

ABSTRACT

Background: Cancer is associated with a high-risk level of venous thromboembolic events (VTE). Our study aimed to determine the cost of hospital management of these common cancer complications in French patients who suffer from four of the most frequent types of cancer: breast cancer (BC), colon cancer (CC), lung cancer (LC) and prostate cancer (PC).

Methods: The French National Hospital Database (PMSI) was analyzed in order to identify patients whose BC, CC, LC or PC was diagnosed in 2010 and who were hospitalized for a VTE at least once during the following two years. The number of stays induced by a VTE, and the corresponding number of patients hospitalized, were determined using the disease-specific ICD-10 codes. Costs were calculated with the French official tariffs, from the healthcare system perspective.

Results: We identified 194,964 patients newly diagnosed with BC, CC, LC or PC in 2010 (62,365 with BC, 47,594 with CC, 39,454 with LC and 45,551 with PC). In total, 8,909 of these new cancer patients were hospitalized for VTE or experienced VTE during hospital stay, representing a global incidence rate of 4,57%. In each group, 1,271 (2%) BC patients, 2,866 (6,0%) CC patients, 3,775 (9,6%) LC patients and 997 (2,2%) PC patients were numbered. During the two years of follow-up, 2,053 patients were hospitalized for a VTE recurrence, representing a recurrence rate of 23,04% among VTE patients. In total, 12,880 stays were analyzed. The mean cost per stay ranged from €3,302 to €3,674 for the first event and from €2,916 to €3,457 for recurrence. For one patient with recurrent VTE, the mean hospital cost over two years ranged from €5,441 to €5,692.

Over a 2-year period, the total cost of hospital stays induced by VTEs reached €13.30 million, including €1.82 million due to recurrent events.

Conclusion: VTE-related hospitalizations in cancer patients represent a high cost. Better prevention and follow-up measures to prevent these complications would be an efficient way to reduce this burden, both for patients and healthcare system.

INTRODUCTION

- In France, cancer-related costs represent a growing part, namely 10% of third-party payer expenses in 2012 (€ 14.5 billion) with an increase of 2.8% compared to 2011. All available options to reduce or at least stabilize the costs without decreasing the quality of patient care must be considered¹.
- Patients with cancer are known to have a four-to-six fold increased risk of venous thromboembolism (VTE), including deep venous thrombosis and pulmonary embolism^{2, 3}. These venous thromboembolic events lead to hospitalizations that dramatically increase the burden of patients' management.
- Several international studies tried to estimate the VTE burden in cancer patients: in the USA, an observational study of patients treated with chemotherapy showed a VTE overall incidence of 13.5% at 12 months⁴. In addition, the risk of recurrence in cancer patients has been estimated at 20.6%, compared to 6.8% in patients without cancer⁵. A study in ambulatory US patients with various types of cancer revealed that patients with VTE had a total healthcare cost increased by 79.9%, compared to those without VTE over the 12-month post VTE follow-up period.⁶
- A previous study regarding breast and prostate cancer, demonstrated that VTEs have significant costs, due to hospitalizations, including an important impact of recurrent events⁷. Our study confirmed these results in four of the most frequent types of cancer in France.

AIMS OF THE STUDY

- To extend the previous results obtained in breast and prostate cancers, to colon and lung cancers.
- To evaluate the epidemiological and economical burden of cancer-related VTE in France in four of the most frequent types of cancer:
 - To estimate the number of hospital admissions related to VTE in newly diagnosed breast, colon, lung or prostate cancers patients;
 - To determine VTE-recurrence impact;
 - To calculate the associated hospital costs.

