy was selected because it is located in a non-urban area and **had provided immunization services for at least 1 vaccine in 2019**. Your responses are important because they represent the views of many pharmacists like yourself.

Our records show that we have not yet heard from you. If you have not yet completed the questionnaire we hope that you will take 20 minutes of your time within **THE NEXT 7 days** to complete and return this questionnaire. The questionnaire may be completed by any pharmacist who played a **key role in the immunization services at your pharmacy in 2019 and 2020.**

We have included a copy of our questionnaire in case you have misplaced the one we previously sent. If you prefer, you can complete the web-version of this survey at (**https://aub.ie/immunizstudy**). Use the unique code printed on your survey when prompted.

If you completed and mailed your questionnaire within the past few days, please accept our sincere thanks for doing so. If you mailed your questionnaire more than a week ago, we would appreciate if you let us know that you sent it so we can work on locating it.

Thank you in advance for your participation in this study. If you have any questions do not hesitate to contact Dr. Salisa Westrick at westrsc@auburn.edu or 334-844-8314.

Sincerely,

Salisa Westrick, PhD
Health Outcomes Research and Policy
Auburn University, Harrison School of Pharmacy
westrsc@auburn.edu

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Appendix 9: Complete Questionnaire

Section 1: COVID-19 Immunizations

Instructions: In this section, you will be asked a few questions about your willingness to receive, administer, and recommend the COVID-19 vaccines and about COVID-19 immunization services.

1.1 Have you been vaccinated against Influenza in the past 12 months?

☐ Yes ☐ No

1.2 Have you been vaccinated against COVID-19?

☐ Yes ☐ No

1.3 Why do you/would you choose to get vaccinated against COVID-19? Check all that apply.

☐ As a health professional, I am at high risk for exposure to COVID-19
☐ I am worried about transmitting COVID-19 to patients
☐ I am worried about becoming ill with COVID-19
☐ I am worried about transmitting COVID-19 to my family members and co-workers
☐ To contribute to herd immunity
☐ I want to set an example for others to get vaccinated
☐ Other, please specify: _____
☐ I am not willing to get a COVID-19 vaccine

1.4 Please indicate your level of agreement or disagreement with the following statements by checking (☒) in the appropriate box.

Item	Strongly disagree (1)	Somewhat disagree (2)	Undecided (3)	Somewhat agree (4)	Strongly agree (5)
When my family member becomes eligible to receive a COVID-19 vaccine, I would recommend that they get it.	☐	☐	☐	☐	☐
When a COVID-19 vaccine becomes available to my patients, I would recommend that they get it.	☐	☐	☐	☐	☐
When a COVID-19 vaccine becomes available in my pharmacy, I or other staff would administer it to my patients.	☐	☐	☐	☐	☐

1.5 Please indicate how much your pharmacy benefit or would benefit from providing COVID-19 immunization services, by checking (☒) in the appropriate box, in terms of:

	No benefit (1)	Slight (2)	Fair (3)	Very (4)	Extreme benefit (5)
Generating additional revenue.	☐	☐	☐	☐	☐
Bringing more patients into the pharmacy.	☐	☐	☐	☐	☐
Increasing ability to compete with other pharmacies.	☐	☐	☐	☐	☐
Being a role model for other pharmacies/pharmacists.	☐	☐	☐	☐	☐
Enhancing relationships with local clinics or public health agencies.	☐	☐	☐	☐	☐

1.6 In 2020, the Department of Health and Human Services (HHS) has issued new guidance pertaining to pharmacy staff immunization authorization.

A. Under this new guidance, who are authorized to administer routine and influenza childhood vaccines under a pharmacist's supervision from the following? Check all that apply.

☐ Qualified pharmacy technicians ☐ State-authorized pharmacy interns

B. Under this new guidance, who are authorized to administer COVID-19 vaccines under a pharmacist's supervision from the following? Check all that apply.

☐ Qualified pharmacy technicians ☐ State-authorized pharmacy inter

C. What age of vaccine recipients is covered under this guidance? Check all that apply.

☐ Less than 3 years
☐ 3-10 years
☐ 11-18 years
☐ Older than 18 years

1.7 Does your pharmacy currently offer a COVID-19 vaccination service?

☐ Yes
☐ No, we are waiting to receive the vaccines
☐ No, we do not plan to offer any COVID-19 vaccination services

1.8 Does your pharmacy submit claims to receive COVID-19 vaccine administration fee?

☐ Yes → Please indicate which of the following insurers you file claims to:
- ☐ Medicaid
- ☐ Medicare
- ☐ Commercial plans
- ☐ Provider Relief Fund for the uninsured

☐ Not currently → Please indicate which of the following insurers you will file claims to:
- ☐ Medicaid
- ☐ Medicare
- ☐ Commercial plans
- ☐ Provider Relief Fund for the uninsured

☐ No, we do not plan to file claims to receive any administration fee
☐ Not applicable, we do not plan to offer COVID-19 vaccination service

Section 2: Provision of non-COVID-19 Immunizations During the COVID-19 Pandemic

Instructions: You will be asked questions about how you provided non-COVID-19 immunization services at your practice site during the COVID-19 pandemic in 2020 and in the year of 2019.

2.1 In 2020, how did you provide non-COVID 19 immunization services at your pharmacy during the COVID-19 pandemic? These include influenza and routine vaccines. Check all that apply.

☐ By appointment - anytime we are open
☐ By appointment - during designated hours
☐ By walk-in - anytime we are open
☐ By walk-in - during designated hours
☐ Others, please specify: _____

Has this changed compared to how you offered immunization services in 2019?

☐ No ☐ Yes, please explain the change(s) _____

2.2 In which location were non-COVID vaccines administered in your pharmacy in 2020? Check all that apply.

☐ Separate room inside the pharmacy
☐ Inside the pharmacy but not inside a separate room
☐ Outdoors (e.g., parking lot, curbside site, drive- through)
☐ Others, please specify: _____

Has this changed compared to how you offered immunization services in 2019?

