COVID-19 Vaccination: Where Do We Stand?

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Emory University School of Medicine
26 May 2022

POTENTIAL CONFLICTS AND DISCLOSURES:

- Financial compensation to Emory for clinical research:
  - Pfizer, Merck, GSK, Sanofi Pasteur, Novavax, Regeneron, PaxVax, MedImmune, Janssen, and Micron unrelated to this talk.
  - Pfizer – pediatric COVID-19 vaccine clinical trial
- I have served as consultant:
  - Medscape, Sanofi Pasteur, Janssen, Moderna, and Pfizer
- Safety monitoring committee
  - Kentucky BioProcessing, Inc
  - Sanofi Pasteur
  - WCG and ACI Clinical – adjudication committee
- NIH funded
  - Local PI for the Moderna mRNA-1273 Phase I and variant studies
  - Local PI for the Moderna mRNA-1273 Phase 3 study
  - Local PI for the Janssen Ad26-Spike protein Phase 3 study
  - Local PI for the Moderna mRNA-1273 KidCOVE

COVID-19 Vaccination: Where do we stand?”

- Pediatric Vaccination: Where do we stand?

- Adult COVID-19 Vaccination: Where do we stand?

COVID-19 Vaccination: Where do we stand?”

- Pediatric Vaccination: Where do we stand?

- Adult COVID-19 Vaccination: Where do we stand?

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Safety, Immunogenicity, and Efficacy of the BNT162b2 Covid-19 Vaccine in Adolescents

Robert W. Frenck, Jr., M.D., Nicola P. Klein, M.D., Ph.D., Nicholas Kitchin, M.D., Alejandra Gurtman, M.D., Judith Absalon, M.D., Stephen Lockhart, D.M., John L. Perez, M.D., Emmanuel B. Walter, M.D., Shelly Senders, M.D., Ruth Bailey, B.Sc., Kena A. Swanson, Ph.D., Hua Ma, Ph.D., Xia Xu, Ph.D., Kenneth Koury, Ph.D., Warren V. Kalina, Ph.D., David Cooper, Ph.D., Timothy Jennings, D.O., Donald M. Brandon, M.D., Stephen J. Thomas, M.D., Özlem Türeci, M.D., Dina B. Tresnan, D.V.M., Ph.D., Susan Mather, M.D., Philip R. Dormitzer, M.D., Ph.D., Uğur Şahin, M.D., Kathrin U. Jansen, Ph.D., and William C. Gruber, M.D., for the C4591001 Clinical Trial Group*

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Pfizer

Booster dose approved ≥12 years

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Evaluation of mRNA-1273 SARS-CoV-2 Vaccine in Adolescents

Kashif Ali, M.D., Gary Berman, M.D., Honghong Zhou, Ph.D., Weiping Deng, Ph.D., Veronica Faughnan, B.S., Maria Coronado-Voges, M.S., Baoyu Ding, M.S., Jacqueline Dooley, B.A., Bethany Girard, Ph.D., William Hillebrand, M.S., Rolando Pajon, Ph.D., Jacqueline M. Miller, M.D., Brett Leav, M.D., and Roderick McPhee, M.D., Ph.D.

Coronavirus

FDA delays decision on Moderna coronavirus vaccine for adolescents to evaluate myocarditis risk, company says

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Early Release / Vol. 71
January 7, 2022

Effectiveness of BNT162b2 (Pfizer-BioNTech) mRNA Vaccination Against Multisystem Inflammatory Syndrome in Children Among Persons Aged 12–18 Years — United States, July–December 2021

Laura D. Zambrano, PhD[1,*]; Margaret M. Newhams, MPH[2,*]; Samantha M. Olson, MPH[1]; Natasha B. Halasa, MD[3]; Ashley M. Price, MPH[1]; Julie A. Boom, MD[4]; Laila C. Sahni, PhD[4]; Satoshi Kamidani, MD[5]; Keiko M. Tarquinio, MD[6]; Aline B. Maddux, MD[7]; Sabrina M. Heidemann, MD[8]; Samina S. Bhumbra, MD[9]; Katherine E. Bline, MD[10]; Ryan A. Nofziger, MD[11]; Charlotte V. Hobbs, MD[12]; Tamara T. Bradford, MD[13]; Natalie Z. Cvijanovich, MD[14]; Katherine Irby, MD[15]; Elizabeth H. Mack, MD[16]; Melissa L. Cullimore, MD[17]; Pia S. Pannaraj, MD[18]; Michele Kong, MD[19]; Tracie C. Walker, MD[20]; Shira J. Gertz, MD[21]; Kelly N. Michelson, MD[22]; Melissa A. Cameron, MD[23]; Kathleen Chiotos, MD[24]; Mia Maamari, MD[25]; Jennifer E. Schuster, MD[26]; Amber O. Ozud, MPH[2]; Manish M. Patel, MD[1]; Angela P. Campbell, MD[1,3]; Adrienne G. Randolph, MD[2,27,†]; Overcoming COVID-19 Investigators

