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ORIGINAL ARTICLE

Chemotherapy uptake and wait times in early-stage non-small-cell lung cancer

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ABSTRACT

Background

Treatment uptake and elapsed times along the care path have emerged as potential quality indicators for cancer care delivery. This retrospective study examined changes in adjuvant chemotherapy uptake and elapsed times along the care path for patients in 2005 and in 2007 who had early-stage non-small-cell lung cancer (NSCLC) and who underwent curative-intent surgery in Nova Scotia, Canada.

Methods

All patients who underwent curative-intent surgery for stages I–III NSCLC in the two years of interest were included. Logistic regression and general linear models were used to examine factors associated with chemotherapy uptake patterns and, at various resolutions (low, intermediate, high), elapsed times between all care events in the care path.

Results

In the 223 patients who underwent curative-intent surgery (108 in 2005, 115 in 2007), several factors were associated with uptake patterns and elapsed times. Cohort year (2007 vs. 2005) was not associated with referral to medical oncology [odds ratio (OR): 1.05; 95% confidence interval (CI): 0.51 to 2.15; $p = 0.905$], but it was associated with less treatment after referral (OR: 0.34; 95% CI: 0.11 to 1.00; $p = 0.057$) and less overall uptake (OR: 0.35; 95% CI: 0.13 to 0.95; $p = 0.040$). Patients were referred sooner to medical oncology in 2007 than in 2005 (21 days vs. 35 days, $p = 0.008$), but experienced longer waits between consultation and chemotherapy delivery (18 days vs. 7 days, $p = 0.001$).

Conclusions

Significant differences were observed in care patterns over time. Frequent monitoring of care patterns at high resolution may optimize insights into emerging trends within cancer care systems.

KEY WORDS

Non-small-cell lung cancer, adjuvant chemotherapy, treatment uptake, elapsed times, wait times

1. INTRODUCTION

Treatment uptake and elapsed times along the care path for cancer patients have emerged as potential quality indicators for cancer care delivery[1–3]. For patients with early-stage non-small-cell lung cancer (NSCLC), the care path includes disease detection, surgical resection, and recently, adjuvant chemotherapy[4].

After curative-intent surgical resection, adjuvant chemotherapy with platinum-based regimens is currently recommended for patients with high-risk early-stage NSCLC[5–8]. In 2004, the CALGB (Cancer and Leukemia Group B) 9633[9] and NCIC JBR.10[10] trials revealed absolute survival benefits of 5%–10% after adjuvant chemotherapy (compared with observation) for stages IB and IB–II NSCLC respectively. Subsequently, a number of studies in a variety of jurisdictions observed adjuvant chemotherapy uptake rates of only 20%–30% for patients with early-stage NSCLC after curative-intent surgery[11–13]. More recently, longer follow up from CALGB 9633 found that the survival benefit associated with adjuvant chemotherapy in stage IB disease was no longer statistically significant[14]. As well, a subset analysis of NCIC JBR.10 revealed that the survival benefit in stage IB disease was limited to patients with larger tumours[15]. Adjuvant chemotherapy is therefore not currently routinely recommended for all patients with stage IB disease, and in light of the more recent data, uptake across all disease stages is largely unknown.

We previously examined the patterns of chemotherapy uptake and elapsed times along the care path for a 2005 population-based cohort with early-stage NSCLC[11,16]. Here, we report changes between 2005 and

2007 in adjuvant chemotherapy uptake and elapsed times along the care path for patients with early-stage NSCLC who underwent curative-intent surgery in Nova Scotia, Canada.

2. METHODS

The present retrospective study included all patients diagnosed with NSCLC in the years 2005 and 2007 who underwent curative-intent surgery for stages I–III disease. Patients were identified through the Nova Scotia provincial cancer registry and retrospective chart reviews at the two health centres in Nova Scotia in which thoracic surgeries are exclusively performed—the QEII Health Sciences Centre (QEII HSC) in Halifax and the Cape Breton Regional Hospital (CBRH) in Sydney. The study was approved by the ethics review boards at both participating institutions.

