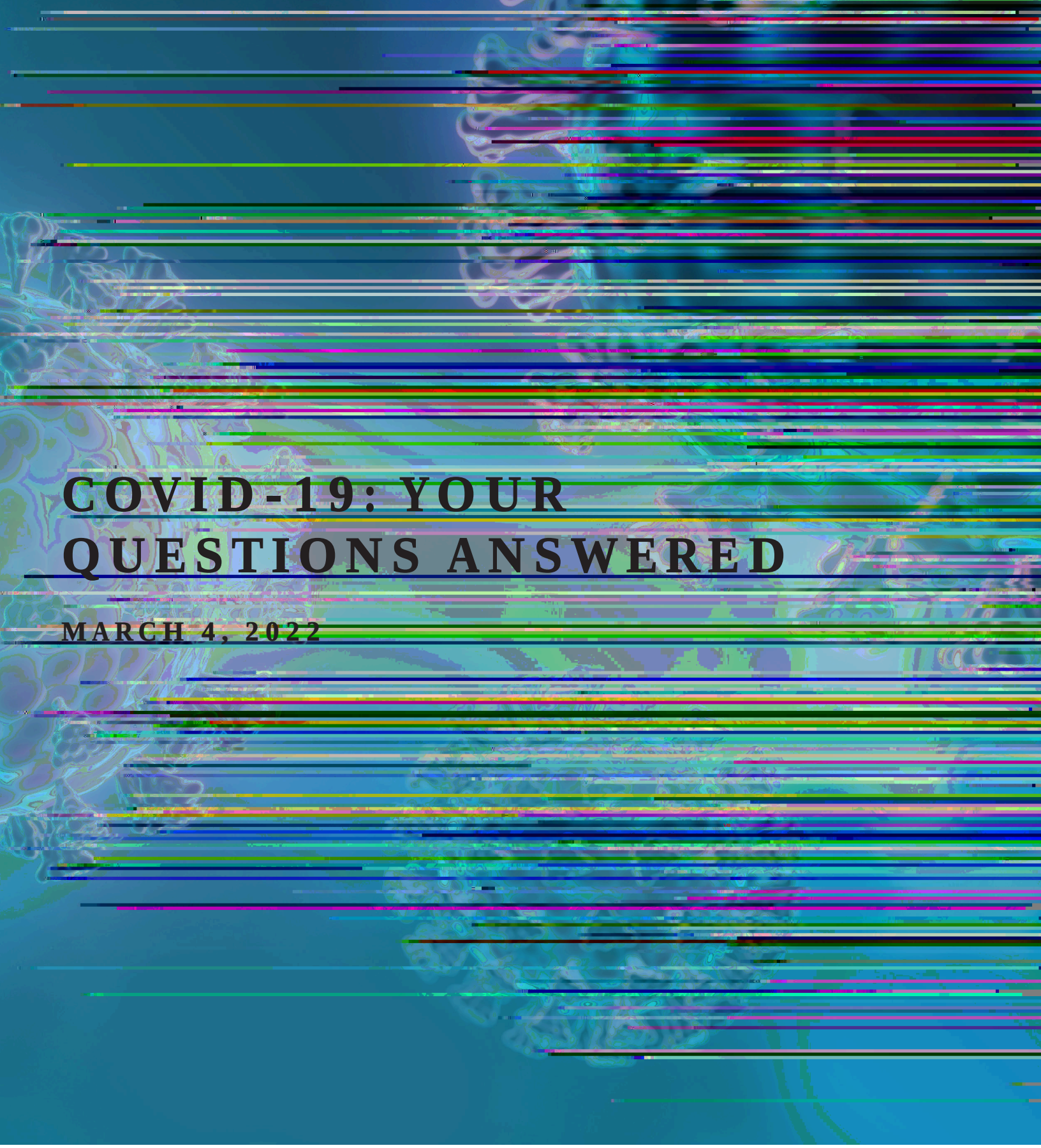

COVID-19: YOUR QUESTIONS ANSWERED

MARCH 4, 2022

The American Association of Immunologists (AAI) is pleased to present this short primer on coronavirus disease 2019 (COVID-19). Here, we focus on four key areas:

Vaccines Symptoms Therapies Prevention

Because scienti c research regarding coronavirus disease 2019 (COVID-19) and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes the disease, is ongoing, our understanding of the disease is rapidly growing. In response, public health advice is naturally and appropriately evolving. We urge readers to regularly consult the websites of the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA) for new developments.

