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COVID-19 Vaccine Mandates: Impact on Radiology Department Operations and Mitigation Strategies

Neo Poyiadji, MD^a, Alexander Tassopoulos, MD^a, Daniel T. Myers, MD^b, Lauren Wolf, BS^a, Brent Griffith, MD^c

Abstract

Objective: Coronavirus disease 2019 (COVID-19) vaccine mandates are being implemented in health systems across the United States, and the impact on the radiology department workforce and operations because of vaccine hesitancy among health care workers is currently unknown. This article discusses the potential impact of the COVID-19 vaccine mandate on a large multicenter radiology department as well as strategies to mitigate those effects.

Methods: Weekly vaccine compliance data were obtained for employees across the entire health system from August 17, 2021, through September 13, 2021, and radiology department–specific data were extracted. Vaccine compliance data was mapped to specific radiology job titles and the five different hospital locations.

Results: A total of 6% of radiology department employees were not fully vaccine compliant by the initial deadline of September 10, 2021. MR technologists and radiology technology assistants had the highest initial rates of noncompliance of 37% and 38%, respectively. Vaccine noncompliance rates by the mandate deadline ranged from 0.5% to 7.0% at the five hospital sites. Only one hospital required a decrease in imaging hours of operation because of the vaccine mandate.

Conclusion: Despite initial concerns about the impact of vaccine mandate noncompliance on departmental operations, there was ultimately little effect because of improved vaccine compliance after the mandate. Understanding individual employee and locoregional differences in vaccine compliance can help leaders proactively develop mitigation strategies to manage this new challenge during the COVID-19 pandemic.

Key Words: COVID-19, mandate, operations, radiology, vaccine

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INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has impacted all aspects of health care and continues to present new challenges to hospitals across the world—and radiology

departments are no exception. Early in the pandemic, in an effort to mitigate disease spread, radiology departments faced a precipitous decline in imaging volume, and subsequently revenue, because of deferment of outpatient and nonurgent imaging studies [1,2]. Reports and shared experiences from radiology departments facing the earliest waves of disease helped to prepare others by describing the extent of impact (eg, expected volume reduction by subspecialty and modality), as well as offering mitigation strategies to minimize productivity losses and optimize staffing [2-4]. As the pandemic cycled through peaks and troughs, imaging volumes eventually returned to prepandemic levels; however, the stress on the health care workforce became evident with studies citing increased anxiety and burnout across the health care system—including physicians, nurses, and ancillary staff [5,6]. The emergence of COVID-19 variants—and the continual threat of new disease surges—amplified these effects.

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The release of the COVID-19 vaccines, first approved for Emergency Use Authorization by the FDA for the Pfizer-BioNTech COVID-19 Vaccine (BNT162b2; Pfizer Inc, New York, NY; BioNTech, Mainz, Germany) on December 11, 2020, offered hope to all, particularly those on the health care frontlines, that the pandemic's devastating effects on our country and health care system were coming to an end [7]. The COVID-19 vaccines were developed in unprecedented time because of the combined efforts of researchers from across the globe. These vaccines have proven to be safe and effective in preventing severe illness related to COVID-19 and are essential for ending the pandemic. As such, health systems across the nation have begun implementing vaccine mandates for their workforces, gaining support from the AMA, the Association of American Medical Colleges, and others [8,9]. The Henry Ford Health System (HFHS) was one of the first health systems to announce a COVID-19 vaccine mandate in June 2021. However, despite the data and support from worldwide experts, vaccine hesitancy among health care workers created a new challenge. Specifically, there has been increasing concern that vaccine mandates may further exacerbate an ongoing workforce shortage among hospitals—with reports of hospitals even being forced to eliminate entire services because of staff resigning over vaccine mandates [10].

As vaccine mandate deadlines approach, the impact on the radiology department workforce and subsequent effect on operations are currently unknown. The purpose of this article is to discuss the potential impact of the COVID-19 vaccine mandate on the clinical operations of a radiology department in a large multihospital health system, as well as strategies to mitigate those effects.

METHODS

This study was undertaken as a quality assurance initiative to understand and lessen the impact of potential workforce shortages on departmental operations caused by COVID-19 vaccine noncompliance.