Data was abstracted from patient charts and the Oncology Patient Information System (a database maintained by the provincial cancer registry and the regional cancer centres). Included were age at diagnosis, sex, marital status, smoking history, score on the Charlson comorbidity index[17], distance between residence and cancer centre, disease stage, cancer histopathology, margin status, health centre where definitive surgery occurred, definitive surgery type, postoperative complications, and cohort year. Postal Code Conversion File Plus (PCCF+5F)[18] was used to compute the distance between a patient's residence and the cancer centre and to conduct neighbourhood linkages with 2006 Canadian census data to generate socioeconomic factors such as education level and median household income in the area of the patient residence[16]. Dates of these care events were also abstracted: disease detection ("Detection"), defined as the first abnormal imaging study prompting surgical consultation; first surgical consultation ("Surgery Consultation"); definitive curative-intent surgery ("Surgery"); receipt of referral to medical oncology at one of the two regional cancer centres for consideration of adjuvant systemic therapy ("Medical Oncology Referral"); first medical oncology consultation ("Medical Oncology Consultation"); and initiation of the first cycle of adjuvant chemotherapy ("Adjuvant Chemotherapy").

The proportions of patients referred to medical oncology after curative-intent surgery (that is, "Referral") and the proportions of patients treated with adjuvant chemotherapy after referral ("Treatment") were examined. As well, the proportions of patients treated with adjuvant chemotherapy among all those undergoing curative-intent surgery ("Uptake") were computed to conform with other published studies that reported only overall uptake, but not referral and treatment patterns separately. Univariate and multivariate logistic regressions were used to identify factors influencing Referral, Treatment, and Uptake patterns. Only factors with a univariate probability of nonrandom association less than 0.3 and the cohort year (fixed-effect) were entered into the multivariate analyses. The Referral analysis included all disease stages; the Treatment and Uptake analyses were limited to stages IB–III because adjuvant chemotherapy is not routinely recommended for patients with stage IA disease. The outcome variables were coded dichotomously (0 or 1): that is, referred or non-referred for the Referral analysis, and treated or not treated for the Treatment and Uptake analyses. Only patients with data available for all variables were included in the multivariate analysis. Tests of interaction between cohort year and other variables were also conducted.

Elapsed times between care events were examined at three levels of care interval resolution[16]: low (Detection to Adjuvant Chemotherapy), intermediate (Detection to Surgery and Surgery to Adjuvant Chemotherapy), and high (Detection to Surgery Consultation, Surgery Consultation to Surgery, Surgery to Medical Oncology Referral, Medical Oncology Referral to Medical Oncology Consultation, and Medical Oncology Consultation to Adjuvant Chemotherapy). All care intervals were calculated in calendar days, and only patients who experienced both events defining an interval were included in the analysis of that interval. Days were logarithmically transformed (in days + 1) to better meet the assumption of normality. A general linear model was used to identify the primary cofactors influencing elapsed times at the three levels of care interval resolution. Geometric mean wait times and their 95% confidence intervals (CIS) were estimated after adjusting for all cofactors that significantly influenced wait times. Data quality control and analyses were performed using the SAS software application (version 9.1: SAS Institute, Cary, NC, U.S.A.).

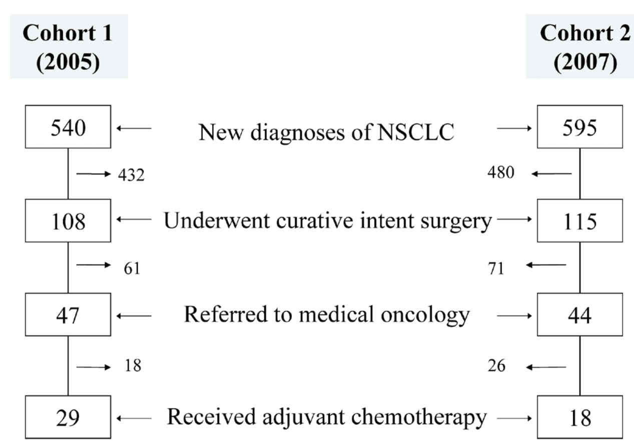

FIGURE 1 Study population: the number of cases eligible for analysis, and those excluded, in the 2005 and 2007 cohorts. NSCLC = non-small-cell lung cancer.