Vaccines

Vaccine Development

COVID-19, the disease caused by SARS-CoV-2, has spread around the world with more than 430 million laboratory-con rmed cases and almost six million deaths as of February 2022.[1] High global vaccination rates are urgently needed to control this pandemic and to help people safely resume the usual activities of daily life. Vaccination slows the spread of disease, reduces the severity of illness to minimize hospitalizations and deaths, and eases the pressure on our strained health care system.

Historically, developing vaccines requires many years of research and involves complex interactions between public and private institutions. However, with the national and global mobilization e orts in response to COVID-19, we have seen the rapid development, testing, approval, manufacture, and distribution of highly e ective vaccines against SARS-CoV-2.[2]

As of February 2022, ten COVID-19 vaccines, generated across multiple platforms (methods of generating vaccines), have been authorized by the World Health Organization (WHO) and are being used in countries around the world.[3] In the U.S., two messenger RNA (mRNA) vaccines have been fully approved, and one viral vector vaccine has been authorized under an Emergency Use Authorization (EUA), by FDA. ese vaccines induce protective immune responses against the SARS-CoV-2 spike protein, a protein needed for the virus to infect cells. Clinical trials and real-world evidence have demonstrated that all three vaccines are safe and highly e ective at preventing severe disease, hospitalization, and death. ese vaccines are:

1. _____

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e mRNA vaccines enable human cells to produce a harmless version of the SARS-CoV-2 spike protein, which prompts the immune system to mount a response against the virus that helps limit symptoms and protect against severe disease from future infection. No live virus is involved, and recipients cannot get COVID-19 from the vaccine.

Johnson & Johnson's vaccine uses viral vector technology, which has been studied in the context of vaccines, gene therapy, and cancer, since the 1970s.

Pediatric clinical trials are ongoing to determine the appropriate dosage, safety, and e cacy of COVID-19 vaccines in children aged 6 months to 4 years.

Booster Shots

All three vaccines are authorized for use as a booster shot (an extra dose in addition to the recommended primary series) and can be given in a "mix and match" fashion. As with the primary series, CDC also recommends that most individuals receive the P zer-BioNTech or Moderna mRNA vaccine as a booster shot rather than the Johnson & Johnson vaccine, unless the person had an adverse reaction to an mRNA vaccine or would not otherwise choose to get boosted. CDC recommends a booster shot for maximal protection against the omicron strain of SARS-CoV-2, currently the dominant strain circulating in the -t(ersn1er d(ai)2 (ta)1 (ur5us S)5.0)7 (tia

How Vaccines Work

As pictured to the right, a vaccine prepares the immune system to recognize and combat the virus if the immune system encounters it. After vaccination, when a person gets exposed to SARS-CoV-2, their immune system can more easily and quickly block or control the infection, limiting symptoms and transmission. is is why a vaccinated person usually has less severe symptoms and may not even get infected as compared to an unvaccinated person.

Understanding Vaccine Induced Immunity: Antibodies and T cells

ere are two types of immune cells that are particularly important in the response to a vaccine: B cells and T cells. B cells produce antibodies that can block the virus from spreading from cell to cell. is is known as "humoral immunity." T cells can seek out and kill infected cells, also preventing viral spread. is is known as "cellular immunity." Although much remains to be understood regarding immune protection for SARS-CoV-2 infection, emerging data have demonstrated the importance of both humoral and cellular immunity in protection. Research is ongoing to better understand the relative contribution of vaccine-induced antibodies and T cells to controlling SARS-CoV-2 infection.

Variant-Speci c Booster Shots

Viruses such as SARS-CoV-2 mutate over time, leading to the presence of new viral "variants," or "strains," which can evade vaccine induced immunity. While T cells induced by primary series vaccination are able to recognize and combat currently existing variants of concern, booster shots have been e ective in increasing antibody production by B cells, providing enhanced protection. To prepare for potential variants that may evade current vaccines, scientists are working to develop booster shots that could enable better immune protection against viral variants and are testing the ability of current vaccines to protect against emerging

- Fatigue
- Muscle or body aches
- Gastrointestinal symptoms (nausea, vomiting, diarrhea)

- Severe symptoms of COVID-19 that require seeking emergency medical care[13]:
  - Trouble breathing
  - Skin, lip, or nail bed discoloration (pale, blue, gray)
  - Constant chest pain or pressure
  - Confusion
  - Extreme fatigue/inability to wake up or stay awake

