SUPPLEMENTARY MATERIALS

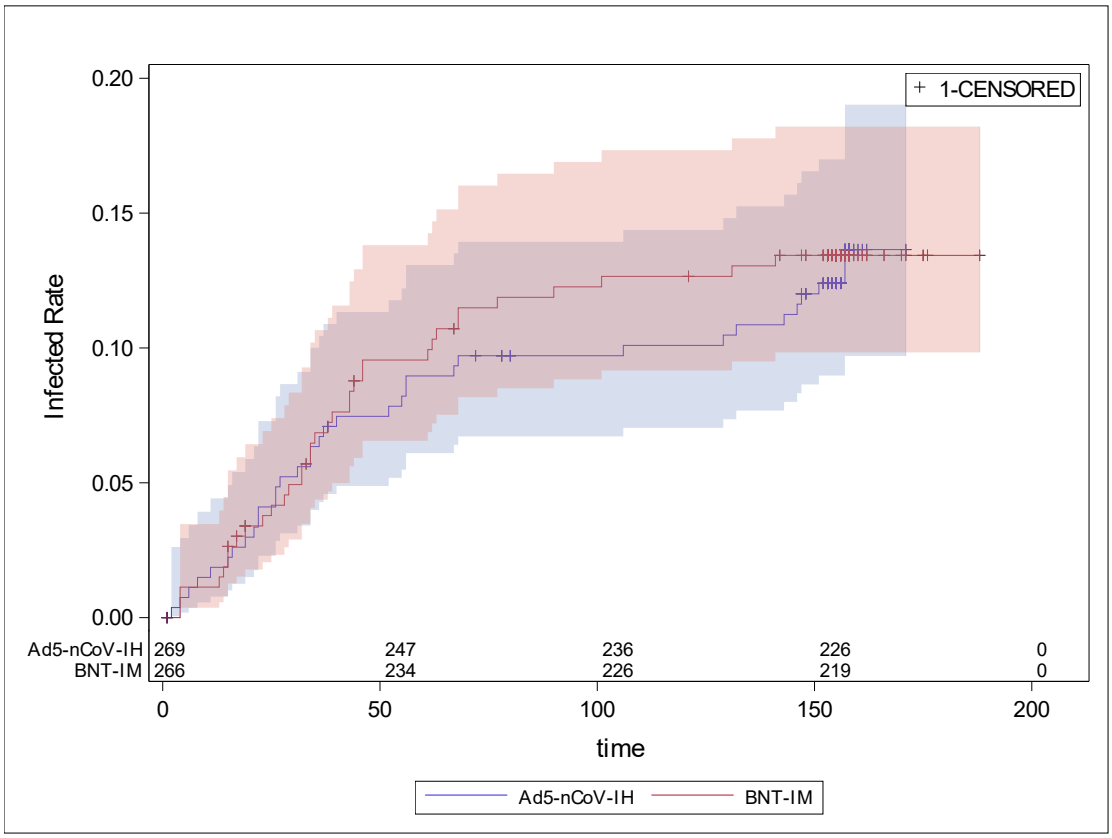
Supplementary Figure

Supplementary Tables

Supplementary Study Protocol

Supplementary CONSORT Checklist

Figure S1: Cumulative risk of breakthrough Covid19 infection (14th day post-vaccination)



BNT-IM=Intramuscular tozinameran vaccine, Ad5-nCoV-IH = Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation.

Endpoint cases were all RT-PCR/RTK confirmed and captured from Day 14 (excluding Day 14) after the second booster dose.

Supplementary Table 1. GMC of S-RBD IgG antibodies (wild-type) (PPS)

Visit		Ad5-nCoV-IH (N=270)	IM Pfizer mRNA (N=268)	Total (N=538)	P-value
D0	n(miss)	270(0)	268(0)	538(0)	
	Mean(SD)	1273.454(3.1130)	1231.701(3.4052)	1252.481(3.2549)	0.7435
	Median	1335.587	1283.772	1306.732	
	Q1,Q3	572.000,2975.970	510.775,2930.177	563.250,2973.380	
	Min,Max	27.79,16431.60	2.67,68418.90	2.67,68418.90	
	95%CI	1111.45,1459.07	1062.93,1427.27	1133.35,1384.13	
D14	n(miss)	269(1)	264(4)	533(5)	
	Mean(SD)	1555.533(2.7581)	6975.264(2.0149)	3270.870(3.1617)	<0.001
	Median	1472.420	7764.470	3821.250	
	Q1,Q3	669.970,3208.130	4639.911,10458.386	1431.400,8301.250	
	Min,Max	57.48,20812.10	610.97,87662.50	57.48,87662.50	
	95%CI	1377.17,1757.00	6407.51,7593.33	2965.69,3607.46	
D28	n(miss)	268(2)	263(5)	531(7)	
	Mean(SD)	1987.784(2.9583)	5260.365(2.1098)	3218.865(2.8616)	<0.001
	Median	1923.369	5747.690	3663.170	
	Q1,Q3	851.587,4661.229	3123.080,8747.500	1456.920,7159.000	
	Min,Max	98.13,35046.56	656.33,79109.80	98.13,79109.80	
	95%CI	1744.68,2264.76	4804.50,5759.48	2942.91,3520.69	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	1908.284(3.0792)	2591.097(2.3313)	2224.899(2.7311)	0.0124
	Median	1961.452	2496.670	2226.230	
	Q1,Q3	827.740,4344.680	1373.330,4579.350	1061.710,4476.130	
	Min,Max	89.16,22455.74	387.42,37698.36	89.16,37698.36	
	95%CI	1574.65,2312.61	2243.41,2992.67	1972.11,2510.09	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	1720.977(2.9406)	1725.299(2.3376)	1723.128(2.6358)	0.9837
	Median	1842.432	1815.740	1815.740	
	Q1,Q3	822.770,3781.050	975.930,2900.490	915.270,3243.640	
	Min,Max	47.38,17047.27	200.98,16821.82	47.38,17047.27	
	95%CI	1422.93,2081.45	1484.50,2005.16	1527.54,1943.76	

N= the number of subjects in each data set, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Supplementary Table 2: GMC of S-RBD IgG antibodies (wild-type) (mITT)

Visit		Ad5-nCoV-IH (N=270)	IM Pfizer mRNA (N=269)	Total (N=539)	P-value
D0	n(miss)	270(0)	269(0)	539(0)	
	Mean(SD)	1273.454(3.1130)	1238.233(3.4079)	1255.752(3.2563)	0.7830
	Median	1335.587	1288.230	1311.380	
	Q1,Q3	572.000,2975.970	520.480,2934.060	563.250,2975.970	
	Min,Max	27.79,16431.60	2.67,68418.90	2.67,68418.90	
	95%CI	1111.45,1459.07	1068.76,1434.57	1136.37,1387.67	
D14	n(miss)	269(1)	265(4)	534(5)	
	Mean(SD)	1555.533(2.7581)	6972.188(2.0123)	3274.795(3.1594)	<0.001
	Median	1472.420	7741.270	3828.468	
	Q1,Q3	669.970,3208.130	4674.600,10415.410	1431.400,8301.250	
	Min,Max	57.48,20812.10	610.97,87662.50	57.48,87662.50	
	95%CI	1377.17,1757.00	6406.72,7587.57	2969.71,3611.23	
D28	n(miss)	268(2)	264(5)	532(7)	
	Mean(SD)	1987.784(2.9583)	5261.316(2.1068)	3222.127(2.8595)	<0.001
	Median	1923.369	5745.385	3671.575	
	Q1,Q3	851.587,4661.229	3127.342,8736.123	1459.997,7155.904	
	Min,Max	98.13,35046.56	656.33,79109.80	98.13,79109.80	
	95%CI	1744.68,2264.76	4807.03,5758.54	2946.33,3523.74	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	1908.284(3.0792)	2591.097(2.3313)	2224.899(2.7311)	0.0124
	Median	1961.452	2496.670	2226.230	
	Q1,Q3	827.740,4344.680	1373.330,4579.350	1061.710,4476.130	
	Min,Max	89.16,22455.74	387.42,37698.36	89.16,37698.36	
	95%CI	1574.65,2312.61	2243.41,2992.67	1972.11,2510.09	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	1720.977(2.9406)	1725.299(2.3376)	1723.128(2.6358)	0.9837
	Median	1842.432	1815.740	1815.740	
	Q1,Q3	822.770,3781.050	975.930,2900.490	915.270,3243.640	
	Min,Max	47.38,17047.27	200.98,16821.82	47.38,17047.27	
	95%CI	1422.93,2081.45	1484.50,2005.16	1527.54,1943.76	

