

# **Feasibility study on an LDCT lung cancer screening program in Switzerland**

## **Part 1: Foundations**

For external use

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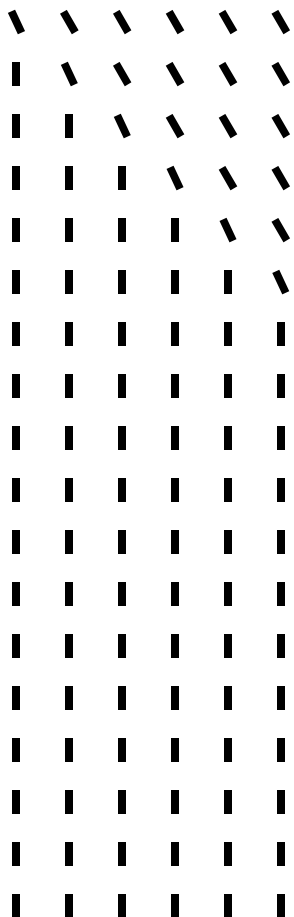
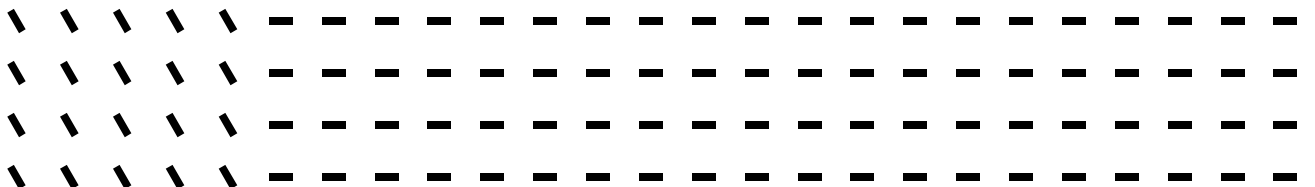
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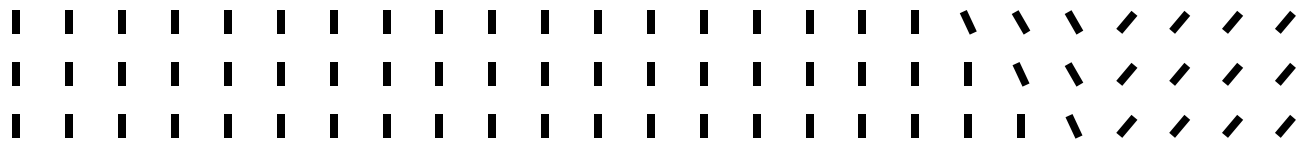
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## **Introduction**

**What is the scope of this report?**



### 1.1 Rationale of the feasibility study

Lung cancer is a major public health burden. Worldwide, lung cancer has the highest incidence rate of all cancers. Furthermore, lung cancer has the highest mortality among all types of cancer. A large share of this burden of disease would be preventable through behavioral changes in the population or the earlier detection of lung cancer. However, lung cancer is frequently diagnosed at a late stage, leading to poor outcomes due to an advanced stage.

There is increasing scientific evidence that lung cancer mortality could be reduced through low-dose computed tomography (LDCT) lung cancer screening. The recently published results of the NELSON trial, which is the second largest randomized controlled trial (RCT) on lung cancer screening, show that lung cancer mortality can be significantly reduced over a 10-year period through yearly screening.<sup>1</sup>

In Switzerland, 4,500 persons are diagnosed annually with lung cancer, which causes 3,200 deaths. Hence, lung cancer leads to highest cancer-related deaths in Switzerland.<sup>2</sup> The high burden of lung cancer as well as the increasing positive evidence of the benefits of lung cancer screening has also led to actions being taken internationally and in Switzerland. The Swiss Cancer Screening Committee is a national expert group for early cancer detection. The committee has taken up the topic of lung cancer and is currently conducting a health technology assessment (HTA) on LDCT lung cancer screening.<sup>3</sup> Furthermore, the Swiss Lung League has funded our research team, including Christophe von Garnier, Milo Puhan and Thomas Frauenfelder, to conduct a feasibility study to establish a lung cancer screening program. Interface Policy Studies in Lucerne has supported the research team in their conduct of the study.

The objective of the project is to

- Assess the feasibility of introducing LDCT lung cancer screening in Switzerland through a bottom-up approach
- Propose and describe characteristics for implementing a lung cancer screening program in Switzerland.

