Pediatric Immunizations: Current and Future Considerations

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Centers for Disease Control and Prevention
Atlanta, GA

April 4, 2024
1130-1300

Presenter(s)

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Army Col (Ret) Cecilia Mikita is the Medical Director for the North Atlantic Region Vaccine Safety Hub, Immunization Healthcare Division, Defense Health Agency – Public Health. She has been a core clinical teaching faculty in the National Capital Consortium Allergy-Immunology Fellowship for over 19 years. Dr. Mikita has held numerous leadership positions including the Associate Program Director of the National Capital Consortium Allergy-Immunology Fellowship, Program Director of the Army Medical Department (AMEDDC&S) Allergy and Immunizations Program, WRAMC Intern Director, and Chief of Clinical Services. Nationally, she is a Fellow in the American Academy of Allergy, Asthma, and Immunology (AAAAI) and an Associate Professor of Pediatrics and Medicine at the Uniformed Services University of the Health Sciences (USUHS).

Dr. Mikita's academic accolades include the Army Medical Department 9A Proficiency Designator Award, the Order of Military Medical Merit (O2M3), the Claire L. Chennault Award, WRNMMC Master Clinician recognition, the WRAMC Outstanding Faculty Teaching Award, and a 2021 MHS Joint Outpatient Experience Survey (JOES) Provider of the Region award.

She earned her Masters in Public Health at Boston University and her Medical Degree at the Uniformed Services University. She completed her pediatric residency at Tripler Army Medical Center and her allergy/immunology fellowship at WRAMC.

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Disclosures

- Dr. Cecilia Mikita and Dr. Lakshmi Panagiotakopoulos have no relevant financial or non-financial relationships to disclose relating to the content of this activity.
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Learning Objectives

At the conclusion of this activity, participants will be able to:

1. Compare and contrast active and passive immunity.
2. Outline different meningococcal vaccines.
3. Identify target populations for new vaccines.
4. List two reasons why all children in the US are recommended to get at least one dose of the updated COVID-19 vaccine.

U.S. Food and Drug Administration (FDA) Approved Immunizations

- 1998: Synagis (palivizumab - RSV mAb)
- 2005-9: Adacel, Boostrix, ProQuad, Menactra 2005, RotaTeq 2006, ACAM2000 2007, Rotarix 2008, Ixiaro(JEV) 2009
- 2010 Prevnar(PCV13) & Menveo (MenACWY)
- 2013: Flublok, Fluzone, & Flulaval (influenza)
- 2014: Trumenba (MenB)
- 2015: Quadracel (DTaP/IPV), Bexsero (MenB)
- 2016: Vaxchora (cholera)
- 2017: Heplisav (HepB), Shingrix (shingles)
- 2018: Vaxelis (Diphtheria, tetanus, pertussis, HiB, HepB)
- 2019 Dengvaxia (dengue), Ervebro, Fluzone HD, Jynneos (smallpox, mpox)
- *2020 Fluad quadrivalent (influenza); MenQuadfi (MGC ACWY)
- *2021: Ticovac (TBE), Prehevbrio (Hep B), Vaxneuvance (PCV15), Prevnar 20 (PCV20)
- *2022: Priorix (MMR)
- *2023: Arexvy, Abrysvo (RSV), Beyfortus (nersevimab - RSV mAb), Cyfendus (anthrax), Ervebo (ebola for peds), PCV 20 (peds), Penbraya (pentavalent MGC)
- *2024: Ixchiq (chikungunya)

*Not including Coronavirus disease (COVID)-19 vaccines

(https://www.immunize.org/newreleases/)

2023/2024 New Immunizations and/or Indications

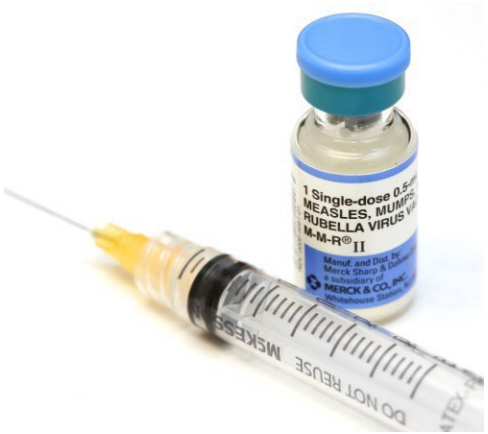
- Respiratory syncytial Virus (RSV)
  - Maternal RSV vaccine – Pfizer (Abrysvo™)
  - RSV Monoclonal antibodies (mAb) - Nersevimab (Beyfortus™)
- Anthrax (Cyfendus™) – post-exposure prophylaxis 18–65 years old
- Chikungunya (Ixchiq®) for 18 years old and older
- Meningococcal pentavalent (ABCWY) (Penbraya™) for 10–25 years old
- Ebola (Ervebo®) - new indication to 12 months old and older
- PCV20 (Prevnar20®) - new indication to six weeks old and older
- *COVID-19 vaccines*

FDA/ACIP/MMWR – Alphabet Soup!

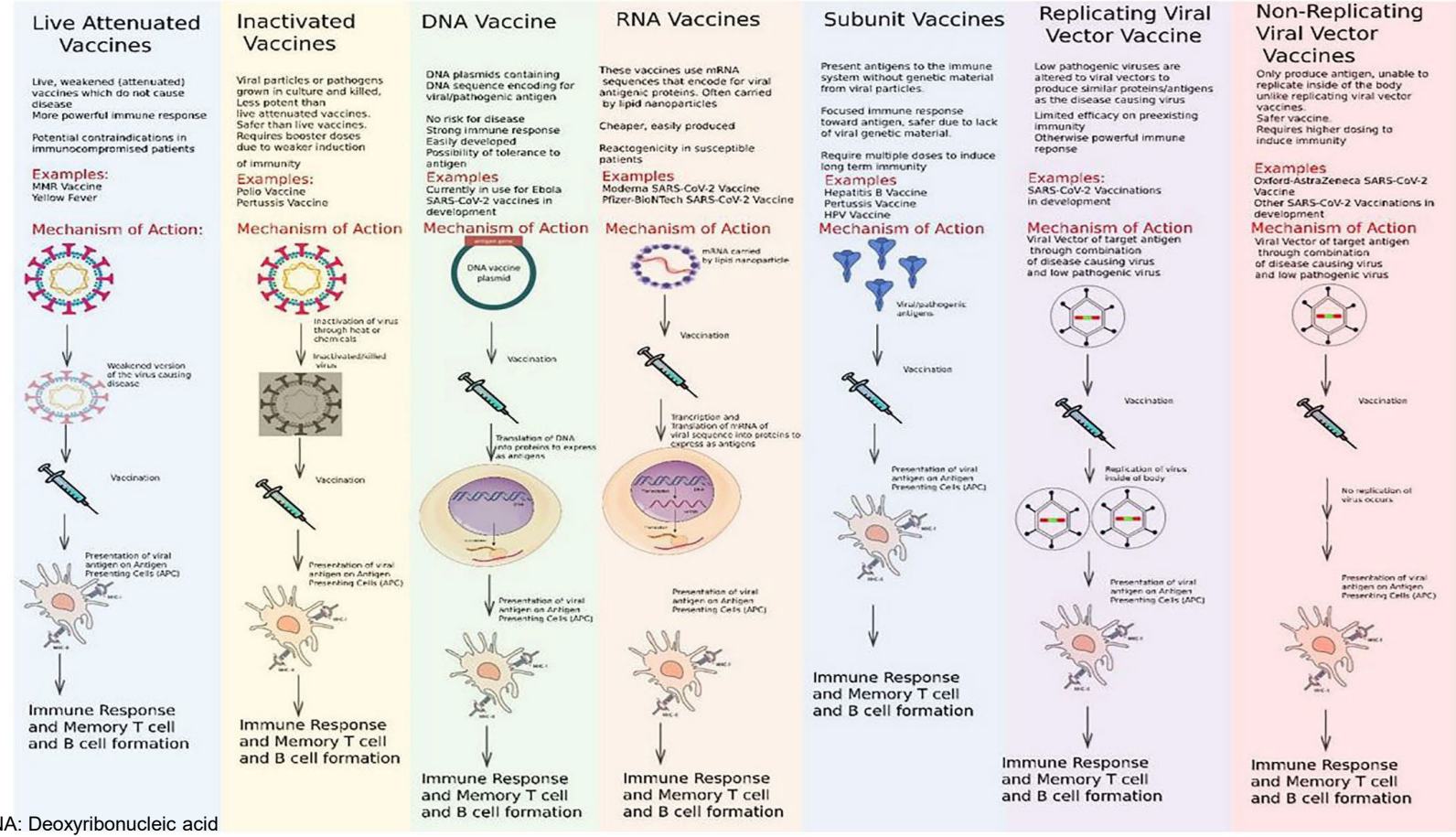
- Step 1: Food and Drug Administration (FDA) approval
  - Center for Biologics Evaluation and Research (CBER)
  - Vaccines and Related Biological Products Advisory Committee (VRBPAC) (sometimes)
    - ✓ Panel of outside, independent, technical experts from various scientific and public health disciplines that provide input on scientific data and its public health significance in a public forum. Make non-binding recommendations to the FDA, which generally follows the recommendations but is not legally bound to do so
- Step 2: Centers for Disease Control and Prevention (CDC) Advisory Committee on Immunization Practices (ACIP)
  - Develops recommendations for U.S. immunizations, including ages when vaccines should be given, number of doses, time between doses, and precautions and contraindications.
  - Committee's recommendations are forwarded to CDC's Director and once adopted, become official CDC policy
- Step 3: CDC's Morbidity and Mortality Weekly Report (MMWR)
  - Primary vehicle for scientific publication of timely, reliable, authoritative, accurate, objective, and useful public health information and recommendations
  - CDC Director's approved recommendations are published in CDC's MMWR

Vaccines

- Antigens from pathogens are introduced (via intramuscular (IM), subcutaneous (SQ), intranasal, oral route, percutaneous
- Innate immune system responds with macrophages, recruitment of neutrophils, inflammation, and triggering of adaptive immunity
- Adaptive immune system responds by presenting antigens to T-cells to proliferate, and stimulating B-cells to produce specific antibodies
- Memory B and T cells ensure future immune response



(https://www.news.iastate.edu)

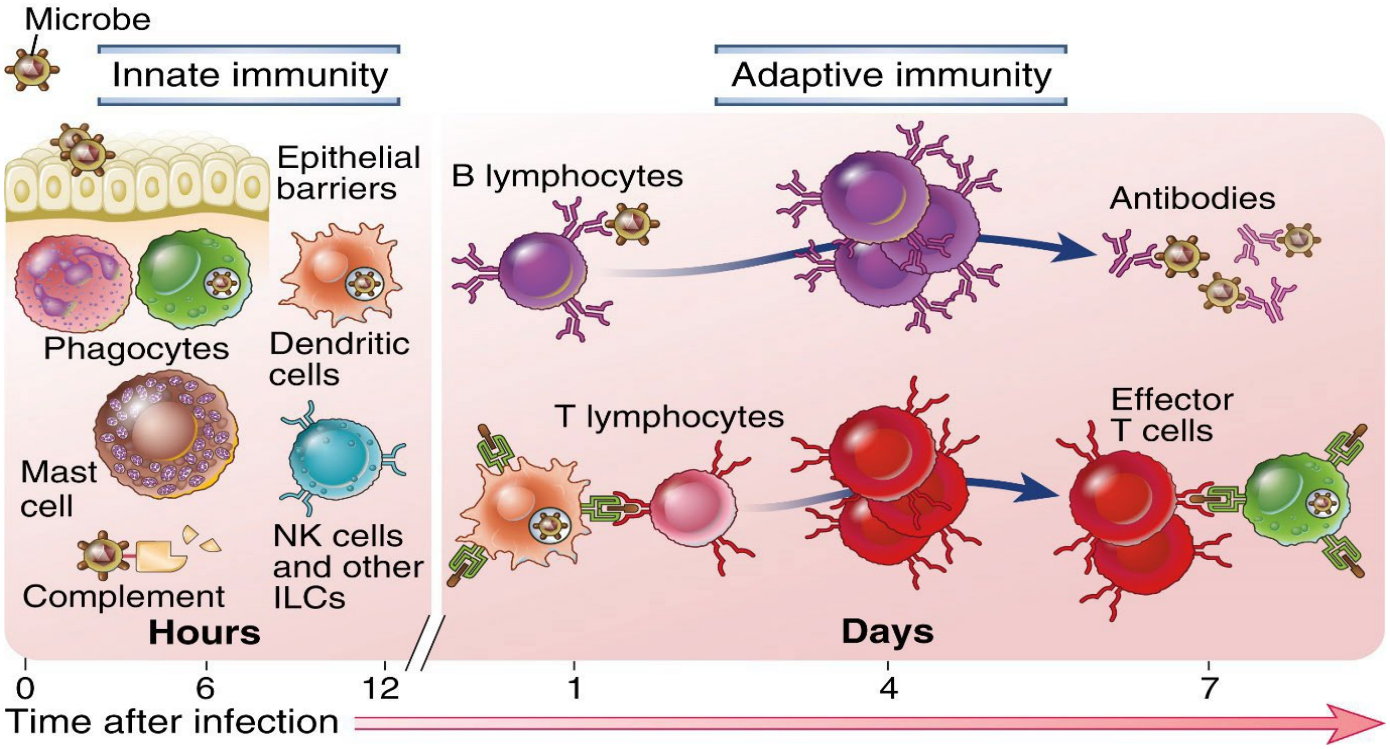


DNA: Deoxyribonucleic acid
RNA: Ribonucleic acid

(https://journals.sagepub.com)

https://journals.sagepub.com/doi/10.1177/25151355211059791

Immune System

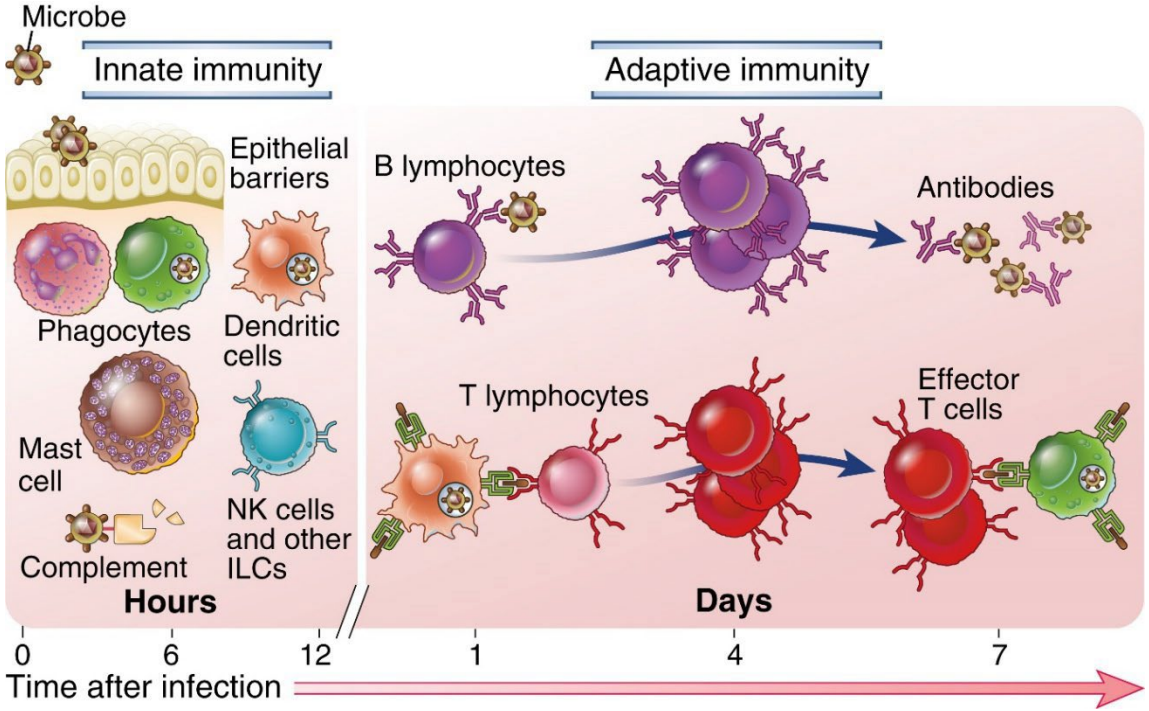


NK cells: Natural killer cells
ILCs: Innate lymphoid cells

(Abbas et al., 2021)

Functions of Innate Immunity

- Initial response to microbes
- Prevent host infection
- Eliminate microbes
- Stimulate adaptive immune response



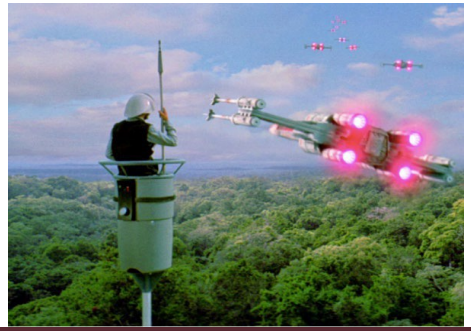
(Abbas et al., 2021)

Innate Immune System – For Star Wars Fans!

