COVID-19 Vaccination Hesitancy among Healthcare Workers

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The COVID-19 pandemic and its associated vaccine have highlighted vaccine hesitancy among healthcare workers (HCWs). Vaccine hesitancy among this group existed prior to the pandemic and particularly centered around influenza vaccination. Being a physician, having more advanced education, and previous vaccination habits are frequently associated with vaccine acceptance. Reasons for hesitancy include concerns about safety and efficacy, mistrust of government and institutions, waiting for more data, and feeling that personal rights are being infringed upon.

health care worker COVID-19 vaccine hesitancy mandate

1. Introduction

The COVID-19 pandemic has generated significant interest in vaccine development and effectiveness, as well as public health policies related to the use of vaccines. This discussion has also highlighted the issue of vaccine hesitancy and skepticism. Many individuals choose not to receive the vaccine despite fatalities from COVID-19, assurances of vaccine safety and efficacy, and public health or employer mandates to do so [1]. While vaccine skepticism is not new, the discussion regarding vaccines has recently intensified due to a global pandemic and a new vaccine to address it. Furthermore, while public vaccination skepticism has been well analyzed [2], vaccine hesitancy among healthcare workers (HCWs) has also become apparent.

Healthcare workers typically have several qualities that would presumably predispose them to vaccine acceptance; these include advanced education in the sciences, clinical experience, and membership in professional societies that support vaccination. Furthermore, many medical professionals are at the forefront of the pandemic, both directly observing the effects of SARS-CoV-2 infection and placing themselves at greater risk of exposure. It may, therefore, seem surprising that some medical professionals have chosen not to receive the vaccine, with some even adopting or promoting incredible theories about the pandemic and the associated vaccine. Proponents of HCW vaccination argue that unvaccinated HCWs place themselves and their patients at increased risk of illness [3]. Furthermore, healthcare professionals are viewed by their communities as leaders in the field and thus examples of good healthcare practice as well as trusted sources of vaccine-related information [4]. If HCWs are hesitant about the vaccine, patients are likely also hesitant. Finally, greatly publicized resistance in a small group of highly visible individuals in healthcare professions may also contribute to vaccine hesitancy in the general population.

Given its impact on the public, there have been various approaches to discussing the issue of HCW COVID-19 vaccination. Although logically sound arguments for vaccination are readily available, some commentators have made broad generalizations and even exaggerated the motives and reasoning of vaccination skeptics. Resorting to ad hominem attacks and caricaturing of skeptics by vaccine advocates will likely be unconvincing and only further separate the public from reliable scientific and medical sources. In reality, the reasons for vaccine skepticism are varied and complex, and are often interwoven with personal emotions, identities, and world views. Concerns are unique to every individual and range from concern over side effects and efficacy to fears over governmental abuse of power, to more outlandish theories, such as microchip implantation [5][6]. These issues also intersect with many important philosophical and ethical issues, such as personal autonomy, epistemology, and utilitarianism [7]. Religious and political ideologies are often invoked by those who feel that the moral cost of vaccination outweighs the possible medical benefits. Indeed, beliefs about vaccination are variable such that no single approach or argument is likely to persuade those opposed to it. Participation in vaccination by vaccine-hesitant HCWs will likely occur only after these varied viewpoints are understood and appropriately addressed, thus warranting a thorough investigation into the motivations behind such hesitancy.

2. Pre-COVID-19 Vaccine Hesitancy among Healthcare Workers

Vaccine hesitancy among HCWs is not new. Many pre-COVID-19 studies have examined HCW vaccine hesitancy, with the majority of this work focusing on seasonal influenza vaccination [8][9]. Before COVID-19, vaccine-hesitant HCWs expressed many concerns similar to those observed during the pandemic, including concerns about safety, mistrust of employers and government authorities, and violation of personal autonomy [8][9]. Intervention programs to encourage HCW vaccination, as well as vaccine mandates, have been previously studied and employed [10].

