

Hospital Costs in resected patients with early-stage Non-Small Cell Lung Cancer (NSCLC): A French Real-World Retrospective Study Based on the National Hospitalization Database (PMSI)

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Objectives

- Lung cancer is the leading cause of cancer deaths in France and worldwide (1,2), and the second and third most common cancers in France, in men and women, respectively (3).

- In France, 52,777 new cases were reported in 2023 while 33,100 deaths were registered in 2018 (3).

- Among lung cancers, 87% are Non-Small Cell Lung Cancer (NSCLC), and 42% of NSCLC are diagnosed at a localized or locally advanced stage (4).

- In patients with localized or locally advanced disease (except for stages IIIB and IIIC), lung resection is the reference treatment strategy (5) and may be combined with neoadjuvant and/or adjuvant chemotherapy, depending on stage of the disease and patients' characteristics (6,7).

- As no economic burden data was available, the aim of this study was to generate real-world data on hospital costs in resected early-stage NSCLC patients to fill this information gap.

Methods

Study design

- This was a non-interventional national retrospective study using secondary data from the French National Hospitalization Database (PMSI).

- PMSI database exhaustively includes hospital-related claims irrespective to healthcare insurance system or hospital settings (public/private). It is composed of four main domains: medicine, surgery and obstetric (MCO); home care (HAD); post-acute care and rehabilitation (SSR) and psychiatry. Data from MCO, SSR and HAD were used to carry out this study.

Study population

- Patients with lung cancer (at least one ICD-10 code *C34 Malignant tumour of the bronchi and lung* as principal, related or associated diagnosis) and who had undergone a first lung resection (at least one CCAM code of interest) between January 1st, 2015 and December 31st, 2020 were included.

- Lung resections included infirralobar resections, lobectomies (including segmentectomies, as the latter are not identifiable in the PMSI when performed by videothoracoscopy), bilobectomies, and pneumonectomies.

- Index date was defined as date of the first lung resection.

- The exclusion criteria were as follows: patients aged less than 18 years or who had received in the 3 years prior to the index date at least one CCAM code relating to lung resection or who had received in the 3 years prior to the index date, during the index stay and/or in the 3 months following the index date at least one ICD-10 code relating to metastases or at least one reimbursement for immunotherapy or targeted therapy used in the treatment of local recurrence or advanced stages.

- It was accepted that the study population mainly gathered incident patients operated at an early-stage of NSCLC, since lung resection is very rarely used in Small Cell Lung Cancer (SCLC) and stages with local recurrence, or advanced or metastatic disease were excluded.

