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Reflection on the importance of vaccination of people with cancer as a strategy in the prevention of complications of vaccine-preventable diseases

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ABSTRACT
Reflective research, aimed to: Reflect on the importance of vaccinating people with cancer as a strategy in the prevention of complications of vaccine-preventable diseases. The basis for the reflections was based on national and international publications in the health area, related to the vaccination of people with cancer. Data collection was conducted between January 2022 and February 2023, in which publications from the health area were included. Thus, the reflection was elaborated in three chapters: Cancer: implications related to disease and treatment; Vaccination of people with cancer; Performance of nursing and other health professionals in the vaccination of people with cancer. As final considerations, it is necessary that, in addition to primary care services, oncology services must consider the insertion of protocols for immunization of cancer patients safely, to reduce the possibility of illness and complications due to diseases preventable by vaccination.

Keywords: Cancer, Vaccination, Nursing care.

1 INTRODUCTION

Cancer is characterized as the main public health problem in the world. Its incidence grows every year due to increased aging, population growth, and changes in the distribution and prevalence of risk factors associated with socioeconomic development. (BRAZIL, 2019a).

People with cancer require cancer treatment, which includes one or more associated modalities. Therapeutic resources can interfere with the immune system leading to immunosuppression, contributing to susceptibility to infections, even those preventable by vaccines. Thus, it is essential to maintain the complete vaccination schedule of this population and/or revaccination in some cases. (AMMAR, SAADDI, CRIVALARO, et al., 2018).

Active vaccination/immunization is characterized by the administration of all or a part of a microorganism in healthy people, to produce an immune response to that infection, without presenting great risk to those who receive it. (DENLINGER; SANFT; SCOTT BAKER, et al., 2018). With the vaccination of children, there was a reduction not only in the cases of diseases but also in the circulation of infectious agents among the population. This caused a positive reflection on the health of adults and the elderly (collective protection) (BALLALAI, 2017).

> "Vaccination is one of the most effective public health measures to prevent disease, however, vaccination coverage rates in the adult population remain below targets, even when vaccines are offered free of charge. The main barriers to adult vaccination are considered to be: mistaken beliefs and low patient awareness; insufficient knowledge and negative attitudes on the part of

> physicians. The lack of a medical prescription is pointed out in the literature as the main reason for adults not getting vaccinated." (BALLALAI, 2017, P.742).

It is estimated the annual occurrence of 600 thousand deaths is related to hepatitis B. (MORAES, 2010). Yellow fever is estimated to have 200,000 cases per year and 30,000 deaths per year. (PAHO, 2023). In Brazil, in 2022, 152 cases of tetanus were confirmed, with a mortality rate of 18%. (BRAZIL, 2023a). While for diphtheria, in 2021, in Brazil, there were 11 suspected cases, of which 1 was confirmed. (PAHO, 2021). The flu led to the death of more than 1,700 Brazilians in the first 2 months of 2022. (IOC/FIOCRUZ, 2022).

It is worth mentioning that people with cancer are prone to develop severe symptoms in the face of contamination by the coronavirus (Covid-19), classified by the World Health Organization as a pandemic. (BRAZIL, 2020).

Unlike the rest of the population, immunocompromised individuals are unable to mount a protective response to receiving the vaccine, so it is aimed at the benefit of the patient and the prevention of damage. (AMMAR, SAADDI, CRIVALARO, et al., 2018). Given this, before applying the vaccines to people with a history of cancer, the viability of the immune system and the history of allergic reactions to the vaccines should be noted and added to the leukocyte count which must be normal or within reasonable limits. The person should not have an ongoing infection present or on immunosuppressive drugs or chemotherapy. (DENLINGER; SANFT; SCOTT BAKER, et al., 2018).

Regarding the immunization of the population, in Brazil there is the National Immunization Program (PNI) and, according to the Ministry of Health (BRASIL, 2023):

> "Brazil's National Immunization Program has advanced year by year to provide a better quality of life to the population with the prevention of diseases. As in developed countries, Brazil's National Vaccination Calendar includes not only children but also adolescents, adults, the elderly, pregnant women, and indigenous peoples. In total, 19 vaccines are available in the immunization routine, whose protection begins in newborns and can be extended throughout life. Vaccines are safe and stimulate the immune system to protect the person against communicable diseases. When adopted as a public health strategy, they are considered one of the best investments in health considering the cost-benefit. Brazil's National Immunization Program is one of the largest in the world, offering 45 different immunobiology to the entire population. There are vaccines aimed at all age groups and annual campaigns to update the vaccination booklet." (BRAZIL, 2023b, p.1).

Thus, it is relevant that nursing professionals who work in vaccine rooms know the singularities that involve the vaccination of people with a history of cancer. Currently, according to the Ministry of Health (MS), there are more than 20 vaccines available in SUS vaccine rooms, with specific recommendations and guidelines for children, adolescents, adults, pregnant women, the elderly, and indigenous people. (IOC/FIOCRUZ, 2022).

> "The use of vaccines in cancer patients is based primarily on the general principles of immunization and safety data in other cohorts. The vast heterogeneity of malignancies and treatments also limits the evidence for vaccination. Different depths and types of immune system dysfunction reflect this heterogeneity. Knowing the type and depth of immune system alteration is crucial to assessing the risk of serious infections, as well as the risks and benefits of vaccines. A patient with breast cancer after surgery, radiation, and hormone treatment will be less prone to serious vaccine-preventable infections than a patient treated with high doses of chemotherapy for relapsing testicular cancer. Treatments targeting specific components of the immune system, for example, B-cell depletion by rituximab, will lead to much less effective vaccinations, especially of subunit vaccines with polysaccharides or proteins for at least several months after the end of therapy." (WEBER; LJUNGMAN, 2018, p.1.).