N= the number of subjects in each data set, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Supplementary Table 3: Analysis of GMI of anti-spike RBD IgG antibodies (wild-type) (PPS)

Visit		Ad5-nCov-IH	BNT-IM	Total	*P* value
D14	n(miss)	269(1)	264(4)	533(5)	
	Mean(SD)	1.23(2.09)	5.74(2.74)	2.64(3.23)	<0.0001
	Median	1.04	4.77	2.11	
	Q1,Q3	0.78,1.58	2.78,9.67	1.01,5.05	
	Min,Max	0.36,67.83	0.72,259.86	0.36,259.86	
	95%CI	1.12,1.34	5.08,6.49	2.39,2.91	
D28	n(miss)	268(2)	263(5)	531(7)	
	Mean(SD)	1.57(2.71)	4.23 (2.66)	2.56 (3.02)	<0.0001
	Median	1.24	3.57	2.12	
	Q1,Q3	0.80,2.32	2.05,7.03	1.20,4.56	
	Min,Max	0.32,90.95	0.56,245.82	0.32,245.82	
	95%CI	1.39,1.77	3.76,4.77	2.33,2.82	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	1.82(3.07)	2.37(2.76)	2.06(2.93)	0.0465
	Median	1.33	1.95	1.68	
	Q1,Q3	0.82,3.32	1.15,4.00	0.99,3.72	
	Min,Max	0.36,73.73	0.26,212.38	0.26,212.38	
	95%CI	1.50,2.21	1.99,2.81	1.83,2.36	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	1.58(2.95)	1.541(2.90)	1.56 (2.92)	0.8483
	Median	1.40	1.21	1.26	
	Q1,Q3	0.73,2.60	0.71,2.76	0.71,2.68	
	Min,Max	0.27,39.35	0.17,106.28	0.17,106.28	
	95%CI	1.31,1.91	1.28,1.86	1.37,1.78	

n=actual number of subjects in each row, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM = intramuscular tozinameran vaccine

The antibody concentration of each subject was log transformed before statistical description. The t-test was used for inter-group comparison. The analysis of D14 (Day 14) and D28 (Day 28) is based on primary immunogenicity group, and D84 (Day 84) and D168 (Day 168) based on persistent immunogenicity group which was defined as last 140 subjects in each arm per protocol 3.1 (10 Jan 2023).

Supplementary Table 4: Analysis of SCR of anti-spike RBD IgG antibodies (wild-type) (PPS)

	Group	N	Positive	SCR (95% CI)	*P* value
D14					
	Ad5-nCov-IH	269	46	17.10(12.80,22.14)	<0.0001
	BNT-IM	264	235	89.02(84.61,92.52)	
	Ad5-nCov-IH-BNT-IM			-71.91(-77.79, -66.04)	
D28					
	Ad5-nCov-IH	268	74	27.61(22.35,33.38)	<0.0001
	BNT-IM	263	203	77.19(71.63,82.12)	
	Ad5-nCov-IH-BNT-IM			-49.57(-56.95, -42.2)	
D84					
	Ad5-nCov-IH	134	46	34.33(26.35,43.02)	0.015
	BNT-IM	135	66	48.89(40.19,57.63)	
	Ad5-nCov-IH - BNT-IM			-14.56(-26.21, -2.91)	
D168					
	Ad5-nCov-IH	126	45	35.71(27.38,44.74)	0.371
	BNT-IM	125	38	30.40(22.49,39.26)	
	Ad5-nCov-IH - BNT-IM			5.31(-6.31,16.93)	

N= the number of subjects in each data set, SCR=seroconversion rate, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

The chi-square test or Fisher's exact test was used for inter-group comparison. The analysis of D14 (Day 14) and D28 (Day 28) is based on primary immunogenicity group, and D84 (Day 84) and D168 (Day 168) based on persistent immunogenicity group which was defined as last 140 subjects in each arm per protocol 3.1 (10 Jan 2023).

Supplementary Table 5: Non-inferiority analysis of GMC and SCR of anti-spike RBD IgG antibodies (wild-type) (PPS)

Non-inferiority analysis of GMC of anti-spike RBD IgG antibodies at Day 14 post vaccination				
	Estimate	97.5% CI	Non-inferiority margin	Outcome
Ad5-nCoV-IH (N=269)	1555.53	1353.09,1788.27		
BNT-IM (N=264)	6972.19	6328.69,7681.12		
Ad5-nCoV-IH/BNT-IM	0.22	0.19,0.26	0.67	No
Non-inferiority analysis of SCR of anti-spike RBD IgG antibodies at Day 14 post vaccination				
	Positive	SCR (97.5% CI)	Non-inferiority margin	Outcome
Ad5-nCoV-IH (N=269)	46	17.10(12.26,22.88)		
BNT-IM (N=264)	235	89.02(83.95,92.94)		
Ad5-nCoV-IH-BNT-IM		-71.91(-78.63, -71.91)	-10%	No

N=number of participants in each data set, GMC=geometric mean concentration, SCR=seroconversion rate, anti-spike RBD IgG=anti-spike receptor-binding domain immunoglobulin G, Ad5-nCoV-IH= Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Log-transformed antibody levels were analyzed with the use of an analysis of covariance (ANCOVA) model, with the study vaccine as a fixed effect and with adjustment for age groups (<65 or >=65 years) and pre-booster titers. With the test level $\alpha = 0.025$ (two-sided), when the lower limit of 97.5% CI for the GMC ratio ($GMC_{Ad5\text{-}nCoV\text{-}IH}$ / $GMC_{BNT\text{-}IM}$) of the anti-spike RBD IgG antibodies (wild-type) was greater than 0.67 after 14 days of vaccination, the non-inferiority hypothesis was considered true. With the test level two-side $\alpha = 0.025$ (two-sided), when the lower limit of 97.5% CI for the SCR difference ($SCR_{Ad5\text{-}nCoV\text{-}IH}$ - $SCR_{BNT\text{-}IM}$) of the anti-spike RBD IgG antibodies (wild-type) was greater than -10% after 14 days of vaccination, the non-inferiority hypothesis was considered true.

Supplementary Table 6. GMT of neutralizing antibodies against Omicron Pseudovirus variants (BA.4/5) (mITT)

Visit		Ad5-nCoV-IH (N=270)	IM Pfizer mRNA (N=269)	Total (N=539)	P-value
D0	n(miss)	270(0)	269(0)	539(0)	
	Mean(SD)	286.92(3.760)	320.82(3.947)	303.37(3.853)	0.3369
	Median	301.45	325.00	314.00	
	Q1,Q3	124.00,700.00	145.00,861.00	132.00,751.00	
	Min,Max	15.0,30882.0	15.0,45953.0	15.0,45953.0	
	95%CI	244.82,336.26	272.07,378.31	270.65,340.04	
D14	n(miss)	269(1)	265(4)	534(5)	
	Mean(SD)	395.3(3.45)	1338.1(2.46)	723.9(3.47)	<0.001
	Median	423.0	1348.0	880.5	
	Q1,Q3	172.0,895.0	874.0,2106.0	349.0,1564.0	
	Min,Max	15,184705	58,218151	15,218151	
	95%CI	340.64,458.62	1200.03,1492.16	651.33,804.65	
D28	n(miss)	268(2)	264(5)	532(7)	
	Mean(SD)	563.81(3.631)	1242.00(2.544)	834.33(3.298)	<0.001
	Median	615.00	1252.40	951.49	
	Q1,Q3	234.00,1396.00	643.99,2329.94	409.98,1756.99	
	Min,Max	15.0,434182.0	114.0,586897.0	15.0,586897.0	
	95%CI	482.81,658.40	1109.11,1390.82	753.69,923.59	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	574.9(3.80)	752.8(3.23)	658.2(3.53)	0.0798
	Median	623.9	785.0	719.0	
	Q1,Q3	226.0,1526.0	385.0,1480.0	295.0,1503.0	
	Min,Max	15,36852	15,223606	15,223606	
	95%CI	457.54,722.31	616.45,919.24	565.64,765.83	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	285.9(3.36)	335.9(3.45)	309.8(3.40)	0.2979
	Median	307.5	333.0	322.0	
	Q1,Q3	119.0,605.0	153.0,710.0	138.0,678.0	
	Min,Max	15,21829	15,458709	15,458709	
	95%CI	230.83,353.99	269.81,418.15	266.00,360.73	

N= the number of subjects in each data set, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Supplementary Table 7: GMT of neutralizing antibodies against Omicron Pseudovirus variants (BA.4/5) (PPS)