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<sup>1</sup> De Koning H. J., van der Aalst C. M., de Jong P. A., et al. (2020): Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial. *The New England Journal of Medicine*.

<sup>2</sup> Arndt V., et al. (2016): Schweizerischer Krebsbericht 2015. Stand und Entwicklungen. Bundesamt für Statistik (BFS), Nationales Institut für Krebs epidemiologie und –registrierung (NICER), Schweizer Kinderkrebsregister (SKKR)

<sup>3</sup> See: <https://cancerscreeningcommittee.ch/en/topics/lung-cancer-screening-using-ldct/> (last accessed: Dec 28, 2020).

Initially, we also planned to assess the screening capacities of potentially involved hospitals in LDCT lung cancer screening. However, during the project, it became apparent that it might be more useful to assess the capacity of the institutions once the regional scope of a potential pilot study is defined. Instead, the project team extended the planned stakeholder consultation and the dissemination of the findings.

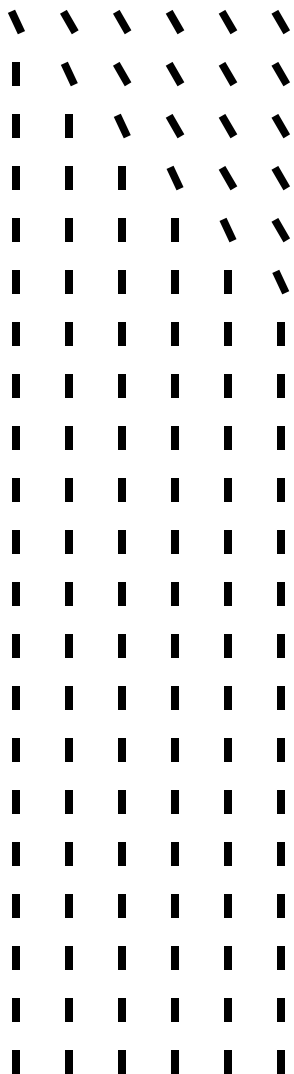
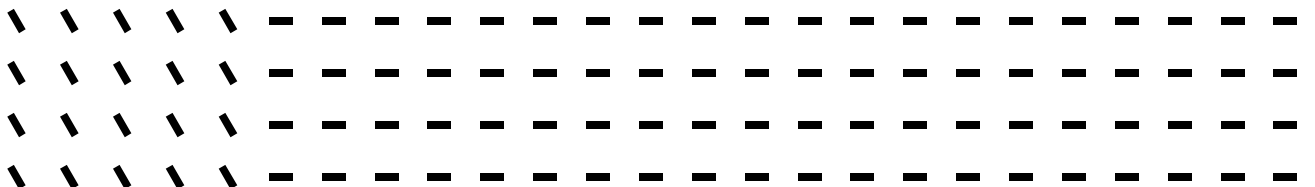
### 1.2 Scope of the report

The results of the project are presented in two reports:

- The goal of this first report is to summarize information on the feasibility of implementing an LDCT lung cancer screening program in Switzerland. To achieve this goal, we conducted an analysis of the national and international literature on lung cancer screening programs and their implementation. The review of the literature is not exhaustive and does not include an assessment of the effectiveness of LDCT screening on health-related outcomes (see chapter 2). Furthermore, we conducted interviews with international experts (see chapter 3) and national stakeholders (see chapter 4) and organized workshops with experts from the Swiss Interest Group for Lung Cancer Screening (CH-LSIG) and workshops at the Swiss Public Health Conference.
- Based on this report, we developed a preliminary model of a Swiss lung cancer screening program, which will be described in a second report.<sup>4</sup>

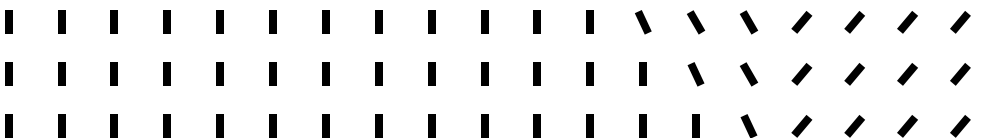
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<sup>4</sup> Von Garnier C., Frauenfelder T., Puhan M. (2021): Feasibility study on a LDCT lung cancer screening program in Switzerland. Part 2: Outline of a Swiss Model.