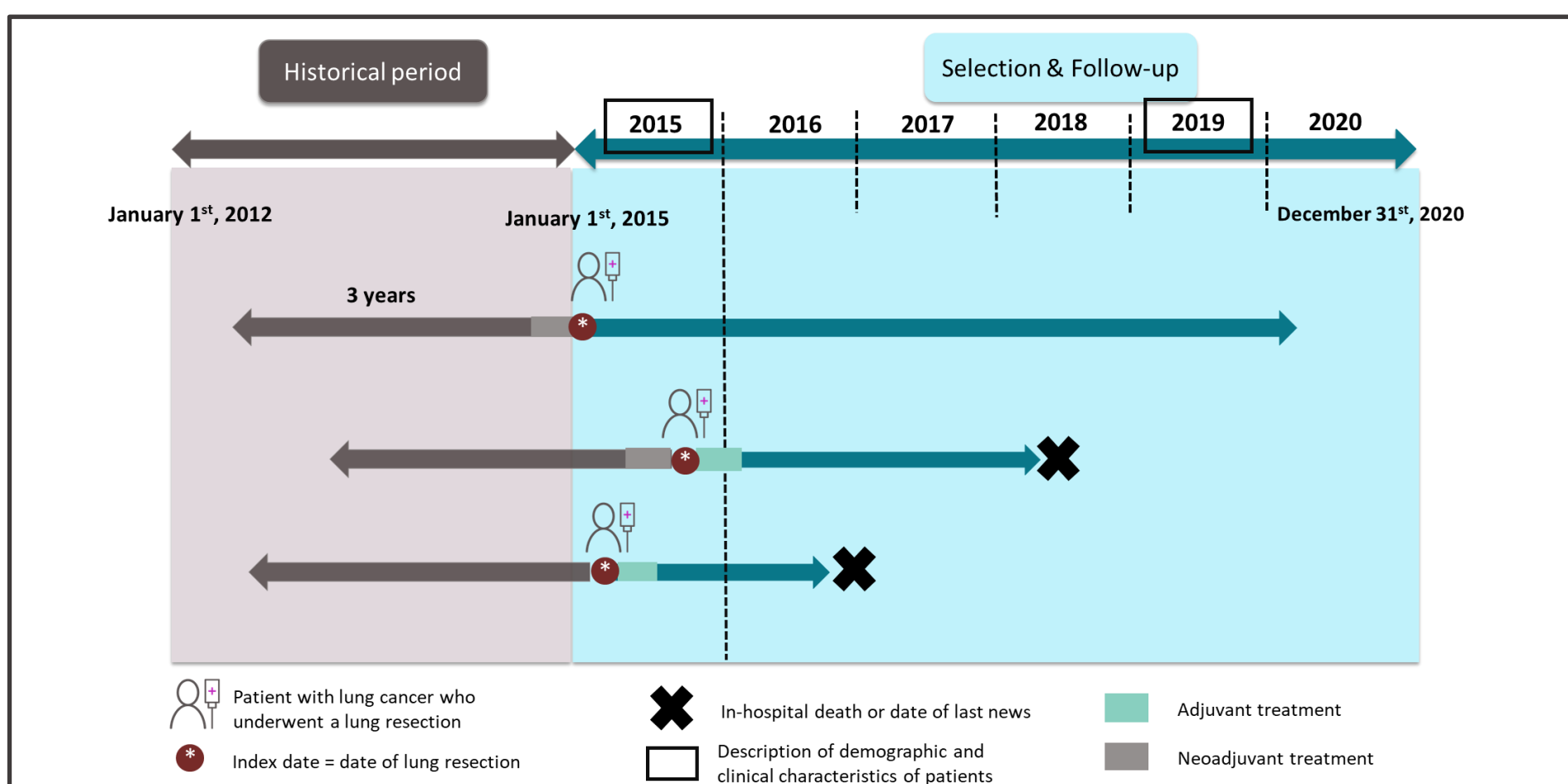
Statistical methodology

- Patients' characteristics:
 - are described among patients identified in 2015 and 2019 as year 2020 was considered as not representative due to COVID-19 context.
 - included age, gender, comorbidities, treatment history, and type of NSCLC therapy (surgery alone, neoadjuvant ± adjuvant chemotherapy, or adjuvant chemotherapy alone). A historical period of 3 years prior to index date was used to identify comorbidities and treatment history.

- The types of surgery were identified during the index stay.

- For survival analysis, as well as for evaluation of economic burden, patients who had undergone lung resection between January 1st, 2015, and December 31st, 2015 were selected and followed from index date until date of last registered hospital resource utilization or until in-hospital death, whichever occurred first (Figure 1).

Figure 1. Study design



Costs considered and assessment of costs

- Costs included all the collected costs in the PMSI, presented in Table 1.

Table 1. Type of costs collected in the PMSI

Item	Definition
Stay	Stays in medicine, surgery, obstetrics, home care and post-acute care and rehabilitation
Expensive therapy (« liste en sus »)	Treatments administered during hospitalization and not included in DRG-related cost
Intensive care unit admission	Admission to reanimation unit, intensive care unit, ...
Emergency room admission	Admission followed or not followed by a in-hospital stay
Hospital specialist visits	Visits identified in public hospitals only
DRG: diagnosis related group.	

- Costs were calculated from a hospital perspective using average costs per diagnosis related group (DRG) edited yearly by the French National Hospital Information Agency (*Etude Nationale des Coûts*, ENC). The 2018 ENC costs were used and were updated to 2020 costs using the National Institute of Statistics and Economic Studies (*Institut National de la Statistique et des Etudes Economiques*, INSEE) consumer price index for health services.

- Costs per patient were described at index stay overall and by type of surgery, and per-month by periods without recurrence (from end of index stay up to first recurrence or end of follow-up), with local recurrence (from local recurrence up to distant recurrence or end of follow-up), and with distant recurrence (from distant recurrence up to end of follow-up).

Results - Population description

Study population

- Between 2015 and 2020, 57,801 patients with early-stage NSCLC underwent a first lung resection.

- The annual number of these patients increased by an average of 4.5% per year between 2015 (n=8,688) and 2019 (n=10,330).

- Patient characteristics were similar between 2015 and 2019 (Table 2).

- In 2015 and 2019, surgery alone was the most common therapy for NSCLC (68.7% and 71.4%), followed by adjuvant chemotherapy (24.7% and 23.3%), then neoadjuvant ± adjuvant chemotherapy (6.6% and 5.2%) (Table 2).

