Advances in Medicine and Engineering Interdisciplinary Research, 2025, Volume 3, Issue 3
DOI: 10.32629/ameir.v3i3.3991
ISSN Online: 2972-3825
ISSN Print: 2972-3833

Immunizations in adults: a look at special populations

Paulina Vergara-Pinto[1], Pablo Herrera-Morgado[2,3,*]

1. Faculty of Medicine, University of Santiago de Chile, Santiago, Chile
2. Internal Medicine, Las Condes Clinic, Santiago, Chile
3. Medical Department, Barros Luco Trudeau Hospital, Santiago, Chile
*Corresponding author.
Email address: pherreram@clinicalascondes.cl

Abstract: Vaccines are synthetic biological products designed for the prevention of infectious diseases. After potable drinking water, they are the most effective public health measure in reducing mortality and other consequences caused by vaccine-preventable diseases. In Chile, they accompany us throughout our life cycle through the National Immunization Program (PNI), created in 1979 and constantly undergoing change and improvements in order to ensure safe and free access to vaccines to the general population. There are certain clinical conditions, however, that exacerbate the acquisition and/or severity of vaccine-preventable diseases. These special populations are on the rise. In this context, the objective of this review is to provide current guidelines for the immunization of these particular groups of patients.

Key words: immunization; vaccines; special populations; patient; immunocompromised; primary prevention; preventable infections

1 Introduction

Vaccines, after drinking water, are the most effective public health measure in reducing mortality and sequelae caused by vaccine-preventable diseases[1]. These are synthetic biological products designed to prevent infectious diseases; their protective effect is achieved by stimulating adaptive immunity after inoculation. Based on their composition, they can be broadly classified as follows[2,3]:

(1) Vaccines with complete infectious agent:

- Live attenuated: live pathogen, weakened under laboratory conditions
- Inactivated: killed pathogen

(2) Subunit vaccines: These vaccines are made from an antigenic portion of the infectious agent. These vaccines can be:

- Protein
- Polysaccharide
- Conjugate: Polysaccharide attached to a carrier protein
- mRNA vaccines

(3) Vaccines with an extracellular product of the infectious agent (toxoids)

In Chile, vaccines accompany the population throughout their life cycle through the National Immunization Program (PNI), created in 1979 from the Expanded Immunization Program (PAI)[4]. Since its inception, the PNI has been based on legal provisions establishing that the Ministry of Health must guarantee free access to vaccines against vaccine-preventable communicable diseases for the corresponding target populations. Exempt Decree No. 6 of 2010 establishes mandatory vaccination against the following diseases: tuberculosis, poliomyelitis, whooping cough, diphtheria, tetanus, infectious diseases caused by H. influenzae type B, measles, mumps, rubella, hepatitis B, invasive S. pneumoniae disease, influenza, and human rabies[5]. This decree also determines the target populations and establishments responsible for their implementation. Since then, amendments have been made to Decree No. 6, adding new vaccines and modifying target groups.

In 2018, following an increase in requests for vaccines in special circumstances from various public and private health providers, the document "Recommendations for the Vaccination of Patients with Special Needs due to Pathologies or Risk Situations" was prepared, which serves to establish protocols and guide health professionals and patients affected by a clinical condition that determines, through various mechanisms, deficiencies in the immune response[4,6].

The objective of this article is to review immunization recommendations for special population groups, such as:

• People with hematologic cancers and solid tumors

• People with solid organ and hematopoietic stem cell transplants

• People on immunosuppressive treatments (corticosteroid therapy and biological therapies)

• People living with human immunodeficiency virus (HIV)

• People with other chronic conditions: bronchopneumopathies, heart disease, liver disease, chronic kidney disease (CKD), nephrotic syndrome, diabetes mellitus, neurological conditions, unresolved cerebrospinal fluid (CSF) leak, and cochlear implants.

• Older people (adults ≥ 65 years old)

• Pregnant women

Understanding the underlying pathophysiological mechanisms that facilitate and/or determine the severity of the genesis and progression of infectious diseases in the aforementioned special groups is essential. In this regard, alterations in innate and adaptive immunity (both humoral and cellular) have been observed; mixed-origin disorders frequently involve both mechanisms.

2 Patients with hematological cancers and solid tumors

Along with the aging of the population, cancer mortality has progressively increased. In Chile, in 2019, cancer replaced cardiovascular disease as the leading cause of overall mortality[7].

Oncological pathology and its associated therapies involve immunological alterations that affect both humoral and cellular components. In this context, infections are one of the main causes of morbidity and mortality in these patients[7, 8].

