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Effectiveness and cost-effectiveness of lung cancer screening

Summary

Background: The lung cancer survival is low since most of the lung cancers are detected in an advanced stage. Thus, an early diagnosis with low-dose computer tomography (LDCT) would help to improve lung cancer survival.

Objective: To estimate the effectiveness of lung cancer screening with LDCT, to propose an optimal screening strategy for Estonia and to estimate the cost-effectiveness and budget impact of the strategy in Estonia.

Methods: A systematic literature search was performed in PubMed to identify randomised controlled trials (RCT) on the effectiveness and safety of lung cancer screening. A meta-analysis of the effectiveness and a systematic review of the cost-effectiveness of lung cancer screening was conducted. Targeted searches were performed for the overview of lung cancer screening guidelines, screening programs in other countries, and the validity of selection criteria for screening. Based on the literature synthesis, an optimal screening strategy was proposed for Estonia. A Markov cohort model and a budget impact model were constructed to estimate the cost-effectiveness and budgetary effects of lung cancer screening in Estonia.

Results: According to the meta-analysis of 11 RCTs, lung cancer screening is effective in reducing both overall and lung cancer mortality in high-risk populations compared to usual care (RR = 0.95, 95% CI 0.91–0.99 and RR = 0.81, 95% CI 0.74–0.88, respectively). The most likely harms of lung cancer screening are overdiagnosis and false positive results. No consensus is among the guidelines on the management of incidental findings. According to the systematic review, lung cancer screening (at least one strategy) is cost-effective in 91% of 22 studies published since 2015. All lung cancer screening guidelines recommend lung cancer screening. Most of the Western countries are in the process of implementing national or regional lung cancer screening.

Considering the RCTs, lung cancer screening guidelines and screening programs in other countries, at least 55–74 years old patients should be invited to screening and in newer guidelines, the age limits are widened to 50–80 years. Lung cancer guidelines recommend narrowing the target group based on smoking habits but mention the benefit of risk models as well. Based on retrospective studies, larger sensitivity can be achieved with risk models, and in specific $PLCO_{m2012}$ model at the same level of specificity compared to smoking-based criteria. Nevertheless, there is no consensus on the threshold of the PLCO model. The larger the target group (i.e., the lower the threshold and wider the age limits), the more lung cancers are identified but also the larger the workload, budget impact, and harms of the screening. Therefore, lung cancer screening is suggested annually for patients aged 55–80 with a six-year lung cancer risk over 1.5% according to the $PLCO_{m2012noRace}$ model in Estonia.

The incremental cost-effectiveness ratio for lung cancer screening with the proposed strategy was 47,000 euros per quality-adjusted life year compared to standard care. Stage shift and lung cancer risk in the target population were the most influential factors affecting cost-effectiveness. Considering an estimated target population of 32,000, lung cancer screening would cost an additional 10.3 million euros in the first year and 7.0 million euros per year further on for Estonian Health Insurance Fund compared to standard care.

Conclusions: Lung cancer screening should be implemented in Estonia. However, an extended pilot study is necessary to gather further information about the key parameters affecting the cost-effectiveness of lung cancer screening strategy in Estonia.

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