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Integrating early supportive care into the diagnostic pathway for advanced lung cancer: a real world analysis of short term budget impact

Victoria Coles

victoria.coles@msd.com

MSD (UK) Limited

Caleb McDougall

Western General Hospital

Ross Maconachie

MSD (UK) Limited

Neil MacDonald

MSD (UK) Limited

Abi Walton

Western General Hospital

Fiona MacCormick

St Johns Hospital

Mark Stares

Western General Hospital

Peter S Hall

Western General Hospital

Marie Fallon

Western General Hospital

Christina Lilley

Western General Hospital

Katelyn Gilmour

Western General Hospital

Colin Barrie

Western General Hospital

Julie Mencnarowski

Western General Hospital

Fiona O'Brien

St Johns Hospital

Iain Phillips

Western General Hospital

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Integrating early supportive care into the diagnostic pathway for advanced lung cancer: a real world analysis of short term budget impact

Victoria Coles*[1], Caleb McDougall[2], Ross Maconachie[1], Neil MacDonald[1], Abi Walton[2,3], Fiona MacCormick[3], Mark Stares[2, 4], Peter S Hall[2,3,4], Marie Fallon[2,4], Christina Lilley[2], Katelyn Gilmour[2], Colin Barrie[2,3], Julie Mencnarowski[2,3], Fiona O'Brien[3] and Iain Phillips[2,4]

[1] MSD (UK) Limited, London, UK

[2] Edinburgh Cancer Centre, Western General Hospital, Edinburgh, Scotland

[3] St Johns Hospital, Livingston, Scotland

[4] CRUK Scotland Centre, Institute of Genetics & Cancer, University of Edinburgh, Scotland.

*Corresponding author: Victoria Coles, victoria.coles@msd.com

ABSTRACT

Purpose: Integrating multimodal prehabilitation into the diagnostic pathway for advanced lung cancer has been shown to reduce time spent in hospital and improve patient outcomes. The objective of the current work is to understand the short-term budget impact of this intervention.

Methods: We constructed a simple decision tree-like model, populated with costs and resource use to estimate the short-term budget impact of prehabilitation. The impact of uncertainty was investigated by means of sensitivity and scenario analyses.

Results: The average prehabilitation cost per patient was £443.16. The model estimated that prehabilitation was associated with short-term savings for the NHS of £850.59 per patient. The intervention remained cost saving in the scenarios tested, in all one-way deterministic sensitivity analyses, and in 99.9% of iterations in probabilistic sensitivity analysis.

Conclusion: According to our model, integrating prehabilitation and supportive care into the diagnostic pathway for advanced lung cancer is highly likely to be cost saving, supporting the case for wider roll-out of the intervention. Wider implementation would allow continual and more detailed economic evaluation. A better understanding of the cost and resource use implications at a local level would strengthen the business case to support long-term and stable access to prehabilitation.

INTRODUCTION

There is increasing interest in prehabilitation to improve cancer treatment outcomes. For less survivable cancers and those going on to non-surgical treatment the prehabilitation model is less well developed, when compared to surgical treatment. There is phase 3 trial evidence that integrating early palliative care into standard care improves survival in lung cancer [1]. International guidelines recommend supportive and palliative care should be part of standard oncological care [2,3]. Multi-modal prehabilitation screening and intervention is now recommended by MacMillan (a UK cancer charity) and, locally, by Scottish Government in 3 domains (nutrition, physical activity and psychological support) [4-6]. There is not an established model of what prehabilitation should involve for less survivable cancers.

One of the perceived barriers to integrating early supportive/palliative care and prehabilitation, in general, is cost. We have previously published the results of the EPIC (Early Prehabilitation In lung Cancer) project. Early intervention with a supportive/palliative care physician, physiotherapist and dietitian reduced time spent in hospital and appeared to improve survival and treatment rates [7]. There is currently a paucity of data for prehabilitation for non-surgical lung cancer treatment, although some evidence is emerging with further work ongoing [8-10].

We sought to further understand the economic impact of the EPIC intervention [7]. We present a short-term budget impact analysis. This is the first published budget impact assessment for prehabilitation for non-surgical treatment for lung cancer. The need to demonstrate cost-effectiveness has become essential to acquiring sustained funding within the health service, and these data can be an initial step in overcoming some of these barriers.