The HFHS announced a COVID-19 vaccine mandate for its employees on June 29, 2021, with a deadline for vaccination or exemption for medical or religious reasons set for September 10, 2021. The deadline was eventually extended to October 1, 2021, for employees in process for vaccination or exemption at the time of the original deadline. Health care workers not in compliance by the deadline were subject to suspension, voluntary resignation, or termination.

HFHS is a nonprofit corporation that is composed of five major hospitals—Henry Ford Hospital (HFH), Henry Ford Allegiance Hospital (HFAH), Henry Ford Macomb Clinton Township (HFMCT), Henry Ford Wyandotte Hospital (HFWH), and Henry Ford West Bloomfield

(HFWB)—that reside in four different Michigan counties. HFH is the flagship hospital located in Detroit, Michigan, and is an 877-bed tertiary care, level I trauma center and teaching hospital. HFAH and HFMCT are level II trauma centers and have 475 and 361 beds, respectively. HFWH and HFWB are level III trauma centers and have 401 and 191 beds, respectively.

Weekly vaccine compliance data were obtained for employees across the entire health system from August 17, 2021, through September 13, 2021, and radiology department-specific data were extracted. Vaccine compliance data were obtained by radiology job title and were also mapped to the five different hospitals within the health system. Major job titles within the radiology department were included in the analysis including radiologists, technologists, nurses, and sonographers. Vaccine compliance was defined as receiving two doses of either the Pfizer (BNT162b2) or Moderna (mRNA-1273; ModernaTX Inc., Cambridge, MA) vaccines, one dose of the Johnson and Johnson/Janssen vaccine (JNJ-78436735; Janssen Pharmaceuticals Companies of Johnson & Johnson, Beerse, Belgium), or obtaining an approved vaccine exemption. Exemptions were processed through a formal application and were approved for either medical or religious reasons. Medical exemption forms required a signature from the employee's licensed health professional and the religious exemption form required a signature from a religious leader. Both forms required discrete explanations for vaccine exemption, in addition to supporting documents. All exemption requests were processed centrally by the health system review committee. The total number of medical and religious exemptions were analyzed for the department.

Regional directors for each hospital provided reports for altered radiology operations caused by the vaccine mandate for each site. Imaging volume data were subsequently analyzed for radiology sites that had altered operations due to the COVID-19 vaccine mandate.

Mitigation Strategies

Several strategies were employed by the health system to improve vaccine compliance and mitigate a potential decrease in the workforce due to the COVID-19 vaccine mandate. Several employee town halls were implemented to provide education and help ease concerns regarding the vaccine. Common questions from vaccine-hesitant workers included concern of vaccine side effects, impact on fertility, hospital coverage from potential vaccine side effects, and the legality of a vaccine mandate. Guidelines and answers to frequently asked questions were made easily available through the health system website. Job fairs were also conducted to increase hires before the deadline in anticipation of a potential workforce shortage due to the vaccine

mandate and potential shift of health care workers into different careers.

Radiology administration met with approximately two-thirds of noncompliant individuals before the vaccine deadline to better understand employees' concerns regarding the COVID-19 vaccine mandate. The primary purpose of these meetings was to ensure that employees had access to information so that they could make an informed decision and understand available options.

RESULTS

A total of 1,506 radiology department employees were included in this vaccine compliance data, of which 656 (43.6%) were located at HFH, 230 (15.3%) at HFMCT, 183 (12.2%) at HFWB, 171 (11.4%) at HFAH, and 114 (7.6%) at HFWH. Demographic data for radiology employees in HFHS and across the five major hospitals are depicted in Table 1.

Michigan county population demographic data as well as socioeconomic and political voter data from the 2020 election for the counties that the five hospitals reside in are depicted in Table 2 [11,12].

Vaccine Noncompliance

Vaccine noncompliance for the entire health system was compared with employees within the radiology department, and both groups were found to have similar rates and trends of noncompliance during the study period (Fig. 1). Initial data, approximately 2 months after the announcement of

the COVID-19 vaccine mandate, demonstrated 20% of radiology department employees and 21% of health system employees to be noncompliant. One day before the initial COVID-19 vaccine mandate deadline, 6% of radiology department employees and 8% of health system employees were noncompliant (Fig. 2).

