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Assessment of a Systematic Screening of Occupational Exposures in Malignant Hemopathies in the Rhone-Alpes Area: Prolymphome Study

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Abstract

Background: *Several studies have highlighted the role of environmental exposures in malignant hemopathies etiology. Some patients with malignant hemopathies can be compensated as occupational diseases. The Prolymphome research aimed to assess a systematic screening of occupational exposures in patients with lymphoma or myeloma treated in three hospitals in the Rhône-Alpes region.* **Methods:** *Patients received a self-administered questionnaire to fill in at home to collect their job history and potential occupational exposures to carcinogens. A physician assessed the questionnaire to determine if a dedicated consultation was required and the possibility of claiming compensation. Patients were systematically assisted by a social worker for administrative procedures.* **Results:** *In 12 months, 754 patients were enrolled in the study, and 361 (48%) returned the questionnaire. A specialized consultation was proposed for 123 patients, and 98 patients attended the consultation. Overall, a compensation claim was proposed to 18 patients: 11 have been occupationally exposed to pesticides and seven to trichloroethylene.* **Conclusions:** *Our results confirmed the feasibility of the systematic screening procedure. Barriers were observed at every step of the process, and it underlined that patients are rarely informed about occupational exposures. As the prevalence of occupational exposures in malignant hemopathies remains scarce, a systematic targeted screening could be relevant in this population.*

1. Introduction

In 2018, France estimated 45,000 new cases of hematological malignancies, accounting for 12% of new cancer cases, making them the sixth most common type of cancer [1]. These cancers occur slightly more frequently in men (55%) than in women (45%), with around two-thirds of cases classified as lymphoid hemopathies. Over the past 30 years, the global trend for hematological malignancies has been rising, with projected cases estimated to exceed 4,600,000 by 2030 [2-3]. Unlike the USA, where the incidence remained at 37.2 per 100,000 in 2017, Europe and Asia have seen increased incidence across various subtypes, including non-Hodgkin's lymphoma (NHL), leukemia, and myeloma [4-6]. NHL's varied forms, treatments, and prognoses create a highly heterogeneous population (approximately 55% have aggressive forms, while 45% are indolent). Assessing the incidence and evolution of

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hematological malignancies requires consideration of specific factors, including gender and age group, as these vary significantly. Occupational exposures are linked to an increased risk of hematological malignancies [7]. Research has identified several substances associated with these cancers, such as benzene, ionizing radiation, pesticides, and organic solvents [8-9]. Certain occupations, such as farming and industrial work, exhibit heightened risks [10]. Exposure to mineral oils, excavation dust, and alkali compounds has been associated with NHL, whereas arsenic and lead compounds correlate with acute myeloid leukemia [11]. Organophosphate pesticides, especially diazinon and malathion, are linked with an increased risk of leukemia, lymphomas, and multiple myeloma, particularly among individuals with prolonged exposure [12]. These findings highlight the need for monitoring and implementing control measures for occupational exposure to prevent hematological malignancies in at-risk workers [8, 12]. In addition to rising incidence rates, variations in incidence and subtypes by region suggest that environmental and occupational factors may partly explain these disparties [7, 13-14]. A report from the International Agency for Research on Cancer (IARC) estimated that 2.2% of hematological malignancies (1.2% of NHL and 1.0% of leukemia) are attributable to occupational exposures [15].

Numerous studies and meta-analyses have quantified the risk of NHL associated with pesticide use among farmers [16-19]. Recently, the IARC has classified several pesticides as certain, probable, or possible carcinogens [20]. Considering these new data, a decree published on June 9, 2015, included NHL in the list of occupational diseases for agriculture (Table 59), mainly listing work usually exposing workers to organochlorine compounds, organophosphorus compounds, carbaryl, toxaphene, and atrazine. This list was modified in 2019 to cover chronic lymphocytic leukemia and multiple myeloma. In addition, the type of pesticides concerned is no longer specified in the list of work, allowing compensation for exposure to other molecules [21].