Given the above, the development of this research is justified, since expanding the publications on the subject, associated with the implementation of a vaccination management plan for people with a history of cancer, with the training of health professionals on the subject, can contribute to the increase in vaccinations and safe vaccinations, considering the specificities that involve the vaccination of people with cancer.

Because of the above, the objective was: To reflect on the importance of vaccinating people with cancer as a strategy for the prevention of complications of vaccine-preventable diseases.

2 METHODOLOGY

This is reflective research, and the basis for the reflections occurred from national and international publications related to the vaccination of people with cancer.

Data collection was carried out between January 2022 and February 2023, in which publications from the health area related to the vaccination of special patients were included.

To enable the deepening of the reflections on the vaccination of people with cancer as a strategy in the prevention of complications due to vaccine-preventable diseases, this reflection was elaborated in three chapters, addressing the following themes - Cancer: implications related to the disease and treatment; Vaccination of people with cancer; Performance of nursing and other health professionals in the vaccination of people with cancer.

3 RESULTS AND DISCUSSION

For better understanding, this chapter was presented in three themes, namely: Cancer: implications related to disease and treatment; Vaccination of people with cancer; Performance of nursing and other health professionals in the vaccination of people with cancer.

3.1 CANCER: IMPLICATIONS RELATED TO DISEASE AND TREATMENT

Cancer is characterized by abnormal and uncontrolled growth and multiplication of cells. In most cases, the cancer cells form a tumor. However some cancers, as in the case of leukemia, rarely form tumors, affecting the blood and organs that produce blood cells, reaching tissues where they develop, this in particular, can lead to immunosuppression. The types of cancer are carcinomas, sarcomas, leukemias, lymphomas, myelomas, and cancers of the Central Nervous System. (ONCOGUIA, 2017).

People with cancer require oncological treatment which can be performed through surgery, chemotherapy, radiation therapy, hormone therapy, immunotherapy, corticosteroid use, hematopoietic cell transplantation (HCT), monoclonal antibodies (e.g., rituximab, alemtuzumab). In many cases, it is necessary to combine more than one treatment modality. (BRAZIL, 2019b).

These therapeutic resources can interfere with the immune system leading to immunosuppression, a factor that provides infection, even those preventable by vaccines, leaving them more susceptible. Thus, the complete vaccination schedule of these patients and/or revaccination in some cases is essential. (AMMAR, SAADDI, CRIVALARO, et al., 2018).

Immunosuppression is characterized by suppression of the immune system and its ability to fight infections and other diseases. It can be deliberately induced with medications, such as preparation for bone marrow transplantation, it can also result from certain diseases (AIDS, lymphoma) or anticancer drugs. (ONCOGUIA, 2021).

3.2 VACCINATION OF PEOPLE WITH CANCER

This chapter will be addressed vaccination in people with a history of cancer during cancer treatment or after the completion of it. Because it deals with special patients, the specificities that involve the vaccination of this population will be addressed.

It is worth mentioning that before proceeding with the vaccination of people with cancer, both before, during, or after cancer treatment, it is of fundamental importance that these patients are evaluated by health professionals of the institution responsible for their treatment, considering their health conditions so that they can be vaccinated safely. Also, it is necessary to follow the institutional protocols, which should be elaborated by professionals with in-depth knowledge in the area and based on the standards established by the Ministry of Health and the Brazilian Society of Immunization.

3.2.1 Vaccination in people with cancer undergoing cancer treatment

Cancer treatment can lead to immunosuppression and, as a consequence, some vaccines are contraindicated during this period, thus avoiding a higher risk of infection, while others can be

administered without greater risks. Cancer is a heterogeneous disease, so recommendations for vaccination may vary in each case, depending on age, vaccination history, disease, treatment, and level of immunocompromise.

Among the benefits of immunization are individual protection, reduction of infectious diseases and outbreaks, in addition to indirect protection to unvaccinated people for some diseases, and also reduction of costs that involve the diagnosis and treatment of vaccine-preventable diseases. (SANTOS et al., 2010).

The vaccines contraindicated for this population during the period of immunosuppressive treatment and/or with uncontrolled malignant disease are those of bacteria and/or live attenuated viruses, as they can result in viral proliferation, also, bacterial toxins are modified to become non-toxic, when administered invade the circulation and induce the formation of antibodies, Although it is effective in immunizing healthy people, it is dangerous to the immunocompromised due to the risk of mild infection progressing to a severe one. (DENLINGER; SANFT; SCOTT BAKER, et al., 2018; AMMAR, SAADDI, CRIVALARO, et al., 2018). These vaccines are MMR (measles, mumps, rubella), Tetra viral (measles, mumps, rubella, and chickenpox), Chickenpox, Herpes Zoster (high risk in hematological neoplasms and solid tumors, especially those with Hodgkin's disease), Rotavirus and yellow fever (if epidemiological indication, it is applied four weeks before chemotherapy or three months after the end) and Oral polio: if immunization against polio is necessary, use the inactivated vaccine. (DENLINGER; SANFT; SCOTT BAKER, et al., 2018; AMMAR, SAADDI, CRIVALARO, et al., 2018).

The ideal time for vaccination is at least 4 weeks before starting immunosuppressive treatment or if this is not possible, at least 15 days before. However, consultation with a specialist or doctor is recommended. When there are other vaccine options they are preferable. (DENLINGER; SANFT; SCOTT BAKER, et al., 2018; AMMAR, SAADDI, CRIVALARO, et al., 2018).