☐ No ☐ Yes, please explain how _____

2.3 Which of the following describe(s) the method(s) used in your pharmacy to assess patients' immunization status during the pandemic in 2020? Check all that apply.

☐ Verbally discuss with patients walking into the pharmacy
☐ Administer paper or electronic questionnaire
☐ Consult state or local immunization information system (IIS)
☐ Contact patients' physician/provider
☐ Review pharmacy immunization records
☐ Other, please specify: _____

Has this changed compared to how you assessed patient's immunization status in 2019?

☐ No ☐ Yes, please explain how:_____

2.4 Immunization Information Systems (IIS) are computerized databases that record all immunization doses administered by participating providers to persons residing within a given geopolitical area. Sometimes they are referred to as immunization registries.

Is your pharmacy currently enrolled in a State or Regional Immunization System?

☐ Yes, please indicate the year of first enrollment: _____ ☐ No

2.5 Which of the following describe(s) the vaccination record-keeping practices for non-COVID vaccines in 2020? Check all that apply.

☐ Giving the receipt and the Vaccine Information Statement (VIS) to the patient
☐ Documenting on the patient's personal paper immunization record
☐ Manually reporting to the patient's primary care provider by fax or hard copy
☐ Documenting in the State or Regional Immunization Registry
☐ Documenting in the pharmacy software
☐ Other, please specify_____

Has this changed compared to how you kept immunization records in 2019?

☐ No ☐ Yes, please explain how _____

2.6 How often does your pharmacy refer patients to other healthcare providers for non-COVID immunizations during the COVID-19 pandemic in 2020?

☐ Never ☐Sometimes ☐ Seldom ☐ Very often ☐ Always

Has this frequency changed compared to 2019?

☐ No ☐ Yes, please explain _____

2.7 How often does your pharmacy receive referrals for non-COVID immunizations from other healthcare providers during the COVID-19 pandemic in 2020?

☐ Never ☐Sometimes ☐ Seldom ☐ Very often ☐ Always

Has this frequency changed compared to 2019?

☐ No ☐ Yes, please explain _____

2.8 What method(s) did your pharmacy use to remind people of missed or upcoming non-COVID vaccines during the COVID-19 pandemic in 2020? Check all that apply.

☐ A record card is given to patients identifying when the next dose is due

☐ Pharmacy sets up the next appointment in the system at the time of the first dose

☐ Pharmacy initiates contact when the next dose is due through:

☐ Postcard/Letter ☐ Telephone call ☐ Text/Email ☐ None

Has this method changed compared to how you sent patient reminders in 2019?

☐ No ☐ Yes, please explain _____

2.9 Who administered influenza and routine vaccines to patients at your pharmacy during the COVID-19 pandemic in 2020? Check all that apply.

☐ Pharmacists ☐ Pharmacy technicians ☐ Pharmacy students/interns

Has this changed compared to who used to administer vaccines at your pharmacy in 2019?

☐ No ☐ Yes, please explain _____

2.10 What role did your <u>pharmacy technician</u> play in immunization services during the COVID-19 pandemic in 2020? Check all that apply.

☐ Asking patients if they are interested in immunizations

☐ Preparing vaccines for administration

☐ Identifying potential vaccine recipients

☐ Billing

☐ Documentation

☐ Vaccine administration

☐ Other, please specify: _____

☐ None; they were not involved in immunization services

Has this changed compared to the role your pharmacy technicians had in 2019?

☐ No ☐ Yes, please explain _____

Section 3: Types and Doses of non-COVID-19 Vaccines Administered in 2020 and 2019

Instructions: In this section, you will be asked questions about the types and number of doses of non-COVID-19 vaccines administered for all age groups at your practice site before the COVID-19 pandemic in 2019 and during the pandemic in 2020.

3.1 Did your pharmacy offer vaccines to adults in 2019 and 2020? ☐ Yes ☐ No, skip to Q3.2

Please indicate below the types of vaccines administered to adults aged 19 years or older at your pharmacy in 2019 and 2020 by checking (☒) in the appropriate box and indicate an approximate number of the doses administered for each vaccine in 2020.

Vaccine for those aged 19 years and older	Did your pharmacy provide this vaccine in 2020?	Estimated number of doses administered in 2020.	Did your pharmacy provide this vaccine in 2019?	How does the number of doses administered of this vaccine in 2020 compare to 2019?
Human Papillomavirus	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Influenza	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Tdap/Td	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Zoster	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Pneumococcal Polysaccharide (PPSV23)	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Pneumococcal conjugate (PCV13)	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019

Measles, Mumps, Rubella	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Haemophilus Influenzae	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019

3.2 Did your pharmacy offer vaccines to adolescents in 2019 and 2020? ☐ Yes ☐ No, skip to Q3.3

Please indicate below the types of vaccines administered to adolescents aged 11-18 years at your pharmacy in 2019 and 2020 by checking (☒) in the appropriate box and indicate an approximate number of the doses administered for each vaccine in 2020.

Vaccine for those aged 11-18 years	**Did your pharmacy provide this vaccine in 2020?**	**Estimated number of doses administered in 2020.**	**Did your pharmacy provide this vaccine in 2019?**	**How does the number of doses administered of this vaccine in 2020 compare to 2019?**
Human Papillomavirus	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Influenza	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Meningococcal (MenACWY)	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
PCV13	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Tdap	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019

3.3 Did your pharmacy offer vaccines to children in 2019 and 2020? ☐ Yes ☐ No, skip to the following page

Please indicate below the types of vaccines administered to <u>children</u> aged 10 years or younger at your pharmacy in 2019 and 2020 by checking (☒) in the appropriate box and indicate an approximate number of the doses administered for each vaccine in 2020.