## **2. Methodological approach**

**What methods were used in this study?**





This project followed a bottom-up approach to assess the feasibility of introducing an LDCT lung cancer screening program in Switzerland. The study employed the following methods.

### **2.1 Literature review**

First, we conducted a review of the most recent literature. This review included scientific literature on the effectiveness of lung cancer screening, the cost-effectiveness of lung cancer screening, recommendations and position statements of international associations and gray literature on the implementation of lung cancer screening. This literature review served as a basis for the further development of the project. An exhaustive literature review was conducted in the context of the scoping report and the HTA of the cancer screening committee.<sup>5</sup>

### **2.2 Interviews with international experts and site visit**

In 2019, we conducted eight interviews with international experts, six of which were conducted as part of a site visit in Manchester. The interviews provided timely information on how other European countries plan and implement LDCT cancer screening and allowed us to benefit from their experiences. Among others, these initiatives were selected because they were all at different stages. The information on the initiatives of each country was validated with the interview partners.

### **2.3 Interviews with national stakeholders**

A key element of the study was interviews with a wide range of actors in the Swiss context. Representatives of all national stakeholders along the patient pathway were included from the beginning of the project in the design period through the assessment of the study. In total, 23 stakeholder interviews were conducted in two stages. The first stage was conducted in autumn 2019, and the second stage was conducted in spring 2020. The interview guide included questions about the patient pathway, organization, financing, and quality assurance of the screening program.

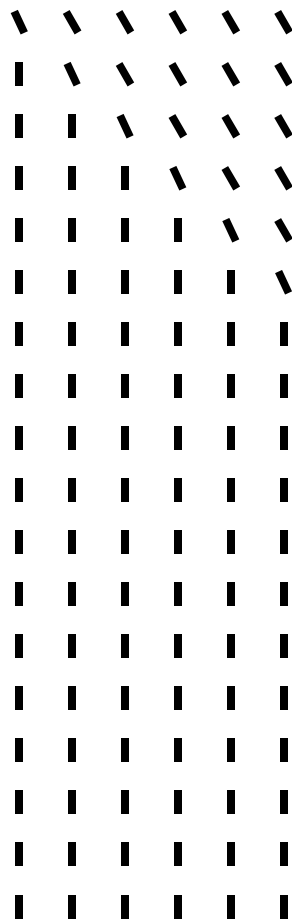
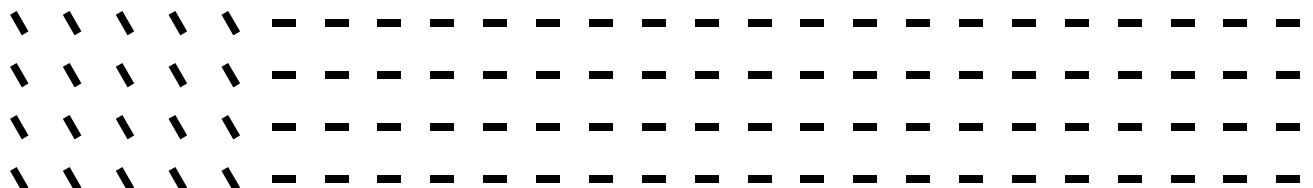
### **2.4 Workshops with national stakeholders**

At the beginning of 2020, after the first stage of the interviews was completed, a workshop of the Swiss Interest Group for Lung Cancer Screening CH-LSIG was held in Bern. The preliminary results of the study were discussed with the members of the group. A second workshop with the CH-LSIG took place in late fall 2020. The goal of the workshops was to gain feedback from the national experts and to validate the latest developments of the project.

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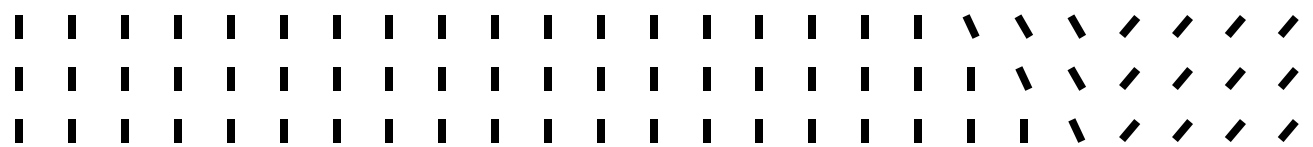
<sup>5</sup> Glinz D., Shaw D., Tomonaga Y., Bucher H. (2020): Low-dose CT screening for lung cancer. Scope. Version 3. Basel institute for clinical epidemiology and biostatistics.