The 2009 H1N1 influenza pandemic provides as close an approximation as possible to the ongoing COVID-19 crisis, both involving a worldwide pandemic and the rapid development of a vaccine to counter it [11]. Some HCWs were hesitant to receive the H1N1 vaccine over concerns it was developed too quickly [12] and surveys showed that as low as 31% of HCWs were willing to obtain the H1N1 vaccine [13][14]. Though the CDC has recommended influenza vaccination for HCWs since 1981 [15], vaccination rates at first were low in general, in part due to influenza vaccination being largely voluntary. However, recent data indicate much higher vaccination rates (overall: 76%, physicians: 91%, nurses: 90%, assistants/aides 65%) in part due to vaccine mandates [16]. Data have shown that influenza vaccination is effective at preventing illness among HCWs [17] and patients [18][19]. In one study, offering influenza vaccination to HCWs increased vaccine uptake among HCWs (51% with recommendation vs. 5% without), and this difference in HCW vaccination rates was associated with a small though significant decrease in mortality of long-term care residents, despite no difference in non-fatal infection rates. [19]. Additional studies have shown low-quality evidence for a significant effect of HCW influenza vaccination on all-cause mortality as well as “flu-like” symptoms [18][20] and reduced doctor consultation and hospital admissions for “flu-like” symptoms [21]. Skeptics of these results have argued that a computational model has shown HCW vaccination to only have a marginal impact on mortality [22], and others have questioned the quality of this evidence [23]. A rebuttal to these

critiques by Hayward points out that death from influenza is hard to track due to the secondary reporting status of influenza. Influenza has the effect of increasing acute illness in older patients with most of the associated mortality being attributed to preexisting conditions rather than influenza. This same paper also points out the relatively weaker effect of vaccines in generating immunity among elderly individuals as an argument for the necessity for HCW vaccination to protect these individuals [24]. Many have drawn comparisons between the influenza and COVID-19; indeed, many of the arguments for vaccination against one highly contagious respiratory virus may be applied to the other.

Vaccination mandates were established in many instances on an institutional level before COVID-19. Vaccinations for healthcare workers against diseases such as hepatitis B, measles, mumps, rubella, pertussis, varicella, and influenza have long been strongly recommended by most public health organizations and regulatory bodies [25][26]. Many institutions and schools, including health profession schools, have historically required HCWs and students to be vaccinated before starting employment or matriculation [27]. In 2005, Poland et al. presented several arguments about mandated influenza vaccination that parallel discussions about COVID-19 vaccination today, including the morbidity and transmissibility of influenza, limitations on scheduling coverage for sick workers, the effectiveness of work requirements in increasing vaccination rates, and the ethical and moral duty of healthcare workers [28]. Despite this duty, one study found that family medicine physicians were more motivated by institutional pressures to vaccinate than the hope of providing protection for their patients [29]. It has also been argued that HCW vaccination requirements establish an example of HCWs as leaders in good preventative medicine practices [25].

Arguments against mandated HCW vaccination include violation of personal liberty [30], questions about the safety and effectiveness of vaccines [31] overestimation of vaccine likelihood to cause adverse effects to those who we rely on for healthcare, and a typical underestimation by HCWs of their own risk of adverse effects from diseases [32] [33]. Indeed, several court cases have examined HCW vaccine mandates. For example, H1N1 vaccination requirements for HCW in New York were met with several lawsuits, with plaintiffs arguing that mandates violated, among other things, personal liberty and freedom of religion [34].

Ultimately, workplace vaccine mandates have proven the most successful intervention at increasing influenza vaccination, and this success was enhanced when combined with other interventions, such as education [35]. On the other hand, influenza outbreaks are relatively common, historically occurring in 30–60% of long-term care facilities each year [36] and studies have been inconclusive so far about whether vaccinating HCWs against influenza actually prevented infection [37]. Research has also found that a need for increased quality and quantity of evidence has been a common request from HCWs when confronting decisions regarding vaccinations and whether to recommend them [8]. Indeed, to counter the overwhelming sources of fear and misinformation that confront HCWs, policymakers and administrators should highlight the multiple sources which address the specific questions and concerns of providers and their patients [8]. Quality education and transparent decision-making have also been found to be important preparation for other more compulsory interventions [8][25][32]. Interventions that enhance institutional accountability, such as having a formalized exemption review process, manager-level compliance tracking, and heightened institutional accountability also can increase vaccination, and may also be effective [38].

Ultimately, pre-COVID-19 vaccine hesitancy among HCWs provides important precedence for understanding hesitancy during the current COVID-19 pandemic.