TABLE 3. Effectiveness* of 2 doses of Pfizer-BioNTech vaccine against multisystem inflammatory syndrome in children among hospitalized patients aged 12–18 years — 24 pediatric hospitals, 20 U.S. states,† July–December 2021

Control groups	No. vaccinated§/Total (%)		Adjusted VE, % (95% CI)
	MIS-C case patients	Control patients	
All controls	5/102 (4.9)	65/181 (35.9)	91 (78–97)
Test-negative	5/102 (4.9)	34/90 (37.8)	92 (77–97)
Syndrome-negative	5/102 (4.9)	31/91 (34.1)	89 (70–96)
Sensitivity analysis			
MIS-C case patients with serologic evidence present¶	5/88 (5.7)	61/161 (37.9)	90 (75–96)

Abbreviations: MIS-C = multisystem inflammatory syndrome in children; VE = vaccine effectiveness.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

BNT162b2 Protection against the Omicron Variant in Children and Adolescents

A.M. Price, S.M. Olson, M.M. Newhams, N.B. Halasa, J.A. Boom, L.C. Sahni, P.S. Pannaraj, K. Irby, K.E. Bline, A.B. Maddux, R.A. Nofziger, M.A. Cameron, T.C. Walker, S.P. Schwartz, E.H. Mack, L. Smallcomb, J.E. Schuster, C.V. Hobbs, S. Kamidani, K.M. Tarquinio, T.T. Bradford, E.R. Levy, K. Chiotos, S.S. Bhumbra, N.Z. Cvijanovich, S.M. Heidemann, M.L. Cullimore, S.J. Gertz, B.M. Coates, M.A. Staat, M.S. Zinter, M. Kong, B.M. Chatani, J.R. Hume, K.V. Typpo, M. Maamari, H.R. Flori, M.W. Tenforde, L.D. Zambrano, A.P. Campbell, M.M. Patel, and A.G. Randolph, for the Overcoming Covid-19 Investigators*

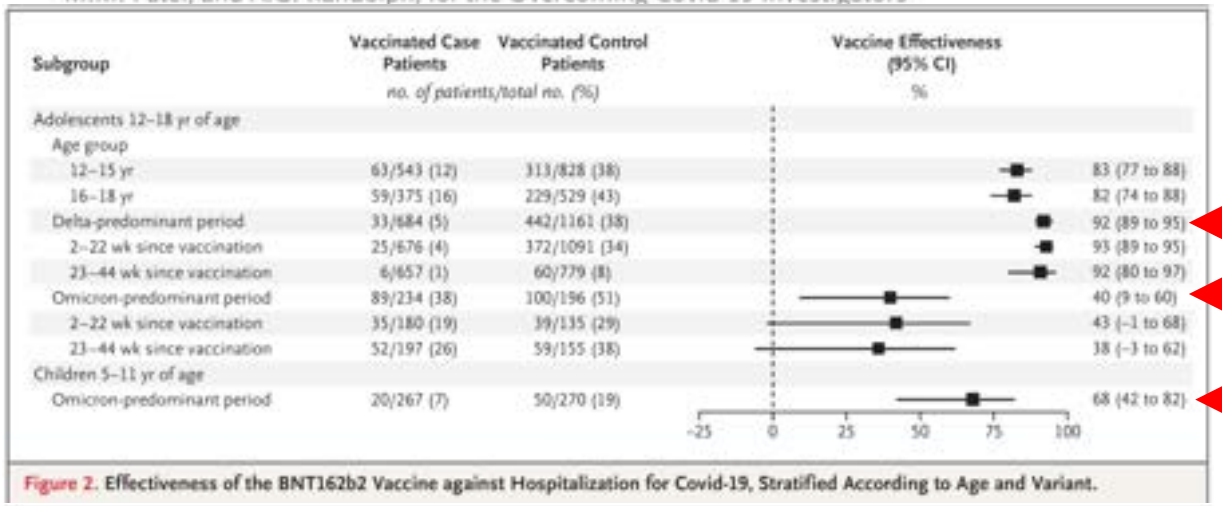

Figure 2. Effectiveness of the BNT162b2 Vaccine against Hospitalization for Covid-19, Stratified According to Age and Variant.