METHODS

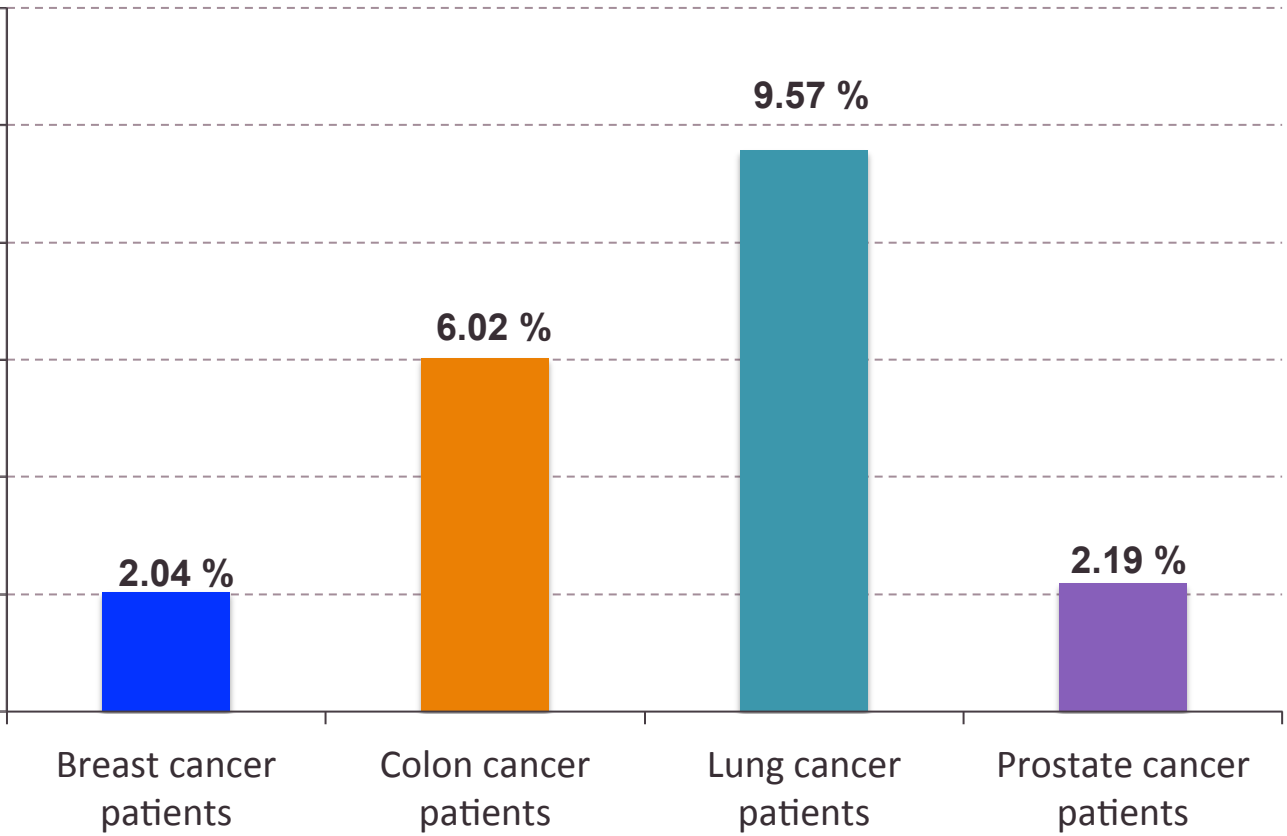
- Data source:** The French Medical Information System (Programme de Médicalisation des Systèmes d'Information: PMSI), which covers all French public and private hospitals. For each patient, PMSI contains: diagnosis that led to hospitalization, associated diagnoses related to co-morbidities and/or complications during admission and examinations performed during the admission.
- Data collection of VTE-related admissions:** cases were extracted from the PMSI database using the International Classification of Diseases, 10th revision (ICD-10 codes). We kept patients with breast cancer (code C50), colon cancer (code C18), lung cancer (code C34) or prostate cancer (code C61) and selected newly diagnosed patients in 2010 (incident cancer cases). Among these new BC, CC, LC or PC patients, we searched for those hospitalized with DVT (code I80) or PE (code I26) as primary diagnosis (PD), related diagnosis (RD) or significant associated diagnosis (SAD). Incident patients with DVT or PE were followed for 2 years (2011 and 2012) using PMSI database, in order to identify the number of thromboembolic recurrences that required hospitalization.
- Number of stays and patients hospitalized for TVE :** the number of hospital stays when a VTE event occurred during the 2 years follow-up period was estimated, as well as the corresponding number of patients hospitalized at least once.
- Economic Evaluation:** hospital costs were estimated from a healthcare payer's perspective. Costs of chemotherapy, ambulatory and indirect costs related to productivity loss were not considered in the analysis. Expenses were calculated using the official 2010, 2011 and 2012 public and private hospitals Diagnosis Related Groups (DRG) tariffs, which included nursing care, treatments, drugs, accommodation and investment costs, as well as medical and technical acts.

