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Locations of COVID-19 vaccination provision: Urban-rural differences

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Abstract

Purpose: Our goal was to compare locations of COVID-19 vaccine provision in urban and rural communities over the course of the pandemic.

Methods: We used the Iowa Immunization Registry Information System (IRIS) to identify the organizations providing COVID-19 vaccines (e.g. pharmacies, public health departments, medical providers). Proportions of first-dose vaccines by organization type and patient-census-based statistical area (CBSA) were generated. We calculated Chi-square tests to assess differences among metropolitan, micropolitan, and noncore communities.

Findings: IRIS data revealed that 64% (n=2,043,251) of Iowans received their first COVID-19 vaccine between December 14, 2020, and December 31, 2022. For metropolitan-dwelling individuals, most first doses were administered at pharmacies (53%), with similar trends observed for micropolitan (49%) and noncore (42%) individuals. The second most common location for metropolitan individuals was medical practices (17%); public health clinics and departments were the second most common provider for micropolitan (26%) and noncore (33%) individuals. These trends shifted over time. In December 2020, hospitals were the most common vaccine provider for everyone, but by December 2022, medical providers were the most common source for metropolitan individuals, and pharmacies were most common for micropolitan and noncore individuals.

Conclusions: Trends in the type of vaccine provider differentiated metropolitan residents from micropolitan and noncore residents. For the latter groups, local public health departments played a more significant role. Across all groups, pharmacists emerged as a critical vaccine provider.

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Our findings can be used to plan for seasonal vaccine campaigns as well as potential future mass vaccination campaigns.

Keywords

COVID-19 vaccination; immunization registry; urban-rural inequities

Introduction

The rollout of the COVID-19 vaccine was an unprecedented and massive undertaking for public health agencies and medical providers across the country. Over 675 million doses of the COVID-19 vaccine have been administered in the United States since the first approvals in December 2020.[1] Vaccine delivery, however, has not been without challenges Beginning in August 2020, the Centers for Disease Control and Prevention directed states to begin planning their own distribution efforts, including tracking and managing distribution.[2]. Rural and micropolitan communities had lower rates of COVID-19 vaccination and those living in the most rural areas were significantly more likely to travel outside their county to be vaccinated.[3] Little is known about the types of locations individuals chose for their vaccines and how that choice differed for urban and rural populations.

Even before the pandemic, public health departments in rural and micropolitan communities struggled to prioritize and meet the needs of their populations.[4] The COVID-19 vaccine rollout introduced another high-priority challenge, further straining existing organizational structures and staffing capacity. Micropolitan and rural communities had significantly lower COVID-19 vaccine rates throughout the pandemic,[5] and while many factors, including vaccine hesitancy,[6,7] could have contributed to this, issues related to access may be a factor.[8] Throughout the pandemic, private-public partnerships emerged to provide vaccines in micropolitan and rural communities. On a nation-wide scale this was seen through the Operation Warp Speed which facilitated the unprecedented development and testing of COVID-19 vaccines.[9] At a state level, partnerships between private pharmacies (e.g., national pharmacy chains, grocery store located pharmacies) were established to ensure widespread vaccine distribution. Our goal was to identify types of organizations that provided the vaccine in rural and micropolitan communities over the course of the pandemic, as compared to urban communities. This analysis provides a reflection on mass vaccination campaigns that may be helpful for future emergency situations, including residents' vaccination-related preferences in various geographic areas. As the Advisory Committee on Immunization Practices moves towards annual COVID-19 boosters, understanding vaccine delivery will continue to be critical, especially in areas where vaccination rates lag.

Methods

To explore patterns in types of organizations administering COVID-19 vaccines, we assessed COVID-19 vaccine dose and location information in Iowa from December 14, 2020, to December 31, 2022. Given that nearly 40% of Iowans reside in a nonmetro county,[10] this is an ideal state in which to understand urban-rural differences. We followed reporting

guidelines set out by the STROBE checklist for cross-sectional studies. This study was not considered human subjects research by the University of Iowa Institutional Review Board.