Other occupational exposures are known to be associated with an increased risk of NHL [19, 22], mainly chlorinated solvents such as trichloroethylene (IARC Group 1, limited level of evidence for NHL). Ethylene oxide is also classified as Group 1, with limited evidence for NHL. 1,3-butadiene is classified with a sufficient level of proof for lymphoma and leukemia, "all subtypes", as well as for multiple myeloma. Other occupational or environmental exposures have sometimes been reported in the literature. Still, the evidence remains insufficient [23]. Due to the heterogeneity of NHL, obtaining significant findings regarding its association with occupational exposures is challenging. Additionally, with a 5-year survival rate of 54% for men and 56% for women across all types of NHL, and considering the high proportion of patients diagnosed who are still of working age, the question of returning to work in positions linked to proven or suspected occupational exposure to NHL may arise, even without any occupational pathology claims, to prevent secondary cancers.

Hodgkin's disease constitutes approximately 10% of lymphomas, predominantly affecting young adults. There is insufficient conclusive data regarding occupational exposure to Hodgkin's disease [23]. However, several studies and meta-analyses indicate a potential association between this disease and exposure to pesticide [24-25] and wood dust [26].

Despite this convincing evidence, there is a lack of awareness among both healthcare professionals and patients of the mechanisms for reporting and recognizing work-related cancers in France. Numerous barriers to the recognition of occupational cancers have been identified in the literature, including oncologists' lack of time to gather patients' occupational histories, multiple exposures, and a lack of knowledge and expertise, due partly to the long latency period between the exposure and the onset of cancer [27-29].

Considering this underreporting and underrecognition of work-related cancers [30] in 2010, the Léon Bérard Center implemented a systematic occupational exposure screening for bronchopulmonary cancers based on an occupational exposure screening questionnaire and specialized consultation [31-33].

Given the new challenges of reporting NHL as an occupational disease since June 2015, we were interested in evaluating this process of systematically identifying occupational exposures in patients with hematological malignancies in several hospitals.

2. Methods

The study received a favorable opinion from the Comité Consultatif sur le Traitement de l'Information en matière de Recherche dans le domaine de la Santé (n°16-313) and was declared to the Comité National de l'Informatique et des Libertés (n° 2016181).

2.1. Design

The Prolymphoma study was a prospective, multicentre study conducted over one year in the Rhône-Alpes region of France on patients with malignant hemopathy.

2.2. Study Population

The study was proposed to all patients (men and women of any age) treated for a histologically confirmed hematological malignancy at the Centre Léon Bérard (CLB), the Centre Hospitalier Universitaire Lyon Sud (CHLS), and the CH de Valence (CHV).

To ensure thoroughness, hematologists recruited patients through the weekly Multidisciplinary Consultation Board (MCB). The study population included incident, prevalent, and relapsed cases. The initial project focused on non-Hodgkin's lymphoma, but at the request of hematologists, it was extended to Hodgkin's disease and myeloma, thereby broadening recruitment to all hematological malignancies.

2.3. Systematic Detection and Assessment System

All eligible patients were sent a self-administered questionnaire for identifying occupational exposures at home, with an information note explaining the identification process and a T envelope for returning the questionnaire free of charge.

The self-administered questionnaire collected the following data: qualifications, complete occupational history including military period, jobs carried out, tasks performed for each job, duration, name, address and activity of the company. Through the self-administered questionnaire, the patient provided a self-declaration of exposure to carcinogens to which he thought he had been exposed, according to a non-exhaustive list drawn up based on the nuisances covered by the tables of occupational diseases [21] and the classification of the IARC [20]. This questionnaire has been previously validated in lung cancer patients, and the nuisance section has been adapted for the study population [32].

One month later, when no reply was received, a clinical research associate systematically contacted patients by telephone and offered to help them complete the questionnaire. Once the questionnaires were returned, they were analyzed by an occupational pathology physician at the CLB or CHLS. Based on experience and the criteria for recognizing an occupational disease, the physician determined whether an occupational pathology consultation was necessary. Special attention was given to patients with occupational histories that involved exposure to pesticides and chlorinated solvents. Exposure could either be clearly stated by the patient or inferred by the physician from the questionnaire. If required, patients were scheduled for a consultation. Patients who did not need a consultation received a letter indicating that their pathology was assessed as unrelated to work. Patients were referred for consultation if they identified a known risk factor for hematological malignancies and/or jobs and tasks that might be associated with it in the self-administered questionnaire.