RESULTS

① Incidence of VTE-related hospitalization

Among all breast, colon, lung and prostate cancer patients hospitalized in 2010, we took out patients who had been hospitalized for those cancers from 2006 to 2010. Newly diagnosed cases in 2010 represented a population of 194,964 patients. 62,365 patients were newly diagnosed with breast cancer, 47,594 with colon cancer, 39,454 with lung cancer and 45,551 for prostate cancer. During a 2-year follow-up period, 8,809 patients were hospitalized for a VTE (or presented a VTE during an hospitalization): 1,271 breast cancer patients (2.19% of incident cases), 2,866 colon cancer patients (6.02%), 3,775 lung cancer patients (9.57%) and 997 prostate cancer patients (2.04%) (**Figure 1**). These results are consistent with literature^{8,9}.

Figure 1. Incidence of VTE-related hospitalizations (%) in newly diagnosed cases



② Re-hospitalization for recurrent thrombo-embolic events

Among all 8,911 patients with VTE, 2,053 (23.04%) were hospitalized for a recurrent event, including 202 breast cancer patients, 639 colon cancer patients, 1068 lung cancer patients and 144 prostate cancer patients (**table 1**).

Table 1. Patients with recurrent VTE (VTE as primary, related and significant associated diagnosis)

	Patients with only one VTE	Patients with recurrent VTE	Percentage of patients with recurrent VTE
Breast cancer	1,069	202	15.9%
Colon cancer	2,227	639	22.3%
Lung cancer	2,709	1,068	28.28%
Prostate cancer	853	144	14.4%
Total	6,858	2,053	15.3%