Data Source

Iowa's Immunization Registry Information System (IRIS) is a secure, confidential, computerized repository of individual immunization records from participating public and private healthcare providers. IRIS is a bidirectional registry that has supported data exchange, or interoperability, with electronic health records systems since 2013. IRIS contains patient records from all ages and is used to keep patients on schedule for recommended immunizations by storing immunization records, documenting vaccine contraindications and reactions, validating immunization history, and providing vaccine recommendations. IRIS currently has a total of 4,957,326 patients. While this number contains records of anyone who has ever received a vaccine from an IRIS-enrolled provider, we only assessed data for patients who had a home address listed in the state of Iowa and had received at least one dose of the COVID-19 vaccine. The Iowa Immunization Program utilized IRIS for the allocation, distribution, and documentation of the COVID-19 vaccine. Each county public health agency had to be enrolled in IRIS as part of the allocation and distribution process to receive the COVID-19 vaccine. As part of the federal COVID-19 Provider Agreement, all healthcare providers administering the COVID-19 vaccine were required to report all doses administered data to IRIS. There are currently 1,966 enrolled COVID-19 vaccine providers in Iowa.

Variable definitions

Our dataset included all Iowa residents who received their COVID-19 vaccination in Iowa as of the April 2023 dataset from Iowa Health and Human Services. We limited the dataset to those who received at least their first dose between December 14, 2020, and December 31, 2022 (n =2,043,251; 64% of entire population of Iowa). The dataset included one row for each vaccine dose per individual. Demographic variables included recipient's date of birth; county and ZIP code of residence; and self-reported sex, race, and ethnicity. Vaccine variables included vaccine type that was administered, dose number in the series, whether vaccine series was considered complete, address where vaccine was administered, and type of organization that administered the vaccine. Vaccination rates by age, sex, and Core-Based Statistical Areas (CBSA) were calculated using 2020 Census Data.[10]

Types of organizations that administered the vaccine were categorized as pharmacy, medical practice, hospital, urgent care, health center (comprising occupational, sexually transmitted disease or HIV clinics; student, migrant, or refugee and community [non-FQHC/non-RHC] health centers), public health (which included vaccines administered at mass vaccination sites), Federally Qualified Health Centers or Rural Health Centers (FQHC/RHC), and Other (comprising long-term care and assisted living, federal allocations to military and tribal health, corrections, home health care, and commercial vaccination service providers). When showing trends over time, urgent care, health centers, FQHC/RHC, and other organizations were combined into a new "Other" category.

CBSAs defined by the Office of Management and Budget[11] were used to categorize metropolitan, micropolitan, and noncore areas. The list of Iowa CBSAs was extracted from the March 2020 Census Delineation file.[12] The Housing and Urban Development USPS ZIP Code to CBSA Crosswalk was used to link to the COVID-19 dataset for both individuals and organizations.[13] For ZIP codes that crossed into multiple CBSAs (n=317, 31%) the CBSA with the highest ratio of residential addresses in the ZIP–CBSA part to the total number of residential addresses in the entire ZIP was taken. This process was decided by consensus in collaboration with a group of researchers who have geography expertise.

Analysis

Frequencies and COVID-19 vaccination rates were calculated by patient CBSA. Proportions of first doses of the COVID-19 vaccine given over time by organization type and patient CBSA were generated. To assess differences between individuals living in different CBSAs, Chi-square tests were calculated. All data were cleaned and analyzed using SAS 9.4 software (SAS Institute, Cary, NC).

Results

IRIS data show that 64% (n=2,043,251) of Iowans received their first COVID-19 vaccine between December 14, 2020, and December 31, 2022. Most of these individuals resided in metropolitan areas (64%), followed by noncore (21%) and micropolitan areas (15%) (Table 1). Metropolitan populations had the highest vaccination rates compared to micropolitan and noncore populations. Sixty-eight percent of metropolitan populations received at least one dose of the COVID-19 vaccine, followed by 60% of micropolitan populations, and 56% of noncore populations.

This same trend can be seen by age and sex. Across all CBSAs the age group 65 and older had the highest vaccination rate, with the vaccine uptake rate for this population in the different regions varying from 86 (noncore and micropolitan areas) to 92% (metropolitan areas). Younger populations had much lower vaccination rates with the youngest (ages 0-14) having an overall initiation rate of 27% and rates ranged between 55-76% for ages 15-54. Males living in noncore areas had the lowest rates of uptake (52%) and females living in metropolitan areas the highest (71%).

