

## ORIGINAL ARTICLE

## Variations in administration of Covid-19 vaccine during last 20 weeks at a vaccination center of Agra, Uttar Pradesh

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### Abstract

**Background:** Covid-19 pandemic has created havoc around the world and vaccination is an effective tool against this demon. Study of variations in administration of daily doses of Covid-19 vaccine at vaccination centre can help in better resource management. **Material & methods:** This record based descriptive study was conducted among beneficiaries of Covid-19 vaccination at S. N. Medical College, Agra. Record of administration of daily doses and vaccine wastage, vaccination of different groups of beneficiaries and occurrence of various national and local events related to vaccination was also analyzed. **Result:** A total of 33,571 doses of any Covid-19 vaccine (Covaxin/Covishield) were administered during past 88 working days in 20 weeks expanded over 5 months. On an average 165 doses were administered every day by each team and overall vaccine wastage was 0.85%. Maximum average of 199 doses per day by each team was observed on Mondays. There are many peaks and drops in administration of daily doses of Covid-19 vaccine at our center which can be attributed to either some national or local events related to supply of vaccine at our center, addition of a new group of beneficiary, any news or political controversy related to Covid-19 vaccination etc. **Conclusion:** Understanding of spikes and drops in the curve of daily/weekly administration of Covid-19 vaccine, in view of occurrence of various national and local events related to vaccination, can help in better formulation of strategies specially related to human resource allocation for success of National Covid-19 vaccination program.

### Keywords

SARS CoV-2, COVID-19 vaccination, Covid-19 vaccine, Vaccine wastage, COVID-19 vaccination center (CVC)

### Introduction

Since the beginning of the COVID-19 pandemic in 2020, more than 3.5 million lives have been lost and the global society has been disrupted in an unprecedented manner(1). After trying many therapeutic modalities with

partial or no success, prevention seems to be a better bet to halt the rapid progression of the pandemic. World Health Organization (WHO) recommended non-pharmaceutical preventive strategies like social distancing, regular use of facial mask, frequent hand sanitization and travel restrictions are successfully used by

various countries for protection of their citizen against Covid-19 infection(2). In view of current scenario, many countries and pharmaceutical companies have galvanized the development of a number of vaccines that have received emergency use authorization from regulatory bodies of various countries(3).

Two such vaccines were granted emergency use authorization by the Central Drugs Standard Control Organization (CDSCO) in India, Covishield® (AstraZeneca's vaccine manufactured by Serum Institute of India) and Covaxin® (manufactured by Bharat Biotech Limited) in January 2021(4). Third vaccine Sputnik - V has also been granted EUA in the month of April 2021(4).

Covid-19 vaccination in India as well as in our institution was started on January 16, 2021. Various groups like Health Care Workers (HCWs), Front Line Workers (FLWs), person's aged 60 years & above, 45-59 years & above and 18-44 year were covered in phased manner(5).

Since the start of Covid-19 vaccination in India, questions are frequently raised regarding ability of government of India to protect all its 1.3 billion citizen through vaccination by the end of this year(6,7,8). On one hand, government is leaving no stone unturned to meet this gigantic demand but on the other hand, judicious use of available vaccine doses is need of the hour as vaccine wastage has emerged as one of the biggest challenge for most state governments of India. Inadequate training of vaccinators in drawing vaccine from multi-dose vials and lack of detailed planning at vaccination sites are identified as two key gaps that have led to vaccine wastage levels in some of these states above the national average of 6.5%(9,10).

Though Covid-19 vaccination is running successfully at our institution, a need was felt to analyze the variations in daily vaccination and vaccine wastage for better resource management at our center.

## Aim & Objective

To analyze variations in administration of COVID-19 vaccine and to recommend suitable suggestions based on the study findings.