METHODS

Population: In the EPIC project, 97 patients with a radiological diagnosis of stage 3 + 4 lung cancer received prehabilitation between July 2021–June 2023 and March 2024-February 2025. Historical control patients (n=199) who underwent a standard pathway were identified between January 2019-June 2021 and July 2023-February 2024. This analysis was based on routine data collected from the NHS Lothian cancer audit, the electronic patient record and data returns from Public Health Scotland. For data collection details see previous publication [7]. Anonymised unidentifiable patient-level data on admissions were available for economic analysis.

This project was approved as a joint working project between MSD and NHS Lothian. The project was registered and supported by the NHS Lothian Cancer Information Team, project number CIR 24089.

Budget impact analysis: All modelling follows best practices as recommended by NICE and SMC. The short-term budget impact of prehabilitation was estimated using a simple decision tree-like model (figure 1a). This modelling approach and structure, whilst relatively simple in nature, reflects data availability and the clinical pathway owing to disease. The model does not account for mortality. It allows a systematic and granular estimation of costs using published unit costs, and permits the assessment of the impact of uncertainty by means of sensitivity analyses. The model was populated with rates (per 100 patients) for admissions and attendances, lengths of stay in hospital and costs accrued for admissions which commenced within 42 days (6 weeks) of diagnosis, in line with the previous publication. This included the diagnostic and pre-treatment pathway. The model was parameterised with EPIC project outcomes and local and national cost data (see online resource, table 1). Costs are reported in 2023/24 GBP.

Scenario analyses were conducted, (1) to investigate the impact of censoring hospital stays at the 42-day cut off, and (2) to account for downstream outpatient appointments which occurred within 42 days.

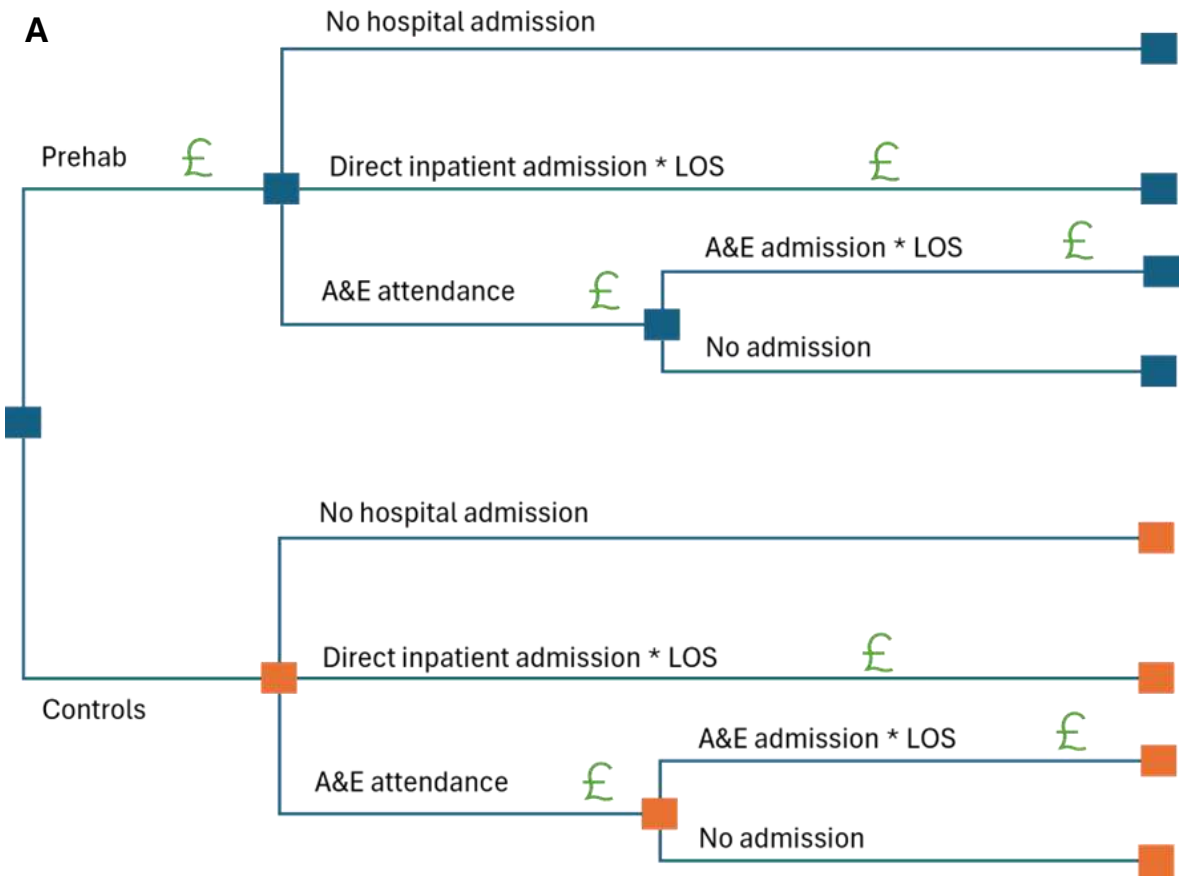
Uncertainty was characterised using deterministic (one-way) sensitivity analysis (DSA) and probabilistic sensitivity analysis (PSA). See online resource for more details.