The most common locations for first-dose vaccine administration during the entire study period were pharmacies, public health clinics, and medical practices, but the proportion of individuals who visited each type of provider varied by CBSA (Table 1). Pharmacies were the most common location, vaccinating 53% of metropolitan, 49% of micropolitan, and 42% of noncore individuals. Public health clinics had an inverse relationship to pharmacies, with more micropolitan individuals receiving vaccines there (33%) and less than 10% of metropolitan individuals utilizing those locations. Seventy-eight percent of metropolitan individuals and 76% of micropolitan individuals received their first vaccine in their county of residence, compared to only 65% of noncore individuals ($p<.0001$).

Trends in first-dose vaccine administration

In December 2020 hospitals were the most common first-dose vaccine administration location for every CBSA. By January 2021 pharmacies were administering the majority of first-dose vaccinations for metropolitan individuals and administered, on average, 60% of their first-dose vaccinations for 17 months (until June 2022) when medical practices became the most common administrator (Figure 1). For micropolitan and noncore individuals (Figures 2, 3), pharmacies and public health clinics, on average, covered 75% of first-dose vaccinations from January to April 2021 (Figure 3). In May 2021 pharmacies became the most common first-dose location for micropolitan individuals, while for noncore individuals medical practices briefly matched pharmacies between June and August of 2022. Throughout vaccine administration, public health clinics provided an average of 38% of first-dose vaccinations for noncore individuals, 32% for micropolitan individuals, and only 5% for metropolitan individuals.

Trends in administration for all vaccine doses

Considering locations for all vaccine doses combined, the switch from pharmacies to medical practices was less noticeable for micropolitan and noncore individuals. For micropolitan individuals, pharmacies administered, on average, 65% of all vaccine doses between June 2021 and December 2022, with only a 10% decrease during August of 2022 when medical practices administered more. This same trend was seen for noncore individuals; pharmacies administered, on average, 55% of all vaccine doses during the same period, decreasing by 8% in August of 2022.

Discussion

Through this analysis of Iowa's Immunization Registry data, we were able to discern key patterns in COVID-19 vaccine administration comparing across metropolitan, micropolitan, and noncore communities. Specifically, we found that for noncore individuals the two locations delivering the most first-dose COVID-19 vaccinations were pharmacies (42%) and local public health clinics (32%), whereas for metropolitan individuals, pharmacies were the primary provider (53.%), but public health clinics were far less involved (9%). To our knowledge, this is the first such analysis of immunization registry data investigating vaccine administration location in this detail.

Nationally, data show that pharmacies have emerged as a primary provider of vaccines for adults, though many children's vaccines are still administered in medical provider offices.[14] Research conducted prior to the pandemic identified rural pharmacists as being vital partners in vaccine delivery.[15–17] Rural pharmacies offer convenience and are often more frequented compared to medical practices; in a sample of Medicare beneficiaries rural residents were found to visit their primary care provider an average of 5 times per year, but visited their community pharmacy an average of 14 times per year.[18] They are often located relatively near their customers, with more than 75% of nonmetropolitan counties having at least two pharmacies that could provide vaccine services.[19] This is in stark contrast to the accessibility of primary care in rural areas where shortages in the primary care workforce are well-documented.[20,21] Given this widespread availability of pharmacies in rural areas and

the increasingly large role they have been taking in vaccine delivery, it is unsurprising that they emerged as a primary provider of COVID-19 vaccines.

We found the role of public health clinics, however, varied noticeably across communities. For micropolitan and noncore individuals, public health clinics were, overall, the second largest provider of COVID-19 vaccines (though the proportion of vaccines at such clinics waned over time). State and local Public Health departments worked to improve access to vaccinations through a variety of means, included providing vaccination services in homes, increasing translation services, offering extended clinic hours on nights and weekends, facilitating transportation to vaccine clinics, and working with trusted community members to reach specific ethnic populations. Ultimately, however, many of the doses provided by public health clinics were offered through mass vaccination clinics at large venues. In December 2022, public health clinics administered 10% and 14% of first-dose vaccines to micropolitan and noncore individuals, respectively, and only 3% to metropolitan individuals, possibly because public health departments in rural and micropolitan areas were mobilizing to meet demand that could not be met by medical providers in those areas. Prior research has shown public health departments in rural areas play a safety-net role for certain health care services[22,23] suggesting that this was a role they could effectively play in delivering COVID-19 vaccines.

