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Research Article

Lung Cancer Care and Outcomes in the West of Scotland During the Introduction of Managed Clinical Networks

Naeima Houssein |

***Corresponding Author:** Naeima Houssein, Faculty of Public Health, University of Benghazi, Libya.

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Abstract

Aim: This study aimed to evaluate lung cancer treatment patterns and survival outcomes during the early implementation of managed clinical networks in the West of Scotland.

Background: The Managed Clinical Networks (MCNs) for lung cancer care in Scotland have been committed to providing and improving services for over 2,000 lung cancer patients annually across the region.

Methods: A retrospective cohort study was conducted using secondary data on lung cancer patients registered in the Scottish Cancer Registry between 1997 and 2007, linked with morbidity and service data from the West of Scotland Managed Clinical Network for Lung Cancer (2004–2007). Survival outcomes were assessed with follow-up to June 2009. This time frame captures the early implementation of managed clinical networks and multidisciplinary team-based lung cancer care in Scotland.

Results: A total of 19,844 non-MCN patients (1997–2004) and 3,394 MCN patients (2004–2007) were included in the comparative analysis. The sex distribution was nearly identical, with males representing approximately 55% in both. The mean age at diagnosis was slightly lower among MCN patients (69.6 years) compared to non-MCN patients (70.2 years), a significant shift was observed in age distribution across the two cohorts ($p = 0.001$). The distribution of socioeconomic status, measured by deprivation categories, showed no significant difference between the two groups ($p = 0.66$). Staging data was missing for 78.3% of the non-MCN patients, and 76. 9% of the MCN patients. Available Staging data revealed notable differences. Fewer MCN patients were diagnosed at stage IV (46.0%) compared to non-MCN patients (55.0%), Treatment modalities showed statistically significant differences. Surgical intervention was more common in the MCN group (11.4%) compared to the non-MCN group (9.3%, $p < 0.001$). Chemotherapy uptake increased significantly from 21.6% in the non-MCN period to 31.3% during the MCN period ($p < 0.001$). Radiotherapy use also increased in the MCN group (36.4%) compared to the non-MCN group (30.5%, $p < 0.001$). 1-year overall survival was better for patients who were in MCN as compared to those who were not in the MCN (27 % vs. 24%).

Conclusion: Despite reflecting an earlier era of lung cancer care, these data provide baseline evidence from the initial implementation of networked services, enabling meaningful comparison with contemporary studies. Overall, the findings support the effectiveness of MCNs in improving the quality of lung cancer management in Scotland, particularly in terms of treatment delivery. However, the comparison between pre- and post-MCN cohorts involves distinct calendar periods and therefore observed outcome improvements may be influenced by broader temporal advancements in diagnostic and treatment modalities rather than the MCN effect alone. The quality of lung cancer data needs to be improved for better survival estimates.

Keywords: Lung Cancer, Managed Clinical Networks (MCN), Survival Outcomes, Treatment Uptake.

Introduction

Lung cancer remains one of the leading contributors to the global cancer burden. Worldwide, it is the most frequently diagnosed cancer, accounting for approximately 2.5 million new cases annually [1]. In the United Kingdom, lung cancer accounts for approximately 13% of all new cancer cases, representing 1 in every 8 new cancer diagnoses.

It is also among the deadliest forms of cancer, responsible for around 20% of all cancer deaths in the UK; specifically, it causes approximately 19% of male cancer deaths and 20% of female cancer deaths [2]. Most of these deaths occur in individuals aged 65 and older [3]. Socioeconomic disparities affect outcomes; individuals in the most deprived areas are 3.7% more likely to die from lung cancer compared to those in the least deprived areas [4]. Geographic disparities also exist, with higher lung cancer incidence and mortality observed in northern England and Scotland compared to lower rates in southern England, Wales, and the Midlands [5]. Scotland reports some of the highest lung cancer rates in the world, largely due to its historical prevalence of smoking [6]. The incidence is particularly concentrated in the densely populated areas between Glasgow and Edinburgh [7]. In 1997, lung cancer was the most frequently diagnosed cancer in Scotland, accounting for 2,662 cases in men (22% of male cancer registrations) and 1,854 in women (14%) [8].

Previous studies have identified various factors that influence lung cancer survival, including patient demographics, tumor characteristics, treatment modalities, and the quality of healthcare services [9-12]. Cancer statistics from Scotland indicate very poor lung cancer survival in the early 2000s, with 5-year relative survival around 7–8% for patients diagnosed in 2000–2004, reflecting the historically low survival outcomes for this disease in the Scottish population [13].