Radiology department vaccine noncompliance was mapped to specific job titles and analyzed across the 5-week study period (Fig. 3). Of the 1,506 HFHS radiology department employees included in these data, job titles could be accurately mapped for 1,295. MR technologists and radiology technology assistants had the highest initial rates of noncompliance of 37% and 38%, respectively. Radiology technology assistants and radiology supervisors had the highest rates of vaccine noncompliance after the initial mandate deadline with rates of 13% and 8%, respectively. Notably, diagnostic radiologists and radiology nurses had the highest vaccine compliance rates, and both groups were 100% compliant well before the vaccine mandate deadline.

Approved exemptions for the COVID-19 vaccine mandate represented an overall small number of the vaccine compliant workforce in the department. Of the 1,506 radiology employees included in these data, 122 (8.1%) received medical or religious exemptions, which included 40 (6.1%) of the radiology employees at HFH, 30 (13.0%) at HFMCT, 22 (12.0%) at HFWB, 19 (11.1%) at HFAH, and 11 (9.6%) at HFWH.

On October 5, 2021, HFHS announced that 99% of all current employees across the health system were fully

Table 1. Baseline demographic data and distribution of radiology health care workers in different hospitals across the health system

| Demographics | Radiology Employees | | | | | |
|----------------------------------|---------------------|---------------------|---------------------|---------------------|--------------------|---------------------|
| | Total HFHS | HFH | HFAH | HFMCT | HFWH | HFWB |
| Age (average \pm SD) | 44.1 \pm 13.3 | 44.0 \pm 13.3 | 41.8 \pm 12.8 | 45.8 \pm 13.9 | 43.0 \pm 11.7 | 43.8 \pm 12.6 |
| Female, % | 77.1 | 65.1 | 86.5 | 85.7 | 83.3 | 84.7 |
| Male, % | 22.9 | 34.9 | 13.5 | 14.3 | 16.7 | 15.3 |
| White, % | 81.2 | 72.6 | 94.2 | 93.0 | 89.5 | 78.7 |
| African American, % | 9.6 | 14.2 | 1.2 | 3.5 | 2.6 | 11.5 |
| Hispanic, % | 2.5 | 2.3 | 1.8 | 0.4 | 7.0 | 3.3 |
| Asian, % | 5.3 | 9.3 | 0 | 2.2 | 0 | 6.0 |
| Other race, % | 1.5 | 1.7 | 2.9 | 0.9 | 0.9 | 0.6 |
| Distribution of employees, % (n) | 100* (1,506) | 43.6 (656 of 1,506) | 11.4 (171 of 1,506) | 15.3 (230 of 1,506) | 7.6 (114 of 1,506) | 12.2 (183 of 1,506) |

HFAH = Henry Ford Allegiance Hospital; HFH = Henry Ford Hospital; HFHS = Henry Ford Health system; HFMCT = Henry Ford Macomb Clinton Township; HFWB = Henry Ford West Bloomfield; HFWH = Henry Ford Wyandotte Hospital.

*Radiology employees at the five major hospitals within HFHS constitute 90.1% of the radiology workforce. The remaining 9.9% of the radiology employees work at smaller, nonhospital, satellite imaging centers.

Table 2. Michigan county population demographic data for the four counties that the five hospitals reside as denoted by parentheses

| Demographics | Michigan County Population [11] | | | |
|------------------------|---------------------------------|--------------------------|--------------------------|--------------------------|
| | Wayne County (HFH and HFWH), % | Oakland County (HFWB), % | Jackson County (HFAH), % | Macomb County (HFMCT), % |
| Age (<24 y) | 33.0 | 29.5 | 30.5 | 29.5 |
| Age (25-54 y) | 38.9 | 39.9 | 37.8 | 39.6 |
| Age (55-74 y) | 22.1 | 24.0 | 24.6 | 23.7 |
| Age (>75 y) | 6.3 | 6.7 | 7.1 | 7.1 |
| Median age (y) | 37.9 | 40.9 | 41.2 | 40.9 |
| Female | 51.0 | 51.8 | 48.9 | 51.3 |
| Male | 49.0 | 48.2 | 51.1 | 48.7 |
| White | 54.6 | 75.3 | 87.6 | 80.3 |
| African American | 38.7 | 13.9 | 8.1 | 12.6 |
| Hispanic | 6.1 | 4.3 | 3.6 | 2.8 |
| Asian | 3.5 | 8.2 | 0.9 | 4.3 |
| Republican* | 30.3 | 42.3 | 58.6 | 53.4 |
| Democrat* | 68.5 | 56.4 | 39.6 | 45.3 |
| Poverty [†] | 19.8 | 7.8 | 13.7 | 8.6 |
| Education [‡] | 23.9 | 47.2 | 22.2 | 24.9 |