Additionally, we observed clear urban-rural differences in the extent to which people traveled to get their first dose of the COVID-19 vaccine—a pattern similar to that observed in national data.[3] Only 65% of noncore residents received their first dose in the county they lived in, compared to almost 80% of residents in metropolitan counties. We do not have information on why an individual may have sought vaccination outside of their home county, but several possibilities could have implications for vaccine distribution planning. For rural residents, the locations offering vaccines in their own county may have not had convenient hours or, depending on their residence, the closest location may have been in a neighboring county. This lower rate of rural individuals receiving vaccines in their county of residence may also reflect where they spend their time (i.e., where they work, go to school, or do their shopping). Further research to explore the reasons behind choice of vaccination location could help streamline vaccine allocation planning.

Our findings highlight differences between urban and rural individuals in their choice of vaccine provider and point to opportunities to leverage for future vaccine delivery efforts. The COVID-19 pandemic exacerbated existing socioeconomic and health disparities (including between urban and rural communities),[24] but it also provided public health professionals with an opportunity to learn valuable lessons about widespread rollout of public health services like vaccination. The mobilization that occurred during the COVID-19 pandemic to ensure rural residents had access to vaccines has the potential to be replicated in the future. Expanding the role of public health departments and pharmacies to serve as safety-net vaccine providers in future pandemics, or just influenza seasons, has the potential to reduce urban-rural vaccine inequities.

Strengths and Limitations

The primary strength of this study is the use of immunization registry data. To our knowledge, ours is the first analysis of registry data to investigate patterns in locations of COVID-19 vaccine administration. Registry data offer nuanced and real-time insights into vaccine patterns that cannot be obtained from other sources like national surveys, which do not provide Zip Code Tabulated Area (ZCTA)-level results, or medical record data, which are limited by health system. Important limitations to acknowledge are those inherent in analysis of registry data. This includes the fact that if vaccines are administered outside of the state they are not captured by the registry nor are vaccines administered at Veteran's Administration clinics. The system does not routinely receive immunization data from other states, nor does the program maintain paper copies of immunization records, although residents can ask healthcare providers to have immunization information entered into IRIS. Iowa shares a border with six other states, so residents may well have received vaccines outside of the state that would not be captured, and this limitation may have affected the calculated vaccine coverage in counties that border other states. IRIS data may also include individuals who no longer reside in Iowa but still have an active record. For example, the system currently reflects that 135% of the population is covered. To minimize the effect of this limitation, we used ACS data for our population estimates, not the total number of patients in IRIS.

Conclusions

In this analysis of COVID-19 vaccine administration data, we found that in Iowa pharmacies and medical providers have been the primary locations for COVID-19 vaccination. However, when the data were examined by CBSA classification, trends emerged that differentiated residents' choice of vaccine administrator by their community. For micropolitan and noncore residents, local public health departments played a much larger role than they did for metropolitan residents. Micropolitan and noncore residents were also more likely to travel outside their home county to get vaccinated. These findings likely reflect geographical availability of resources as well as the emerging role of pharmacists in vaccine services nationwide. The trends we identified can be used to leverage existing infrastructure and plan for future mass vaccination campaigns.

Funding Sources:

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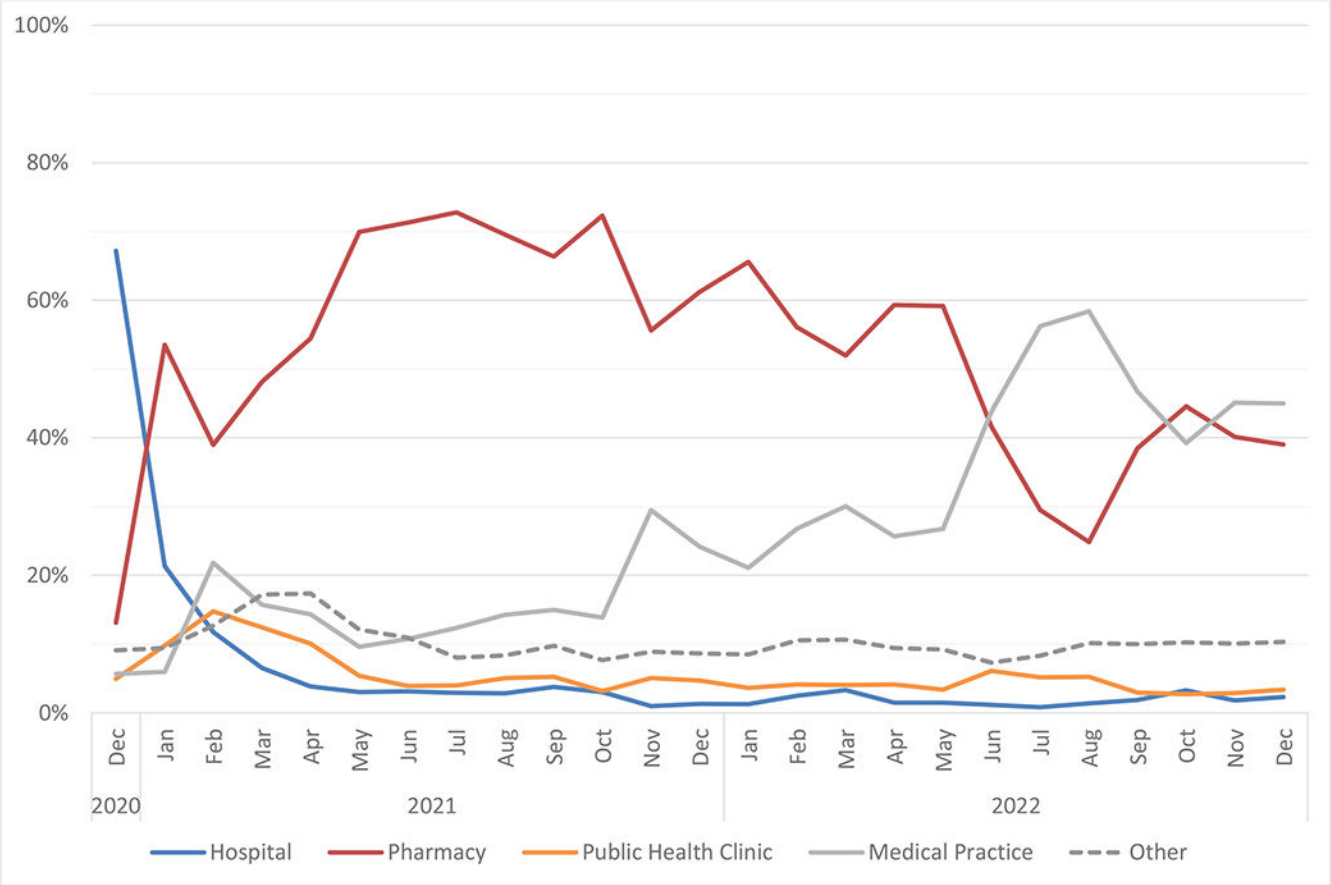

Figure 1.
Proportion of first dose vaccines each organization gave each month for Metro individuals