To assess patients' deprivation and its impact on systematic occupational exposure screening, patients were asked to complete the EPICES (Evaluation of Deprivation and Inequalities in Health Examination Centres) score simultaneously with the self-administered questionnaire. The EPICES is a validated composite index used to measure individual deprivation [34, 35].

The EPICES score consists of 11 binary items (yes/no) covering marital status, health insurance status, economic status, family support, and leisure activities. It ranges from 0 (no deprivation) to 100 (maximum deprivation), with a cut-off point 30.

2.4. Occupational Pathology Consultations

Occupational pathology consultations took place at the CLB or the CHLS (as the Valence hospital

does not offer this type of consultation, patients who requested an indication came to the CLB for a consultation).

During the occupational pathology consultation, the physician had to review the patient's work history in greater detail, complete the assessment of exposure to carcinogenic agents (including conditions, frequency, duration, level of exposure, and both collective and individual protective measures), and identify additional extrinsic risk factors (particularly, exposure to environmental pesticides from spraying around the home).

At the end of the consultation, when evidence in favor of an occupational origin was found, the patient was offered the possibility of a claim. These patients received an "initial medical certificate" and systematic support from a social worker to help them through the process.

2.5. Additional Data Collection

In addition to data from the self-administered questionnaire, the EPICES score, and the occupational pathology consultation, socio-demographic, clinical, and tumor data were collected from the patient's medical records. All consultations were recorded in the database of the Réseau National de Vigilance et de Prévention des Pathologies Professionnelles (RNV3P) [36].

2.6. Statistical Analysis

All eligible patients were included in the data analysis. The patient characteristics were analyzed descriptively, using means and standard deviations for quantitative data and frequencies and percentages for qualitative data. We compared patient demographic and clinical data and data from the tracking system across centers using t-tests or the Wilcoxon rank sum test for quantitative data and Chi-squared or Fisher tests for qualitative data. A 5% threshold was considered statistically significant for all statistical tests. Analyses were conducted using R software.

3. Results

Between March 2016 and February 2017, 754 patients were treated for hematological malignancies at CLB, CHLS, and CHV. All of them were included in the Prolymphoma study: 350 patients at CLB (47%), 356 at CHLS (47%), and 48 at CHV (6%). Recruitment began in March 2016 at CLB and in May 2016 at CHLS, concluding in December 2016 at these two centers. Systematic screening was conducted at CHV from September 2016 to February 2017. Recruitment lasted 11 months at CLB, eight months at CHLS, and five months at CHV. Self-questionnaire for identifying occupational exposure

The flowchart is described in Figure 1. The self-administered questionnaire was sent to the 754 patients recruited. Among them, 361 returned it (240 NHL, 94 myeloma, and 27 Hodgkin's disease), for an overall response rate of 48%.

3.1. Patient Characteristics

Table 1 summarizes patient characteristics. Men returned more of the self-administered questionnaire than women, and there was no difference in age between respondents and non-respondents.

The profile of patient care varied from one center to another. Patients at the CLB were more likely to be incident cases (43%) or patients receiving follow-up (32%), while at the CHLS and CHV, patients were more likely to have relapsed (56% and 42%, respectively).

Table 1 also presents the recruitment of patients based on histological type. The majority were diagnosed with NHL (63%), myeloma (27%), or Hodgkin's disease (9%). Incident cases returned the questionnaire more often than prevalent cases.

Table 2 shows the return data for the self-administered questionnaire from the recruitment center. Most patients who responded (37%) submitted the questionnaire spontaneously, while the remaining 11% returned it after receiving a reminder. Among the 393 non-responders (52%), 34% did not return the questionnaire, citing their main reason as feeling "unconcerned" about identifying occupational exposures. After three phone reminders, 17% were unreachable.