In this section, we will address patients with leukemia, lymphoma, and solid tumors. Treatment will be divided into two phases: induction and remission. The induction phase is the initial stage of aggressive chemotherapy aimed at achieving remission of the neoplastic disease. During this stage of treatment, bone marrow aplasia develops, which contraindicates the administration of live attenuated vaccines for safety reasons. In the case of inactivated vaccines, this leads to a lower immunogenic response with the concomitant risk of inadequate protection. Therefore, only influenza vaccination is recommended for induction (depending on the respective campaign).

On the other hand, the remission phase is defined as the disappearance of neoplastic evidence in the examination used for diagnosis. At this stage, inactivated vaccines are recommended for achieving a better immunogenic response[6]. According to the above, in the case of the hepatitis B vaccine, it is recommended to measure anti-HBsAg antibodies 30 days after administration. If a value <10 mIU/ml is obtained, the initial vaccination schedule should be repeated, and a new antibody concentration measurement should be performed subsequently[9].

Generally speaking, in this particular population group, during adulthood, the measurement of vaccine-preventable infections focuses on influenza virus, hepatitis B virus (HBV), and Streptococcus pneumoniae; after age 50, the recommendation is expanded to include herpes zoster[9,10] (Table 1).

Table 1.Vaccine recommendations for adults with hematologic cancer or solid tumors

Vaccine	Number of doses	Scheme	Observations
Influenza	1	-	Annual (campaign)
VNC-13*	2	0 - 2 months	In remission
VNP-23	3	2 months after VNC-13	In remission
Hepatitis B	3	0 - 1 - 6 months	In remission
Herpes zoster (recombinant)	2	0 - 2 months	In patients over 50 years of age who are in remission
SARS-CoV-2	1	-	Booster dose if you received an anti-SARS-CoV-2 vaccine 6 months or more ago

VNC-13: pneumococcal conjugate vaccine-13; VNP23: pneumococcal polysaccharide vaccine-23; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2.

* If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. Note that VNC-20 does not require boosting with VNP-23.

3 People with solid organ and hematopoietic stem cell transplants

The number of transplant recipients, both solid organs and hematopoietic stem cells, is constantly increasing. This is due to increased survival rates and the broadening of the spectrum of indications for transplant recipients. Infections, including vaccine-preventable diseases, are one of the leading causes of death in this group[11]. In this context, we will now address the vaccination recommendations for this population:

3.1 Solid organs

In Chile, in terms of frequency, the kidney leads the list of transplanted solid organs, followed by the liver and, less frequently, the lung and heart. 12 Patients receiving these organs, due to their underlying disease and other pre-transplant conditions, are more susceptible to infections. For this reason, the following vaccines are recommended for all transplant candidates (Table 2): annual influenza, SARS-CoV-2, hepatitis B vaccine (in cases of total anti-core (-)), and, in patients with liver disease, the hepatitis A vaccine if there is no history of previous disease[6]. Table 3 details the recommendations for vaccination of solid organ transplant recipients.

Table 2. Recommendations for vaccination in transplant candidates

Vaccine	Number of doses	Scheme	Observations
Influenza	01	Annual	
SARS-CoV-2	01	Annual	Adjustment according to current recommendations
Hepatitis B	03	0 - 1 - 6 months	Requirement: total negative anti-core.
Measure anti-HBs after 1 to 2 months	3	0 - 1 - 6 months	In remission
Hepatitis A	02	0-6 months	Carriers of liver disease
VNC-13	01		
VNP-23	01		8 weeks after VNC-13

VNC-13: pneumococcal conjugate vaccine-13; VNP23: pneumococcal polysaccharide vaccine-23; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2.

*If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. VNC-20 does not require boosting with VNP-23.

Table 3. Recommendations for vaccination of solid organ transplant recipients

Vaccines	Administration	Observations
6 months post-transplant	Immunizations in adults: a look at special populations - Paulina Vergara-Pinto et al.	
Influenza	Annual	
Other inactivated vaccines	According to epidemiological risk	-VNC-13 is administered if it was not received pre-transplant -Booster dose if you received an anti-SARS-CoV-2 vaccine 6 months or older.
12 months post-transplant		
Influenza	Annual	Independent of immunosuppression status
Hepatitis B vaccine	According to anti-HBsAg level	Booster dose if level <10 mIU/mL
Herpes zoster vaccine	2 doses	Recombinant vaccine. It does not require chickenpox serology or history of disease.

VNC-13: pneumococcal conjugate vaccine-13; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2; Anti-HBsAg: anti-hepatitis B virus surface antigen antibodies.

In the 12 months post-transplant, depending on the stage of immunosuppression, booster doses of inactivated vaccines may be administered. It is important to note that some live vaccines can be administered two years after transplantation, provided there is no other cause of immunosuppression, such as the use of immunosuppressive drugs.

3.2 Hematopoietic precursors

Hematopoietic stem cell transplants can be classified according to the type of donor:

- Autologous: Hematopoietic stem cells (HSCs) are obtained from the patient.
- Allogeneic: HSCs come from another individual.

