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# Vaccine hesitancy in patients with solid tumors: a cross-sectional single-center survey

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## Abstract

**Background** Vaccination rates are still suboptimal in cancer patients. Oncologists play a central role in recommending vaccines to their patients. Our goal was to investigate vaccine acceptance among cancer patients and understand the factors shaping their choices, thereby aiding physicians in better supporting their patients' vaccination decisions.

**Methods** We designed a prospective cross-sectional survey exploring vaccination status, attitudes, and reasons for hesitancy towards vaccinations against the main vaccine preventable diseases (VPDs) among patients undergoing active cancer treatment. The primary endpoint was to evaluate the proportion of vaccinated subjects in our cohort of cancer patients. The secondary endpoints were to assess the proportion of vaccinated subjects against different types of VPDs: flu, COVID-19, pneumococcal disease, Herpes Zoster (HZ).

**Results** Between 12 February and 01 March 2024, a total of three hundred and seventeen patients with cancer were invited to respond to the survey, 309 of whom (97%) agreed to do it. Two hundred seventy-three patients (0.88, 95% confidence interval [CI] 0.84–0.91) had received at least one vaccination. Two hundred thirty-one patients (74.76%) reported that at their first oncology visit their oncologist recommended vaccinations, primarily anti-flu (92.21%) and anti-SARS-CoV-2 (83.55%) vaccinations, while less frequently the anti-pneumococcal (42.42%) and anti-HZ (37%) vaccines were recommended. On the univariate analysis, age over 75 years ( $p=0.041$ ), marital status ( $p=0.003$ ) and the oncologist's vaccine recommendation during the first visit ( $p<0.001$ ) were significantly associated to vaccine acceptance. At the multivariable analysis, these variables were independently associated with vaccine willingness. Overall in our cancer population, the two main reasons for vaccine hesitancy were the lack of recommendation by the oncologist (55.41%,  $n=128$ ) and the lack of awareness of the importance of vaccination in the context of oncological care (49.35%,  $n=114$ ).

**Conclusions** This survey emphasizes the importance of vaccine counseling by the oncologist to their patients. Oncologists can motivate patients to receive the correct vaccine schedule by addressing doubts and concerns about the potential negative impact of the vaccine on cancer and cancer therapies.

**Keywords** Vaccine hesitancy, COVID-19, RZV, Influenza, Pneumococcal vaccine, Cancer, Supportive care

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## Background

The impairment of the immune system due to cancer itself and oncological therapies is a risk factor for the development of vaccine-preventable diseases (VPDs) [1]. Moreover, when infected, the patients with cancer often have to suspend/delay their oncological treatments and are more at risk of hospitalization, even prolonged [2]. Despite this, vaccination rates are still suboptimal [3].

Vaccine hesitancy is a complex phenomenon influenced by socio-demographic and attitudinal factors that cause “a delay in acceptance or refusal of vaccination despite the availability of vaccination services” [4]. In 2019 the World Health Organization (WHO) declared it as one of the top threats to global health [5]. It is also an issue in patients with cancer, albeit to a lesser extent than in the general population [6]. However, the decision-making implication of a cancer diagnosis on vaccination needs to be further explored. Oncological patients are apprehensive about the impact of vaccines on cancer itself and the possibility of interactions with cancer therapies [7, 8].

Oncologists play a central role in recommending vaccines to their patients, explaining their importance, and dispelling doubts and fears. The Italian Association of Medical Oncology (AIOM) has been involved in promoting recommendations about vaccination for more than ten years. It takes forward the mission of promoting vaccinations of major VPDs such as seasonal flu [9, 10], pneumococcal disease [10, 11], COVID-19 [10], and herpes zoster (HZ) [12]; however, there is still a long road to go.

The first survey conducted among Italian oncologists highlighted that only one-third of the respondents discuss vaccinations with patients at their first oncological visit, while slightly less than half (41%) are not aware of the main vaccines and/or do not consider it their duty to discuss vaccinations with patients [13].