TABLE I Characteristics of the study population (patients undergoing curative-intent surgery)

Cofactor[a]	*Patients*						p *Value* *(2005 vs. 2007)*
	Overall		*2005*		*2007*		
	(n)	*(%)*	*(n)*	*(%)*	*(n)*	*(%)*	
Age (years)							0.415
<65	91	41	46	43	45	39	
65–75	92	41	40	37	52	45	
>75	40	18	22	20	18	16	
Sex							0.193
Male	118	53	62	57	56	49	
Female	105	47	46	43	59	51	
Smoking[b]							0.082
Current	75	34	36	33	39	34	
Former	127	57	57	53	70	61	
Never	17	8	11	10	6	5	
Comorbidity[c]							0.772
No	56	25	25	23	31	27	
Yes	167	75	83	77	84	73	
Histopathology							0.007
Adenocarcinoma	114	51	46	43	68	59	
Squamous	70	31	35	32	35	30	
Other	39	17	27	25	12	10	
Stage							0.062
IA	97	44	41	38	56	49	
IB	56	25	25	23	31	27	
II–III	70	31	42	39	28	24	
Margin[d]							0.027
Negative	203	91	99	92	104	90	
Positive	13	6	3	3	10	9	
Cancer centre							0.225
QEII HSC	194	87	97	90	97	84	
CBRH	29	13	11	10	18	16	
Surgery type							0.357
Wedge	44	20	20	19	24	21	
Lobectomy	153	69	72	67	81	70	
Pneumonectomy	26	12	16	15	10	9	
Social status[e]							0.456
Single	33	15	13	12	20	17	
Married	153	69	75	69	78	68	
Median distance (km)	69		51		81		0.294

[a] No significant differences in median household income or education level were observed between the 2005 and 2007 cohorts (data not shown).
[b] Unknown for 4 patients in 2005.
[c] "No" when score on the Charlson comorbidity index was 0; "Yes" when score was ≥1.
[d] Unknown for 6 patients in 2005 and 1 in 2007.
[e] Unknown for 20 patients in 2005 and 17 in 2007.
QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

3. RESULTS

Of the 540 and 595 patients diagnosed with NSCLC in 2005 and 2007 respectively, 108 (20%) and 115 (19%) underwent curative-intent surgery (Figure 1). Table I presents patient and disease characteristics in the study cohorts (that is, all patients who underwent curative-intent surgery). Significant differences were evident between the 2005 and 2007 cohorts in underlying histopathology (adenocarcinoma: 43% vs. 59%; squamous: 32% vs. 30%; others: 25% vs. 10%; $p = 0.007$) and margin status (negative: 92% vs. 90%; positive: 3% vs. 9%; $p = 0.027$). Other characteristics were evenly distributed between the two cohorts.

Figure 2 shows patterns of Referral, Treatment, and overall Uptake according to cohort year, and Table II further illustrates those patterns by disease stage. The Referral rates were not significantly different between the 2007 and 2005 cohorts [38% vs. 44%; relative risk (RR): 0.88; 95% CI: 0.64 to 1.21; $p = 0.425$]; Adjuvant Chemotherapy after Medical Oncology Referral declined by a relative 34% (41% vs. 62%; RR: 0.66; 95% CI: 0.44 to 1.01; $p = 0.055$) corresponding to a 42% lower chemotherapy Uptake in the latter compared with the former cohort (16% vs. 27%; RR: 0.58; 95% CI: 0.34 to 0.99; $p = 0.044$). Overall, 21% (47 of 223) of the patients who underwent curative-intent surgery in 2005 and 2007 also received adjuvant chemotherapy, including 49% (34 of 70) of those with stage II–III disease.

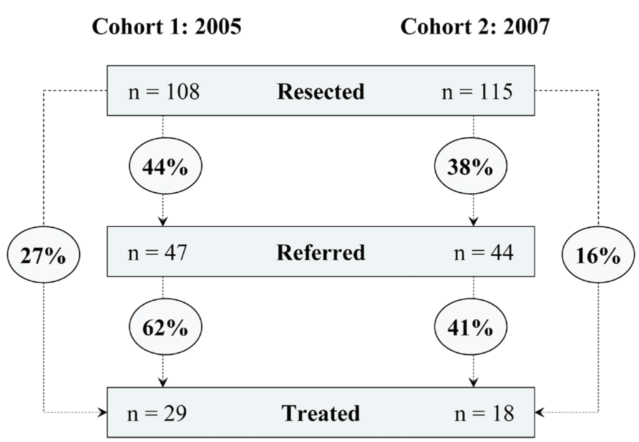

FIGURE 2 Uptake patterns: the number and percentages of patients who underwent surgical resection, and who were referred and treated, in the 2005 and 2007 cohorts.