Patients from CHLS submitted the self-administered questionnaire more spontaneously, whereas those from CLB and CHV required more assistance in completing the form and received

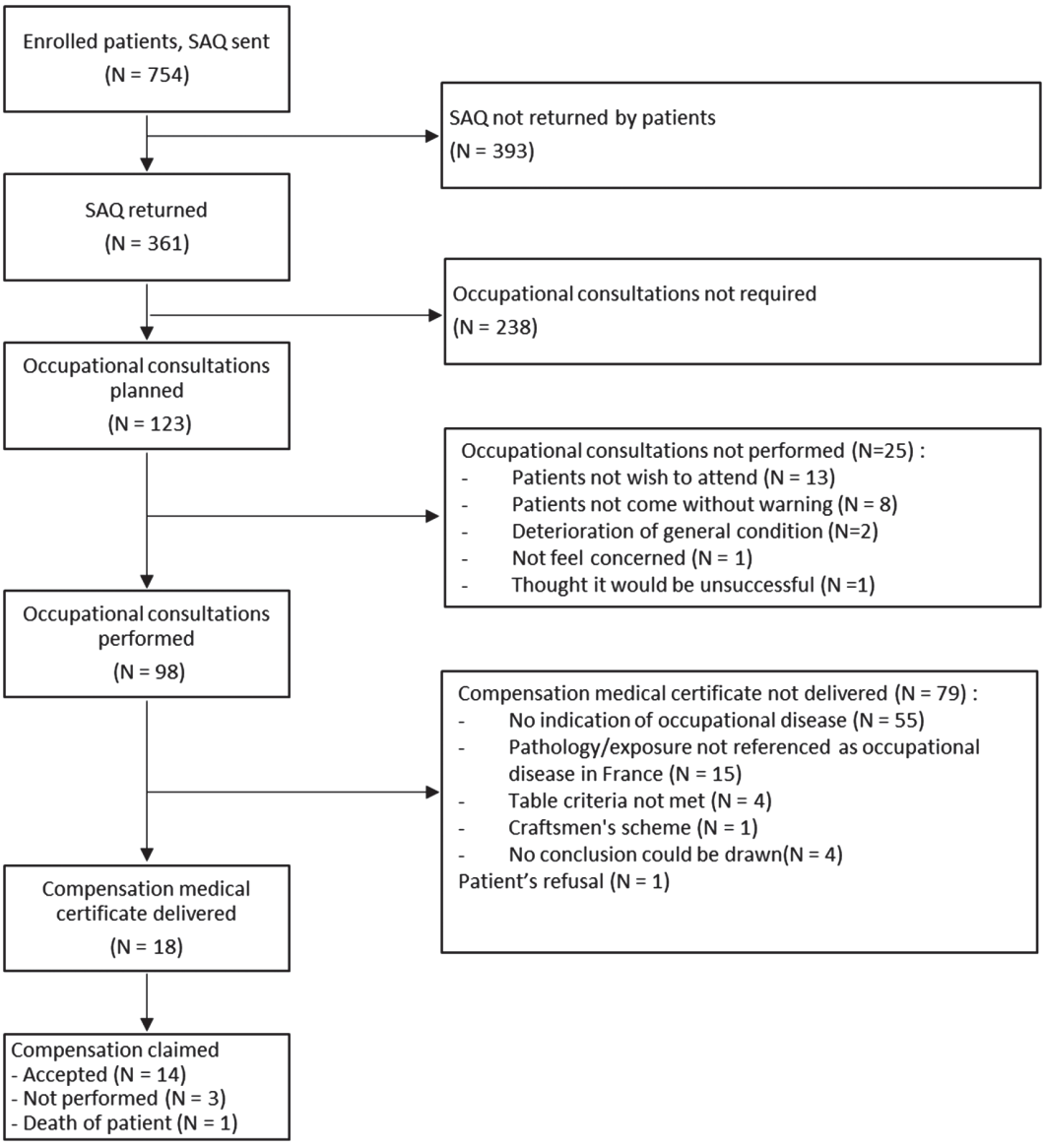

Figure 1. Study flow-chart.

additional phone reminders. There was a significant difference in response time across the various centers. On average, patients at CHLS returned their questionnaires more quickly (35 days) compared to those at CLB (45 days) and CHV (48 days) (p=0.01). The overall average delay was 41 days (SD=35.3).

Two-thirds of the responders had a General Certificate of Secondary Education or less. Regarding their occupational careers, the number of job changes was low, with half of the patients holding fewer than four jobs. Nearly a quarter of patients reported having held a skilled job in the industrial or craft sectors throughout their careers (ISCO categories). Of the exposures covered by the questionnaire, 64 patients (18%) indicated exposure to trichloroethylene, 22 (6%) to perchloroethylene, 29 (8%) to benzene, and 62 (17%) to another solvent. Additionally, 53 patients reported pesticide exposure (15%).

