

Characteristics and outcomes of lung cancer patients presenting through the emergency department: a Waikato District Health Board study

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ABSTRACT

AIM: This research examines the characteristics and survival outcomes of patients receiving a lung cancer diagnosis after attending the emergency department (ED) of Waikato hospitals in New Zealand.

METHODS: This retrospective study was based on a comprehensive database of Waikato patients recorded on the Midland Lung Cancer Register from 2011 to 2021. We compared the characteristics of patients with and without emergency presentations within 14 days before their lung cancer diagnosis. The survival of patients with and without ED attendance was compared between Māori and non-Māori. This study also analysed the odds ratios (OR) of presenting via ED before diagnosis and surviving 12 months based on logistic regressions.

RESULTS: In total, 2,397 patients were included, with 39.6% attending the ED prior to diagnosis. Māori were 1.27 times more likely than non-Māori to be diagnosed after attending the ED. Other characteristics of patients included being male, being diagnosed with small cell lung cancer and having more advanced-stage disease. Patients attending the ED were less likely to survive 12 months than those without ED visits (OR 0.42), and those with two or more ED visits were even less likely to survive 12 months (OR 0.33).

CONCLUSION: Patients presenting through the ED have more advanced-stage disease, while those presenting through their general practitioners (GPs) have evidence of being diagnosed earlier and having better survival. Barriers to early diagnoses through attendance with a GP, particularly for Māori and for men, need to be explored.

The emergency department (ED) is an important component of the healthcare system, providing immediate access to care. The option of using the emergency route for cancer diagnosis may be appropriate for those with red flag symptoms such as severe pain, bleeding or shortness of breath.¹ However, most lung cancer patients have a history of symptoms prior to diagnosis, and, internationally, an emergency presentation is seen as a marker for delayed diagnosis.² Diagnostic delay may be due to early symptoms not being recognised by the patient as important, barriers in access to general practice or an extended diagnostic period before referral to specialist care.¹ Delay may lead to urgent symptoms developing that require immediate assessment and treatment. A review of patient perceptions of the causes of delay reported that system factors, patient factors and disease factors could all contribute.³ Patients with cancers with a poor outcome, such as pancreatic, oesophageal and lung cancer, are more likely to first present

to the ED.⁴ In an international study, the proportion of lung cancer patients presenting through ED ranged from 26.7 to 51.1%, with New Zealand performing worst in comparison with eight jurisdictions in Canada, the United Kingdom (UK) and Norway.⁴ Patients with more advanced tumour stage are known to be more likely to present to the ED,^{5,6} and were associated with lower 12-month survival than those presenting through other diagnostic pathways.⁷

A small Auckland study in 2009 reported 36% of patients were diagnosed after presenting to the ED.⁸ There is now a set of New Zealand National Quality Performance Indicators for lung cancer, which state that most patients should be diagnosed through an elective referral pathway from their primary care provider.⁹ The national data between 2015 and 2018 demonstrated 45% of lung cancer cases presented through the ED.⁹ In the New Zealand system, the general practitioner (GP) clinic is the typical initial step for referrals to secondary care, either for diagnostic imaging

or specialist opinion. There are, however, barriers in New Zealand to access GP service, with patient co-payment and inability to access appointments.¹⁰ Barriers for Māori also include the lack of a relationship with trusted GPs and travel constraints.^{11,12} The Waikato District Health Board serves a population of 430,000, with around 23% identifying as Māori and 74% being of European descent. It has a main hospital (in Hamilton) and four rural hospitals with EDs. In cases of suspected lung cancer, free chest X-rays are available through the five Waikato hospitals or through contracted external providers. This study compares the characteristics and outcomes of lung cancer patients diagnosed following presentations through the EDs of Waikato hospitals in New Zealand with patients from the same population diagnosed through GPs in order to identify opportunities for earlier diagnosis and treatment and to improve survival.