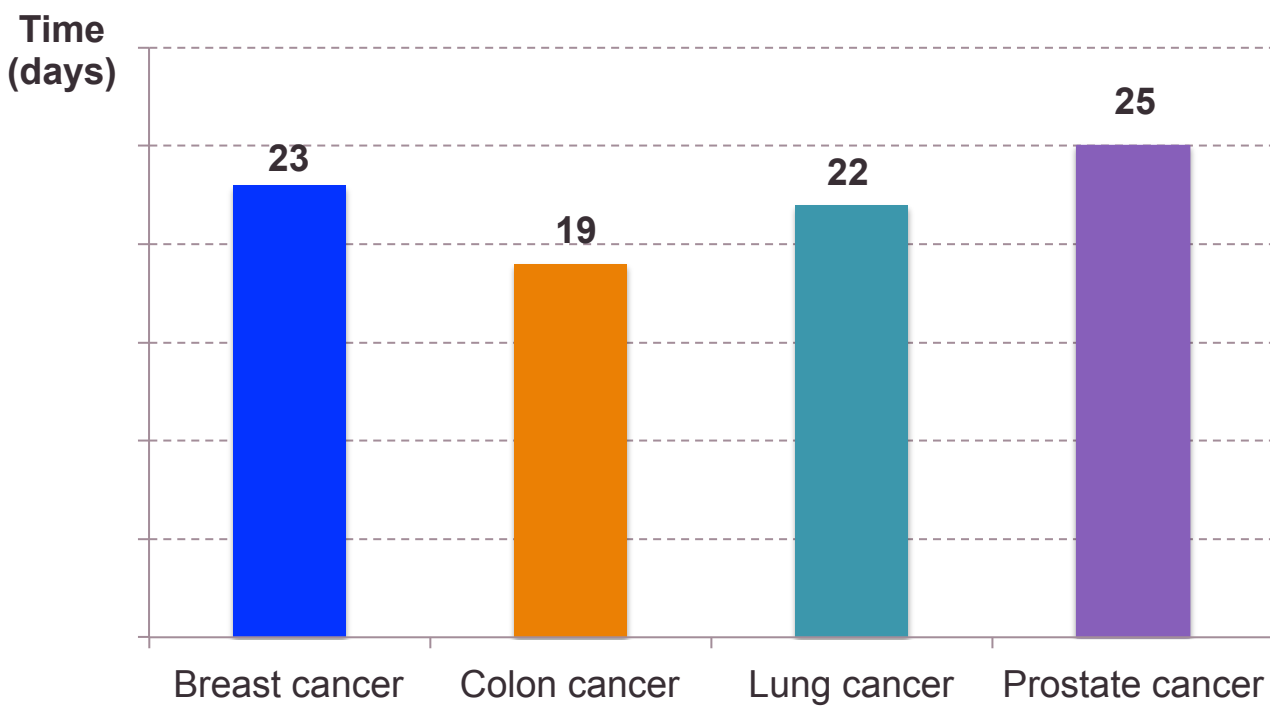
For the patients with VTE, we identified 12,880 hospital stays. 3,969 admissions (30,8%) were therefore due to a recurrent VTE (**Table 2**). The mean number of stays per patient with VTE was 1.45.

Table 2. Admissions for recurrent VTE (VTE as primary, related and significant associated diagnosis)

	Overall admissions	Admissions for recurrent VTE	Percentage of admissions for recurrent VTE
Breast cancer	1,604	333	20.76%
Colon cancer	4,104	1,238	30.17%
Lung cancer	5,962	2,185	36,65%
Prostate cancer	1,210	213	17.6%
Total	12,880	3,969	30.82%

Median duration from the first event to recurrent VTE has been identified for the four types of cancer (**Figure 1**). It ranged from 19 to 25 days depending on the cancer localization.