Immune compromise is present before receiving a transplant, both due to the underlying pathology and the

preparation prior to it. The latter is known as bone marrow conditioning, which varies in intensity and is intended to suppress the patient's bone marrow and immune system[13]. In this context, all HSC recipients should be considered "naive" to vaccine-preventable diseases (virgin, unvaccinated, or unexposed to the disease), and therefore should receive all effective and currently available vaccines.

The post-transplant immune reconstitution phase is influenced by multiple factors, including the origin of the HSCs, the conditioning chemotherapy regimen used, drugs used to prevent graft-versus-host disease (GVHD) and their presentation in the patient, and the development of opportunistic infections during the hematologic recovery period. Immune reconstitution is usually completed 6–12 months after transplantation, after which immunization is recommended; this excludes live attenuated vaccines, which should be administered after a minimum of 24 months[6,13] (Table 4).

Table 4. Vaccination recommendations for hematopoietic stem cell transplant recipients

Vaccine	Post-transplant time	Scheme
dTpa + Hib + VPI + VHB	From 12 months	0 - 2 - 4 - 18 months
VNC-13*	From 12 months	0 - 2 - 4 months
Booster at 12 months	Annual	Independent of immunosuppression status
VNP-23	12 months after VNC-13	1 dose
Meningococcal ACWY conjugate	From 12 months	0 - 2 months Booster dose at 3 years
Meningococcal conjugate B	From 12 months	0 - 2 months
Hepatitis A	12 months	0 - 6 months
Three viral	12 months	0 - 1 month
chicken pox	24 months	0 - 3 months
Tetravalent human papillomavirus	12 months	0 - 2 - 6 months
SARS-CoV-2	12 months	1 dose
Herpes zoster (recombinant)	From 12 months	0 - 2 months

dTpa: diphtheria, tetanus, acellular pertussis; Hib: Haemophilus influenzae type B; VPI: inactivated polio vaccine (inactivated virus); VHB: hepatitis B virus; VNC-13: pneumococcal conjugate vaccine-13; VNP-23: pneumococcal polysaccharide vaccine-23; meningococcal conjugate ACWY: serogroups A, C, W, and Y; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2.

* If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. Considering that VNC-20 does not require boosting with VNP-23, it is important to remember that VNP-23 is not required.

In addition to this recommendation regarding timing, the patient must meet certain immunological conditions to begin vaccination:

(1) Absolute CD4(+) T lymphocyte count: >400/mm^3

(2) Absolute CD19 B lymphocyte count: >200/mm^3

(3) Absolute lymphocyte count: >1,000/mm^3

(4) Normal plasma Immunoglobulin G (IgG) concentrations for age

Under certain particular epidemiological risk situations (influenza outbreak, meningococcal disease, tetanus risk, among others) inactivated vaccines can be applied from 3 to 6 months post-transplant[6,13].

4 People on immunosuppressive treatment

4.1 Corticosteroids

Corticosteroids are drugs with potent anti-inflammatory effects, capable of regulating numerous inflammatory and immune-mediated diseases. Their prevalence is increasing, increasing with age. Through various mechanisms, systemic corticosteroid therapy produces cellular and humoral immunosuppression. The degree of immune impairment is usually related to the dose used, as well as the duration and potency of treatment. However, due to the quantitative and qualitative immunosuppressive effects of these drugs, it is difficult to accurately estimate the dose and administration time capable of generating significant immunosuppression, leading to a decreased response to vaccine administration or determining a safety risk. In this context, it has been defined and established that this dose in adults would correspond to 20 mg/day of prednisone (or equivalent dose) starting after 7 days of use[14].

In these patients it is recommended[6,15]:

- Administration of live attenuated vaccines should be postponed 1 to 3 months after the end of corticosteroid treatment. For inactivated vaccines, postpone administration until 1 month after the end of treatment.

- If the duration of corticosteroid therapy is prolonged, it is recommended to administer vaccines according to the PNI schedule and the respective influenza and anti-SARS-CoV-2 campaigns, considering that a lower immune response will occur.

- The possibility of vaccinating should be evaluated at a time when the patient is on the lowest possible dose of corticosteroid.

4.2 Biological therapies

The use of biological therapies has been increasing, representing a significant advance in the management of autoimmune and neoplastic diseases. However, due to their effect on modulating the immune response and their distinct mechanisms of action, this group of patients is more susceptible to infections. In these patients, vaccination should preferably be performed before the start of biological therapy or at the time of lowest immunosuppression, in order to improve the immune response to the vaccine. It is important to note that vaccines containing live components are contraindicated in immunosuppressed states[16].

There is an exponential increase in available biological therapies, with little evidence supporting immunization recommendations for these patients. This is why many of the guidelines governing the administration of vaccines in this population are based on expert opinion.