HFAH = Henry Ford Allegiance Hospital; HFH = Henry Ford Hospital; HFMCT = Henry Ford Macomb Clinton Township; HFWB = Henry Ford West Bloomfield; HFWH = Henry Ford Wyandotte Hospital.

*Republican and Democrat percent popular vote in 2020 presidential election based on Michigan county election data [12].

[†]Percentage of county population that lives in poverty as defined by the US Census Bureau.

[‡]Percentage of county with a bachelor's degree or higher.

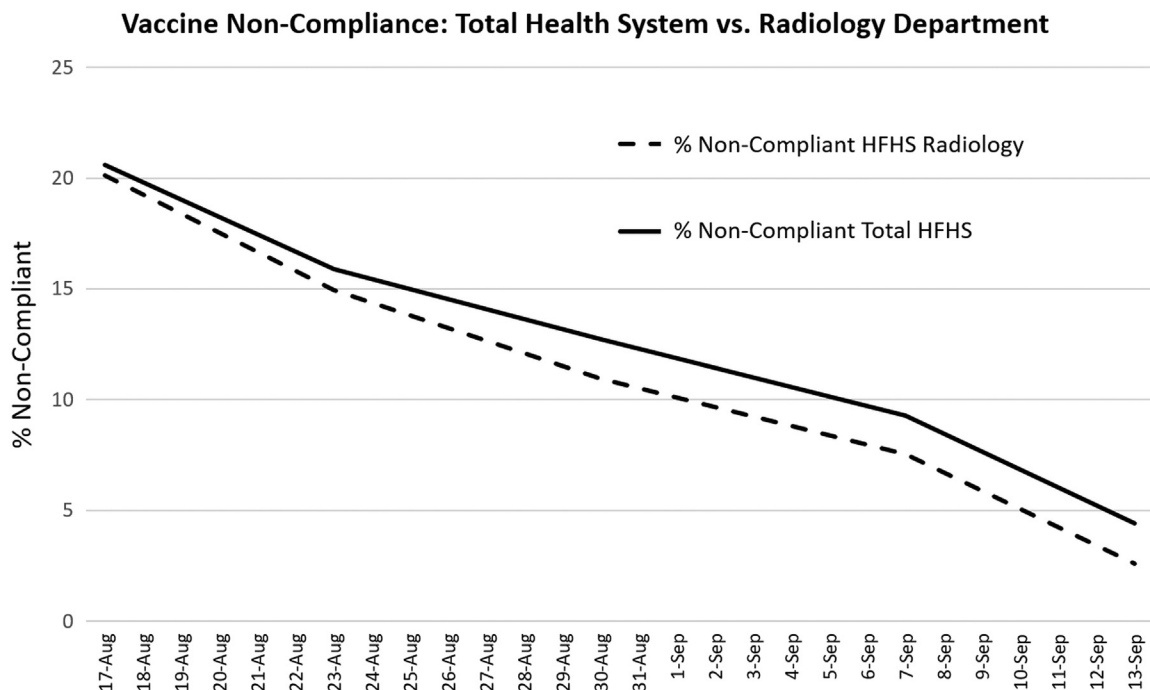
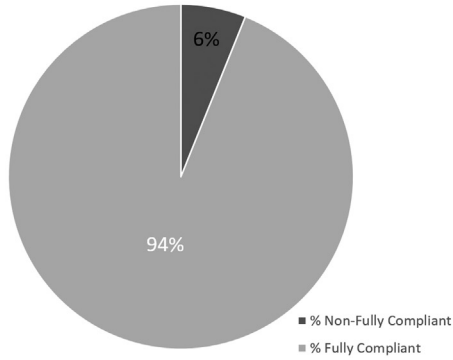


Fig. 1. Trend of vaccine noncompliance for radiology department employees compared with employees in the entire health system from August 17, 2021, to September 13, 2021. HFHS = Henry Ford Health system.