Since the implementation of Managed Clinical Networks (MCNs) for lung cancer care in Scotland, some evidence attributes these modest improvements to enhanced lung cancer management in Scotland and an increasing proportion of patients receiving potentially curative treatments [14].

However, limited evidence is available on the factors associated with lung cancer survival and quality of care in Scotland. Against this background, the present study examined factors related to lung cancer survival and management in the West of Scotland. Specifically, it aimed to evaluate treatment patterns and survival outcomes during a key transitional period in Scottish cancer care, encompassing the introduction and early implementation of managed clinical networks and multidisciplinary team–based service models. By linking population-based cancer registry data with morbidity data from the West of Scotland Managed Clinical Network, this study sought to assess how emerging networked care structures influenced treatment uptake and outcomes in routine clinical practice.

Materials and Methods

Study design and study population

A retrospective descriptive study was conducted by a quantitative analysis of secondary data on lung cancer cohort of patients from the Scottish Cancer Registry registered during the period 1997-2007, linked with their morbidity data from the West of Scotland Managed Clinical Network for Lung Cancer from the period 2004-2007.

Data sources

The Scottish Cancer Registry (SCR) has been responsible for collecting information on incident cancers since 1958. Its records are linked to other health data to produce detailed reports on incidence, prevalence, lifetime risks, mortality, and survival. Originally, five regional registries collected their data on patients' identifiers, demographics, cancer stage, and treatments from different sources, and then forwarded these data to the central. The West of Scotland Cancer Surveillance Unit covers the four NHS Health Boards in the region: Ayrshire and Arran, Fort Valley, Greater Glasgow and Clyde, and Lanarkshire. This unit, together with the Managed Clinical Networks (MCNs), ensures that the quality of services for cancer patients is of a high standard Since 2002, the MCN for lung cancer in the West of Scotland has been committed to providing and improving services for over 2,000 lung cancer patients per year across the region.

Data Extraction

From both datasets, the following data fields were extracted: Sex of patient, age (age at incidence from the SCR, and age at diagnosis from the MCN), deprivation categories, clinical stage at diagnosis, type of treatment offered (surgery, chemotherapy, and radiotherapy), cause of death, date of incidence, days to death. Only the clinical stage of non-small cell lung cancer (NSCLC) was included, as staging data on small cell lung cancer (SCLC) was not available from the SCR at the time of data extraction for this study. The socio-economic status of every patient was derived using the DEPCAT score, which is calculated by using the postcode of the residential address. The DEPCAT is a widely used seven-category score that ranks all postcode areas from 1 (most affluent) to 7 (most deprived) using the four census variables shown to correlate best with health outcomes: car ownership; overcrowding; the proportion of the population in occupational Social Classes IV and V; and male unemployment [15].

Linkage of data

The data obtained from the MCN were then linked with the SCR of the same patients for the period 2004-2007. For record linkage, the patient's identification data was compared in two different datasets. These data included surname, first name, sex, date of birth, and postcode.

Data Analysis

Two separate SPSS files were created. The first cohort represents lung cancer patients who registered at the SCR from 1997-2003; these patients were not treated in the MCN (non-MCN patients). The second cohort represents lung cancer patients who were treated within the MCN from 2004-2007. Comparative analysis was performed to assess the trends in the baseline characteristics and treatments of patients registered in the Scottish Cancer Registry and not treated in the MCN in the period 1997-2003, and those treated at the West of Scotland Managed Clinical Network for lung cancer from 2004-2007. Chi-square tests for trend were used for ordered categorical variables, while Pearson's Chi-square tests were applied to nominal variables. Mean age was compared using an independent samples t-test. Estimation of one year survival was performed by the Kaplan-Meier method. All statistical tests were consistently considered significant at a two-tailed P value less than 0.05.

Ethical consideration

The datasets used in this study were secondary data. The data obtained was anonymous, therefore, formal ethical approval was not required. The author required to read and sign the West of Scotland Cancer Surveillance Unit's Standard Operating Procedures for Maintaining Confidentiality and Security of Data. These provide detailed guidance on the transfer and storage of data according to Data Protection Act and Caldicott Principles.