- Good – innate immune system

Ewoks from Return of the Jedi

(https://www.wired.com)



Rebel sentry on recon tower

(https://twitter.com)

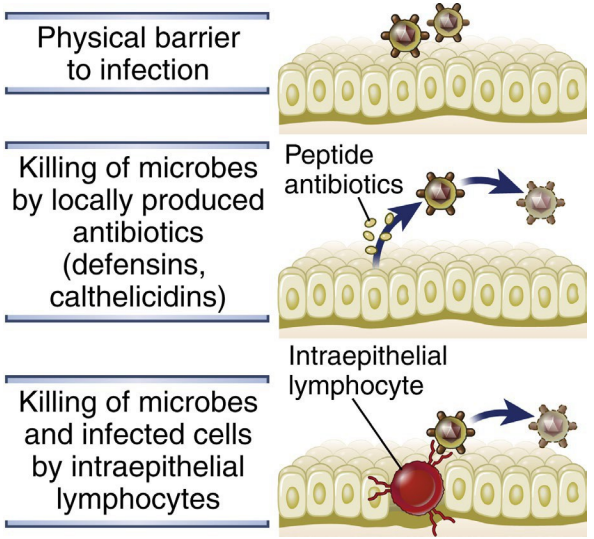
- Evil (antigens) - Galactic Empire

(https://www.deviantart.com)

Innate Immunity

Luke Skywalker sustained a puncture wound through his Stormtrooper boot with a rusty piece of metal in the trash compactor. It's been >5 years since his last tetanus shot.

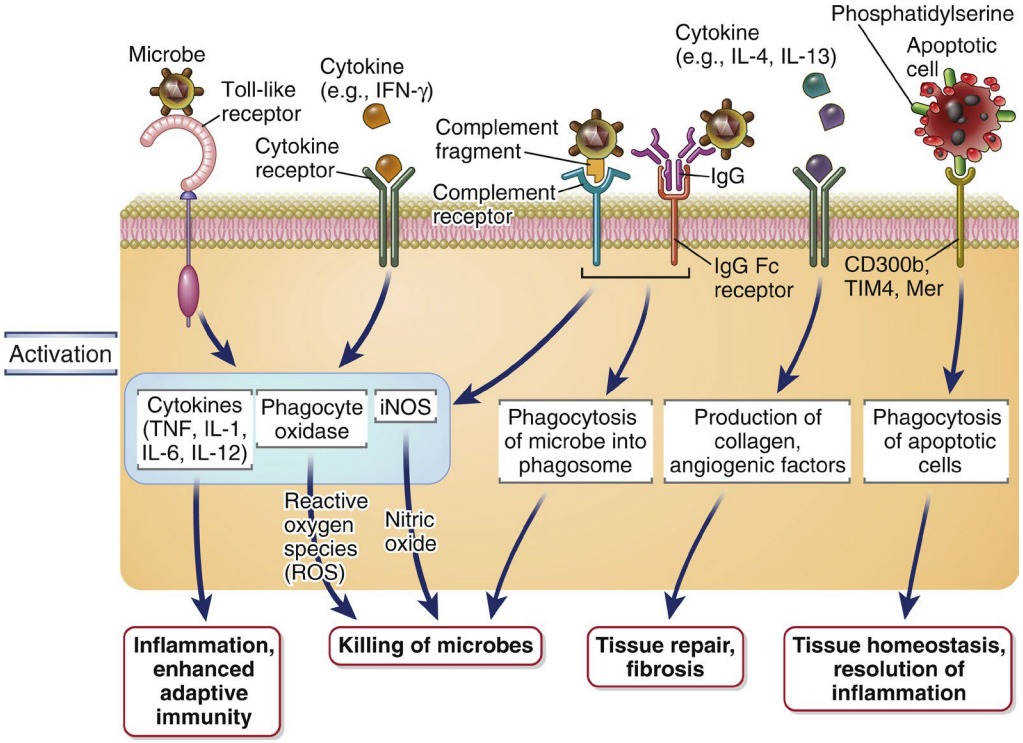
- Epithelial barrier
- Macrophages
- Dendritic cells



(https://www.cnet.com)

(Abbas et al., 2021)

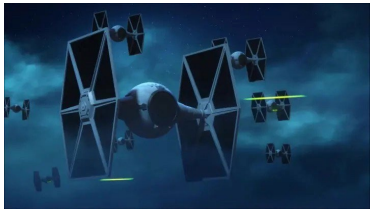
Macrophages “Jabba the Hut”



(https://ar.pinterest.com)

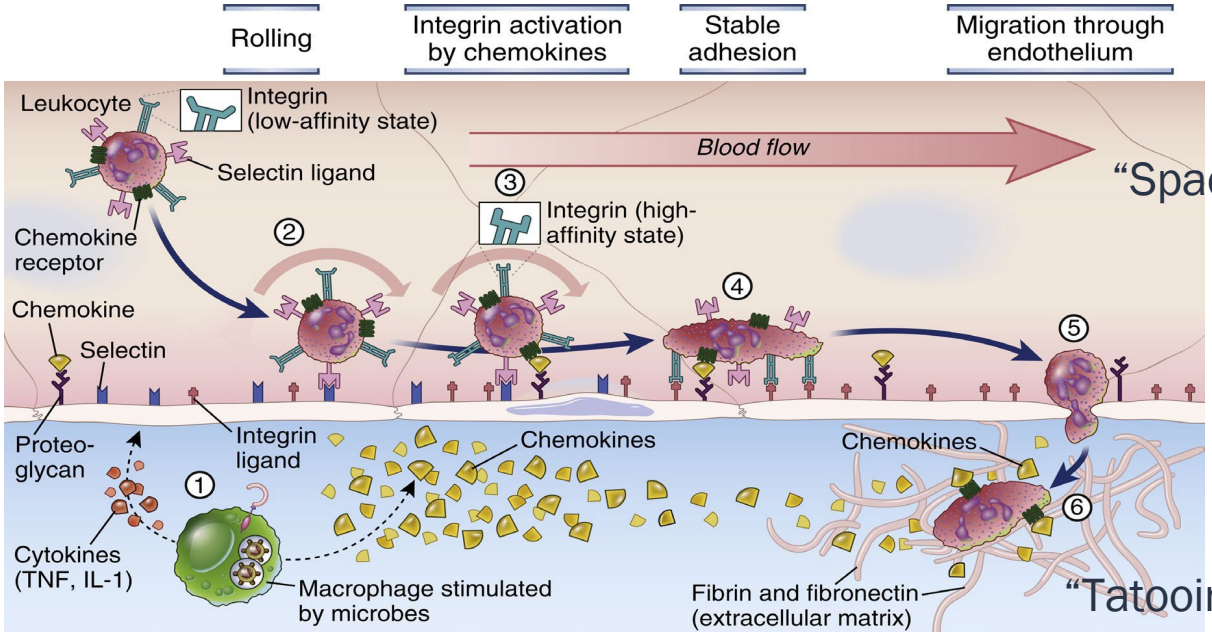
(Abbas et al., 2021)

Neutrophils – “TIE fighters”



(https://www.digitaltrends.com)

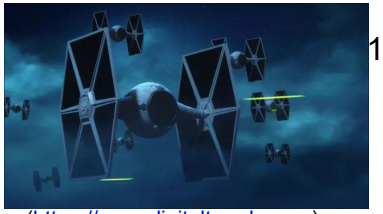
- Macrophages release cytokines (TNF-α) which attract neutrophils
- Neutrophils migrate “tractor beams” to sites of infection within a few hours of entry of microbes



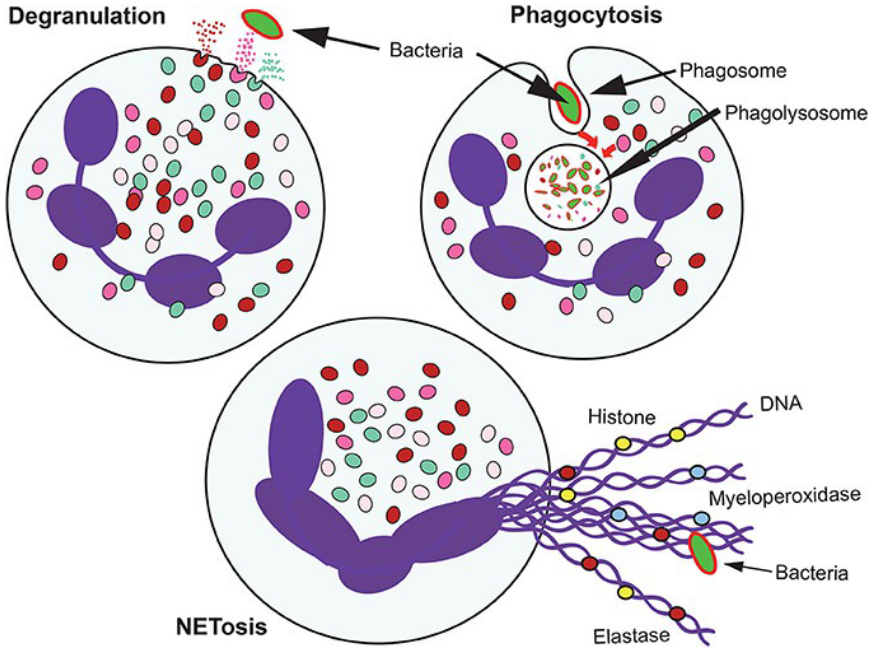
(Abbas et al., 2021)

TNF-α: Tumor necrosis factor alpha
IL – 1: Interleukin-1

Neutrophil Antimicrobial Actions



(https://www.digitaltrends.com)



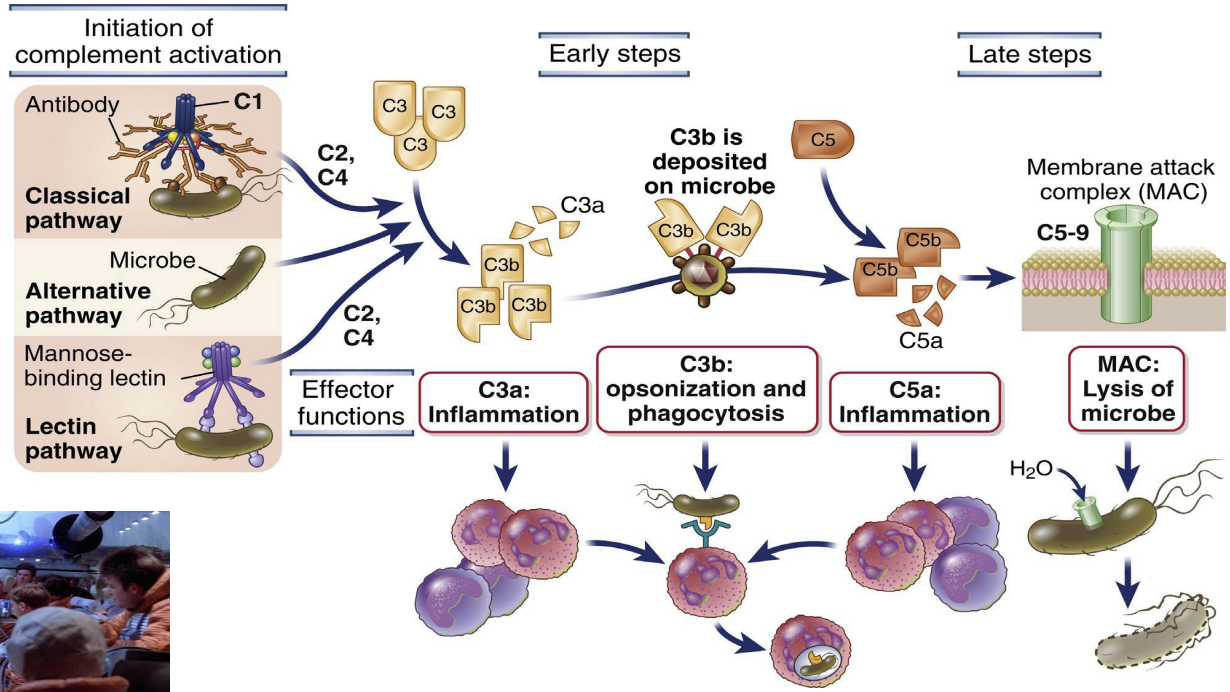
(https://www.frontiersin.org/files/Articles/324475/fphys-09-00113-HTML-r1/image_m/fphys-09-00113-g001.jpg)

- Phagocytosis – phagolysosome
  - Killed by low pH and degrading enzymes
- Degranulation of lysosomes
- Neutrophil Extracellular Traps
  - Extracellular traps formed by DNA and proteins from the granule
  - Large microbes that can't be engulfed

Complement Proteins – "Rebel Forces"