Visit		Ad5-nCoV-IH (N=270)	IM Pfizer mRNA (N=268)	Total (N=538)	P-value
D0	n(miss)	270(0)	268(0)	538(0)	
	Mean(SD)	286.92(3.760)	319.38(3.950)	302.65(3.853)	0.3573
	Median	301.45	322.49	313.00	
	Q1,Q3	124.00,700.00	145.00,854.98	132.00,751.00	
	Min,Max	15.0,30882.0	15.0,45953.0	15.0,45953.0	
	95%CI	244.82,336.26	270.75,376.75	269.98,339.28	
D14	n(miss)	269(1)	264(4)	533(5)	
	Mean(SD)	395.3(3.45)	1338.8(2.47)	723.3(3.47)	<0.001
	Median	423.0	1349.0	877.0	
	Q1,Q3	172.0,895.0	873.5,2128.9	349.0,1564.0	
	Min,Max	15,184705	58,218151	15,218151	
	95%CI	340.64,458.62	1200.13,1493.50	650.62,804.06	
D28	n(miss)	268(2)	263(5)	531(7)	
	Mean(SD)	563.81(3.631)	1240.68(2.548)	833.26(3.301)	<0.001
	Median	615.00	1237.00	948.00	
	Q1,Q3	234.00,1396.00	640.00,2430.00	406.00,1764.00	
	Min,Max	15.0,434182.0	114.0,586897.0	15.0,586897.0	
	95%CI	482.81,658.40	1107.47,1389.91	752.61,922.56	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	574.9(3.80)	752.8(3.23)	658.2(3.53)	0.0798
	Median	623.9	785.0	719.0	
	Q1,Q3	226.0,1526.0	385.0,1480.0	295.0,1503.0	
	Min,Max	15,36852	15,223606	15,223606	
	95%CI	457.54,722.31	616.45,919.24	565.64,765.83	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	285.9(3.36)	335.9(3.45)	309.8(3.40)	0.2979
	Median	307.5	333.0	322.0	
	Q1,Q3	119.0,605.0	153.0,710.0	138.0,678.0	
	Min,Max	15,21829	15,458709	15,458709	
	95%CI	230.83,353.99	269.81,418.15	266.00,360.73	

N= the number of subjects in each data set, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Supplementary Table 8: Analysis of GMI of neutralizing antibodies against Omicron Pseudovirus variants (BA.4/5) (PPS)

Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P* value
D14	n(miss)	269(1)	264(4)	533(5)	
	Mean(SD)	1.39(2.649)	4.28(2.83)	2.42(3.17)	<0.0001
	Median	1.11	4.36	2.18	
	Q1,Q3	0.74,2.22	2.16,7.69	1.00,5.27	
	Min,Max	0.24,176.60	0.17,98.07	0.17,176.60	
	95%CI	1.23,1.56	3.77,4.86	2.20,2.67	
D28	n(miss)	268(2)	263(5)	531(7)	
	Mean(SD)	1.97(3.14)	3.82(2.83)	2.73(3.14)	<0.0001
	Median	1.66	3.68	2.45	
	Q1,Q3	0.70,3.52	1.82,7.60	1.26,5.79	
	Min,Max	0.25,89.80	0.13,243.93	0.13,243.93	
	95%CI	1.71,2.26	3.36,4.33	2.48,3.01	
D84	n(miss)	134(5)	135(6)	269(11)	
	Mean(SD)	2.26(3.48)	2.46 (3.01)	2.36(3.24)	0.5636
	Median	1.86	2.16	2.07	
	Q1,Q3	0.84,5.12	1.09,4.93	1.00,4.93	
	Min,Max	0.29,111.20	0.19,48.41	0.19,111.20	
	95%CI	1.83,2.80	2.04,2.97	2.05,2.72	
D168	n(miss)	126(13)	125(16)	251(29)	
	Mean(SD)	1.13(3.25)	1.08 (3.86)	1.11(3.54)	0.8013
	Median	0.92	0.82	0.89	
	Q1,Q3	0.52,2.34	0.45,2.44	0.47,2.38	
	Min,Max	0.11,19.93	0.02,37.93	0.02,37.93	
	95%CI	0.92,1.39	0.85,1.38	0.95,1.29	

n=actual number of subjects in each row, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

The antibody concentration of each subject was log transformed before statistical description. The t-test was used for inter-group comparison. The analysis of D14 (Day 14) and D28 (Day 28) is based on primary immunogenicity group, and D84 (Day 84) and D168 (Day 168) based on persistent immunogenicity group which was defined as last 140 subjects in each arm per protocol 3.1 (10 Jan 2023).

Supplementary Table 9: Analysis of SCR of neutralizing antibodies against Omicron Pseudovirus variants (BA.4/5) (PPS)

	Group	N	Positive	SCR (95% CI)	*P* value
D14					
	Ad5-nCov-IH	269	31	11.52(7.97,15.96)	<0.0001
	BNT-IM	264	140	53.03(46.82,59.18)	
	Ad5-nCov-IH - BNT-IM			-41.51(-48.63,-34.38)	
D28					
	Ad5-nCov-IH	268	56	20.90(16.19,26.26)	<0.0001
	BNT-IM	263	123	46.77(40.61,53.00)	
	Ad5-nCov-IH - BNT-IM			-25.87(-33.62,-18.12)	
D84					
	Ad5-nCov-IH	134	38	28.36(20.91,36.79)	0.969
	BNT-IM	135	38	28.15(20.75,36.53)	
	Ad5-nCov-IH - BNT-IM			0.21(-10.55,10.97)	
D168					
	Ad5-nCov-IH	126	18	14.29(8.69,21.63)	0.297
	BNT-IM	125	24	19.20(12.71,27.21)	
	Ad5-nCov-IH - BNT-IM			-4.91(-14.13,4.31)	

N=the number of subjects in each data set, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

The chi-square test or Fisher's exact test was used for inter-group comparison. The analysis of D14 (Day 14) and D28 (Day 28) is based on primary immunogenicity group, and D84 (Day 84) and D168 (Day 168) based on persistent immunogenicity group which was defined as last 140 subjects in each arm per protocol 3.1 (10 Jan 2023).

97 Supplementary Table 10: Analysis of GMC of Salivary SIgA antibodies (PPS)

Assay	Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P*-value
B.1.1.529-BA.1	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	17.594(2.3195)	19.617(2.4308)	18.541(2.3645)	0.5727
		Median	16.039	21.471	20.440	
		Q1,Q3	9.880,32.994	10.967,39.025	10.967,33.740	
		Min,Max	1.07,76.99	2.35,102.74	1.07,102.74	
		95%CI	13.54,22.87	14.71,26.16	15.33,22.43	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	24.163(2.7924)	23.875(2.3747)	24.024(2.5766)	0.9549
		Median	23.269	21.737	22.011	
		Q1,Q3	9.984,60.569	13.161,39.945	12.069,45.247	
		Min,Max	4.43,235.23	3.38,168.74	3.38,235.23	
		95%CI	17.55,33.28	18.04,31.60	19.49,29.62	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	25.443(3.4096)	17.716(2.1263)	21.374(2.8196)	0.1115
		Median	17.832	19.948	19.598	
		Q1,Q3	11.078,62.352	9.223,29.101	10.988,40.208	
		Min,Max	1.70,708.98	1.95,58.85	1.70,708.98	
		95%CI	17.36,37.29	13.87,22.62	17.00,26.88	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	17.914(2.8006)	15.373(2.3598)	16.642(2.5818)	0.4719
		Median	13.715	14.131	13.783	
		Q1,Q3	9.171,34.887	7.936,28.741	9.099,31.896	
		Min,Max	3.40,169.74	3.01,91.24	3.01,169.74	
		95%CI	13.00,24.69	11.64,20.31	13.49,20.53	
BA.2.75	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	20.620(2.5382)	20.636(2.6663)	20.628(2.5843)	0.9971
		Median	18.869	22.671	22.596	
		Q1,Q3	11.702,42.654	11.916,46.344	11.916,42.654	
		Min,Max	0.89,111.77	1.96,114.47	0.89,114.47	
		95%CI	15.43,27.56	15.02,28.36	16.72,25.45	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	29.097(2.7342)	25.742(2.5127)	27.431(2.6170)	0.5702
		Median	27.619	23.335	24.415	
		Q1,Q3	12.172,60.518	13.490,45.657	12.766,51.673	
		Min,Max	5.31,311.70	3.20,179.42	3.20,311.70	
		95%CI	21.27,39.81	19.10,34.70	22.17,33.93	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	32.072(3.5405)	19.217(2.3894)	25.063(3.0532)	0.0361
		Median	25.587	21.604	22.836	
		Q1,Q3	14.317,85.872	10.151,37.402	12.819,45.197	
		Min,Max	0.98,940.08	1.54,98.99	0.98,940.08	
		95%CI	21.63,47.56	14.49,25.49	19.58,32.08	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	20.408(2.9348)	16.014(2.5435)	18.159(2.7494)	0.2839
		Median	19.134	15.871	17.578	
		Q1,Q3	8.171,46.821	9.203,26.508	9.203,43.146	
		Min,Max	2.67,188.50	3.08,94.66	2.67,188.50	
		95%CI	14.59,28.54	11.83,21.67	14.52,22.71	