On the other hand, vaccines for dead/inactivated viruses and bacteria are safer and unable to cause disease in this population, can be applied at least two weeks before treatment and avoided during it, ensuring a better vaccine response. If the vaccine is made during treatment, valid doses should only be considered if antibodies are detected later. (AMMAR, SAADDI, CRIVALARO, et al, 2018). The main ones are Tetanus, diphtheria, pertussis (consider the booster in all patients), Influenza (annually), VIP, Hepatitis A and B, Pneumococcal 10/13 and 23 (before the start of chemotherapy), Meningococcal, and HPV. (AMMAR, SAADDI, CRIVALARO, et al., 2018).

The adjuvants, stabilizers, and preservatives present in vaccine formulations may be associated with the appearance of adverse reactions and events. Thus, the administration of certain vaccines is contraindicated in patients with a history of anaphylactic reaction to milk, egg, or any other component

that is present in a given formulation. Another important risk related to vaccines is non-vaccination, worrisome due to the resurgence of once-eradicated diseases. Adverse reactions and effects occur infrequently and insignificantly when compared to the risks of non-vaccination when late (48 to 96 hours after vaccination) are not life-threatening and do not contraindicate their use, and if serious adverse reactions after vaccination with a causal relationship with the vaccine, there may be a contraindication of subsequent doses. (APS et al., 2018).

A study of 273 medical oncologists showed that influenza, pneumococcal and hepatitis B vaccines were the most commonly recommended. The main neoplasms suggested for vaccination were patients with lung, breast, and lymphoma cancers. The period of remission/follow-up or before the start of chemotherapy was the most common time for vaccination. Only 23.4% of the physicians considered their recommendation of vaccination efficient and adequate, however, the lack of time, knowledge, and/or experience about vaccination are the most common limitations. There is a positive correlation between experience in the area and the evaluation of patients for vaccination; On the other hand, there is a negative correlation between the number of patients seen daily and those under evaluation for immunization. (ALKAN, KARCI, YAŞAR et al., 2017).

Inactivated vaccines may be recommended in the pre-and post-transplantation of solid organs, however, in the postoperative period, a minimum interval of two months must be respected for the production of antibodies to be more effective. People undergoing hematopoietic stem cell transplantation (HSCT) should wait six months to start vaccination with inactivated vaccines and two years for live attenuated vaccines. In the presence of the disease, live attenuated vaccines remain contraindicated. In solid tumors, the attenuated vaccine is applied up to 30 days before chemotherapy, three months after the end of chemotherapy or radiotherapy, and six months after the suspension of biologics. People with severe neutropenia should not receive any vaccines, to prevent acute febrile episodes. (ATAGI, 2018).

Revaccination or recommendation of additional doses after the immunosuppression period needs to be considered individually. It is worth noting that if a person has not completed a primary vaccination schedule before diagnosis and treatment, it is important to continue to offer routine or recovery vaccination during therapy. (ATAGI, 2018).

Regarding vaccination against Covid-19, as they are functionally inactivated, it is soon possible to apply to immunocompromised. There are three vaccines available in Brazil, coronavac (Sinovac-Butantan), from inactivated virus, to covishield. (Oxford/AstraZeneca - Fiocruz), of non-replicating viral vector and Comirnaty (Pfizer), of mRNA. Vaccination will only take place upon medical prescription. (SBOC-SBIM, 2021).

The vaccines recommended by the Ministry of Health are available in the Basic Health Units (UBS), while the vaccines indicated for special patients are made available in the Reference Centers for Special Immunobiologics (CRIE).

The Brazilian Society of Immunization SBIm (2022) has developed recommendations for the vaccination of people with neoplasms or in use of immunosuppressive drugs, as can be seen in chart 1:

CHART 1 - VACCINATION OF PEOPLE WITH NEOPLASMS OR USING IMMUNOSUPPRESSIVE DRUGS.

VACCINES	OUTLINES/RECOMMENDATIONS	AVAILABILITY IN CRIE* and/or UBS**
VACCINES ESPECIALLY RECOMMENDED		
Influenza	• As long as it is available, the quadrivalent influenza vaccine (4V) is preferable to the trivalent influenza vaccine (3V), as it confers greater coverage of the circulating strains. If it is not possible to use the 4V vaccine, use the 3V vaccine. • In the elderly and/or immunocompromised and an epidemiological situation of risk, a second dose may be considered, starting three months after the annual dose. • If the composition of the available vaccine is consistent with the circulating viruses, it may be recommended to international travelers to the northern hemisphere and/or Brazilians residing in the northern states of the country in the pre-season influenza period. • Recommend from 6 months of age, according to SBIm calendars for each age group.	YES – in the UBS and CRIE: 3V vaccine. NO – 4V vaccine.
Conjugated pneumococcal (VPC10 or VPC13)	• Whenever possible, use VPC13. • Children: vaccinate as early as possible from 2 months of age (the number of doses will depend on the age at which you start vaccination). See the SBIm child vaccination schedule. • Children between 12 and 23 months who did not receive PCV13, even if adequately vaccinated with PCV10: two doses of PCV13, two months apart. • Children from 2 years, adolescents, adults, and the elderly not vaccinated with PCV13: one dose of VPC13.	SIM – PCV10 in the UBS and CRIE: for children up to 6 months of age, three doses and reinforcement in the second year of life are available (3 + 1 regimen). For children 7 months to 4 years of age, not previously vaccinated, the dose schedule will depend on the age of vaccination initiation. YES – in the CRIE: PCV13 for ≥ 5 years of age with neoplasia, not previously vaccinated with PCV10.
Pneumococcal polysaccharide 23-valent (PPV23)	From 2 years of age: two doses with an interval of five years between them. If the second dose of PPV23 was given before 60 years of age, a third dose is recommended after that age, with a minimum interval of five years from the last dose.	YES – in the CRIE: two doses
Notes for VPC13 and VPP23 sequential schema 1. Always start a regimen with the conjugate vaccine (PCV13), followed by the application of the VPP23 vaccine, respecting the minimum interval of two months between them. 2. For individuals who have already received VPP23 and were not previously vaccinated with PCV13, an interval of 12 months is recommended for the application of PCV13 and five years for the application of the second dose of VPP23, with a minimum interval of two months between the conjugate and polysaccharide vaccines.		
Inactivated herpes zoster (VZR)	• Recommended from 18 years for immunosuppressed: two doses (0 - 2 months) and a minimum interval of one month can be used. • Recommended for patients who have already had the disease and for those previously vaccinated with the	NO