To enhance physicians' approach to vaccination discussions with cancer patients, we aimed to assess vaccine acceptability and investigate the determinants influencing their choices. Our ultimate goal is to implement strategies that effectively address vaccine hesitancy.

## Methods

### Purpose/aim

The objective of this survey was to assess the vaccination status against the main VPDs and analyze attitudes towards vaccines in patients with cancer undergoing active cancer treatment in our referral center.

The primary endpoint was to evaluate the proportion of vaccinated subjects in our cohort of cancer patients undergoing active cancer treatment (number of patients who received at least one vaccine/ total number of patients).

The secondary endpoints were: (I) to assess the proportion of vaccinated subjects with the anti flu vaccine in our cohort of cancer patients undergoing active cancer treatment (number of patients who received anti flu vaccine/ total number of patients); (II) to assess the proportion of vaccinated subjects with anti SARS-CoV-2 vaccine in our cohort of cancer patients undergoing active cancer treatment (number o. patients who received anti SARS-CoV-2 vaccine/ total number of patients); (III) to assess the proportion of vaccinated subjects with anti pneumococcal vaccine in our cohort of cancer patients undergoing active cancer treatment (number of patients who received anti pneumococcal vaccine/ total number of patients); (IV) to assess the proportion of vaccinated subjects with anti HZ vaccine in our cohort of cancer patients undergoing active cancer treatment (number of patients who received anti HZ vaccine/ total number of patients); (V) to assess which variables (sex, age, degree of education, marital state, comorbidities, type of tumor, type of oncological treatment) were associated with not willingness to receive vaccines (anti flu, anti SARS-CoV-2, anti pneumococcal, anti HZ).

### Study design

We conducted a cross-sectional survey exploring vaccination status, attitudes, and reasons for hesitancy towards vaccinations against the main VPDs among patients undergoing active cancer treatment. The conduct and reporting of the study adhered to the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) [14]. Patients from the AMOS patient association (Amici dell'Oncologia del San Matteo) were involved in drafting the survey items to identify poorly intelligible expressions and survey items.

### Data collection methods

The survey was divided into three sections. The first set of questions collected the demographic, training, and employment details of respondents (Q1-Q9), and the second one included general questions about attitudes toward specific vaccine types for cancer patients (Q10-Q15). The third part reported specific questions focused on the main vaccines and the reasons why the patient did not want to receive the vaccines (Q18-Q23). Closed (multiple-choice, with either single or multiple permitted answers) questions were included (see Additional file 1). The paper version of the survey was given to the patients in the oncology outpatient room. Patients who agreed to answer the survey completed questions anonymously. Along with the survey, written information about the study was provided, and informed consent was obtained.

### Sample characteristics

The population of this cross-sectional survey included consecutive out-patients treated in the Medical Oncology Unit, Fondazione IRCCS Policlinico San Matteo Pavia, from 12 February to 01 March 2024.

The target group included patients meeting the following criteria: I) >18 years of age; II) oncology patient defined as a patient with solid tumors undergoing active systemic treatment or undergoing follow-up; III) written informed consent.

The exclusion criteria were: (I) patients with hematological tumors; (II) patients who were unable to understand informed consent documents.

To avoid only patients more aware of vaccinations answering the survey (selection bias), while the others refused to answer, the oncologist carefully explained the importance of answering the survey to improve the quality of care. The closed form of the survey items reduced the information bias.

### Statistical analysis

All analyses are performed using the Stata software (release 18, StataCorp, College Station, TX, USA). A 2-sided  $p$ -value < 0.05 is considered statistically significant.

Counts and percent are used to describe categorical variables, median and quartiles for continuous variables. The proportion of vaccinated patients is reported together with its exact binomial 95% confidence interval (95%CI). The association of patients characteristics and the willingness to be vaccinated is evaluated using the Fisher exact test. A multivariable logistic model was fitted to assess the independent association of patients' characteristics and vaccine willingness. The model area under the ROC curve and model calibration were assessed.