TABLE II Uptake patterns by cohort year and disease stage

Uptake variable	*Disease stage*					
	2005			*2007*		
	IA[a]	*IB*	*II–III*	*IA*[a]	*IB*	*II–III*
Resected	41	25	42	56	31	28
Referred	4	13	30	10	9	25
Treated	0	7	22	2	4	12

[a] Multivariate analysis of treatment (treated/referred) and uptake (treated/resected) patterns did not include the stage IA patients.

A number of factors, including cohort year (2007 vs. 2005), were associated with the patterns of Referral, Treatment, and Uptake. In univariate analysis (Table III), cohort year did not appear to be a significant predictor of Referral, Treatment, or overall Uptake. In multivariate analysis (Tables IV–VI), cohort year was not associated with Referral [odds ratio (OR): 1.05; 95% CI: 0.51 to 2.15; $p = 0.905$], but it was a predictor of both less Treatment (OR: 0.34; 95% CI: 0.11 to 1.00; $p = 0.057$) and less overall Uptake (OR: 0.35; 95% CI: 0.13 to 0.95; $p = 0.040$). Other independent predictors of Referral, Treatment, and overall Uptake included age, comorbidities, disease stage, cancer centre, and surgery type (Tables IV–VI). Tests of interaction further revealed that, compared with the earlier cohort (2005), the later cohort (2007) was specifically associated with less Referral (Table IV) for stage IB disease (OR: 0.27; 95% CI: 0.08 to 0.94; $p = 0.039$) and also less Treatment (Table V—OR: 0.2; 95% CI: 0.06 to 0.8; $p = 0.020$) and lower overall Uptake (Table VI—OR: 0.21; 95% CI: 0.06 to 0.67; $p = 0.008$) at the QEII HSC.

A number of factors, including cohort year (2007 vs. 2005), were associated with elapsed times (Figure 3). Cohort year was associated with the Surgery–to–Medical Oncology Referral and the Medical Oncology Consultation–to–Adjuvant Chemotherapy intervals. After surgical resection, patients were referred sooner to medical oncology in 2007 than in 2005 (21 days vs. 35 days, $p = 0.008$), but experienced longer wait times between Medical Oncology Consultation and Adjuvant Chemotherapy delivery (18 days vs. 7 days, $p = 0.001$). Overall, elapsed times between surgical resection and adjuvant chemotherapy administration were not significantly different between 2007 and 2005 (64 days vs. 55 days, $p = 0.53$). Other factors associated with elapsed times included age, comorbidities, disease stage, and cancer centre (Figure 3).

4. DISCUSSION

The significant changes in chemotherapy Uptake (27% in 2005 vs. 16% in 2007) and in elapsed times observed in our study arose over a relatively short period and suggest that frequent monitoring of care indicators will be required to better capture emerging or evolving trends in care patterns. A number of other studies have also reported significant changes over time in chemotherapy Uptake for patients with early-stage NSCLC[12,13,19] and also in elapsed times for patients with early-stage breast cancer[20]. More

TABLE III Results of the univariate analysis

Cofactor[a]	*Referral* (n/N)	(%)	p Value	Treatment (n/N)	(%)	p Value	Overall uptake (n/N)	(%)	p Value
Cohort year			0.425			0.074			0.061
2005	47/108	(44)		29/43	(67)		29/67	(43)	
2007	44/115	(38)		16/34	(47)		16/59	(27)	
Age (years)			0.025			0.013			<0.001
<65	47/91	(52)		31/42	(74)		31/52	(60)	
65–75	31/92	(34)		10/24	(42)		10/50	(20)	
>75	13/40	(33)		4/11	(36)		4/24	(17)	
Comorbidity[b]			0.718			0.026			0.075
No	24/56	(43)		18/23	(78)		18/38	(47)	
Yes	67/167	(40)		27/54	(50)		27/88	(31)	
Stage[c]			<0.001			0.344			0.001
IA	14/97	(14)		—	—		—	—	
IB	22/56	(39)		11/22	(50)		11/56	(20)	
II–III	55/70	(79)		34/55	(62)		34/70	(49)	
Cancer centre			<0.001			0.087			0.001
QEII HSC	66/194	(34)		30/57	(53)		30/104	(29)	
CBRH	25/29	(86)		15/20	(75)		15/22	(68)	
Surgery type[d]			<0.001			0.026			<0.001
Wedge	5/44	(11)		—	—		—	—	
Lobectomy	63/153	(41)		27/54	(50)		27/101	(27)	
Pneumonectomy	23/26	(88)		18/23	(78)		18/25	(72)	
Social status			0.019			0.711			0.688
Single	20/33	(61)		9/17	(53)		9/22	(41)	
Married	61/153	(40)		31/53	(58)		31/86	(36)	
Distance (km)[e]	—		0.005	—		0.216	—		0.044
Detection–Surgery (days)[e]	—		0.044	—		0.209	—		0.013