	attenuated vaccine, respecting a minimum interval of two months between them. • Recommended for previously vaccinated with VZA, respecting a minimum interval of two months between them. • When possible, administer the vaccine before the start of chemotherapy, treatment with immunosuppressants, radiotherapy, or splenectomy. If time is not available, vaccinate at the best time for the patient, when the most intense immunosuppression has ceased. • Patients using monoclonal antibodies (anti-B cells, such as rituximab, for example): the vaccine should be administered at least four weeks before the next dose.	
Conjugated meningococcal (MenC or MenACWY)	• Whenever possible, use the ACWY meningococcal conjugate vaccine. • Children and adolescents: recommend according to the SBIm calendars for each age group. • For never-vaccinated adults: one dose. If immunosuppressed, two doses are two months apart. • In force and for as long as immunosuppression lasts: one booster dose every five years. • Patients with paroxysmal nocturnal hemoglobinuria (PNH) over 14 years of age who will start treatment with eculizumab: Two doses of Meningo ACWY up to two weeks before starting therapy and booster every three years.	YES – in the UBS: MenC for children under 5 years old. Men ACWY for 11- and 12-year-olds. YES – in CRIE: MenC. Booster every 5 years as long as immunosuppression persists. Men ACWY for those over 14 years of age with PNH who will start treatment with eculizumab. Reinforcement every three years.
Meningococcal B	• Children and adolescents: recommend according to the SBIm calendars for each age group. • Adults up to 50 years: two doses with an interval of one to two months between them. Above this age group, the use is off-label.	NO
Hepatitis A	Recommend according to the SBIm calendars for each age group.	YES – in the CRIE: two doses
Hepatitis B	• Four doses: 0 - 1 - 2 - 6 months, with twice the recommended volume for the age group. • Required to request serology for hepatitis B 30 to 60 days after the last dose of the regimen. It is considered immunized if Anti HBs = or >10 mIU/mL. If serology is negative, repeat the four-dose vaccination schedule with doubled volume, only once.	YES – CREATE US
HPV	Three doses: 0 - 1 to 2 - 6 months. A three-dose regimen is mandatory for immunosuppressed people, even between 9 and 14 years.	YES – in CRIE: three doses from 9 to 45 years for both sexes, for neoplasms. Three doses from 9 to 26 years of age on immunosuppressive drugs depending on the underlying disease.
THE DOSES OF VACCINES APPLIED DURING IMMUNOSUPPRESSIVE TREATMENTS MAY BE REPEATED AFTER DISCONTINUATION OF TREATMENT AND IMMUNOCOMPETENT PATIENT.		
CONSIDERATIONS FOR THE USE OF OTHER VACCINES ARE RECOMMENDED IN THE CALENDARS FOR EACH AGE GROUP		
The immunocompromised patient is considered to be at high risk for vaccine-preventable infections and, therefore, all vaccines on the calendars of each age group are highly recommended for him. Some contraindicated vaccines in the presence of severe immunosuppression can preferably be applied three to four weeks before the start of treatment: BCG, rotavirus, SCR, SCR-V***, chickenpox, herpes zoster, and yellow fever. When this is not possible, a minimum interval of 15 days needs to be respected.		
Inactivated polio	Recommend according to the SBIm child's vaccination schedule.	YES – in the BHU the first three doses of the first year of life. YES – CREATE

		reinforcements at 15 months and 4 years.
Triple bacterial (DTPw or DTPa) and its combinations, OR triple bacterial of the adult type (dTpa and dTpa-VIP) OR double adult (dT)	Recommend according to the SBIm calendars for each age group.	YES – in the CRIA DTPa for children under 7 years of age with neoplasia.
Haemophilus influenza b	Recommend according to the SBIm calendars for each age group.	YES – in the UBS for children under 5 years of age. YES – in the CRIE.
CONTRAINDICATED VACCINES		
In the presence of severe immunosuppression, live attenuated vaccines are contraindicated: BCG, rotavirus, oral polio (PWV), yellow fever, MMR, chickenpox, MMR-V, and dengue. If a moderately immunocompromised patient is, evaluate clinical parameters and epidemiological risk for decision-making for the recommendation of yellow fever, MMR, MMR-V, and chickenpox vaccines.		
VACCINATION OF HOUSEHOLD COHABITANTS		
It is highly recommended and should follow vaccination schedules for each age group. The CRIA makes influenza, chickenpox, and MMR vaccines available to susceptible cohabitants of immunocompromised patients. The oral polio vaccine (PWV) is contraindicated for those living with immunocompromised people – when protection for this disease is recommended, it should be replaced by the inactivated polio vaccine (VIP).		
MINIMUM INTERVALS BETWEEN IMMUNOSUPPRESSIVE DRUGS AND VACCINES – See Table 4.		