Assay	Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P*-value
BA.2.75.2	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	25.671(2.5656)	25.643(2.6540)	25.657(2.5925)	0.9959
		Median	27.552	26.274	27.468	
		Q1,Q3	13.917,44.446	15.391,51.210	14.044,44.446	
		Min,Max	1.03,322.84	2.90,202.90	1.03,322.84	
		95%CI	19.14,34.43	18.69,35.19	20.78,31.67	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	34.703(2.6137)	30.191(2.6077)	32.452(2.6019)	0.5159
		Median	33.066	28.237	31.656	
		Q1,Q3	16.506,69.943	14.770,49.471	16.493,60.964	
		Min,Max	6.29,399.07	4.14,306.70	4.14,399.07	
		95%CI	25.72,46.82	22.13,41.19	26.27,40.09	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	37.085(3.5172)	22.696(2.4452)	29.277(3.0606)	0.0453
		Median	28.596	25.842	27.939	
		Q1,Q3	17.937,79.661	11.862,39.604	15.409,53.996	
		Min,Max	1.20,1275.23	2.93,118.67	1.20,1275.23	
		95%CI	25.06,54.88	16.99,30.33	22.86,37.49	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	23.872(2.8227)	20.614(2.6254)	22.243(2.7181)	0.5126
		Median	20.514	16.984	19.175	
		Q1,Q3	10.643,50.011	12.125,37.035	11.096,44.897	
		Min,Max	4.24,262.19	3.42,203.16	3.42,262.19	
		95%CI	17.28,32.99	15.08,28.19	17.83,27.75	
BA.4.6	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	28.940(2.4642)	29.793(2.6458)	29.348(2.5370)	0.8894
		Median	28.663	36.879	35.914	
		Q1,Q3	16.116,56.831	17.176,59.664	17.176,57.860	
		Min,Max	1.24,124.39	3.21,144.31	1.24,144.31	
		95%CI	21.85,38.33	21.73,40.84	23.89,36.06	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	39.922(2.7065)	36.327(2.5025)	38.149(2.5959)	0.6592
		Median	38.680	36.209	38.223	
		Q1,Q3	18.172,77.549	24.032,56.987	18.386,73.903	
		Min,Max	6.84,953.69	5.49,297.20	5.49,953.69	
		95%CI	29.27,54.45	26.98,48.91	30.89,47.11	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	42.832(3.4894)	26.371(2.4583)	33.912(3.0509)	0.0475
		Median	39.256	27.368	34.387	
		Q1,Q3	19.819,100.032	14.179,47.959	16.422,56.614	
		Min,Max	1.55,1046.75	2.98,162.66	1.55,1046.75	
		95%CI	29.02,63.23	19.70,35.30	26.50,43.40	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	28.994(2.5703)	24.106(2.5547)	26.528(2.5595)	0.3804
		Median	24.461	24.211	24.211	
		Q1,Q3	15.256,55.457	13.082,61.006	14.280,55.457	
		Min,Max	4.15,217.34	4.84,173.97	4.15,217.34	
		95%CI	21.61,38.91	17.79,32.67	21.55,32.66	
BA.5	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	37.358(2.5629)	40.687(2.5607)	38.926(2.5493)	0.6844
		Median	33.114	51.512	44.781	

Assay	Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P*-value
		Q1,Q3	23.521,76.823	21.714,78.959	22.666,76.823	
		Min,Max	1.53,207.09	4.67,209.27	1.53,209.27	
		95%CI	27.86,50.09	30.00,55.19	31.65,47.87	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	51.512(2.7991)	47.473(2.4205)	49.526(2.6038)	0.7038
		Median	45.434	44.311	44.441	
		Q1,Q3	23.334,103.591	32.174,80.105	26.966,98.245	
		Min,Max	8.65,1250.99	7.53,361.85	7.53,1250.99	
		95%CI	37.38,70.99	35.65,63.23	40.08,61.20	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	55.203(3.4659)	36.442(2.2933)	45.198(2.9395)	0.0793
		Median	55.823	37.002	42.095	
		Q1,Q3	24.101,132.480	19.794,63.656	22.970,67.171	
		Min,Max	1.94,1198.62	5.11,196.28	1.94,1198.62	
		95%CI	37.48,81.32	27.85,47.69	35.61,57.37	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	37.885(2.5453)	33.445(2.3707)	35.678(2.4530)	0.5356
		Median	31.794	31.137	31.673	
		Q1,Q3	18.886,82.204	18.280,76.487	18.886,76.487	
		Min,Max	6.14,256.50	7.83,194.07	6.14,256.50	
		95%CI	28.32,50.69	25.28,44.24	29.26,43.51	
BF.7	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	25.380(2.4528)	27.515(2.6231)	26.386(2.5223)	0.6972
		Median	23.844	33.157	30.346	
		Q1,Q3	14.063,52.333	13.852,59.271	14.063,53.546	
		Min,Max	1.19,109.41	2.78,129.96	1.19,129.96	
		95%CI	19.19,33.57	20.13,37.61	21.50,32.38	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	36.431(2.7408)	34.113(2.4772)	35.296(2.5999)	0.7591
		Median	34.650	33.025	34.042	
		Q1,Q3	16.166,71.051	21.531,65.158	17.031,68.210	
		Min,Max	6.50,868.28	4.71,256.51	4.71,868.28	
		95%CI	26.61,49.88	25.42,45.78	28.57,43.60	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	39.579(3.3851)	25.617(2.4131)	32.099(2.9611)	0.0683
		Median	34.769	25.017	29.645	
		Q1,Q3	20.672,94.679	14.689,43.586	16.305,53.873	
		Min,Max	1.70,940.85	2.75,155.31	1.70,940.85	
		95%CI	27.07,57.88	19.25,34.08	25.25,40.81	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	26.035(2.5957)	22.568(2.5856)	24.304(2.5825)	0.5017
		Median	21.205	21.314	21.314	
		Q1,Q3	13.460,56.313	13.023,53.026	13.212,53.026	
		Min,Max	4.25,213.08	4.97,152.79	4.25,213.08	
		95%CI	19.34,35.05	16.59,30.71	19.70,29.98	
BQ.1	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	24.610(2.5068)	27.240(2.7286)	25.843(2.6015)	0.6359
		Median	25.105	33.195	32.940	
		Q1,Q3	12.239,50.238	12.627,49.816	12.627,49.816	
		Min,Max	1.19,135.69	2.75,185.36	1.19,185.36	
		95%CI	18.48,32.77	19.67,37.72	20.92,31.93	