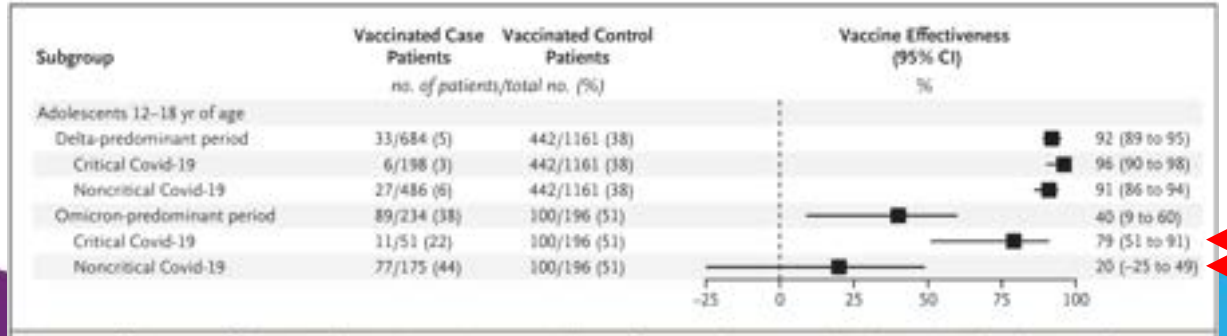

Figure 3. Effectiveness of the BNT162b2 Vaccine against Hospitalization for Critical as Compared with Noncritical Covid-19 in Adolescents 12 to 18 Years of Age, Stratified According to Variant.

JAMA | Original Investigation

Myocarditis Cases Reported After mRNA-Based COVID-19 Vaccination in the US From December 2020 to August 2021

Matthew E. Oster, MD, MPH; David K. Shay, MD, MPH; John R. Su, MD, PhD, MPH; Julianne Gee, MPH; C. Buddy Creech, MD, MPH; Karen R. Broder, MD; Kathryn Edwards, MD; Jonathan H. Soslow, MD, MSCI; Jeffrey M. Dendy, MD; Elizabeth Schlaudecker, MD, MPH; Sean M. Lang, MD; Elizabeth D. Barnett, MD; Frederick L. Ruberg, MD; Michael J. Smith, MD, MSCE; M. Jay Campbell, MD, MHA; Renato D. Lopes, MD, PhD, MHS; Laurence S. Sperling, MD; Jane A. Baumblatt, MD; Deborah L. Thompson, MD, MSPH; Paige L. Marquez, MSPH; Penelope Strid, MPH; Jared Woo, MPH; River Pugsley, PhD, MPH; Sarah Reagan-Steiner, MD, MPH; Frank DeStefano, MD, MPH; Tom T. Shimabukuro, MD, MPH, MBA

Figure 2. Cases of Myocarditis After mRNA-Based COVID-19 Vaccination by Time From Vaccination to Symptom Onset

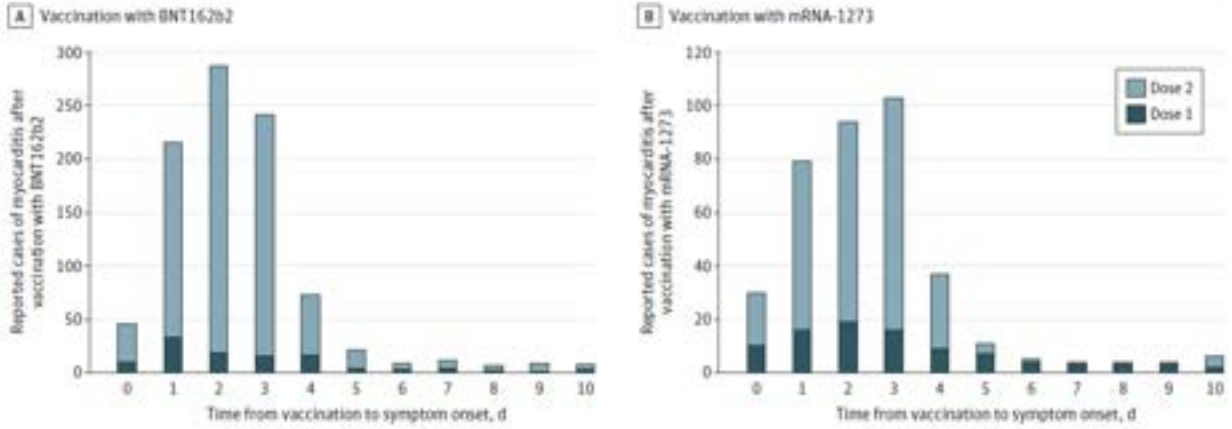

Table 2. Reports to VAERS After mRNA-Based COVID-19 Vaccination That Met the CDC's Case Definition for Myocarditis Within a 7-Day Risk Interval per Million Doses of Vaccine Administered