Vaccine for those aged 10 years or younger	**Did your pharmacy provide this vaccine in <u>2020?</u>**	**Estimated number of doses administered in <u>2020</u>.**	**Did your pharmacy provide this vaccine in <u>2019</u>?**	**How does the number of doses administered of this vaccine in <u>2020</u> compare to <u>2019?</u>**
Haemophilus Influenzae	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Hepatitis A	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Hepatitis B	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Influenza	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Measles, Mumps, Rubella	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Pneumococcal (PCV13)	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
DTaP/Tdap	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Varicella	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019

Rotavirus	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019
Polio	☐ No ☐ Yes		☐ No ☐ Yes	☐ Increased from 2019 ☐ About the same ☐ Decreased from 2019

Section 4: Individual and Pharmacy Characteristics

Please indicate your sex: ☐ Male ☐ Female

Please indicate your age: ____ years

Please indicate your ethnicity: ☐ Hispanic or Latino ☐ Not Hispanic or Latino

Please indicate your race:

☐ White
☐ Black or African American
☐ Asian
☐ Native Hawaiian or Other Pacific Islander
☐ American Indian or Alaska Native
☐ Other, please specify: ____

Which of the following best describes the pharmacy that is your primary practice location?

☐ Single independent
☐ Multiple independent (i.e., 2 or more stores under About the same ownership)
☐ Grocery store chain
☐ Regional chain
☐ National chain
☐ Other, please specify: _____

Please indicate your education/training. Check all that apply.

☐ B.S. Pharmacy
☐ PharmD
☐ Pharmacy technician certification
☐ Residency
☐ Masters
☐ None of the above
☐ Other, please specify: _____

What is the average prescription volume per day at your primary practice location?
_____ prescriptions

How many FTEs (full-time equivalents, 40 hrs/wk) of licensed pharmacists does your pharmacy schedule including the manager? _____FTE

How many FTEs (full-time equivalents, 40 hrs/wk) of licensed technicians does your pharmacy schedule? ____FTE

What is the number of pharmacists who are trained to administer immunizations in your pharmacy?_____

What is the number of technicians who are trained to administer immunizations in your pharmacy?_____

What is the number of interns who are trained to administer immunizations in your pharmacy?_____

Please indicate number of years of immunization experience of your pharmacy: ____ years

Appendix 10: Potential nonresponse bias investigation

Comparison in pharmacy and pharmacist characteristics between early respondents and late respondents.			
Characteristics	**Early respondents N= 15 ^**	**Late respondents N =15**	**p-value***
Characteristics of pharmacists who completed the survey			
Age (years) mean (SD)	37.0 (8.6)[a]	49.4 (14.5)	**0.0080** [б]
Education/training [b]			
B.S. Pharmacy	2 (8.7)	7 (30.4)	
PharmD	5 (21.7)	8 (34.8)	0.3473[Δ]
Residency	1 (4.4)	0	
Sex			
Male	7 (23.3)	7 (23.3)	1.0000[×]
Female	8 (26.7)	8 (26.7)	
Race		14 (46.7)	1.0000[Δ]
White	15 (50.0)	1 (3.3)	
Black or African American	0 (0.0)		
Received COVID-19 vaccination			
Yes	11 (36.8)	12 (40.0)	1.0000[Δ]
No	4 (13.3)	3 (10.0)	
Received influenza vaccination in the previous 12 months			
Yes	12 (40.0)	15 (50.0)	0.2241[Δ]
No	3 (10.0)	0	
Characteristics of the community pharmacy where survey respondents most often work			
Pharmacy immunization experience (years) mean (SD)	12.7 (11.9)	11.9 (7.1)	0.8185 [б]

Pharmacy ownership			
Single independent	7 (24.1)	7 (24.1)	0.1141[Δ]
Multiple independent	7 (24.1)	2 (6.9)	
Grocery store chain	0	1 (3.5)	
National chain	1 (3.5)	4 (13.8)	
Enrolled in a State or Regional IIS			
Yes	14 (46.7)	3 (10.0)	0.5977[Δ]
No	1 (3.3)	3 (10.0)	

* Statistically significant at $\alpha < 0.05$. [b] Participants were asked to select all options that apply.
[Δ] Fisher's exact test, ✖ Chi-squared test, [ϭ] Two-sample t-test.

Appendix 11: Internal Consistency Reliability

Acceptance of COVID-19 Vaccination

Internal Consistency Reliability: Acceptance of COVID-19 Vaccination Scale					
Item	**Scale Mean if Item Deleted**	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Squared Multiple Correlation**	**Cronbach's Alpha if Item Deleted**
When my family member becomes eligible to receive a COVID-19 vaccine, I would recommend that they get it.	8.6	5.3	0.759	0.814	0.758
When a COVID-19 vaccine becomes available to my patients, I would recommend that they get it.	8.5	5.3	0.887	0.851	0.633
When a COVID-19 vaccine becomes available in my pharmacy, I or other staff would administer it to my patients.	8.2	6.9	0.549	0.406	0.943

Perceived benefits of offering COVID-19 immunization services

Internal Consistency Reliability: Perceived Benefits Of Offering COVID-19 Immunization Services Scale					
Item	**Scale Mean if Item Deleted**	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Squared Multiple Correlation**	**Cronbach's Alpha if Item Deleted**
Generating additional revenue.	15.41	18.912	0.749	0.769	0.889
Bringing more patients into the pharmacy.	15.25	17.974	0.834	0.818	0.872
Increasing ability to compete with other pharmacies.	15.67	17.462	0.727	0.554	0.894
Being a role model for other pharmacies/pharmacists.	15.42	17.176	0.727	0.700	0.895
Enhancing relationships with local clinics or public health agencies.	15.47	17.300	0.809	0.755	0.875

Appendix 12: Aim 2: Changes of the Delivery of Non-COVID-19 Immunization Activities During the COVID-19 Pandemic Compared to 2019

Item	Comments as reported by respondents
Provision of immunization services	**1.** Appointments helped ensure patients came to the pharmacy in a controlled manner for fast and efficient service **2.** As of March 2020 our front end was closed to foot traffic so our immunizations were done outside in patient vehicles. 2019 all immunizations were done as walk in, no appt needed **3.** Before the COVID-19 pandemic, patients were able to walk in at any time during business hours and receive immunization services. **4.** During the pandemic, patients were forced to make appointments for immunization services. **5.** Before the pandemic, we offered on-demand walk-up vaccination. **6.** Did not offer appointment times previously **7.** Drive thru is new to use for vaccinations **8.** During the shutdown we were curbside only and required an appointment for anything to be administered by the pharmacy. **9.** Pre pandemic our vaccination service was walk-in only **10.** We went to appointments only and have the shots outside. **11.** before no appointment required covid-appointment **12.** normally made appointments only **13.** now offering appts **14.** schedule each patient **15.** we had walk ins before no appointment needed.

