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## Vaccine

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## COVID-19 vaccine uptake among Arkansas public K-12 school teachers and staff



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### ABSTRACT

In December 2020, the first coronavirus disease 2019 (COVID-19) vaccines received emergency use authorization from the Food and Drug Administration (FDA). To strategically allocate the limited availability of COVID-19 vaccines, the Advisory Committee on Immunization Practices (ACIP) developed a phased approach for eligibility that prioritized certain population groups that were more vulnerable to infection and severe outcomes. Public K-12 teachers and staff were included in Phase 1b. The Arkansas Department of Health (ADH) sought to evaluate the uptake of COVID-19 vaccines within this priority group. In partnership with the Arkansas Department of Education (ADE), ADH received a list of 66,076 certified staff, classified staff, and teachers within the public K-12 school system. This list was matched to the state immunization registry via deterministic methods across three identifiers: first name, last name and date of birth. Uptake was assessed and the population was characterized using descriptive analyses. After 13 weeks of availability, 34,783 (51.2 %) of public K-12 teachers and staff had received at least one dose and 29,870 (44.0 %) had completed the series. School districts with the least robust uptake of COVID-19 vaccines tended to be in more rural areas, with some districts having less than 10 % of teachers and staff with at least one dose. The proportion of public K-12 teachers and staff with at least one dose of any COVID-19 vaccine grew quickly between January 18th and February 14th (4 % to 43 %) but has plateaued in the most recent seven weeks (45 % to 51 %). Although not directly measured, it is possible that vaccine hesitancy could be a factor in the attenuated uptake of COVID-19 vaccines within certain factions of the Arkansas public K-12 teacher and staff population. Overcoming vaccine hesitancy during the COVID-19 vaccine rollout will be critical in bringing an end to the pandemic.

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### 1. Introduction

As of April 2021, three coronavirus disease 2019 (COVID-19) vaccines produced by the pharmaceutical companies, Pfizer-BioNTech, Moderna and Johnson & Johnson (Janssen), have been granted Emergency Use Authorization (EUA) by the Food and Drug Administration (FDA) [1–3]. In the United States, COVID-19 vaccines are becoming increasingly available to adult and adolescent Americans [4]. However, during the early months of the vaccine rollout, availability was limited and earmarked for the most vulnerable individuals and other prioritized groups.

On December 1, 2020, the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices

(ACIP) released its initial recommendations on allocation of limited initial COVID-19 vaccine supplies to high-risk population groups designated Phase 1a. These recommendations targeted vaccinating healthcare personnel and residents of long-term care facilities [1]. On December 20, 2020, the ACIP released further guidance on additional priority population groups, aligning frontline essential workers and persons aged 75 years or older in Phase 1b, and persons aged 65 years and older, persons aged 16 to 64 years with high-risk medical conditions and essential workers not captured in 1b in Phase 1c. All other adults would be included in Phase 2 [5].

According to the ACIP recommendations, education personnel fall within the frontline essential worker group of Phase 1b [1]. Schools in Arkansas reopened for in-person instruction in August of 2020. Since then, more than 42,000 cases of COVID-19 have been identified among public kindergarten through 12th grade (K-12) school students, teachers, and staff. Teachers and staff alone

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account for more than 11,000 cases, 244 hospitalizations, and 24 deaths. These include all cases diagnosed among teachers and staff, including those that may not be related to the school setting [6]. On January 18, 2021, Arkansas opened vaccine availability to individuals 65 years and older as well as education personnel ahead of all other essential workers within Phase 1b [7]. Since this announcement, public K-12 school districts across the state have coordinated vaccine clinics for their teachers and staff with local pharmacies. On March 8, 2020, the current administration opened vaccination of teachers as a priority group through the Federal Retail Pharmacy Program (FRPP), further increasing accessibility of COVID-19 vaccines to education staff in Arkansas. At the time of analysis, vaccine has been available to this population for 13 weeks.

Many states are challenged by the data reported passively concerning characteristics of individuals who receive the COVID-19 vaccines. The Arkansas Department of Health (ADH) has proactively sought methods to improve the completeness of COVID-19 data within the state immunization registry by linking a multitude of internal datasets, and through collaborations with other state agencies. As a result, the ADH has developed the capability to analyze and monitor the progress of vaccination efforts among certain priority groups, including public school K-12 teachers. The objective of this paper is to provide a descriptive analysis on COVID-19 vaccine uptake among Arkansas’ public K-12 teachers and staff during the periods of initial state-wide and national prioritization of this group.