Table 1. Characteristics of study population according to the self-administered questionnaire participation.

	Respondents N (%)	Non respondents N (%)	Total N (%)	p Value
Total	361 (48)	393 (52)	754 (100)	
Gender				
Male	226 (63)	217 (55)	443 (59)	p=0.04
Female	135 (37)	176 (45)	311 (41)	
Mean age at diagnosis (SD)[1]	62.1 (13.3)	60.6 (15.4)	61.7 (14.8)	p=0.14
Disease management				
Incident cases	160 (44)	133 (34)	293 (39)	p=0.01
Relapse	132 (37)	175 (45)	307 (41)	
Follow-up	69 (19)	77 (20)	146 (19)	
Missing data	0 (0)	8 (1)	8 (1)	
Histology				
Hodgkin Lymphoma	27 (7)	40 (10)	67 (9)	p=0.28
Non-Hodgkin lymphoma	240 (67)	239 (61)	477 (63)	
Myeloma	94 (26)	109 (28)	203 (27)	
Missing data	0 (0)	5 (1)	5 (1)	

3.2. Occupational Pathology Consultations

Among the 361 self-administered questionnaires assessed, 123 patients were invited to an occupational pathology consultation, and 98/123 consultations were carried out (80%). Of the 25 consultations that were not carried out, 13 patients did not wish to attend (11%), eight patients did not come to the consultation without warning (6%), two patients had a deterioration of their general condition (1%), one patient did not feel concerned by the process (1%) and one patient thought that it would not be successful (1%).

At the end of the consultations, 19/98 patients (19%) were deemed eligible for compensation for an occupational disease. An initial medical certificate was finally issued to 18 patients, one of whom did not finally wish to proceed. Of the 18 initial medical certificates issued, ten were related to exposure to the pesticides listed in Table 59 of the Agricultural Insurance (AI), seven were not listed in a dedicated table (NHL with exposure to trichloroethylene and myeloma with exposure to pesticides) and one patient did not meet the criteria of Table 59 of the AI.

A claim for recognition was not considered for 79/98 patients (80%): there was no indication of an occupational disease for 55 patients; for 15 patients, there were scientific arguments for a link with occupational exposure, but the pathology and exposure were not referenced in an occupational disease table according to the French regimen; and for four patients the table criteria were not met. One patient came under the craftsmen's scheme and was not eligible for compensation as an occupational disease. No conclusion could be drawn for four patients based on the available evidence.

Overall, 14 out of 18 patients (82%) received compensation for their claim as an occupational disease; three patients did not seek recognition, and one patient died before completing the process. Details of the occupational disease compensation are presented in Table 3.

3.3. Social Vulnerability

The median EPICES score was 20.7. A vulnerability situation (EPICES score ≥ 30) was identified in 122 patients (34%). This situation was more prevalent among patients at CLB (24.19) than at CHLS (21.53) and CHV (17.4; p=0.04). On average, patients identified in a vulnerable situation needed more time to complete the self-administered

Table 2. Self-administered questionnaire return, overall and by recruiting center.

	CLB N (%)	CHLS N (%)	CHV N (%)	Total N (%)
Self-administered questionnaire returned	350 (100)	356 (100)	48 (100)	754 (100)
Return by patient without reminder	123 (35)	141 (40)	17 (35)	281 (37)
Return after phone call reminder	55 (16)	15 (4)	10 (21)	80 (11)
by patient	44 (13)	15 (4)	4 (9)	63 (8)
self-administered questionnaire completed during the call	3 (1)	0 (0)	3 (6)	6 (1)
self-administered questionnaire completed at hospital	8 (2)	0 (0)	3 (6)	11 (2)
Self-administered questionnaire non-returned	124 (35)	126 (35)	7 (15)	257 (34)
Patient not concerned	40 (11)	44 (12)	2 (4)	86 (11)
Patient should have returned the self-administered questionnaire but did not	51 (15)	18 (5)	3 (6)	75 (10)
Patient deceased	4 (1)	18 (5)	1 (2)	23 (3)
Fatigue	13 (4)	20 (6)	0 (0)	33 (4)
Patient did not wish to complete the self-administered questionnaire	12 (3)	24 (7)	1 (2)	37 (5)
Problems with French language	4 (1)	0 (0)	0 (0)	4 (1)
Patient managed in another hospital	0 (0)	2 (1)	0 (0)	2 (0)
Patients could not be reached (after 3 attempts)	48 (14)	74 (21)	5 (10)	127 (17)
Call reminder not performed	0 (0)	0 (0)	10 (21)	10 (1)
Delay to complete the self-administered questionnaire	178 (100)	156 (100)	27 (100)	361 (100)
< 1 month	92 (52)	102 (65)	9 (33)	203 (57)
> 1 month	86 (48)	54 (35)	18 (67)	156 (43)