Location of vaccine administration	**1.**	2019 all vaccinations were given in a separate room inside the pharmacy or at business locations
	2.	Prior to the pandemic, immunizations were given in a specific room inside the pharmacy.
	3.	We administered outside and used a staff training room also.
	4.	We had not previously administered vaccines outside of the pharmacy (ie-parking lot)
	5.	We have a vaccination room, but pharmacists did not feel comfortable being on a confined space due to pandemic.
	6.	appointments for vaccines
	7.	inside ..
	8.	outdoors is new
	9.	removed shelf for more room
	10.	separate areas now
Assessment of patient immunization status	**1.**	In addition to the above we added face to face discussion with patient inside the pharmacy
	2.	now have immprint
	3.	Consulting state immunization information systems.
Vaccine administration record-keeping	**1.**	IIS
	2.	Improved reporting to state database by setting up pharmacy software to automatically send info.
	3.	immprint integration
	4.	no cards in past
	5.	None
	6.	state registry started because of covid comment about 2nd choice: covid only
	7.	we did not use immprint

Immunization referrals from other healthcare providers	**1.**	GI associates has begun to refer Hep A and B Vaccines to us
	2.	More emphasis on immunization so we've seen more non-covid vaccines.
	3.	The push for shingles vaccination slowed during COVID and is still slow. Other vaccinations have not changed.
	4.	We have had increased referrals over time as word gets out about us doing vaccines.
	5.	We received more orders towards the end of the year than we did the rest of the year.
	6.	increased
	7.	less
	8.	less referrals
	9.	more referrals in previous years
Vaccine reminder/recall strategies	**1.**	For 2nd pneumonia and shingles shots, we call the patient to remind them.
	2.	Prior to 2020, only used telephone calls to initiate contact with patient. Now use personal record cards that document first dose and show date/time of appointment for additional doses, if required. If patient doesn't show at future appointments, pharmacy calls patient and/or notifies primary provider of need for additional doses of vaccines
	3.	Record cards have only been given with the Covid-19 vaccine as appointment reminders.
	4.	Texting within our scheduling software
	5.	We leave responsibility on patient if they miss their appointment
	6.	We started using acuity scheduling which has been fantastic
	7.	no reminders given previously
	8.	taking/booking appointments

Personnel administering vaccines at the pharmacy	**1.**	Pharmacy technicians have taken on a greater role in immunizing patients.
	2.	Technicians are a new role
	3.	We have our first technician certified to administer vaccines who was certified in 2020.
	4.	Yes now techs can
	5.	first-year to have intern
	6.	interns administered vaccines previously
	7.	tech administration
	8.	techs
Role of pharmacy technicians in immunization services	**9.**	DIDN'T GIVE VACCINES
	10.	Technicians have not previously been able to administer vaccines
	11.	They did not administer pre pandemic
	12.	administration
	13.	administration
	14.	more active role taken
	15.	recently licensed to give vaccines
	16.	several technicians have received certification for giving vaccines
	17.	tech never gave shots before
	18.	technicians could not previously administer vaccines
	19.	techs can give the imz now

Appendix 13: Results for RURAL-CP Pharmacists and the Hayes Pharmacists

Respondent and Pharmacy Characteristics.		
Characteristics	**n** **Mean (SD)** **Median**	
	RURAL-CP Pharmacists	**Hayes Pharmacists**
Respondent age (years)	**29** 45.2 (12.9) 42.0	**56** 40.6 (12.0) 36.5
Average prescription volume per day	**29** 276.6 (156.6) 250.0$^{\Delta}$	**54** 279.9 (129.6) 255.0
Number of FTEs of pharmacists	**29** 2.4 (1.9) 2.0$^{\Delta}$	**55** 1.8 (0.8) 2.0$^{\Delta}$
Number of FTEs of technicians	**29** 4.0 (3.2) 3.0$^{\Delta}$	**55** 3.5 (1.5) 3.0$^{\Delta}$
Number of pharmacists trained in immunization administration	**29** 2.7 (1.8) 2.0$^{\Delta}$	**56** 2.4 (0.8) 2.0
Number of technicians trained in immunization administration	**29** 0.7 (1.1) 0$^{\Delta}$	**55** 0.9 (1.5) 0$^{\Delta}$
Number of interns trained in immunization administration	**29** 0.4 (0.7) 0$^{\Delta}$	**55** 0.2 (0.5) 0$^{\Delta}$
Pharmacy immunization experience (years)	**29** 12.7 (8.7) 10.0$^{\Delta}$	**54** 12.3 (8.8) 10.0$^{\Delta}$
	N **n (%)**	
Sex Male Female	**29** 13 44.83 16 55.17	**56** 22 (39.3) 34 (60.7)

Race	**29**	**56**
White	28 (96.6)	52 (92.9)
Black or African American	1 (3.5)	3 (5.4)
Asia	0	1 (1.8)
Ethnicity	**28**	**56**
Not Hispanic or Latino	28 (100.0)	56 (100.0)
Education/Training [a]	**29**	**50**
B.S. Pharmacy	10 (34.5)	15 (30.0)
PharmD	18 (62.1)	32 (64.0)
Pharmacy technician certification	4 (13.8)	2 (4.0)
Residency	1 (3.4)	1 (2.0)
Masters	1 (3.4)	0
Others	1 (3.4)	1 (2.0)
Pharmacy ownership	**29**	**55**
Single independent	18 (62.1)	23 (40.4)
Multiple independent	10 (34.5)	16 (28.1)
Grocery store chain	1 (3.5)	1 (1.8)
National chain	0	13 (22.8)
Others	0	2 (3.5)
State	**29**	**57**
AL	7 (24.1)	57 (100.0)
AR	3 (10.3)	0
MS	3 (10.3)	0
NC	5 (17.2)	0
SC	11 (37.9)	0
Enrolled in a State or Regional IIS	**28**	**55**
Yes	26 (92.9)	45 (81.8)
No	2 (7.1)	10 (18.2)
Year of first enrollment in IIS	**21**	**39**
Before 2018	16 (76.2)	6 (15.4)
2018 or after[b]	5 (23.8)	33 (84.6)

FTE, full-time equivalent; IIS, Immunization Information System; N, the total number of positive answers for a given category; SD, standard deviation. [a] Participants were instructed to select all options that apply.