Assay	Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P*-value
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	33.952(2.7786)	31.906(2.5454)	32.951(2.6515)	0.7763
		Median	28.264	27.800	28.076	
		Q1,Q3	16.040,76.101	17.107,54.868	16.590,71.537	
		Min,Max	4.65,474.77	5.03,301.75	4.65,474.77	
		95%CI	24.69,46.68	23.57,43.19	26.56,40.88	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	38.086(3.4724)	24.379(2.4017)	30.724(3.0030)	0.0647
		Median	37.463	25.525	29.448	
		Q1,Q3	17.482,92.773	12.839,45.203	15.026,52.977	
		Min,Max	1.57,1025.50	3.42,146.05	1.57,1025.50	
		95%CI	25.84,56.14	18.35,32.39	24.09,39.18	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	26.567(2.6300)	22.343(2.5988)	24.442(2.6096)	0.4204
		Median	21.957	20.851	21.146	
		Q1,Q3	13.614,51.484	12.597,47.536	12.778,47.536	
		Min,Max	3.61,195.07	4.02,184.51	3.61,195.07	
		95%CI	19.65,35.91	16.39,30.45	19.77,30.22	
BQ.1.1	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	24.197(2.5209)	26.113(2.7703)	25.101(2.6269)	0.7251
		Median	26.590	32.618	30.788	
		Q1,Q3	12.826,48.621	10.983,47.951	12.826,48.166	
		Min,Max	1.02,132.58	3.03,192.29	1.02,192.29	
		95%CI	18.14,32.28	18.77,36.33	20.27,31.08	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	33.749(2.6071)	30.011(2.6077)	31.894(2.5965)	0.5833
		Median	32.608	28.109	31.242	
		Q1,Q3	17.256,68.571	17.387,51.235	17.387,64.926	
		Min,Max	5.02,317.65	4.20,323.76	4.20,323.76	
		95%CI	25.04,45.49	22.00,40.95	25.83,39.39	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	36.009(3.4987)	22.673(2.4328)	28.819(3.0361)	0.0578
		Median	36.197	23.833	25.505	
		Q1,Q3	17.067,89.953	11.883,43.392	15.142,50.677	
		Min,Max	1.55,895.93	3.52,131.56	1.55,895.93	
		95%CI	24.37,53.20	17.00,30.25	22.54,36.84	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	25.355(2.5495)	20.428(2.5810)	22.850(2.5656)	0.3054
		Median	21.972	20.528	21.188	
		Q1,Q3	13.424,47.446	11.083,44.854	11.708,46.257	
		Min,Max	3.22,176.95	4.00,180.44	3.22,180.44	
		95%CI	18.94,33.94	15.02,27.78	18.55,28.14	
WT	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	47.572(2.6991)	52.113(2.5582)	49.707(2.6183)	0.6729
		Median	48.248	54.157	48.694	
		Q1,Q3	27.576,97.461	27.921,105.838	27.921,99.238	
		Min,Max	1.28,275.54	4.13,299.50	1.28,299.50	
		95%CI	34.91,64.82	38.43,70.66	40.18,61.50	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	69.550(2.7424)	72.042(2.3220)	70.739(2.5265)	0.8657
		Median	62.023	76.202	67.146	

Assay	Visit		Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P*-value
		Q1,Q3	31.596,130.523	48.198,118.389	38.368,122.523	
		Min,Max	10.05,2108.69	9.60,350.55	9.60,2108.69	
		95%CI	50.79,95.24	54.83,94.66	57.63,86.83	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	74.294(3.5207)	54.413(2.1809)	63.949(2.8886)	0.1818
		Median	59.563	55.861	55.861	
		Q1,Q3	34.399,195.152	27.325,92.118	33.743,120.484	
		Min,Max	2.05,1519.44	4.62,225.06	2.05,1519.44	
		95%CI	50.19,109.98	42.26,70.06	50.58,80.85	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	48.889(2.6064)	46.162(2.2391)	47.556(2.4183)	0.7722
		Median	43.581	46.007	45.307	
		Q1,Q3	28.321,87.837	26.056,92.324	26.898,87.837	
		Min,Max	7.08,388.50	9.11,187.44	7.08,388.50	
		95%CI	36.27,65.90	35.55,59.95	39.12,57.81	
XBB.1	D0（V1）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	18.069(2.5176)	21.389(2.6056)	19.598(2.5547)	0.4221
		Median	18.087	23.640	21.125	
		Q1,Q3	9.616,34.952	8.951,48.450	9.616,39.319	
		Min,Max	1.03,117.19	2.59,96.60	1.03,117.19	
		95%CI	13.55,24.09	15.68,29.18	15.93,24.11	
	D14（V3）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	24.274(2.9028)	23.427(2.4804)	23.863(2.6834)	0.8727
		Median	20.516	21.362	20.993	
		Q1,Q3	10.676,62.997	12.620,39.221	12.620,44.066	
		Min,Max	4.31,234.98	3.75,188.34	3.75,234.98	
		95%CI	17.41,33.84	17.45,31.45	19.18,29.68	
	D28（V4）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	26.396(3.8088)	17.993(2.3746)	21.948(3.1396)	0.1275
		Median	21.728	18.607	20.222	
		Q1,Q3	11.072,53.493	9.322,31.627	10.147,43.690	
		Min,Max	1.06,1751.20	2.62,137.53	1.06,1751.20	
		95%CI	17.40,40.04	13.59,23.82	17.04,28.27	
	D84（V5）	n(miss)	42(228)	39(229)	81(457)	
		Mean(SD)	17.479(2.9258)	16.100(2.5616)	16.801(2.7355)	0.7160
		Median	13.564	15.335	13.593	
		Q1,Q3	8.211,40.937	7.577,32.554	7.940,32.643	
		Min,Max	3.18,150.26	3.00,99.74	3.00,150.26	
		95%CI	12.51,24.42	11.87,21.84	13.45,20.99	

Note: 'N' is the number of subjects in each data set. n(%) is the actual number of subjects observed and the corresponding percentage. Comparing between groups used the Chi-square test or Fisher's exact test. SCR was defined as 2-fold increase from baseline.

101 Supplementary Table 11: Analysis of GMI of saliva samples SIgA antibodies (PPS)

			Ad5-nCov-IH (N=270)	**BNT-IM (N=268)**	**Total (N=538)**	***P* value**
Assay	Visit					*P* value
B.1.1.529-BA.1	D14(V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.37(2.96)	1.22(2.46)	1.30(2.70)	0.5879
		Median	1.16	1.18	1.18	
		Q1, Q3	0.73,1.88	0.75,2.32	0.75,2.12	
		Min, Max	0.21,191.30	0.14,10.39	0.14,191.30	
		95% CI	0.98,1.93	0.91,1.63	1.04,1.61	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.45(3.48)	0.90(2.37)	1.15(3.00)	0.0504
		Median	1.04	1.06	1.06	
		Q1, Q3	0.83,1.91	0.44,1.54	0.66,1.57	
		Min, Max	0.98,2.13	0.68,1.19	0.90,1.47	
		95% CI	0.98,2.13	0.68,1.19	0.90,1.47	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.02(3.08)	0.78 (2.40)	0.90(2.76)	0.2483
		Median	0.87	0.78	0.87	
		Q1, Q3	0.42,1.64	0.49,1.20	0.46,1.35	
		Min, Max	0.24,62.54	0.09,9.30	0.90,62.54	
		95% CI	0.72,1.44	0.59,1.04	0.72,1.12	
BA.2.75	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.41(2.98)	1.25(2.63)	1.33(2.80)	0.5932
		Median	1.08	1.40	1.27	
		Q1, Q3	0.72,1.96	0.80,2.55	0.79,2.16	
		Min, Max	0.26,209.46	0.10,7.64	0.10,209.46	
		95% CI	1.00,1.98	0.19,1.71	1.06,1.67	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.56(3.40)	0.93(2.45)	1.22(3.01)	0.0353
		Median	1.13	1.05	1.05	
		Q1, Q3	0.88,1.93	0.52,1.90	0.70,1.91	
		Min, Max	0.11,326.32	0.11,4.90	0.11,326.32	
		95% CI	1.06,2.28	0.70,1.24	0.95,1.55	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	0.99(2.92)	0.78(2.57)	0.88(2.75)	0.2831
		Median	0.86	0.73	0.85	
		Q1, Q3	0.50,1.47	0.46,1.34	0.48,1.38	
		Min, Max	0.19,63.25	0.07,16.44	0.07,63.25	
		95% CI	0.71,1.38	0.57,1.05	0.70,1.10	
BA.2.75.2	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.35(2.85)	1.18(2.52)	1.27(2.68)	0.5320
		Median	1.17	1.36	1.23	
		Q1, Q3	0.71,1.89	0.80,2.28	0.74,2.057	
		Min, Max	0.46,215.95	0.08,5.89	0.08,215.95	
		95% CI	0.98,1.87	0.87,1.59	1.02,1.57	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.45(3.45)	0.89(2.52)	1.14(3.06)	0.0481
		Median	1.07	0.97	0.97	
		Q1, Q3	0.80,1.95	0.56,1.69	0.71,1.72	
		Min, Max	0.10,415.52	0.09,5.53	0.09,415.52	

			Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P* value
		95% CI	0.98,2.12	0.66,1.19	0.89,1.46	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	0.93(2.99)	0.80 (2.63)	0.87(2.80)	0.5287
		Median	0.80	0.89	0.81	
		Q1, Q3	0.49,1.39	0.42,1.54	0.45,1.421	
		Min, Max	0.22,62.79	0.06,16.17	0.06,62.79	
		95% CI	0.66,1.31	0.59,1.10	0.69,1.09	
BA.4.6	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.38(3.06)	1.22(2.63)	1.30(2.84)	0.5978
		Median	1.16	1.44	1.23	
		Q1, Q3	0.68,2.19	0.86,2.10	0.74,2.10	
		Min, Max	0.30,225.45	0.09,7.22	0.09,225.45	
		95% CI	0.97,1.95	0.89,1.67	1.03,1.64	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.48(3.66)	0.89(2.44)	1.16(3.14)	0.0399
		Median	1.00	1.02	1.00	
		Q1, Q3	0.78,1.99	0.50,1.90	0.70,1.94	
		Min, Max	0.14,480.18	0.10,3.81	0.10, 480.18	
		95% CI	0.99,2.22	0.66,1.18	0.90,1.49	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.00(3.07)	0.81(2.74)	0.90(2.91)	0.3712
		Median	0.82	0.90	0.82	
		Q1, Q3	0.41,1.74	0.46,1.49	0.46,1.54	
		Min, Max	0.22,63.07	0.07,22.91	0.07, 63.07	
		95% CI	0.71,1.42	0.58,1.12	0.71,1.14	
BA.5	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.38(2.98)	1.17(2.53)	1.27(2.75)	0.4618
		Median	1.14	1.36	1.25	
		Q1, Q3	0.71,2.18	0.77,2.10	0.73,2.10	
		Min, Max	0.34,210.27	0.10,5.66	0.10, 210.27	
		95% CI	0.98,1.94	0.86,1.58	1.02,1.59	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.478(3.4798)	0.90(2.34)	1.16(2.99)	0.0370
		Median	1.063	1.05	1.05	
		Q1, Q3	0.80,2.01	0.53,1.69	0.69,1.85	
		Min, Max	0.12,424.61	0.12,3.59	0.12,424.61	
		95% CI	1.00,2.18	0.68,1.18	0.91,1.48	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.01(2.92)	0.82(2.60)	0.92(2.77)	
		Median	0.86	0.89	0.89	
		Q1, Q3	0.47,1.51	0.51,1.48	0.48,1.49	
		Min, Max	0.24,64.07	0.07,19.89	0.07,64.07	
		95% CI	0.71,1.42	0.60,1.12	0.73,1.15	
BF.7	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.44(2.99)	1.24(2.66)	1.34(2.82)	0.5282
		Median	1.20	1.48	1.24	
		Q1, Q3	0.71,2.12	0.86,2.11	0.83,2.11	
		Min, Max	0.27,214.27	0.08,7.17	0.08,214.27	
		95% CI	1.02,2.02	0.90,1.70	1.06,1.68	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.56(3.44)	0.93(2.41)	1.22(3.01)	0.0326

			Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P* value
		Median	1.13	1.05	1.05	
		Q1, Q3	0.81,2.10	0.56,1.81	0.69,2.05	
		Min, Max	0.14,398.23	0.10,3.52	0.10,398.23	
		95% CI	1.06,2.29	0.70,1.24	0.95,1.55	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.03(2.99)	0.82(2.65)	0.92(2.83)	0.3366
		Median	0.93	0.83	0.83	
		Q1, Q3	0.53,1.60	0.50,1.51	0.50,1.51	
		Min, Max	0.21,63.84	0.06,21.25	0.06,63.84	
		95% CI	0.73,1.44	0.60,1.13	0.73,1.16	
BQ.1	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.38(3.04)	1.17(2.66)	1.28(2.85)	0.4854
		Median	1.12	1.27	1.23	
		Q1, Q3	0.66,2.06	0.84,2.21	0.68,2.18	
		Min, Max	0.29,205.08	0.08,6.93	0.08,205.08	
		95% CI	0.98,1.95	0.85,1.61	1.01,1.61	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.55(3.51)	0.90(2.42)	1.19(3.06)	0.0253
		Median	1.15	1.04	1.12	
		Q1, Q3	0.80,2.00	0.55,1.77	0.72,1.85	
		Min, Max	0.14,484.81	0.11,3.39	0.11,484.81	
		95% CI	1.05,2.29	0.67,1.19	0.93,1.52	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.08 (2.96)	0.82(2.78)	0.95(2.88)	0.2453
		Median	1.08	0.90	0.95	
		Q1, Q3	0.42,1.76	0.53,1.43	0.53,1.49	
		Min, Max	0.22,64.17	0.06,21.64	0.06,64.17	
		95% CI	0.77,1.51	0.59,1.14	0.75,1.19	
BQ.1.1	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.40(2.95)	1.15(2.72)	1.27 (2.83)	0.4067
		Median	1.11	1.29	1.22	
		Q1, Q3	0.69,2.17	0.84,2.07	0.72,2.07	
		Min, Max	0.32,218.10	0.07,6.34	0.07,218.10	
		95% CI	1.00,1.95	0.83,1.59	1.01,1.60	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.49(3.66)	0.87(2.48)	1.15(3.17)	0.0327
		Median	1.08	1.05	1.06	
		Q1, Q3	0.81,1.96	0.53,1.72	0.67,1.85	
		Min, Max	0.16,757.11	0.09,3.90	0.09,757.11	
		95% CI	0.99,2.23	0.65,1.17	0.89,1.48	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.05(2.95)	0.78(2.78)	0.91(2.88)	0.2163
		Median	0.97	0.80	0.88	
		Q1, Q3	0.41,1.65	0.52,1.38	0.51,1.54	
		Min, Max	0.22,65.57	0.06,23.31	0.06,65.57	
		95% CI	0.75,1.47	0.56,1.09	0.72,1.15	
WT	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.46(2.88)	1.38(2.45)	1.42 (2.66)	0.7984
		Median	1.16	1.75	1.44	
		Q1, Q3	0.74,2.09	0.72,2.23	0.74,2.11	
		Min, Max	0.30,214.64	0.11,8.81	0.11,214.64	

			Ad5-nCov-IH (N=270)	BNT-IM (N=268)	Total (N=538)	*P* value
		95% CI	1.05,2.03	1.03,1.85	1.15,1.77	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.56(3.30)	1.04(2.21)	1.29(2.81)	0.0760
		Median	1.11	1.12	1.12	
		Q1, Q3	0.88,2.25	0.65,1.71	0.80,1.97	
		Min, Max	0.13,337.27	0.14,5.56	0.13,337.27	
		95% CI	1.08,2.27	0.81,1.35	1.02,1.62	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.03(2.95)	0.89(2.35)	0.96(2.65)	0.4964
		Median	1.00	0.95	0.96	
		Q1, Q3	0.44,1.52	0.54,1.29	0.50,1.49	
		Min, Max	0.21,60.31	0.09,10.75	0.09,60.31	
		95% CI	0.73,1.44	0.67,1.17	0.77,1.19	
XBB.1	D14 (V3)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.34(2.96)	1.10(2.83)	1.22(2.90)	0.3911
		Median	1.06	1.53	1.21	
		Q1, Q3	0.69,1.83	0.59,2.10	0.69,2.01	
		Min, Max	0.42,227.76	0.06,7.22	0.06,227.76	
		95% CI	0.96,1.88	0.78,1.54	0.96,1.54	
	D28 (V4)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	1.46(3.58)	0.84(2.62)	1.12(3.20)	0.0319
		Median	0.95	1.04	1.03	
		Q1, Q3	0.75,1.83	0.49,1.66	0.69,1.78	
		Min, Max	0.14,442.33	0.10,5.68	0.10,442.33	
		95% CI	0.98,2.17	0.62,1.15	0.87,1.45	
	D84 (V5)	n(miss)	42(228)	39(229)	81(457)	
		Mean (SD)	0.97(2.98)	0.75(2.97)	0.86(2.98)	0.3038
		Median	0.78	0.78	0.78	
		Q1, Q3	0.47,1.35	0.41,1.36	0.43,1.35	
		Min, Max	0.21,62.09	0.04,15.76	0.04,62.09	
		95% CI	0.69,1.36	0.53,1.07	0.67,1.09	

N=number of subjects in each data set, n=actual number of subjects in each row, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

The antibody concentration of each subject was log transformed before statistical description. Chi-square test or Fisher's exact test was used for inter-group comparison.