## Material & Methods

**Type of study:** This is a record based descriptive type of study, **Study population:** The study was conducted among beneficiaries of Covid-19 vaccination, **Site of study:** Covid-19 Vaccination Center (CVC) of S. N. Medical College, Agra was the site of study, **Duration of study:** The data collected over 5 months between January to May, 2021 was used for this study, **Sample size calculation:** This is a record based study and data of all the beneficiaries attending Covid-19 vaccination center (CVC) at S. N. Medical College, Agra over the stipulated time-frame was taken into account for purpose of this study, **Methodology:** The present study is a record based descriptive study. Covid-19 vaccination in India as well as in our institution was started on January 16, 2021. In

phase one, vaccination of the most priority group i.e. health-care workers (HCWs) was started initially which later on expanded to include front line workers (FLWs) in the month of February. Later on, vaccination of individuals aged 45 years and above was started in phase two in March 2021 while vaccination of 18-44 year old persons was started in third phase at the start of month of May. In the beginning, 4 teams were formed in our institution by which vaccination was done only once a week but gradually vaccination days were increased to 2, 3, 4 and 5 days a week. By the month of March, vaccination days were increased to 6 per week while number of teams was reduced to 2. Each Covid-19 vaccination team originally constituted by Chief Medical Officer (CMO), Agra has 6 members: vaccinator officer-1 (security personal), vaccinator officer-2 (verifier), vaccinator officer-3 (mobilizer), vaccinator officer-4 (home guard), vaccinator and additional vaccinator (ANM/GNM). Additionally, nodal officers, security guards, computer operators, class-IV staffs and cleaning staffs were also appointed by college administration vis-à-vis work load of daily vaccination.

The COVID-19 Vaccine Intelligence Network (Co-WIN) system, a digital platform was used to track the enlisted beneficiaries for vaccination and COVID-19 vaccines on a real-time basis. At the vaccination site, only pre-registered beneficiaries were vaccinated as per the prioritization, and there was no provision for on-the-spot registrations(11). With roll out of second phase of vaccination, CoWIN 2.0 portal was launched enabling eligible beneficiaries to self-register and book a slot in addition to on-the-spot registration at CVC(12).

During the last 20 weeks, beneficiaries were given either Covaxin or Covishield at our CVC ensuring second dose of same brand of vaccine as first dose. Though both brands of vaccines were supplied to us at different times, Covaxin was available at our CVC during most of the period of study. In-fact, our CVC is locally well known for administration of Covaxin to vaccine beneficiaries. Both Covaxin and Covishield is given in two doses i.e. first and second dose keeping interval of minimum 4 weeks between 2 doses. Interval between 2 doses of Covishield has now increased to 12-16 weeks while interval between 2 doses of Covaxin is still 4-6 weeks. Record of daily vaccination at our CVC was maintained electronically since the beginning. Factors like late supply of vaccine in the morning, glitches in start of a session at CoWIN app, absence/day-off of a vaccinator/verifier were also observed but their effect on day to day variations in vaccination was mostly mitigated by appropriate early interventions and thus probably have no effect in weekly and monthly variations in Covid-19 vaccination.

Various national and local events related to vaccination like addition of a new group of beneficiary, availability/absence of a particular type of vaccine at our CVC, formidable second wave of Covid-19 pandemic in Agra city, occurrence of festivals like Holi and Nav-ratri

etc. were also recorded. An analysis of weekly variations was done in respect to such Covid-19 vaccination related events.

Despite best of the efforts, vaccine wastage happens in all programs chiefly during transportation, storage and at vaccination centers. Covaxin in India was introduced as 20-dose vial while Covishield was launched as 10-dose vial. Later-on, 20-dose vial was replaced by 10-dose vial of Covaxin to minimize vaccine wastage. A vial of COVID-19 vaccine has to be used within a fixed time period (4 hours) after opening it. If 10 people are not available to get inoculated during the time period, then the left over doses is wasted.

All the data thus collected was entered in Microsoft Excel daily which was later on clubbed to analyze weekly and monthly trends in Covid-19 vaccination. As for other descriptive studies, percentages and proportion were used to analyze the data. Results were compared with available studies and inferences were drawn based on the findings of the study.