[Δ] Indicates that median was more appropriate to report than mean.

[b] Eleven pharmacies enrolled in 2020; 2 from the RURAL-CP group and 6 enrolled in 2021; 1 from the RURAL-CP group.

Non-COVID-19 immunization activities during the COVID-19 pandemic.		
Activity	**N n (%)**	
	RURAL-CP pharmacists	**Hayes pharmacists**
Provision of immunization services [a]	**29**	**56**
By appointment - any time the pharmacy is open	11 (37.9)	13 (23.2)
By appointment - during designated hours only	8 (27.6)	9 (16.1)
By walk-in - anytime we are open	19 (65.5)	39 (69.6)
By walk-in - during designated hours	7 (24.1)	7 (12.5)
Others	2 (6.9)	0
Activity changed compared to 2019	**29**	**54**
Yes	7 (24.1)	11 (20.4)
No	22 (75.9)	43 (79.6)
Assessment of patient immunization status [a]	**29**	**56**
Verbally discuss with patients walking into the pharmacy	27 (93.1)	41 (73.2)
Administer paper or electronic questionnaire	16 (55.2)	28 (50.0)
Consult state or local immunization information system (IIS)	20 (69.0)	23 (41.1)
Contact patients' physician/provider	15 (51.7)	19 (33.9)
Review pharmacy immunization records	23 (79.3)	35 (62.5)
Other	1 (3.4)	0
Activity changed compared to 2019	**29**	**56**
Yes	2 (6.9)	3 (5.4)
No	27 (93.1)	53 (94.6)
Location of vaccine administration [a]	**29**	**48**
Separate room inside the pharmacy	21 (72.4)	22 (45.8)
Inside the pharmacy but not inside a separate room	7 (24.1)	23 (47.9)
Outdoors (e.g., parking lot, curbside site, drive-through)	22 (75.9)	16 (33.3)
Other	1 (3.4)	2 (4.2)
Activity changed compared to 2019	**29**	**54**
Yes	4 (13.8)	8 (14.8)
No	25 (86.2)	46 (85.2)

Vaccine administration record-keeping [a]	**29**	**51**
Giving the receipt and the VIS to the patient	26 (89.7)	47 (92.2)
Documenting on the patient's immunization record	11 (37.9)	26 (51.0)
Manually reporting to the patient's primary care provider by fax or hard copy	19 (65.5)	22 (43.1)
Documenting in the State or Regional Immunization Registry	25 (86.2) 28 (96.6)	37 (72.5)
Documenting in the pharmacy software	0	46 (90.2)
Other		1 (2.0)
Activity changed compared to 2019	**29**	**56**
Yes	0	9 (16.1)
No	29 (100)	47 (83.9)
Immunization referrals sent	**29**	**57**
Never	15 (51.7)	16 (28.1)
Sometimes	8 (27.6)	24 42.11
Seldom	6 (20.7)	13 22.81
Very often	0	4 7.02
Always	0	0
Activity changed compared to 2019	**29**	**54**
Yes	0	0
No	29 (100)	54 (100.0)
Immunization referrals received	**29**	**57**
Never	3 (10.3)	0
Sometimes	8 (27.6)	13 (22.8)
Seldom	5 (17.2)	13 (22.8)
Very often	11 (37.9)	30 (52.6)
Always	2 (6.90)	1 (1.8)
Activity changed compared to 2019	**29**	**57**
Yes	8 (27.6)	4 (7.0)
No	21 (72.4)	53 (93.0)

Vaccine reminder/recall strategies [a]	**29**	**51**
A record card given to patients	15 (51.7)	28 (54.9)
Pharmacy sets up the next appointment in the system	12 (41.4)	24 (47.1)
Postcard/Letter	1 (3.4)	3 (5.9)
Telephone call	23 (79.3)	34 (66.7)
Text/Email	8 (27.6)	17 (33.3)
None	1 (3.4)	3 (5.9)
Activity changed compared to 2019	**29**	**54**
Yes	4 (13.8)	4 (7.4)
No	25 (86.2)	50 (92.6)
Personnel administering vaccines at the pharmacy [a]	**29**	**50**
Pharmacists	29 (100.0)	50 (100.0)
Pharmacy technicians	5 (17.2)	4 (8.0)
Pharmacy students/interns	9 (31.0)	14 (28.0)
Activity changed compared to 2019	**26**	**57**
Yes	9 (34.6)	5 (8.8)
No	17 (65.4)	52 (91.2)
Role of pharmacy technicians in immunization services[a]	**29**	**51**
Asking patients if they are interested in immunizations	27 (93.1)	43 (84.3)
Preparing vaccines for administration	8 (27.6)	11 (21.6)
Identifying potential vaccine recipients	19 (65.5)	28 (54.9)
Documentation	24 (82.8)	39 (76.5)
Billing	25 (86.2)	38 (74.5)
Vaccine administration	8 (27.6)	13 (25.5)
Others	0	0
None	0	4 (7.8)
Activity changed compared to 2019	**29**	**56**
Yes	7 (24.1)	9 (16.1)
No	22 (75.9)	(47 83.9)

[a] Participants were instructed to select all options that apply.