To reach a broader audience for feedback on the progress of the project and to disseminate the idea of a potential model of LDCT screening, we also organized a workshop at the Public Health Conference in Switzerland in 2020, and we prepared a poster for the Nationale Tagung Krebsfrüherkennung 2020.



### **3. Background of LDCT lung cancer screening**

**What is the evidence supporting the implementation of an LDCT lung screening program?**



The goal of this chapter is to provide a short overview of the international scientific evidence on the relevance of lung cancer, the scientific evidence in support of lung cancer screening and the evidence from the introduction of lung cancer screening. The chapter is by no means a comprehensive review of the current state of research, as this is the aim of the HTA conducted by the cancer screening committee.<sup>6</sup> An overview of the results and characteristics of large studies is given in Table D 3.1.

### 3.1 The relevance of lung cancer – burden of disease

According to the World Health Organization (WHO), cancer is the second leading cause of death globally. In 2018, an estimated 9.6 million individuals died of lung cancer. This number is approximately 18% of all cancer deaths worldwide.<sup>7</sup> Furthermore, the WHO estimates that approximately 30% of all cancer deaths are due to five leading behavioral risks, including smoking.

In Switzerland, the yearly cancer incidence is approximately 41,000, and cancer is the leading cause of death, causing 30% of all deaths.<sup>8</sup> The incidence of lung cancer is approximately 4,500 per year and leads to 3,200 deaths a year. The financial burden of lung cancer in Switzerland is estimated to be yearly 721 million Swiss Francs yearly. According to this estimation, lung cancer is the most expensive cancer in Switzerland.<sup>9</sup>

### 3.2 Scientific evidence from RCTs

#### 3.2.1 Early detection of lung cancer

An HTA report from the UK included twelve RCTs in a systematic review of the clinical effectiveness of LDCT.<sup>10</sup> Most of these studies were conducted in the EU, but some were conducted in the US. The meta-analysis showed that the number of lung cancers detected was significantly higher in the LDCT screening group than in the control group (pooled RR 1.38, 95% CI 1.02 to 1.86). With respect to the stage of the detected lung cancer, LDCT demonstrated a clear benefit according to the meta-analysis. LDCT screening increased the likelihood of the detection lung cancer in stages I and II (pooled RR 1.73, 95%

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<sup>6</sup> See: <https://cancerscreeningcommittee.ch/themen/lungenkrebs-screening-mittels-ldct/>, last accessed: December 3, 2020.

<sup>7</sup> WHO, Cancer, Key Facts, <https://www.who.int/news-room/fact-sheets/detail/cancer>, last accessed: April 7, 2020.

<sup>8</sup> <https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/gesundheitszustand/krankheiten/krebs.html>, last accessed: April 7, 2020.

<sup>9</sup> Wieser S., Tomonaga Y., Riguzzi M., et al. (2014): Die Kosten der nichtübertragbaren Krankheiten in der Schweiz. Schlussbericht. Im Auftrag des Bundesamts für Gesundheit.

<sup>10</sup> Snowsill T., Yang H., Griffin E., et al. (2018): Low-dose computed tomography for lung cancer screening in high-risk populations: a systematic review and economic evaluation.

CI 1.27 to 2.37) and significantly reduced the probability of late-stage cancer in the treatment group compared with that in the control group.

### 3.2.2 Lung cancer mortality

Furthermore, the meta-analysis showed that LDCT screening was associated with a (non-significant) decrease in lung cancer mortality. After the removal of a low-quality RCT, the decrease in lung cancer mortality in the treatment group relative to that in the control group became statistically significant (pooled RR 0.85, 95% CI 0.74 to 0.89). The reduction in lung cancer mortality was also supported by the recently published long-term results of the NELSON trial and the MILD trial.<sup>11</sup> In the NELSON trial, the cumulative rate of death from lung cancer at 10 years for men was 0.76 in the treatment group (95% CI 0.61 to 0.94) compared with the control group. In the MILD trial, the screening arm had a 39% lower lung cancer mortality at 10 years than the control arm (hazard ratio 0.61; 95% CI 0.39 to 0.95).