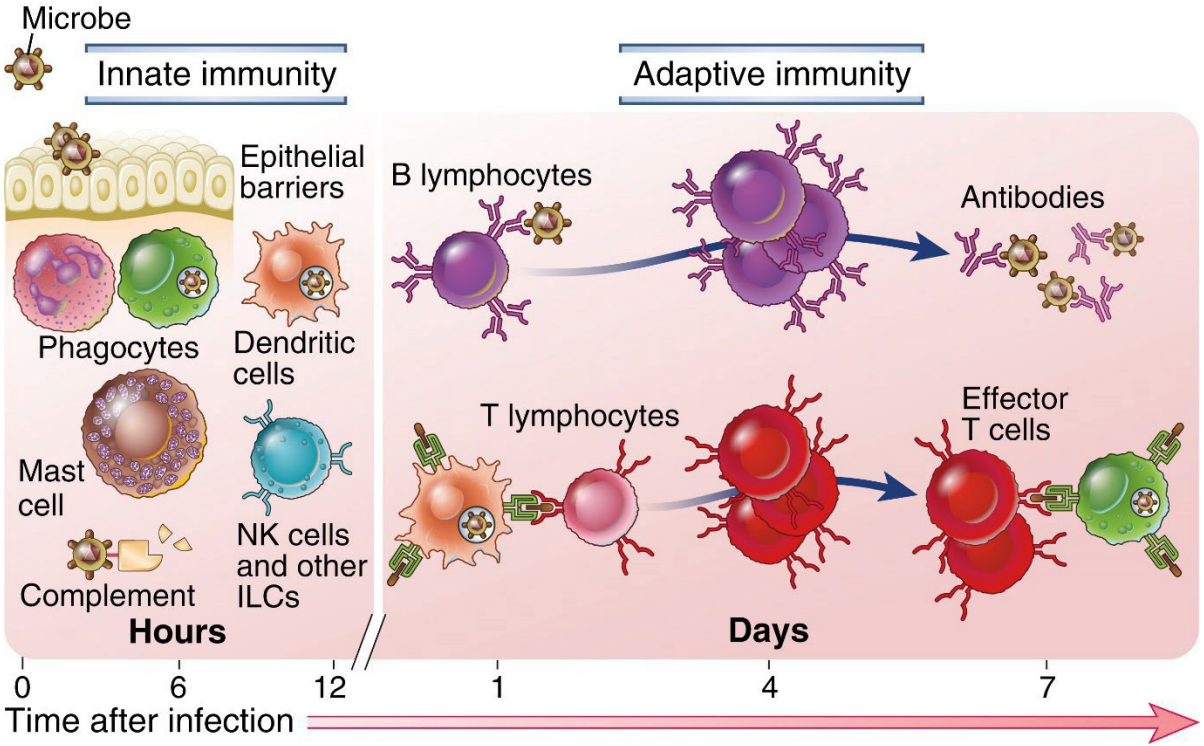
- Promote lysis of microbes
- Promote inflammation
- Opsonization and phagocytosis of microbes

(https://nortenews.org)



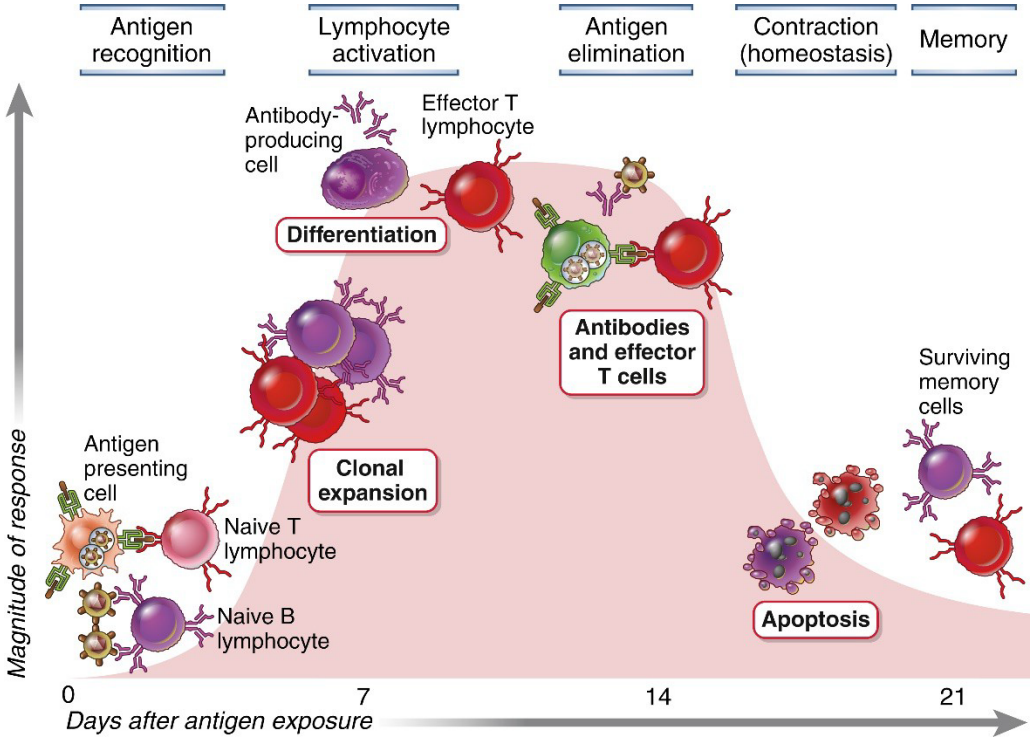
(Abbas et al., 2021)

Adaptive Immunity



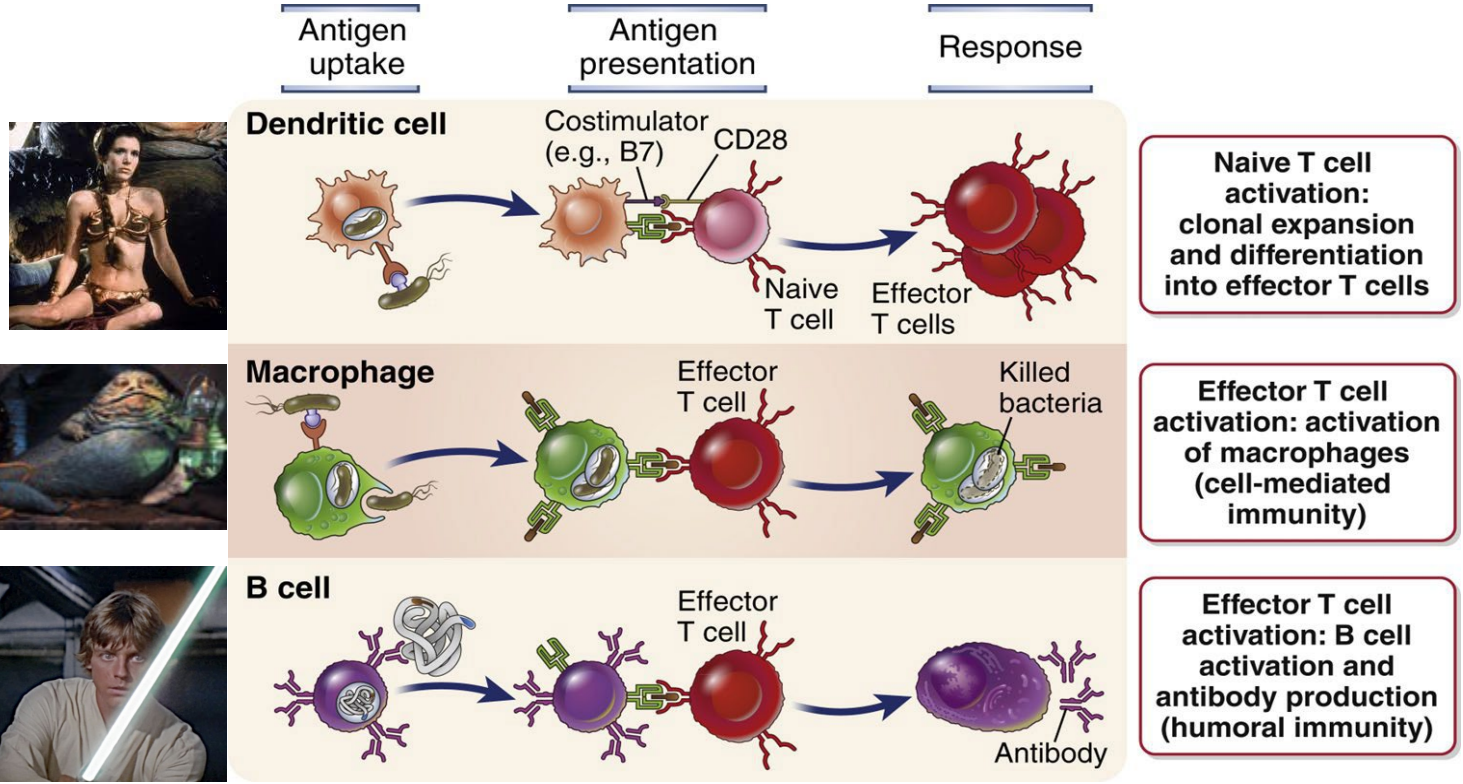
(Abbas et al., 2021)

Phases of Adaptive Immune Response



(Abbas et al., 2021)

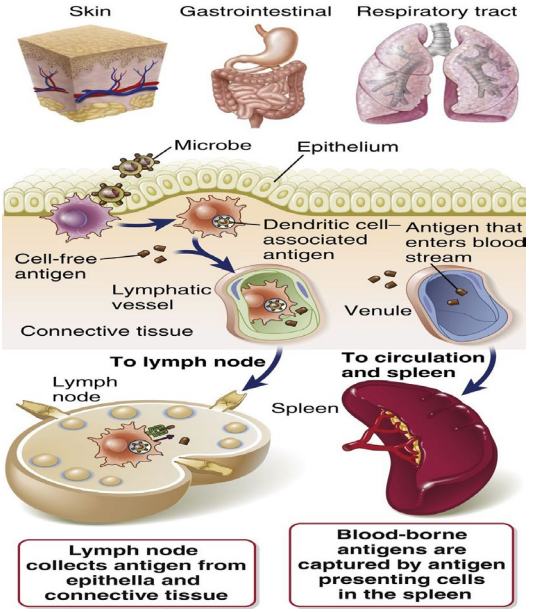
Professional Antigen Presenting Cells (APCs)



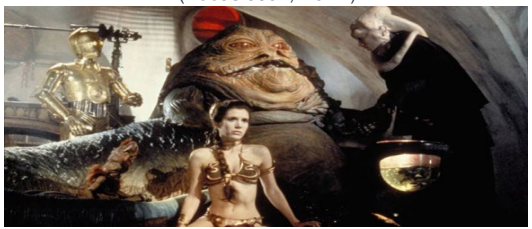
(Abbas et al., 2021)

Dendritic Cells – “Princess Leia”

- Microbes and protein antigens that enter through the epithelia are concentrated in lymph nodes
  - Dendritic cells engulf antigen
    - ✓ Present antigen on surface
    - ✓ Travel to lymph nodes to initiate adaptive immune response
  - Some antigens enter lymphatics cell-free
- Blood-borne antigens are captured mostly in the spleen



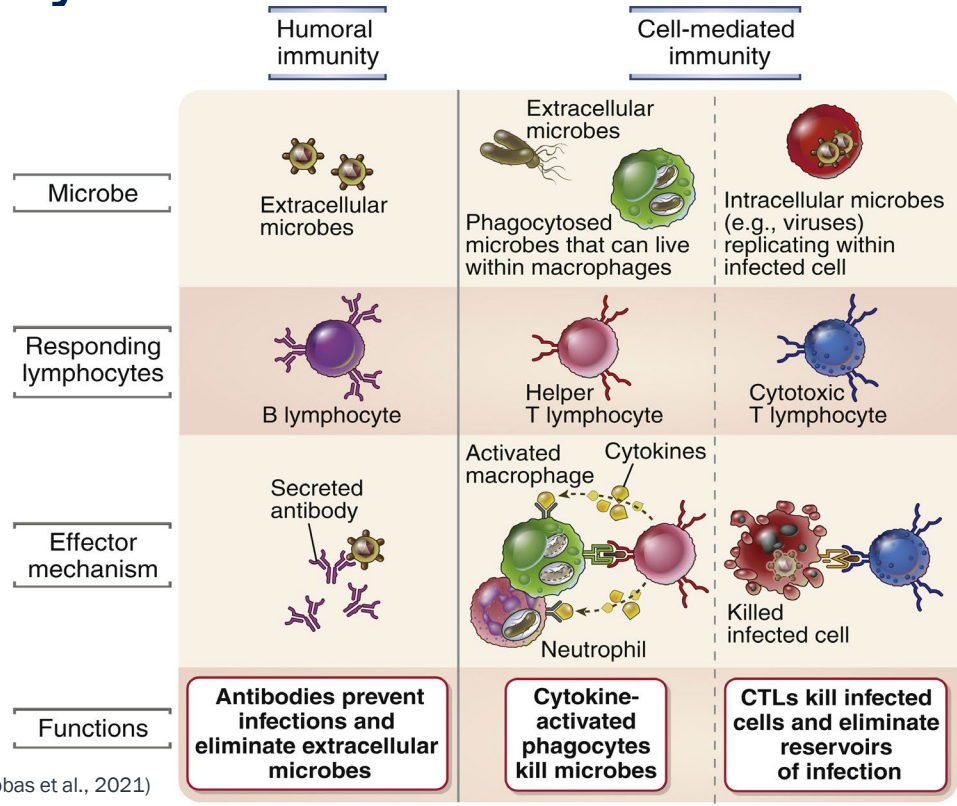
(Abbas et al., 2021)



(https://www.usatoday.com)

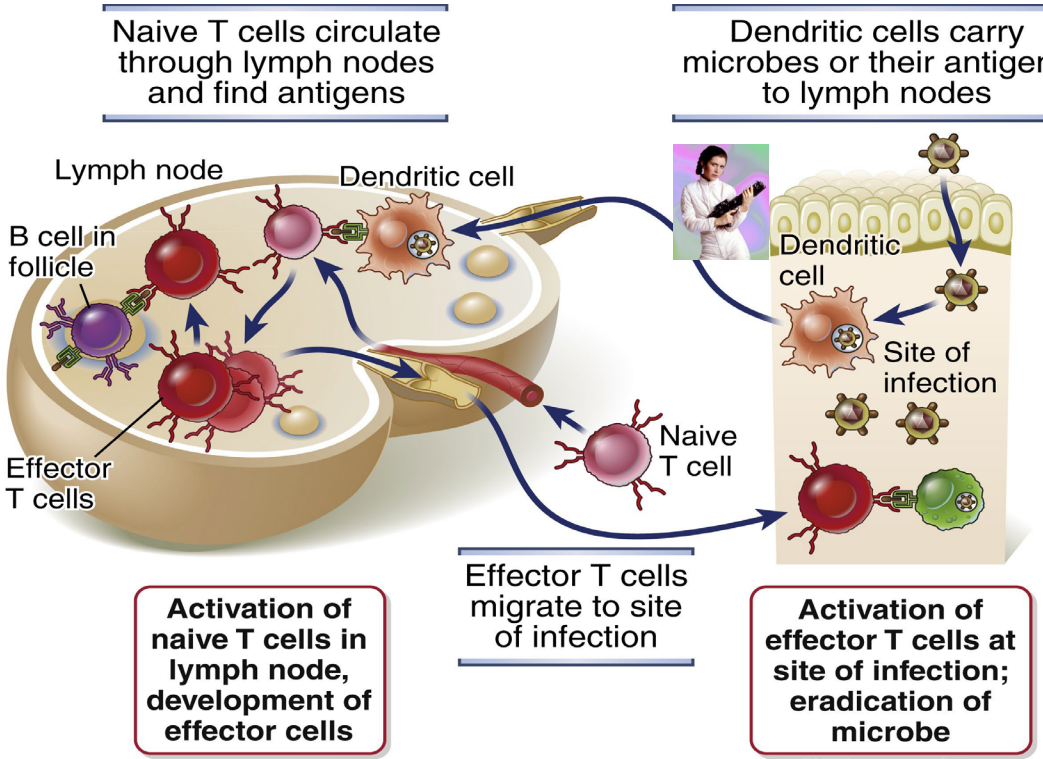
Types of Adaptive Immunity

- Humoral
  - Extracellular microbes
    - ✓ B cells
- Cell-mediated
  - Phagocytosed microbes that can survive within macrophages
    - ✓ Helper T cells
  - Intracellular microbes
    - ✓ Killer (cytotoxic) T cells
  - Regulatory T cells