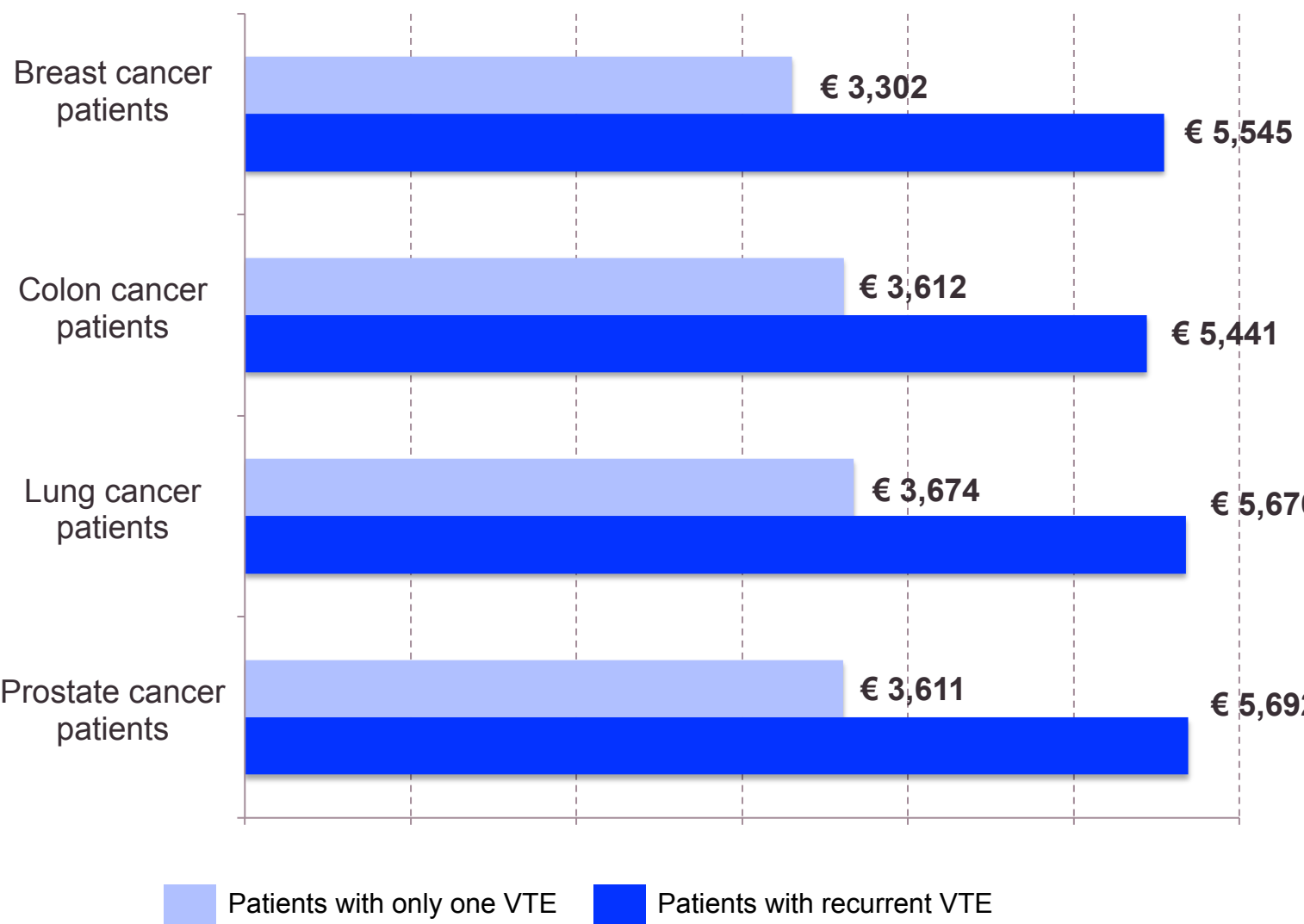
Figure 2. Median duration from the first event to recurrent VTE (days)