**2. Materials and methods**

Starting on January 18, 2021, all public K-12 teachers and staff were eligible for COVID-19 vaccines in 239 school districts in Arkansas. These individuals could access vaccination through onsite clinics, local pharmacies, hospitals, or other healthcare providers with vaccine supply. Additionally, from March 8, 2021 onward they could access vaccine through any of the pharmacies in the FRPP. This study only included public K-12 teachers and staff, and excluded private, charter, and college or university teachers and staff. Data for the latter groups were incomplete at the time of these analyses.

Arkansas utilizes an immunization registry that accepts data submitted by providers in a variety of ways, including individual entry through a user interface, bulk import of flat files, or through electronic mechanisms such as Health Level 7 (HL7) messaging. Providers that administer COVID-19 vaccines are asked to report patient information, including demographics, vaccine received, date of vaccination, lot number and occupation or phase grouping, within 72 h of vaccination. Despite this request, data that were received were often incomplete. To fill the information gaps, the ADH has linked a variety of datasets, from internal sources and from other state agencies.

In partnership with the Arkansas Department of Education (ADE), ADH received a complete list of 66,076 certified staff, classified staff, and teachers within the Arkansas public K-12 school system. Certified staff are defined as those individuals who are required to be licensed by ADE (e.g., administrators), while classified staff include all other staff (e.g., bus drivers, cafeteria workers). Although teachers are technically certified staff, they are separated into their own group for analytic purposes. The list of public K-12 teachers and staff was matched to the state immunization registry via deterministic methods in SAS Version 9.4 using three variables: first name, last name, and date of birth [8].

Data on public K-12 teachers and staff who have received a COVID-19 vaccine were extracted from the state immunization registry and analyzed using R version 3.6.3 (Revolution Analytics,

San Francisco, CA, USA) [9]. The study period for these analyses was January 18, 2021 to April 22, 2021. Analyses were descriptive in nature and included frequency tables and plots. Maps were generated using ArcGIS (ESRI, Redlands, CA, USA) to visualize the top and bottom performing school districts relating to vaccine uptake.

Vaccine uptake was categorized into two groups: (1) those who had at least one dose and (2) those who completed the series. The former category captures those who have received a minimum of one dose of any COVID-19 vaccine. The latter category includes only those who received two doses of either the Pfizer-BioNTech or Moderna mRNA-based vaccines or a single dose of Johnson & Johnson adenovirus vector vaccine. The two categories are not mutually exclusive. Further, for those who accepted vaccine, analysis was undertaken to evaluate the number who completed the vaccination schedule within the proscribed window (i.e., 21 or 28 days following initial administration) and those outside of the allowable 42-day period from initial dose.

The University of Arkansas for Medical Sciences Institutional Review Board determined that this project was not human subjects research.

**3. Results**

After 13 weeks of availability, a total of 34,783 (51.2 %) public K-12 teachers and staff had received at least one dose of any COVID-19 vaccine, and 29,870 (44.0 %) had completed the series. Those receiving at least one dose of a COVID-19 vaccine were predominantly women (n = 25,519, 73.4 %), white (n = 26,177, 75.3 %) and between the ages of 45 to 64 (n = 18,013, 51.8 %). Table 1 illustrates the complete demographic breakdown.

Table 2 shows COVID-19 vaccine uptake across the different education staff types. Certified staff, exclusive of certified teachers, had the highest proportion of individuals receiving at least one dose (n = 4,301, 66.5 %), followed by teachers (n = 18,497, 54.7 %) and classified staff (n = 11,985, 46.4 %). More than half of certified staff had completed the series. For groups listed previously, successful completion of an immunization series (2 doses for the Pfizer-BioNTech and Moderna vaccines and a single dose for the Johnson and Johnson vaccine) is significantly lower: 57.8 % (n = 3,735), 47.5 % (n = 16,034), and 39.1 % (n = 10,101), respectively.