(Abbas et al., 2021)

Activation of T cells in Lymph Nodes – “Cantina”

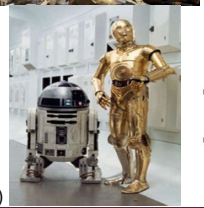


(https://www.thewrap.com)

(Abbas et al., 2021)

Adaptive Immunity Cells

- B cells – “Luke Skywalker”
- T helper cells – “Han Solo”
- T killer cells – “Clone Army”
- T regulatory cells – “Droids”



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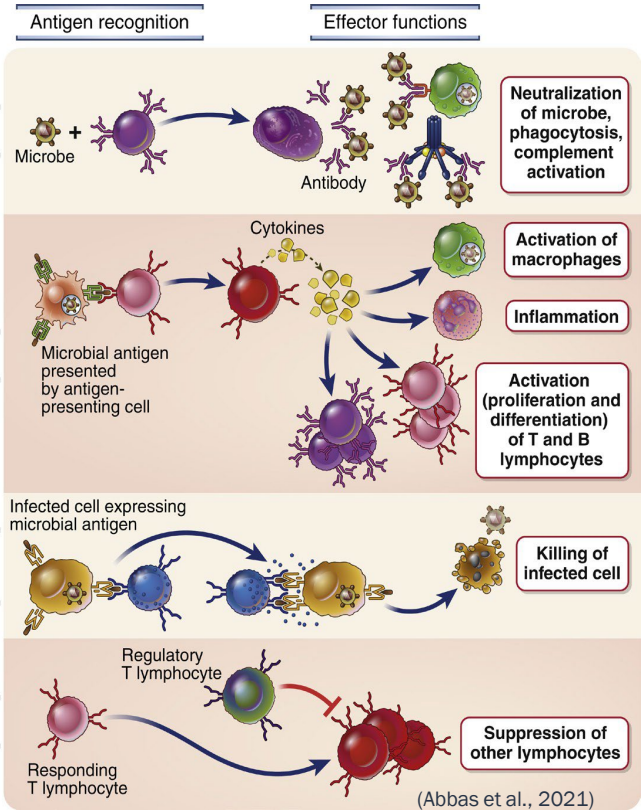
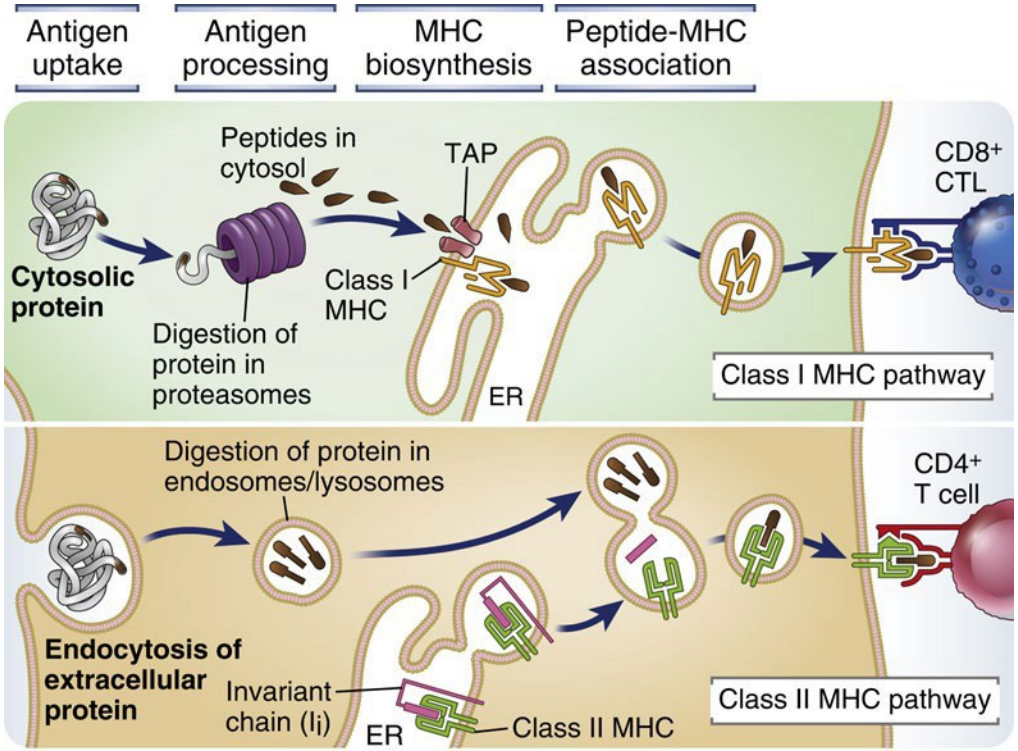


Any Cell Can Present Protein Antigens to a T cell



MHC: major histocompatibility complex
TAP: transporter associated with antigen processing
ER: endoplasmic reticulum
CD 8: cluster of differentiation
CTL: Cytotoxic T lymphocyte

(Abbas et al., 2021)

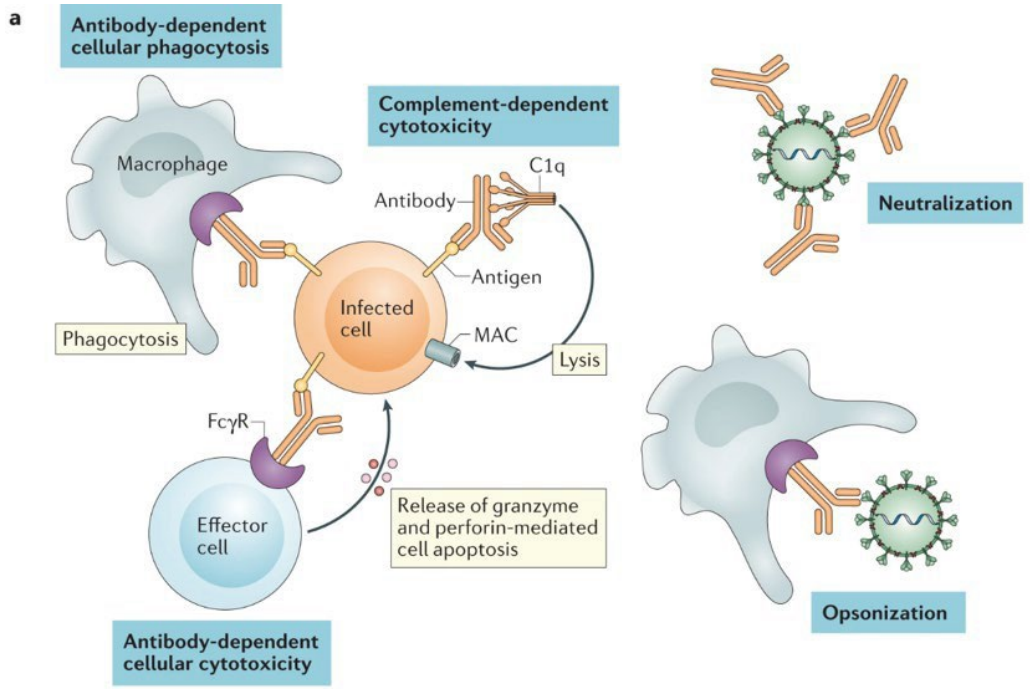
B Lymphocyte Activation

- B cell proliferation and formation of germinal centers
- Differentiate into memory B cells
- Differentiate into plasma cells
  - Immunoglobulin (Ig) class switching and antibody production

(https://www.pinterest.com)

Effector Functions of Antibodies

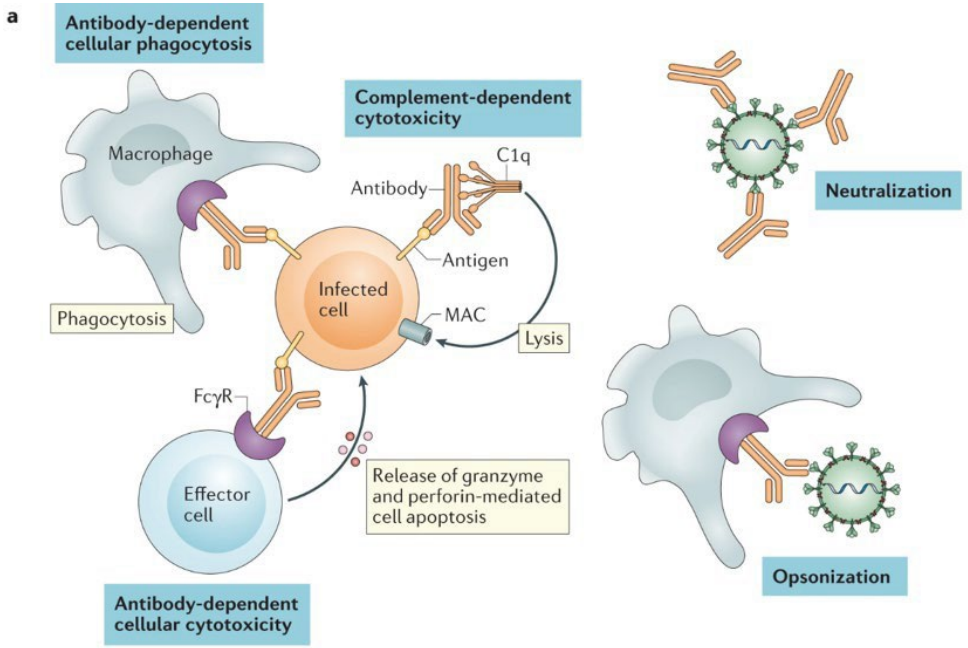
- Neutralization
- Opsonization
- Antibody-dependent cellular cytotoxicity
- Antibody-dependent cellular phagocytosis
- Complement-dependent cytotoxicity



(Abbas et al., 2021)

What is an example of passive immunity?

- Transplacental transfer
- Breastmilk
- Replacement IgG (SQ, intravenous [IV], IM)
- Hyperimmune IgG

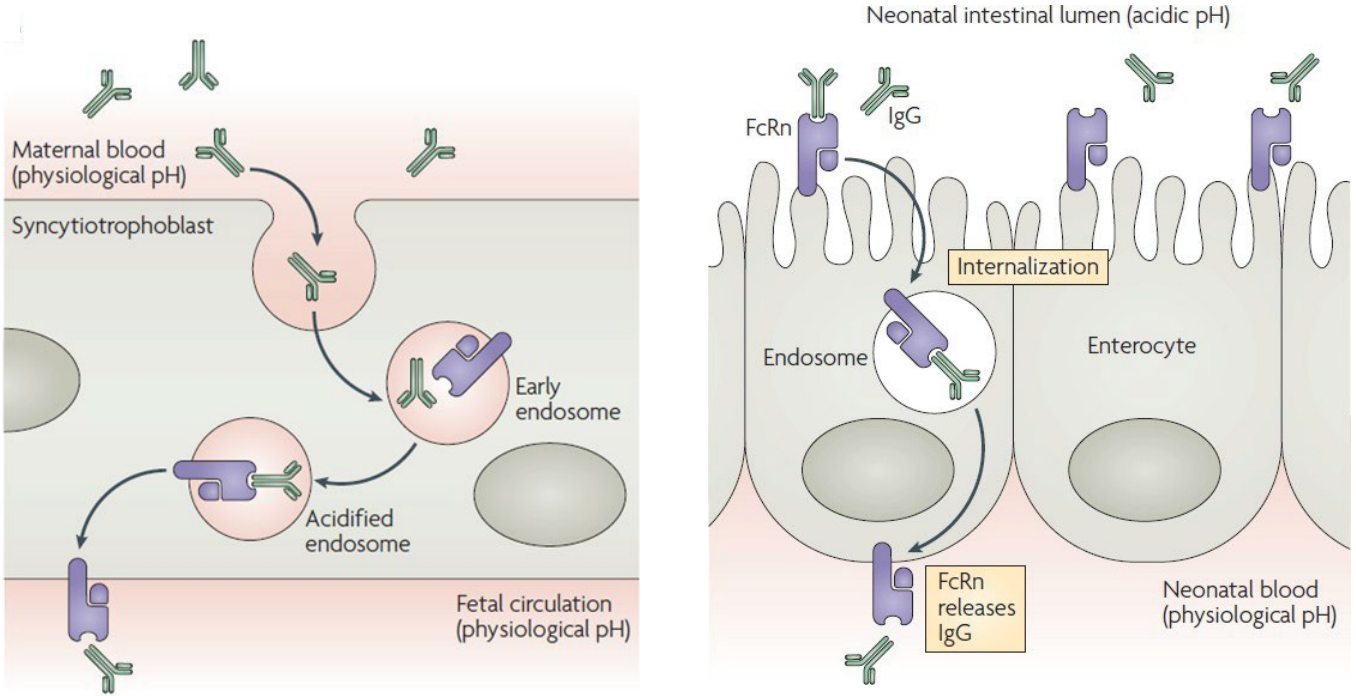


(Abbas et al., 2021)

How are antibodies recycled in the body?