We planned to enroll at least 150 patients, based on feasibility. With this sample size, the precision of the estimate of the primary endpoint is at worst  $\pm 8\%$  (corresponding to a proportion of 0.5). The precision is measured as half the 95%CI of the estimate.

### Ethical considerations

The study was approved by the Comitato Etico Territoriale Lombardia 6 (P-3736/24) on 19 January 2024. Written consent was obtained from all patients.

## Results

### Demographic, training and employment details of respondents (Q1-Q9)

Between 12 February and 01 March 2024, a total of three hundred and seventeen patients with cancer were invited to respond to the survey, 309 of whom (97%) agreed to do it. The median age of the respondents was 67 years (interquartile range [IQR] 59–76 years). 50.49% of respondents

( $n=156$ ) were female and 49.51% ( $n=153$ ) were male. The most common cancer was breast cancer (27.18%) and the most common treatment was chemotherapy (51.85%). Table 1 describes the demographics and employment details of respondents.

### General questions focused on vaccination (Q10-Q15)

At the time of completing the survey, 273 patients (0.88, 95% confidence interval [CI] 0.84–0.91) had received at least one vaccination (primary endpoint). The majority of respondents believe that vaccinations are moderately important (49.51%,  $n=152$ ) or very important (37.46%,  $n=115$ ). Two hundred thirty-one patients (74.76%) reported that at their first oncology visit their oncologist recommended vaccinations, primarily anti-flu (92.21%) and anti-SARS-CoV-2 (83.55%) vaccinations, while the anti-pneumococcal (42.42%) and anti-HZ (37%) vaccines were recommended less frequently. The most important source of information on vaccines is the oncologist for 208 patients (68.09%) and the general practitioner for 202 patients (66.23%), while the internet and mass media are poorly consulted to find information about this issue. Altogether, for 163 patients (52.75%) vaccinations can contribute to optimal oncological management, but the remaining half of the respondents are doubtful about the importance of vaccinations during cancer therapy. Table 2 exposes all the responses to the general questions focused on vaccination.

### Specific questions focused on the main vaccine-preventable diseases (Q16-Q23)

Among the respondents, 252 patients (81.55%) received the anti-flu vaccine, 132 patients (42.72%) received the anti-pneumococcal vaccine, 182 patients (58.9%), and 99 patients (32.04%) received the anti-SARS-CoV-2 and the anti-HZ vaccines, respectively. In the third section, we investigated the reasons why patients did not receive the vaccines listed above. In particular, the respondents who did not receive the anti-influenza vaccination were mainly because they did not consider it essential (49.12%,  $n=28$ ). The main reason for not receiving the anti-pneumococcal vaccination was that no doctor offered them this vaccine (51.41%,  $n=91$ ), while 63 patients (35.59%) did not consider pneumococcal vaccination essential in the case of their oncological disease. In respondents who did not support the anti-SARS-CoV-2 vaccine, 37.5% ( $n=48$ ) did not want to receive the vaccine for fear of adverse events. Finally, 102 patients (48.57%) did not receive the HZ vaccine because it was not proposed by their oncologist. Table 3 illustrates all the different reasons for refusing specific vaccines.