The average proportion of teachers and staff vaccinated among the 239 public school districts in Arkansas was 48.4 % and varied

**Table 1**  
Characteristics of Arkansas teachers and staff who have received at least one dose of any COVID-19 vaccine (n = 34,783).

| Characteristic                            | No. (%)               |
|---|-----------------------|
| <b>Gender</b>                             |                       |
| Female                                    | 25,519 (73.4 %)       |
| Male                                      | 7,767 (22.3 %)        |
| Unknown                                   | 1,497 (4.3 %)         |
| <b>Race/Ethnicity</b>                     |                       |
| American Indian or Alaskan Native         | 68 (0.2 %)            |
| Asian                                     | 134 (0.4 %)           |
| Black or African American                 | 4,186 (12.0 %)        |
| Hispanic                                  | 903 (2.6 %)           |
| Native Hawaiian or Other Pacific Islander | 24 (0.1 %)            |
| Other                                     | 1,177 (3.4 %)         |
| Unknown or Not Reported                   | 3,017 (8.7 %)         |
| White                                     | 26,177 (75.3 %)       |
| <b>Age Category</b>                       |                       |
| 18–24                                     | 785 (2.3 %)           |
| 25–44                                     | 13,567 (39.0 %)       |
| 45–64                                     | 18,013 (51.8 %)       |
| 65 and older                              | 2,415 (6.9 %)         |
| <b>Total</b>                              | <b>34,783 (100 %)</b> |

**Table 2**

Proportion of Arkansas teachers and staff who have at least one dose and who have completed the series of any COVID-19 vaccine.

| Education Staff Type         | At least One Dose, No. (%) | Completed Series, No. (%) |
|------------------------------|----------------------------|---------------------------|
| Certified Staff <sup>a</sup> | 4,301 (66.5 %)             | 3,735 (57.8 %)            |
| Classified Staff             | 11,985 (46.4 %)            | 10,101 (39.1 %)           |
| Teachers                     | 18,497 (54.7 %)            | 16,034 (47.5 %)           |
| All Education Personnel      | 34,783 (51.2 %)            | 29,870 (44.0 %)           |

<sup>a</sup> Excludes certified teachers. Certified teachers are included in the Teachers category.

widely (5.9 % – 73.7 %) with at least one dose, and 41.3 % (3.0 % – 67.1 %) that have completed the series. The uppermost and bottommost school districts with respect to vaccine uptake by district are listed in Tables 3 and 4. There was a wide range in the proportion of teachers and staff with at least one dose of vaccine. Each of the school districts within the top ten range had over 60 % of teachers and staff with at least one dose of a COVID-19 vaccine. However, only the top four school districts achieved ≥ 70 % immunization of the staff with at least one dose. Conversely, only one of the school districts in the bottom ten range had more than 25 % of teachers and staff receiving at least one dose. Fig. 1 shows the distribution of the top ten and bottom ten school districts within the state. In general, public school districts in the bottom ten range tended to be located in more rural areas of Arkansas. Table 4 provides a demographic breakdown of teachers and staff with at least one dose in the uppermost and bottommost school districts with respect to overall uptake. Slight differences are observed with the bottommost districts having proportionally higher uptake among men, Black or African Americans and among individuals 45 years and older.

Fig. 2 shows the cumulative proportion of public K-12 teachers and staff that have received at least one dose and who have completed the series of any vaccine over time. The most rapid increase coincides with the initial announcement that the state would make teachers and staff eligible as a priority group within Phase 1b populations. Although the proportion of individuals with at least one dose continues to increase at the time of the preparation of this manuscript, it is doing so at a slower pace in the most recent seven

**Table 3**

Uppermost ten Arkansas school districts with respect to the proportion of teachers and staff who have at least one dose of any COVID-19 vaccine.