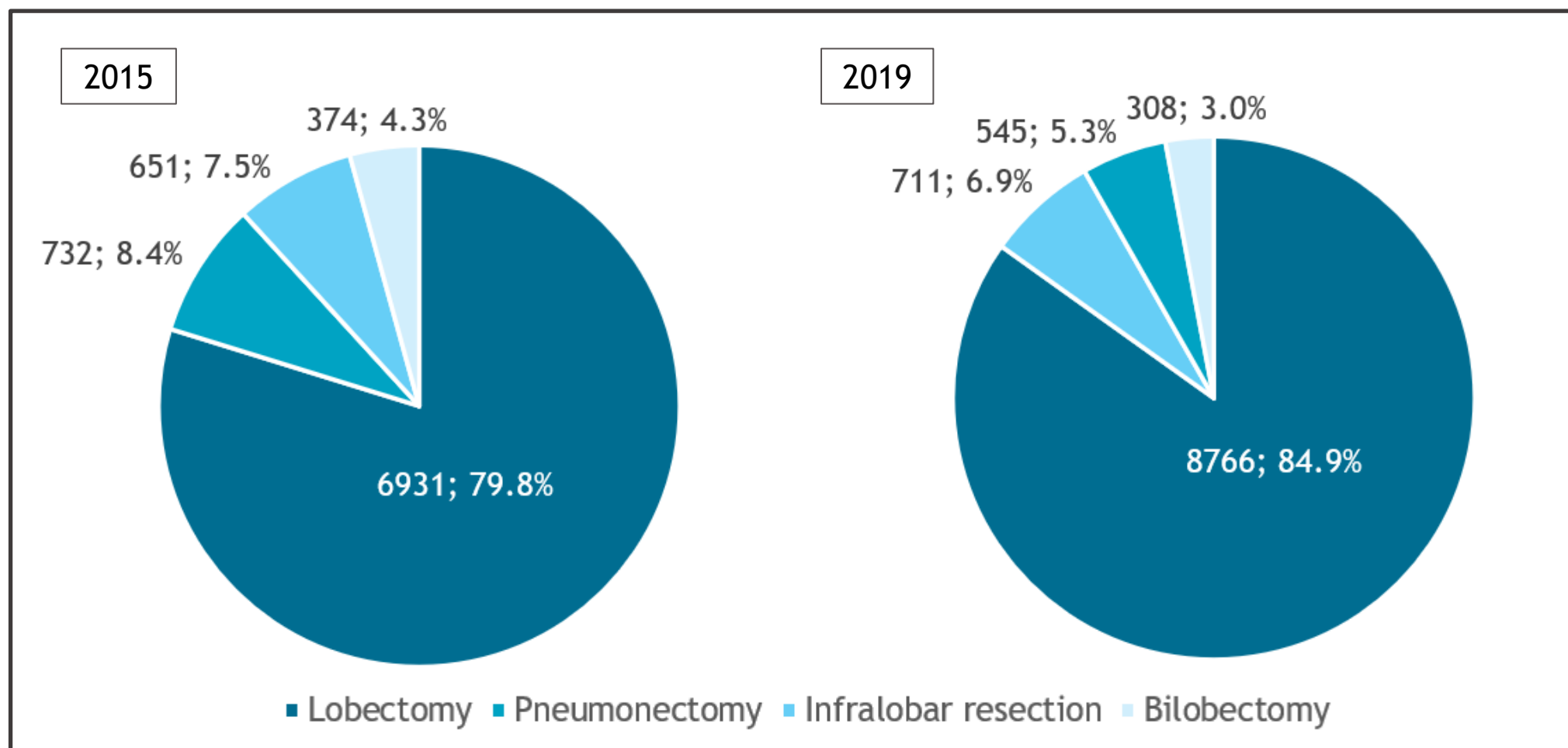
Table 2. Patient characteristics at the time of lung resection, by year

Characteristics	Patients with early-stage NSCLC undergoing surgery in 2015 (n= 8,688)	Patients with early-stage NSCLC undergoing surgery in 2019 (n= 10,330)
Age (years)		
Median (Q1 - Q3)	65.0 (59.0 - 72.0)	67.0 (60.0 - 72.0)
<70 years	5,845 (67.3%)	6,449 (62.4%)
[70 - 75[years	1,365 (15.7%)	2,014 (19.5%)
≥75 years	1,478 (17.0%)	1,867 (18.1%)
Male, n (%)	5,767 (66.4%)	6,393 (61.9%)
Main comorbidities, n (%)		
Chronic pulmonary disease	3,350 (38.6%)	3,837 (37.1%)
Obesity	1,719 (19.8%)	2,080 (20.1%)
Diabetes	1,333 (15.3%)	1,550 (15.0%)
Peripheral vascular disease	1,318 (15.2%)	1,406 (13.6%)
Myocardial infarction	837 (9.6%)	995 (9.6%)
Cerebrovascular disease	569 (6.5%)	709 (6.9%)
Congestive heart failure	414 (4.8%)	454 (4.4%)
Chronic kidney disease	356 (4.1%)	483 (4.7%)
Treatment history, n (%)		
Radiotherapy	218 (2.5%)	246 (2.4%)
Chemotherapy ^a	260 (3.0%)	274 (2.7%)
NSCLC therapy, n (%)		
Surgery alone	5,972 (68.7%)	7,379 (71.4%)
Neoadjuvant ± adjuvant chemotherapy	574 (6.6%)	540 (5.2%)
Adjuvant chemotherapy alone	2,142 (24.7%)	2,411 (23.3%)

