

# Experience of COVID-19 Vaccination of Healthcare Workers in a Hospital Setting

Tariq Azamgarhi (✉ [tariq.azamgarhi@nhs.net](mailto:tariq.azamgarhi@nhs.net))

Royal National Orthopaedic Hospital

Michelle Hodgkinson

Royal National Orthopaedic Hospital

Ashik Shah

Royal National Orthopaedic Hospital

John Skinner

Royal National Orthopaedic Hospital

Tim Briggs

Royal National Orthopaedic Hospital

Iva hauptmannova

Royal National Orthopaedic Hospital

Simon Warren

Royal National Orthopaedic Hospital

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## Article

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# Abstract

**Introduction** Several COVID-19 vaccines against SAR-CoV-2 have demonstrated high efficacy in clinical trials. This is the first report describing their use in a healthcare setting.

**Methods** We conduct a single centre observational study assessing vaccine uptake and apparent efficacy of the Pfizer BioNTech vaccine among healthcare workers (HCW).

**Results** Overall uptake was 60.8%, however we saw statistically significant differences in uptake between age groups, ethnic origins, and job roles. In the 42 days after vaccination, 45 new cases of COVID were identified, of which 4 (8.9%) occurred in HCWs who were beyond 10 days of vaccination. Kaplan Meier curves for vaccinated and unvaccinated groups were congruent until day 14 and continued to diverge up to 42 days. Cox regression analysis showed a 79.0% (95%CI 21 – 95; p=0.02) risk reduction for COVID infection in vaccinated HCWs.

**Conclusions** Initial vaccination rates among HCW were generally good, although uptake was lower in certain groups and efforts should focus on increasing uptake in these groups. The Pfizer BioNTech vaccine is effective from 14 days post-vaccination in a frontline clinical setting and protection continues beyond 21 days post 1st dose without a 2nd dose, being given.

## Introduction

COVID-19 has had a significant impact on populations worldwide. Healthcare workers (HCW) have been disproportionately affected and therefore been designated a high priority group for vaccination by the Joint Committee on Vaccination and Immunization (JCVI) [1]. Vaccines have been shown to be highly effective in clinical trials with several now approved for clinical use [2] [3] [4]. However, vaccine uptake and apparent efficacy in an NHS healthcare setting has not yet been described. Here we describe early experience of vaccinating HCW at a single center in London.

## Methods

We assessed uptake of COVID-19 vaccinations among HCWs at our tertiary hospital. At the time, we were treating COVID-19 patients in three wards and in an expanded ITU. All staff were offered a first dose of the Pfizer BioNTech vaccine at our onsite vaccination center over an 8-day period up to 14th January 2021 [5]. Vaccines were administered by trained peer-vaccinators in accordance with the National Protocol or by patient specific direction [6]. Our online booking system was accessible to all RNOH HCWs and was used to manage vaccination appointments. At the time of vaccination, a minimum dataset was uploaded to the National Immunization and Vaccination System (NIVS). All staff were observed for a minimum of 15 minutes post-vaccination in accordance with the MHRA temporary authorisation for

Pfizer BioNTech vaccine and were asked to report any serious adverse events to the vaccination team or occupational health.

Human resource records containing baseline characteristics including age, gender, ethnicity, and job role for all RNOH HCWs were collected. Contractor companies provided the same dataset for HCWs working onsite but not directly employed by the RNOH. We identified all HCWs who received the vaccine using data submitted to NIVs. Staff were asked to provide details of vaccination if they received it elsewhere.

All cases of laboratory confirmed COVID were reported to Occupational Health. New cases included symptomatic infection and asymptomatic cases identified through mandatory fortnightly screening of all HCWs working onsite. All HCWs were routinely asked questions relating to potential exposures and contacts, and more recently whether they had received a vaccine. New cases identified after the start of vaccinations were categorised as either: occurring within 10 days of vaccination, more than 10 day after vaccination or in an unvaccinated individual. A 10-day cut-off was chosen because it matches the criteria recommended by PHE for enhanced COVID surveillance [7]. We calculated a rolling 7-day average of new cases for our hospital for comparison with reported regional London data [8].