Healthcare workers are often asked to make recommendations for others; for example, 95.9% of Finnish HCWs reported accepting all vaccinations for their children before the pandemic [39]. Among this pronounced majority, however, 13% reported hesitating and 6.3% reported postponing a vaccination for their children. This same group of workers reported that they very rarely guided hesitant patients toward vaccination, and it was found that their recommendation behavior was related more to personal attitudes toward vaccines than trust in other HCWs' recommendations and competence [39].

Vaccine hesitancy historically may be influenced by both the relative familiarity with and perceived personal risk from diseases. For example, HCWs typically have better uptake of vaccines for diseases less common in the general population, such as measles, tetanus, and hepatitis B [25]. In contrast, the vaccine against the more familiar influenza virus has commonly been involved in HCW hesitancy [40]. A survey of HCW influenza vaccination attitudes and behaviors noted that the main reason HCWs cited for receiving influenza vaccinations was the perception of a risk to themselves and not necessarily consideration of risks to their patients [40][41]. This could simply be because HCWs are not confident the vaccine will protect patients. However, the idea that a disease would not likely pose a personal risk to HCWs may outweigh the potential for protecting vulnerable patients from harm when HCWs make decisions about influenza vaccinations [32][42].

The COVID-19 pandemic provides a rather unique situation involving a new pathogen and high worldwide infection rates with significant medical and economic impact. A review of trends in hesitancy before COVID-19 helps identify which aspects of HCW hesitancy are new and evolving and which have been seen prior.

3. The COVID-19 Pandemic and Vaccine Development

The COVID-19 pandemic created a rush to develop a vaccine against SARS-CoV-2. The World Health Organization declared a global pandemic in March of 2020 [43]. By late 2020, there were over 200 COVID-19 vaccines in development and over 40 vaccines were undergoing clinical trials [44]. The first vaccines were available for high-risk groups in late 2020. Countries invested billions of US dollars in vaccine research and development, [45] with Phase I trials beginning in April 2020 [46]. The most notable of these vaccines include BNT162b2 (produced by Pfizer-BioNTech) and mRNA-1273 (produced by Moderna, Inc., Cambridge, MA, USA), which use recombinant mRNA technology. Of note was both the speed with which these vaccines were developed and the fact that they were the first approved vaccines using mRNA technology. The first doses of the vaccine were administered to a member of the public on 8 December 2020 [47]. In the United States, these vaccines were granted emergency authorization by the Federal Drug Administration (FDA) on 11 December 2020 (Pfizer) and 18 December 2020 (Moderna), respectively [48]. Due to limited supplies, certain populations, including HCWs, were prioritized to receive the vaccine first. The FDA subsequently granted full approval for both of these vaccines in August of 2021 (Pfizer, New York, NY, USA), and January 2022 (Moderna) [49][50]. Healthcare workers faced significant challenges during the pandemic, including higher workloads, shortages of personal protective equipment, increased risk of

COVID-19 illness, burnout, and emotional distress [51]. A COVID-19 vaccine would presumably receive widespread support among healthcare workers as a way to provide personal protection and limit viral transmission, morbidity, and mortality. However, studies before vaccine rollout indicated notable hesitancy among HCWs [52][53][54][55][56], with those willing to vaccinate ranging from 29.7–76.9% prior to availability across a variety of countries, including Belgium, Canada, and Italy (**Figure 1**).