questionnaire than those who were not (50 days vs. 37 days; p=0.003). On the other hand, no significant difference in precarity was found in terms of age, sex, or proposal to declare an occupational disease.

4. Discussion

Our study evaluated systematic screening for occupational exposures in lymphoma or myeloma patients at three hospitals in the Rhône-Alpes region. It aimed to enhance the identification and compensation of these conditions as occupational diseases. An initial medical certificate was issued to 18 patients (2% of the study population), and 14 received compensation for work-related pathologies. The results align with the literature on the proportion of hematological malignancies linked to occupational exposures [37]. While the latency between occupational exposures and disease onset is shorter for hematological malignancies than solid cancers [15], the diversity of these malignancies and the complexity of occupational exposures pose challenges in pinpointing attributive factors.

Compensation claims for occupational diseases were proposed for 9% of the study patients, a percentage higher (15%) than in the RHELYPRO study [38]. However, this approach necessitated oncologist involvement before identifying occupational exposures, and limited time from oncologists was frequently noted as a barrier to identifying occupational cancers [28]. This multicenter study revealed population differences across centers regarding age,

treatment status, and vulnerability. The study population reflects the diversity of individuals with hematological malignancies in France. Identification via the Multidisciplinary Consultation Board ensures that all patients potentially concerned about their disease's occupational origin can be systematically informed and integrated into the care pathway without burdening hematologists' limited time.

It is also crucial to consider the French system regarding occupational compensation. There are tables that specify the required symptoms or pathological lesions, the types of work known to cause the condition, and the time limits for compensation claims. Any disease that meets these medical, occupational, and administrative requirements is systematically assumed to be work-related. When a disease is not listed in the table or when the criteria are not fully met, patients are examined by regional committees for occupational disease recognition, which typically base their assessment on the IARC Group 1 classification. In France, the current context is favorable since the creation of the occupational disease table related to occupational exposure to pesticides (RA n° 59). This table was revised in 2019 to include multiple myeloma among the list of pathologies eligible for recognition as an occupational disease. Furthermore, in 2020, the Pesticide Victims Compensation Fund was established to investigate the growing number of claims for recognition of occupational diseases related to pesticide exposure, also helping to standardize recognition practices [39].

Considering these findings compared to the same process in lung cancer patients in two studies conducted in 2015 and 2019 [33, 40] is interesting. Indeed, the results of Prolymphome show a response rate to the self-administered questionnaire slightly lower than in the pilot study (53%) but higher than in the multicentre study (37%). In both populations, the impact of vulnerability was observed in the time needed to return questionnaires. However, the prevalence of vulnerability was higher among lung cancer patients (46% and 37% versus 34% of respondents).

Finally, the frequency of occupational exposures related to the disease was more prevalent in patients with lung cancer (9% of the overall study population and 18% of self-administered questionnaire responders) than for hematological malignancies (2% of the study population and 5% of self-administered questionnaire responders). Systematic screening seems more appropriate for patients with bronchopulmonary cancer than for hematological malignancies, where occupational exposure is less frequent and less diverse and requires a systematic but more targeted screening.

One of the strengths of this study is the relatively high response rate (48%), which underlines the patients' interest in occupational exposures. As patients with hematological malignancies generally have a good prognosis, the acceptance and implementation of occupational exposure investigation seem appropriate in this context. In addition, identifying occupational exposures will help to prevent them more effectively, particularly in the case of working patients. This system enables systematic screening for work-related cancers, with information and guidance where necessary, to reduce social disparities. Better reporting of occupational cancers will help patients claim their rights and better identify and register the carcinogens involved in these cancers.