## **Statistical analysis**

We summarised data using descriptive statistics. Categorical data on baseline characteristics were compared using Pearson's Chi-Square test.

We applied survival analysis to investigate the impact of COVID-19 vaccination on new COVID cases. The outcome variable was time to infection, constructed as the time between vaccination and symptom onset or time of first positive test if asymptomatic (failure). A start date of 5th January 2021, coinciding with the start of the RNOH vaccination programme was used for unvaccinated HCWs. All HCWs not infected on 16th February 2021 were censored. The Kaplan-Meier method was used to plot cumulative hazards for vaccinated and unvaccinated groups. In the phase 2/3 safety and efficacy study of the Pfizer BioNTech vaccine, it was demonstrated that COVID-19 vaccination would unlikely have an impact on COVID infections until Day 14 post-vaccination [3]. Statistically this means that the hazards are unlikely to be proportional. There may be expected to be no effect in the first 13 days, followed by an effect after this. To allow for the likely non-proportional hazards, two sets of analyses were performed. The first set compared the groups from Day 0 to Day 13. A second set of analyses compared the groups with the start point being Day 14, up until the end of the follow-up period. As it is unlikely that patients would have more than one COVID infection in such a short space of time, staff with a COVID-19 infection with the first 13 days, in both groups, were omitted from the analysis of the second period. Due to the survival nature of the outcome, the analyses were performed using Cox regression for both time periods, two analyses were performed. Initially a simple 'unadjusted' comparison between vaccinated and unvaccinated groups was made. Subsequently, the groups were compared adjusting for demographic details found to vary significantly between groups.

## Results

We vaccinated 1,373 (60.8%) out of a total 2,257 HCWs working at RNOH. The split by age, sex, ethnicity, and staff group are shown in Table 1. Uptake was higher for male (65.0%) than females (58.9%) ( $p = 0.006$ ). Statistically significant differences were seen between ethnic groups with Whites and Asians more likely to be vaccinated but only 27.0% of Black / Afro-Caribbean and 43.0% of mixed-race staff being vaccinated ( $p = 0.001$ ). Differences were also seen between staff groups with only approximately half of nursing (52.9%) and clinical support (49.2%) staff, and even fewer portering, domestic and catering staff (30.5%) were vaccinated ( $p = 0.001$ ).

The number of new cases identified at the RNOH since October 2020 are shown in Fig. 2. There were 45 new cases identified in the 42 days following the start of vaccinations. Of these, 25 (55.6%) were unvaccinated, 16 were within 10 days of vaccination and 4 (8.9%) were beyond 10 days of vaccination.

Figure 3 shows the Kaplan Meier curves of new cases identified in vaccinated and unvaccinated groups. The curves appear to be congruent from day 0, then starts to diverge at day 14, then continues to diverge up to day 42. Separate Cox regression analyses performed for the two stages of the follow-up period, for vaccinated and unvaccinated groups are compared in Table 2. There was no significant difference between groups for the first 13 days of follow-up. This was the case in both the unadjusted and adjusted analysis. For the second follow-up period from Day 14 onwards both the unadjusted and adjusted analyses suggested a statistically significant difference between the two groups. The risk of infection was significantly lower in those receiving vaccination. The demographic-adjusted analysis risk of an infection at any time was only 0.2 times as big in the vaccinated group. This equates to an 80.% (95%CI 21–95;  $p = 0.02$ ) reduction in the risk of infection in the vaccinated group.

No serious adverse events were reported in our staff and we submitted no yellow cards to the MHRA.

Table 1  
Comparing baseline characteristics in vaccinated and unvaccinated groups.

