

Model-based assessment of the costs and benefits of lung cancer screening in the Czech Republic before introduction of the national pilot programme

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Objectives

- Lung cancer** is the most frequent cause of cancer deaths in Czechia. Around 6,500 patients are newly diagnosed with this cancer each year and approximately 5,200 patients die from it.
- Lung cancer is an insidious disease. It can go for a long time without any symptoms, and patients often come to the doctor at a stage when the tumour cannot be treated effectively. **The solution to improve the situation is early detection of the tumour.**
- The introduction of a **national lung cancer screening (LCS) pilot programme** was a critical step toward improving public health outcomes.
- Key Steps in the Development of the Lung Cancer Screening Programme:**
 - Identifying and characterizing the target population, focusing on individuals at high risk due to a history of heavy smoking.
 - Designing a model flow-chart to assess the potential benefits and risks associated with the screening programme, ensuring a clear understanding of the screening pathway and outcomes.
 - An economic evaluation of the LCS programme was needed to assess its cost-effectiveness in the Czech context.**
 - Developing strategic and operational guidelines for the pilot project to ensure effective rollout and management of the screening programme.
 - Forming a steering committee to oversee programme development, implementation, and evaluation, ensuring alignment with public health goals.

Methods

- All results were modelled for a 5-year pilot programme
- Data sources:**
 - the Czech National Health Information System
 - NELSON study results
 - European health interview survey national data
- Design of LCS:**

Addressing the patient by a general practitioner

Outpatient lung physician

Radiology screening department (RD)

 - Screening test is a low dose CT (LDCT) examination performed by a radiologist
- Target population:**
 - Current smoker or ex-smoker
 - Men and women aged 55–74 years
 - 20 pack-years; one pack-year is the equivalent of smoking one pack of cigarettes (20 cigarettes) per day for one year
- Within the five-year pilot LCS, each participant should complete this screening process three times.
- A model calculation of the effectiveness of the programme was based on simulated results of 1,000 persons who participated in all three rounds of LCS.**

A model calculation of the effectiveness of the programme

- Target population

Heavy smokers 55–74 years
N = 1,000

Screening tests

LDCTs done by RD
N = 3,251
(321 repetitions)

Positive result
N = 67

Malignant tumours
N = 32

False positives
N = 35

Operable tumours thanks to screening
N = 16

Operable tumours
N = 5

Overdiagnosis
N = 3

Non-operable tumours
N = 8

Interval cancers
N = 5
- Quantification of benefits and risks of the proposed programme in the Czech context:**
 - After three rounds of screening considering 100 % participation, **3,251 LDCT scans are expected to be performed** (including repeat scans), with a total of **67 positive radiology results** (indicating referral for further multidisciplinary assessment at a pulmonology-oncology center).
 - The estimation used parameters from the NELSON study [1].
 - Lung cancer was confirmed in 32 cases** through the subsequent diagnostic process, broken down as follows:
 - 19 operable cancers were detected.
 - 5 operable cancers would have been detected as operable even through regular clinical practice (without screening)
 - 8 inoperable cancers were found
 - More than half of the positive LDCT results (**35 out of 67**) **were false positives**.
 - Overdiagnosis is expected in 3 cases (out of the 19 operable cancers), based on an assumption that 10 % of detected cancers in screening are likely overdiagnoses.
 - Given the available data on the epidemiology of lung cancer in the target population, **34 cancers can be expected over 6 years in the absence of screening.** In comparison to the cancers detected through screening (after accounting for overdiagnosis), we observe **5 interval cancers** (considering a two-year follow-up after the last round of screening).
 - Based on the above calculation, **an estimate of the years of life saved (including cost per 1 year saved) in lung cancer patients due to the early detection programme was made:**

Tumour stage	Model without screening*		Model with screening**	
	N	Survival from diagnosis (yrs)	N	Survival from diagnosis (yrs)
I	3	20.1	20	133.8
II	2	7.8	2	7.8
III	9	15.8	9	15.8
IV	20	14.1	3	2.1
Total	34	57.8	34	159.5

*Estimate of stages according to the National Cancer Registry. ** Estimate of stages according to the NELSON study [1] without overdiagnosis tumours.

	Model without screening	Model with screening
Lifetime costs	442,000 EUR	710,000 EUR
Cost of screening	-	332,030 EUR
Total costs	442,000 EUR	1,042,030 EUR

Costs per 1 year saved	
The difference between total costs in the scenario with and without early detection.	Estimate of the number of years of life saved
600,030 EUR	101.7
5,900 EUR per 1 year of life saved	

Thanks to the early detection programme, 101.7 years of life are saved, with the cost per year of life saved amounting to 5,900 euros.

Conclusions

- LCS appears to be cost-effective in the Czech national context, based on the results of an economic evaluation. These results facilitated the decision and preparatory process leading to the introduction of the Czech LCS pilot.
- Czech LCS pilot was launched in January 2022, The cost-benefit modeling will be validated using real-world data that is already being collected as part of the ongoing programme.