**Table 1** Demographic, training and employment details of respondents

Questions	Respondents, n (%)
<b>Q1 Age</b> , median years (range)	67, (59–76)
<b>Q2 Sex</b>	
Female	156 (50.49%)
Male	153 (49.51%)
Prefer not to answer	0
<b>Q3 Marital status</b>	
Single	27 (8.74%)
Married	192 (62.14%)
Separated/Divorced	43 (13.92%)
Widower	42 (13.59%)
Prefer not to answer	5 (1.62%)
<b>Q4 Education</b>	
Primary school or lower	35 (11.33%)
Junior high	71 (22.98%)
High school	145 (46.93%)
University or higher	58 (18.77%)
<b>Q5 Occupational status</b>	
Part-time worker	19 (6.15%)
Full-time worker	54 (17.48%)
Freelancer	44 (14.24%)
Unemployed	23 (7.44%)
Student	1 (0.32%)
Retired	168 (54.37%)
<b>Q6 Type of cancer</b>	
Lung cancer	69 (22.33%)
Breast cancer	84 (27.18%)
Gastrointestinal cancer	49 (15.86%)
Melanoma	50 (16.18%)
Urogenital cancer	1 (0.32%)
Gynaecological cancer	17 (5.50%)
Head and neck cancer	30 (9.71%)
Others	9 (2.91%)
<b>Q7 Stage tumor</b>	
I/II/III	120 (38.83%)
IV	189 (61.17%)
<b>Q8 Type of oncological treatments (more than one answer was allowed)</b>	
I have not started treatment yet	10 (3.25%)
Chemotherapy	154 (51.85%)
Immunotherapy	122 (40.94%)
Targeted therapy	18 (6.04%)
Radiotherapy	17 (5.70%)
Hormonal therapy	35 (11.74%)
I have completed the therapy and I am doing the follow-up visits	10 (3.37%)
<b>Q9 Comorbidities (more than one answer was allowed)</b>	
None	129 (41.88%)
Hypertension	127 (70.95%)
Cardiac disease	34 (18.99%)
Chronic lung disease	23 (12.85%)
Chronic renal failure	11 (6.15%)
Diabetes Mellitus	37 (20.67%)
Endocrinopathies	23 (12.92%)
Anxiety-depressive syndrome	17 (9.50%)

**Table 2** General questions focused on vaccination (Q10-Q15)

Questions	Respondents, <i>n</i> (%)
<b>Q10. At the time of completing this survey, have you received at least one vaccination?</b>	
Yes	273 (88.34%)
No	36 (11.66%)
<b>Q11. On a scale of 1 to 4 how important do you think vaccinations are if you have cancer? (1-not important; 2-little important; 3-quite important; 4-very important)</b>	
Not important	18 (5.86%)
Little important	22 (7.17%)
Quite important	152 (49.51%)
Very important	115 (37.46%)
<b>Q12. Did your oncologist mention/recommend one or more vaccines at your first oncological visit?</b>	
Yes	231 (74.76%)
No	78 (25.24%)
<b>Q13. If you answered 'Yes', could you specify which vaccine you were offered? (more than one answer was allowed)</b>	
Anti-flu	213 (92.21%)
Anti-pneumococcal	98 (42.42%)
Anti-SARS-CoV-2	193 (83.55%)
Anti-Herpes Zoster	84 (37%)
<b>Q14. Who do you ask for information about vaccines? (more than one answer was allowed)</b>	
Oncologist	207 (68.09%)
General Practitioner	202 (66.23%)
Internet	13 (4.3%)
Mass media	8 (2.66%)
Family	17 (5.72%)
<b>Q15. Do you think that the correct vaccination can help improve the outcome of cancer therapies?</b>	
Yes	163 (52.75%)
No	40 (12.94%)
I don't know	106 (34.30%)

### Global results

Overall in our cancer population, the two main reasons for vaccine hesitancy were the lack of recommendation by the oncologist (55.41%,  $n=128$ ) and the lack of awareness of the importance of vaccination in the context of oncological care (49.35%,  $n=114$ ). On the analysis of the potential correlate of vaccine willingness, age over 75 years ( $p=0.041$ ), marital status ( $p=0.003$ ), and the oncologist's vaccine recommendation during the first visit ( $p<0.001$ ) were significantly associated with vaccine acceptance (Table 4). These variables were independently associated with vaccine willingness at the multivariable analysis. Comorbidities, type of cancer, and type of treatment were not significantly associated with vaccine acceptance.

### Results according to type of vaccine

Tables 5, 6, 7 and 8 report the analyses for each type of vaccines (anti-flu, anti-SARS-CoV-2, anti-pneumococcal disease, and anti-HZ, respectively). The only variable that confirms the statistically significant association for all four vaccines is the oncologist's vaccine counseling ( $p<0.001$ ). The age over 75 years is associated with

vaccine acceptance only for anti-flu and anti-HZ vaccines ( $p=0.004$  and  $p<0.001$ , respectively). Sex is associated with vaccine acceptance only for the anti-SARS-CoV-2 vaccine ( $p=0.006$ ). Finally, comorbidities are statistically associated with vaccine acceptance only for the HZ-vaccine (Tables 5, 6, 7 and 8).