## Results

A total of 33,571 doses were inoculated during past 88 working days in 20 weeks expanded over 5 months. (Table 1) shows distribution of Covid-19 vaccine type (Covaxin and Covishield) and dose (first and second) in different population sub-groups. Accordingly, 5312 doses were administered to HCWs, 3485 to FLWs, 7531 to person above sixty years of age, 11007 doses to persons aged 45-59 years and 6236 doses were given to persons aged 18-44 years. Of the total, 65% were first doses while 35% were second doses. Three fourth of vaccine doses administered at our CVC were Covaxin while one fourth were Covishield. Reason for usage of a particular brand of vaccine is mostly administrative and is related to availability/supply of vaccine at that time (Table 2).

### Daily variation in Covid-19 vaccination

It was observed that minimum 41 doses of Covid-19 vaccine were administered on January 16th 2021 (first day of vaccination) while maximum 850 doses of doses were administered on May 10th 2021 (first day of vaccination among persons below 45 years of age). (Table 2) shows that a total of 33,571 doses of Covid-19 vaccines were inoculated during past 88 working days. In the start; 4 teams were formed for Covid-19 vaccination (except for day 1 when only one team was assigned for vaccination) but number of teams was reduced to 2 in later stage. Total team-days of Covid-19 vaccination were 203 while daily average of vaccination per team was calculated to be 165 doses per day by each team. There are many peaks and drops in daily coverage of Covid-19 vaccination at our center which is evident from the (Figure 1).

Days-wise distribution of Covid-19 vaccination shows that maximum vaccine doses were given on Fridays followed by Mondays and Thursdays (Table 3). This do not represent true picture of daily vaccination as in first phase

only Fridays and Thursdays were chosen for Covid-19 vaccination. When calculation of work load was done it was observed that maximum 199 doses (Figure 2) were administered on an average by each team on Mondays while only 132 doses were administered on Thursdays and 130 were administered on Sunday (which was the only working Sunday till date and was incidentally the first day of 4-days long Tika Utsav).

### Weekly variations in Covid-19 vaccination

In the beginning; vaccination was done only once every week which was later on increased to 2-3 days per week and later on maximized to 6 days a week in the month of March except for 3rd week of April where vaccination sessions were also held on Sunday to celebrate Tika-Utsav (Vaccine Festival). Graph 3 shows that weekly Covid-19 vaccine coverage at S. N. Medical College, Agra was increased from 41 in first week to 3,440 at the end of the 20th week. A total of 33,571 doses were inoculated during past 20 weeks with an average of 1679 doses per week (Table 2).

Weekly Covid-19 vaccination graph shows four distinct peaks (Figure 3).

First peak at 8th week of vaccination corresponds to rising public confidence in vaccine as Prime Minister himself took first dose of indigenous vaccine Covaxin (Table 2). Facility of on the spot registration of individuals aged more than 60 years and individuals between 45-59 years with specified co-morbidities in addition to abolition of previous strategy of vaccination from pre-fixed list of beneficiaries only was also started in this week. COWIN 2.0 app was launched at the start of second phase of vaccination drive resulting in quicker vaccination process with inoculation of much larger number of doses by each team per day.

Second peak at 10th week was probably attributed to strategy of vaccination on 6 days a week (except Sunday) even on Gazetted Holidays. Extensive electronic and print media coverage of vaccine administration to local prominent public figures like city Mayor, state Minister, elected Members of Legislative Assembly (MLAs) etc. at our CVC during 9th and 10th week also led to rush of common public to our center for Covid-19 vaccination.

Third peak at 13th week coincide well with administration of second dose of vaccine to Prime Minister and start of vaccination of all individuals aged 45 years and above thus removing necessity of co-morbidity in this group as a criteria of eligibility for Covid-19 vaccination.

Fourth peak at 19th week has some interesting finding as availability of Covaxin seems to improve the vaccination numbers over the previous week which incidentally was the first week of Covid-19 vaccination for 18-44 years age group in Agra district.

### Monthly variation and vaccine wastage in Covid-19 vaccination

Total number of doses of Covid-19 vaccine administered at our institution significantly increased from 765 in

month of January to 13628 in May (till 30th May 2021). Maximum 374% increase was observed between month of February (1922 doses) and March (7194 doses) which can be attributed to drastic expansion of beneficiary base (with addition of people aged 60 plus and 45 plus with specified co-morbidities) and increase in number of vaccination days from 3 to 6 in the month of March.