Pharmacist's willingness to recommend a COVID-19 vaccine to family and patients, and to administer a COVID-19 vaccine to patients.		
Item	**n (%)**	
	RURAL-CP Pharmacists N= 29	**Hayes Pharmacists N= 56**
Pharmacists' willingness to RECOMMEND a COVID-19 vaccine to family		
Strongly disagree	1 (3.5)	8 (14.3)
Somewhat disagree	4 (13.8)	4 (7.1)
Undecided	1 (3.5)	3 (5.4)
Somewhat agree	6 (20.7)	8 (14.3)
Strongly agree	17(58.6)	33 (58.9)
Pharmacists' willingness to RECOMMEND a COVID-19 vaccine to patients		
Strongly disagree	2 (6.9)	5 (8.9)
Somewhat disagree	3 (10.3)	2 (3.6)
Undecided	1 (3.5)	6 (10.7)
Somewhat agree	5 (17.2)	10 (17.9)
Strongly agree	18 (62.1)	33 (58.9)
Pharmacists' willingness to ADMINISTER a COVID-19 vaccine to patients		
Strongly disagree	4 (13.8)	4 (7.1)
Somewhat disagree	0	3 (5.4)
Undecided	0	2 (3.6)
Somewhat agree	2 (6.9)	3 (5.4)
Strongly agree	23 (79.3)	44 (78.6)

Pharmacist personal experience with immunization.		
Question	**n (%)**	
	RURAL-CP pharmacists N= 29	**Hayes pharmacists N= 57**
Have you been vaccinated against Influenza in the past 12 months?		
Yes	22 (75.9)	51 (89.5)
No	7 (24.1)	6 (10.5)
Have you been vaccinated against COVID-19?		
Yes	22 (75.7)	46 (80.7)
No	7 (24.1)	11 (19.3)

Reasons for receiving vaccination against COVID-19.		
Reasons [a]	**n (%)**	
	RURAL-CP pharmacists N= 29	**Hayes pharmacists N = 49**
Concerns about high-risk exposure.	20 (69.0)	36 (73.5)
Concerns about transmitting COVID-19 to family members and co-workers.	22 (75.9)	34 (69.4)
Intention to set an example for others to get vaccinated.	22 (75.7)	32 (65.3)
Concerns about transmitting COVID-19 to patients.	20 (69.0)	33 (67.4)
Intention to contribute to herd immunity.	20 (69.0)	27 (55.1)
Concerns about becoming ill with COVID-19.	17 (58.6)	23 (46.9)
Other	2 (6.9)	1 (2.0)
Not willing to get a COVID-19 vaccine.	7 (24.1)	8 (16.3)

[a] Participants were instructed to select all options that apply.

Knowledge of the department of health and human services (HHS) new guidance on pharmacists' immunization practice.		
Item	**N n (%)**	
	RURAL-CP pharmacists	**Hayes pharmacists**
Personnel authorized to administer routine and influenza childhood vaccines under this guidance[a]	**29**	**47**
Qualified pharmacy technicians	18 (62.1)	26 (55.3)
State-authorized pharmacy interns	25 (86.2)	42 (89.4)
Correct answer (both)	17 (58.6)	23 (48.9)
Personnel authorized to administer COVID-19 vaccines under this guidance	**28**	**48**
Qualified pharmacy technicians	23 (82.1)	40 (83.3)
State-authorized pharmacy interns	26 (92.9)	40 (83.3)
Correct answer (both)	23 (82.1)	36 (75.0)
Age of vaccine recipients covered under this guidance [a]	**29**	**48**
< 3 years	2 (6.9)	3 (6.3)
3-10 years	11 (37.9)	17 (35.4)
11-18 years	21 (72.4)	29 (60.4)
> 18 years	21 (72.4)	44 (97.7)
Correct answer (>= 3 years)	5 (17.2)	13 (27.1)

[a] Participants were instructed to select all options that apply.

Pharmacist perceived benefits from offering COVID-19 vaccination services.		
Item	**n (%)**	
	RURAL-CP Pharmacists N= 29	**Hayes Pharmacists N= 56**
Generating additional revenue		
Strongly disagree	1 (3.5)	4 (7.1)
Somewhat disagree	1 (3.5)	3 (5.4)
Undecided	2 (6.9)	10 (17.9)
Somewhat agree	14 (48.3)	24 (42.9)
Strongly agree	11 (37.9)	15 (26.8)
Bringing more patients into the pharmacy		
Strongly disagree	1 (3.5)	5 (8.9)
Somewhat disagree	1 (3.5)	1 (1.8)
Undecided	1 (3.5)	7 (12.5)
Somewhat agree	11 (37.9)	23 (41.1)
Strongly agree	15 (51.7)	20 (35.7)
Increasing ability to compete with other pharmacies		
Strongly disagree	2 (6.9)	8 (14.3)
Somewhat disagree	3 (10.3)	4 (7.1)
Undecided	4 (13.8)	8 (14.3)
Somewhat agree	8 (27.6)	23 (41.1)
Strongly agree	12 (41.4)	13 (23.2)
Being a role model for other pharmacies/pharmacists		
Strongly disagree	2 (6.9)	8 (14.3)
Somewhat disagree	1 (3.5)	3 (5.4)
Undecided	3 (10.3)	7 (12.5)
Somewhat agree	8 (27.6)	15 (26.8)
Strongly agree	15 (51.7)	23 (41.1)
Enhancing relationship with local clinics or public health agencies		
Strongly disagree	2 (6.9)	6 (107)
Somewhat disagree	1 (3.5)	4 (7.1)
Undecided	4 (13.8)	5 (8.9)
Somewhat agree	12 (41.4)	22 (39.3)
Strongly agree	10 (34.5)	19 (33.9)

Reimbursement for Administration of COVID-19 Vaccination. [a]		
Item	**n (%)**	
	RURAL-CP Pharmacists N= 29	**Hayes pharmacists N= 49**
Pharmacy currently files claims to:		
Medicaid	24 (82.8)	39 (79.6)
Medicare	24 (82.8)	40 (81.6)
Commercial plans	24 (82.8)	25 (51.0)
Provider Relief Fund for the uninsured	22 (75.9)	4 (8.2)
Pharmacy plans to file claims to		
Medicaid	3 (10.3)	4 (8.2)
Medicare	2 (6.9)	3 (6.1)
Commercial plans	1 (3.4)	3 (6.1)
Provider Relief Fund for the uninsured	5 (17.2)	4 (8.2)
Pharmacy not planning to file claims to receive any administration fee	0	0
Pharmacy does not plan to offer COVID-19 vaccination service	2 (6.9)	5 (10.2)

[a] Participants were instructed to select all options that apply .