[a] Only cofactors with at least one Uptake pattern $p < 0.05$, and the cohort year, are shown. The cohorts for Treatment and overall Uptake include only patients referred with stage IB–III disease (that is, excluding stage IA).
[b] "No" when score on the Charlson comorbidity index was 0; "Yes" when score was ≥1.
[c] Stage IA excluded from the treatment and uptake analyses.
[d] Because of the small numbers of patients with wedge resections, wedge resection and lobectomy were combined in the Treatment and Uptake analyses.
[e] Modelled as a continuous variable.
QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

importantly, the more detailed analysis of overall treatment Uptake (that is, the analysis of referral and treatment patterns separately) and the elapsed-times analyses based on high-resolution care intervals (compared with intervals used in other reports) in the present study were more informative in understanding changes in care patterns[21–23].

The analysis of overall Uptake identified a number of factors associated with higher chemotherapy use, including younger age, less comorbidity, higher

TABLE IV Multivariate analysis: referral patterns in 223 patients[a]

Cofactor[b]	*Referred/resected (n/N)*	*Odds ratio*	*95% CI*	p *Value*[c]
Year[d]				0.905
2005 (reference)	47/108			
2007	44/115	1.05	0.51 to 2.15	
Stage				<0.001
IB (reference)	22/56			
IA	14/97	0.33	0.14 to 0.80	
II–III	55/70	4.9	2.1 to 11.7	
Cancer centre				<0.001
QEII HSC (reference)	66/194			
CBRH	25/29	12.4	3.5 to 43.8	
Surgery type				0.012
Lobectomy (reference)	63/153			
Wedge	5/44	0.33	0.1 to 1.1	
Pneumonectomy	23/26	4.7	1.2 to 18.9	
2007 vs. 2005 : stage[e]				0.025
IB	9/31 vs. 13/25	0.27	0.08 to 0.94	0.039
IA	10/56 vs. 4/41	1.7	0.4 to 6.5	0.449
II–III	25/28 vs. 30/42	3.4	0.8 to 14.4	0.101

[a] Only patients with complete data for all variables were included in the multivariate analysis. This cohort includes patients who underwent resection for all disease stages (IA–III). The outcome variable is referred versus non-referred.
[b] Only variables retained in the final multivariate model are shown.
[c] By likelihood ratio chi-square test.
[d] Cohort year was fixed in the main effects models.
[e] Only variables that had significant interactions with year are shown.
CI = confidence interval; QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

disease stage, CBRH treatment centre, and more-aggressive surgery. However, the detailed analyses of Referral and Treatment further highlighted factors that could have potentially influenced decisions by surgical and medical oncologists. Patients with higher-stage disease (II/III vs. IB vs. IA) and those who underwent more-aggressive surgery (pneumonectomy vs. lobectomy) were more likely to be referred by surgeons for consideration of adjuvant chemotherapy. In contrast, patients less than 65 years of age and those without comorbidities were more likely to undergo chemotherapy after their medical oncology consultation. A greater proportion of Referrals and Treatments were also both observed at the CBRH centre than at the QEII HSC, perhaps reflecting different practice patterns between the smaller community-based centre (CBRH) and the larger tertiary-care centre (QEII HSC).