Results

A total of 23,238 lung cancer patients were included in the analysis, comprising 19,844 non-MCN patients registered in the SCR between 1997-2004 and 3,394 MCN patients treated between 2004-2007.

Demographic Characteristics

As shown in Figure 1, the sex distribution was similar in both groups, with males accounting for approximately 55% of patients in each cohort. No statistically significant difference in sex distribution was observed between MCN and non-MCN(P=0.26).

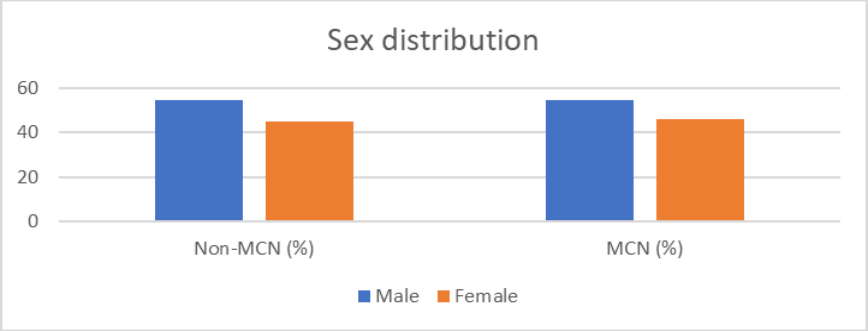

Figure 1: Sex distribution of lung cancer patients.

The age profile of patients differed slightly between groups (Figure 2). Although the mean age was slightly lower among MCN patients (69.6 years) compared with non-MCN patients (70.2 years), this difference was statistically significant (P<0.001). Across age categories, both cohorts showed a predominance of patients aged 65-74 years, followed by those aged 75-84 years. A lower proportion of patients aged over 85 years was observed in the MCN group compared with the non-MCN group.

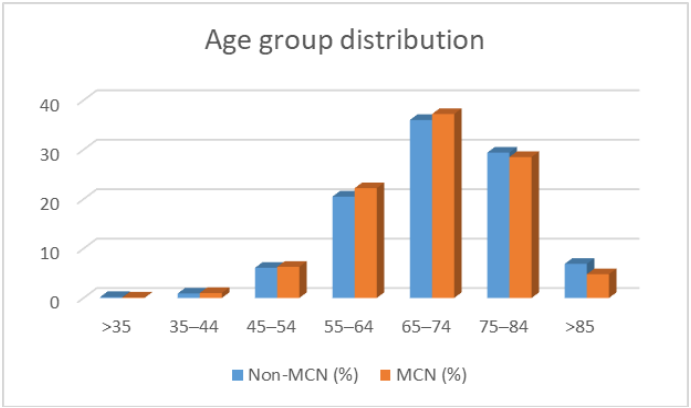

Figure 2: Age distribution of lung cancer patients.

The distribution of patients across deprivation categories is presented in Figure 3. Both groups demonstrated a similar socioeconomic profile, with the largest proportion of patients residing in moderate to high deprivation categories (categories 4-6). No statistically significant differences were observed between MCN and non-MCN patients across deprivation levels (p=0.66).

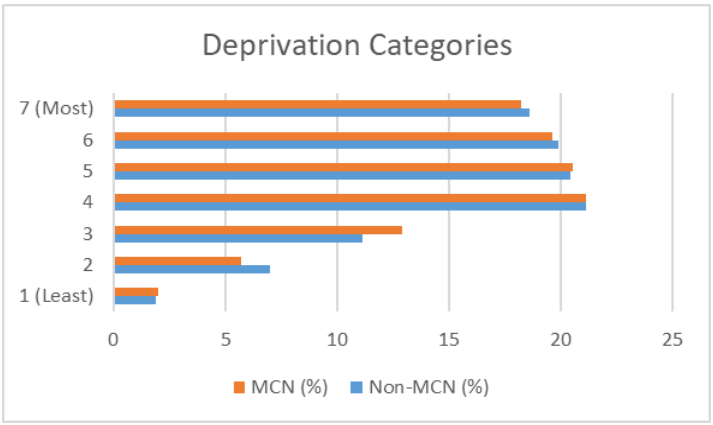

Figure 3: Distribution of deprivation categories.