Baseline Characteristic	Total N=	Vaccinated with BNT162B2 n= (%)	Unvaccinated n= (%)	p-value
Total	2257	1373 (60.8)	884 (39.2)	
Sex no. (%)				
Male	728	473 (65.0)	255 (35.0)	0.006
Female	1529	900 (58.9)	629 (41.1)	
Race or ethnic Group				
White	1105	778 (70.4)	327 (30.0)	< 0.001
Asian	583	391 (67.1)	192 (32.9)	
Black or Afro Caribbean	378	102 (27.0)	276 (73.0)	
Chinese	19	13 (68.4)	6 (31.2)	
Mixed	60	26 (43.3)	34 (56.7)	
Other	70	48 (68.6)	22 (31.4)	
Unknown	42	15 (35.7)	27 (64.3)	
Age Group				
16–34 year.	601	304 (50.6)	297 (49.4)	< 0.001
35–54 year.	1189	768 (64.6)	421 (35.4)	
> 55 year.	467	329 (74.4)	138 (29.6)	
Staff group				
Administrative and Clerical	635	454 (71.5)	181 (28.5)	< 0.001
Nursing	501	265 (52.9)	236 (47.1)	
Allied Health Professionals	244	184 (75.4)	60 (25.6)	
Clinical support staff	236	116 (49.2)	120 (50.8)	
Surgeons and medics	233	177 (76.0)	56 (24.0)	
Portering and catering	226	69 (30.5)	157 (69.5)	
Professional scientific and technical staff	186	112 (60.2)	74 (39.8)	

Table 2

Comparison of time to COVID-19 infection in Unvaccinated and Vaccinated staff

Follow-up period	Analysis	Vaccinated with BNT162B2 n / N	Unvaccinated n/N	Hazard Ratio (95% CI) (+)	P-value
Up to Day 13	Unadjusted	16 / 1374	13 / 884	0.79 (0.38, 1.64)	0.53
	Adjusted (*)	-	-	1.28 (0.55, 2.94)	0.64
Day 14 onwards	Unadjusted	4 / 1358	12 / 871	0.23 (0.07, 0.70)	<b>0.01</b>
	Adjusted (*)	-	-	0.20 (0.05, 0.79)	<b>0.02</b>
(*) Adjusted for: age, sex, staff group and ethnicity. HCWs with unknown ethnicity were excluded from the analysis.					
(+ ) Expressed as hazard of COVID in Vaccinated group relative to Unvaccinated group.					

## Discussion

Overall vaccine uptake was 60.8% in our hospital. Whilst this is encouraging it is unclear what proportion need to be vaccinated to confer herd immunity. Several estimates have put the proportion between 70–80% across a population [9]. It is likely that the current rate will provide some protection against nosocomial spread, but hospital populations are dynamic with patients, often with relatives or carers, attending frequently. Therefore, it remains uncertain whether there will be an impact on the recommended level of infection prevention & control precautions.

We saw differences in uptake between groups. There was little difference between the sexes, but staff were more likely to be vaccinated with increasing age. This may be important if there are areas where staff are typically younger, for example general wards.

We saw lower uptake in nursing and clinical support staff, but the lowest rates were seen in portering, domestic and catering staff, all of whom are potentially more at risk of coming into close contact with patients with COVID or their environment.

It was striking that uptake is lower amongst Black / Afro-Caribbean staff and those of mixed heritage. This is concerning as these groups have been disproportionately adversely affected by COVID and potentially remain at risk. Additionally, these groups are over-represented amongst the staff groups above. Furthermore, London has a higher proportion of staff from these groups when compared with the rest of the UK which may have an impact on a health service level [8].

It is clear that, to improve uptake, more work is needed to understand the reasons why it is lower in certain groups. It would be important to know whether this represents an issue with access or whether there is

true hesitancy in receiving the vaccine and if so, what are the reasons why staff may not wish to be vaccinated. Some work has already begun around this nationally [10]. We are currently conducting a survey locally to explore reasons. We are also conducting small focus groups and other engagement sessions over the coming weeks.

We did not see any serious adverse events and we did not routinely collect data on minor side effects. Consequently, we do not have enough data from our cohort to make reliable conclusions around safety, however, early indications are that the Pfizer-BioNTech vaccine appears to be safe.