The elapsed-times analyses based on high-resolution care intervals also revealed wait-time patterns that were undetected at low- or intermediate-resolution intervals. In our study, differences in elapsed times between the 2005 and 2007 cohorts at low- or intermediate-resolution intervals were nonsignificant, but patients in 2007 experienced shorter elapsed times between Surgery and Medical Oncology Referral and longer elapsed times between Medical Oncology Consultation and Adjuvant Chemotherapy than did patients in 2005. The former decrease in elapsed time could be the result of a more efficient process of identifying patients who would potentially benefit from Medical Oncology Consultation after Surgery, and the latter increase in elapsed time might indicate limitations in system capacity at the level of Medical OncologyConsultation despite fewer referrals for adjuvant NSCLC chemotherapy. Overall, a median elapsed time of approximately 7.5 weeks (53 days) was observed between Surgery and Adjuvant Chemotherapy in our study, which is generally consistent with the 6- to 8-week post-surgery

TABLE V Multivariate analysis: treatment pattern in 77 patients[a]

Cofactor[b]	*Treated/referred* (n/N)	*Odds ratio*	*95% CI*	p *Value*[c]
Year[d]				0.057
2005 (reference)	29/43			
2007	16/34	0.34	0.11 to 1.0	
Age (years)				0.027
<65 (reference)	31/42			
65–75	10/24	0.27	0.08 to 0.85	
>75	4/11	0.18	0.04 to 0.87	
Comorbidity[e]				0.028
No (reference)	18/23			
Yes	27/54	0.24	0.07 to 0.86	
Cancer centre				0.033
QEII HSC (reference)	30/57			
CBRH	15/20	4.7	1.1 to 19.2	
2007 vs. 2005 : cancer centre[f]				0.13
QEII HSC	7/22 vs. 23/35	0.2	0.06 to 0.8	0.02
CBRH	9/12 vs. 6/8	1.8	0.2 to 18.9	0.628

[a] Only patients with complete data for all variables were included in the multivariate analysis. This cohort includes patients referred with stage IB–III disease (that is, excluding stage IA). The outcome variable is treated versus not treated.
[b] Only variables retained in the final multivariate model are shown.
[c] By likelihood ratio chi-square test.
[d] Cohort year was fixed in the main effects models.
[e] "No" when score on the Charlson comorbidity index was 0; "Yes" when score was ≥1.
[f] Only variables that had significant interactions with year are shown.
CI = confidence interval; QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

timeline criterion used for enrolment in clinical trials that examined adjuvant chemotherapy in lung cancer[7–10,16]. The foregoing observations highlight the complexity of the balance between care demand and system capacity in health care systems and also the balance between wait times for one disease site apart from all other competing ones. Nevertheless, elapsed-time monitoring at high-resolution intervals could provide opportunities for relevant intervention to maintain wait times within acceptable benchmarks.

Disease stage was an important predictor of Referral and overall Uptake, but not of Treatment. Overall, compared with patients having stage IB disease, those with stage II/III disease were more likely to be referred (79% vs. 39%; OR: 4.9; 95% CI: 2.1 to 11.7; $p < 0.001$), although disease stage was not an independent predictor of adjuvant chemotherapy administration after referral. That observation perhaps suggests that surgeons selectively refer patients with stage IB disease who are more likely to be recommended for, or to accept, adjuvant chemotherapy. Interestingly, in 2007 compared with 2005, patients with stage IB disease were less likely to be referred to medical oncology, and those referred at QEII HSC were less likely to receive adjuvant chemotherapy after referral. The decline in stage IB referrals was expected given the recently demonstrated lack of survival benefit for adjuvant chemotherapy in stage IB disease with small tumour size[8,14,24,25]. A recent Canadian study from Alberta similarly observed a significant decline in adjuvant chemotherapy uptake for stage IB lung cancer in 2006 compared with 2005 or 2004[13]. However, the overall decline in chemotherapy administration observed in our study in 2007 at QEII HSC was somewhat surprising. It could, perhaps, reflect an overall declining enthusiasm for platinum-based chemotherapy, given the relatively modest associated survival benefit and the potential residual peripheral neuropathy.