*Availability follows the standards contained in the Manual of CRIA (Reference Centers for Special Immunobiologicals), available at: http://portalarquivos2.saude.gov.br/images/pdf/2019/dezembro/11/manual-centros-referencia-imunobiologicos-especiais-5ed.pdf
** Basic Health Unit
SCR (measles, mumps, and rubella) and SCR-V (measles, mumps, rubella, and chickenpox

Source: SBIm (2022, p.26-27).

3.2.2 Vaccination in people with a history of cancer after completion of cancer treatment

Since some vaccines are not indicated to be applied during treatment, as was pointed out in the previous chapter, it is important to maintain the vaccination schedule of people after cancer treatment, following the same objective of preventing infectious diseases.

In the same way that to apply the vaccines in people with a history of cancer in active treatment there are peculiarities, for the application after the completion of the treatment there are also some specificities that must be considered.

Cancer patients who are in remission can receive live and inactivated vaccines as long as they wait for the three-month interval from the end of chemotherapy treatment. Already, for patients who have undergone treatment with targeted anti-B cell therapy (rituximab, alemtuzumab) it is necessary to wait six months before being vaccinated. (ATAGI, 2018; AMMAR, SAADDI, CRIVALARO, et al., 2018).

After immunosuppressive treatment, when the immune system is established, the vaccination schedule indicated by the PNI and SBIm is followed, according to each age group. Vaccination schedules for adults and the elderly, according to SBIm (SBIm, 2021/2022a; SBIm, 2021/2022b).

The vaccination of women with a history of cancer who become pregnant after the completion of treatment requires specific care with viable vaccines of application. If it has the immune system

recovered, it follows the pregnant woman's calendar proposed by SBIm, which brings as recommended vaccines Dtpa, Dt, Hepatitis B, and Influenza. The vaccines indicated are MMR, HPV, Chickenpox, Dengue, and Yellow Fever. (SBIm, 2021/2022c). This can be seen in Chart 2.

TABLE 2 - SBIM PREGNANT VACCINATION SCHEDULE (2021/2022).

VACCINES	**SCHEMES AND RECOMMENDATIONS**		**COMMENTS**	**AVAILABILITY OF VACCINES**	
				Free at UBS*	**Private vaccination clinics**
ROUTINE					
Triple acellular bacterial of the adult type (diphtheria, tetanus, and pertussis) – Tdap or dTpa-VIP Double adult (diphtheria and tetanus) – dT	**Vaccination history**	**Conduct during pregnancy**	Tdap is recommended in all pregnancies because, in addition to protecting the pregnant woman and preventing her from transmitting *Bordetella pertussis* to the newborn, it allows the transfer of antibodies to the fetus, protecting it in the first months of life until it can be immunized. Unvaccinated women in pregnancy should be vaccinated in the puerperium as early as possible. If Tdap is not available, it can be replaced by Tdap-VIP, leaving the prescription at the doctor's discretion.	YES, dT and dTpa	YES, dTpa and dTpa-VIP
	Previously vaccinated, with at least three doses of vaccine containing the tetanus component.	A dose of Tdap from the 20th week of gestation.			
	In pregnant women with incomplete vaccination having received a dose of vaccine containing the tetanus component.	One dose of dT and one dose of Tdap, and Tdap should be applied from the 20th week of gestation. Respect a minimum interval of one month between them.			
	In pregnant women with incomplete vaccination having received two doses of vaccine containing the tetanus component.	A dose of Tdap from the 20th week of gestation.			
	In unvaccinated pregnant women and/or unknown vaccination history.	Two doses of dT and one dose of Tdap,			

		and Tdap should be applied from the 20th week of gestation. Respect a minimum interval of one month between them.			
Hepatitis B	Three doses, in the scheme of 0 - 1 - 6 months.		The hepatitis B vaccine should be given to pregnant women who have not previously been vaccinated and are susceptible to infection.	YES	NO
Influenza (flu)	Single annual dose. In an epidemiological situation of risk, especially for immunocompromised pregnant women, a second dose may be considered from 3 months after the annual dose.		Pregnant women are at risk for complications of influenza virus infection. The vaccine is recommended in the months of the seasonality of the virus, even in the first trimester of pregnancy. Since available, the influenza 4V vaccine is preferable to the influenza 3V vaccine, as it confers greater coverage of the circulating strains. If it is not possible to use the 4V vaccine, use the 3V vaccine. If available, the vaccine used in the last season in the northern hemisphere may be recommended to international and Brazilian travelers residing in the northern states of the country, in the pre-gestational period of influenza.	YES, 3V	YES, 3V and 4V
Covid-19	Access the updated data on the availability of vaccines and the groups covered by the PNI at: sbim.org.br/covid-19				
RECOMMENDED IN SPECIAL SITUATIONS					
Hepatitis A	Two doses, in the scheme of 0 - 6 months.		It is an inactivated vaccine, therefore without theoretical risk to the pregnant woman and the fetus. Since in Brazil situations of risk of exposure to HAV are frequent, vaccination should be considered.	NO	YES
Hepatitis A and B	For children under 16 years: two doses, at 0 - 6 months. From 16 years: three doses, at 0 - 1 - 6 months.		The combination vaccine is an option and can replace the isolated vaccination of hepatitis A and B.	NO	YES
Pneumococcal	A sequential regimen of PCV13 and VPP23 can be done in pregnant women at risk		VPC13 and VPP23 are inactivated vaccines, therefore without	NO	YES