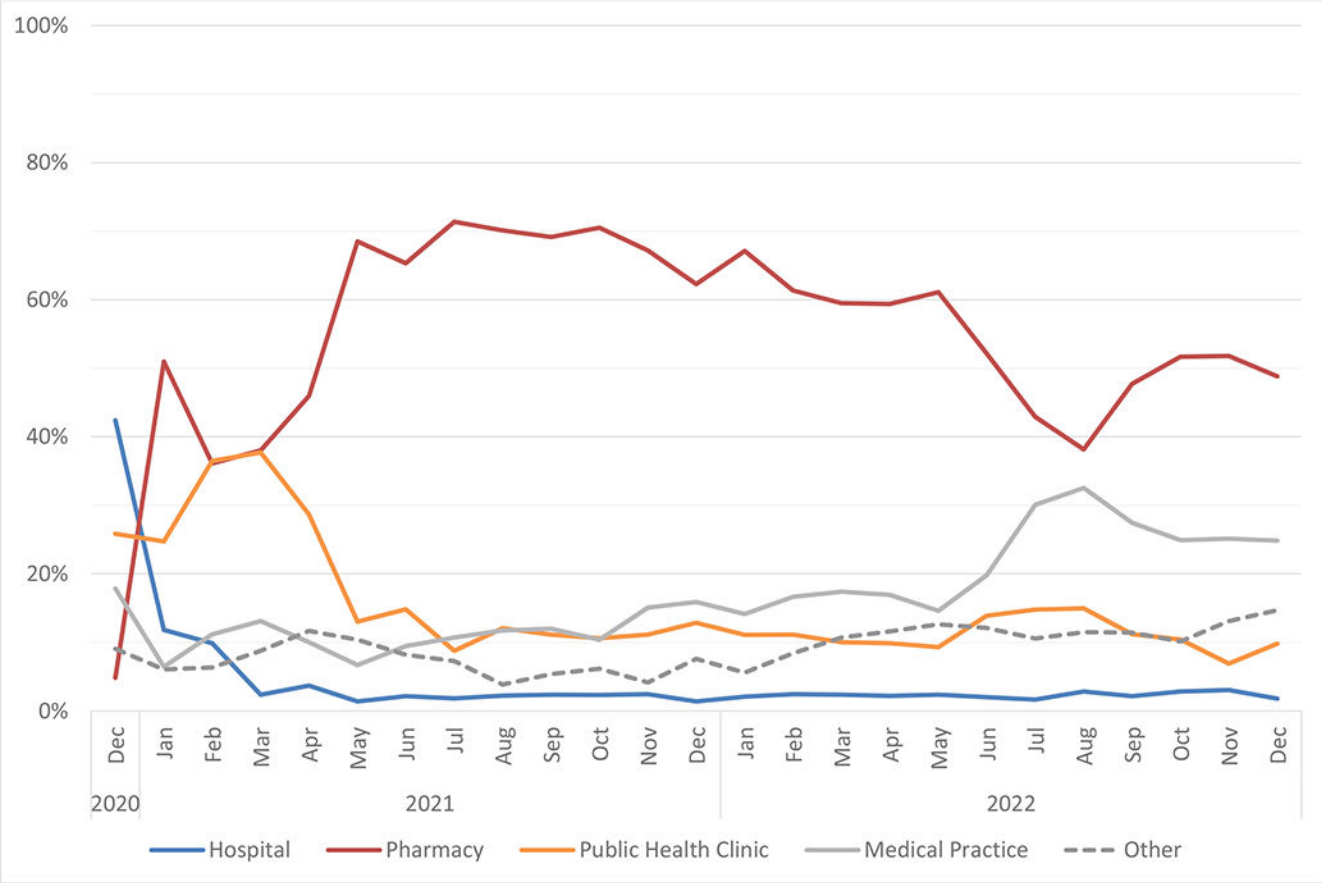

Figure 2.
Proportion of first dose vaccines each organization gave each month for Micro individuals