Supplementary Table 12: Summary of solicited and unsolicited AEs emerged in the 0 to 28 Days post booster vaccination by preferred term (PT) (SS)

	Ad5-nCov-IH (N=270)		**BNT-IM (N=269)**		**Total (N=539)**		***P* value**
	n(%)	e	n(%)	e	n(%)	e	P value
OVERALL	127(47.04)	816	189(70.26)	1169	316(58.63)	1985	<0.0001
Grade 3 or higher AE	9(3.33)	20	13(4.83)	21	22(4.08)	41	0.3791
Solicited AE	126(46.67)	806	189(70.26)	1157	315(58.44)	1963	<0.0001
Grade 3 or higher AE	9(3.33)	20	13(4.83)	21	22(4.08)	41	0.3791
Local AE							
Vaccination site erythema	0	0	4(1.49)	4	4(0.74)	4	0.1312
Vaccination site induration	0	0	4(1.49)	4	4(0.74)	4	0.1312
Vaccination site pain	1(0.37)	1	169(62.83)	174	170(31.54)	175	<0.0001
Vaccination site pruritus	0	0	14(5.20)	15	14(2.60)	15	0.0001
Vaccination site rash	0	0	1(0.37)	1	1(0.19)	1	0.4991
Vaccination site swelling	0	0	13(4.83)	13	13(2.41)	13	0.0003
Oropharyngeal pain	54(20.00)	64	37(13.75)	54	91(16.88)	118	0.0530
Pharyngeal swelling	18(6.67)	19	9(3.35)	10	27(5.01)	29	0.0772
Dysphonia	33(12.22)	34	21(7.81)	28	54(10.02)	62	0.0878
Dry mouth	31(11.48)	33	22(8.18)	30	53(9.83)	63	0.1979
Stomatitis	16(5.93)	18	6(2.23)	6	22(4.08)	24	0.0302
Systemic AE							
Constipation	6(2.22)	7	10(3.72)	15	16(2.97)	22	0.3064
Diarrhoea	17(6.30)	20	22(8.18)	23	39(7.24)	43	0.3991
Dysphagia	20(7.41)	24	13(4.83)	14	33(6.12)	38	0.2125
Nausea	19(7.04)	20	12(4.46)	17	31(5.75)	37	0.1990
Vomiting	10(3.70)	11	4(1.49)	4	14(2.60)	15	0.1057
Chest pain	18(6.67)	18	19(7.06)	22	37(6.86)	40	0.8555
Fatigue	60(22.22)	69	83(30.86)	100	143(26.53)	169	0.0232
Pain	9(3.33)	9	30(11.15)	31	39(7.24)	40	0.0005
Pyrexia	24(8.89)	31	25(9.29)	30	49(9.09)	61	0.8702
Hypersensitivity	3(1.11)	3	4(1.49)	4	7(1.30)	7	0.9961
Decreased appetite	14(5.19)	15	17(6.32)	22	31(5.75)	37	0.5716
Arthralgia	13(4.81)	15	19(7.06)	26	32(5.94)	41	0.2694
Arthritis	7(2.59)	10	11(4.09)	12	18(3.34)	22	0.3336
Myalgia	44(16.30)	51	94(34.94)	109	138(25.60)	160	<0.0001
Headache	71(26.30)	89	92(34.20)	116	163(30.24)	205	0.0457
Syncope	1(0.37)	1	1(0.37)	1	2(0.37)	2	1.0000
Anxiety	12(4.44)	12	8(2.97)	10	20(3.71)	22	0.3665
Depression	12(4.44)	12	8(2.97)	10	20(3.71)	22	0.3665
Insomnia	18(6.67)	20	36(13.38)	40	54(10.02)	60	0.0094
Mental disorder	7(2.59)	7	7(2.60)	9	14(2.60)	16	0.9944
Bronchospasm	4(1.48)	4	3(1.12)	3	7(1.30)	7	1.0000
Cough	54(20.00)	62	44(16.36)	55	98(18.18)	117	0.2729
Dyspnoea	12(4.44)	13	10(3.72)	14	22(4.08)	27	0.6697
Rhinorrhoea	46(17.04)	55	48(17.84)	64	94(17.44)	119	0.8050
Sneezing	43(15.93)	49	39(14.50)	52	82(15.21)	101	0.6445
Mucocutaneous disorder	2(0.74)	2	2(0.74)	2	4(0.74)	4	1.0000
Pruritus	8(2.96)	8	12(4.46)	13	20(3.71)	21	0.3576
Unsolicited AE	9(3.33)	10	7(2.60)	12	16(2.97)	22	0.6170
Lymphadenopathy	0	0	1(0.37)	1	1(0.19)	1	0.4991
Swelling of eyelid	1(0.37)	1	0	0	1(0.19)	1	1.0000

Abdominal pain	0	0	1(0.37)	1	1(0.19)	1	0.4991
Flatulence	1(0.37)	1	0	0	1(0.19)	1	1.0000
Chills	0	0	2(0.74)	2	2(0.37)	2	0.2486
Feeling cold	0	0	1(0.37)	1	1(0.19)	1	0.4991
Conjunctivitis	1(0.37)	1	0	0	1(0.19)	1	1.0000
Ligament sprain	1(0.37)	1	0	0	1(0.19)	1	1.0000
Pain in extremity	0	0	1(0.37)	1	1(0.19)	1	0.4991
Dizziness	4(1.48)	4	1(0.37)	1	5(0.93)	5	0.3711
Hypoaesthesia	0	0	1(0.37)	1	1(0.19)	1	0.4991
Confusional state	0	0	1(0.37)	1	1(0.19)	1	0.4991
Menstruation delayed	1(0.37)	1	1(0.37)	1	2(0.37)	2	1.0000
Dry throat	0	0	1(0.37)	1	1(0.19)	1	0.4991
Yellow skin	1(0.37)	1	0	0	1(0.19)	1	1.0000
Peripheral coldness	0	0	1(0.37)	1	1(0.19)	1	0.4991

N=number of subjects in each data set, n=actual number of subjects observed and the corresponding percentage, e=number of adverse events in the specified category, AE=adverse event, Ad5-nCov-IH= Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

Supplementary Table 13: Severity analysis of SAEs (SS)

		Ad5-nCov-IH (N=270)		**BNT-IM (N=269)**		**Total (N=539)**		***P* value**
Serious adverse event (Solicited or Unsolicited)		n(%)	e	n(%)	e	n(%)	e	*P* value
SAE		5(1.85)	5	8(2.97)	10	13(2.41)	15	0.3959
	Mild	0	0	0	0	0	0	
	Moderate	2(0.74)	2	4(1.49)	5	6(1.11)	7	0.6781
	Severe	3(1.11)	3	4(1.49)	5	7(1.30)	8	0.9961
Unsolicited		5(1.85)	5	8(2.97)	10	13(2.41)	15	0.3959
	Mild	0	0	0	0	0	0	
	Moderate	2(0.74)	2	4(1.49)	5	6(1.11)	7	0.6781
	Severe	3(1.11)	3	4(1.49)	5	7(1.30)	8	0.9961

N=number of subjects in each data set, n=actual number of subjects observed and the corresponding percentage, e=number of adverse events in the specified category, SAE=serious adverse event, Ad5-nCov-IH= Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

In addition to the adverse event, if the subject has more than one repeated adverse event, the most severe grade will be taken. Chi-square test or Fisher's exact test was used for inter-group comparison.

Supplementary Table 14: Summary of SAEs by system organ class and preferred term (PT) (SS)

	Ad5-nCov-IH (N=270)		**BNT-IM (N=269)**		**Total (N=539)**		***P* value**
Serious adverse event (SOC)							
	n(%)	e	n(%)	e	n(%)	e	*P* value
SAE	5(1.85)	5	8(2.97)	10	13(2.41)	15	0.3959
Cardiac Disorders	1(0.37)	1	2(0.74)	2	3(0.56)	3	0.9974
Acute myocardial infarction	0	0	2(0.74)	2	2(0.37)	2	0.2486
Myocardial infarction	1(0.37)	1	0	0	1(0.19)	1	1.0000
Infections and infestations	3(1.11)	3	3(1.12)	3	6(1.11)	6	1.0000
COVID-19	1(0.37)	1	0	0	1(0.19)	1	1.0000
Dengue fever	0	0	3(1.12)	3	3(0.56)	3	0.2456
Pneumonia	1(0.37)	1	0	0	1(0.19)	1	1.0000
Urinary tract infection	1(0.37)	1	0	0	1(0.19)	1	1.0000
Metabolism and nutrition disorders	1(0.37)	1	0	0	1(0.19)	1	1.0000
Dehydration	1(0.37)	1	0	0	1(0.19)	1	1.0000
Musculoskeletal and connective tissue disorders	0	0	1(0.37)	1	1(0.19)	1	0.4991
Musculoskeletal pain	0	0	1(0.37)	1	1(0.19)	1	0.4991
Nervous system disorders	0	0	1(0.37)	1	1(0.19)	1	0.4991
Epilepsy	0	0	1(0.37)	1	1(0.19)	1	0.4991
Renal and urinary disorders	0	0	1(0.37)	1	1(0.19)	1	0.4991
End stage renal disease	0	0	1(0.37)	1	1(0.19)	1	0.4991
Vascular disorders	0	0	2(0.74)	2	2(0.37)	2	0.2486
Hypertension	0	0	2(0.74)	2	2(0.37)	2	0.2486

N=number of subjects in each data set, n=actual number of subjects observed and the corresponding percentage, e=number of adverse events in the specified category, SAE=serious adverse event, SOC=system organ class, Ad5-nCov-IH=Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) For Inhalation, BNT-IM= intramuscular tozinameran vaccine.