	for invasive pneumococcal disease (ILD) (see SBI vaccination schedules for special patients).	theoretical risks for the pregnant woman and the fetus.		
Meningococcal conjugates ACWY or C	One dose. Consider its use by evaluating the epidemiological situation and/or the presence of comorbidities considered at risk for meningococcal disease (see the SBI vaccination calendars for special patients).	Meningococcal conjugate vaccines are inactivated, therefore without theoretical risk to the pregnant woman and the fetus. In the unavailability of the meningococcal conjugate vaccine ACWY, replace it with the meningococcal C conjugate vaccine.	NO	YES
Meningococcal B	Consider its use by evaluating the epidemiological situation and/or the presence of comorbidities considered to be at high risk for invasive meningococcal disease (AMD). See the *SBI vaccination calendars for special patients*. Two doses with a minimum interval of 1 month (Bexsero®) or 6 months (Trumenba®).	Meningococcal B vaccines are inactivated, therefore without theoretical risk to the pregnant woman and the fetus. Bexsero® licensed until the age of 50. Trumenba® licensed until the age of 25. The two vaccines are not interchangeable.	NO	YES
Black vomit	Usually contraindicated in pregnant women. However, in situations where the risk of infection outweighs the potential risks of vaccination, it can be done during pregnancy. **PNI recommendation**: if you received the first dose before the age of 5, a second dose is indicated. If applied from 5 years of age in a single dose. **SBIm recommendation**: as there is no consensus on the duration of protection conferred by the vaccine; according to the epidemiological risk, a second dose at other ages may be considered for the possibility of vaccine failure.	Pregnant women traveling to countries that require the International Certificate of Vaccination and Prophylaxis (CIVP) should be exempted from vaccination by the attending physician if there is no risk of contracting the infection. It is contraindicated in nursing mothers until the baby turns 6 months; If vaccination cannot be avoided, suspend breastfeeding for ten days.	YES	YES
CONTRAINDICATED				
MMR (measles, mumps, and rubella)	Do not vaccinate during pregnancy.	It can be applied in the puerperium and during breastfeeding.	YES, for postpartum women up to 59 years old	YES, for postpartum and lactating women

HPV	Do not vaccinate during pregnancy. If the woman has started the scheme before pregnancy, suspend it until puerperium.	It can be applied in the puerperium and during breastfeeding.	NO	YES, for postpartum and lactating women
Chickenpox (chickenpox)	Do not vaccinate during pregnancy.	It can be applied in the puerperium and during breastfeeding.	NO	YES, for postpartum and lactating women
Dengue fever	Do not vaccinate during pregnancy.	The vaccine is contraindicated in women seronegative for dengue; who are breastfeeding and immunodepression.	NO	NO

Source: SBIm (2021/2022c, p.1).

In people who have undergone hematopoietic stem cell transplantation (HSCT), inactivated vaccines can be applied after 6 months of transplantation, while for attenuated vaccines, one must wait 24 months to start revaccination. There are some exceptions to these deadlines such as the combined vaccine Hepatitis A and B can be used, if it facilitates the revaccination schedule (three-dose schedule at 11-12-17 months after transplantation), the MMR if epidemiological risk and immunological situation allow, can be applied from 12 months, otherwise wait 24 months. PPV23 two months after the last dose of PCV13. Influenza can be applied 3 to 4 months after transplantation. These vaccines are available in CRIES or private clinics. (SBIm 2021-2022d). This can be seen in Chart 3.

In the presence of conditions such as the use of immunosuppressants, graft-versus-host disease (GVHD), use of an anti-CD20 monoclonal antibody in the last 6 months, recent use of immunoglobulin, the most appropriate period to initiate revaccination should be reconsidered. (SBIm 2021-2022d).

Although not all vaccines are available in the Basic Health Units (BHU), considering the needs of each patient, health professionals should check the availability of vaccines at the Reference Center for Special Immunobiologics (CRIE), or advise on the availability of private vaccination clinics.

The Brazilian Society of Immunization SBIm (2022) highlights that every individual should be up to date with the vaccines recommended according to the vaccination schedule for their age group, and presents in detail the specificities related to the vaccination of special patients. This can be seen both in Chart 1 and also in Tables 3 and 4.

TABLE 3 - VACCINATION OF PEOPLE TRANSPLANTED WITH HEMATOPOIETIC STEM CELLS.