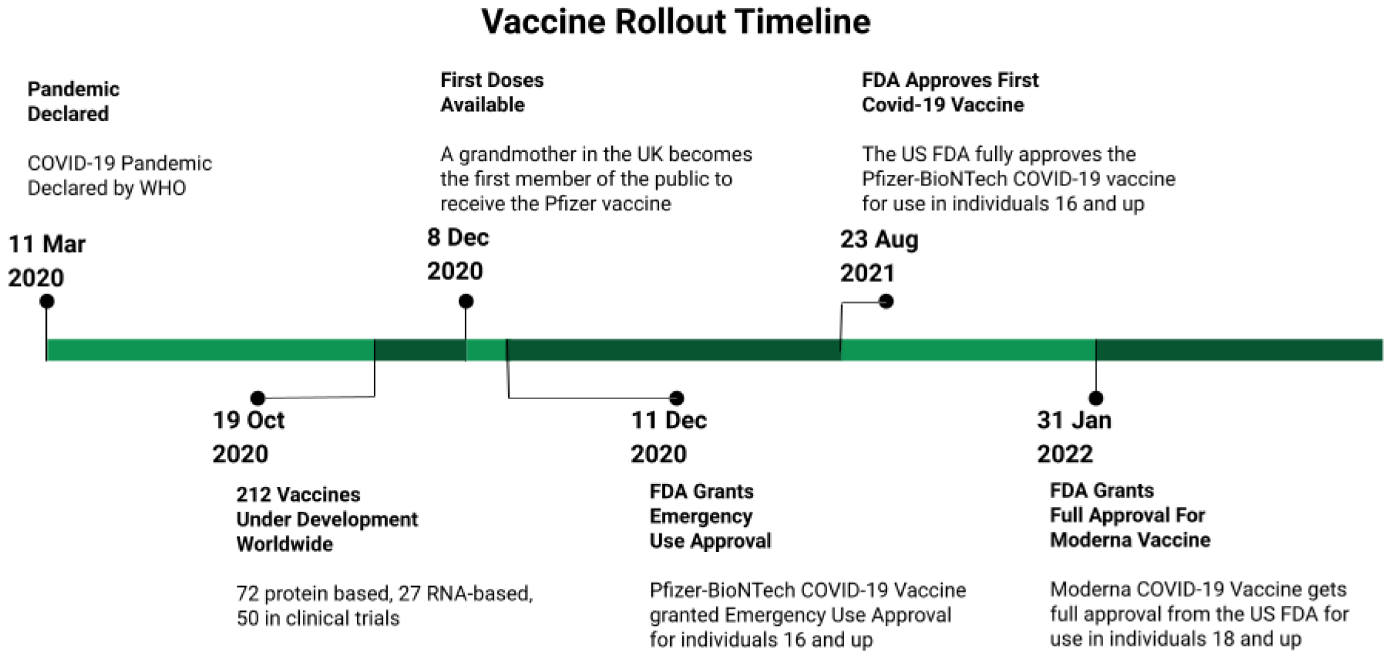

Figure 1. A brief timeline of selected events related to the vaccine rollout.

When vaccines did become available, many healthcare workers were quickly vaccinated. Long-term care facilities were also prioritized, and by 17 January 2021, a median of 37.5% of staff members, and an astonishing 77.8% of residents in long-term care facilities had received at least one dose of the vaccine [57]. Surveillance data from over 2000 US healthcare facilities found at least 50% of workers across facilities were vaccinated by mid-March 2021 [58]. Eventual acceptance varied across the different professions, from vaccination rates as high as 75% among doctors to the lowest rate of vaccine acceptance among a cohort of nurses (56.7%) and nursing aides (45.6%) [59] in March 2021. On the other hand, despite the AMA reporting a 96% vaccination rate among doctors by June 2021 [60] a significant number in the healthcare field chose not to vaccinate, with general rates of vaccination plateauing at 70% in September of 2021, and slowly growing after that to only 77% by December 2021 [61].

Ranges of vaccine hesitancy have been described. For example, Hagood and Herlihy suggest three categories—vaccine-resisting, vaccine-hesitant, and vaccine-rejecting [62]. Other classifications have focused on categories related to hesitancy, such as the 3C (complacency, convenience, and confidence) [63] and 5C models (complacency, confidence, constraints, calculation, and collective responsibility) [64], and the Vaccine Hesitancy Matrix (contextual influences, individual and group influences, and vaccine/vaccination specific issues) [65]. While

these classifications will not specifically be employed here, they indicate the spectrum of attitudes among those who do not readily support COVID-19 vaccination (**Figure 2**).