	Reported cases of myocarditis within a 7-d risk interval per million doses of vaccine administered (95% CI)[a]				Expected cases of myocarditis in a 7-d risk interval per million doses (95% CI)[c]
	Vaccination with BNT162b2		Vaccination with mRNA-1273[b]		
	First dose	Second dose	First dose	Second dose	
Males					
Age group, y					
12-15	7.06 (4.88-10.23)	70.73 (61.68-81.11)			0.53 (0.40-0.70)
16-17	7.26 (4.45-11.86)	105.86 (91.65-122.27)			1.34 (1.05-1.72)
18-24	3.82 (2.40-6.06)	52.43 (45.56-60.33)	10.73 (7.50-15.34)	56.31 (47.08-67.34)	1.76 (1.58,1.98)
25-29	1.74 (0.78-3.87)	17.28 (13.02-22.93)	4.88 (2.70-8.80)	24.18 (17.93-32.61)	1.45 (1.21-1.74)
30-39	0.54 (0.20-1.44)	7.10 (5.26-9.57)	3.00 (1.81-4.97)	7.93 (5.61-11.21)	0.63 (0.54.0.73)
40-49	0.55 (0.21-1.48)	3.50 (2.28-5.36)	0.59 (0.19-1.82)	4.27 (2.69-6.78)	0.78 (0.67-0.90)
50-64	0.42 (0.17-1.01)	0.68 (0.33-1.43)	0.62 (0.28-1.39)	0.85 (0.41-1.79)	0.77 (0.68-0.86)
≥65	0.19 (0.05-0.76)	0.32 (0.10-1.00)	0.18 (0.05-0.72)	0.51 (0.21-1.23)	
Females					
Age group, y					
12-15	0.49 (0.12-1.98)	6.35 (4.05-9.96)			0.17 (0.11-0.29)
16-17	0.84 (0.21-3.37)	10.98 (7.16-16.84)			0.42 (0.27-0.66)
18-24	0.18 (0.03-1.31)	4.12 (2.60-6.54)	0.96 (0.31-2.96)	6.87 (4.27-11.05)	0.38 (0.30-0.49)
25-29	0.26 (0.04-1.84)	2.23 (1.07-4.69)	0.41 (0.06-2.94)	8.22 (5.03-13.41)	0.48 (0.35-0.65)
30-39	0.72 (0.32-1.60)	1.02 (0.49-2.14)	0.74 (0.28-1.98)	0.68 (0.22-2.10)	0.47 (0.39-0.57)
40-49	0.24 (0.06-0.97)	1.73 (0.98-3.05)	0.18 (0.02-1.25)	1.89 (0.98-3.63)	0.89 (0.77-1.04)
50-64	0.37 (0.15-0.88)	0.51 (0.23-1.14)	0.65 (0.31-1.36)	0.43 (0.16-1.15)	1.00 (0.89-1.13)
≥65	0.08 (0.01-0.54)	0.35 (0.13-0.92)		0.26 (0.08-0.81)	

Risk of getting struck by lightning/year = 2/million *(CDC)*

4 - 10 fold higher risk of myocarditis with SARS-CoV-2 infection than with vaccination

1/350 US adults has died from COVID to date (2,900/million)

https://www.nytimes.com/2021/07/26/us/politics/fda-covid-vaccine-trials-children.html

The Coronavirus Outbreak › LIVE Covid-19 Updates Coronavirus Map and Cases Delta Variant Map Risks in School

Coronavirus Updates ›

At the F.D.A.'s urging, Pfizer-BioNTech and Moderna are expanding their trials for children 5 to 11.

By Sheryl Gay Stolberg, Sharon LaFraniere and Noah Weiland

July 26, 2021

The F.D.A. has asked the companies to include 3,000 children in the 5-to-11-year-old group, the group for whom results were expected first, according to people familiar with the situation. One of the people, granted anonymity to speak freely, described that figure as double the original number of study participants.

Dig deeper into the moment.
Special offer: Subscribe for $1 a week.

A spokesman for Moderna, Ray Jordan, confirmed that the company intends to expand its trial "to enroll a larger safety database which increases the likelihood of detecting rarer events" and expects to seek emergency authorization late this year or early next year.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Evaluation of the BNT162b2 Covid-19 Vaccine in Children 5 to 11 Years of Age

E.B. Walter, K.R. Talaat, C. Sabharwal, A. Gurtman, S. Lockhart, G.C. Paulsen, E.D. Barnett, F.M. Muñoz, Y. Maldonado, B.A. Pahud, J.B. Domachowske, E.A.F. Simões, U.N. Sarwar, N. Kitchin, L. Cunliffe, P. Rojo, E. Kuchar, M. Rämet, I. Munjal, J.L. Perez, R.W. Frenck, Jr., E. Lagkadinou, K.A. Swanson, H. Ma, X. Xu, K. Koury, S. Mather, T.J. Belanger, D. Cooper, Ö. Türeci, P.R. Dormitzer, U. Şahin, K.U. Jansen, and W.C. Gruber, for the C4591007 Clinical Trial Group*