Clinical Stage at Diagnosis

Regarding the clinical stage of (NSCLC) in both groups, data was missing for considerable numbers of the MCN and non-MCN patients. 15538 (78.3%) of the non-MCN patients and 2613 (76.9%) of the MCN patients had no staging details. Therefore, these patients were not included in the stage comparison. The statistical test was then performed using the available data on the clinical stage of (NSCLC). Figure 4 illustrates differences in clinical stage at diagnosis. MCN patients were more frequently diagnosed at locally advanced stages (IIIA and IIIB) compared with non-MCN patients. Conversely, a higher proportion of non-MCN patients were presented with stage IV disease. Early-stage disease (stage I and II) accounted for a relatively small proportion of cases in both cohorts. Overall, the stage distribution differed significantly between the two groups ($p < 0.001$).

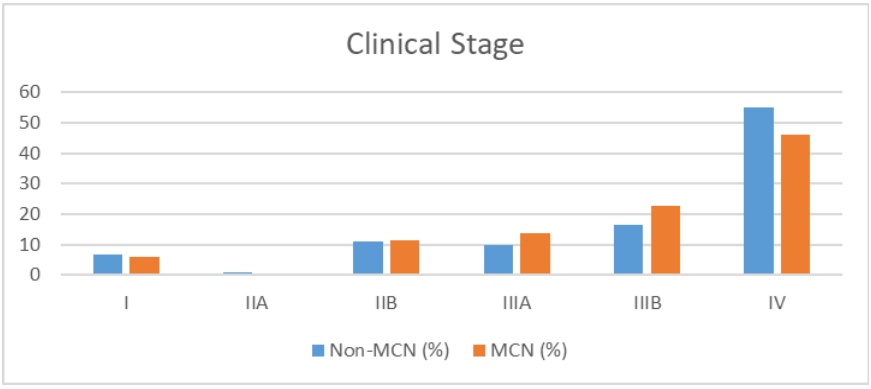

Figure 4: Clinical stage at diagnosis for NSCLC.

Treatment Modalities

Overall patterns of treatment modalities differed between MCN and non-MCN patients, as shown in Figure 5. MCN patients were more likely to receive active treatment, whereas non-MCN patients more frequently received no treatment. The difference in overall distribution of treatment modalities between the two cohorts was statistically significant ($p < 0.001$).

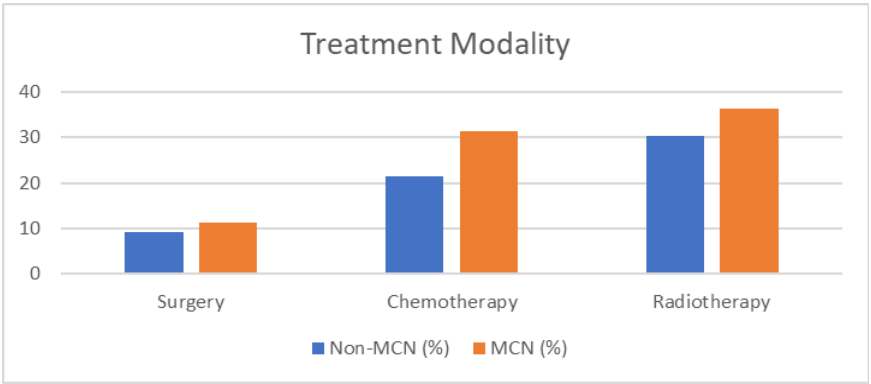

Figure 5: Overall treatment modalities.

Treatment specific distributions are presented in (figures 6a-6c). Surgical treatment was more commonly reported among MCN patients (Figure 6a). Similarly, the use of chemotherapy (Figure 6b) and radiotherapy (Figure 6c) was higher in the MCN cohort. Across all treatment modalities, the proportion of patients with unknown treatment status was higher among MCN patients.

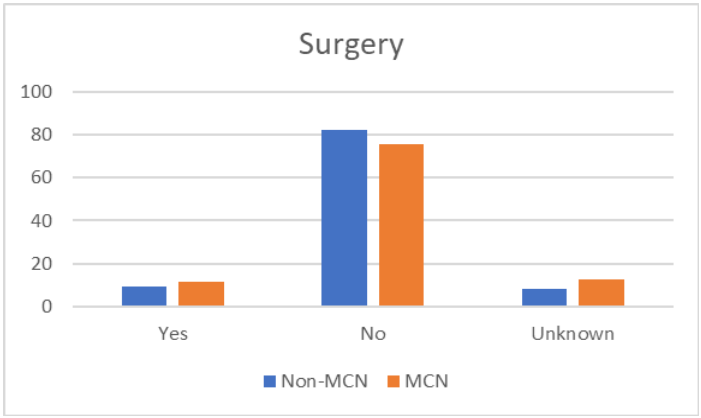

Figure 6a: Surgical treatment by patient group.