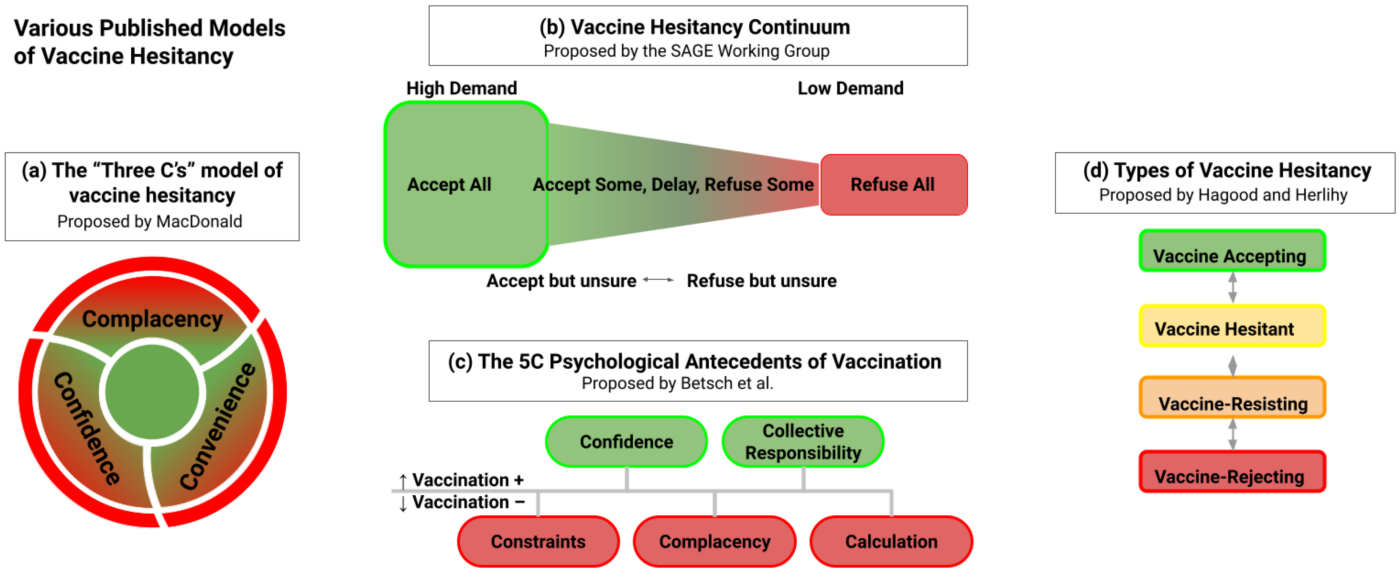

Figure 2. A compilation of the various models proposed to describe vaccine hesitancy. (**a**) The "Three C's" model of vaccine hesitancy proposed by Macdonald, (**b**) "Vaccine Hesitancy Continuum" proposed by Sage Working Group, (**c**) "The 5C Psychological Antecedents of Vaccination" proposed by Betch et al., and (**d**) "Types of Vaccine Hesitancy" proposed by Hagood and Herlihy.

Vaccination hesitancy has persisted despite these vaccines receiving full approval in several countries and hundreds of millions of doses being administered worldwide [66]. As the pandemic has progressed, the discussion has focused on the role of employers and governments in encouraging, if not mandating, vaccination. The discussions around these ideas have interacted with various political and philosophical ideologies and generated discussion, debate, and strong opinions on both sides of the argument [67]. For example, in the United States, attempts to mandate vaccination were met with resistance. In September 2021, the Biden administration announced its intent to mandate COIVD-19 vaccination for HCWs. On 5 November 2021, the Centers for Medicare and Medicaid Services (CMS) also ruled that staff working at Medicare or Medicaid-certified facilities would be required to be fully vaccinated by 4 January 2022, barring an exemption [68]. It was argued that HCW vaccination both protected workers and patients, with data showing reduced infection and transmission in healthcare settings [69]. For example, a large study of Spanish nursing homes found COVID-19 vaccination was associated with an 80–91% reduction in SARS-CoV-2 infections among residents, staff, and HCWs during the 5-month surveillance period [70]. Twenty-four states challenged this ruling with the Supreme Court initially ruling that these states would be exempt from the renewed mandates [71]. On 13 January 2022, the Supreme Court ruled (5–4) that the CMS mandate to be enforced in all states, reversing the interim ruling, with the current deadline for an initial dose being 14 February 2022, with employees fully vaccinated by 15 March [72][73]. Nevertheless, issues around HCW COVID-19 vaccine hesitancy persist and the demographics of these hesitant individuals are varied.

4. Demographics of Vaccine Hesitant HCWs

Demographics of HCWs receiving or declining the COVID-19 vaccine, both before and after vaccine distribution, have been widely studied. Positive predictors of COVID-19 vaccination include caring for COVID-19 patients [74] and male sex [74][75][76]. Negative predictors include occupation as a nurse [74] or working at a skilled nursing facility [77][78]. Two studies were observed.