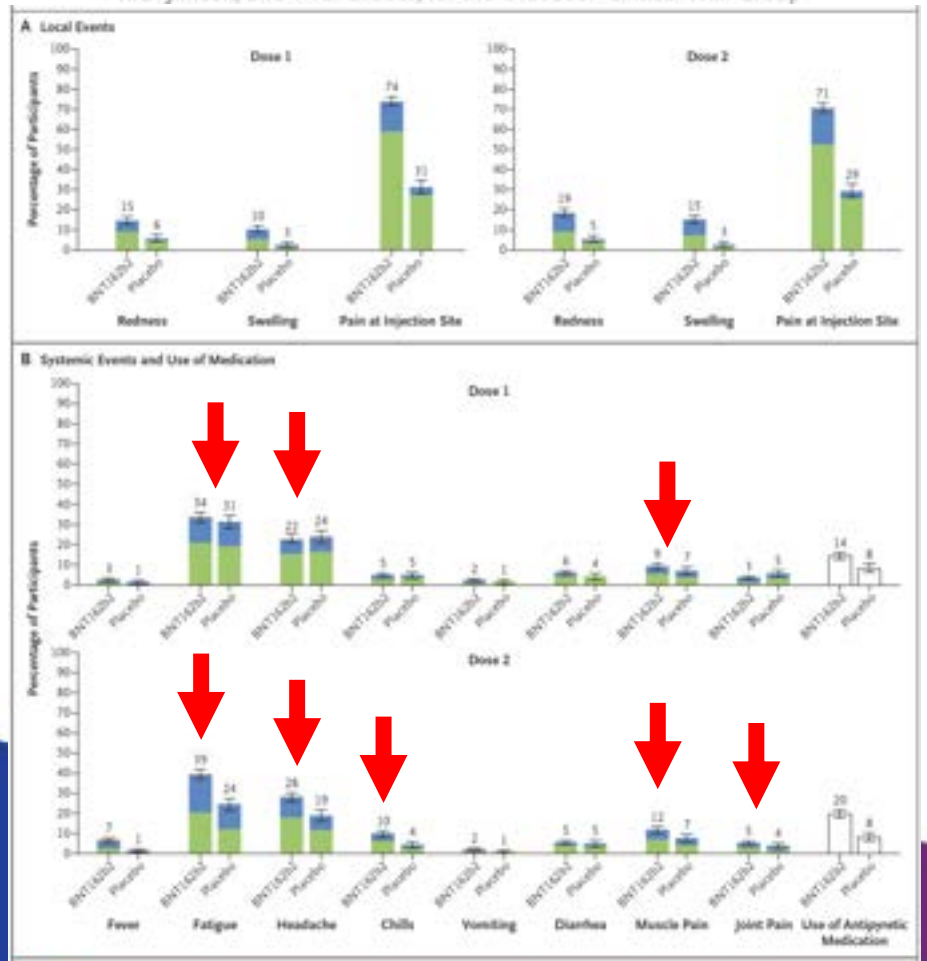

Figure 2. Local Reactions and Systemic Events Reported in the Phase 2–3 Trial within 7 Days after Injection of BNT162b2 or Placebo.

Placebo rates are much higher in children than in adults.

Red arrows highlight 10% difference from adult Phase 3 studies.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Evaluation of mRNA-1273 Covid-19 Vaccine in Children 6 to 11 Years of Age

C.B. Creech, E. Anderson, V. Berthaud, I. Yildirim, A.M. Atz, I. Melendez Baez, D. Finkelstein, P. Pickrell, J. Kirstein, C. Yut, R. Blair, R.A. Clifford, M. Dunn, J.D. Campbell, D.C. Montefiori, J.E. Tomassini, X. Zhao, W. Deng, H. Zhou, D. Ramirez Schrempp, K. Hautzinger, B. Girard, K. Slobod, R. McPhee, R. Pajon, R. Das, J.M. Miller, and S. Schnyder Ghamloush, for the KidCOVE Study Group*