### Discussion

To our knowledge, this is the first survey to investigate the acceptability of four different types of vaccines among cancer patients. In particular, we aimed to investigate the reasons for vaccine hesitancy in patients with cancer for the anti-flu, anti-SARS-CoV-2, anti-pneumococcal, and anti-HZ vaccines concerning the vaccine counseling received from their oncologist. Overall in our cancer population, the two main reasons for vaccine hesitancy were represented by the lack of recommendation by the oncologist and the lack of awareness of the importance of vaccination in the context of oncological care.

41.1% of respondents reported that they did not want to receive the anti-SARS-CoV-2 vaccine. Several studies have examined the reasons for hesitancy of the anti-SARS-CoV-2 vaccine. Compared to the start of the

**Table 3** Specific questions focused on the main vaccine-preventable diseases (Q16–Q23)

Questions	Respon- dents, n (%)
<b>Q16. On a scale of 1 to 4, how important do you think flu vaccination is if you have cancer? (1-not important; 2-little important; 3-quite important; 4-very important)</b>	
Not important	19 (6.23%)
Little important	29 (9.51%)
Quite important	122 (40%)
Very important	135 (44.26%)
<b>Q17. On a scale of 1 to 4, how important do you think anti-SARS-CoV-2 vaccination is if you have cancer? (1-not important; 2-little important; 3-quite important; 4-very important)</b>	
Not important	27 (8.82%)
Little important	50 (16.34%)
Quite important	118 (38.56%)
Very important	111 (36.27%)
<b>Q18. On a scale of 1 to 4, how important do you think anti-pneumococcal vaccination is if you have cancer? (1-not important; 2-little important; 3-quite important; 4-very important)</b>	
Not important	39 (12.75%)
Little important	88 (28.76%)
Quite important	97 (31.70%)
Very important	82 (26.8%)
<b>Q19. On a scale of 1 to 4, how important do you think anti-Herpes Zoster vaccination is if you have cancer? (1-not important; 2-little important; 3-quite important; 4-very important)</b>	
Not important	48 (15.79%)
Little important	109 (35.86%)
Quite important	86 (28.29%)
Very important	61 (20.07%)
<b>Q20. What is the most important reason why you have not had the anti-flu vaccination? (if you have had the flu vaccine, please do not answer)</b>	
I am concerned about the serious side effects of the vaccine	8 (14.04%)
I am concerned that the vaccine interferes with cancer therapies	11 (19.3%)
No one recommended flu vaccination to me	10 (17.54%)
I do not consider flu vaccination essential	28 (49.12%)
<b>Q21. What is the most important reason why you have not had the anti-pneumococcal vaccination? (if you have had the pneumococcal vaccine, do not answer)</b>	
I am concerned about the serious side effects of the vaccine	9 (5.08%)
I am concerned that the vaccine interferes with cancer therapies	14 (7.91%)
No one recommended pneumococcal vaccination to me	91 (51.41%)
I do not consider the pneumococcal vaccination essential	63 (35.59%)
<b>Q22. What is the most important reason why you have not had the anti-SARS-CoV-2 vaccination? (if you have had the SARS-CoV-2 vaccine, please do not answer)</b>	
I am concerned about the serious side effects of the vaccine	48 (37.5%)
I am concerned that the vaccine interferes with cancer therapies	18 (14.06%)
No one recommended SARS-CoV-2 vaccination to me	14 (10.94%)
I do not consider the SARS-CoV-2 vaccination essential	48 (37.5%)
<b>Q23. What is the most important reason why you have not had the anti-Herpes Zoster vaccination? (if you have had the Herpes Zoster vaccine, please do not answer)</b>	
I am concerned about the serious side effects of the vaccine	8 (3.81%)
I am concerned that the vaccine interferes with cancer therapies	14 (6.67%)
No one recommended Herpes Zoster vaccination to me	102 (48.57%)
I do not consider the Herpes Zoster vaccination essential	86 (40.95%)