Pharmacy Offering a COVID-19 Vaccination Service.		
Does your pharmacy currently offer a COVID-19 immunization service?	**n (%)**	
	RURAL-CP pharmacists N= 29	**Hayes pharmacists N= 56**
Yes	26 (89.7)	46 (82.1)
No, we are waiting to receive the vaccines	1 (3.5)	4 (7.1)
No, we do not plan to offer any COVID-19 vaccination services	2 (6.9)	6 (10.7)

Age group(s) of vaccine recipients at rural community pharmacies pre pandemic and 2020.		
Age group	**n (%)**	
	RURAL-CP pharmacists N= 29	**Hayes pharmacists N= 57**
Childhood (<= 10 years) Yes	10 (34.5)	17 (29.8)
Adolescence (11-18 years) Yes	17 (58.6)	36 (63.2)
Adult (>= 19 years) Yes	29 (100)	57 (100)

Types and Doses of Adult Non-COVID-19 Vaccines Offered at Rural Community Pharmacies pre pandemic and 2020.							
Vaccine type	**Administered the vaccine pre pandemic**		**Administered the vaccine in 2020**		**N***	**Annual Average dose[a]**	**SD**
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**			
RURAL-CP Pharmacists							
Influenza	23 (100.0)	0	29(100.0)	0	23	433.7	458.3
Zoster	20 (95.2)	1 (4.8)	28 (96.6)	1 (3.5)	22	69.1	69.4
PCV13	22 (100.0)	0	28 (96.6)	1(3.5)	23	24.7	31.4
PPSV23	1 (4.6)	1 (4.6)	24 (82.8)	5 (17.2)	21	27.9	38.7
DTaP, Tdap, or Td	19 (86.4)	3 (13.6)	26 (89.7)	3 (10.3)	19	20.6	17.1
HPV	3 (13.6)	19 (86.4)	6 (20.7)	23 (79.3)	6	0.5	0.8
MMR	5 (26.3)	14(73.7)	15(51.7)	14 (48.3)	7	28.6	35.8
Hib B	3 (15.0)	17(85.0)	20(69.0)	9 (31.0)	4	0	0
Hayes Pharmacists							
Influenza	53 (98.2)	1 (1.9)	57 (100.0)	0	39	284.1	276.1
Zoster	48 (92.3)	4 (7.7)	53(94.6)	3 (5.5)	35	79.0	93.3
PCV13	49 (92.5)	4 (7.6)	53 (94.6)	3 (5.4)	35	60.9	113.5
PPSV23	49 (89.1)	6 (10.9)	53 (93.0)	4 (7.0)	34	63.0	114.7
DTaP, Tdap, or Td	48 (88.9)	6 (11.1)	49 (87.5)	7 (12.5)	33	33.7	58.9
HPV	18 (34.6)	34 (65.4)	19(34.6)	36 (65.5)	14	6.0	1.3
MMR	17 (37.8)	28(62.2)	21(40.4)	31 (59.6)	15	16.8	34.2
Hib B	7 (14.9)	40 (85.1)	7 (13.5)	45 (86.5)	9	9.4	26.5

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Doses of adult non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.		
Vaccine type	**N n (%)**	
	RURAL-CP pharmacists	**Hayes pharmacists**
Influenza	**23**	**54**
Increased	10 (43.5)	22 (40.7)
Remained about the same	10 (43.5)	24 (44.4)
Decreased	3 (13.0)	8 (14.8)
Zoster	**21**	**48**
Increased	9 42.86	18 (37.5)
Remained about the same	7 33.33	25 (52.1)
Decreased	5 23.81	5 (10.4)
PCV13	**22**	**50**
Increased	3 (13.6)	13 (26.0)
Remained about the same	13 (59.1)	32 (64.0)
Decreased	6 (27.3)	5 (10.0)
PPSV23	**22**	**49**
Increased	6 27.27	12 (24.5)
Remained about the same	11 50.00	31 (63.3)
Decreased	5 22.73	6 (12.2)
DTaP, Tdap, or Td	**19**	**46**
Increased	5 (26.3)	6 (13.0)
Remained about the same	10 (52.6)	36 (78.3)
Decreased	4 (21.1)	4 (8.7)
HPV	**3**	**18**
Increased	0	2 (11.1)
Remained about the same	3 (100.0)	13 (72.2)
Decreased	0	3 (16.7)
MMR	**8**	**21**
Increased	3 (37.5)	3 (14.3)
Remained about the same	4 (50.0)	13 (61.9)
Decreased	1 (12.5)	5 (23.8)
Hib B	**3**	**7**
Increased	0	1 (14.3)
Remained about the same	3 (100.0)	5 (71.4)
Decreased	0	1 (14.3)

* Pharmacies provided dose data for 2020.