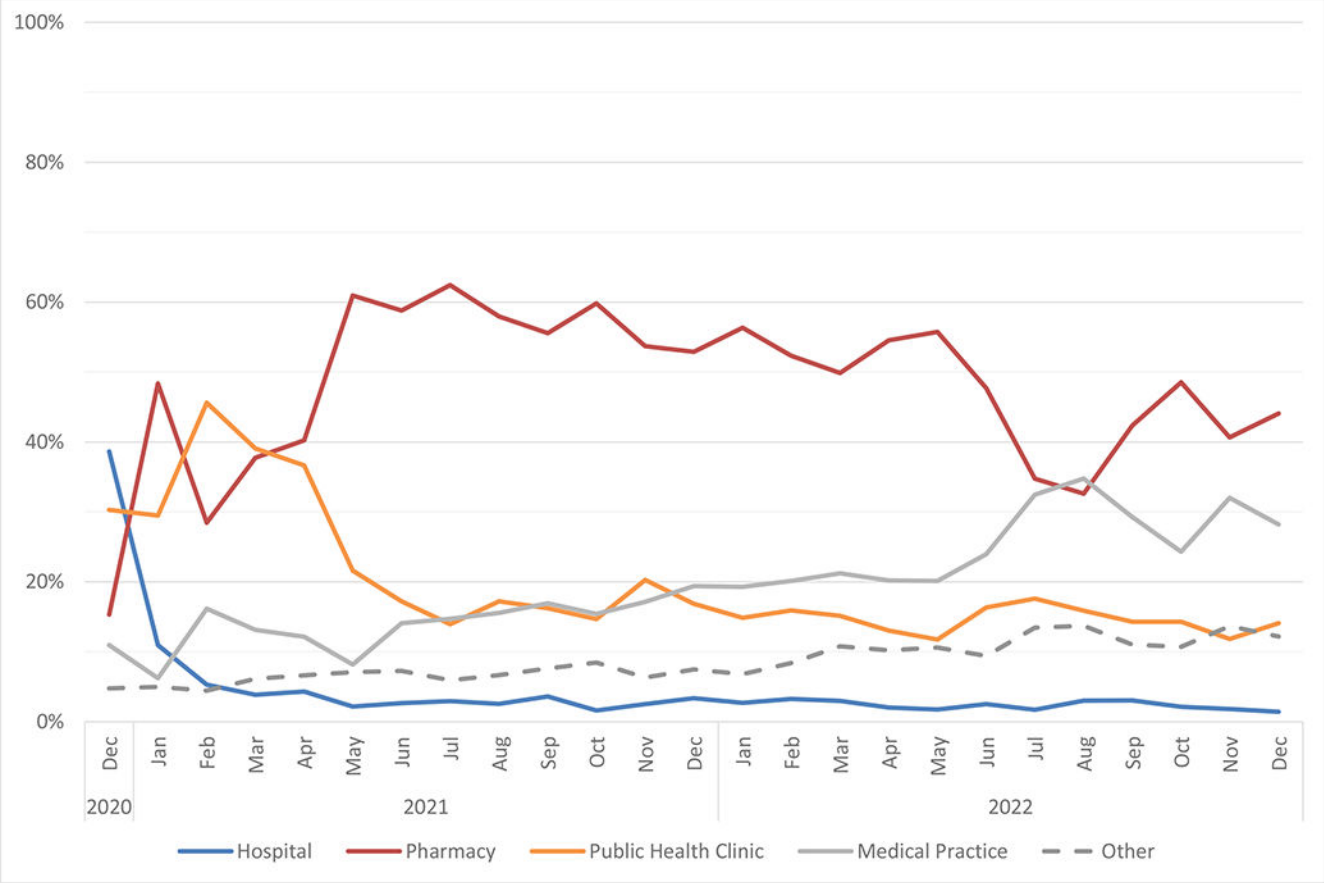

Figure 3.
Proportion of first dose vaccines each organization gave each month for Noncore individuals

Table 1.

First dose vaccination characteristics of population that *initiated* COVID-19 vaccination by CBSA

		Metro		Micro		Noncore		
		N	**%**	**N**	**%**	**N**	**%**	**p-value**
Age at first dose vaccination	0-14	127699	9.75	18112	5.9	21499	5.04	<.0001
	15-19	82679	6.31	15956	5.2	21155	4.96	
	20-29	181525	13.86	33035	10.76	38982	9.15	
	30-44	273185	20.85	55905	18.21	69329	16.27	
	45-64	365857	27.93	93436	30.43	133897	31.42	
	65+	279115	21.31	90587	29.5	141298	33.16	
Sex	Male	612548	46.76	142246	46.33	196249	46.05	<.0001
	Female	690036	52.67	159998	52.11	225138	52.83	
	Unknown	7476	0.57	4787	1.56	4773	1.12	
Location where first dose administered	Hospital	103314	7.89	16976	5.53	24004	5.63	<.0001
	Medical Practice	218896	16.71	35884	11.69	58955	13.83	
	Pharmacy	695246	53.07	148927	48.51	177693	41.7	
	FQHC/RHC	27401	2.09	4450	1.45	9545	2.24	
	Public Health Clinic	120310	9.18	80216	26.13	139504	32.74	
	Urgent Care	90905	6.94	4356	1.42	2300	0.54	
	Other Provider Type *	20139	1.54	8728	2.84	9365	2.2	
	Health Centers	33849	2.58	7494	2.44	4794	1.12	
Received first dose vaccine in same MSA category of residence	No	85273	6.51	58293	18.99	101302	23.77	<.0001
	Yes	1224787	93.49	248738	81.01	324858	76.23	

*Other Provider Type includes long term care and assisted living, federal allocations to military and tribal health, corrections, home health care, and commercial vaccination service providers