Our 7-day rolling average of cases mirrored the London 7 day rolling average. This is not surprising as our hospital falls within the London area and suggests that a substantial proportion of cases amongst our staff reflect what is happening in the local community rather than nosocomial spread within our institution. Our rate appeared to rise, peak, and start to fall slightly before the London rate, and we do not have an explanation for this. We saw relatively fewer cases after Christmas and during the first 2 weeks of January and we postulate that this was for 2 main reasons. Firstly, the onsite testing centre closed for a period over Christmas & New Year. Secondly, we suspect there was an effect due to more staff than usual being on annual leave.

Once the vaccination campaign began a clear difference in the groups testing positive for COVID began to emerge. Cases initially occurred in the unvaccinated and recently vaccinated groups, however, the groups diverged by 14 days with almost all subsequent cases occurring in the unvaccinated group. This appears to be similar to what was reported in the initial efficacy study and most likely reflects the development of an effective immune response in the vaccinated group [3]. It is reassuring that the survival analysis beyond 14 days, showed an 80% lower risk of COVID infection in vaccinated HCWs. Although this is a statistically significant difference in risk, there is a large amount of uncertainty around our estimate, with the 'true' risk reduction being anywhere from 21–95%. Larger studies are required to verify our findings.

Importantly, our small study shows that the protective effect of this vaccine continues beyond 21 days in an hospital setting following the first dose. This is reassuring given that the National Strategy is to delay administration of the 2nd dose of the vaccine to 90 days [11].

## **Conclusion**

Initial vaccination rates among HCW were generally good although uptake was lower in certain groups and efforts should focus on increasing uptake in these groups.

The Pfizer BioNTech vaccine is effective from 14 days post-vaccination in a frontline clinical setting and protection continues beyond 21 days post 1st dose without a 2nd dose, being given.

## **Declarations**

**Conflict of interest** the authors declare that there are no conflicts of interest. The review was signed off locally as service evaluation.