**Table 4** Evaluation of the proportion of vaccinated subjects according to patients characteristics

	Total (%)	<i>p</i> value*	Multivariable Model <i>P</i> < 0.001 [AUC-ROC 0.87, 95%CI 0.82–0.91; calibration <i>P</i> = 0.649]	<i>p</i> -value
			OR (95%CI)	
<b>Age</b>				0.012
≤ 75 years	199 (86.1%)	<b>0.041</b>	1	
> 75 years	74 (94.9%)		5.13 (1.44–18.25)	
<b>Sex</b>				0.731
Male	134 (87.6%)	0.725	1	
Female	139 (89.1%)		0.85 (0.34–2.11)	
<b>Marital status</b>				<b>0.002</b>
Single	20 (74%)	<b>0.003</b>	1	
Married	177 (92.2%)		7.70 (2.24–26.47)	0.001
Separated/Divorced	32 (74.4%)		1.56 (0.40–6.04)	0.517
Widower	39 (92.9%)		8.88 (1.32–59.88)	0.025
Prefer not to answer	5 (100%)		//	//
<b>Education</b>				0.085
Primary school or lower	32 (91.4%)	0.296	1	
Junior high	58 (81.7%)		1.06 (0.20–5.60)	0.941
High school	130 (89.7%)		3.19 (0.55–18.42)	0.194
University or higher	53 (91.4%)		4.77 (0.69–33.04)	0.114
<b>Comorbidities</b>				0.996
No	110 (85.3%)	0.208	1	
Yes	162 (90.5%)		1.00 (0.41–2.45)	
<b>Stage of tumor</b>				0.854
I/II/III	104 (86.7%)	0.472	1	
IV	169 (89.4%)		1.09 (0.44–2.70)	
<b>Oncologists' vaccine recommendation during the first oncological visit</b>				<b>&lt; 0.001</b>
Yes	221 (95.7%)	<b>&lt; 0.001</b>	1	
No	52 (66.67%)		0.07 (0.23–17.37)	

vaccination campaign against COVID-19, this percentage of patients who refused the vaccine in the 2023–2024 season was significantly higher than the literature data of previous seasons. For example, Di Noia and colleagues reported that 102 patients with cancer (11.2%) treated at Medical Oncology 1 Unit of Regina Elena National Cancer Institute in Rome refused the vaccine from 1st March to 20th March 2021 with the main reason of the fear of vaccine-related adverse events (48.1%) [15]. Villarreal-Garza and colleagues recorded that 34% of patients with breast cancer treated in Mexico (183/619) were hesitant to receive the anti-SARS-CoV-2 vaccine in 2021 mainly out of fear of vaccine adverse events [16]. In France, the percentage of cancer patients who refused the COVID-19 vaccine was 16.6% primarily due to the poor knowledge of the scientific results of the efficacy of the vaccine (88%) [17].

In our cohort, age over 75 years, marital status, and the oncologist's vaccine recommendation during the first visit, were significantly associated with vaccine acceptance, while the type of cancer or the disease stage was not. AlMasri et al. published a cross-sectional study on

factors that influenced adherence to COVID-19 vaccination in Jordan between February and April 2021 and showed that patients with metastatic cancer were less likely to receive the vaccine than patients with early disease [18]. Educational level has also not been shown to correlate with vaccine hesitancy, while Arce and colleagues had reported that it was a positive predictor of anti-SARS-CoV-2 vaccine acceptance in the USA [19].

Remarkably, our patients stated that they did not receive certain vaccines (mainly the pneumococcal vaccine and the HZ vaccine) because the oncologist did not recommend them. The doctor's authority is respected for influenza vaccination, so these data demonstrate how indispensable the oncologist's role in vaccine counseling is. The key role of the doctor is confirmed in many papers. For example, in a prospective cross-sectional survey trial conducted at a Supportive Care Clinic, the doctor's opinion was considered the most important determinant of whether or not to accept vaccination (0.82, 95% CI 0.73–0.89) [20].