However, some studies have found contradictory results. For example, some found that younger ages [55][79][80][81] were more associated with vaccination; conversely, others observed the same for older ages [54][82][83]. The reasons for this discrepancy are unclear. Older HCWs would be more amenable to vaccination due to the greater risk for severe disease, whereas younger HCWs may be more hesitant due to greater exposure to social media [84] and may be more prone to risk-taking behaviors [85]. On the other hand, younger HCWs may be more receptive due to more liberal political views compared to older adults [29]. One study noted that older HCWs were more likely to vaccinate across all professions except for physicians, but younger physicians were more likely to vaccinate. The authors suggest this may be due to younger physicians, including house staff, being more involved with patient care than older physicians [83]. Interestingly, some studies noted that older individuals had lower perceived COVID-19 vulnerability than younger HCWs [54][75], which is unusual given that older age is a risk factor for COVID-19 morbidity and mortality [86]. Conversely, the presence of underlying conditions also positively affected vaccine acceptance [81] which may be partly responsible for the observation of greater vaccine acceptance among older individuals, who likely have more comorbidities than a younger demographic group.

Education and scope of practice are also associated with hesitancy; HCWs with more education and advanced practice scope (particularly physicians) were more likely to support vaccination [74][75][79][80][81][87][88] though some studies have found no association [89]. More advanced levels of education may result in a greater understanding of COVID-19 research and more resistance to conspiracy theories. However, some authors suggest that accessing reliable information, rather than education, is a better determinant of acceptance and hesitancy [90]. Indeed, knowledge about the COVID-19 illness and vaccine was also associated with vaccination acceptance [85][90]. This could explain why HCWs with higher education are more likely to vaccinate, although information regarding vaccine safety and efficacy is widely distributed and readily available. Rather, this may be due more to increased experience with the analysis of clinical research in some professions.

Race and ethnicity have been widely studied regarding the pandemic. Much like the general population [91]. Black and Latino healthcare workers generally had higher rates of hesitancy than White HCWs [80][92][93][94] with some exceptions. This has been attributed to several factors, including the previous mistreatment of racial and ethnic groups and socioeconomic disparities [91][95]. Interestingly, one study found no ethnic/racial differences between COVID-19 vaccine acceptance among physicians, suggesting that minority physicians might serve as role models to address hesitancy among other HCWs in their racial/ethnic group [83].

It is unclear if exposure to COVID-19 is associated with increased vaccination since some studies have found a positive association between direct patient care (including care of COVID-19 patients) and vaccination [55][82][83][96],

while others have found greater hesitancy among those caring for patients [97] or no correlation [88][92][98]. One systematic review found that a majority of included studies (20/35; 57.1%) found that caring for COVID-19 patients or having higher risk perception/fear of COVID-19 was associated with decreased hesitancy [99]. Unsurprisingly, vaccinated HCWs also perceived greater benefits from vaccination, including protection from illness [80]. These observations may be due to differences between medical professions, with some studies finding direct exposure leads to lower rates of vaccine hesitancy in physicians [100] and advanced practice providers [79] but not in other healthcare professions. Studies on HCWs with a previous history of COVID-19 infection are also mixed, with some studies finding HCWs were more [101] or less [75] likely to vaccinate. One study found that HCWs in the emergency department were more likely to be vaccinated compared to other departments [84], possibly due to exposure to patients whose COVID-19 status is unknown. Risk perception is considered an important factor in determining vaccine acceptance. Unsurprisingly, some studies have found the perceived risk of COVID-19 was associated with vaccination [54]. However, some studies have found that risk perception was low in a notable number of HCWs. For example, a survey at an Italian medical center observed that 27% perceived that COVID-19 is not dangerous and 65% believed they were not at risk for infection [55]. Another study of HCWs in Saudi Arabia found that 41.9% of respondents had little or no risk of contracting COVID-19 [102]. One study noted that a majority of unvaccinated participants considered themselves at low risk [103]. Furthermore, exposure to COVID-19 might actually make HCWs more complacent toward COVID-19 and decrease their sense of personal risk, possibly due to having “survivorship bias” from direct exposure to COVID-19 [104].