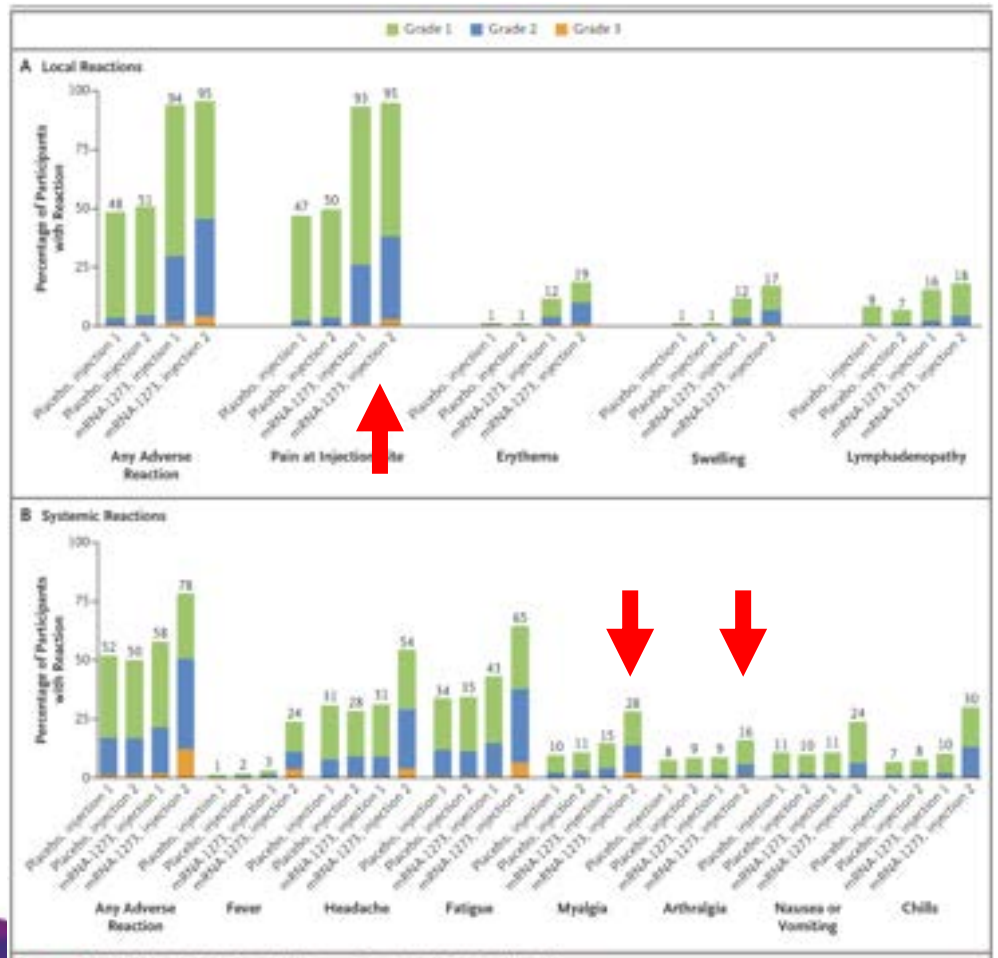

Figure 2. Solicited Local and Systemic Adverse Reactions in Part 2 of the Trial.

ORIGINAL ARTICLE

Evaluation of the BNT162b2 Covid-19 Vaccine in Children 5 to 11 Years of Age

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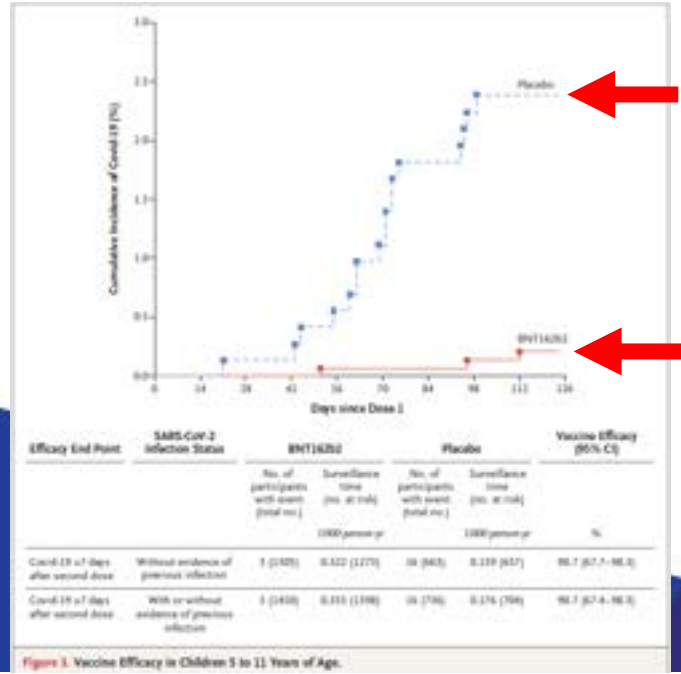
Table 2. Results of Serum SARS-CoV-2 Neutralization Assay 1 Month after the Second Dose of BNT162b2 among Participants 5 to 11 and 16 to 25 Yr of Age.*

Age Group	BNT162b2 Dose Level	No. of Participants	GMT (95% CI)†	Geometric Mean Ratio, 5-to-11-yr-olds vs. 16-to-25-yr-olds (95% CI)‡
5–11 yr	10 μg	264	1197.6 (1106.1–1296.6)	1.04 (0.93–1.18)
16–25 yr	30 μg	253	1146.5 (1045.5–1257.2)	—



Pfizer booster dose now also approved

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Evaluation of mRNA-1273 Covid-19 Vaccine in Children 6 to 11 Years of Age

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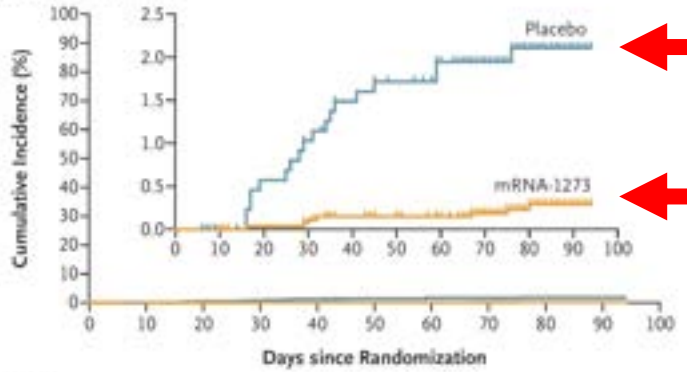
Table 2. Immunogenicity of the mRNA-1273 Vaccine in Part 2 of the Trial.*