| School District     | At least One Dose, No. (%) | Completed Series, No. (%) |
|---------------------|----------------------------|---------------------------|
| <b>Uppermost</b>    |                            |                           |
| School District 1   | 56 (73.7 %)                | 51 (67.1 %)               |
| School District 2   | 1,110 (72.4 %)             | 1,014 (66.1 %)            |
| School District 3   | 250 (71.0 %)               | 233 (66.2 %)              |
| School District 4   | 46 (69.7 %)                | 37 (56.1 %)               |
| School District 5   | 152 (68.2 %)               | 125 (56.1 %)              |
| School District 6   | 66 (67.3 %)                | 56 (57.1 %)               |
| School District 7   | 789 (67.0 %)               | 729 (61.9 %)              |
| School District 8   | 319 (67.0 %)               | 306 (64.3 %)              |
| School District 9   | 212 (66.9 %)               | 161 (50.8 %)              |
| School District 10  | 1,499 (66.2 %)             | 1,258 (55.6 %)            |
| <b>Bottommost</b>   |                            |                           |
| School District 230 | 22 (26.8 %)                | 22 (26.8 %)               |
| School District 231 | 505 (24.3 %)               | 406 (19.6 %)              |
| School District 232 | 19 (23.8 %)                | 17 (21.2 %)               |
| School District 233 | 38 (23.5 %)                | 25 (15.4 %)               |
| School District 234 | 140 (23.3 %)               | 130 (21.6 %)              |
| School District 235 | 32 (22.1 %)                | 23 (15.9 %)               |
| School District 236 | 15 (22.1 %)                | 12 (17.6 %)               |
| School District 237 | 22 (21.0 %)                | 18 (17.1 %)               |
| School District 238 | 58 (9.5 %)                 | 27 (4.4 %)                |
| School District 239 | 6 (5.9 %)                  | 3 (3.0 %)                 |

**Table 4**

Characteristics of Arkansas teachers and staff who have received at least one dose of any COVID-19 vaccine in the top ten (n = 4,499) and bottom ten (n = 857) school districts in terms of uptake.

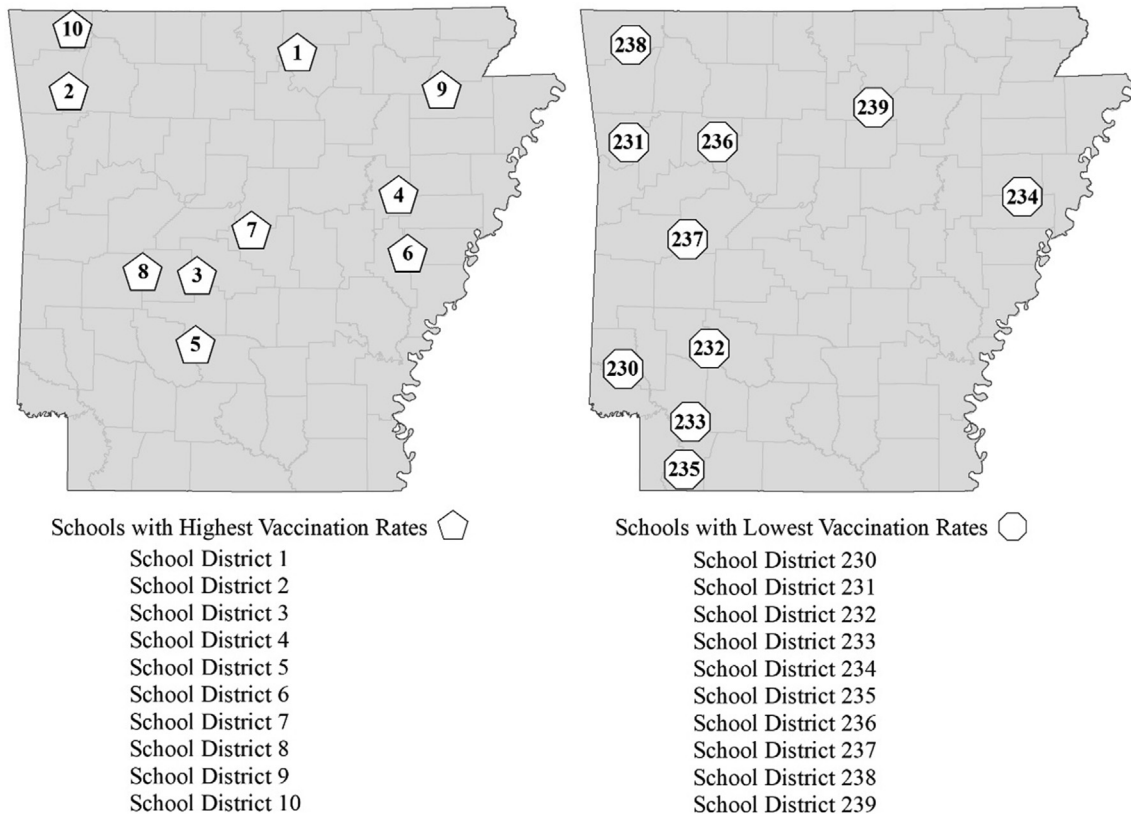
| Characteristic                            | Uppermost      | Bottommost   |
|---|----------------|--------------|
|   | No. (%)        | No. (%)      |
| <b>Gender</b>                             |                |              |
| Female                                    | 3,396 (75.5 %) | 610 (71.2 %) |
| Male                                      | 1,033 (22.9 %) | 220 (25.7 %) |
| Unknown                                   | 70 (1.6 %)     | 27 (3.2 %)   |
| <b>Race/Ethnicity</b>                     |                |              |
| American Indian or Alaskan Native         | 21 (0.5 %)     | 7 (0.8 %)    |
| Asian                                     | 17 (0.4 %)     | 10 (1.2 %)   |
| Black or African American                 | 254 (5.6 %)    | 88 (10.3 %)  |
| Hispanic                                  | 150 (3.3 %)    | 36 (4.2 %)   |
| Native Hawaiian or Other Pacific Islander | 3 (0.1 %)      | 1 (0.1 %)    |
| Other                                     | 209 (4.6 %)    | 29 (3.4 %)   |
| Unknown or Not Reported                   | 148 (3.3 %)    | 85 (9.9 %)   |
| White                                     | 3,847 (85.5 %) | 636 (74.2 %) |
| <b>Age Category</b>                       |                |              |
| 18–24                                     | 172 (3.8 %)    | 52 (6.1 %)   |
| 25–44                                     | 2,045 (45.5 %) | 323 (37.7 %) |
| 45–64                                     | 2,093 (46.5 %) | 426 (49.7 %) |
| 65 and older                              | 179 (4.0 %)    | 54 (6.3 %)   |
| <b>Total</b>                              | 4,499 (100 %)  | 857 (100 %)  |