Severe disease most commonly occurs in the elderly, immunocompromised, and those with underlying conditions including hypertension, diabetes, and obesity.[14] It is important to note, however, that severe disease can occur in all age groups. In rare cases, people can develop multisystem in ammatory syndrome (MIS-C in children and MIS-A in adults), a serious disease associated with COVID-19 in which patients develop in ammation of the heart, lungs, kidneys, brain, skin, eyes, or gastrointestinal organs.[15]

COVID-19 Long-Term E ects[16]

COVID-19 can have long-term adverse e ects on the neurological, cardiovascular, gastrointestinal, musculoskeletal, and pulmonary systems, as well as on mental health. ese post-COVID conditions are also called long COVID, long-haul COVID, or post-acute sequelae of COVID-19 (PASC) and can linger for weeks or months after rst being infected by SARS-CoV-2. Long-term e ects are more likely in vulnerable populations, such as the elderly and those with certain comorbidities (having two or more diseases or medical conditions siaously) but can occur in anyone who has been infected with SARS-CoV-2.

- Commonly reported adverse e ects include:
  - Change in smell or taste
  - Di culty breathing or shortness of breath
  - Tiredness or fatigue
  - Worsening symptoms after physical or mental activities

- Rash
- Mood changes
- Changes in menstrual period cycles

- Rare but serious adverse e ects[17-19]
  - Brain: In ammation of the brain tissue (encephalitis) and lack of oxygen can result in cognitive impairment (changes in memory and attention), mood swings, mental health disorders (anxiety, depression, post-traumatic stress disorder), sleep problems, seizures, and increased risk of

- Sotrovimab – (GlaxoSmithKline) (Originally granted EUA by FDA on May 26, 2021)
- Bebtelovimab (Eli Lilly) (originally granted EUA by FDA on February 11, 2022)
- Tixagevimab plus cilgavimab (Evusheld™, AstraZeneca) (Originally granted EUA by FDA on December 8, 2021)
  - Administered to certain individuals with moderately to severely compromised immune systems or those with a history of severe adverse reactions to COVID-19 vaccines, who are not currently infected or exposed, for th7tct

- Analgesics and NSAIDs – reduce ongoing symptoms and in ammation
- Nasal steroids – reduce local in ammation, may help relieve loss of sense of smell

Prevention[23]

1. **Vaccination:** Widespread immunization is the best way to achieve reliable, long-term control of COVID-19.

2. **Masks:** Because SARS-CoV-2 is transmitted within respiratory droplets/particles that are produced when a person breathes, sings, coughs, or sneezes, high quality, well- tting masks can protect oneself and others from infection.[25,26] e virus is spread primarily by two airborne routes:

   — droplet transmission: large respiratory droplets that contain virus are inhaled by someone close to the infectious person, generally within about six feet

   — aerosol transmission: small viral particles in the air (which can linger for minutes to hours) infect others by being inhaled through the nose or mouth, or (less likely) by deposition on the eyes

   AAI recommends that individuals consult current CDC mask guidelines, and when appropriate, wear high quality masks with the best t and protection possible.

3. **Social Distancing:** Social distancing will help reduce the risk of being exposed to SARS-CoV-2. Data show that being outdoors is far safer than being indoors, for the same activity and distance. e risk of transmission is much lower outside than inside because viruses that are released into the air can rapidly become diluted through the atmosphere.

Other ways to reduce risk include avoiding:

- places where people are not wearing masks, especially indoors;
- crowded spaces;
- close proximity (within six feet) to others, especially if they are vigorously exhaling as a result of loud talking/shouting/singing, or aerobic exercise;
- environments with poor ventilation; and
- contact with others whose vaccination and COVID-19 status are unknown.

4. **Testing:** Testing for SARS-CoV-2 is helpful in preventing the spread of disease. Two types of tests are

available to determine if an individual is infected with SARS-CoV-2:

- Polymerase chain reaction (PCR) tests, which are the most accurate for detecting the presence of any SARS-CoV-2 viral particles, infectious or not. ese tests must be overseen by a professional and submitted to a laboratory for results, which usually yield results within a few days.
- Rapid antigen tests, which typically detect only infectious virus particles, can be taken anywhere, are easy to self-administer, and produce rapid results, usually within minutes.

5. **Practice good hygiene:**
   - oroughly washing hands (with soap and water for 20 seconds) or using a hand sanitizer (that contains at least 60% alcohol) and disinfecting frequently touched objects and surfaces may protect an individual from contact droplet transmission, which, although rare with COVID-19, is infection spread through direct contact with an article or surface that is contaminated.
   - Cover coughs and sneezes using an elbow or tissues and put on a new, clean mask after coughing or sneezing.