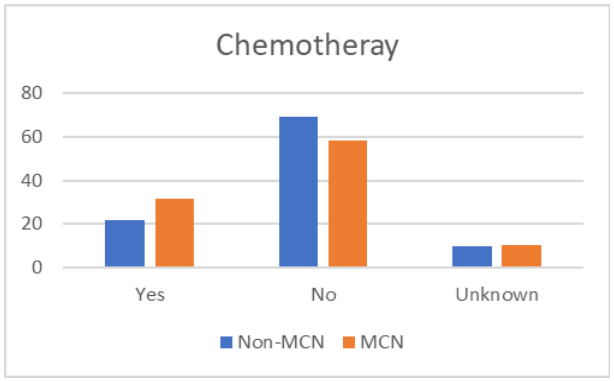

Figure 6b: Chemotherapy use by patient group.

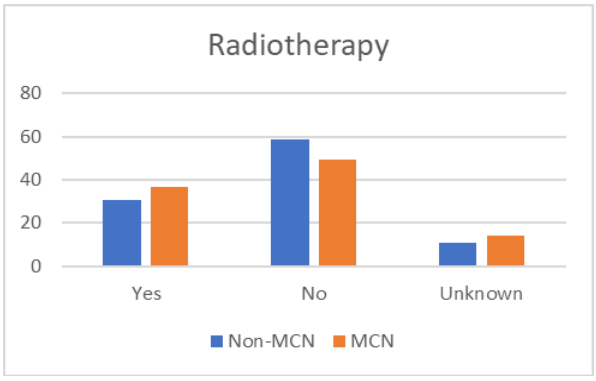

Figure 6c: Radiotherapy use by patient group.

Survival Analysis

Survival from lung cancer was compared for patients managed within the MCN during 2004-2007 and those not managed within the MCN during 1997-2003. Both cohorts were followed up to 30th June 2009. Overall, 1-year overall survival was higher among patients managed within the MCN compared to those not managed within the MCN (27 % vs. 24%) (Figure 7). The Kaplan Meier survival test demonstrated longer median survival for patients managed within MCN [161 days, 95% CI (150.1 – 171.9)] than for those not managed within the MCN [128 days, 95% CI (124.3 – 131.8)]. The difference in survival was statistically significant based on the log-rank test ($p<0.001$).

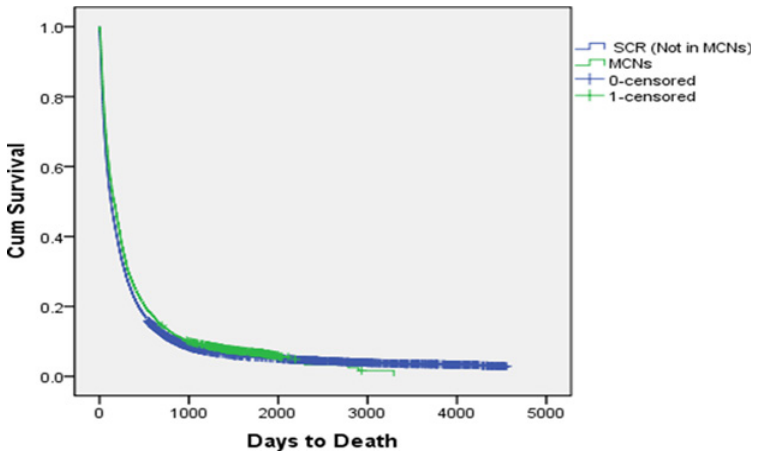

Figure 7: KM plot for the MCN and non-MCN lung cancer patients.

Discussion

This study compared lung cancer patient characteristics, stage at diagnosis, and treatment modalities before and after the implementation of Managed Clinical Networks (MCNs) in Scotland, revealing several notable differences. In the west of Scotland, the MCN patients were slightly younger on average and had a greater likelihood of receiving chemotherapy and radiotherapy. Notably, surgical treatment was also more common among MCN patients, which may reflect better access to specialist care or more structured referral pathways within the MCN. While stage IV disease remained the most common diagnosis in both groups, a slightly lower proportion of MCN patients were diagnosed at this advanced stage, suggesting a possible shift toward earlier detection and consequently better prognosis.