weeks. Additionally, there is an absolute difference of 7 % between individuals with at least one dose and those who have completed the series at the most recent time interval. Included in this are 3,576 (10.3 %) individuals who have only one dose of the Pfizer-BioNTech or Moderna vaccine and are ≥ 42 days from their first dose.

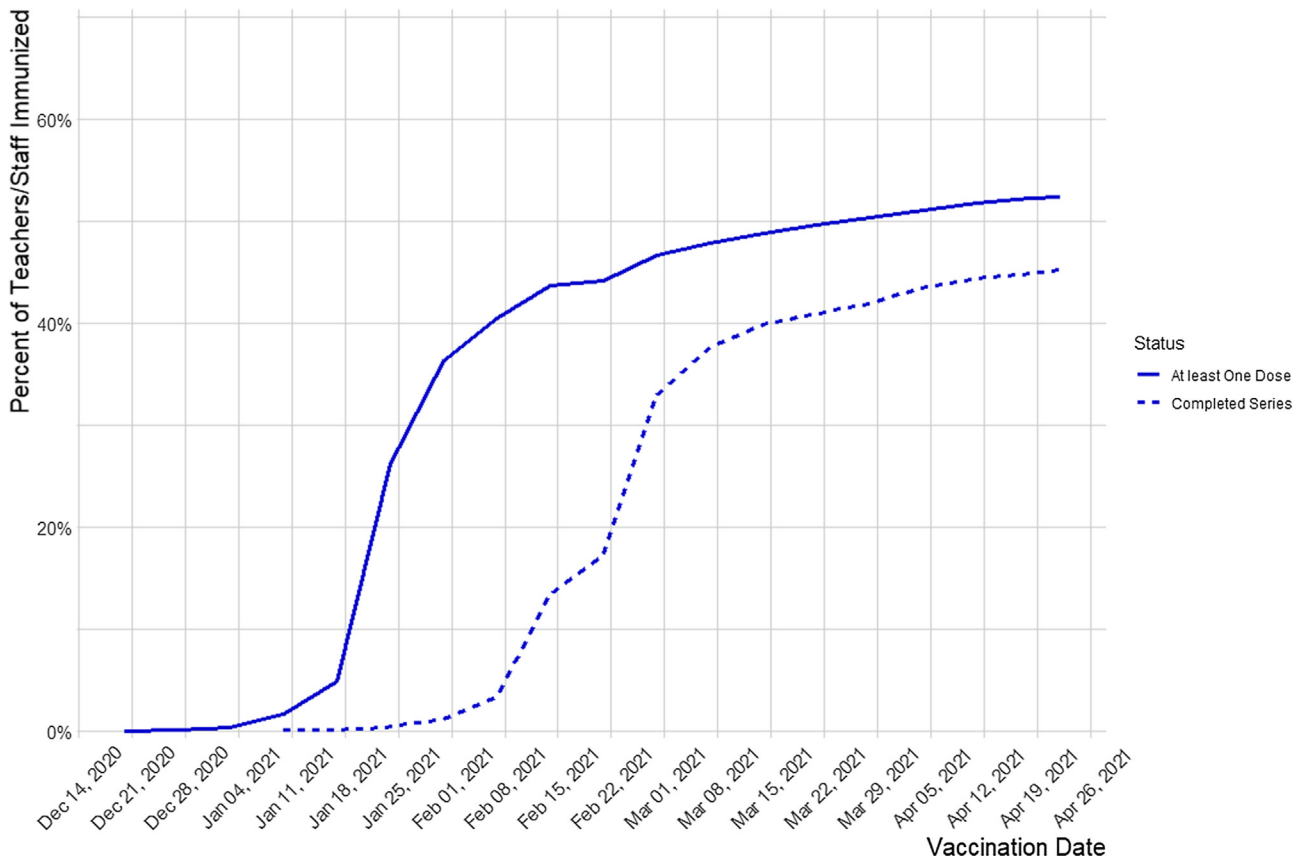
**4. Discussion**

This analysis provides one of the first detailed analyses of COVID-19 vaccine uptake within specific priority groups and, to our knowledge, the first analysis of K-12 teachers and staff. In early March, the current administration announced that states should prioritize their teachers and staff for vaccination so that schools across the country could reopen. By this point, Arkansas had been vaccinating teachers and staff for six weeks following the announcement of the state’s partial transition to Phase 1b on January 18th. Increased access to vaccines through the FRPP, as a result of the administration’s prioritization, did not improve the rate of vaccine uptake in public K-12 teachers and staff. As of April 22, 2021, half of Arkansas public K-12 teachers and staff have received at least one dose, and 44 % have been fully immunized. This is in contrast to data recently published by the Centers for Disease Control and Prevention (CDC) that announced that nearly 80 % of teachers, school staff, and childcare workers nationwide had received at least one dose of a COVID-19 vaccine [10].

Most teachers and staff receiving at least one dose were women (73 %), white (75 %) and between the ages of 45 and 64 (52 %). This demographic breakdown is relatively consistent with the overall characteristics of public-school teachers across the country [11]. Certified staff, exclusive of certified teachers, had the highest proportion of individuals with at least one dose (67 %), followed by teachers (55 %), and classified staff (46 %). Classified staff typically include those which are not certified, such as bus