With increase in number of vaccine doses administered per month, wastage of vaccine decreased sharply (Figure 4). Overall 289 doses of Covid-19 vaccines were wasted among 33860 doses utilized by us leading to less than one percentage vaccine wastage at our institution. In the beginning, vaccine wastage was quite high i.e. 4.37% and 3.42% in month of January and February respectively which was decreased to less than two percentages in the month of March. Drastic decrease in vaccine wastage to a level of 0.18% and 0.16% was observed in the month of April and May respectively (Table 4).

Vaccine wastage was nil from April 2nd to May 8th but again rose due to re-introduction of pre-fixed list of beneficiaries in the age group of 18-44 years. After 7 days of hitch, we were again able to achieve zero wastage by ensuring 10 persons before opening of a vaccine vial to ensure no wastage at all.

## Discussion

Overall first dose outnumbered second dose which might be due to recent surge in pace of vaccination in different groups, recent increase in gap between 2 doses of vaccine (specially Covishield) and omission of second dose by many due to side effect, forgetfulness or any disease/Covid-19 after first dose. Difference in vaccine type among various groups is mostly due to administrative reason like availability of vaccine rather than their choice. Lately, many persons chose our center for Covid-19 vaccination as Covaxin was mostly available at our place during entire period of the study.

Though increase in administration of monthly, weekly and daily doses of covid-19 vaccine seems significant over the period, this curve is far from smooth. There are many peaks and drops in administration of daily doses of Covid-19 vaccine at our center which can be attributed to either some national or local events related to supply of vaccine, addition of new group of beneficiary, political controversy or news related to Covid-19 vaccination etc. as mentioned in the table 2. Relative scarcity of a particular brand of vaccine like for example absence of Covaxin at our CVC for first dose during 14th and 20th week of vaccination was associated with a sharp decrease in number of average weekly vaccine doses administered at our CVC.

Apart from that a lower vaccine dose administration on Thursday can be attributed to deep rooted myth in local society where a person is not supposed to visit any hospital on a Thursday out of fear of repetitive frequent visits to the hospital. Similarly, lowest turnout on Sunday depicts common public perception of a non-working day.

CVC staff also need one day break at the end of the week to avoid burnout due to continuous work for more than 8 hours each day.

Overall vaccine wastage of Covishield at our CVC was 1.77% while wastage of Covaxin was 0.54% which is well below the district average of 2.77% for Covishield and 1.17% for Covaxin(21). In the beginning, vaccine wastage was quite high i.e. 4.37% and 3.42% in month of January and February respectively as a pre-fixed list of beneficiaries for Covid-19 vaccination were provided to us at the start of each day and we had no authority to add potential beneficiary to minimize wastage at our level. Later on, with start of on spot registration of persons above 60 years and 45-59 years with co-morbidity, wastage of vaccine was decreased to less than two percentages in the month of March. Drastic decrease in vaccine wastage to a level of 0.18% and 0.16% was observed in the month of April and May respectively partially due to immense administrative pressure in addition of full flexibility in enrollment of beneficiaries at our level.

## Conclusion

Though Covid-19 vaccination rate at our center has steadily increased over the period of time, the curve is not smooth. Spikes and drops in daily/weekly administration of Covid-19 vaccine can help in formulation of strategy for success of program. Regular supply of a particular brand of vaccine at a designated CVC should be ensured otherwise daily/weekly vaccine dose administration decreases whenever people don't get the specific vaccine which they are supposed to get at that center routinely. Extra man power like security staff, vaccinator etc. can be deployed in view of increase in expected number of beneficiaries especially on Mondays and after announcement of start of vaccination for some special group of people. Grant of leave to vaccination staff can also be better managed keeping in view the expected vaccination load on different days of the week. Addition of a special service like vaccination camp or special group invitation can be restricted to Thursdays and Fridays only. Vaccine wastage can be reduced by ensuring 10 persons before opening of a vaccine vial. Alternatively, re-registration of those who had missed their pre-booked slot on previous day can be allowed during next session to minimize wastage without troubles of re-booking.