Types and Doses of Adolescent Non-COVID-19 Vaccines Offered at Rural Community Pharmacies pre pandemic and 2020.							
Vaccine type	**Administered the vaccine pre pandemic**		**Administered the vaccine in 2020**		**N***	**Annual Average dose[a]**	**SD**
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**			
RURAL-CP Pharmacists							
Influenza	11 (84.6)	2 (15.4)	17 (94.4)	1 (5.6)	12	43.6	42.4
PCV13	1 (11.1)	8 (88.9)	2 (11.1)	16 (88.9)	2	0	0
DTaP, Tdap, or Td	3 (33.3)	6 (66.7)	5 (27.8)	13 (72.2)	3	7.7	9.3
MenACWY	2 (22.2)	7 (77.8)	3(16.7)	15 (83.3)	2	7.5	3.5
HPV	1(14.3)	6 (85.7)	2 (11.1)	16 (88.9)	1	1.0	.
Hayes Pharmacists							
Influenza	34 (91.9)	3 (8.1)	36 (94.7)	2 (5.3)	23	71.1	120.3
PCV13	19 (55.9)	15 (44.1)	20 (54.1)	17 (46.0)	11	65.0	148.5
DTaP, Tdap, or Td	21 (63.6)	12 (36.4)	22 (61.1)	14 (38.9)	11	22.7	31.6
MenACWY	15 (46.9)	17 (53.1)	16 (44.4)	20 (55.6)	11	20.2	32.7
HPV	14 (41.2)	20 (58.8)	16(42.1)	22 (57.9)	11	23.6	40.6

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Doses of Adolescent non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.		
Vaccine type	**N n (%)**	
	RURAL-CP pharmacists	**Hayes pharmacists**
Influenza	**11**	**29**
Increased	5 (45.5)	4 (13.8)
Remained about the same	5 (45.5)	22 (75.9)
Decreased	1 (9.1)	3 (10.3)
PCV13	**1**	**16**
Increased	0	2 (12.5)
Remained about the same	1 (100.0)	12 (75.0)
Decreased	0	2 (12.5)
DTaP, Tdap, or Td	**3**	**17**
Increased	0	1 (5.9)
Remained about the same	2 (66.7)	13 (76.5)
Decreased	1 (33.3)	3 (17.7)
MenACWY	**2**	**13**
Increased	0	0
Remained about the same	2 (100.0)	11 (84.6)
Decreased	0	2 (15.4)
HPV	**3**	**16**
Increased	0	0
Remained about the same	3 (100.0)	12 (80.0)
Decreased	0	3 (20.0)

* Pharmacies provided dose data for 2020.

Types and Doses of Childhood Non-COVID-19 Vaccines Offered at Rural community Pharmacies pre pandemic and 2020.							
Vaccine type	**Administered the vaccine pre pandemic**		**Administered the vaccine in 2020**		**N ***	**Annual Average dose[a]**	**SD**
	Yes n (%)	**No n (%)**	**Yes n (%)**	**No n (%)**			
RURAL-CP Pharmacists							
Influenza	7 (87.5)	1 (12.5)	10(100.0)	0	8	11.4	16.0
PCV13	1 (25.0)	3 (75.0)	1 (10.0)	9 (90.0)	1	0	0
DTaP, Tdap, or Td	1 (25.0)	3 (75.0)	1 (10.0)	9 (90.0)	1	0	0
Hepatitis B	0	3 (100.0)	0	10 (100.0)	0	-	-
Hepatitis A	0	3 (100.0)	0	10 (100.0)	0	-	-
MMR	0	3 (100.0)	0	10 (100.0)	0	-	-
Hib B	0	3 (100.0)	0	10 (100.0)	0	-	-
Polio	0	3 (100.0)	0	10 (100.0)	0	-	-
Varicella	0	3 (100.0)	0	10 (100.0)	0	-	-
Rotavirus	0	3 (100.0)	0	10 (100.0)	0	-	-
Hayes Pharmacists							
Influenza	16 (88.9)	2 (11.1)	17(85.0)	3 (15.0)	13	72.1	89.8
PCV13	8 (53.3)	7 (46.7)	9 (47.4)	10 (52.6)			
DTaP, Tdap, or Td	9 (60.0)	6 (40.0)	10(52.6)	9 (47.4)	8	11.9	17.1
Hepatitis B	7 (46.7)	8 (53.3)	8 (42.1)	11 (57.9)	7	8.1	18.6
Hepatitis A	7 (46.7)	8 (53.3)	8 (42.1)	11 (57.9)	7	8.1	18.6
MMR	5 (33.3)	10 (66.7)	6 (31.6)	13 (68.4)	6	1.2	2.0
Hib B	3 (20.0)	12 (80.0)	3 (15.8)	16 (84.2)	6	0.3	0.8
Polio	1 (6.7)	14 (93.3)	0	18 (100.0)	6	0	0
Varicella	5 (33.3)	10 (66.7)	6 (31.6)	13 (68.4)	6	0.8	2.0
Rotavirus	1 (6.7)	14 (93.3)	1 (5.3)	18 (94.7)	6	0	0

[a] Average annual doses per pharmacy in 2020.

* Number of pharmacies provided dose data for 2020.

Doses of Childhood non-COVID-19 vaccines offered at rural community pharmacies in 2020 compared to 2019.		
Vaccine type	**N n (%)**	
	RURAL-CP Pharmacists	**Hayes Pharmacists**
Influenza	**7**	**15**
Increased	1 (14.3)	4 (26.7)
Remained about the same	5 (71.4)	9 (60.0)
Decreased	1 (14.3)	2 (13.3)
PCV13	**1**	**8**
Increased	0	1 (12.5)
Remained about the same	1 (100.0)	6 (75.0)
Decreased	0	1 (12.5)
DTaP, Tdap, or Td	**1**	**8**
Increased	0	1 (11.1)
Remained about the same	1 (100.0)	7 (77.8)
Decreased	0	1 (11.1)
Hepatitis B	**0**	**7**
Increased		0
Remained about the same		6 (85.7)
Decreased		1 (14.3)
Hepatitis A	**0**	**7**
Increased		0
Remained about the same		6 (85.7)
Decreased		1 (14.3)
MMR	**0**	**5**
Increased		0
Remained about the same		4 (80.0)
Decreased		1 (20.0)
Hib B	**0**	**3**
Increased		0
Remained about the same		2 66.67
Decreased		1 (33.3)
Polio	**0**	**1**
Increased		0
Remained about the same		0
Decreased		1 (100)

Varicella	**0**	**5**
Increased		0
Remained about the same		4 (80.0)
Decreased		1 (20.0)
Rotavirus	**0**	**1**
Increased		0
Remained about the same		0
Decreased		1 (100)

* Pharmacies provided dose data for 2020.

Categories with the highest frequencies are in bold.