In general, the following are recommended for all patients: annual influenza vaccination, pneumococcal vaccination, and SARS-CoV-2 vaccination, both for their underlying pathology and the use of biologic therapy. In addition, there are some specific features depending on the mechanism of action of the biologic therapy[15 - 17] (Table 5):

- Complement function inhibitors (eculizumab, ravulizumab, zilucoplan): Administer the quadrivalent meningococcal ACWY (for serogroups A, C, W, and Y) conjugate vaccine, the meningococcal serotype B conjugate vaccine, a pneumococcal regimen, and Haemophilus influenzae type B at least 2 weeks before (if possible).

- Antitumor necrosis factor (anti-TNF-alpha) (adalimumab, infliximab, etanercept, certolizumab, golimumab, etc.): Anti-HBV vaccine in patients with no evidence of prior infection. Consider the herpes zoster (VZV) vaccine if the patient is older than 18 years of age with positive serology or a history of prior disease.

- Anti-CD52 monoclonal antibody (alemtuzumab): HBV vaccine for those without evidence of prior infection. Also consider VVZ vaccination if the above conditions apply.

- Anti-CD20 monoclonal antibody (rituximab, ocrelizumab): Anti-HBV vaccination is recommended in those without evidence of prior infection.

Table 5. Vaccination recommendations for patients on pharmacological immunosuppression

Vaccine	Number of doses	Scheme	Considerations
Influenza	01	Annual	If possible, discontinue methotrexate for 2 weeks after vaccination.
VNC-13	01	-	
VNP-23	02	8 weeks post-conjugate	Booster at 5 years (only 1 time)
dT/dTpa	01	Every 10 years	Since the age of 23
	03	0 - 1 - 6 months	Born before 1975, never vaccinated
Human papillomavirus	03	0 - 2 - 6 months	Under 26 years of age, not previously vaccinated
Virus hepatitis B	03	0 - 1 - 6 months	Requirement: total anti-core negative. Measure anti-HBs after 1 to 2 months.
Meningococcus B	02	0 - 2 months	Only with drugs that have an effect on complement function
Meningococcus ACWY	02	0 - 2 months	Only with drugs that have an effect on complement function. Booster after 5 years if risk persists.
Virus hepatitis A	02	0 - 6 months	<40 years, with risk factors, no history of previous immunization
Herpes zoster	02	0 - 2 months	Recombinant vaccine does not require chickenpox serology or history of disease

dT: diphetheria, tetanus; dTpa: diphtheria, tetanus, acellular pertussis; VNC-13: pneumococcal conjugate vaccine-13; VNP-23: pneumococcal polysaccharide vaccine-23; meningococcal conjugate vaccine ACWY: serogroups A, C, W, and Y;

*If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. Considering that VNC-20 does not require a booster with VNP-23.

4.3 People living with human immunodeficiency virus (PLHIV)

The initiation of antiretroviral therapy (ART) marks a before and after in the history of this disease, achieving in many cases a life expectancy similar to that of the population without this condition. Concomitantly, transmission of the virus is still frequent; it is estimated that worldwide during 2021, around 1.5 million people were infected with the human immunodeficiency virus (HIV) 18. Due to this significant increase in the number of PLHIV, it is extremely important to know the recommendations regarding vaccination schedules for these patients[6,18,19] (Table 6).

Table 6. Vaccine recommendations for adults with HIV infection

Vaccine	Nº the dose	Scheme	Observations
VNC-13***	1	-	If you receive VNP-23 first, you must receive VNC-13 12 months later.
VNP-23	1	2 months after VNC-13	Repeat in 5 years, once
Meningococcal ACWY conjugate	2	0 - 2 months	Repeat in 3-5 years
Meningococcal conjugate B	2	0 - 2 months	Consider according to epidemiological context
Hepatitis B	3	0 - 1 - 6 months	Only in seronegatives
Hepatitis A	2	0 - 6 months	Annual according to campaign
Influenza	1	-	
Shingles	2	0 - 2 months	Recombinant vaccine It does not require varicella serology or history of disease.
Varicella	2	0 - 3 months	Seronegative* Only if CD4 count >500/mm^3
Monkeypox	2	0 - 1 month	According to immunosuppression status, dose and route of administration**
SARS-CoV-2	1	-	Booster dose if you received an anti-SARS-CoV-2 vaccine 6 months or more ago
VPH	3	0 - 2 - 6 months	Under 26 years of age, not previously vaccinated
dT/dTpa	01	-	Every 10 years from age 23
	03	0 - 1 - 6 months	Born before 1975, never vaccinated

HIV: human immunodeficiency virus; VNC-13: pneumococcal conjugate vaccine-13; VNP-23: pneumococcal polysaccharide vaccine-23; LTCD4: CD4 (+) T lymphocytes; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2; HPV: human papillomavirus.