Methods

Data source

The population of interest in this retrospective study were all patients diagnosed with lung cancer between 2011 and 2021 who were domiciled in the Waikato District Health Board. The method of presentation was classified as attendance to the ED in the 14 days before diagnosis or referral from another source. While the International Cancer Benchmarking Partnership (ICBP)⁴ and Quality Performance Indicator (QPI) framework¹³ use attendance in the previous 30 days, it is acknowledged that a number of presentations to the ED may not be for cancer-related symptoms and we believe the shorter period increases the specificity of an emergency lung cancer-related attendance. The referral was most commonly from a GP but could also be from another specialist service or after following up through a lung nodule clinic. ED presentations could be one attendance or two or more attendances in the 14 days prior to diagnosis. The 14-day timeframe of ED attendance was based on the New Zealand Lung Cancer Quality Performance Indicator specifications.¹³ The 14-day timeframe is useful when investigating more acute presentations, which require immediate medical attention before lung cancer diagnosis.

The patients were all identified from the Midland Lung Cancer Register database. This register includes data on age, gender, ethnicity (Māori or non-Māori), rurality, smoking status,

cancer cell type (small cell lung cancer [SCLC], non-small cell lung cancer [NSCLC], other or unknown), cancer stage, comorbidities and year of diagnosis. Further data on comorbidities were collected from the National Minimum Dataset (NMDs). The Charlson Comorbidity Index (CCI) was calculated according to the research of Glasheen et al.¹⁴ The ED presentation of patients was identified from the database system of Waikato hospitals.

Statistical analysis

We reviewed the characteristics of lung cancer patients with and without ED attendance within 14 days before their diagnosis date. Categorical and continuous variables were compared using Chi-squared tests and Student's *t*-Tests. The Kaplan–Meier method was used to examine all-cause survival of lung cancer patients without and with ED visits by ethnicity (Māori or non-Māori). Multivariate logistic regressions were utilised to examine the adjusted odds ratios (OR) of visiting the ED at least once or twice within 14 days before diagnosis, adjusting for age, gender, ethnicity, rurality, smoking status, cell type, cancer stage, CCI score and year of diagnosis. Then, we analysed the unadjusted and adjusted ORs of surviving 12 months using logistic regressions. All analyses were carried out using Stata 15 (StataCorp LLC, Texas, United States).

Results

We identified 2,397 lung cancer cases. Table 1 shows that 949 (39.6%) lung cancer patients presented through the ED within 14 days before diagnosis. Of those with ED attendances, 75% (714/949) visited the ED once within 14 days, and 25% (235/949) presented to the ED at least twice. Men are more likely than women to attend the ED ($p < 0.05$). Approximately 43% (268/618) of Māori patients attended the ED, compared with 38% of non-Māori patients. There were rural and urban differences in ED attendance. While 47.6% (1,140/2,391) of Waikato lung cancer patients lived in rural areas, those rural patients diagnosed through the ED were more likely to attend two or more times than those domiciled in Hamilton, who were more likely only to have one attendance in the prior 14 days. The percentage of patients presenting through the ED at least once within a 14-day period before their diagnosis of SCLC was 50.2% (144/287). Only 36.2% (590/1,629) of patients attended the ED before being diagnosed

with NSCLC. Around 52% (721/1,373) of patients visited the ED before being diagnosed with Stage IV, while the proportion of patients with emergency presentations before being diagnosed with Stage I or II was lower than 20%. There was a high percentage of ED attendances that had no information on smoking status, cell type and stage (more than 45%). This may represent poorly documented patients lacking usual care. The proportion of patients attending the ED decreased over time, from 43.3% for those diagnosed in 2011–2014 to 35.6% in 2019–2021.