### 3.2.3 All-cause mortality

Four RCTs that assessed the effects of LDCT screening on the outcome of all-cause mortality with at least five years of follow-up were included in the HTA conducted by Snowsill and colleagues in 2018.<sup>12</sup> The meta-analysis showed a marginal, non-significant increase in all-cause mortality (pooled RR 1.01, 95% CI: 0.87 to 1.16). Furthermore, the effects with respect to all-cause mortality were heterogeneous, and the results should thus be interpreted with caution. After a low-quality trial was excluded, there was a decrease in all-cause mortality of the treatment group (pooled RR 0.95, 95% CI 0.89 to 1.00) compared to that of the controls. The results of the NELSON trial indicate that after 10 years, the all-cause mortality did not decrease for the treatment group relative to the control group (RR 1.01, 95% CI 0.92-1.11).<sup>13</sup> However, it is disputed if the trial design was powered to address this question.

### 3.2.4 Cost-effectiveness

Tomonaga et al. (2018) conducted a modeling study on the cost-effectiveness of lung cancer screening in Switzerland. Fifteen of the 27 scenarios on the efficiency frontier led to cost-effectiveness ratios below Euro 50,000 per life year gained. The authors concluded that lung cancer screening may be cost-effective for a high-income country with elevated smoking prevalence, such as Switzerland. Raymaker et al. (2016) reviewed the cost-effectiveness analyses of LDCT lung cancer screening strategies.<sup>14</sup> The results varied across the identified studies. The cost per quality-adjusted life year (QALY) ranged from US\$18,452 to US\$66,460. The variation in the cost per QALY could partially be explained by the prevalence of lung cancer, the cost of the screening and especially the definition of

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<sup>11</sup> Koning H. J., van der Aalst C. M., de Jong P.A., et al. (2020): Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial. *The New England Journal of Medicine*. DOI: 10.1056/NEJMoa1911793

Pastorino U., Silva M., Sestini S., et al. (2019): Prolonged lung cancer screening reduced 10-year mortality in the MILD trial: new confirmation of lung cancer screening efficacy. *Annals of Oncology*. DOI: <https://doi.org/10.1093/annonc/mdz117>

<sup>12</sup> Snowsill T., Yang H., Griffin E., et al. (2018): Low-dose computed tomography for lung cancer screening in high-risk populations: a systematic review and economic evaluation.

<sup>13</sup> Koning H. J., van der Aalst C. M., de Jong P.A., et al. (2020): Reduced Lung-Cancer Mortality with Volume CT Screening in a Randomized Trial. *The New England Journal of Medicine*. DOI: 10.1056/NEJMoa1911793

<sup>14</sup> Raymakers A. J. N., Mayo J., Lam S., et al. (2016): Cost-Effectiveness Analyses of Lung Cancer Screening Strategies Using Low-Dose Computed Tomography: a systematic Review. *Applied Health Economics and Health Policy*, 14, 409-418.

the eligible group. Currently, a modeling study based on the data from the Nelson study is ongoing. This study will be conducted in collaboration with the University of Zurich and the Erasmus University Medical Center in Rotterdam.

**D 3.1: Overview of LDCT lung cancer trials**

Trial	Control arm	Intervention schedule	N intervention N control	Age	Inclusion criteria		Nodule interpretation	Results
					Tobacco	Other		
NLST (USA)	CXR	Baseline LDCT + at years 1-3	26722 26732	55-75	>30 PY Ex< 15 Y		NLST >4 mm	-20% (6.8 – 26.7)
DANTE (IT)	CXR T0 then observe	Baseline CXR + sputum cytology + Baseline LDCT + at years 1-4	1264 1186	60-75	>20 PY EX<10 Y		NLST >= 10 mm	0.99 (0.69 – 1.43), no difference in lung cancer mortality
DLCST (DK)	Observe	Baseline LDCT + at years 1-4	2052 2052	50-70	>20 PY EX<10 Y	FEV1 >30%	NELSON	Nonsignificant difference in lung cancer-specific mortality
ITALUNG (IT)	Observe	Baseline LDCT + at years 1-3	1613 1593	50-70	>20 PY EX<10 Y		NELSON	0.70 (0.47 – 1.03)
MILD (IT)	Observe	Baseline + annual LDCT (9 years) vs. baseline + biennial LDCT (9 years)	2376 1723	50-75	>20 PY EX<10 Y		NELSON	0.61% (0.39 – 0.95) (Year 10)
LUSI (GE)	Observe	Baseline LDCT + at years 1-4	2029 2023	50-70	>15 cig/d >25 Y OR >10 cig/d >30 Y EX<10 Y		NELSON	0.74 (0.46 – 1.19) M 0.94 (0.54 – 1.61) F 0.31 (0.1 – 0.96)
NELSON (NL/BE)	Observe	Baseline LDCT + at years 1, 3, 5.5	5279 7892	50-70	>15 cig/d >25 Y OR >10 cig/d >30 Y EX<10 Y		NELSON	M 0.74 (0.6 – 0.91) F 0.61 (0.35 – 1.04) (Year 10)
UKLS (UK)	Observe	Baseline LDCT	2028 2027	50-70		LLP>=5%	NELSON	Not reported