* Seronegative: no history of chickenpox.

** In immunosuppressive states, dose 0.5 ml subcutaneously. Otherwise, dose 0.1 ml intradermally.

*** If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. Considering that VNC-20 does not require boosting with VNP-23, it is important to remember that VNP-23 is not required.

In pathophysiological terms, the genesis of HIV infection involves defects in both the cellular and humoral immune systems. The mechanisms responsible for this immunological impairment include: direct infection and destruction of CD4 T lymphocytes, quantitative and qualitative impairment of Natural Killer (NK) cells, defects in the chemotaxis and function of monocytes and macrophages, and a reduced immunogenic response capacity of B cells compared to the HIV-negative population[18].

It should also be considered that PLHIV may be exposed to other preventable infections associated with risky sexual behavior[18,19].

5 Other chronic pathologies

There is a wide range of chronic pathologies that lead to increased susceptibility and/or potential severity in the development of vaccine-preventable infections. The mechanisms of immune dysfunction associated with these diseases center on the chronic inflammatory state, with the resulting immune dysregulation.

In this section, we will cover: bronchopneumopathies, heart diseases, liver diseases, kidney diseases (chronic kidney disease, nephrotic syndrome), diabetes mellitus, neurological conditions, unresolved cerebrospinal fluid leak, and cochlear implants. For practical purposes, we will also include patients with asplenia or hyposplenia (functional asplenia).

Below, we will mention some pathophysiological mechanisms that participate in the immunological compromise in each associated pathology[6,14,15]:

Chronic obstructive pulmonary disease (COPD): Impaired cellular immunity with decreased cytotoxicity of NK cells and reduced phagocytic capacity of monocytes, macrophages, and polymorphonuclear cells (PMNs). This is compounded by the immunocompromised nature of the use of systemic corticosteroids, which are widely used in this patient group (see the corresponding section in this review).

Asthma: Primarily affecting cellular immunity, with overactivated Th2 and decreased Th1 responses. Impaired immune cell function has also been described, including Langerhans cells, dendritic cells, basophils, and mast cells. They also exhibit defective innate immune responses and constitute a frequent user population of systemic corticosteroids.

Diabetes: These patients present with immune disorders at both the humoral and cellular levels; in addition, dysfunctional innate immunity related to persistent hyperglycemia has been described.

Chronic kidney disease: Similar to what is observed in diabetic patients, there is impairment in innate and adaptive immunity (cellular and humoral function). The need for dialysis (peritoneal or hemodialysis) increases vulnerability to infections and is associated with greater immunocompromised function.

Asplenia/Hyposplenia: The spleen is a key organ for phagocytosis, one of the primary mechanisms against encapsulated bacteria. Therefore, its absence or hypofunction constitutes a risk factor for serious bacterial infections, primarily caused by Streptococcus pneumoniae, Haemophilus influenzae type B (Hib), and Neisseria meningitidis (serogroup B and serogroups ACWY).

Immunization recommendations for each patient group are described in Tables 7 and 8.

Table 7. Vaccination recommendations according to chronic conditions

Pathology	Vaccines
Chronic broncho-pneumopathies: EPOC Asma Bronchiectasis Alveolar pneumonitis occupational or environmental respiratory disease Sarcoidosis Cystic fibrosis Partial or total pneumonectomy	annual influenza (campaign) SARS-CoV-2 VNC-13* + VNP-23** Haemophilus Influenzae type B (1 dose) Hepatitis A (2 doses / 0 - 6 months) Hepatitis B (3 doses / 0 - 1 - 6 months Chickenpox (2 doses / 0 - 3 months) shingles (2 doses / 0 - 2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)
Chronic heart disease Heart failure Cardiomyopathy	annual influenza (campaign) SARS-CoV-2 VNC-13* + VNP-23**

High blood pressure	Shingles (2 doses/0 - 2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)
Chronic liver disease	Annual Influenza (Campaign) SARS-CoV-2 VNC-13* + VNP-23** Hepatitis A (2 doses / 0 - 6 months) Hepatitis B (3 doses / 0 - 1 - 6 months) Meningococcal ACWY conjugate (1 dose) Herpes zoster (2 doses / 0 - 2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)
Chronic nephropathy	Annual Influenza (Campaign) SARS-CoV-2 VNC-13* + VNP-23** Meningococcal ACWY conjugate (1 dose) Haemophilus influenzae type B (1 dose) Hepatitis B (3 doses / 0 - 1 - 6 months) Chickenpox (2 doses / 0 - 3 months) Shingles (2 doses / 0 - 2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)
Neurological diseases: Sequelae of cerebrovascular accident Parkinson Cerebral palsy	Annual influenza (campaign) SARS-CoV-2 VNC-13* + VNP-23** Haemophilus Influenzae type B (1 dose) Shingles (2 doses / 0 - 2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)
Diabetes Mellitus	Annual influenza (campaign) SARS-CoV-2 VNC-13* + VNP-23** Haemophilus Influenzae type B (1 dose) Hepatitis A (2 doses / 0 - 6 months) Hepatitis B (3 doses / 0 - 1 - 6 months) Meningococcal ACWY conjugate (1 dose) Chickenpox (2 doses / 0 - 3 months) Shingles (2 doses / 0-2 months) dT/dTpa (1 dose every 10 years, previously vaccinated)