Table 2 shows that while age was not a factor, gender was, with men 1.22 times ($p < 0.05$) more likely to present through the ED at least once within 14 days before the lung cancer diagnosis date than women, after adjustment for age, ethnicity, rurality, smoking status, cell type, cancer stage, CCI score and year of diagnosis. Māori were more likely to present through the ED than non-Māori (adjusted OR 1.27, 95% confidence interval [CI] 1.03–1.57). Patients were more likely to present via the ED at least once or twice within 14 days before being diagnosed with SCLC than those with NSCLC. Patients were more likely to visit the ED at least once (adjusted OR 2.13, OR 7.06) or twice (adjusted OR 3.27, OR 3.64) within 14 days before being diagnosed with stages III and IV than those with stage I. Lung cancer patients diagnosed during 2019–2021 were less likely to visit the ED than those diagnosed during 2011–2014 (adjusted OR 0.79, 95% CI 0.63–1.00). There was no significant difference in the CCI score or smoking status.

The median survival for those without emergency presentations was 13.6 months, while the median survival for those with one ED visit was 3 months, and for those with at least two ED attendances it was 2.3 months. Figure 1 demonstrates that patients who presented through the ED within 14 days before the lung cancer diagnosis date had a poor prognosis, with a 5-year survival of less than 10%. Māori tended to have poorer survival outcomes than non-Māori in those without ED visits ($p = 0.02$). There was an insignificant difference in survival between Māori and non-Māori presenting through the ED ($p > 0.05$).

Table 3 illustrates that lung cancer patients presenting through the ED once or at least twice were less likely to survive 12 months than those without ED visits (adjusted OR 0.42 and 0.33, respectively, $p < 0.001$). Māori were less likely to survive 12 months than non-Māori (adjusted

OR 0.75, 95% CI 0.58–0.96). Older patients, male patients and those with more comorbidities (CCI score 2+ vs 0) were less likely to survive 12 months (respective adjusted OR 0.97, 0.75, 0.61). Patients without a smoking history had a higher chance of surviving 12 months than current smokers (adjusted OR 2.74, 95% CI 1.78–4.23).

Discussion

The ED presentation rate in this study was lower than the national rate (45%) in the *Lung Cancer Quality Improvement Monitoring Report*.⁹ This is likely due to the shorter 14-day window used in this analysis. Therefore, we cannot compare directly with results based on the 30-day window.⁴ While these indicators are being updated, our analysis addresses two key factors: 1) the route to diagnosis—i.e., the proportion of people with lung cancer who are diagnosed following presentation to the ED, by stage, and 2) overall survival for people with lung cancer at 1 year (2 and 3) from diagnosis, by type (NSCLC/SCLC) and stage.

The finding that men are more likely to be diagnosed after an ED attendance is consistent with evidence from Suhail et al.,¹⁵ but Nilssen et al. found no gender differences.¹⁶ Our finding maybe a reflection that, generally, New Zealand men have a higher use of the ED than women do.¹⁷ Māori lung cancer patients were 27% more likely than non-Māori to visit the ED within 14 days prior to their lung cancer diagnosis. Non-Māori in our region are principally of European ancestry, although our non-Māori comparison group will include a small proportion of Pacific and Asian patients. The concern is that barriers for Māori to primary care are leading to diagnostic delay and thus presentation to the ED with more advanced disease.⁵ Multiple barriers have been cited and include longer travel times, since many live in rural areas,¹⁸ socio-economic barriers and racism.^{11,19,20} The results of our study, which are adjusted for stage, cell type, smoking and rurality, indicate that there are persistent barriers in the system rather than patient and tumour factors alone that lead to more Māori presenting through ED.

The finding that lung cancer patients presenting through the ED were more likely to be diagnosed with advanced stage is consistent with a Canadian study.¹⁵ In England, the proportion of patients diagnosed with stage IV following ED attendance was 72% during 2015–2016,²¹ compared to 76% in our study. UK patients with emergency

presentations were also less likely to have treatment of curative intent or to receive surgery.²² Patients with advanced diseases presenting through the ED may delay seeking care because they lack understanding of the symptom severity. On the other hand, patients may face barriers to primary care, including financial, geographic, cultural or informational obstacles.²³