Variable	Children, 6–11 Yr mRNA-1273, 50 μg (N = 320)	Young Adults, 18–25 Yr mRNA-1273, 100 μg (N = 295)	Children vs. Young Adults
Baseline			
No. of participants with nonmissing data	317	295	
Geometric mean pseudovirus neutralizing antibody titer (95% CI)†	9.3 (NE to NE)	9.3 (9.2 to 9.4)	
Day 57			
No. of participants with nonmissing data	319	295	
Geometric mean pseudovirus neutralizing antibody titer (95% CI)‡	1610 (1457 to 1780)	1300 (1171 to 1443)	Geometric mean titer ratio, 1.2 (95% CI, 1.1 to 1.4)‡

A Covid-19, CDC Definition



	Vaccine Efficacy (95% CI)	Incidence Rate (95% CI)
	%	per 1000 person-yr
Placebo		117.1 (69.4–185.1)
mRNA-1273	88.0 (70.0–95.8)	14.0 (5.6–28.9)

No. at Risk

Placebo	880	876	870	865	858	854	845	777	407	83	0
mRNA-1273	2687	2685	2679	2677	2670	2667	2660	2561	1677	548	0

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Pfizer Falters With Test of Vaccine for Youngest Children

Pfizer determined that two low doses of its vaccine did not produce an adequate immune response in some kids under 5, likely posing a setback to providing shots for the youngest population.

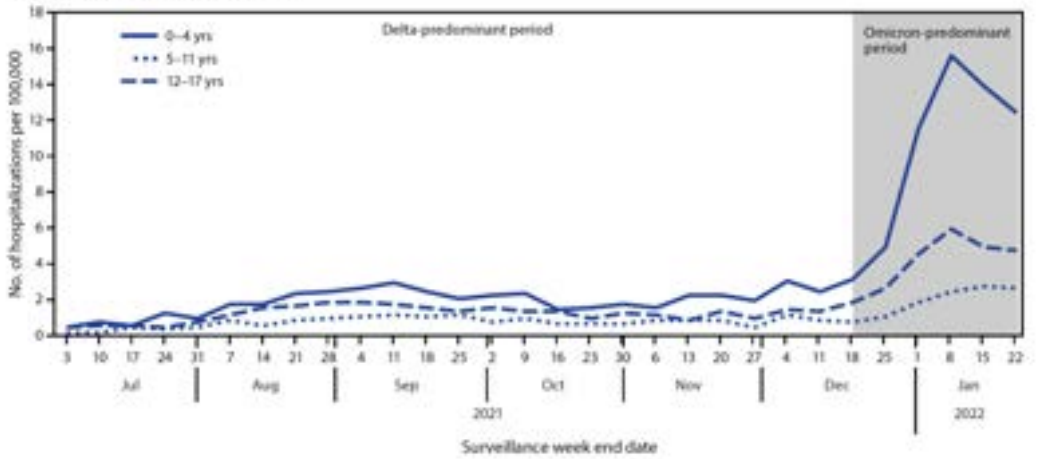
By Kaia Hubbard | Dec. 17, 2021, at 4:03 p.m.

The change to the ongoing trials, which studies children between six months and 5 years old, is likely a setback in the timeline for making the shots available to the youngest population. Although the company said the two lower doses of a vaccine generated a strong immune response in kids under age 2, the same wasn't true for 2- to 5-year-olds.

Hospitalizations of Children and Adolescents with Laboratory-Confirmed COVID-19 — COVID-NET, 14 States, July 2021–January 2022

Kristin J. Marks, PhD[1,2]; Michael Whitaker, MPH[1]; Onika Anglin, MPH[1,3]; Jennifer Milucky, MSPH[1]; Kadam Patel, MPH[1,3];

FIGURE. Weekly COVID-19–associated hospitalization rates* among children and adolescents aged 0–17 years, by age group — COVID-NET, 14 states,† July 3, 2021–January 22, 2022



Abbreviation: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network.
* Number of patients with laboratory-confirmed COVID-19–associated hospitalizations per 100,000 population; rates are subject to change as additional data are reported.
† COVID-NET sites are in the following 14 states: California, Colorado, Connecticut, Georgia, Iowa, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah. Starting the week ending December 4, 2021, Maryland data are removed from weekly rate calculations.