## Relevance of the study

Covid-19 vaccination is at highest priority of government of India and optimization of available resources is the key for success of program. The present study highlights need of microplanning for better outcome at the CVC.

## Authors Contribution

All authors contributed equally.

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**Tables**

**TABLE 1 COVID-19 VACCINATION IN DIFFERENT GROUPS OF POPULATION**

Group	Dose		Vaccine		Total
	First	Second	Covishield	Covaxin	
Health Care Workers (HCWs)	3003	2309	2646	2666	5312
Front Line Workers (FLWs)	1450	2035	818	2667	3485
Persons aged 60 years & above	4362	3169	211	7320	7531
Persons aged 45-59 years	6759	4248	723	10284	11007
Persons aged 18-44 years	6236	0	4040	2196	6236
Total	21810	11761	8438	25133	33571

**TABLE 2 WEEKLY COVID-19 VACCINATION AND SOME SIGNIFICANT NATIONAL/LOCAL EVENTS OF THE WEEK**

Week	Total doses given in week	Vaccination days in week	Total team-days in week*	Daily average per team in week	Significant national/local events in the week
1	41	1	1	41	Pre-fixed list of beneficiary <sup>(11)</sup> , Apprehension of new vaccine, Political controversies <sup>(13,14,15)</sup>
2	118	1	4	30	Pre-fixed list with once a week vaccination, Rumours of serious side effects or death after vaccination <sup>(16,17)</sup>
3	606	2	8	76	Rising confidence in vaccine and two days per week vaccination
4	431	2	8	54	Vaccination of HCWs only with some repetitions in the list
5	490	2	8	61	Vaccination of FLWs at our CVC
6	438	3	11	40	Many repetitions in beneficiaries list, Mostly second dose for HCWs
7	563	3	12	47	Many repetitions in beneficiaries list, Mostly second dose for HCWs
8	1744	4	11	159	Rising confidence in vaccine, PM took first dose of Covaxin <sup>(18)</sup> , No pre-fixed list of beneficiaries, vaccination for 60 plus and 45 plus comorbid started, User friendly COWIN 2.0 app launched <sup>(12)</sup>
9	1398	5	10	140	Number of vaccination teams reduced from 4 to 2, 6 days a week vaccination except GH
10	2262	6	12	189	6 days a week vaccination even on GH, Local public figures got vaccinated
11	1582	6	12	132	Holi-dip before festive season
12	1570	4	8	196	Announcement of vaccination for all 45 plus individuals
13	3180	6	12	265	PM took second dose of vaccine <sup>(19)</sup> , very high turnout of 45 plus individuals
14	2150	7	14	154	Tika-Utsav, Nav-ratri festival, No Covaxin for first dose
15	1930	6	12	161	Nav-ratri festival (9-days fast)
16	1610	6	12	134	Lock-down started, Second wave of Covid-19 pandemic at its peak in Uttar Pradesh <sup>(20)</sup>
17	1970	6	12	164	Covid-19 cases started to fall from peak
18	3882	6	12	324	Vaccination for 18-44 years started in Agra but no Covaxin for them
19	4166	6	12	347	Covaxin for first dose for people of 18-44 years as well as 45 plus group
20	3440	6	12	287	No Covaxin for first dose in any group
<b>Total</b>	<b>33571</b>	<b>88</b>	<b>203</b>	<b>165</b>	

\*Team-days means total number of sessions conducted by all teams during the week

**TABLE 3 DAYS-WISE COVID-19 VACCINATION**

Day	Total doses administered	Number of days	Doses per day
Monday	6180	31	199
Tuesday	4278	22	194
Wednesday	4234	23	184
Thursday	6064	46	132
Friday	7327	52	141
Saturday	5228	27	194
Sunday	260	2	130