TABLE VI Multivariate analysis: overall uptake in 126 patients[a]

Cofactor[b]	*Treated/resected (n/N)*	*Odds ratio*	*95% CI*	p *Value*[c]
Year[d]				0.04
2005 (reference)	29/67			
2007	16/59	0.35	0.13 to 0.95	
Age (years)				0.001
<65 (reference)	31/52			
65–75	10/50	0.3	0.11 to 0.84	
>75	4/24	0.07	0.02 to 0.32	
Comorbidity[e]				0.016
No (reference)	18/38			
Yes	27/88	0.26	0.09 to 0.78	
Stage[f]				0.033
IB (reference)	11/56			
II–III	34/70	3.1	1.10 to 8.84	
Cancer centre				0.002
QEII HSC (reference)	30/104			
CBRH	15/22	8.5	2.2 to 33.0	
Surgery type				0.025
Lobectomy/wedge (reference)[g]	27/101			
Pneumonectomy	18/25	4.2	1.2 to 14.65	
2007 vs. 2005 : cancer centre[h]				0.047
QEII HSC	7/47 vs. 23/57	0.21	0.06 to 0.67	0.008
CBRH	9/12 vs. 6/10	3.1	0.30 to 32.9	0.351

a Only patients with complete data for all variables were included in the multivariate analysis. This cohort includes patients who underwent surgical resection for stage IB–III disease (that is, excluding stage IA). The outcome variable is treated versus not treated.
b Only variables retained in the final multivariate model are shown.
c By likelihood ratio chi-square test.
d Cohort year was fixed in the main effects models.
e "No" when score on the Charlson comorbidity index was 0; "Yes" when score was ≥1.
f Excludes stage IA.
g Because of the small numbers of patients with wedge resections, wedge resection and lobectomy were combined.
h Only variables that had significant interactions with year are shown.
CI = confidence interval; QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

Cancer centre was also an important predictor of treatment Uptake and patterns of elapsed time. Overall, referral to medical oncology and treatment with adjuvant chemotherapy were more likely in patients treated at CBRH than in those treated at the QEII HSC, and the patients at CBRH also experienced shorter waits along the care path at a number of care intervals, including disease Detection to Surgical Consultation, Surgical Consultation to Surgery, and Medical Oncology Referral to Medical Oncology Consultation. Moreover, the lower Treatment and overall Uptake observed in 2007 compared with 2005 were observed only at QEII HSC and not at CBRH. Those observations may partly reflect differences between the smaller community-based centre (CBRH) and the larger tertiary-care centre (QEII HSC) in the conduct or effect of multidisciplinary team meetings, in system capacities, in centre-specific guidelines, or in patient demographic factors. More importantly, they also illustrate differences in practice patterns across health care centres and the caution that is required in generalizing observations from single-centre studies.

Our study has limitations. We could not examine all factors potentially influencing treatment Uptake or elapsed times, such as patient preference and missed or cancelled appointments, because the relevant data were not available. We did not perform