^aDoes not include adjuvant chemotherapy.

- Between 2015 and 2019, the use of lobectomy increased by around 5 points (79.8% and 84.9%), while the use of pneumonectomy (8.4% and 5.3%) and bilobectomy (4.3% and 3.0%) declined. Only the use of infirralobar resection remained stable (7.5% and 6.9%) (Figure 2).

Figure 2. Types of surgery performed in 2015 and 2019



Results - Survival analysis

- In 2015 resected early-stage NSCLC patients, the observed median (Q1-Q3) time of follow-up was 63.0 (47.0 - 67.0) months.

- The 1-month, 3-month, and 5-year DFS and OS [CI95%] from lung resection were 94.7% [94.2-95.2], 90.4% [89.8-91.0], 48.9% [47.8-50.0] and 96.9% [96.5-97.3], 96.0% [95.5-96.4], 66.8% [65.8-67.9], respectively (Figures 3 and 4).

Figure 3. Disease-free survival from lung resection (Kaplan-Meier method)

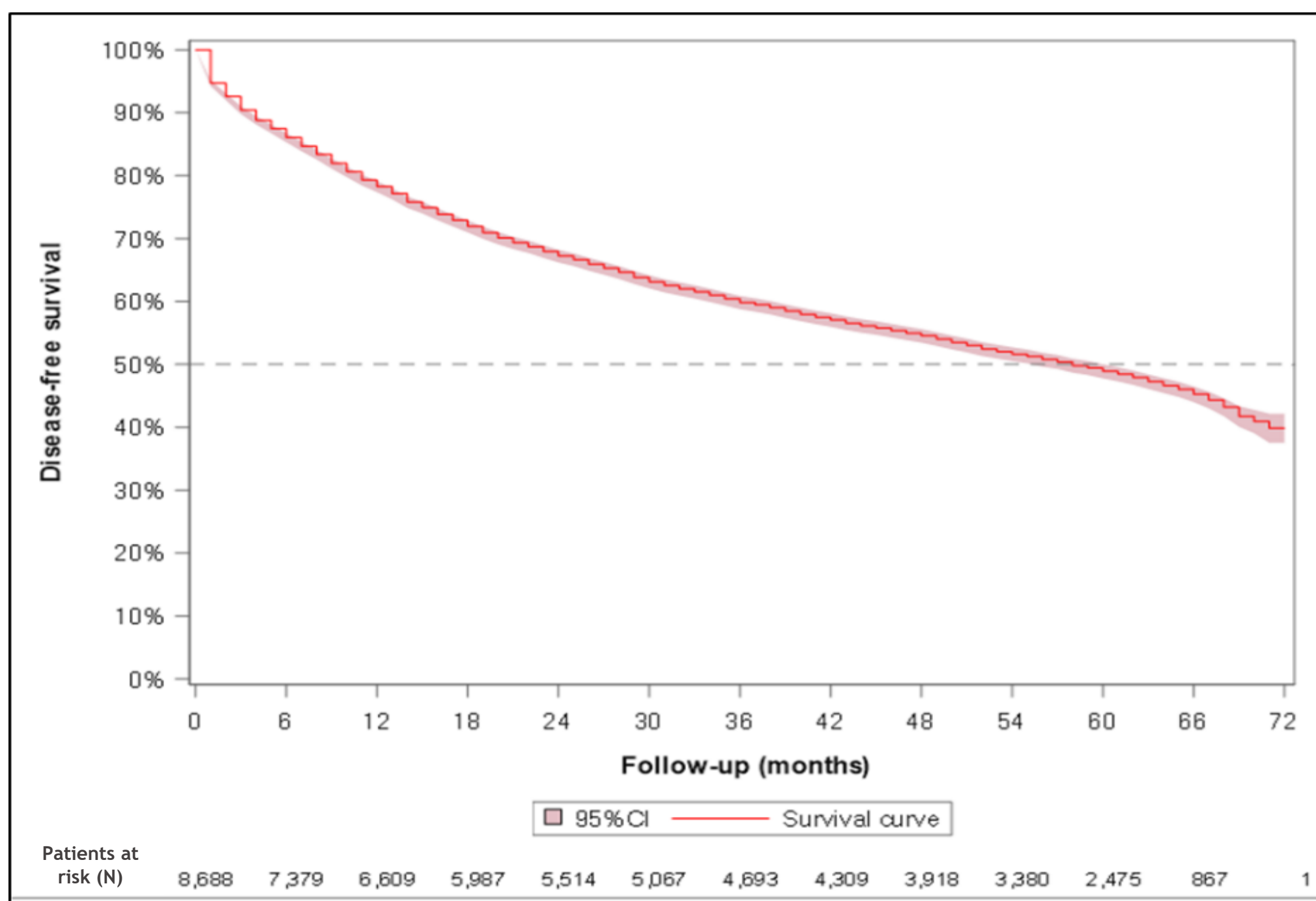
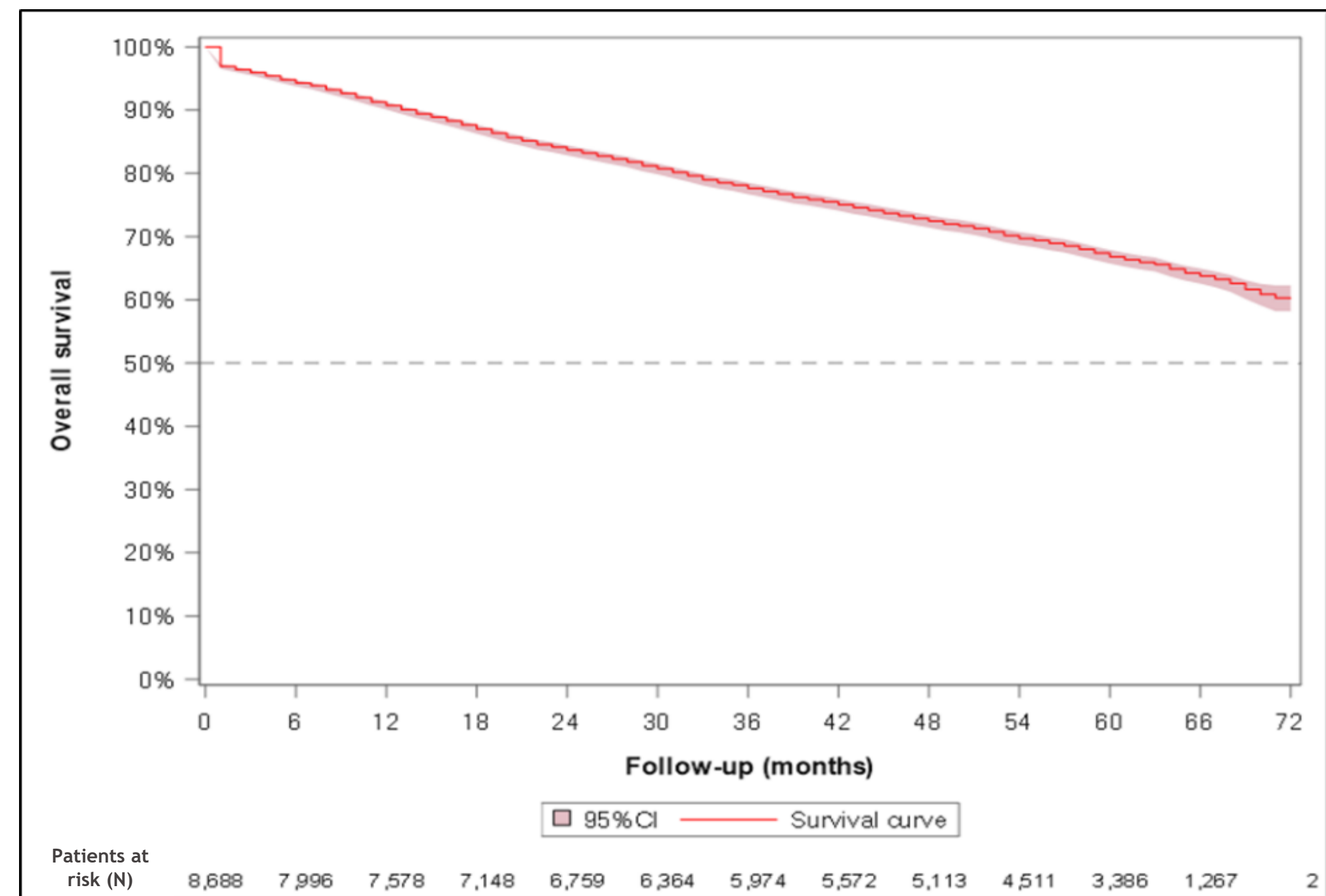