	Annual influenza (campaign)
	SARS-CoV-2
	VNC-13* + VNP-23**
CSF fistula / Cochlear implant	Haemophilus Influenzae type B (1 dose)
	Meningococcal conjugate ACWY (1 dose)
	Shingles (2 doses / 0 - 2 months)
	dT/dTpa (1 dose every 10 years, previously vaccinated)

EPOC: chronic obstructive pulmonary disease; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2; VNC-13: pneumococcal conjugate vaccine-13; VNP-23: pneumococcal polysaccharide vaccine-23; meningococcal conjugate vaccine ACWY: serogroups A, C, W, and Y.

* If VNC-15 is available, it should be preferred over VNC-13. If VNC-20 is available, it should be preferred over 13- and 15-valent vaccines. Note that VNC-20 does not require boosting with VNP-23.

** The intervals between VNC-13 and VNP-23 vary by age and immunosuppression status. Booster vaccination with VNP-23 at age 5 is only performed for conditions that result in greater immunocompromise (hemoglobinopathies, asplenia, HIV, CKD, any malignancy, pharmacological immunosuppression).

Table 8. Vaccine recommendations for splenectomized patients

Vaccine	Dose	Observations
VNC-13	1	2 weeks before surgery
VNP-23	1	2 months after VNC-13. Revaccinate once at 5 years of age.
Haemophilus influenzae type B (conjugated)	1	
Meningococcal ACWY conjugate	2	Revaccinate in 3 - 5 years (0 - 2 months)
Meningococcal conjugate B	2	(0 - 2 months)
Influenza	1	Annual (campaign)
SARS-CoV-2	1	Booster dose if you received an anti-SARS-CoV-2 vaccine 6 months or more ago
Shingles	2	Recombinant vaccine Does not require chickenpox serology or history of disease
dT/dTpa	01	Every 10 years from age 23
	03	Born before 1975, never vaccinated

VNC-13: pneumococcal conjugate vaccine-13;VNP-23: pneumococcal polysaccharide vaccine-23; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; Meningococcal conjugate ACWY: serogroups A, C, W, and Y.

5.1 Seniors (65 years and older)

Immune system aging, or immunosenescence, affects both humoral and cellular immune responses. This makes this population more vulnerable to vaccine-preventable diseases.

Alterations such as imbalance between pro- and anti-inflammatory mechanisms, lower production and diversification of T lymphocytes, decreased antibody synthesis, among others, are the responsible mechanisms[20,21].

In these patients, the risk of pneumococcal pneumonia increases with age and the presence of comorbidities[22]. Furthermore, as with influenza infections, if they develop illness, they present more severe symptoms associated with

higher mortality.

In this context, it is important to reinforce the importance of immunization in these patients (Table 9).

Table 9. Vaccine recommendations for older people (65 years and older)

Vaccines	Dose	Observations
VNP-23	1 dose	Revaccination at 5 years according to chronic pathologies
Influenza	1 dose	Annual campaign
SARS-CoV-2	1 dose	Booster dose if you received an anti-SARS-CoV-2 vaccine 12 months or more ago
Shingles	2 dose	Recombinant vaccine: Consider in patients over 50 years of age. Does not require chickenpox serology or history of disease.
Respiratory syncytial virus	1 dose	For all those over 75 years of age. Consider those >60 years of age with comorbidities or institutionalized.

VNP-23: pneumococcal polysaccharide vaccine 2; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2.

5.2 Pregnant women

During pregnancy, various physiological hormonal changes cause variations in the immune response; increased estradiol concentrations induce greater activity of Th2 responses and a decrease in Th1 responses. Other components of the immune response, such as phagocytic activity, remain unchanged and may even increase during the second and third trimesters of pregnancy. Altered cellular immunity explains the suboptimal response to certain viral infections, such as influenza. This is why pregnant women are at greater risk of suffering serious complications related to influenza and SARS-CoV-2 infection, compared to non-pregnant women[23].

Furthermore, vaccination during pregnancy is an effective way to reduce morbidity and mortality in newborns and infants through the transfer of placental antibodies to the fetus, protecting it in its first months from highly fatal diseases, such as severe whooping cough. This is known as the cocoon strategy, implemented in Chile during the period 2012–2013[24]. The vaccines recommended for all pregnant women are listed below (Table 10).