RESULTS

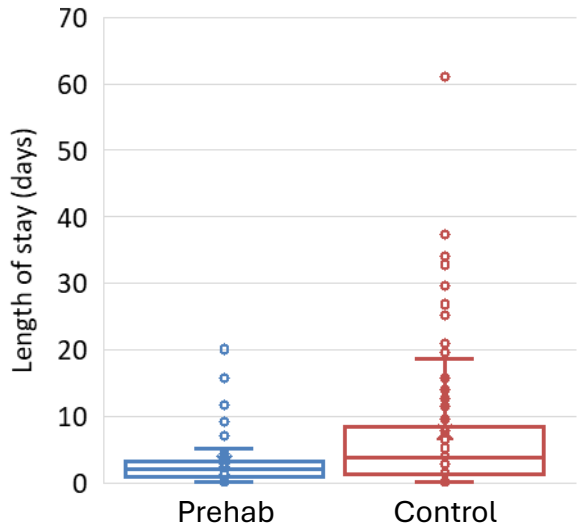
Baseline patient characteristics are available in our previous publication [7]. Within 6 weeks of diagnosis, A&E and non-A&E admissions were slightly higher in historical control patients (28.1 vs 26.8 A&E admissions per 100 patients and 35.7 vs 29.9 non-A&E admissions per 100 patients). Patients who had received prehabilitation had a 15.3% higher rate of A&E attendances than historical controls (42.3 vs 36.7 per 100 patients), but it is unclear whether this represents a meaningful difference. Mean length of stay was 3.03 days (standard error, 0.52) for the prehabilitation group and 7.62 days (standard error, 0.96) for historical controls (figure 1b).

The average cost of prehabilitation was £443.16 per patient (see online resource, table 2). The model estimates that the average cost of A&E attendances and hospital stays which commenced within 42 days of diagnosis was £820.23 per patient in receipt of prehabilitation and £2,113.98 per historical control patient. Therefore, according to our model, the average short term budget impact of prehabilitation in advanced lung cancer was -£850.59 per patient (figure 1c, see online resource, table 3 for calculation). In the scenarios tested, prehabilitation remained cost saving, although the magnitude of the short-term budget impact was slightly lower, at -£425.09 and -£579.58 (figure 1c). One-way DSA demonstrated that the short-term budget impact was most sensitive to the parameters relating to inpatient stays: cost per inpatient day, length of stay for control patients and length of stay for those in receipt of prehabilitation (online resource, figure

1). PSA estimated a mean budget impact of -£852.61 and a median budget impact of -£842.38 (95% confidence interval, -£1,523.30 – -£226.23). Prehabilitation was cost saving in 99.9% of iterations in the PSA (online resource, figure 2).



B



C

Scenario	Short-term budget impact
Base case	-£850.59
Inpatient stays censored at 42 days	-£425.09
Including outpatient appointments within 42 days	-£579.58

Figure 1. Estimation of the budget impact of prehabilitation. (a) Structure of the decision tree used to estimate the short-term budget impact of prehabilitation. (b) Box and whisker plot illustrating lengths of stay in hospital for patients following receipt of prehabilitation, and for historical controls, starting within 42 days of diagnosis. (c) Short-term budget impact of prehabilitation in the base case and defined deterministic scenarios.

DISCUSSION

The budget impact model's results suggest that implementing multimodal early prehabilitation has a high probability (99.9%) of being a cost saving strategy, in patients being investigated for lung cancer. We have previously shown that this model of prehabilitation (including integrating early supportive/palliative care) has a meaningful impact on length of stay, treatment rates and survival. The model's results further support the case for further implementation and evaluation of this intervention.

There are few published studies on the benefits of prehabilitation in patients with lung cancer, receiving non-surgical treatment. A gym-based prehabilitation programme appears to increase physical function in patients receiving curative non-surgical treatments for lung cancer [9]. Those who completed the programme had a better survival rate than those who couldn't [9]. A South Korean study has shown benefit of pretreatment pulmonary prehabilitation increases physical function and appears to reduce the risk of radiation pneumonitis (9.4% vs 54.5%, p=0.001), although the pneumonitis rate in the control arm was surprisingly high, and generalisability to the UK may be limited [10].