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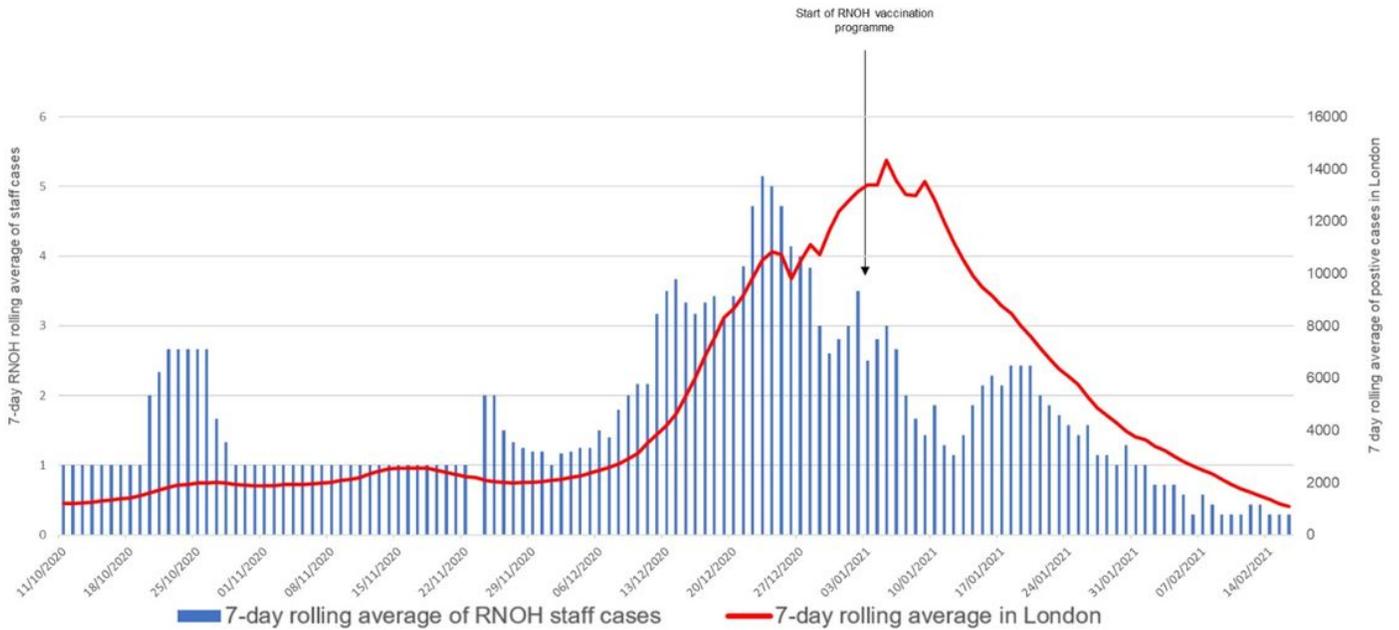
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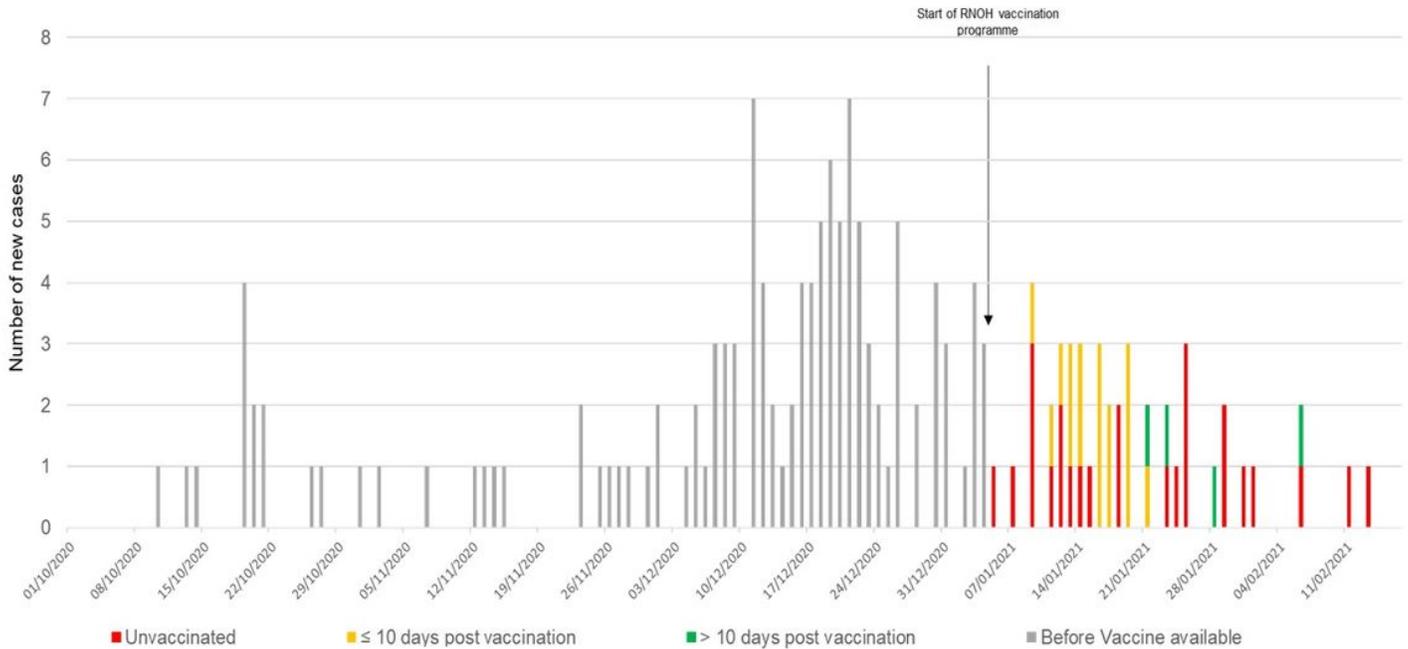
## Figures



London, included people with at least one positive COVID-19 test result (either lab-reported or lateral flow device). RNOH only included staff with no previous positive test within 90 days. London reported by specimen date. RNOH reported by date of symptom onset or specimen date if asymptomatic.