Emergency presentation is associated with a combination of less attention to cancer symptoms and more difficulties in accessing care, contributing to poorer outcomes⁷ and higher care and treatment costs. We found that patients with ED attendance tended to have median survival of fewer than 3 months, while patients presenting through other diagnosis routes had longer median survival (around 13.6 months). Emergency presentation is one of the strongest negative predictors of survival in those diagnosed with lung cancer.²⁴ The likelihood of death within the first month after diagnosis is 4 times greater for patients with ED visits compared to those presenting via other routes.²² In the UK, the 1-year relative survival of lung cancer patients diagnosed through GP referral was 40% (95% CI 40–41), while the 1-year survival rate in those diagnosed via ED presentation was only 12% (95% CI 11–12).²⁴ Earlier diagnosis in primary care will reduce emergency presentations.⁹ This can be achieved through increased access to primary care services, public awareness campaigns and early diagnosis initiatives. In the UK, a National Awareness and Early Diagnosis Initiative launched in 2008 to raise public awareness of early symptoms of cancers and to promote early diagnosis²⁵ significantly increased public awareness of lung cancer symptoms and the number of urgent GP referrals for suspected cases, and also decreased the percentage of lung cancer patients diagnosed through the ED.²⁶ A similar but smaller “cough cough cough” campaign in New Zealand did not seem to have any significant changes. We believe any measures to improve early diagnosis could improve survival rates, including adoption of a national lung cancer screening programme.²⁷

There has been a smaller proportion of patients presenting in the ED before lung cancer diagnosis in recent years. A reduction in lung cancer patients’ emergency presentation rate was also observed in England (37.9% in 2006 and 34.3% in 2013).²⁸ Patients with lung cancer are less likely to be diagnosed through the emergency pathway, and are more likely to be diagnosed with early-stage and treatable disease if they have better access to primary care or specialist services where

symptoms may be recognised early.²⁹ Primary healthcare practitioners play a crucial role in reducing delays to cancer diagnosis, as they can encourage patients to participate in cancer screening programmes or to visit their GP practice with symptoms before receiving a diagnosis.³⁰ With that in mind, the New Zealand government and regional health bodies continue introducing new initiatives to improve patient access to primary healthcare, i.e., Very Low Cost Access (VLCA) fees and the Primary Options for Acute Care programme. These and other initiatives are aimed at making appointments cheaper or accessing the diagnostics otherwise only available via the hospital more quickly. While workforce and capacity issues also need to be addressed, any further development and roll out of these programmes could have a significant impact if they reduce the number of ED presentations prior to a lung cancer diagnosis.

One of the strengths of this study is that we utilised comprehensive information regarding demographic characteristics, smoking status, cell type, cancer stage, comorbidities and emergency presentations of lung cancer patients. We also identified rural–urban areas based on a novel rural–urban classification for New Zealand health research created by Whitehead et al.³¹ This research also had some limitations. We could not classify ED presentations by admission method or referral sources such as via accident and emergency services, GP, other emergency admissions to inpatients and emergency referrals to outpatients. While overall numbers give us a target to reduce from given the terrible mortality for those with an ED presentation within 14 days, in our rural hospitals the ED is often the only pathway to some services. There may also be bias in that some groups (men, Māori and Pacific people, and those from low socio-economic communities) may preferentially use the ED for healthcare and may also have reasons other than diagnostic delay for having more advanced disease.

Conclusion

Patients presenting through the ED have more advanced-stage disease, while those presenting through their GPs have evidence of being diagnosed earlier and having better survival. The barriers for Māori and for men that lead to greater reliance on the ED for diagnosis need to be addressed. Without this, the health system will continue its role of perpetuating the stark inequity that exists for Māori.

Table 1: Characteristics of lung cancer patients with and without emergency department visits within 14 days before diagnosis date.