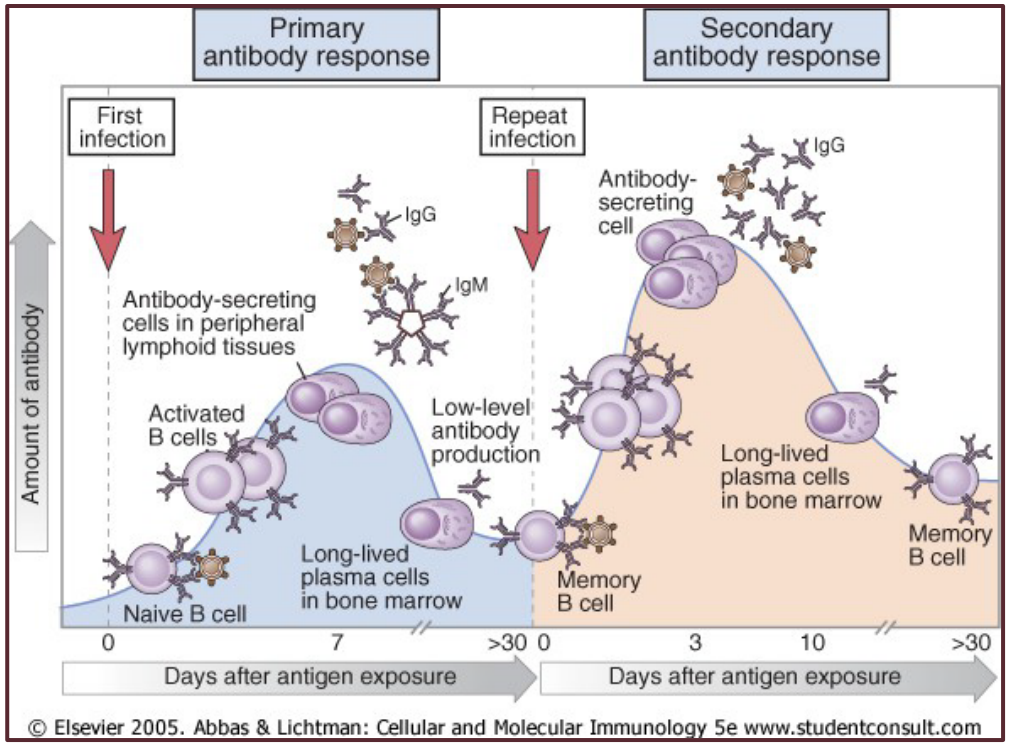
- Fc neonatal receptor

Fc Neonatal Receptor (FcRn): Fetus and Neonate



(Roopenian & Akilesh, 2007)

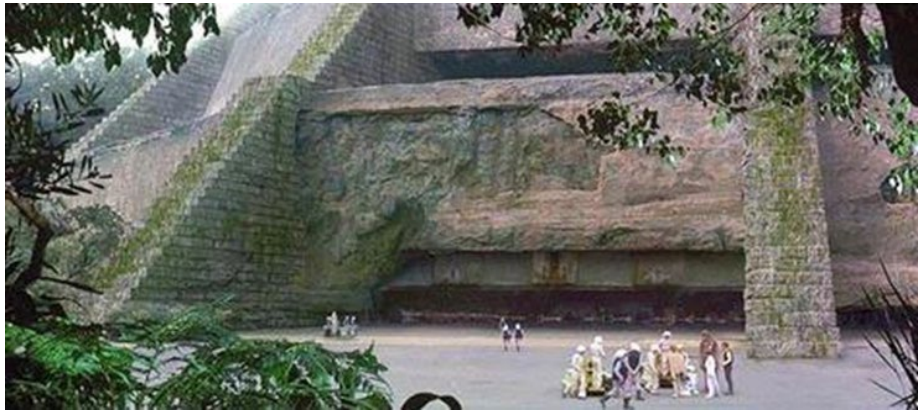
Primary and Secondary Antibody Response

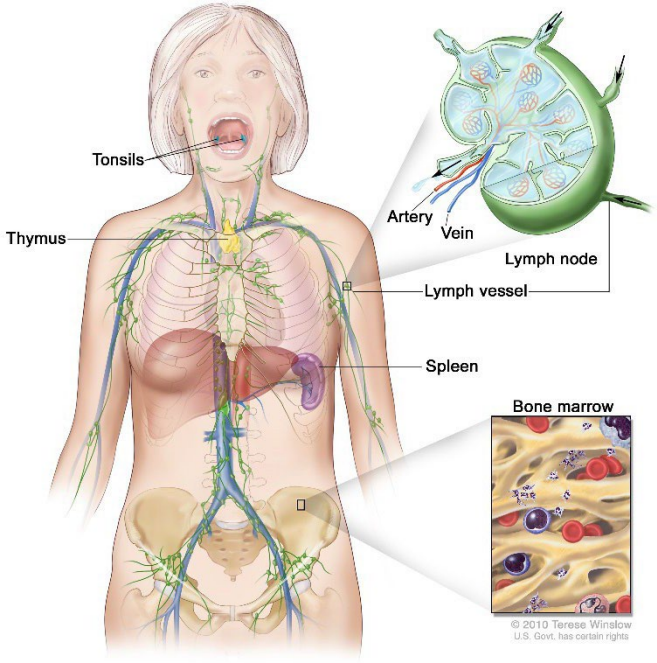


(Abbas et al., 2005)

Spleen – “Rebel Base”

- Involved in destruction and elimination of encapsulated organisms





(https://nci-media.cancer.gov)

(https://www.pinterest.com)

Identify three encapsulated bacteria cleared by the spleen

- *Streptococcus pneumoniae*
- *Haemophilus influenzae B*
- *Neisseria meningitidis*

Which *N. meningitidis* serogroup causes 60% of the meningococcal disease in children and young adults under the age of 25 in the US?
(Accounts for 40% of all US cases)

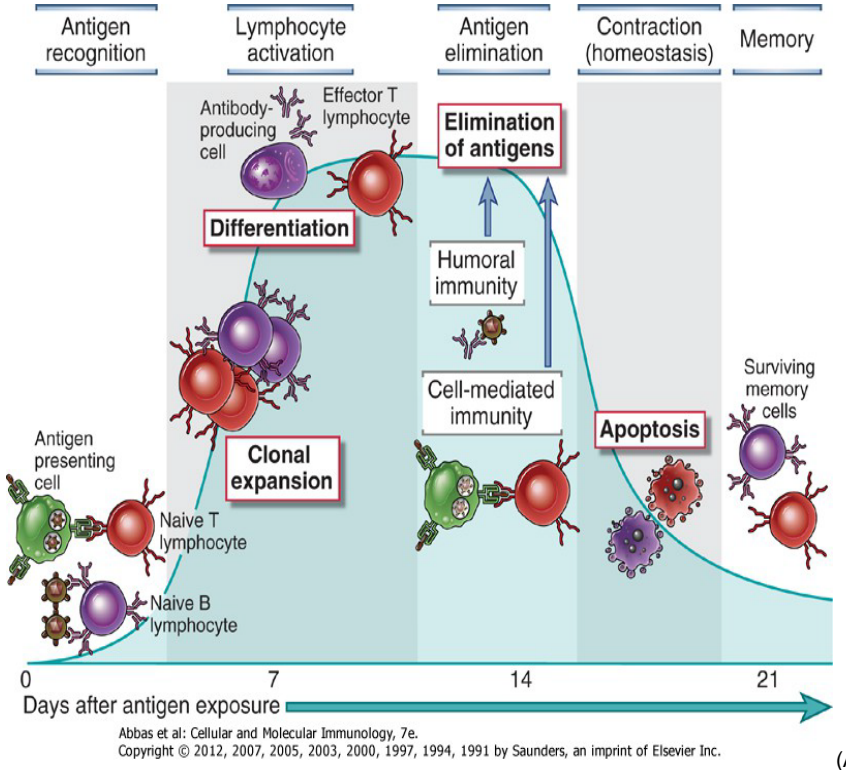
Serogroup B

(https://www.cdc.gov)

Contraction/Homeostasis

- T regulatory cells – “Droids”

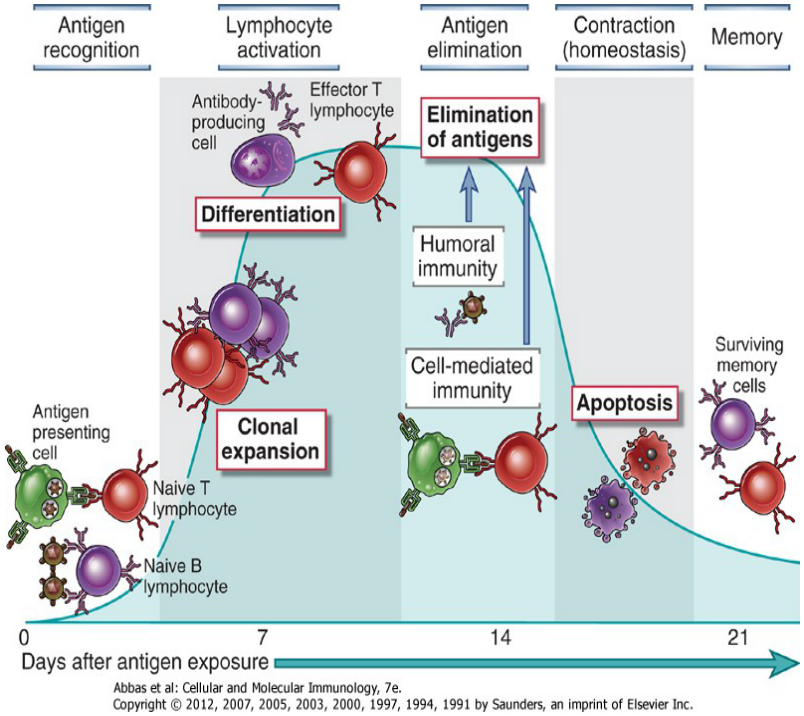
(https://fineartamerica.com)



(Abbas et al., 2012)

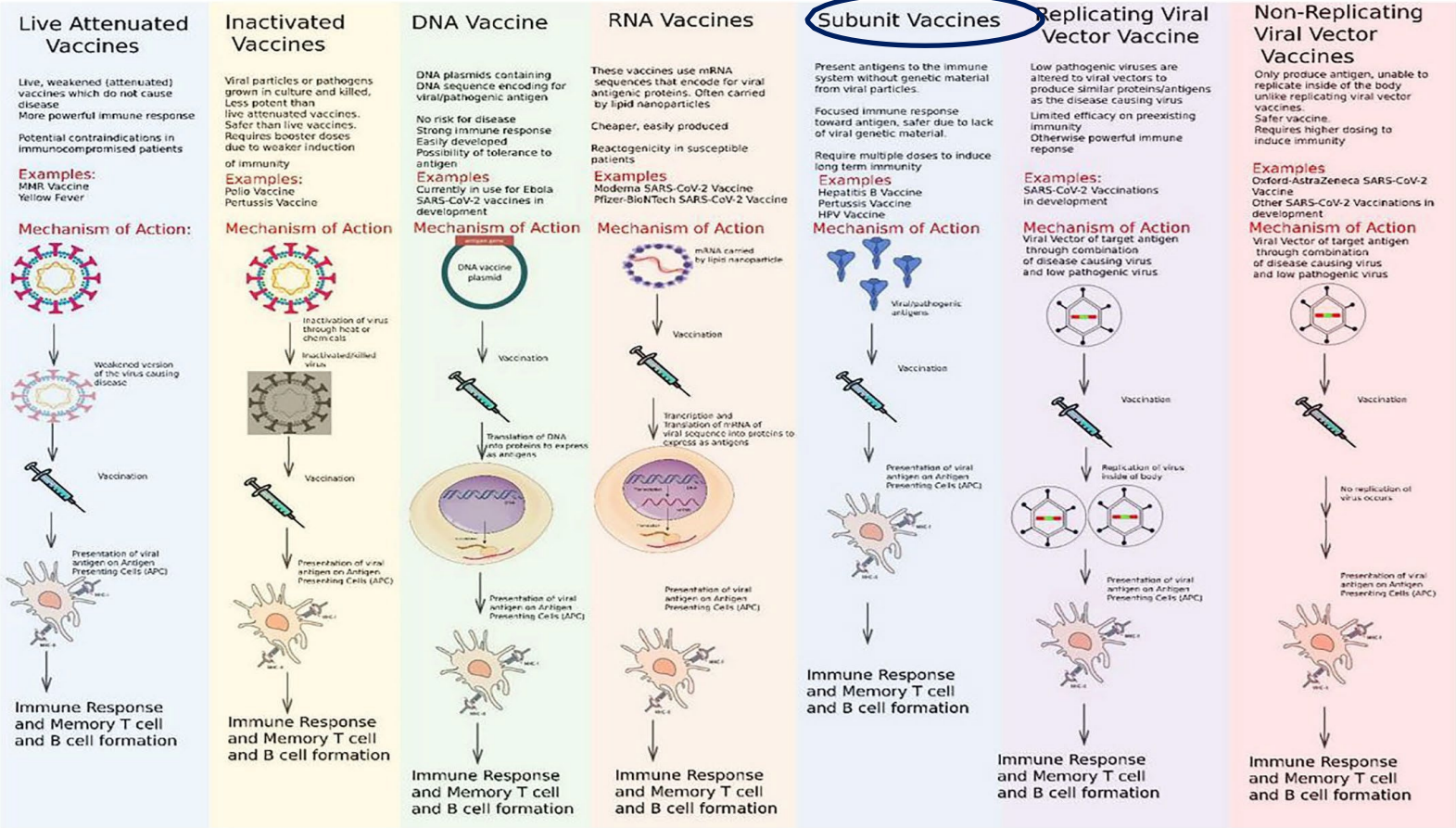
Memory B and T Cells – "Jedi Knights"

(https://twitter.com)



(Abbas et al., 2012)

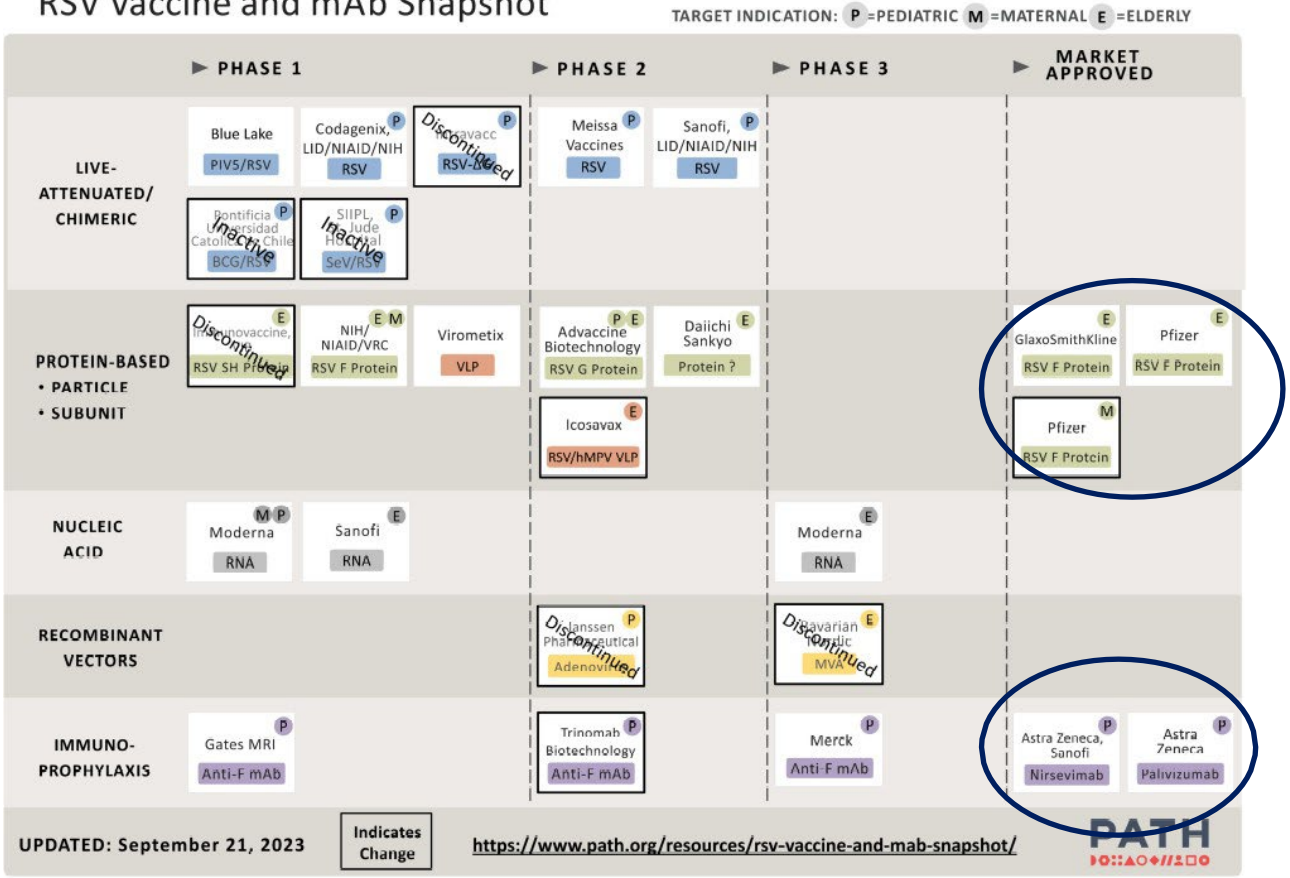
RSV Vaccines and Monoclonal Antibodies



(https://journals.sagepub.com/doi/full/10.1177/25151355211059791)