Figure 4. Overall survival from lung resection (Kaplan-Meier method)



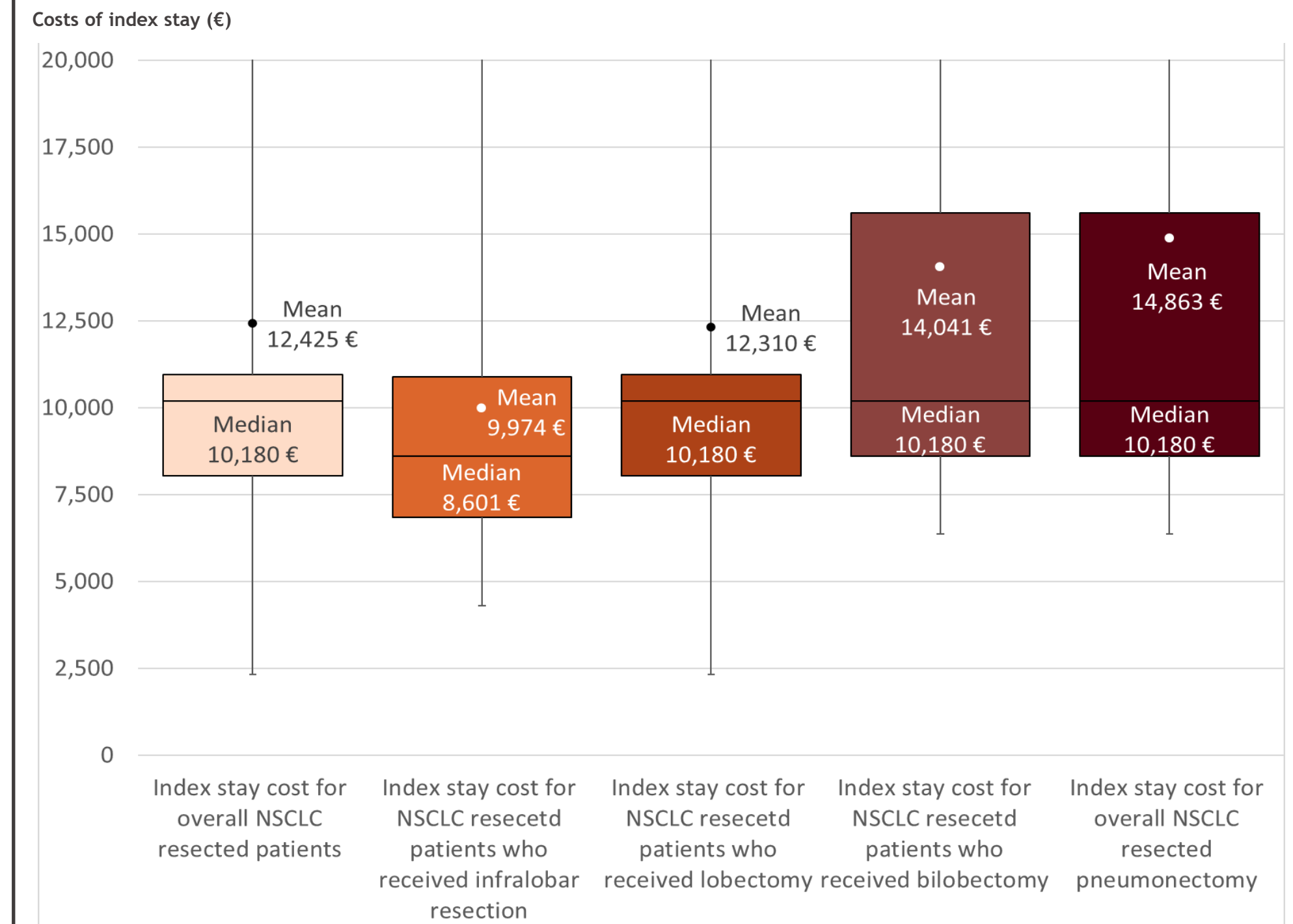
Results - In-hospital costs

Costs of index stay overall and by type of surgery

- At index stay, mean overall costs were €12,425 (±8,234) whatever the type of surgery.