The clinical setting may also have a role. One study noted higher rates of vaccination among HCWs at hospitals (66%) and outpatient clinics (64%) compared to doctor offices (52%), nursing homes, or care facilities (50%). Home health workers had even a lower rate at 26% [105]. Interestingly, some of the highest rates of vaccine hesitancy were observed in nursing homes or long-term care facility staff [106] which care for elderly individuals who are at higher risk for severe disease. For example, one study found that among long-term care staff, only 44.9% were willing to receive the vaccine as of November 2020, with clinical staff less likely than certain non-clinical staff such as house staff and administration (this study included both clinical and non-clinical staff) [107]. Hesitancy has also been noted among HCWs in the military [108] and at rural hospitals [109]. One study found that the only hospital department or setting associated with higher rates of vaccination worked in the intensive care unit (ICU) [110]. Thus, direct exposure to the severe COVID-19 illness, such as in the ICU, may be a stronger motivator for vaccination.

Higher income [111][112][113] and increased years of work experience [111] are positive predictors. Income may be due to associations with higher educational attainment, leadership positions, advancement in career, and greater perceived benefit from continued employment. It may also reflect healthcare leadership, who may feel more pressure or responsibility to vaccinate due to the visibility of their positions and the precedent their vaccination status sets for those they lead.

Previous vaccination habits, particularly regarding influenza, were correlated with support for/receiving COVID-19 vaccination [54][56][76][114][115]. This suggests that hesitancy for the COVID-19 vaccine may be rooted in previous vaccine hesitancy. Nevertheless, some vaccine-hesitant HCWs contend that COVID-19 vaccine hesitancy is a separate issue, in part because they have previously received other vaccines and chosen to vaccinate their

children. This suggests that hesitancy is complicated and cannot always be connected to previous vaccination habits.

Political affiliation is associated with vaccine hesitancy. For example, one study of HCWs in Chicago found a significantly higher rate of vaccination among Democrats than Republicans (63% vs. 19%) [80]. This result mirrors what has been observed in vaccination rates for the general public [116]. This may be for a variety of reasons, although political polarization during the pandemic likely has had a role [117]. This polarization may cause people to reflexively line up along ideological or political party lines rather than assessing decisions individually. Indeed, one author noted that some in the general public may view their vaccine hesitancy as an identity, connecting them with larger groups of individuals who share similar values about vaccination, healthcare, and personal autonomy [118].

Media consumption, particularly social media, has been a major source of speculation and even misinformation regarding the pandemic and vaccination [119]. Some HCWs feel that the media has exaggerated the severity of the pandemic or COVID-19 [110]. A study of Ethiopian healthcare found that social media was more frequently viewed by HCWs as the best source of COVID-19 vaccine information (53.4%) compared to government websites (19.0%) [84]. Some studies have found an association between social media use and COVID-19 vaccine misinformation in the general public [120][121] possibly because these platforms can spread misinformation and isolate users from other sources and arguments. Though misinformation can be spread through these platforms, social media is also used by government and public health institutions, such as the Centers for Disease Control (CDC), to share information about the pandemic. These and other institutions developed campaigns to educate the public about the COVID-19 pandemic and associated public health practices and vaccines. Therefore, it is possible that HCWs are subject to the same social forces that allow for the rapid spread of misinformation through the public at large, and that by virtue of association with certain kinds of people, may end up falling into the same algorithmic echo chambers and disinformation campaigns that promote fringe sources and ideas [122]. This is also interesting, as HCWs presumably have access to more reliable information as “insiders” in the medical community, such as institutional data and subscriptions to academic journals. However, one study found a lack of quality resources as a significant factor in nurses’ hesitation to recommend the HPV vaccine [123]. Therefore, while some HCWs may have access to better information, it is only likely to be useful if these HCWs access, trust, and correctly interpret these sources.