(https://journals.sagepub.com)

RSV Vaccine and mAb Snapshot



Live attenuated/chimeric

Particle

Subunit

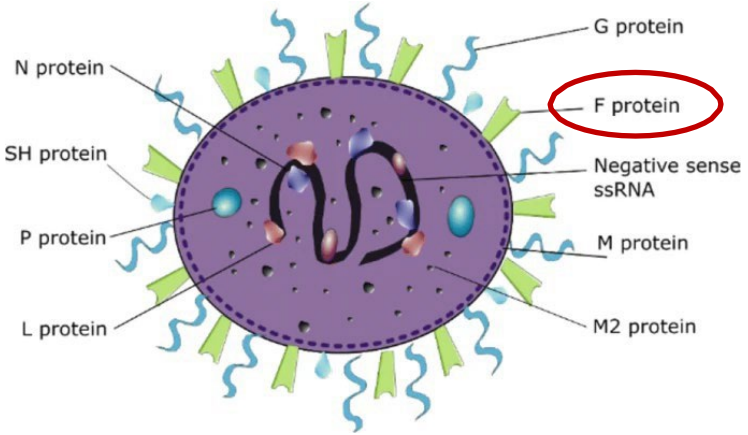
RNA

Vector

Monoclonal Ab

RSV Vaccines – Mechanism of Action

- Three integral membrane proteins
  - Receptor attachment glycoprotein (G)
    - ✓ Involved in viral attachment to the host cell
  - Fusion protein (F)
    - ✓ Responsible for fusion with host cell
  - Short hydrophobic (SH) protein
    - ✓ Forms a pentameric ion channel

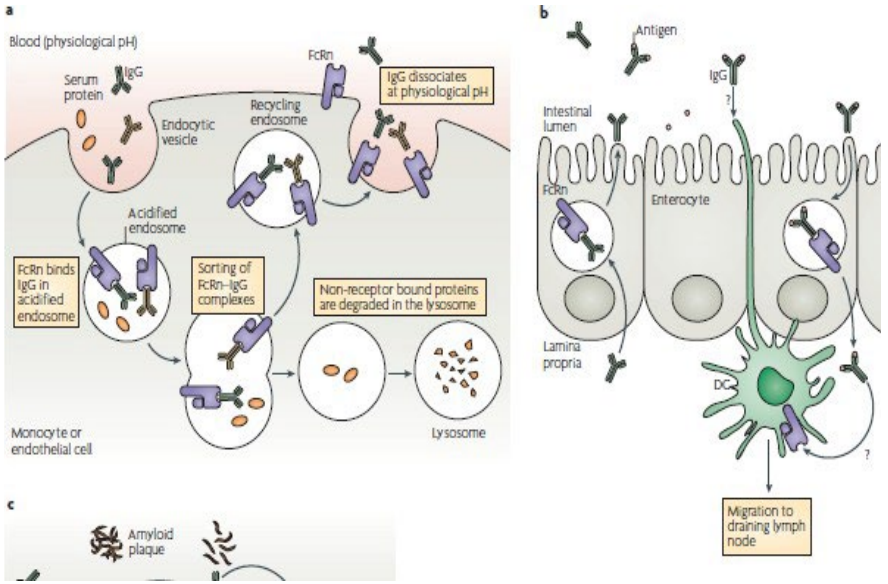


(https://www.researchgate.net, 2020)

- Prefusion F (preF) is a key form of the viral fusion protein (F) that RSV uses to enter human cells
- Antibodies specific to preF are highly effective at blocking virus infection

FcRn – Children and Adults

- Blood
  - FcRn expressed by endothelial cells and circulating monocytes
  - Cells internalize serum IgG and recycles IgG back into circulation
- Intestinal lumen
  - FcRn expressed by enterocytes and lamina propria antigen presenting cells (APCs) central nervous system (CNS) vascular endothelial cells
- Glomerular epithelial cells



(Roopenian & Akilesh, 2007)

ACIP Maternal RSV Vaccination (RSVpreF) - ABRYSVO

- FDA approval 21 August 2023
- ACIP recommendation 22 Sept 2023

- Maternal Respiratory Syncytial Virus (RSV) vaccine is recommended for pregnant people during 32 through 36 weeks gestation, using seasonal administration, to prevent RSV lower respiratory tract infection in infants

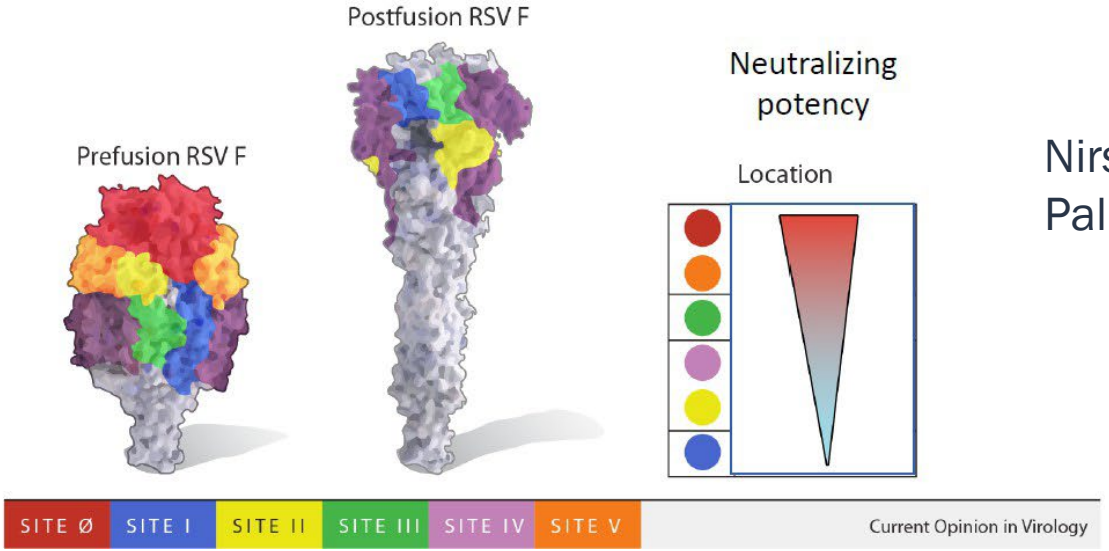
What does “seasonal administration” to pregnant persons mean?

- Most of the continental US 1 Sept. – 31 Jan.
- Alaska, southern Florida, Guam, Hawaii, Puerto Rico, US-affiliated Pacific Islands, US Virgin Islands have different RSV seasonality

Palivizumab (Synagis™)

- FDA approved 1998
- Monoclonal antibody directed against site II of the prefusion and post-fusion (F) protein
  - Antibody binds to F protein and prevents the structural conformational change that is necessary for fusion of the viral RSV envelope with the plasma membrane of the respiratory epithelial cell
  - Prevents cell-to-cell fusion of RSV-infected cells
- Passive immunity
- Recommended by American Academy of Pediatrics (AAP) for administration to infants and young children who are at increased risk of severe RSV disease based on gestational age and certain underlying medical conditions
- Monthly intramuscular injections during RSV season

Monoclonal antibody prophylactic products target different antigenic regions (sites)



II

Nirsevimab – targets Site 0 (red)
Palivizumab – targets Site II (yellow)

(Graham, 2007)
(https://www.cdc.gov)

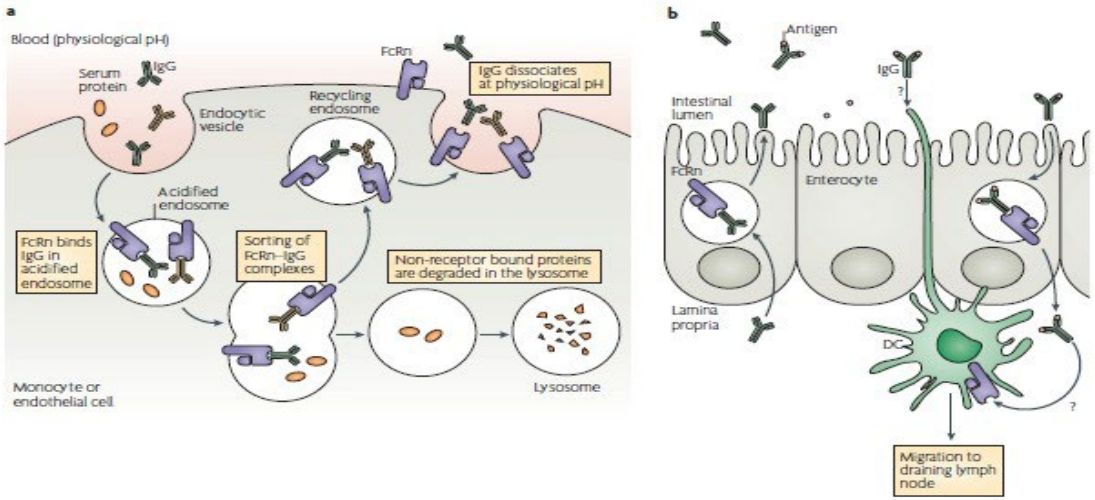
Nersevimab (Beyfortus™)

- FDA approved 17 July 2023, ACIP recommendation 3 Aug 2023
- Long-lasting RSV monoclonal antibody
- Passive immunity
- One dose for all infants < 8 months of age
  - Born during, or entering, their first RSV season
- Second dose in second RSV season
  - Small group of children ages 8 – 19 months who are at increased risk of severe RSV disease (e.g., chronic lung disease of prematurity, CF, severe immunocompromise, American Indian and Alaska Native children)
- Dosing
  - < 5 kg 50mg IM
  - ≥ 5 kg 100mg IM
  - Children who remain vulnerable through their second RSV season: 200 mg IM (100mg IM x 2 in separate sites)

(https://www.cdc.gov)

What immune mechanism does nersevimab use to make it a long-lasting antibody?

- Fc neonatal receptor
- Triple amino acid substitution (YTE) in the Fc region which increases binding to the FcRn and thereby extends serum half-life to 71 days



(Roopenian & Akilesh, 2007)

Nirsevimab (Beyfortus™)

- Efficacy:
  - RSV hospitalization: 83%
  - Severe disease: 76%
- Safety: No significant safety concerns

- Breastfeeding: Exclusive breastfeeding for >4months significantly lowered hospitalization and oxygen use with RSV bronchiolitis infection
- WHO recommends exclusive breastfeeding for maximal immune protection against viral infections in infants

What is considered seasonal administration for nersevimab (Beyfortus) to infants?

- CDC/ACIP defines typical RSV season as 1 Oct – 31 Mar
- For infants < 8 months born to unvaccinated mothers, administer nersevimab, 1 Oct – 31 Mar

- State, local, or territorial guidance on timing of administration in jurisdictions with seasonality that differs from most of continental US (e.g., Alaska, tropical climates including Hawaii, parts of Fla., Puerto Rico, Guam, US Virgin Islands, US-affiliated Pacific Islands)
- Individual military treatment facilities (MTFs) and individual providers should NOT make individual determinations on RSV seasonality

Clinical Considerations
Maternal RSVpreF vaccine and nirsevimab

- Maternal vaccination RSVpreF vaccine, seasonal administration
  - 1 Sept. – 31 Jan. in most of continental US
  - State, local, or territorial guidance on timing of administration in jurisdictions with seasonality that differs from most of continental US (e.g., Alaska, tropical climates including Hawaii, parts of Fla., Puerto Rico, Guam, US Virgin Islands, US-affiliated Pacific Islands)
  - May be simultaneously administered with other indicated vaccinations
- Nirsevimab is not needed for most infants born ≥ 14 days after maternal RSVpreF vaccination

Why are the dates for seasonal administration of maternal RSV vaccine and infant administration of RSV monoclonal antibody (mAb) different?

- RSV season is October - March

- Maternal RSV vaccination 1 September– 31 January
- RSV mAb administration 1 October – 31 March

- Maternal RSV vaccination is recommended at 32 to 36 weeks pregnancy during Sept – Jan to passively transfer antibodies to the fetus (and to the infant during breastfeeding) during the high-risk season

- Infants receive RSV mAb throughout the RSV season as they receive immediate protection after administration

Clinical Consideration
Nirsevimab after maternal RSVpreF ≥ 14 days prior to birth

- Consider nirsevimab in rare circumstances when the potential incremental benefit of administration is warranted
  - Infants born to pregnant people who may not mount an adequate immune response to vaccination (e.g., people with immunocompromising conditions) or have conditions associated with reduced transplacental antibody transfer (e.g., people living with human immunodeficiency virus [HIV] infection)
  - Infants who have undergone cardiopulmonary bypass, leading to loss of maternal antibodies
  - Infants with substantial increased risk for severe RSV disease (e.g., hemodynamically significant congenital heart disease, intensive care unit [ICU] admission and requiring supplemental oxygen at discharge)

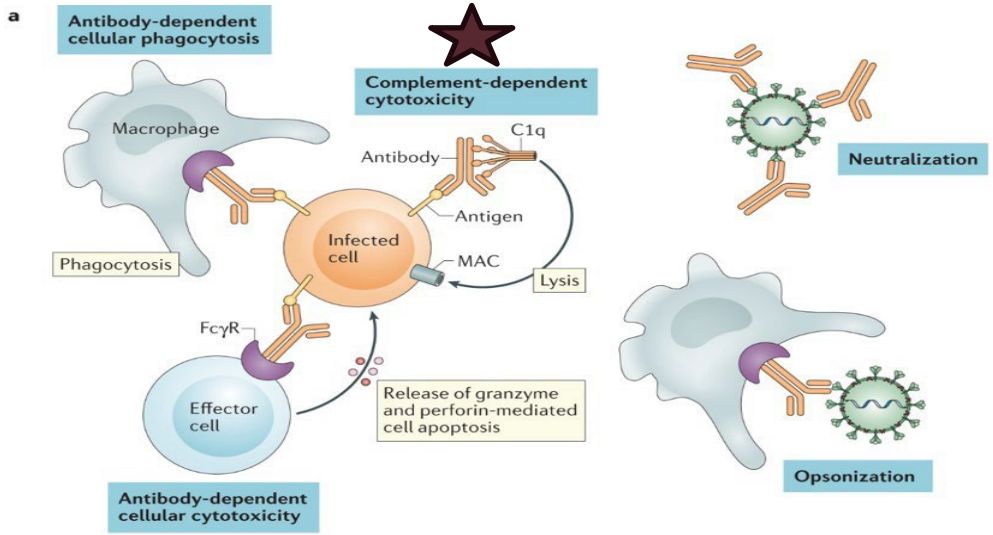
Can RSV monoclonal antibodies be administered with other immunizations?