VACCINES	OUTLINES/RECOMMENDATIONS	AVAILABILITY IN CRIE* and/or UBS**
VACCINES ESPECIALLY RECOMMENDED		
Influenza	• As long as it is available, the quadrivalent influenza vaccine (4V) is preferable to the trivalent influenza vaccine (3V), as it confers greater coverage of the circulating strains. If it is not possible to use the 4V vaccine, use the 3V vaccine. • In the elderly and/or immunocompromised and an epidemiological situation of risk, a second dose may be considered, starting three months after the annual dose. • If the composition of the available vaccine is consistent with the circulating viruses, it may be recommended to international travelers to the northern hemisphere and/or Brazilians residing in the northern states of the country in the pre-season influenza period.	YES – in the UBS and CRIE: 3V vaccine. NO – 4V vaccine.
13-valent conjugated pneumococcal (PCV13)	Children from 1 year of age, adolescents, adults, and the elderly: use VPC13, three doses with an interval of two months (minimum of 30 days).	YES – in the UBS and CRIE: VPC10 for children under 5 years of age. YES – in CRIE: VPC13 for ≥ 5 years old.
Pneumococcal polysaccharide 23-valent (PPV23)	From 2 years of age: two doses with an interval of five years between them. If the second dose of PPV23 was given before 60 years of age, a third dose is recommended after that age, with a minimum interval of five years from the last dose.	YES – in the CRIE: two doses
Notes for VPC13 and VPP23 sequential schema 1. Always start a regimen with the conjugate vaccine (PCV13), followed by the application of the VPP23 vaccine, respecting the minimum interval of two months between them. 2. For individuals who have already received VPP23 and were not previously vaccinated with PCV13, an interval of 12 months is recommended for the application of PCV13 and five years for the application of the second dose of VPP23, with a minimum interval of two months between the conjugate and polysaccharide vaccines.		
Inactivated herpes zoster (VZR)	• For over 18 years: two doses with an interval of two months (0-2 months). • Administer the VZR vaccine six months after transplantation.	NO
Haemophilus influenza b	Three doses, two months apart (minimum 30 days), at any age. If under 1 year of age, do the booster	YES – in the UBS for children under 5 years of age. YES – in the CRIE.
Conjugated meningococcal (MenC or MenACWY)	• Whenever possible, use the ACWY meningococcal conjugate vaccine. • Children under 1 year: recommend according to SBIm child's vaccination schedule. • For over 1 year, adolescents and adults: two doses with an interval of two months between them. • Do booster every five years as long as immunosuppression persists.	YES – in the UBS: MenC for children under 5 years of age and MenACWY for adolescents aged 11 and 12 years. Yes – in CRIE: MenC, two doses. A booster after 5 years.
Meningococcal B	Children and adolescents: Recommend according to the SBIm calendars for each age group. • Adults up to 50 years: two doses with an interval of one to two months between them. Above this age group, the use is off-label.	NO
Inactivated polio	Three doses with an interval of two months between them (minimum of 30 days).	YES – CREATE US
Hepatitis A	Recommend according to the SBIm calendars for each age group.	YES – in the BHU: single dose for children under 5 years of age. YES – in CRIE: two doses.

Hepatitis B	• Three doses: 0 - 1 - 6 months. • Required to request serology for hepatitis B 30 to 60 days after the last dose of the regimen. It is considered immunized if Anti HBs = or >10 mIU/mL. If serology is negative, repeat the three-dose vaccination schedule once.	YES – in UBS and CRIA
HPV	Three doses: 0 - 1 to 2 - 6 months. A three-dose regimen is mandatory for immunosuppressed people, even between 9 and 14 years.	YES – CREATE three doses from 9 to 45 years, for both sexes.
Acellular bacterial triplet (aPTD) or adult type acellular bacterial triplet (tdap) and their combinations and adult type double (tDt)	The acellular MMR vaccine (aPTD and its combinations) is preferable in children because it causes fewer reactions than the whole-cell vaccine (DTPw). • For ages 3 and up, the Tdap and Tdap-VIP vaccine is an option. • For over 7 years, adolescents, adults, and the elderly, the recommended vaccine is the acellular MMR of the adult type (Tdap). • The dT vaccine is recommended for those older than 7 years in a sequential Tdap vaccine schedule. • After the basic dose schedule for each age group, make a booster with Tdap (preferably) or dT every 10 years.	YES – in the UBS and CRIE: dT for over 7 years of age. YES – in the CRIE: DTPa for children under 7 years old and Tdap from 7 years old.
Black vomit	From 24 months after transplantation, in the absence of GVHD and AFTER IMMUNE RECONSTITUTION, Recommend according to the SBIm calendars for each age group.	YES – in UBS and CRIA
MMR	• From 24 months after transplantation, in the absence of GVHD and AFTER IMMUNE RECONSTITUTION, Recommend according to the SBIm calendars for each age group. • The MMR vaccine is contraindicated in the first 12 months after transplantation. Between 12 and 24 months can be considered by the doctor, in a situation of epidemiological risk and provided that the individual immunological situation allows. • In case of rejection after the procedure or need for immunosuppressive therapy, vaccination is also contraindicated.	YES – in UBS and CRIA
Chickenpox	From 24 months after transplantation, in the absence of GVHD and AFTER immunological reconstitution, vaccinate the susceptible with two doses. If it is impossible to perform serology, consider susceptible and vaccinate.	YES – in the UBS for children under 7 years of age. YES – in the CRIE.
CONSIDERATIONS FOR THE USE OF OTHER VACCINES ARE RECOMMENDED IN THE CALENDARS FOR EACH AGE GROUP		
Vaccines given during treatment with immunosuppressants should be repeated after discontinuation of treatment and immunocompetent patient.		
Inactivated vaccines: start vaccination preferably six months after transplantation, being able to anticipate, depending on the clinical and laboratory conditions of the patient.		
Live attenuated vaccines (yellow fever, MMR or tetraviral, chickenpox, herpes zoster, and dengue): start vaccination two years after bone marrow progenitor cell transplantation, after immune reconstitution, except in the case of GVHD.		
CONTRAINDICATED VACCINES		
In the presence of severe immunosuppression, live attenuated vaccines are contraindicated: BCG, rotavirus, oral polio (PWV), yellow fever, MMR, chickenpox, MMR-V, and dengue. If the moderately immunocompromised patient is, evaluate clinical parameters and epidemiological risk for decision-making for the recommendation of yellow fever, MMR, MMR-V, and chickenpox vaccines.		
VACCINATION OF HOUSEHOLD COHABITANTS		
It is highly recommended and should follow vaccination schedules for each age group. The CRIA makes influenza, chickenpox, and MMR vaccines available to susceptible cohabitants of immunocompromised patients. The oral polio vaccine (PWV) is contraindicated for those living with immunocompromised people – when protection for this disease is recommended, it should be replaced by the inactivated polio vaccine (VIP).		
MINIMUM INTERVALS BETWEEN IMMUNOSUPPRESSIVE DRUGS AND VACCINES – See Table 4.		