The overall aim of this study was to determine whether better survival of the MCN patients compared with non-MCN patients resulted from the difference in prognostic factors including patient's age, sex, socioeconomic status, clinical stage, and treatment rates. The results from this study indicated that the overall median survival of lung cancer patients was significantly higher in patients treated within the MCN (n=3394) from 2004-2007 compared with those who were not treated in the MCN (n=19844) from 1997-2003 (161 vs.128 days, P<0.001). As results reveal, sex distribution remained consistent between cohorts and most patients in the two cohorts were male and middle-deprived (category 4 &5). All deprivation categories appear to have benefited equally from the MCN, suggesting that MCN may have mitigated some access-related barriers that disproportionately affect the most deprived groups. Importantly, the socioeconomic distribution of lung cancer patients did not change significantly between groups. However, the equitable distribution of treatment improvements across all deprivation categories suggests that MCNs may help reduce health inequalities, consistent with earlier findings from Romeri et al. [4] who showed excess lung cancer mortality among the most deprived.

In addition, non-MCN patients were slightly older than the MCN patients (70.2 years vs. 69.6 years), this small difference, in spite of its statistical significance (P<0.001) would not be clinically important as both average ages belonged to the elderly segment of the population The slight but statistically significant reduction in mean age at diagnosis in the MCN group may reflect improved awareness and earlier presentation[16].

Another study [17] reported that there is no difference in survival of elderly patients within different age strata (60-69, 70-79, >80). Therefore, it seems unlikely that the MCN treats patients of younger age as most patients in both groups were over 65 years of age. Similar age trends have been observed in other UK-wide studies, such as those reported by Harkness et al [8]. which highlighted shifting demographics of lung cancer diagnosis, particularly among women.

Staging data was missing for 78.3% of the non-MCN patients, and 76. 9% of the MCN patients. Therefore, the actual distribution of these stages among the MCN and non-MCN patients remains unclear. In addition, staging data of the NSCLC clinical stage was missing for a high number of patients both in the MCN and non-MCN cohorts, and no data was available from the registry to compare staging data for SCLC type. Therefore, this study could not exactly determine the difference in tumor characteristics between the two cohorts.

Considering the available staging data, the proportion of stage IV diagnoses decreased from 55% to 46% after MCN implementation. This finding aligns with earlier reports by the Scottish Public Health Observatory [18], which may suggest that centralized care and multidisciplinary team (MDT) input could lead to earlier intervention. The finding on the clinical stage found significant differences regarding the severity of disease at diagnosis among the MCN and non-MCN patients with NSCLC (P<0.001), indicating that most non-MCN patients may were presented with more advanced disease (stage IV) than MCN patients (55% vs.46%). While stage IV disease remained the most common diagnosis in both groups, a slightly lower proportion of MCN patients were diagnosed at this advanced stage, suggesting a possible shift toward earlier detection.

On the other hand, the most significant findings are the increase in treatment uptake among MCN patients. The proportion of patients receiving chemotherapy rose from 21.6% to 31.3%, and radiotherapy use increased from 30.5% to 36.4%. These trends reflect national improvements reported by Cancer Research UK [19], where guideline-based care and specialist involvement were associated with higher treatment rates. Surgical treatment also increased in the MCN group (11.4% vs. 9.3%), likely reflecting improved surgical referrals and patient selection. This interpretation is supported by recent evidence from a Scottish lung cancer cohort, in which the introduction and wider implementation of stereotactic ablative body radiotherapy (SABR) was associated with increased use of radical treatment and improved selection of patients for surgical management, ultimately contributing to better clinical outcomes [20].

It appears that the improved management of lung cancer patients in the region has led to better survival outcomes. Increased uptake of surgery, chemotherapy, and radiotherapy in the MCN group reflects enhanced access to curative and palliative treatment options. This suggests that MCN may have improved care coordination, multidisciplinary management, and adherence to national guidelines, thereby facilitating optimal treatment decisions. However, the increase in patients with unknown treatment status in the MCN period (e.g., surgical unknowns: 12.7% vs. 8.2%) may also reflect ongoing challenges in data completeness or record-keeping systems. The possible explanation of the better survival in the MCN patients based on the comparison of the prognostic factors above, would be the increase in treatment rates and a smaller number of patients with more advanced stages. No differences in demographics were found. However, the change in characteristics of the disease in both cohorts could not be properly determined due to the incompleteness of data. With consideration to suggestions reported in prior study [21], this temporal observed improvement in lung cancer survival overtime would be explained by the trend for increasing life expectancy in Scotland.