- YES
- Nirsevimab (Beyfortus) and palivizumab (Synagis) do not interfere with the immune response to live or inactivated vaccines
- Can be administered simultaneously with vaccines

Meningococcal Vaccines

What is the main immunologic pathway involved in *N. meningiditis* killing?

- Complement-mediated antibody-depending killing



(https://www.nature.com)

Meningococcal Vaccines

- 3 types of meningococcal vaccines available in the US
  - Meningococcal conjugate (MenACWY)
    - ✓ Menveo® and MenQuafi®
  - Serogroup B meningococcal recombinant protein (MenB)
    - ✓ Bexsero® and Trumenba®
  - Pentavalent conjugate and recombinant protein (MenABCWY)
    - ✓ Penbraya™ (contains Trumenba®MenB vaccine) (Pfizer)

ACIP Meningococcal Recommendations

- MenACWY
  - 11- to 12-year-old should get a MenACWY vaccine
  - Booster dose at 16 years old

- Booster
  - If received the first dose at age 13 through 15 years, administer a booster dose at age 16 through 18 years
  - If received first dose ≥ 16-year-old, do not need a booster dose

MenACWY Vaccination of Younger Children and Adults at Increased Risk

Younger children (down to two months old) and adults should receive MenACWY vaccines

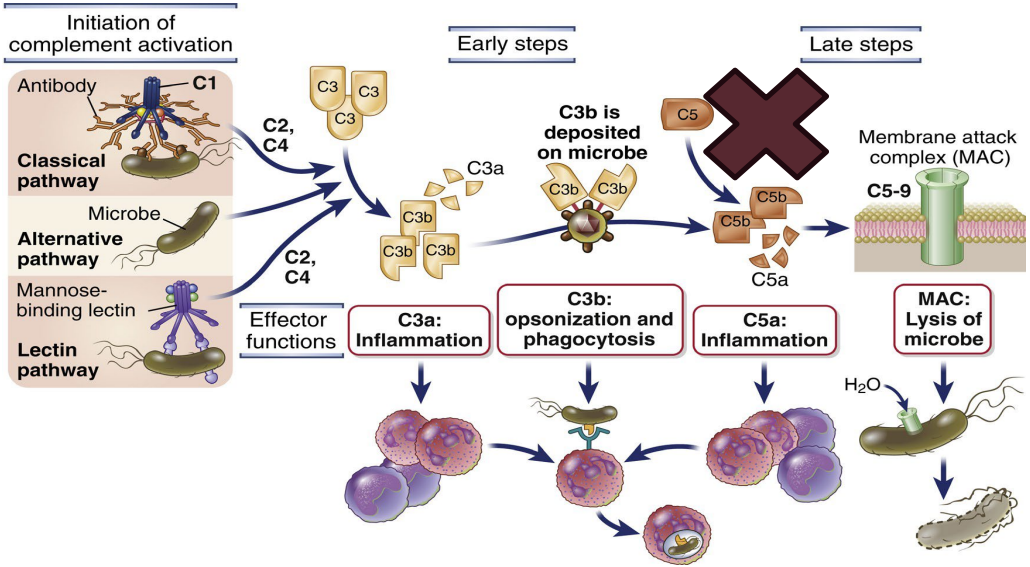
- Having certain medical conditions
  - Complement component deficiency (e.g., C5-C9, properdin, factor H, factor D)
  - Functional or anatomic asplenia (including sickle cell disease)
  - HIV
- Taking specific medications
  - Complement inhibitor (e.g., Soliris® or Ultomiris®)
- Traveling or residing in countries in which serogroup A, C, W, or Y meningococcal disease is common
- Working in specific professions or living in specific settings
  - Military recruit
  - First-year college student living in a residence hall and are not up to date with this vaccine
- Being a part of a community experiencing a serogroup A, C, W or Y meningococcal disease outbreak

ACIP Meningococcal Recommendations

- MenB
  - 16 to 23 years old may get a MenB vaccine
  - Those at increased risk of serogroup B meningococcal disease outbreak and people with certain medical conditions or taking certain medications should get a MenB vaccine
    - ✓ Complement component deficiency (e.g., C5-C9, properdin, factor H, factor D
    - ✓ Functional or anatomic asplenia (including sickle cell disease)
    - ✓ Complement inhibitor (e.g., Soliris® or Ultomiris®)

What is the mechanism of action of the complement inhibitors eculizumab (Soliris®) and ravulizumab (Ultomiris®)?

- Monoclonal antibodies that bind to and prevent activation of complement component C5



(Abbas et al., 2021)

MenABCWY Vaccination as an Option for ≥ 10 years old

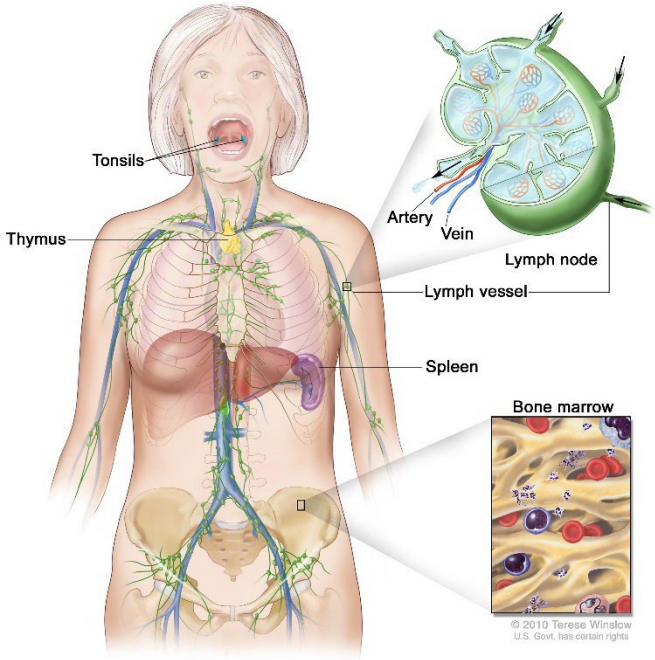
- ACIP Meeting 25-26 Oct 2023
- MenABCWY may be used if receiving MenACWY and MenB vaccines at the same visit
  - Healthy individuals aged 16–23 years (routine schedule) when shared clinical decision-making favors administration of MenB vaccination
  - Individuals aged 10 years and older at increased risk of meningococcal disease due for both vaccines
- The minimum interval between MenABCWY doses is six months
- If a patient receives MenABCWY vaccine, then administer Trumenba® for additional MenB dose(s) when MenACWY isn't indicated
- Any MenACWY vaccine when MenB isn't indicated
- People with prolonged increased risk for serogroup A, C, W, or Y and B meningococcal disease need regular boosters
  - Recommended interval between doses various by age and vaccine type
  - MenABCWY can only be used when both MenACWY and MenB vaccines are indicate at the same visit

Meningococcal Vaccine Additional Boosters

- MenACWY
  - Those who remain at increased risk need regular booster doses
  - <7 years old, administer a booster dose three years after completion of the primary series and every five years thereafter
  - 7 years old or older, administer a booster dose five years after completion of the primary series and every 5 years thereafter
  - Traveling or residing in countries in which serogroup A, C, W, or Y meningococcal disease is common
- MenB
  - Those who remain at increased risk need regular booster doses
  - Administer a booster dose once year after series completion and then every two to three years thereafter
  - If previously vaccinated and at increased risk due to an outbreak, CDC recommends a booster dose if a year or more has passed since primary series completion

Why are patients with functional or anatomic asplenia at increased risk of infection with encapsulated bacteria?

- Pathogens containing a polysaccharide capsule can evade phagocytosis by macrophages
- These pathogens must be opsonized with IgG and C3b to be recognized and phagocytosed by macrophages in the spleen
- With functional or anatomic asplenia, the opsonized pathogens are not cleared by splenic macrophages



(https://nci-media.cancer.gov)

Tick-Borne Encephalitis Vaccine

Tick-Borne Encephalitis (TBE)

- Acute viral illness caused by two closely related members of family *Flaviviridae*
- May cause death or long-term neurologic sequelae in 35-58% patients
- 70 - 98% may have subclinical infection
- Asia:
  - Abrupt onset of fever, severe headache, nausea, vomiting and severe back pain often associated with focal epilepsy and flaccid paralysis, especially of the shoulder girdle
  - Case fatality rate 20%
- Central Europe: biphasic
  - Initial febrile stage is normally not associated with CNS infection
  - 4-10 days after apparent recovery, fever and meningoencephalitis
  - Case fatality rate 1-5%
- Siberian

Tick-Borne Encephalitis (TBE) cont.

- 5,000 to 13,000 cases reported annually in endemic areas
- Most cases occur April to November
- Field exercises, outdoor work, and recreational activities such as hiking or camping place individuals at higher risk to contract TBE
- 99% efficacy in disease prevention
- one year of age and older
- three shot series

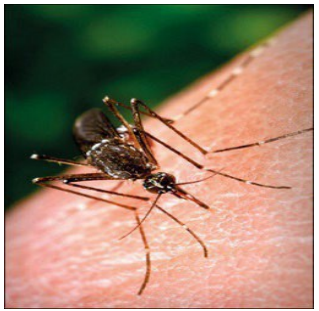
Source: Dobler et al, Wien Med Wochenschr 2012

(Dobler et al., 2012)

Chikungunya Vaccine

Chikungunya Virus

- Mosquito-borne viral disease characterized by acute onset of fever and severe polyarthralgia
- Single stranded RNA virus; Genus Alphavirus, Family Togaviridae
- Transmitted by *A. aegypti* and *A. albopictus* mosquitos
- Larvae develop in discarded tires and household containers
  Aggressive daytime-biting mosquitoes
- Often occurs in large outbreaks with high attack rates



(https://phil.cdc.gov)

Chikungunya Infection

- Typically, tropical and subtropical regions, most commonly Asia and Americas
- Virus transmission usually highest during wet season
- Clinical symptoms include febrile illness, severe, debilitating arthralgias, headache, maculopapular rash, myalgia, anorexia
- Joint symptoms often include multiple joints, most commonly hands and feet
- Symptoms last 7-10 days, but can have relapsing or persistent symptoms
- Rare serious complications including hepatitis, myocarditis, neurologic disease, renal disease

Chikungunya Vaccines

- Ixchiq® by Valneva
  - FDA approved Jan 2024, ACIP recommendations Feb 2024
  - Live attenuated virus vaccine
  - 0.5ml IM single dose vaccine
  - Recommended for 18 yo and older traveling to a country where there is an outbreak
  - Considered for 18 yo and older traveling to a country with previous outbreak in past 5 years and staying for >6 months

Updates and Vaccines in the Pipeline

- GSK MenABCWY (Bexsero® and Menveo®) vaccine in Phase III trials
- Pfizer and BioNTech studying combination influenza and COVID-19 messenger RNA (mRNA) vaccine
- PCV21 – adding serotypes 15A, 15C, 16F, 23A, 23B, 24F, 31, 35B
- Epstein Barr virus – for lymphoma and multiple sclerosis (MS)
- Norovirus
- RSV mAb infants (different manufacturer)
- Dengue (different manufacturer)
- Chikungunya – trials to lower age of administration
- Chikungunya (different manufacturer)

Immunization (IZ) Gateway Program

- Joint venture Veterans Affairs (VA)/Department of Defense (DoD)/CDC to connect to state Immunization Information Systems (IIS)
- Data exchange hub enabling efficient data exchange between critical immunization information systems across the nation
- Wash., Calif., N.C., Okla., and Fla. onboarded
  - Covers 2.4M beneficiaries
- Texas, Va., Md., and D.C. next

MHS Genesis Immunizations

- MHSG End User Engagement Teams channel
  - https://dod.teams.microsoft.us/l/team/19%3adod%3a485ca5eb494b441a9a57966abdc60fae%40thread.tacv2/conversations?groupId=a56290de-f658-4d34-808d-049230330832&tenantId=8903a443-af33-4ed4-acf5-ee613bcb2f59

Immunization Tool Kit Mobile App and Electronic Version

- Comprehensive resource booklet based on military immunization policy, national recommendations, evidenced-based, peer-reviewed published medical literature, and clinical practice guidelines

Key Takeaways

- Passive immunity is utilized in maternal vaccination with RSV vaccine and infant administration of RSV monoclonal antibody

- Patients with anatomic or functional asplenia should be vaccinated against encapsulated bacteria including *S. pneumoniae, H. influenzae,* and *N. meningitidis*

- New meningococcal vaccines incorporate serogroups A, B, C, W, Y

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Immunization Healthcare Support Center

- Staffed 24/7 to address worldwide questions from providers, patients, and family members
- Clinical staff have expertise and experience in vaccine schedules, medical exemptions, response to administration errors, and management of patients with complex adverse reactions

DHA IHD Website

1-877-GET-VACC or 1-877-438-8222
DSN 761-4245

Centers for Disease Control and Prevention
National Center for Immunization and Respiratory Diseases

Protecting Your Pediatric Patients against COVID-19

Lakshmi Panagiotakopoulos, MD, MPH
Co-Lead, COVID-19 vaccine Advisory Committee on Immunization Practices Work Group
Coronavirus and Other Respiratory Viruses Division (CORVD), CDC
April 4, 2024

Learning Objective

At the conclusion of this activity, participants will be able to:

1. List two reasons why all children in the US are recommended to get at least one dose of the updated COVID-19 vaccine.

YOU are patients' **most trusted** source of information on vaccines.

What are the current COVID-19 vaccine recommendations for children?