The flu vaccine appears to be the most accepted by patients with cancer. Overall, there has been an increase

**Table 5** Evaluation of the proportion of vaccinated subjects against flu according to patients characteristics

	Total (%)	p value*
<b>Age</b>		
≤ 75 years	180 (77.9%)	<b>0.004</b>
> 75 years	72 (92.3%)	
<b>Sex</b>		
Male	127 (83%)	0.559
Female	125 (80.1%)	
<b>Marital status</b>		
Single	18 (66.7%)	0.010
Married	162 (84.4%)	
Separated/Divorced	29 (67.4%)	
Widower	38 (90.5%)	
Prefer not to answer	5 (100%)	
<b>Education</b>		
Primary school or lower	32 (91.4%)	0.212
Junior high	53 (74.6%)	
High school	119 (82.1%)	
University or higher	48 (82.8%)	
<b>Comorbidities</b>		
No	99 (76.7%)	<b>0.051</b>
Yes	153 (85.5%)	
<b>Stage of tumor</b>		
I/II/III	94 (78.3%)	0.292
IV	158 (83.6%)	
<b>Oncologists' anti-flu vaccine recommendation during the first oncological visit</b>		
Yes	210 (90.9%)	<b>0.000</b>
No	42 (53.8%)	

**Table 6** Evaluation of the proportion of vaccinated subjects against SARS-CoV-2 according to patients characteristics

	Total (%)	p value*
<b>Age</b>		
≤ 75 years	129 (55.8%)	0.064
> 75 years	53 (67.9%)	
<b>Sex</b>		
Male	78 (50.98%)	<b>0.006</b>
Female	104 (66.7%)	
<b>Marital status</b>		
Single	10 (37.04%)	<b>0.001</b>
Married	129 (67.2%)	
Separated/Divorced	16 (37.2%)	
Widower	24 (57.1%)	
Prefer not to answer	3 (60%)	
<b>Education</b>		
Primary school or lower	19 (54.3%)	0.415
Junior high	41 (57.8%)	
High school	92 (63.5%)	
University or higher	30 (51.7%)	
<b>Comorbidities</b>		
No	76 (58.9%)	1.000
Yes	105 (58.7%)	
<b>Stage of tumor</b>		
I/II/III	71 (59.2%)	1.000
IV	111 (58.7%)	
<b>Oncologists' anti-SARS-CoV-2 vaccine recommendation during the first oncological visit</b>		
Yes	154 (66.7%)	<b>0.000</b>
No	28 (35.9%)	

in flu vaccine acceptance after the pandemic period. In a cross-sectional study in Japan in the time 2020–2021, the influenza vaccination rate increased by 6% points post-COVID-19 (from 38.1 to 44.6%) [21]. In our population, more than 80% of respondents had received the flu vaccine. We did not specifically enroll cancer survivors, so we do not know whether their acceptance of influenza vaccination (as well as that of other vaccines) would have changed. Recently, Guo and colleagues conducted a multicenter, cross-sectional study among cancer survivors in China on the acceptance of influenza vaccination. The authors reported vaccination hesitancy in 42.06% of the respondents. They also showed that lack of information from doctors was a major determinant of vaccination hesitancy [22].

One of the main reasons for rejecting the pneumococcal vaccine turned out to be the lack of knowledge of which disease it prevents. This response should make us further reflect on how important vaccination counseling is. In case of difficulties in explaining the benefit of vaccines in the prevention of certain diseases, a multidisciplinary approach might be useful. Sitte and colleagues demonstrated that with the help of a consultant in infectious diseases, pneumococcal vaccination coverage rates

in patients with gastrointestinal cancer (GC) rose from 10.1 to 87.5% [23].