Pfizer Science Products News About

Pfizer and BioNTech Initiate Rolling Submission for Emergency Use Authorization of Their COVID-19 Vaccine in Children 6 Months Through 4 Years of Age Following Request From U.S. FDA

Tuesday, February 01, 2022 - 04:20pm

https://www.cnbc.com/2022/02/11/pfizer-delays-its-application-to-the-fda-to-expand-its-covid-vaccine-to-kids-under-5.html

BREAKING ECB member pushes for quick move to raise rates, says Russia-Ukraine war could derail recovery

CNBC MARKETS BUSINESS INVESTING TECH POLITICS CNBC TV INVESTING CLUB PRO

Pfizer delays its FDA application to expand its Covid vaccine to kids under 5 until ~~April~~ MAY

PUBLISHED FRI, FEB 11 2022•1:37 PM EST | UPDATED FRI, FEB 11 2022•6:55 PM EST

Spencer Kimball
@SPENCEKIMBALL

SHARE

KEY POINTS

- Pfizer and BioNTech said they needed more data "because rates of infection and illness remain high in children of this age" due to the omicron variant.
- Dr. Peter Marks, head of the FDA division responsible for vaccine safety, said the sudden decision to delay authorization should reassure parents that the FDA is doing due diligence to make sure the vaccine is safe and effective for kids.
- Marks said parents will have to rely on mitigation measures to protect their children as they wait for the vaccine's authorization in the coming months.

TV
The News With Shepard Smith
UP NEXT | Worldwide Exchang
05:00 am ET

Pfizer and BioNTech's three-dose Covid vaccine for children 6 months to 5 years old was 80% effective at preventing illness during the omicron wave, according to preliminary clinical trial results released Monday.

A third dose of the vaccine elicited a strong immune response and was well tolerated by the kids with a majority of the side effects mild to moderate, according to the companies.

Moderna Files for Authorization of Its COVID-19 Vaccine in Young Children Six Months to Under Six Years of Age

4/28/2022

Positive interim results from the Phase 2/3 KidCOVE study, announce**on March 23, 2022** showed a robust neutralizing antibody response in the 6 month to under 6 years of age group after a two-dose primary series of mRNA-1273, along with a favorable safety profile. The antibody titers in the pre-specified 6 month to 23 month and 2 years to under 6 years age sub-groups met the statistical criteria for similarity to the adults in the COVE study, which satisfied the primary objective of the study. The previously announced results included a supportive

preliminary efficacy analysis on cases mostly collected during the Omicron wave, including home testing for COVID-19. When the analysis is limited only to cases confirmed positive for SARS-CoV-2 by central lab RT-PCR vaccine efficacy remained significant at 51% (95% CI: 21-69) for 6 months to <2 years and 37% (95% CI: 13-54) for 2 to <6 years. These efficacy estimates are similar to vaccine efficacy estimates in adults against Omicron after two doses of mRNA-1273.

The EUA submission for children ages 6 months to under 6 years will be complete next week. Moderna is also currently studying booster doses for all pediatric cohorts.

VRBPAC meeting: Moderna 6 – 17 year old on June 14
Moderna + Pfizer (2 dose vs 3 dose primary series) on June 15
After VRBPAC meeting → FDA decision
ACIP meeting → ACIP decision → CDC decision

What is the effectiveness of these vaccines?

What is the effectiveness of these vaccines?

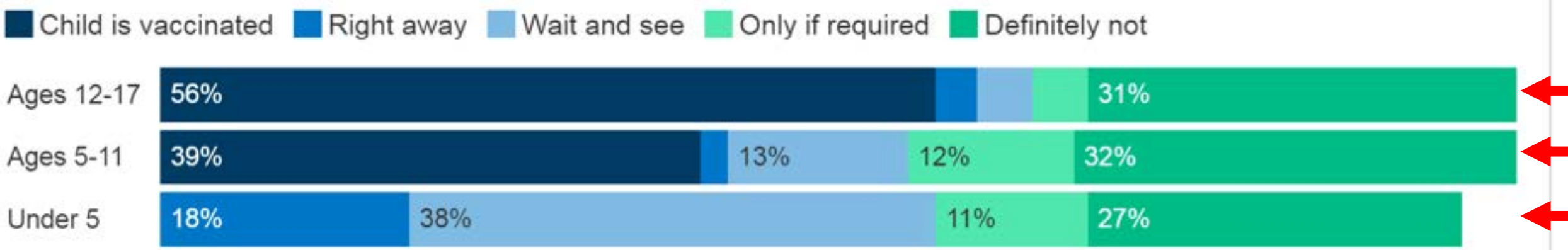
!!!ZERO!!!

Walt Orenstein: Vaccinations save lives

Figure 1

One In Five Parents Of Children Under 5 Want To Vaccinate Their Child For COVID-19 Right Away When Authorized, But Four In Ten Want To Wait And See

Thinking about your child between the ages of...have they received at least one dose of a COVID-19 vaccine, or not? If not, do you think you will get them vaccinated…?



NOTE: Asked of parents or guardians of children under 18. For parents of children under 5, question was worded "Thinking about your child under the age of 5, once there is a COVID-19 vaccine authorized and available for your child's age group, do you think you will…?" See topline for full question wording.

SOURCE: KFF COVID-19 Vaccine Monitor (April 13-26, 2022) • PNG

KFF COVID-19 Vaccine Monitor