Pediatric COVID-19 Vaccine Policy

- ACIP met September 12, 2023, to review the available evidence for updated COVID-19 vaccines (monovalent, XBB.1.5 component)
- **ACIP recommended updated COVID-19 vaccines as authorized under EUA or approved by BLA in persons aged ≥6 months**
  - Moderna COVID-19 vaccine in persons ≥6 months
  - Pfizer-BioNTech COVID-19 vaccine in persons ≥6 months
  - Novavax COVID-19 vaccine in persons ≥ 12 years

Recommendations for children aged 6 months – 4 years without immunocompromise

Doses recommended:

- Initial series of 2 Moderna vaccine doses OR 3 Pfizer-BioNTech vaccine doses
- **Including at least 1 dose of 2023–2024 COVID-19 vaccine**

- All doses should be homologous (i.e., from the same manufacturer)
- All Moderna doses in ages 6 months – 11 years are now 25 µcg

Recommendations for people aged 5 years and older without immunocompromise

Doses recommended:

- **1 dose of 2023–2024 COVID-19 vaccine**

- mRNA COVID-19 vaccines authorized or approved for ages ≥6 months and Novavax COVID-19 vaccine authorized for ages ≥12 years
- Unvaccinated persons receiving Novavax COVID-19 should complete a 2-dose initial series
- New harmonized age cutoff for recommendations for young children for Moderna and Pfizer-BioNTech COVID-19 vaccines resulting in simplified recommendations for 5-year-olds
- All Moderna doses in ages 6 months – 11 years are now 25 µcg
- 2023–2024 COVID-19 vaccine dose is recommended at least 2 months after receipt of the last COVID-19 vaccine dose

Recommendations for people aged ≥6 months who are moderately or severely immunocompromised

Doses recommended:

- Initial COVID-19 vaccine series*
- **At least 1 2023–2024 COVID-19 vaccine dose**
- May receive 1 or more additional 2023-2024 COVID-19 vaccine doses**

*Series of 3 homologous mRNA COVID-19 vaccine doses or 2 homologous Novavax COVID-19 vaccine doses at time of initial vaccination. This could also include a history of receipt of 1 or more doses of Novavax or Janssen, including in combination with mRNA vaccine dose(s).

**Further additional dose(s) may be administered, informed by the clinical judgement of a healthcare provider and personal preference and circumstances. Further additional doses should be administered at least 2 months after the last 2023-2024 COVID-19 vaccine dose.

Everyone, including people who are pregnant, trying to become pregnant, may become pregnant, and who are breastfeeding, should stay up to date with COVID-19 vaccines and get recommended updated (2023-2024) COVID-19 vaccination

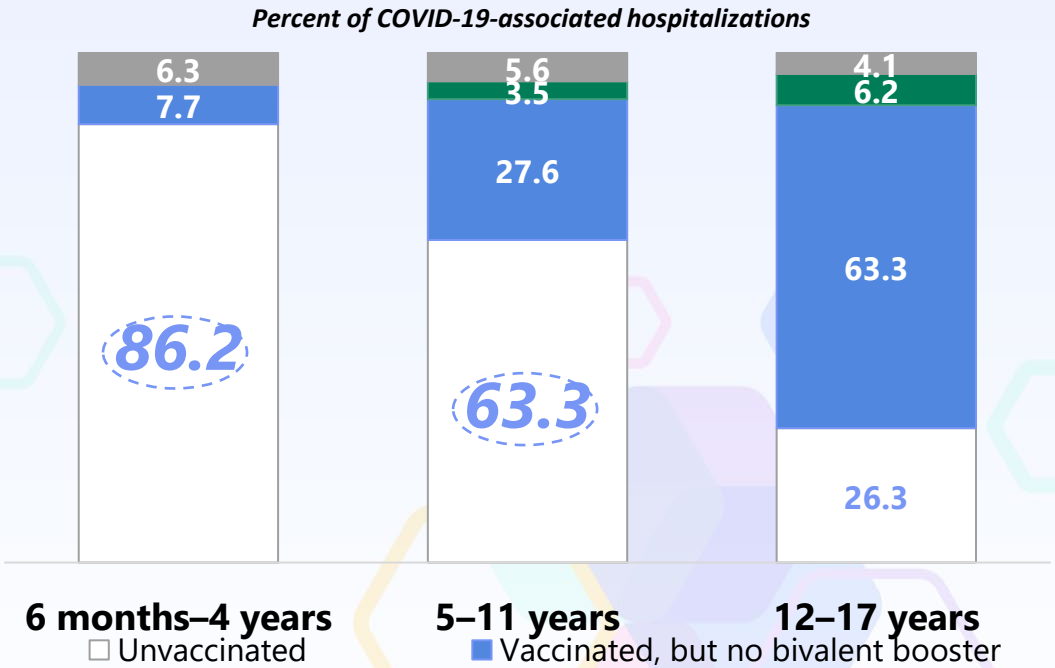
Why do we vaccinate children against COVID-19?

Why vaccinate kids against COVID-19?

Reduce hospitalization for infants, children and adolescents

Key Patient Counseling Points

Most kids under 12 years who were hospitalized for COVID-19 were unvaccinated. Let's make sure we protect your child against severe COVID-19 this season.



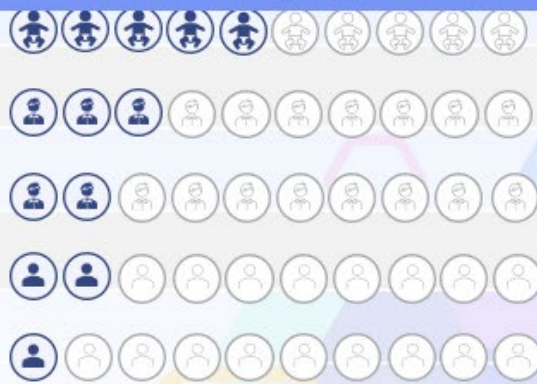
Data are limited to hospitalizations where COVID-19 is a likely primary reason for admission. **Unvaccinated**: No recorded doses of COVID-19 vaccine. **Vaccinated, but no bivalent booster**: Completed a primary series with or without ≥1 booster dose but did not receive an updated bivalent booster dose. **Updated bivalent booster**: Received updated bivalent booster dose. **Partially vaccinated**: Received at least one dose of COVID-19 but was not considered fully vaccinated at the time of a positive SARS-CoV-2 test. Persons with unknown vaccination status are excluded.

Data source: COVID-NET Overview and Methods | CDC

Why vaccinate kids against COVID-19?

Even healthy children can get severely ill from COVID-19

Age category	% hospitalized admitted to ICU with NO underlying conditions
6-23 months	
2-4 years	32%
5-11 years	24%
12-17 years	22%
18-49 years	13%



Key Patient Counseling Points

It's not only people with medical conditions who are getting very sick from COVID-19 and other respiratory viruses. For example, over half of children less than 2 years old who were hospitalized for COVID-19 and admitted to the intensive care unit were otherwise healthy.

[1]Data source: COVID-NET Overview and Methods | CDC

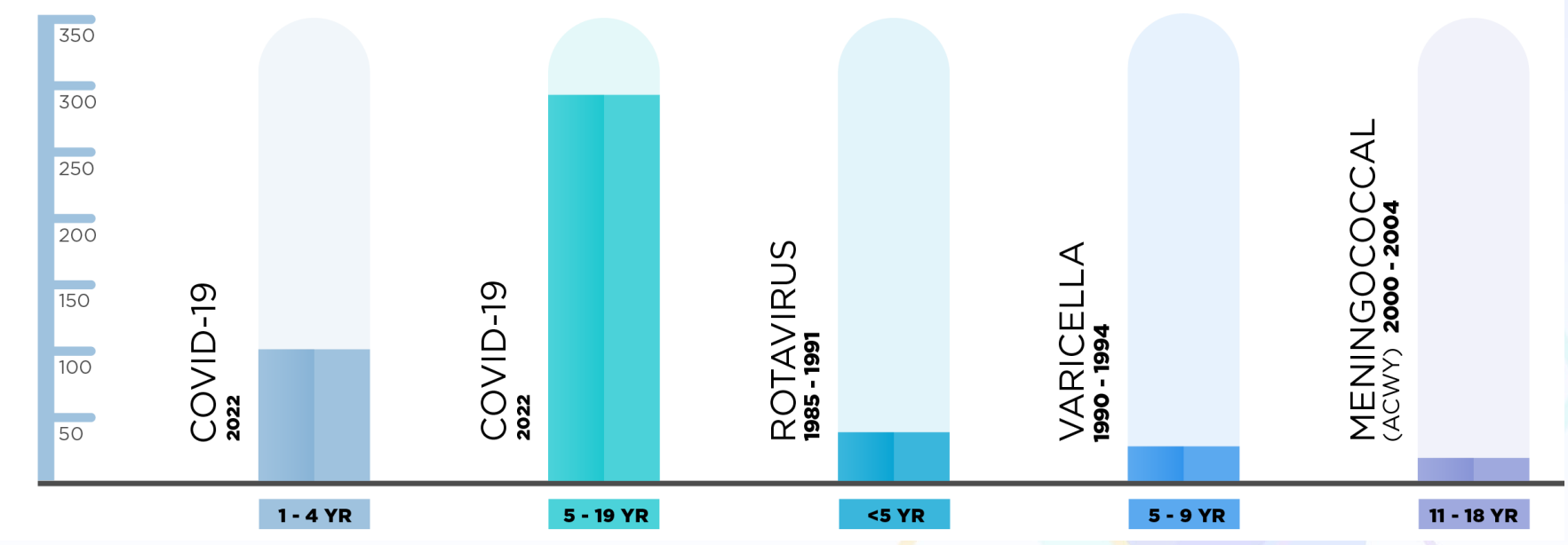
COVID-19 vaccines reduce the chance of Long COVID

- Can cause a wide range of ongoing health problems that **can last weeks, months, or years**
- In the U.S., **3.4% of adults** and **0.5% of children** currently report having Long COVID
- **COVID-19 vaccination before infection** reduces the likelihood of Long COVID by 30 – 40% across all ages

Key Patient Counseling Points

Long COVID can be a debilitating condition and can happen to anyone. Vaccination reduces the chance of getting Long COVID by almost 40%.

More pediatric deaths from COVID-19 than from other vaccine-preventable diseases, at the time each vaccine recommendation was made



Key Patient Counseling Points

Children should not be dying from diseases that have very safe and effective immunizations. Let's protect your child by vaccinating them against COVID-19.

The benefits of COVID-19 vaccine outweigh the risks

- COVID-19 vaccines have **excellent safety records** with robust safety monitoring
- **Side effects are generally mild** and resolve within a few days
  - Serious adverse events after COVID-19 vaccine are rare
- The risk of cardiac complications, including **myocarditis**, in adolescent males was 1.8 – 5.6 times **higher after COVID-19 infection** than after COVID-19 vaccination

Key Patient Counseling Points

Almost 700 million people have been vaccinated against COVID-19. We are more confident than ever in the safety of these vaccines.

Vaccinating pregnant patients against COVID-19 protects them and their babies

- Pregnant people are at increased risk for hospitalization from COVID-19 compared to non-pregnant people of reproductive age
- COVID-19 during pregnancy may be associated with adverse pregnancy outcomes (e.g., preterm birth, stillbirth, and low birth weight)
- Vaccinating pregnant people COVID-19 protects young infants who are at higher risk for severe disease

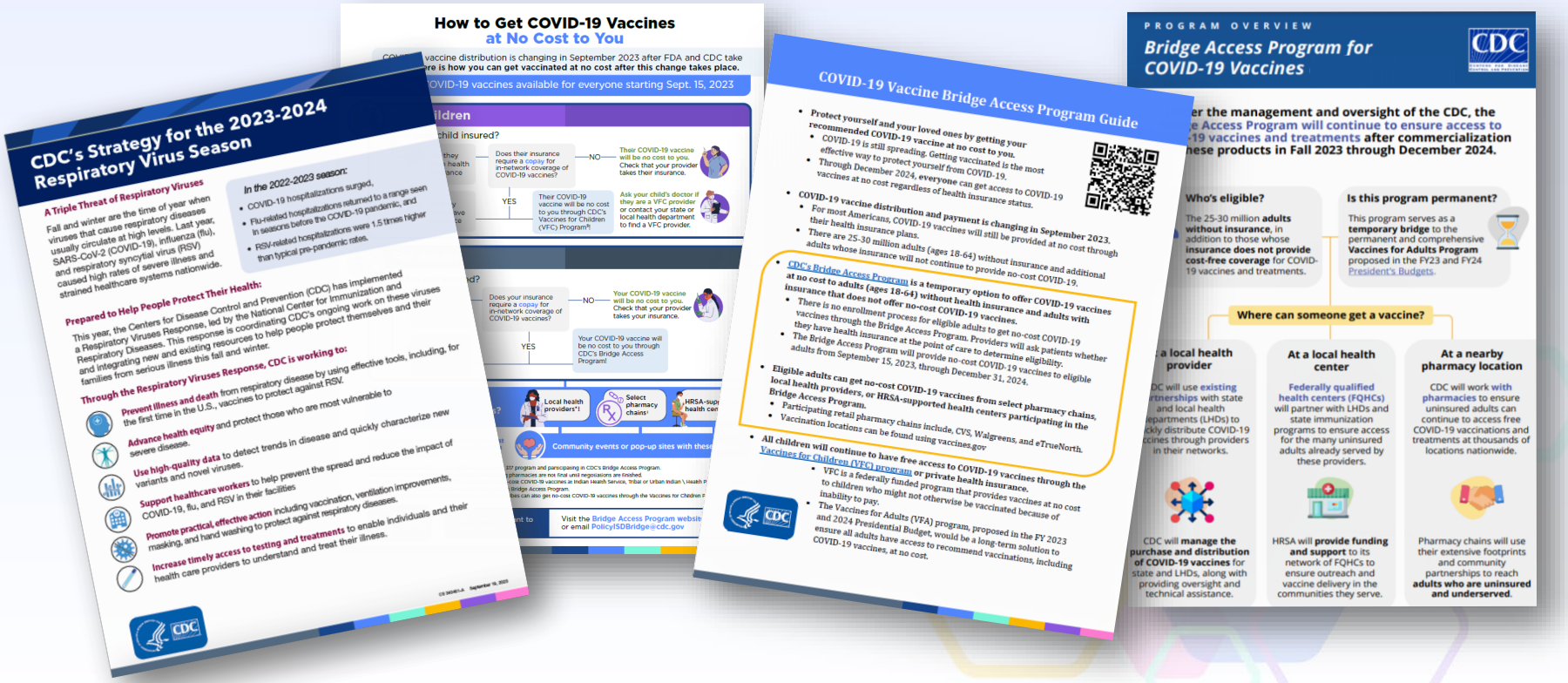
Key Patient Counseling Points

Vaccinating against COVID-19 while you are pregnant will not only protect you but also your baby.

Source: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html | CDC, webpage

Raising Awareness About Vaccination

Resources: www.cdc.gov/respiratory-viruses



Key Takeaway

- COVID-19 can cause severe disease, including in previously healthy children, and vaccination of children and pregnant people is an important tool to help protect your patients.

References

Centers for Disease Control and Prevention. Updated Oct 12, 2023. COVID-NET Overview and Methods.

https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covid-net/purpose-methods.html

Centers for Disease Control and Prevention. Updated Mar 8, 2024. Pregnancy or Breastfeeding.

https://www.cdc.gov/coronavirus/2019ncov/vaccines/recommendations/pregnancy.html

Thank you!

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

Questions?

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