drivers, cafeteria workers, and maintenance workers. In Arkansas, this group comprises 40 % of all public K-12 teachers and staff. The comparatively low uptake of COVID-19 vaccines cannot be directly explained by any one factor using these data. However, given that vaccine has been prioritized and available to this group for over three months, that accessibility was increased through onsite vaccination clinics that were widely available, and that local availability of vaccine



**Fig. 1.** Map of the top and bottom ten school districts with respect to the proportion of public K-12 teachers and staff who have received at least one dose of any COVID-19 vaccine.



**Fig. 2.** Cumulative proportion of public K-12 teachers and staff who have received at least one dose and who have completed the series of any COVID-19 vaccine by week.

has increased over time, hesitancy and/or health literacy could be significant factors in the lack of vaccine uptake.

Tables 3 and 4 provide the top and bottom ten school districts, out of 239 within the state, in terms of the proportion of teachers and staff with at least one vaccine dose and the respective demographic distribution. Fig. 1 shows their respective geographic locations. Six of the school districts listed in the top ten are located around population centers within the state. It is of note that the school districts within the bottom ten tended to be in more rural areas. Some of the school districts in the bottom ten had virtually no uptake of vaccine (less than 10 % with at least one dose), despite the availability of onsite clinics. Additionally, the bottom ten school districts had slightly higher uptake among men, Black or African Americans, and older individuals relative to the top ten districts. There is clear evidence that Americans living in rural areas are hesitant to receive a COVID-19 vaccine, and previous studies have shown geographic clustering of nonCOVID-19 vaccine hesitancy [12–15]. Our data suggest congruency with those findings.