In comparison with other previous studies, the findings of this study on the improved survival of lung cancer patients in the West of Scotland were consistent with the study by Forrest et al [22], in which the median survival of two cohorts (1997 and 2001) improved from 3.2 months to 6.6 months. The authors explained survival improvement by the increased number of NSCLC patients being staged in 2001 and the improved treatment by chemotherapy for patients with stage IIIB. However, the percentages of patients receiving chemotherapy (23%) and radiotherapy (2%) in 2001 were lower than that reported in the present study, indicating that there has been further increase in the uptake of treatment in the region in the period from 2004-2007. In addition, treatment rates increased from 2004-2007, compared with treatment in 1991-92 when only low proportions of patients of 5% underwent surgery, 2.5% received chemotherapy, and 10.2% were offered radiotherapy [23].

The length of survival time estimated in this study after the introduction of the MCN was relatively low (161 days) compared with that reported in South- East Scotland in 2002 as the median survival was 5.76 months, which is approximately 172.8 days [21,24]. This would reflect differences in the delivery of cancer services across the country in addition to differences in patients' characteristics [25,26].

Although evidence on the value of the MCN in the management of lung cancer in Scotland generally and the west of Scotland particularly is still very limited, it seems that the introduction of such multidisciplinary care benefits the outcomes of these patients through the increase of treatment rates. Despite these improvements, the continued high proportion of stage IV diagnoses and a non-trivial number of patients with unknown treatment status, particularly in the MCN cohort highlight ongoing challenges. These include late presentation, variations in data recording, and possibly differing clinical thresholds for treatment documentation, as raised in studies on registry data completeness [27].

This large population-based study has several strengths, including an almost complete ascertainment of lung cancer cases along with a complete follow-up of these patients. The large sample size makes the findings more likely to be representative of [28] lung cancer cases in the West of Scotland. In addition, administrative health data as used in this study is considered as an important and efficient source of valuable information for assessing the quality of care [29]. It is often updated daily and is readily available, and this reduces the cost of research.

Linking cancer registry data with different administrative health databases helps to piece together the individual patterns of care and to enhance the potentiality of health care evaluation at a population level [30]. It also creates an opportunity to identify missing cases and to review discrepant cases to correct any errors. The findings of this study therefore may add to contemporary literature by providing real-world evidence on lung cancer management and survival during the early adoption of networked cancer services, a period in which incremental improvements in treatment delivery and outcomes were observed across Scotland and the wider UK.

However, there were several notable limitations in this descriptive study. Being a retrospective study, it might be prone to selection bias as the comparison was based only on the available records. This is because both disease outcome and exposure have already been ascertained at the time of participant selection [31]. A prospective study design would be a better choice to address the limitations of a retrospective study. This approach allows for the collection of higher-quality data. Furthermore, adjusting survival analysis for stage-specific comparisons in small cell lung cancer (SCLC) could provide valuable insights into disease outcomes for SCLC patients. Multivariate analysis using the Cox proportional hazards model could be used to examine the relationship between patient survival and their demographic and clinical characteristics. However, further assessment of data quality is necessary before making precise comparisons between MCN and SCR outcomes.

Conclusion

Although the data reflects an earlier era of lung cancer management, the results contribute to the current literature by documenting outcomes during the initial establishment of networked care, enabling comparison with more recent studies to better understand long-term trends and the sustained impact of system-level service reforms. Overall, the findings support previous assertions that the introduction of MCNs has contributed to improved treatment delivery and potential survival outcomes in Scottish lung cancer patients. There was no significant social gradient between patients treated in the MCN and those who were not, and this leads to the conclusion that the MCN did treat patients from different social and economic levels. However, the comparison between pre- and post-MCN cohorts involves distinct calendar periods and therefore observed outcome improvements may be influenced by broader temporal advancements in diagnostic and treatment modalities rather than the MCN effect alone. In addition, it seems that patients treated in the MCN had some better prognostic features regarding age, stage at diagnosis, and treatment uptake. Importantly, the quality of data in both sources needs further consideration for a better survival estimate.

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