- The less conservative the surgery was, the more expensive the index stay was with mean (± standard deviation) ENC costs per patient of €9,974 (±6,207), €12,310 (±8,023), €14,041 (±9,596), and €14,863 (±10,066), for patients with infirralobar resection, lobectomy, bilobectomy, and pneumonectomy, respectively (Figure 5).

Figure 5. Costs of index stay, overall and by type of surgery



Overall and monthly costs, by periods without recurrence, with local recurrence and with distant recurrence

- During follow-up, mean (± standard deviation) monthly and overall costs per patient were €950 (±2,325) and €28,334 (±31,687).

- Periods with recurrences, especially distant recurrences, were more expensive than periods without recurrence, with mean monthly and overall costs per patient of €835 (±2,266) and €15,407 (±21,303), €1,677 (±2,851) and €21,349 (±19,683), and €4,607 (±6,051) and €33,119 (±29,042), during periods without recurrence, with local recurrence, and with distant recurrence, respectively (Figures 6 and 7).

Figure 6. Overall costs, by periods without recurrence, with local recurrence and with distant recurrence

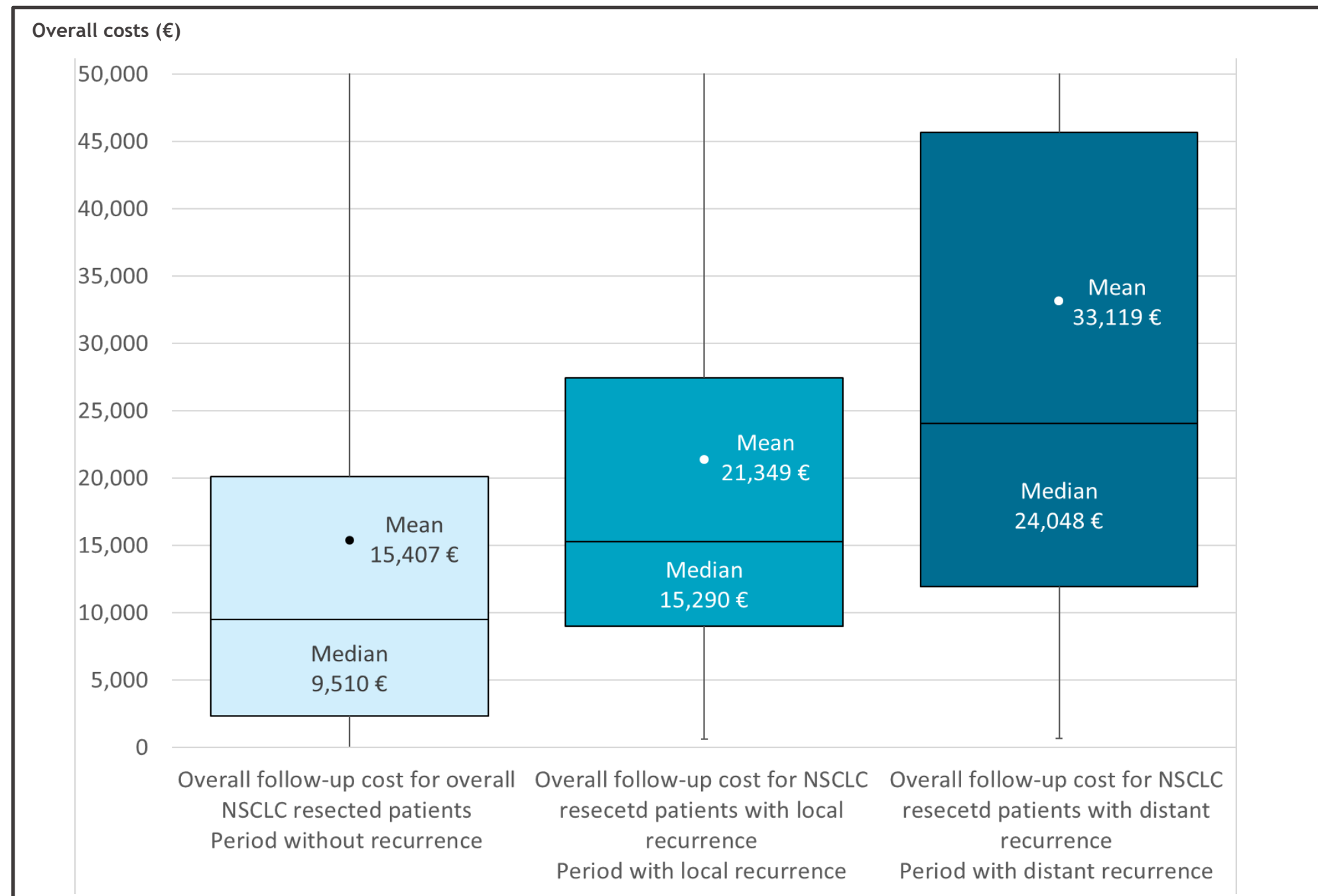
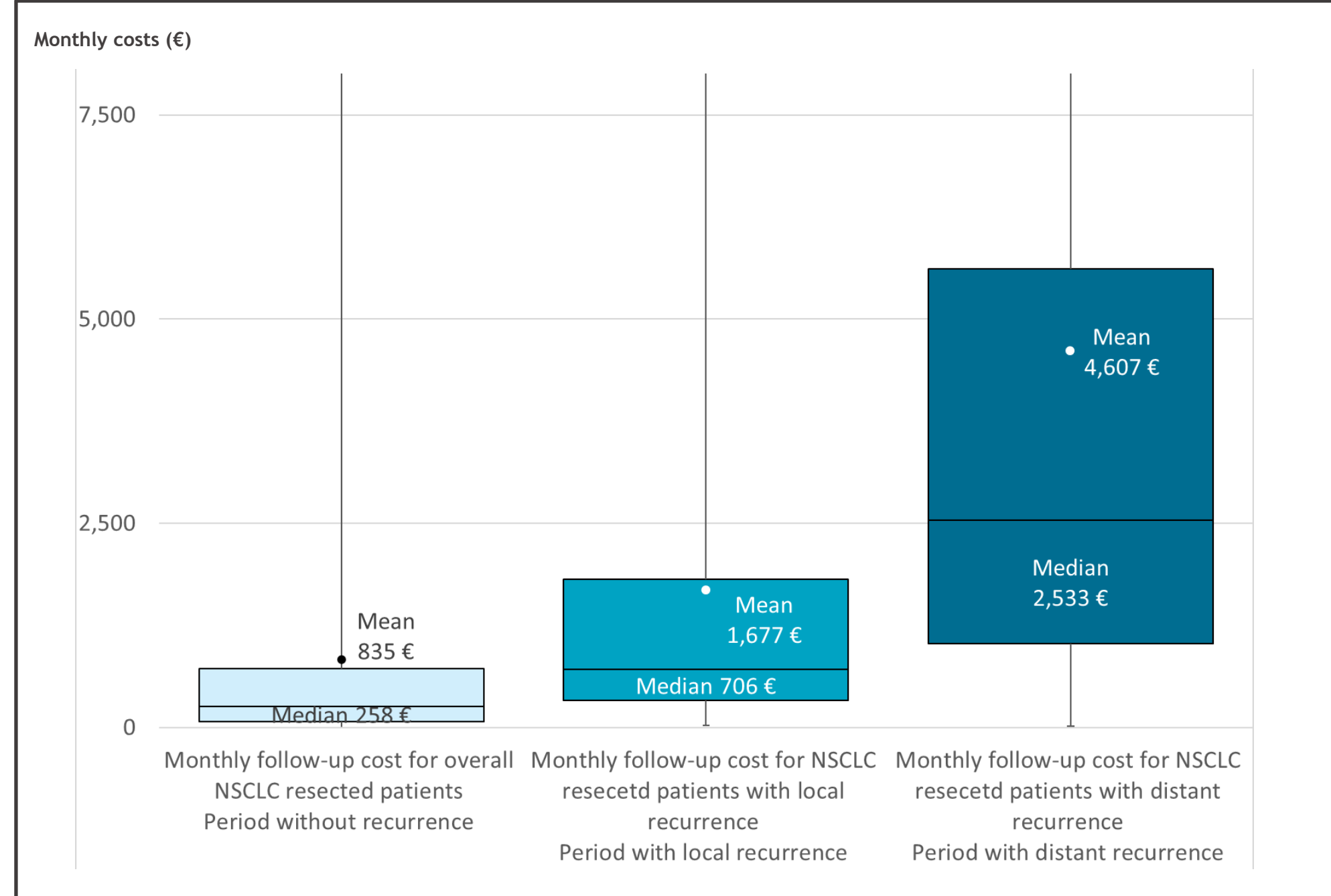


Figure 7. Monthly costs, by periods without recurrence, with local recurrence and with distant recurrence



Conclusions

- This study provides the first and exhaustive real-world evidence of in-hospital costs related to resected early-stage NSCLC patients who have undergone a lung resection in France since 2015, with a 6-year maximum follow-up.

- This study highlights the economic burden of resected early-stage NSCLC, both during index stay for first lung resection and over whole follow-up period.

- Mean costs varied by type of surgery and increased after disease progression, especially in case of distant recurrence.

- Optimal patient management at an early stage may prevent or delay costly recurrences.

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