Radiology Department Vaccine Compliance by September 9, 2021



Total Health System Vaccine Compliance by September 9, 2021

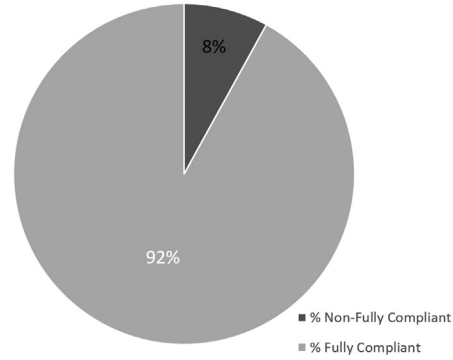


Fig. 2. Vaccine compliance rates of radiology department and health system employees 1 day before the initial vaccine mandate deadline.

Radiology Department Vaccine Non-Compliance by Job Title

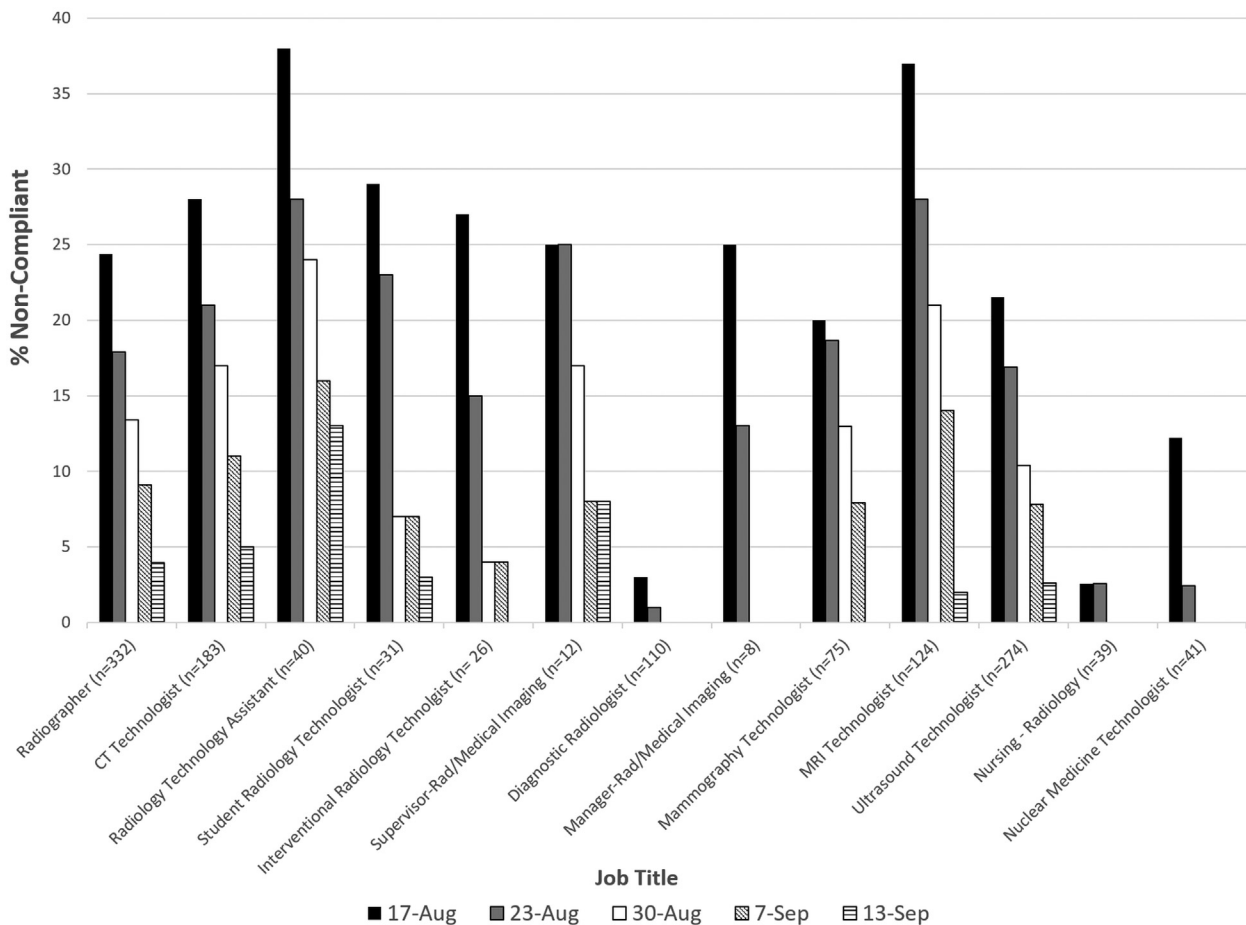


Fig. 3. Radiology department vaccine noncompliance rates by job title from August 17, 2021, to September 13, 2021. Total number of radiology employees with a specific job title is denoted by n.

vaccinated, had received their first dose of a two-dose series, or had received an approved medical or religious exemption. HFHS also announced that approximately 400 employees chose to leave their jobs rather than take the required vaccine. This included a total of 14 (0.9%) radiology employees who either resigned or retired because of the vaccine mandate.

Regional Effects on Vaccine Compliance

Regional differences of vaccine noncompliance within the radiology department are depicted in Figure 4, which demonstrates noncompliance rates across the five different hospitals within the health system. HFWH, HFH, and HFWB had the lowest rates of vaccine noncompliance throughout the study period with post-vaccine mandate noncompliance rates of 2.6% (3 of 114), 1.5% (10 of 656), and 0.5% (1 of 183), respectively. HFAH and HFMCCT had the highest rates of vaccine noncompliance with 7.0% (12 of 171) and 5.7% (13 of 230) noncompliance, respectively, after the initial vaccine mandate deadline.

Effect on Departmental Operations

Because of a staffing shortage secondary to the vaccine mandate, HFAH ceased performing outpatient MRI

examinations for one Saturday (1 day after the final vaccine mandate deadline). The weekly average number of MRI examinations performed at HFAH from June 27, 2021, to October 17, 2021, was 280 ± 15.9 examinations. During the week that included the canceled Saturday outpatient scanning shift, there was a decline of -5.5% in outpatient MRI imaging volume relative to the weekly average. During the 4 weeks leading up to the final vaccine mandate deadline, there was a decline in weekly HFAH MRI imaging volume ranging from -1.9% to -5.8% . No other sites were required to close or limit access because of a staffing shortage.

DISCUSSION

COVID-19 vaccine mandates are being implemented in health systems across the United States, and despite the proven efficacy and safety of COVID-19 vaccines, vaccine hesitancy exists among health care workers. It is critical for health systems, as well as radiology departments, to understand vaccine hesitancy, the potential impact of vaccine mandates on the workforce, and potential strategies to mitigate these effects.