Factors		Without ED visits	With one ED visit	With two or more ED visits	P-value	P-value
		(1)	(2)	(3)	(2) vs (1)	(3) vs (1)
Age group	<50	42 (53.8%)	26 (33.3%)	10 (12.8%)	0.11	0.86
	50–54	62 (58.5%)	35 (33.0%)	9 (8.5%)		
	55–59	122 (63.9%)	48 (25.1%)	21 (11.0%)		
	60–64	183 (61.4%)	91 (30.5%)	24 (8.1%)		
	65–69	240 (62.7%)	108 (28.2%)	35 (9.1%)		
	70–74	287 (63.1%)	118 (25.9%)	50 (11.0%)		
	75–79	216 (59.7%)	107 (29.6%)	39 (10.8%)		
	>80	296 (56.5%)	181 (34.5%)	47 (9.0%)		
Gender	Female	740 (63.3%)	323 (27.6%)	106 (9.1%)	0.01	0.09
	Male	708 (57.7%)	391 (31.8%)	129 (10.5%)		
Ethnicity	Māori	350 (56.6%)	195 (31.6%)	73 (11.8%)	0.11	0.02
	Non-Māori	1,098 (61.7%)	519 (29.2%)	162 (9.1%)		
Rural/urban	Urban	747 (59.7%)	441 (35.3%)	63 (5.0%)	<0.01	<0.01
	Rural	696 (61.1%)	272 (23.9%)	172 (15.1%)		
	Unknown	5 (83.3%)	1 (16.7%)	0		
Smoking status	Current smoker	444 (59.8%)	229 (30.9%)	69 (9.3%)	<0.01	0.02
	Ex-smoker	769 (63.1%)	333 (27.3%)	116 (9.5%)		
	Never smoked	120 (61.9%)	57 (29.4%)	17 (8.8%)		
	Unknown	115 (47.3%)	95 (39.1%)	33 (13.6%)		
Cell type	NSCLC	1,039 (63.8%)	449 (27.6%)	141 (8.7%)	<0.01	<0.01
	SCLC	143 (49.8%)	95 (33.1%)	49 (17.1%)		
	Others	14 (82.4%)	2 (11.8%)	1 (5.9%)		
	Unknown	252 (54.3%)	168 (36.2%)	44 (9.5%)		
Cancer stage	I	282 (86.8%)	39 (12.0%)	4 (1.2%)	<0.01	<0.01
	II	113 (81.9%)	19 (13.8%)	6 (4.3%)		
	III	348 (75.5%)	87 (18.9%)	26 (5.6%)		
	IV	652 (47.5%)	534 (38.9%)	187 (13.6%)		
	Unknown	53 (53.0%)	35 (35.0%)	12 (12.0%)		

Table 1 (continued): Characteristics of lung cancer patients with and without emergency department visits within 14 days before diagnosis date.

CCI score	0	338 (60.4%)	166 (29.6%)	56 (10.0%)	0.13	0.39
	1	354 (64.4%)	148 (26.9%)	48 (8.7%)		
	2+	756 (58.7%)	400 (31.1%)	131 (10.2%)		
Year of diagnosis	2011–2014	416 (56.7%)	248 (33.8%)	70 (9.5%)	<0.01	0.93
	2015–2018	564 (60.3%)	283 (30.2%)	89 (9.5%)		
	2019–2021	468 (64.4%)	183 (25.2%)	76 (10.5%)		
Total		1,448 (60.4%)	714 (29.8%)	235 (9.8%)		

ED = emergency department; NSCLC = non-small cell lung cancer; SCLC = small cell lung cancer; CCI = Charlson Comorbidity Index.

Figure 1: Kaplan–Meier survival curves by ethnicity and emergency department visits.