Fig. 2 illustrates the uptake of the vaccine over time. The proportion of teachers and staff with at least one dose increased rapidly between January 18th (date of announcement of transition to Phase 1b) and February 14th (4 % to 43 %), suggesting that a portion of the target population was motivated to be vaccinated. On the contrary, between February 28th and April 22nd, the proportion of teachers and staff taking the vaccine changed minimally, increasing slightly from 45 % to 51 % receiving at least one dose. This would indicate that lack of access to vaccine, improved or overcome through prioritization of teachers and staff by the FRPP, was not a major contributor to the lack of uptake. Again, pointing to vaccine hesitancy as a significant cause of the low vaccination rates. Over this period, vaccine allocation has consistently increased throughout Arkansas. As of April 22, 2021, Arkansas had administered 69 % of its allotted vaccine supply. The stagnation in the proportion of teachers and staff with at least one dose coupled with the increasing vaccine supply could be yet another sign of considerable vaccine hesitancy. Data showing that individuals in the US are hesitant to receive any of the COVID-19 vaccines is growing [14,16]. This represents a profound public health messaging and intervention challenge. In recent years, vaccine hesitancy has been fueled by misinformation and disinformation and is more commonly associated with certain individual characteristics, including religious beliefs, sociodemographic characteristics, political affiliation, and geographic location [12,13]. This phenomenon appears to have become accentuated during the COVID-19 vaccine rollout.

Delaying second doses in a two-dose series represents yet another layer of complexity to the COVID-19 vaccine rollout. Data regarding individuals who delay receiving their second dose is scarce and ill-described. However, a recent report documented that nationally 3.4 % of individuals that received vaccine in the initial 8 weeks of COVID-19 vaccine rollout had not received their 2nd vaccine dose within 42 days of the first [17]. Ten percent of Arkansas public teachers and staff that have received at least one dose have yet to complete their vaccination series within 42 days of their first dose, a rate nearly-three times higher than the national average. As vaccination campaigns progress, it will be prudent for states to adequately measure and understand factors which may inhibit individuals from completing their COVID-19 vaccination series.

The consequences of poor COVID-19 vaccine uptake among K-12 educators and staff are multiple. As states and school districts relax or do away with masking and physical distancing requirements, COVID-19-infected unvaccinated teachers and staff will pose a greater exposure risk to children. These exposures will undoubtedly result in quarantine of students, thus disrupting the educational experience. The 66,076 teachers and staff serve a stu-

dent population of 473,861, which represents more than 85 % of the school-aged children in Arkansas. Because COVID-19 vaccines are currently unavailable for use in children, exposure to unvaccinated infected teachers and staff can result in childhood illness, hospitalization, or even death. Exposure and quarantine of unvaccinated teachers will place further stress on the already short supply of educators, in particular, in rural areas of the country. Additionally, the threat of more contagious and possibly virulent COVID-19 variants is already cause for concern in the U.S. Unvaccinated teachers, staff and students will be the most vulnerable as these variants gain a foothold in states.

This study has several limitations. First, deterministic matching methods were used with three variables (e.g., first name, last name, and date of birth) to link teachers and staff to the immunization registry. Since patient identifiers were limited, information bias is possible in that some individuals may not have been correctly identified as having received a vaccine due to variations in name spelling or data entry errors. Also, data on vaccine administrations are reported passively from providers through a variety of mechanisms. Providers may not have been able to report data in a complete or timely fashion, which may have impacted the data linkage. Finally, it is possible that teachers and staff residing along state borders may have been vaccinated outside of Arkansas and would not be captured in the Arkansas registry. Immunization registry data is not currently shared between states for COVID-19 vaccinations. However, these factors would not be expected to affect the time trends observed in this analysis. Despite these limitations, these analyses provide an important initial glimpse at COVID-19 vaccine uptake within a priority group.

## 5. Conclusion

According to this initial data analysis, approximately half of Arkansas public K-12 teachers and staff have received at least one dose of any COVID-19 vaccine and only 44 % are fully immunized. The proportion of teachers and staff vaccinated with at least one dose has remained stagnant over the past few weeks despite onsite clinics, prioritization of this essential worker group, and increasing vaccine availability. Although it cannot be definitively assessed using these data, it is possible that vaccine hesitancy may be considerable within this group. The consequences of under immunized K-12 teachers and staff are significant.

## Conflict of Interest Disclosure

The authors report no conflicts of interest.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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