According to self-administered questionnaire feedback, and consistent with the literature, exposure to solvents and trichloroethylene (IARC group 1, limited evidence for NHL) is the most frequently self-reported exposure in this population (18%), followed by pesticides reported by 15% of respondents. However, these exposures often lacked the intensity or duration required for compensation as an occupational disease. The systematic recording of consultation data in the national database of the occupational pathology network (RNV3P) enhances the understanding and prevention of occupational risks in France [36].

A limitation of our study is the lack of systematic feedback from the self-administered questionnaire. Additionally, a quarter of the recommended consultations were not completed; some patients declined to attend for logistical reasons (distance, organization), making it difficult to identify the occupational aetiologies of hematological malignancies. The dropout rate at each stage highlights patients' lack of awareness regarding occupational exposure and their rights. Supporting patients throughout the process, including the compensation claim

Table 3. Details of exposure assessments for patients who asked for compensation.

Histology	Occupation and condition of exposures	Occupational carcinogens	Social regimen	Compensation
		Pesticides		
Myeloma	Exposure to pesticides (insecticides and herbicides) for around ten days a year throughout professional career for 35 years until 2003. Treatment of cereals, potatoes, pastures and gardens. Parasite treatment of 35 cows twice a year.	Organochlorine compounds	GS	Accepted
Myeloma	From 1960 to 2009, winegrower. Exposure to pesticides for vine treatments 6 to 8 times / year. Pesticide application with protective suit and cartridge mask, but no protective equipment when re-entering crops, generally 2 to 3 days after treatment. Vineyard herbicide application twice a year, with gloves only.	Organochlorine compounds	AR	Accepted
Myeloma	From 1971 to 2000, winegrower. Handling of phytosanitary products for vineyard treatment 4 to 5 times a year. Herbicide application 2 times a year. Preparation, application of products and washing of equipment. Application by high-clearance tractor without protective equipment. Frequent re-entry into treated crops.	Organochlorine compounds	AR	Accepted
Marginal zone lymphoma	From 2004 to 2011, he worked as a castle groundskeeper. He carried out glyphosate herbicide spraying over an area of 5000 m2 (borders, driveways, embankments and ditches) 6 to 7 times a year using a backpack sprayer, generally without any protection. Each application lasted up to a day and a half.	Organophosphorus compounds	GS	Accepted
Marginal zone lymphoma	1986 to 1992 farm worker in vegetable and fruit growing. Regularly handled and prepared pesticides. 1992 to 2010 technical officer for a municipality. Herbicides used for at least two months a year. Pesticides used included glyphosate, paraquat and 2-4-D.	Organophosphorus compounds	AR	Accepted
Mantle cell lymphoma	Arboricultural worker since 1981. No direct preparation or handling of pesticides. However, was regularly in the orchards for maintenance or tree pruning while treatments were being applied by other workers. No personal protection. Fruit picking (apricots, apples, peaches, strawberries) and vegetable picking (asparagus, mushrooms, etc.) as well as grape harvesting every year.	Organophosphorus compounds	AR	Accepted
Diffuse large B-cell lymphoma	Farmer from 1978 to 2007. Tobacco growing, arboriculture, vegetable production and poultry farming. No direct exposure, but frequent re-entry for crop maintenance and picking, especially tobacco.	Organochlorine compounds	AR	Accepted

Table 3 (*Continues*)