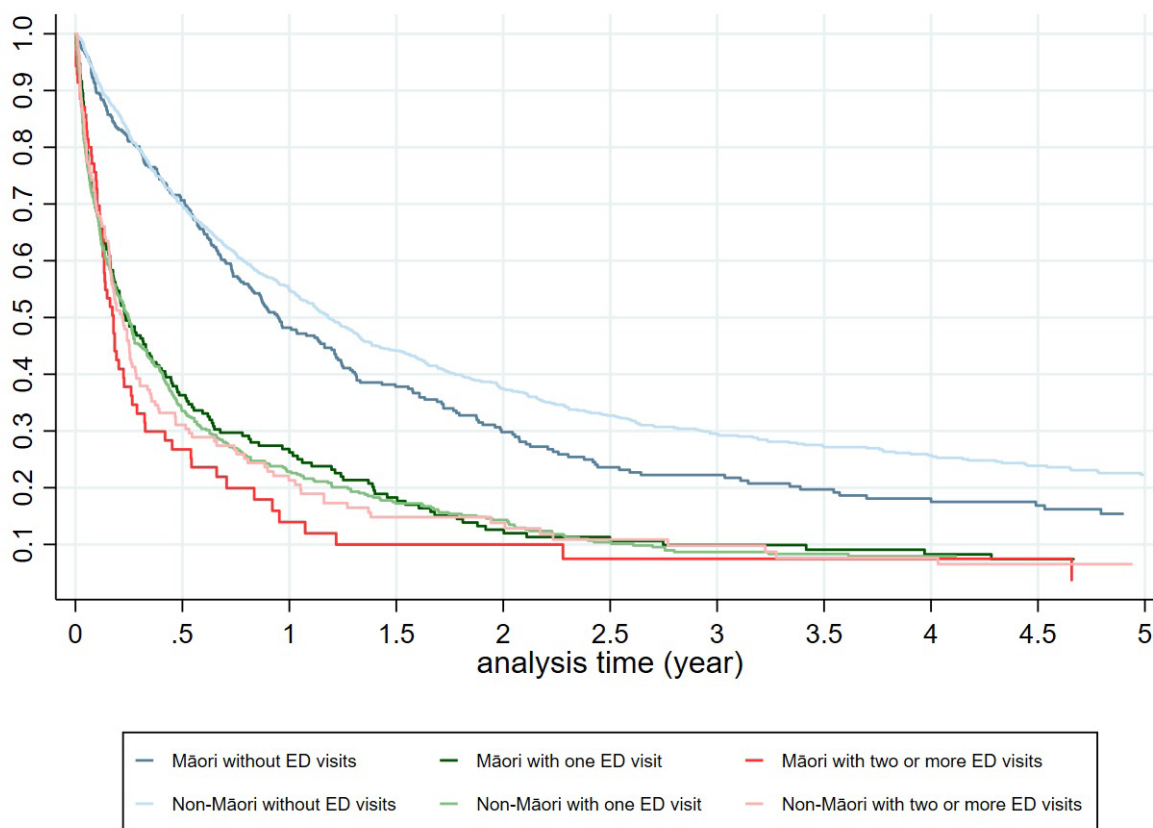


Table 2: Adjusted odds ratios of emergency department visits.

Variables	With ED visits vs without (95% CI)	With two or more ED visits vs with one ED visit (95% CI)
Age (years, continuous)	1.00 (0.99–1.01)	0.99 (0.97–1.00)
Gender		
Female	Reference	Reference
Male	1.22 (1.02–1.47)*	1.03 (0.74–1.41)
Ethnicity		
Non-Māori	Reference	Reference
Māori	1.27 (1.03–1.57)*	1.03 (0.71–1.50)
Rural/urban		
Urban	Reference	Reference
Rural	0.94 (0.78–1.12)	4.65 (3.33–6.49)***
Smoking status		
Current smoker	Reference	Reference
Ex-smoker	0.86 (0.70–1.07)	1.46 (0.99–2.17)
Never smoked	1.08 (0.75–1.56)	1.41 (0.71–2.78)
Unknown	1.26 (0.88–1.79)	1.54 (0.85–2.80)
Cell type		
NSCLC	Reference	Reference
SCLC	1.45 (1.11–1.90)**	1.74 (1.12–2.69)*
Others	0.49 (0.13–1.86)	2.38 (0.18–31.95)
Unknown	1.59 (1.25–2.04)***	0.87 (0.56–1.35)
Cancer stage		
I	Reference	Reference
II	1.43 (0.83–2.46)	3.39 (0.80–14.31)
III	2.13 (1.43–3.15)***	3.27 (1.01–10.60)*
IV	7.06 (4.99–9.98)***	3.64 (1.23–10.82)*
Unknown	4.26 (2.43–7.49)***	3.60 (0.94–13.73)
CCI score		
0	Reference	Reference

Table 2 (continued): Adjusted odds ratios of emergency department visits.