In addition to the incidence of adverse event, each row will be counted only once for one subject in each experimental group. Chi-square test or Fisher's exact test was used for inter-group comparison.

Supplementary Table 15: Stratified analysis of the efficacy of recombinant COVID-19 vaccine (Ad5-nCoV-IH) in preventing virologically confirmed COVID-19 cases

	Ad5-nCoV-IH N=270	**BNT-IM** N=269	**VE (95% CI)**	**aVE (95% CI)**
60 median follow-up days	22/270	26/269	0.17(-0.46-0.53)	0.19(-0.43-0.55)
Has infection history	10/145	15/139	0.38(-0.38-0.72)	0.31(-0.57-0.7)
No infection history	12/125	11/130	-0.14(-1.58-0.5)	-0.22(-1.89-0.48)
mRNA+mRNA+X	8/106	12/113	0.33(-0.63-0.73)	0.38(-0.56-0.75)
ICV+ICV+X	6/88	8/98	0.11(-1.56-0.69)	0.04(-1.88-0.68)
AZ+AZ+X	8/69	6/50	0.09(-1.61-0.69)	-0.06(-2.13-0.64)
90 median follow-up days	26/270	31/269	0.18(-0.38-0.51)	0.2(-0.35-0.53)
Has infection history	13/145	18/139	0.33(-0.37-0.67)	0.32(-0.42-0.67)
No infection history	13/125	13/130	-0.03(-1.22-0.52)	-0.07(-1.39-0.52)
mRNA+mRNA+X	10/106	14/113	0.27(-0.65-0.67)	0.33(-0.53-0.71)
ICV+ICV+X	7/88	10/98	0.22(-1.05-0.7)	0.16(-1.3-0.69)
AZ+AZ+X	9/69	7/50	0.13(-1.34-0.68)	0(-1.74-0.64)
120 median follow-up days	27/270	33/269	0.2(-0.32-0.52)	0.22(-0.3-0.53)
Has infection history	14/145	20/139	0.35(-0.29-0.67)	0.34(-0.34-0.67)
No infection history	13/125	13/130	-0.02(-1.21-0.53)	-0.06(-1.36-0.52)
mRNA+mRNA+X	10/106	14/113	0.26(-0.66-0.67)	0.33(-0.53-0.71)
ICV+ICV+X	7/88	12/98	0.36(-0.64-0.75)	0.28(-0.9-0.73)
AZ+AZ+X	10/69	7/50	0.03(-1.54-0.63)	-0.1(-1.96-0.59)
169 median follow-up days (full time)	34/270	35/269	0.06(-0.51-0.41)	0.07(-0.49-0.42)
Has infection history	20/145	21/139	0.13(-0.61-0.53)	0.12(-0.64-0.53)
No infection history	14/125	14/130	-0.02(-1.15-0.51)	-0.11(-1.38-0.49)
mRNA+mRNA+X	14/106	15/113	0.04(-1-0.53)	0.1(-0.89-0.57)
ICV+ICV+X	8/88	13/98	0.32(-0.63-0.72)	0.29(-0.78-0.71)
AZ+AZ+X	11/69	7/50	-0.06(-1.74,0.59)	-0.12(-1.96-0.57)

N number of participants in each data set, *n* actual number of COVID-19 cases, *mRNA* tozinameran vaccine, *X* first booster dose of any vaccine, *ICV* COVID-19 Vaccine (Vero Cell), Inactivated, *AZ* COVID-19 Vaccine ChAdOx1-S Recombinant, *Ad5-nCoV-IH* Recombinant Covid-19 Vaccine (Adenovirus Type 5 Vector) for Inhalation, *BNT-IM* intramuscular tozinameran vaccine, *VE* vaccine efficacy, *aVE* adjusted vaccine efficacy.

Supplementary Table 16: List of endpoint cases

Randomisation ID	Group	Lineage	Randomisation ID	Group	Lineage
A001-003	BNT-IM	BN.1	A001-031	Ad5-nCoV-IH	XBL
A001-009	BNT-IM	BN.1.2	A001-044	Ad5-nCoV-IH	XBB.1
A001-012	BNT-IM	XBB.1	A001-049	Ad5-nCoV-IH	XBB.1
A001-023	BNT-IM	BE.1	A001-097	Ad5-nCoV-IH	XBB.1
A001-058	BNT-IM	BQ.1.1	A001-101	Ad5-nCoV-IH	BM.1.1.3
A001-064	BNT-IM	XBB.1	A001-105	Ad5-nCoV-IH	BA.2.10.1
A001-066	BNT-IM	BA.2.10.1	A003-008	Ad5-nCoV-IH	XBB.1.2
A001-103	BNT-IM	BN.1.3	A003-010	Ad5-nCoV-IH	XBB.1.1
A003-022	BNT-IM	XBB.1.2	A003-021	Ad5-nCoV-IH	Unassigned
A003-023	BNT-IM	Unassigned	A004-019	Ad5-nCoV-IH	BA.2.10.1
A003-061	BNT-IM	BN.1.3	A004-026	Ad5-nCoV-IH	XBB
A004-056	BNT-IM	BA.5.2	A004-050	Ad5-nCoV-IH	XBB
A004-061	BNT-IM	BA.5.2	A004-053	Ad5-nCoV-IH	BA.2.10.1
A004-069	BNT-IM	BA.2	A004-065	Ad5-nCoV-IH	Unassigned
A004-078	BNT-IM	XBB.1	A004-076	Ad5-nCoV-IH	BQ.1.1
A004-082	BNT-IM	Unassigned	A004-085	Ad5-nCoV-IH	XBB
A004-090	BNT-IM	XBB.1	A004-087	Ad5-nCoV-IH	XBB
A004-115	BNT-IM	XBB.1.9.1	A004-091	Ad5-nCoV-IH	XBB.1
A004-171	BNT-IM	BQ.1.1	A004-096	Ad5-nCoV-IH	Unassigned
A004-188	BNT-IM	BM.1.1	A004-113	Ad5-nCoV-IH	XBB.1
A004-215	BNT-IM	XBB.3	A004-114	Ad5-nCoV-IH	XBB.1.9.1
A004-219	BNT-IM	XBB.1	A004-172	Ad5-nCoV-IH	XBB.1.9.1
A004-238	BNT-IM	Unassigned	A004-173	Ad5-nCoV-IH	XBB.1
A004-262	BNT-IM	XBB.1.9.1	A004-200	Ad5-nCoV-IH	CQ.2
A004-266	BNT-IM	XBB.1	A004-208	Ad5-nCoV-IH	BN.1.2
A004-272	BNT-IM	BN.1.1	A004-225	Ad5-nCoV-IH	XBB.1.9.1
A004-276	BNT-IM	XBB.1	A004-282	Ad5-nCoV-IH	Unassigned
A004-290	BNT-IM	Unassigned	A004-292	Ad5-nCoV-IH	XBB.1.9.1
A004-328	BNT-IM	CH.1.1.1	A004-314	Ad5-nCoV-IH	XBB.1.16
A004-336	BNT-IM	CH.1.1.1	A004-317	Ad5-nCoV-IH	XBB.1

A004-349	BNT-IM	XBB.1	A004-323	Ad5-nCoV-IH	XBB
A001-004	BNT-IM	BN.1.3	A004-108	Ad5-nCoV-IH	NA
A001-043	BNT-IM	XBB.1	A004-289	Ad5-nCoV-IH	NA
A004-016	BNT-IM	RTK only	A004-046	Ad5-nCoV-IH	RTK only
A004-168	BNT-IM	RTK only			

Ad5-nCoV-IH= Recombinant COVID-19 Vaccine (Adenovirus Type 5 Vector) for Inhalation, BNT-IM= intramuscular tozinameran vaccine.

All 69 endpoint cases from 14 days (excluding Day 14) after the second booster vaccination were confirm by both RT-PCR and RTK (64 cases) or RTK only (3 cases). NA indicates the collected sample not available for sequencing.