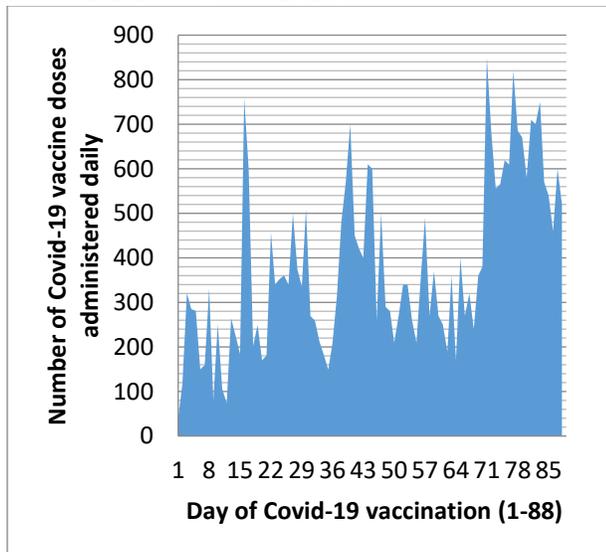
**TABLE 4 MONTH-WISE WASTAGE OF DIFFERENT COVID-19 VACCINES (IN PERCENTAGES)**

Month	Covishield	Covaxin-20 dose vial	Covaxin-10 dose vial	Total
January	4.37	N.A.	N.A.	4.37
February	3.89	2	N.A.	3.42
March	3.17	1.74	N.A.	1.99
April	0.1	3.54	0	0.18
May	0.44	N.A.	0.04	0.16
Overall	1.77	1.88	0.02	0.85

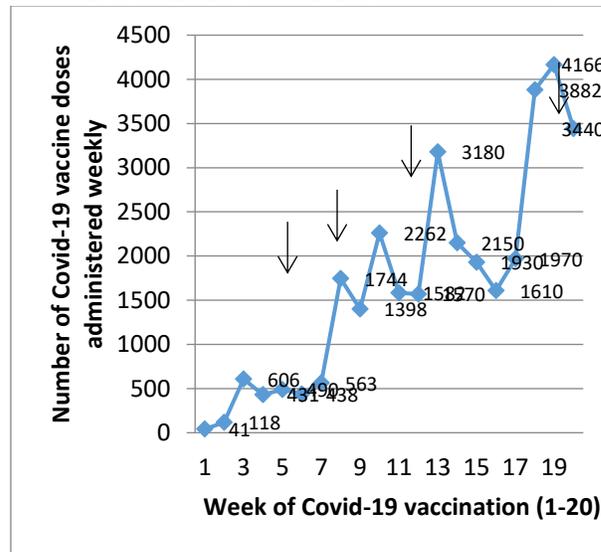
*N.A. – Not available*

**Figures**

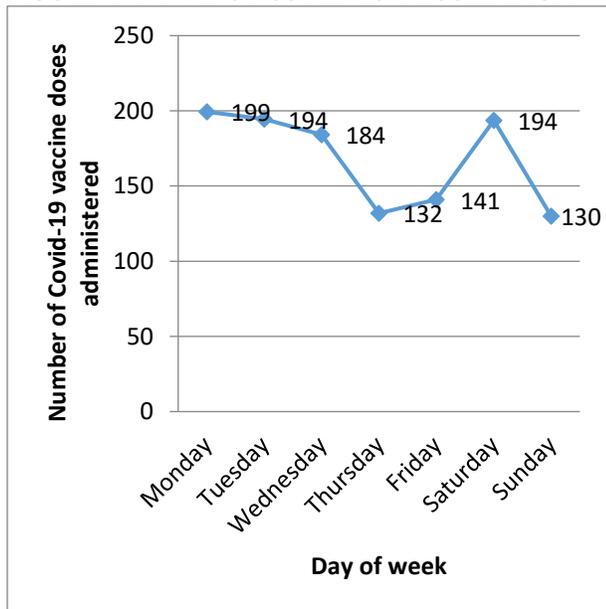
**FIGURE 1 DAILY COVID-19 VACCINATION**



**FIGURE 3 WEEKLY COVID-19 VACCINATION**



**FIGURE 2 DAY-WISE COVID-19 VACCINATION**



**FIGURE 4 MONTH-WISE COVID-19 VACCINATION AND VACCINE WASTAGE (%)**