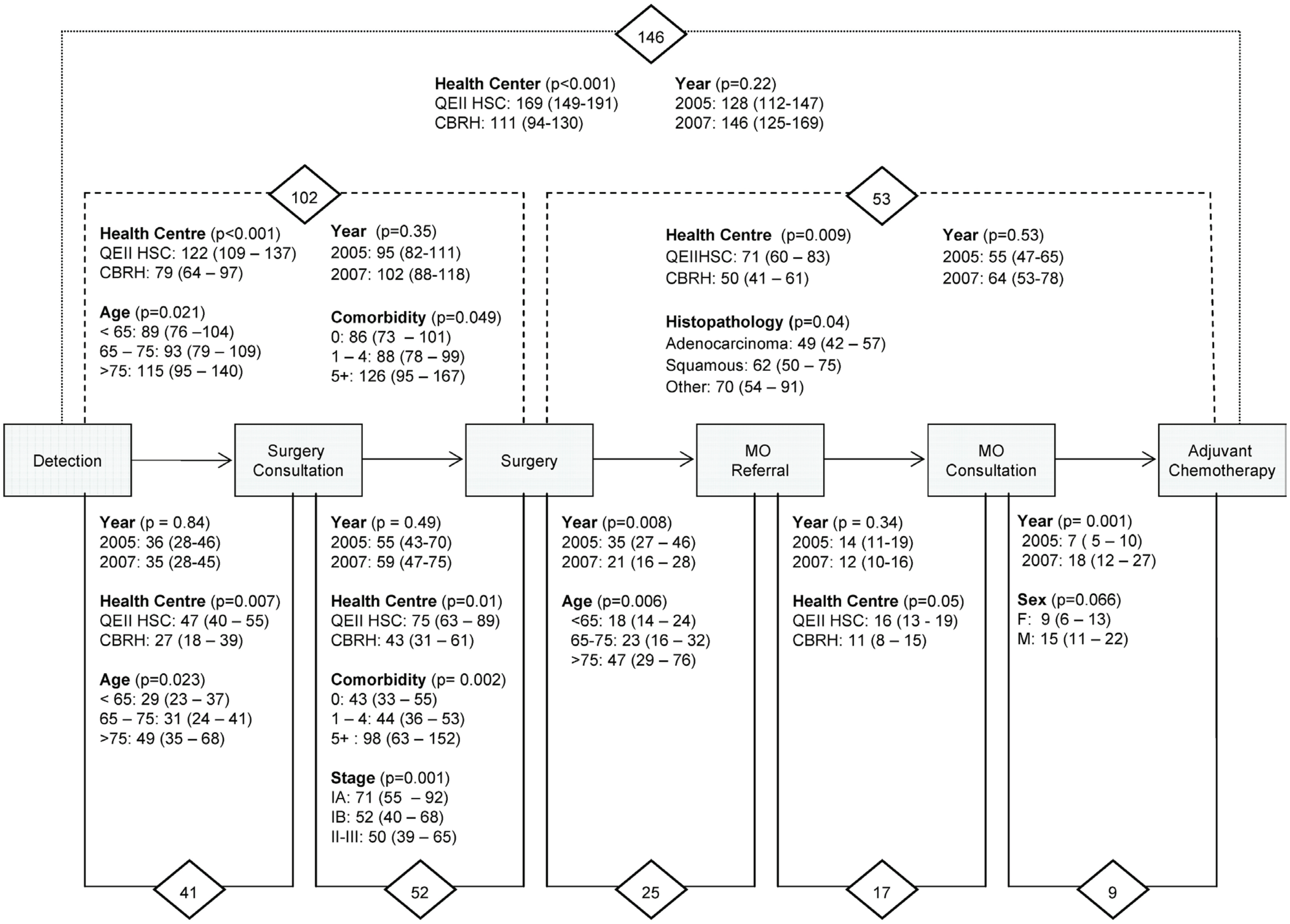

FIGURE 3 Wait times at care intervals: elapsed times in days and the covariates affecting elapsed times, at three resolutions of care intervals [low (dotted lines), intermediate (dashed lines), and high (solid lines)]. All 223 patients experienced timelines from disease Detection to Surgery; 91 experienced timelines from Detection to Medical Oncology (MO) Referral; and 47 experienced timelines from Detection to initiation of chemotherapy. For each care interval, the median number of days (unadjusted for cofactors) is shown in a diamond. The covariates retained in the final model are shown below each interval, with the geometric mean number of days (adjusted for cofactors) and associated 95% confidence intervals (in parenthesis). QEII HSC = QEII Health Sciences Centre; CBRH = Cape Breton Regional Hospital.

a comprehensive second-order (between-cofactor) analysis of interactions for all factors because of the study's relatively small sample size. We also did not examine the potential effect of either chemotherapy Uptake or elapsed times on survival outcomes or quality of life, and therefore the clinical impact of our observations on patient outcomes is unknown. In other studies, Mohammed *et al.*[26] documented NSCLC disease progression while the patient awaited treatment, but Diaconescu *et al.*[27] found no correlation between treatment delays and inferior survival. Finally, and although our study is population-based, the results may not be generalizable to all other jurisdictions. The relatively lower uptake of chemotherapy in our study could be a result of the proportion (about 70%) of patients with stage I disease in our population-based cohort, which is large compared with that in populations from individual tertiary-care centres that primarily see patients at more advanced disease stages. Massard *et al.*[28] and Kassam *et al.* [29] reported overall chemotherapy uptake rates of 40% and 46% for patient cohorts involving 53% and 67% stage I disease respectively.

5. CONCLUSIONS

This population-based study of chemotherapy uptake and wait times in early-stage NSCLC suggests that frequent monitoring of care patterns at high resolution may optimize insights into emerging trends within cancer care systems.

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7. CONFLICT OF INTEREST DISCLOSURES

The authors have no financial conflicts of interest to declare.

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