1	0.93 (0.71–1.21)	1.18 (0.73–1.91)
2+	1.20 (0.96–1.51)	1.15 (0.76–1.72)
Year of diagnosis		
2011–2014	Reference	Reference
2015–2018	0.92 (0.74–1.14)	0.92 (0.62–1.35)
2019–2021	0.79 (0.63–1.00)*	1.46 (0.97–2.21)

***p<0.001, **p<0.01, *p<0.05.

ED = emergency department; CI = confidence interval; NSCLC = non-small cell lung cancer; SCLC = small cell lung cancer; CCI = Charlson Comorbidity Index.

Table 3: Odds ratios of 1-year survival.

Variables	Unadjusted odds ratios (95% CI)	Adjusted odds ratios (95% CI)
ED visits		
Without	Reference	Reference
With one ED visit	0.25 (0.21–0.32)***	0.42 (0.32–0.54)***
With two or more ED visits	0.18 (0.12–0.27)***	0.33 (0.21–0.50)***
Age (years, continuous)	0.98 (0.97–0.98)***	0.97 (0.96–0.98)***
Gender		
Female	Reference	Reference
Male	0.65 (0.55–0.78)***	0.75 (0.60–0.92)**
Ethnicity		
Non-Māori	Reference	Reference
Māori	0.78 (0.64–0.96)*	0.75 (0.58–0.96)*
Rural/urban		
Urban	Reference	Reference
Rural	0.96 (0.80–1.13)	0.96 (0.77–1.18)
Smoking status		
Current smoker	Reference	Reference
Ex-smoker	1.10 (0.90–1.34)	1.39 (1.08–1.79)*
Never smoked	2.20 (1.57–3.08)***	2.74 (1.78–4.23)***
Unknown	0.33 (0.23–0.49)***	0.58 (0.35–0.96)*
Cell type		

Table 3 (continued): Odds ratios of 1-year survival.

NSCLC	Reference	Reference
SCLC	0.61 (0.46–0.81) ^{***}	1.08 (0.78–1.49)
Others	4.76 (1.31–17.38) [*]	2.51 (0.44–14.26)
Unknown	0.67 (0.53–0.84) ^{***}	0.67 (0.49–0.93) [*]
Cancer stage		
I	Reference	Reference
II	0.35 (0.20–0.59) ^{***}	0.35 (0.20–0.60) ^{***}
III	0.13 (0.08–0.19) ^{***}	0.12 (0.08–0.18) ^{***}
IV	0.03 (0.02–0.05) ^{***}	0.03 (0.02–0.05) ^{***}
Unknown	0.04 (0.02–0.07) ^{***}	0.09 (0.04–0.19) ^{***}
CCI score		
0	Reference	Reference
1	0.88 (0.68–1.12)	0.76 (0.56–1.03)
2+	0.69 (0.56–0.85) ^{***}	0.61 (0.46–0.80) ^{***}
Year of diagnosis		
2011–2014	Reference	Reference
2015–2018	1.08 (0.88–1.32)	1.02 (0.80–1.31)
2019–2021	1.37 (1.09–1.72) ^{**}	1.16 (0.87–1.55)

^{***}p<0.001, ^{**}p<0.01, ^{*}p<0.05.

CI = confidence interval; ED = emergency department; NSCLC = non-small cell lung cancer; SCLC = small cell lung cancer; CCI = Charlson Comorbidity Index.

COMPETING INTERESTS

All authors disclose no competing interests.
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DATA AVAILABILITY

The data supporting this study cannot be publicly shared for ethical or privacy reasons.

ETHICS APPROVAL

The study was approved by the Health and Disability Ethics Committee, Ministry of Health, New Zealand (ref. no. 2022 AM 5900).

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