Table 10. Vaccination recommendations for pregnant women

Vaccines	Dose	Observations
dTpa	1 dose	From the 28th week of gestation until the immediate postpartum period
Influenza	1 dose	From any month of pregnancy
SARS-CoV-2	1 dose	From any month of pregnancy

dTpa: Diphtheria, tetanus, pertussis; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2.

There are special situations during pregnancy where, based on the risk/benefit assessment, additional vaccines will be recommended beyond those mentioned above. These include situations such as travel where an endemic disease (yellow fever, typhoid fever, polio) is present, or certain high-risk situations where vaccination against hepatitis A, hepatitis B, pneumococcus (conjugate and polysaccharide), meningococcus (conjugate and polysaccharide), or rabies will be

required[25,26].

6 Conclusions

Vaccines are an effective measure for reducing mortality and the consequences associated with vaccine-preventable diseases. In Chile, we have the National Plan for Vaccination (PNI), which is constantly modified to ensure safe and free access to the general population, which has had a significant and indisputable impact on the country's public health.

Special populations with clinical conditions that lead to deficiencies in their immune response have shown a steady increase, supported by increased life expectancy. This underscores the need to understand the underlying causes in order to provide a personalized and targeted approach to the prevention and timely management of an increasing number of vaccine-preventable diseases.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Ferrer PL. Historia General de la Medicina en Chile. La viruela: epidemias y enfermedades, recetas y sistemas curativos. Imprenta Talca 1904. Disponible en: http://www.memoriachilena.cl/602/w3-article-98488.html.

[2] OMS. Organización Mundial de la Salud 2024. Vacunas e inmunización. ¿qué es la vacunación? Disponible en: https://www.who.int/es/news-room/questions-and-answers/item/vaccines-and-immunization-what-is-vaccination.

[3] OMS. Organización Mundial de la Salud. Distintos tipos de vacunas que existen. 2021. Disponible en: https://www.who.int/es/news-room/feature-stories/detail/the-race-for-a-covid-19-vaccine-explained.

[4] C. González. Programa nacional de inmunización en Chile, pasado, presente y futuro. [National immunization program in Chile, past, present and future]. Rev Med Clin Condes., 31 (2020), pp. 225-232 http://dx.doi.org/10.1016/j.rmclc.2020.04.005

[5] Subsecretaria de Salud Pública. Decreto N° 6 Exento, de 2010: Dispone vacunación obligatoria contra enfermedades inmunoprevenibles de la población del país. 29 enero 2010.

[6] MINSAL. Ministerio de Salud de Chile. Recomendaciones para la vacunación de pacientes con necesidades especiales por patologías o situaciones de riesgo. 2018. Disponible en https://www.sochinf.cl/portal/templates/sochinf2008/documentos/2019/MANUAL_VACUNAS_ESPECIALES.pdf.

[7] S. Parra-Soto, F. Petermann-Rocha, M.A. Martínez-Sanguinetti, A.M. Leiva-Ordeñez, C. Troncoso-Pantoja, N. Ulloa, et al. Cáncer en Chile y en el mundo: una mirada actual y su futuro escenario epidemiológico. [Cancer in Chile and worldwide: an overview of the current and future epidemiological context]. Rev Med Chil., 148 (2020), pp. 1489-1495 http://dx.doi.org/10.4067/S0034-98872020001001489

[8] J. Fortún. Principales infecciones en el paciente oncológico: manejo práctico [Principal infections in the oncology patient: practical treatment]. An Sist Sanit Navar., 27 (2004), pp. 17-31

[9] P. Peremiquel-Trillas, L.M. Leguízamo, C. Asensio Ostos, X. Martínez-Gómez. Vaccines that should be administered to patients receiving treatment with immunosuppressive, immunomodulatory and/or biological drugs. Med Clin (Barc)., 151 (2018), pp. 498-502 http://dx.doi.org/10.1016/j.medcli.2018.05.008

[10] H. Lal, A.L. Cunningham, O. Godeaux, R. Chlibek, J. Diez-Domingo, S.J. Hwang, et al. ZOE-50 Study Group. Efficacy of an adjuvanted herpes zoster subunit vaccine in older adults. N Engl J Med., 372 (2015), pp. 2087-2096 http://dx.doi.org/10.1056/NEJMoa1501184

[11] J.R. Yuste, J.L. del Pozo, E.G. Quetglás, J.R. Azanza. Infecciones más comunes en el paciente trasplantado [The most common infections in the transplanted patient]. An Sist Sanit Navar., 29 (2006), pp. 175-205

[12] A.M. Arriagada, S. Maquilón, C. Benítez. Donación y trasplante de órganos en Chile [Organ Transplantation in Chile]. Rev Med Chil., 146 (2018), pp. 675-676 http://dx.doi.org/10.4067/s0034-98872018000500675