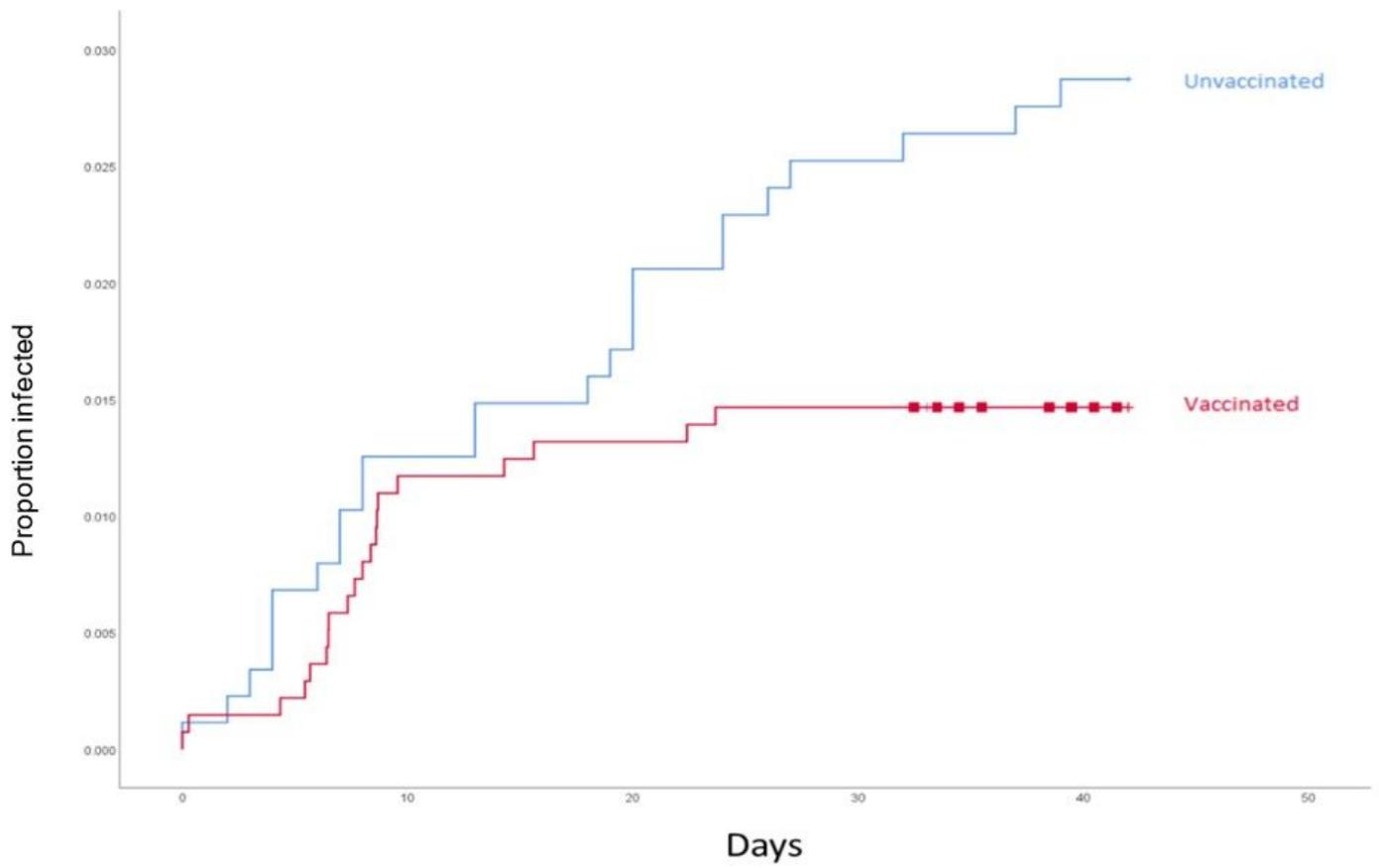
**Figure 1**

shows the 7-day rolling average cases for our hospital compared with the London region average.



**Figure 2**

shows actual cases in our hospital split by staff who were unvaccinated and staff who had received the vaccine more or less than 10 days prior.



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**Figure 3**

Kaplan Meier curves demonstrating the cumulative hazards of COVID in vaccinated and unvaccinated groups.