For the HZ vaccine, patients generally know which disease it prevents but tend not to get it because their treating oncologist rarely recommends it or because the patient himself does not consider it indispensable while receiving oncological treatments. HZ has both clinical and economic impacts with delayed treatment and overall deterioration of patient's quality of life [24].

Our study has some limitations. Firstly, it is a single-center survey, so selection bias may affect the generalizability of the results. Secondly, the type of study (cross-sectional study) may not reflect future trends. We recognized that there is a potential bias arising from the involvement of oncologists in explaining the survey. The oncologist explained the importance of participation in the survey but also emphasized the anonymity of the answers and the importance of answering honestly and not to please the oncologist. The patients completed the survey separately from the oncologists. Despite these limitations, our study provides an in-depth assessment of the vaccination status of cancer patients by not limiting itself to one type of vaccine and by investigating the reasons for vaccine refusal.



**Table 7** Evaluation of the proportion of vaccinated subjects against pneumococcal-disease according to patients characteristics

	Total (%)	p value*
<b>Age</b>		
≤ 75 years	94 (49.7%)	0.235
> 75 years	38 (48.7%)	
<b>Sex</b>		
Male	61 (39.9%)	0.358
Female	71 (45.5%)	
<b>Marital status</b>		
Single	7 (25.9%)	<b>0.002</b>
Married	95 (49.5%)	
Separated/Divorced	9 (20.9%)	
Widower	18 (42.9%)	
Prefer not to answer	3 (60%)	
<b>Education</b>		
Primary school or lower	15 (42.9%)	0.178
Junior high	25 (35.2%)	
High school	71 (48.9%)	
University or higher	21 (36.2%)	
<b>Comorbidities</b>		
No	49 (37.9%)	0.162
Yes	83 (46.4%)	
<b>Stage of tumor</b>		
I/II/III	42 (35%)	<b>0.034</b>
IV	90 (47.6%)	
<b>Oncologists' anti-pneumococcal vaccine recommendation during the first oncological visit</b>		
Yes	119 (51.5%)	<b>0.000</b>
No	13 (16.7%)	

## Conclusions

In summary, vaccine acceptance in cancer patients is substantially influenced by their relationship with their oncologist. Oncologists can motivate patients to receive the correct vaccine schedule by addressing doubts and concerns about the potential negative impact of the vaccine on cancer and cancer therapies.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-20468-y>.

Supplementary Material 1

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## Author contributions

A.L., G.G., C.K., and P.P. wrote the main manuscript text, N.A., S.C., T.M., and D.C. prepared tables. All authors reviewed the manuscript.

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**Table 8** Evaluation of the proportion of vaccinated subjects against HZ according to patients characteristics

	Total (%)	p value*
<b>Age</b>		
≤ 75 years	61 (26.4%)	<b>0.000</b>
> 75 years	38 (48.7%)	
<b>Sex</b>		
Male	40 (26.1%)	<b>0.029</b>
Female	59 (37.8%)	
<b>Marital status</b>		
Single	6 (22.2%)	<b>0.000</b>
Married	72 (37.5%)	
Separated/Divorced	2 (4.6%)	
Widower	18 (42.9%)	
Prefer not to answer	1 (20%)	
<b>Education</b>		
Primary school or lower	17 (48.6%)	<b>0.043</b>
Junior high	21 (29.6%)	
High school	49 (33.8%)	
University or higher	12 (20.7%)	
<b>Comorbidities</b>		
No	31 (24%)	<b>0.010</b>
Yes	68 (38%)	
<b>Stage of tumor</b>		
I/II/III	34 (28.3%)	0.317
IV	65 (34.4%)	
<b>Oncologists' anti-HZ vaccine recommendation during the first oncological visit</b>		
Yes	92 (39.8%)	<b>0.000</b>
No	15 (42.9%)	

## Data availability

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

## Declarations

### Ethics approval and consent to participate

The study was approved by the local Ethics Committee (Comitato Etico Territoriale Lombardia 6 - Area Pavia) and Institutional Review Board (P-3736/2024) of Fondazione IRCCS Policlinico San Matteo Pavia. All the subjects signed the informed written consent.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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