Other studies show a reduction in hospital costs following prehabilitation in the surgical treatment of ovarian cancer, colorectal cancer, and elective surgery [11-13]. However, to our knowledge there is no published account of prehabilitation being cost saving for non-surgical patients.

There are data suggesting enhanced supportive/palliative care is cost saving by reducing admissions. Early palliative care appears to improve outcomes in patients fit for anti-cancer treatment [1]. This approach, however, has not become standard of care. One reason may be the cost implication; our data suggests that an early universal supportive/palliative care approach may reduce short-term costs.

This study conducted a systematic and granular analysis using local NHS high quality costing data including Scottish Health Service Cost data, and an average per-day bed cost calculated from study participants' actual ward occupancy data. Comprehensive sensitivity analyses have been carried out to investigate the impact of scenarios and of parameter uncertainty both individually with a DSA and jointly with a PSA.

However, there are some limitations. Firstly, our analysis involves using real-world data to make an unmatched comparison with historical controls. There were no statistically significant differences in either the age distributions or gender distributions between the prehabilitation and historical control patients [7]. Factors outside the prehabilitation protocol may have influenced length of stay and appointment types and numbers. Notably, the project was carried out in a health system recovering from the COVID-19 pandemic, which altered the diagnostic pathway for many patients, and may have impacted other aspects of their care. However, the inclusion of two distinct cohorts of

patients receiving prehabilitation, as well as control cohorts from four different calendar years, may help to control for some of these differences.

In the base case, any appointments leading to non-A&E admissions are not accounted for, as the nature of these appointments was not recorded. However, the number of non-A&E admissions was not substantially different between patients undergoing prehabilitation and historical controls, and the scenario including all outpatient appointments within 42 days of diagnosis helps to mitigate this by giving a more complete picture of downstream secondary care costs.

There was some uncertainty about the number of prehabilitation appointments in the first cohort of patients, where a small number of patients had several follow up phone calls. The actual cost of prehabilitation in the very early patients may therefore have been slightly underestimated. However, one-way sensitivity analysis demonstrated that this was not a major driver of the short-term budget impact.

EPIC was performed in a small District General Hospital. The methodology is readily deliverable, inexpensive and does not require a specialist cancer centre. A larger project will be established soon to explore its effect on a larger cohort. The aim would be to re-evaluate the budget impact using the framework laid out in this paper once more data are available. Furthermore, we aim to understand wider costs such as impact on primary care and prescribing, and more precisely identify who benefits most from prehabilitation. We hypothesise that it may be those patients for whom there is uncertainty about fitness to receive anti-cancer treatment, classified as “orange” in our proposed traffic-light classification system [14], who would benefit from the most intensive prehabilitation. A better understanding of the cost and resource use implications would strengthen the business case to support long-term and stable access for these patients.

FUNDING

This analysis follows on from a joint working project between NHS Lothian and MSD, which was funded by MSD.

COMPETING INTERESTS

The prehabilitation team previously received funding as part of a joint working project between NHS Lothian and MSD. VC, RM and NM are employees of MSD, which manufactures a treatment for advanced NSCLC. IP received an honorarium for speaking about prehabilitation and for a round table discussion on cachexia.

AUTHOR CONTRIBUTIONS

The EPIC study was conceptualised by Iain Phillips, Colin Barrie, Julie Mencnarowski and Fiona O'Brien, with input from Peter S Hall and Mark Stares, and conducted by Abi Walton, Fiona MacCormick and Iain Phillips, with project administration by Julie Mencnarowski and Neil MacDonald and data curation and analysis by Christina Lilley. The budget impact methodology was developed by Victoria Coles and Ross Maconachie, with formal analysis by Victoria Coles, Ross Maconachie and Caleb McDougall. The manuscript was drafted by Victoria Coles and Iain Phillips and reviewed, edited and approved for submission by all authors.

ETHICS APPROVAL

The EPIC project was a quality improvement project approved by NHS Lothian. Eligible patients were offered the prehab pilot project. As all three interventions were available as part of routine clinical practice, only the timing that was different, it was felt that formal ethical approval was not required. Verbal consent was obtained when patients attended for palliative care, physiotherapy and dietetic appointments. This consent was documented in the electronic patient record.

PATIENT CONSENT FOR PUBLICATION

Not applicable.

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