Histology	Occupation and condition of exposures	Occupational carcinogens	Social regimen	Compensation
		Pesticides		
Diffuse large B-cell lymphoma	Winegrowing career from 1948 to 1994. Use of copper, sulfur and arsenic at the start of his career to treat grape berry worm. DDT (dichloro-diphenyl-trichloroethane) to treat grape berry worm. Herbicides used from the 70s.	Organochlorine and organophosphorus compounds	AR	Not done
Chronic lymphocytic leukemia	1967-1990 Farmer, fruit production (cherries, strawberries, peaches, pears, apples, etc.) some 30 days a year of organophosphorus insecticides, and occasionally organochlorine insecticides, carbaryl. 1990-2002 Multi-skilled landscape worker, mainly maintenance work (planting, pruning, mowing, small-scale masonry work, etc.) occasional exposure to insecticides on rosery plants and some herbicides (glyphosate).	Organophosphorus compounds	AR	Accepted
Follicular lymphoma	Farming since 1993. Numerous tasks related to sheep and cow breeding. Performed crop treatments, including product preparation. Until 2013, she reported applying herbicides to pastures and various crops (barley, maize, wheat) for around 4 half-days a year, without protection.	Organophosphorus compounds	AR	Accepted
Myeloma	From 1984 to 2004 farmer combining mixed farming of cereals, corn, beet, sunflowers and potatoes with cattle, sheep, pig and poultry farming. Treated crops several times a year with a variety of pesticides: organochlorines, organophorus and atrazine. Also treated livestock buildings with insecticides. Continued working as a family helper until 2014.	Organochlorine and organophosphorus compounds	AR	Not done
Myeloma	Farmer from 1960 to 2006. Cereals, corn, colza, sunflower and soy. Herbicides twice a year, insecticides and fungicides 6 times a year. Use of organochlorines including lindane, organophosphates, glyphosate and atrazine. Had no protection and only owned a tractor with a cab for the last 10 years. Associated livestock farming but no use of pesticides.	Organochlorine and organophosphorus compounds	AR	Not done
		Solvents		
Mantle cell lymphoma	From 1971 to 1999, machinist and toolmaker for various metalworking companies. Regular use of organochlorine solvents for cold degreasing of parts prior to quality control. Alternative use of trichloroethylene and trichloroethane 111, depending on the period. Degreasing with detergent at the end of the career.	Trichloroethylene	GS	Accepted

Chronic lymphocytic leukemia	From 1967 to 1998, warehouseman in the chemical industry, transferring trichloroethylene from large containers into smaller drums. Daily handling of 150 liters/day. An open bin of trichloroethylene was permanently located near his workstation.	Trichloroethylene	GS	Accepted
Follicular lymphoma	From 1968 to 1980 machining technician. Machining with cutting oils, welding, painting and daily degreasing of parts in cold trichloroethylene baths. From 1980 to 2000, technician and engineer in various laboratories, with the same but decreasing exposure.	Trichloroethylene	GS	Accepted
Diffuse large B-cell lymphoma	1971-1981, automotive mechanic. Had a tub of trichloroethylene on the workbench to dip vehicle mechanical parts several times a day. Used a brush to apply trichloroethylene to degrease brake systems before blowing. One-hour daily exposure. 1982-1998 was team leader, decreasing exposure to trichloroethylene. Exposure to benzene through contact with gasoline-containing parts.	Trichloroethylene	GS	Accepted
Diffuse large B-cell lymphoma	From 1967 to 1979 pipe fitter and welder for several companies. Installation of industrial sites in the chemical sector and maintenance work on heating systems. Describes regular use of cold trichloroethylene to degrease parts. He was also exposed to benzene.	Trichloroethylene	AR	Not done

procedure, is crucial. The involvement of a social worker to assist with complex administrative procedures, which patients see as a barrier, is essential [29]. Furthermore, the introduction of teleconsultations may help to address organizational issues for occupational consultations.

Despite these efforts, systematic screening remains effective only for a minority of patients with specific profiles (e.g., those working in agriculture/viticulture or handling solvents like trichloroethylene). Given the substantial time needed to identify these patients, expanding this screening to all hematological malignancies is impractical. Targeting those affiliated with the agricultural regimen could be beneficial, making it essential to raise awareness among medical teams managing these patients to ensure they can identify and refer them for occupational pathology consultation.

5. Conclusion

Our study confirms the feasibility of the process for screening occupational exposure to diseases other than bronchopulmonary cancer, and its implementation through a multicenter approach. However, it appears that systematic screening is time-consuming in a context where occupational etiology is rarer for hematological malignancies than for lung cancer. Since screening for potential occupational exposures is valuable for the patients themselves, particularly in a context of long survival, it is essential to inform them about occupational exposures. Therefore, it seems more appropriate to identify patients by hematologists or their teams during treatment, with referral to the occupational pathology consultation. The necessity for information and education regarding occupational exposures for workers, patients, and healthcare professionals must be a public health priority priority.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board Comité Consultatif sur le Traitement de l'Information en matière de Recherche dans le domaine de la Santé (protocol code 16-313 on 12 May 2016).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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