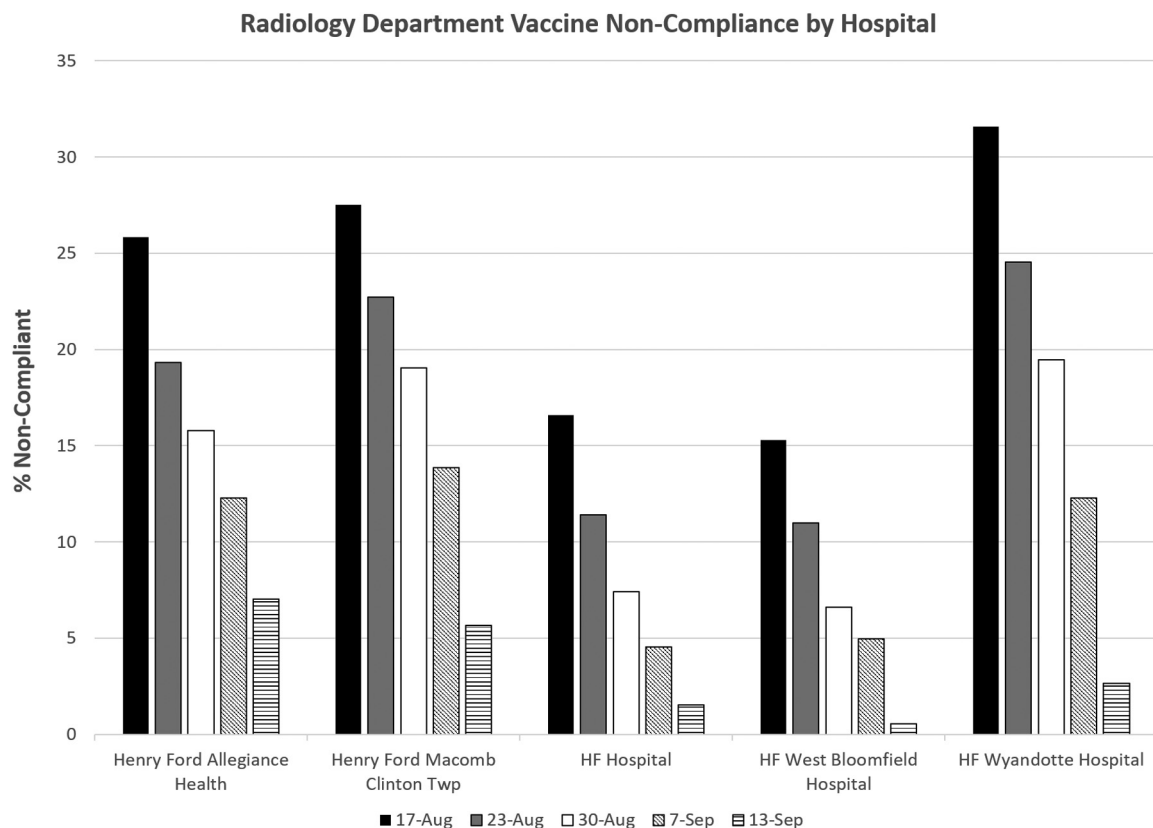


Fig. 4. Locoregional differences in radiology department vaccine noncompliance rates among five different hospitals in southeastern Michigan from August 17, 2021, to September 13, 2021. HF = Henry Ford.

Vaccine History and Hesitancy

Vaccination against contagious diseases began in 1796 when Edward Jenner, an English doctor, discovered that material from a cowpox sore could protect against smallpox [13]. Since that time, vaccinations have evolved, and global vaccination programs have been implemented, resulting in eradication of diseases such as smallpox and polio [14]. The legal precedent for vaccine mandates was established in the Supreme Court case of *Jacobson v Massachusetts* in 1905 regarding the smallpox vaccine, which allowed states to enforce vaccination mandates if deemed necessary for public health [15]. Since that time, annual influenza vaccine mandates for health care workers have been implemented in numerous states. Likewise, public schools have required children to be fully vaccinated against a multitude of diseases.

Despite the long history of vaccine integration within society, vaccine hesitancy has emerged as a public health threat. Early general population surveys regarding COVID-19 vaccines have cited safety, fear of side effects, and efficacy as reasons for vaccine hesitancy. In addition, Republicans, Independents, women, and African Americans were statistically less likely to accept a COVID-19 vaccine [16,17]. Individuals with lower income, less education, or living in rural areas were also less likely to get vaccinated [17]. Among American health care workers, vaccine hesitancy has been reported to be higher in minority groups, including African Americans and Latinos [18]. Interestingly, although HFH had the highest proportion of African American employees and also resides in Wayne County (which has the highest African American population), it had one of the lowest vaccine noncompliance rates at 1.5%. In an Israeli survey, nurses and health care workers not providing direct care for COVID-19 patients were also more likely to have vaccine hesitancy [19].

Impact of the COVID-19 Vaccine Mandate on the Radiology Workforce

Two months after the announcement of a systemwide COVID-19 vaccine mandate, 20% of radiology department employees were not vaccinated, including 37% of MR technologists. This rate of vaccine noncompliance would have been incompatible with maintaining adequate imaging volume in a busy multicenter radiology department. Furthermore, if vaccine compliance did not improve, and a substantial proportion of technologists resigned or were terminated, the radiology department would have been required to significantly scale back operations, with a subsequent dramatic decline in imaging volumes and revenue. Fortunately, vaccine compliance

improved within the radiology department and across the health system by the vaccine mandate deadline. Despite improved vaccine compliance, the MRI site at HFAH was forced to reduce its outpatient operations for one weekend after the final vaccine mandate deadline because of a staffing shortage related to the COVID-19 vaccine mandate, with a decline in MRI examinations performed during this week and the weeks leading up to the final vaccine mandate deadline.