*Availability follows the standards contained in the Manual of CRIA (Reference Centers for Special Immunobiologicals), available at: http://portalarquivos2.saude.gov.br/images/pdf/2019/dezembro/11/manual-centros-referencia-imunobiologicos-especiais-5ed.pdf

** Basic Health Unit.

Source: SBIm (2022, p.30-31).

CHART 4 - USE OF DRUGS THAT CAN CAUSE IMMUNOCOMPROMISE AND INTERVAL BETWEEN DISCONTINUATION OF TREATMENT AND APPLICATION OF ATTENUATED VACCINES.

Drugs	Immunosuppressive dose	Vaccination interval
Corticosteroids (Prednisone or equivalent)	≥2 mg/kg/day or ≥20 mg/day for more than two weeks	One month
Methotrexate	≥ 0.4 mg/kg/week; ≥20 mg/day	One to three months
Leflunomide	0.25 - 0.5 mg/kg/day; ≥20 mg/day	When serum levels are below 0.02 mg/L
Sulfasalazine and hydroxychloroquine	–	None
Mycophenolate mofetil	3 g/day	Three months
Azathioprine	1-3 mg/kg/day	Three months
Cyclophosphamide	0.5 - 2.0 mg/kg/day	Three months
Cyclosporine	> 2.5 mg/kg/day	Three months
Tacrolimus	0.1 to 0.2 mg/kg/day	Three months
6-mercaptopurine	1.5 mg/kg/day	Three months
Biological: anti-cytokines and T lymphocyte costimulation inhibitors		Three months, a minimum of five half-lives, or whatever is less
Biologics depleting B lymphocytes		Six months
Synthetic target-specific: JAK inhibitors (Tofacitinib)		Two weeks
OBSERVATIONS: 1. Vaccinate preferably before immunosuppression. Inactivated vaccines should be given at least 14 days before initiation of immunosuppressive therapy and live vaccines attenuated ideally four weeks before. If it is not possible to wait, keep a minimum interval of two weeks. 2. Babies of women who used biologics during pregnancy: live attenuated vaccines can be applied after 6 to 8 months of age.		

Source: SBIm (2022, p.32).

3.3 PERFORMANCE OF NURSING AND OTHER HEALTH PROFESSIONALS IN THE VACCINATION OF PEOPLE WITH CANCER

Nursing has a role to be played in the vaccination room, which involves the definition of actions that are under their responsibility aiming at the control and/or eradication of preventable diseases by immunizers. In addition, it is up to Nursing to correctly execute the policy that deals with the conservation of immunobiological's, with correct administration and preparation of vaccines. Adopting conducts to be followed in the face of adverse effects, filling out the forms, in addition to continuing education for professionals, are actions that are also part of the performance of the role of Nursing in the vaccination room. (MARINELLI; OAK; ARAÚJO, 2015, p.27).

The role of health professionals in disseminating the benefits associated with vaccination is one of the most important, and this contributes to ensuring health and quality of life for society. (APS et al., 2018).

Fonseca et al. (2021) highlight that Nursing has an important role in immunization due to its participation in health education and information. However, they reveal that the little interest in the subject or the non-recognition of the importance of vaccination of cancer patients as an object of nursing work, results in publications carried out by other areas of knowledge.

Considering the above, it is extremely important that nurses, professionals responsible for coordinating the Basic Health Unit, the vaccination room, and for the training of the other professionals who work there, have knowledge about the peculiarities of vaccination in people with a history of cancer and that training on the subject is carried out frequently.

Immunizing health professionals is essential since they act directly and/or indirectly with microorganisms with the potential to cause infections. These infections can have implications not only for individual professionals but also for institutions and clients. (SANTOS, et al., 2010).

Among the vaccines for health professionals, recommended by Sbim, are: MMR, hepatitis B, hepatitis A, acellular MMR of the adult type (Tdap), chickenpox, influenza, meningococcal conjugate ACWY or C, and Covid-19. (SBIM, 2022/2023).

Health professionals can increase vaccination coverage by improving their knowledge on the subject, including in the anamnesis the review of the vaccination schedule, as well as providing basic information about vaccines in the waiting room, clarifying all doubts and informing about expected adverse effects, identifying possible risks and contraindications, having redoubled attention with patients in special situations (immunosuppressed) and their contacts and remembering about future doses. (SBIm, 2018).

Considering the PNI, it is also possible to establish partnerships with civil societies, universities, and schools, expand the training of professionals working in vaccine rooms, expand the vaccination of workers, establish house-to-house vaccination strategies, extend the operation of vaccination units, and increase the training and performance of community health agents. (SBIm, 2018).

4 FINAL CONSIDERATIONS

In addition to primary care services, oncology services must consider the insertion of protocols aimed at the immunization of cancer patients, to reduce the possibility of illness and complications due to vaccine-preventable diseases.

There is a need to reassess the actions taken by health services and professionals because of the low vaccination coverage for special patients. Strategies may increase adherence to vaccination, among them are the involvement of professionals from different levels of health care in the referral of this population for vaccination; re-evaluation and implementation of specific protocols for this population in both primary care and high complexity; expansion of active searches and continuous professional training.

The results of this research can bring contributions to teaching through the training of future professionals better qualified to work in the vaccination of people with a history of cancer, as well as

to research aimed at instigating nursing for the development of new studies on vaccination, contributing to the expansion of knowledge. It can also contribute to professional practice so that professionals working in high-complexity oncology services and those working in primary care can reassess and implement new strategies to expand the vaccination coverage of this population.

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