The influence of close social ties has also been examined as a source of hesitancy. Surprisingly, one study found that a history of acquaintances becoming ill, being hospitalized, being admitted to the ICU, or dying from COVID-19 was not associated with vaccine acceptance [85]. Furthermore, if hesitancy was reported in the HCW’s family, friends, or colleagues, the HCW was more likely to also be vaccine-hesitant [85]. It is unclear if this is the result of peer influence on HCW attitudes and vice versa, or if similar attitudes about vaccination tend to cluster together due to social, geographical, or other features. Individuals may also be insulated within groups with similar thinking, thus preventing significant contact with or creating suspicion of outside ideas. This likely occurs to some degree for most individuals, as people tend to interact with those who share similar values and ideas; however, behavioral studies have shown that suspicion and fear decrease, and a more meaningful exchange of ideas between opposing sides can be facilitated by extended contact. Family or household size was also related to vaccine

hesitancy, with larger households being associated with higher rates of hesitancy [110]. Interestingly, HCWs with children were more likely to vaccinate themselves [124][125]. This contrasts with studies of the general population, where parents were less likely to vaccinate compared to non-parents [126][127]. Among parents, being an HCW is associated with a willingness to vaccinate children [128][129]. This has been observed among the general public and may be related to socioeconomic factors [130]. Perceptions of whether vaccines primarily are for individual or community protection may also drive behaviors; those who view vaccines as primarily for individual protection may be less likely to vaccinate to support public health measures [131].

Lack of access or difficulty receiving vaccines has been examined, though this is not likely to be an issue for most HCWs [92]. However, HCWs that work several part-time jobs at multiple facilities have reported finding time to vaccinate more difficult [132]. During the early phase of vaccine rollout when distribution was limited, some HCWs who were not employed by a major hospital or healthcare organization may have lived a significant distance from these sites [104]. Financial barriers to receiving the vaccine are unlikely to be an issue in areas where the vaccine is freely available and where employers will allow for HCWs to be vaccinated.

Finally, it should be noted that HCWs are typically more willing to be vaccinated than non-HCWs [133][134][135][136]. While vaccine hesitancy among HCWs has been described as alarmingly high, the number HCWs who had no intention of being vaccinated typically has been in the minority, ranging from approximately 1–5% [82][133][137][138]. This suggests that many HCWs could be persuaded to vaccinate.

5. Reasons for Hesitancy

Reasons for hesitancy are varied but grouped across several themes in HCWs, many of which are also by the general public. Several of these major themes are discussed here, but this list is not comprehensive (**Table 1**).

Table 1. Representative surveys analyzing vaccine hesitancy.

Author	Survey Date	Country	Participants Number	Response	Author's Conclusion
Verger [53]	October–November 2020	France, Belgium, Canada	2678 (Physicians and Nurses)	48.6%—high acceptance 23.0%—moderate acceptance 28.4%—hesitancy or reluctance Main concern- safety	Must build trust about efficacy and safety

Author	Survey Date	Country	Participants Number	Response	Author's Conclusion
Biswas [99]	February 2020–January 2021 35 different studies	Worldwide	HCW 76,741	22.51% hesitant Range 4.3–72.0% Main concerns: side effects, safety, efficacy	Education and policy-based interventions are needed to ensure vaccination
Meyer [139]	December 2020	United States	HCW 16,292	55.3% will receive 16.3% will not 28.4 % unsure Intentions to receive increased after EUA recommendation	Highly visible information from experts may increase intent
Pal [140]	February–March 2021	United States	HCW 1374	7.9% hesitant Mistrust important factor 83.6% would accept an annual booster	Concerns about safety and efficacy and lack of trust underlie hesitancy
Bell [103]	January 2021	United Kingdom	HCW SCW 1917	6.6% declined vaccine offer Complex analysis of characteristics of participants	Authors offer detailed policy recommendations
Woolf [141]	April–June 2021	United Kingdom	HCW	18% favored mandatory vaccination	Building trust with education and support

Author	Survey Date	Country	Participants Number	Response	Author's Conclusion
			5633 total 3235 answered free text question		may be effective with hesitant HCW
Janssen [81]	December 2020–March 2021	France	4349 HCWs	Online survey presenting hypothetical scenarios for efficacy, longevity, and adverse events. Quantified the effect of each on willingness.	Fear of adverse events was main concern, hesitancy decreased with time. Reassurance about adverse events is important.
Choi [142]	March–May 2021	United States	2948 HCWs surveyed, with semi-structured interviews	Nurses less likely than physicians to see vaccine as safe or effective. Many claiming vaccines unnecessary or unsafe.	Stressed education and mandates

HCW—health care workers, SCW—social care workers, EUA—emergency use authorization.

fect.

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