Interestingly, in contrast to both national and local data, nurses within the radiology department had a high rate of vaccine compliance. Additionally, all radiologists were vaccinated well before the vaccine mandate deadline, thus setting a precedent for the rest of the department.

There are regional differences in departmental vaccine compliance rates noted among the five hospitals within the health system. HFAH and HFMCCT had the highest rates of vaccine noncompliance by the vaccine mandate deadline with noncompliance rates of 7.0% and 5.7%, respectively, whereas HFWH, HFH, and HFWB had the lowest rates of vaccine noncompliance by the mandate deadline with rates of 2.6%, 1.5%, and 0.5%, respectively. Although it is difficult to draw conclusions with the limited available data, it is interesting to note that both HFAH and HFMCCT reside in counties that voted a majority Republican in the 2020 presidential election, whereas HFWH, HFWB, and HFH, which had the lowest rates of vaccine noncompliance, all reside in counties that voted a majority Democrat in the 2020 presidential election [12]. As noted earlier, studies have shown that Republicans and Independents were statistically less likely to accept a COVID-19 vaccine [16]. Although multifactorial, it is important for health systems to recognize and understand locoregional differences in vaccine acceptance so that administrators can anticipate potential sites that need focused mitigation strategies.

Mitigation Strategies

Prior studies have evaluated various interventions to improve vaccine uptake by health care providers with other vaccines such as influenza and hepatitis B. These studies cite that the provision of free and easy access to vaccines, information campaigns, and peer vaccination improved vaccine uptake [20]. Proactive open communication with employees addressing their concerns is also critical to develop employee trust and promote vaccine compliance. A systematic review found that multicomponent and dialogue-based interventions were most effective in addressing vaccine hesitancy [21]. This review also found that tailored interventions to specific populations and their specific concerns were

most effective. Interestingly, one study found that focusing on COVID-19 vaccine effectiveness in preventing death rather than preventing symptomatic infection was associated with greater vaccine confidence [22]. Although many studies have discussed vaccine hesitancy and have proposed strategies to improve vaccine uptake, few studies have quantified the effectiveness of these strategies.

Ultimately, it is critical for health systems to be proactive and anticipate staffing shortages to minimize any potential interruptions in patient care caused by a vaccine mandate. Notably, because of a systemwide shortage of nurses in other departments, HFHS has begun looking to recruit nurses from the Philippines to fill the health care work gap [23].

Limitations

Vaccine compliance will vary depending on regional perception of vaccine mandates, and the results of this study may not be applicable to other health systems. Additionally, reasons for vaccine noncompliance among health care workers were not directly assessed. Furthermore, demographic trends described in early survey studies regarding COVID-19 vaccine hesitancy could not be assessed because of a lack of available demographic-specific vaccine compliance data. A small percentage of radiology employees worked at small, nonhospital imaging centers and were not included in the locoregional or job title-specific data. Additionally, not all employees' job titles were able to be mapped in the initial data set and may be underrepresented. Finally, the improvement in vaccine compliance over time is multifactorial, and it is possible that the mandate itself (and individual self-interest to maintain employment) had the greatest influence on vaccine-hesitant individuals to get vaccinated. Thus, the true effectiveness of mitigation strategies is difficult to ascertain.

TAKE-HOME POINTS

- COVID-19 vaccine mandates are being implemented across health systems within the United States, and radiology departments must be prepared for the potential impact on their workforce.
- The vaccine mandate was controversial across the country, with many different viewpoints. However, once the decision to implement the vaccine mandate was made by the health system, it set into motion a series of efforts that, in the end, saw nearly all employees get vaccinated. The approach taken in our health system and radiology department provides a pathway for others to do the same.

- Recognizing differences in COVID-19 vaccine compliance among employees and locoregional differences in vaccine compliance is critical to prevent a workforce shortage and subsequent decreased ability to provide adequate imaging services for patients.
- Proactive mitigation strategies, such as town halls, open communication, job fairs, and ease of access to vaccination, may be helpful in managing this new challenge during the COVID-19 pandemic.

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