③ Costs evaluation

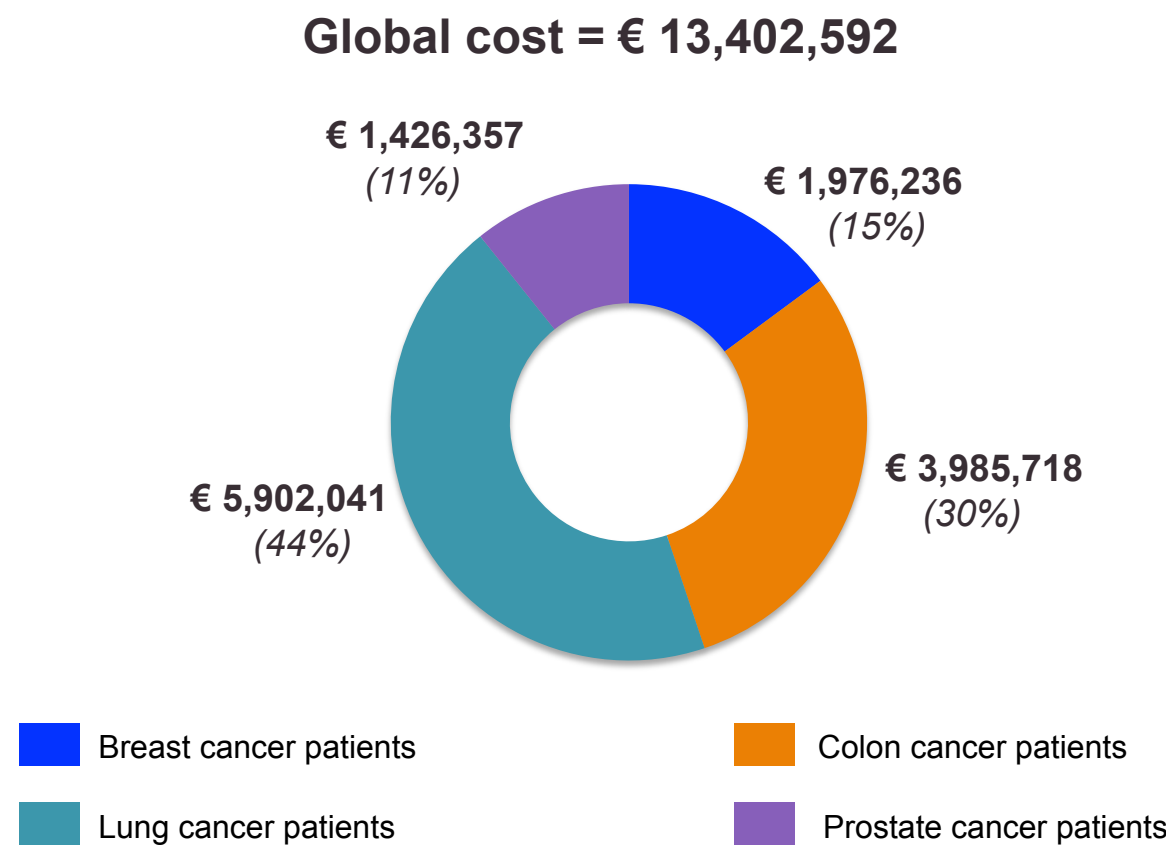
During the 2-year follow-up, the mean cost per stay ranged from €3,302 to €3,674 for the first event depending on the type of cancer. For recurrent events, the mean cost per stay ranged from €2,916 to €3,457. For patients with recurrent VTE, the cost was therefore dramatically increased in the four types of cancer, from €5,441 to €5,692 (**Figure 3**).

Figure 3. Mean cost per patient hospitalized at least once (VTE as PD/RD only)



The global cost of VTE-related hospitalizations neared **€13.4 millions** over a two-year period, for admissions with VTE as primary or related diagnosis only (**Figure 4**). Re-hospitalizations for recurrent VTE represented a total cost of **€1,822,571** (13.71%), including €186,620 for breast cancer patients, €608,499 for colon cancer patients, €879,492 for lung cancer patients and €147,959 for prostate cancer patients.

Figure 4. Global cost of VTE-related hospitalizations over a 2-year period (VTE as PD/RD only)



- Among a population of 194,964 new patients with breast, colon, lung or prostate cancer, 8,809 patients experienced a thrombosis event leading to hospitalization. The cost of these hospitalizations in France appears to be elevated: € 13.4 million dedicated to this complication. Moreover, we did not consider admissions with VTE as a significant associated diagnosis, neither ambulatory costs nor indirect costs.
- Compared to our previous study on breast and prostate cancer only, we found that VTE was highly more frequent in lung cancer and colon cancer patients, leading to a much more elevated global cost for the management of thombosis in these two cancers.
- The mean cost of VTE hospital management ranged from € 3,302 to € 5,692 per patient experiencing a VTE and per year. This cost is substantial considering that the global yearly expenditure for a cancer patient is estimated at € 10,000 per year (all types of cancer included).
- Yet, thrombosis incidence could be reduced and recurrence could be avoided by recommended VTE prophylaxis and management. Indeed, although the guidelines are consistent and easy to implement, they're poorly followed:
 - the ENDORSE study showed that only 55% of French cancer patients with thrombosis risks were administered prophylaxis (2011)¹¹;
 - the CARMEN study showed that 58% of French cancer patients with VTE were treated in accordance with recommendations (2010)¹².
- A better follow-up of recommendations regarding both curative and preventive treatments as well as ambulatory management could reduce thrombosis incidence and recurrence in patients with cancer and decrease the cost of its management.

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