[13] J.J. Rifón. Trasplante de progenitores hemopoyéticos [Transplant of hemopoietic progenitors]. An Sist Sanit Navar., 29 (2006), pp. 137-151

[14] D.B. Chastain, M. Spradlin, H. Ahmad, A.F. Henao-Martínez. Unintended Consequences: Risk of Opportunistic Infections Associated With Long-term Glucocorticoid Therapies in Adults. Clin Infect Dis., 78 (2024), pp. e37-e56 http://dx.doi.org/10.1093/cid/ciad474

[15] F. Alnaimat, J.J.G. Sweis, J. Jansz, Z. Modi, S. Prasad, A. AbuHelal, et al. Vaccination in the Era of Immunosuppression. Vaccines (Basel)., 11 (2023), pp. 1446 http://dx.doi.org/10.3390/vaccines11091446

[16] I. Cerón, P. Gambra, C. Vizcaya, M. Ferres, T. Bidart, T. López, et al. Consenso sobre riesgo de complicaciones infecciosas en pacientes usuarios de medicamentos biológicos seleccionados. Parte I [Consensus of infectious complications in patients treated with selected biological therapies: first Part]. Rev Chilena Infectol., 36 (2019), pp. 608-615. http://dx.doi.org/10.4067/S0716-10182019000500608

[17] M. Her, A. Kavanaugh. Alterations in immune function with biologic therapies for autoimmune disease. J Allergy Clin Immunol., 137 (2016), pp. 19-27. http://dx.doi.org/10.1016/j.jaci.2015.10.023

[18] L.G. Bekker, C. Beyrer, N. Mgodi, S.R. Lewin, S. Delany-Moretlwe, B. Taiwo, et al. HIV infection. Nat Rev Dis Primers., 9 (2023), pp. 42 http://dx.doi.org/10.1038/s41572-023-00452-3

[19] N. Rodríguez-Ortiz, Saa-Aguilera, L. Bastidas-Leal, P. Ross-Pérez, M.E. Ceballos-Valdivielso. Orientaciones para el manejo ambulatorio de adultos que viven con VIH en Chile. [Guidelines for the primary care of adult people living with HIV in Chile]. Rev Chil Infectol., 41 (2024), pp. 259-281. http://dx.doi.org/10.4067/s0716-10182024000200259

[20] R. López-Mongil, J.A. López-Trigo, A. Mariano-Lázaro, G. Mato-Chaín, P. Ramos-Cordero, L. Salleras-Sanmartí. en representación del Grupo de Vacunas de la Sociedad Española de Geriatría y Gerontología (SEGG). Vacunación frente a la gripe estacional en las personas mayores. Evaluación de la vacuna adyuvada: Informe de posicionamiento. Rev Esp Geriatr Gerontol., 52 (2017), pp. 1-14. http://dx.doi.org/10.1016/S0211-139X(18)30086-6

[21] M. Barrera-Salas, A.E. Morales-Hernández, J.J. Hernández-Osorio, D.R. Hernández-Salcedo, R. Valencia-López, M.A. Ramírez-Crescencio. Inmunosenescencia. Med Interna Méx., 33 (2017), pp. 696-704 http://dx.doi.org/10.24245/mim.v33i5.1204

[22] M. Calvo, J. Inostroza, M. Bastías, J. Dabanch, J. Cerda, C. González, et al. Recomendación del CAVEI de vacunación antineumocócica en adultos [CAVEI recommendation for pneumococcal vaccine use in adults]. Rev Chilena Infectol., 37 (2020), pp. 47-50. http://dx.doi.org/10.4067/S0716-10182020000100047

[23] Influenza in Pregnancy: Prevention and Treatment: ACOG Committee Statement No. 7. Obstet Gynecol. 2024;143(2):e24-e30. doi: 10.1097/AOG.0000000000005479.

[24] J. Cofré. ¿Es tiempo de vacunar a la mujer embarazada contra la coqueluche? [Is it time to vaccine pregnant woman against pertussis?]. Rev Chilena Infectol., 33 (2016), pp. 55-58. http://dx.doi.org/10.4067/S0716-10182016000100008

[25] A. Vilajeliu, A.L. García-Basteiro, A. Goncé, J.M. Bayas. Vacunación integral en la embarazada. [Comprehensive vaccination in pregnant women]. Prog Obstet Ginecol., 57 (2014), pp. 88-96. http://dx.doi.org/10.1016/j.pog.2013.09.005

[26] A. Kachikis, J.A. Englund. Maternal immunization: Optimizing protection for the mother and infant. J Infect., 72Suppl (2016), pp. S83-S90. http://dx.doi.org/10.1016/j.jinf.2016.04.027