Source: Couraud S., Milleron B. (2016): Lung cancer screening: what is new since the NLST results? *Curr Pulmonol Rep* DOI 10.1007/s13665-016-0139-7.

cig/d cigarettes per day, CXR chest X-ray, DA Denmark, DU/BE Dutch/Belgium, EX quit smoking, F female, FEV1 forced expiratory volume in one second, fu follow-up, GE Germany, IT Italy, JA Japan, LDCT low-dose computed tomography, LLP *Liverpool Lung Project*, M male, PY pack-years, UK United Kingdom, USA United States of America, VDT volume doubling time, Y years

### 3.3 Implementation of lung cancer screening

Only a limited body of relevant literature is available on the implementation of lung cancer screening, mainly because lung cancer screening programs have hardly been implemented on a large scale. In January 2020, Croatia was the first EU country to launch a national lung cancer screening program; the program targets all active smokers (or who have

stopped smoking within the last 15 years) between 50 and 70 years of age. In total, eleven health facilities across Croatia provide the screening.<sup>15</sup> Poland initiated a lung cancer early detection program within its National Cancer Plan financed by the Ministry of Health.<sup>16</sup> The experience in Poland makes a strong case for introducing LDCT cancer screening locally and building up facilities gradually.<sup>17</sup> Furthermore, the UK has established regional LDCT lung cancer screening programs.<sup>18</sup> In the US, screening programs are organized on a private basis.

Field et al. (2019) published the results of a roundtable discussion of experts on the implementation of lung cancer screening in Europe.<sup>19</sup> The authors recommended that national health policy groups start implementing CT screenings as adequate evidence of their effectiveness becomes available; therefore, lung cancer screening should become a priority in Europe. In addition, the following key statements were made:

- Future studies should focus on the implementation of LDCT screening.
- Recruitment in hard-to-reach communities should be improved.
- The methodologies applied within the screening should follow the newest scientific developments.
- Training and quality assurance are necessary.
- A European registry on lung cancer CT screening data should be fostered.
- Lung cancer screening should follow a multidisciplinary approach engaging all clinical specialties.

In addition to articles referring to single countries, European societies such as the European Society of Radiology (ESR), the European Respiratory Society (ERS) and the European Society of Thoracic Surgery (ESTS) have published position papers and recommendations in favor of introducing long-term screening programs.

In the USA, private hospitals have implemented lung cancer screening. In this sense, even though lung cancer screening is widely available in the USA, there is no national cancer screening program in place. However, most major medical organizations in the USA recommend yearly lung cancer screening for high-risk individuals. The American Thoracic Society and American Lung Association have published an implementation guide for lung

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<sup>15</sup> Juničić K., Euractiv. ZAGREB – First national lung cancer detection program [Internet]. Available from: [https://www.euractiv.com/section/all/short\\_news/zagreb-first-national-lung-cancer-detection-program/](https://www.euractiv.com/section/all/short_news/zagreb-first-national-lung-cancer-detection-program/), last accessed: October 7, 2020.

The health facilities providing the screening are in: Zagreb, Osijek, Rijeka, Split, Varazdin, Zadar, Dubrovnik, Slavonski Brod, Virovitica, Pula and Krapinske Toplice.

<sup>16</sup> The Economist, Intelligence Unit (2020): Breathing in a new era. A comparative analysis of lung cancer policies across Europe.

<sup>17</sup> Rzyman W., Szurowska E., Adamek M. (2019): Implementation of lung cancer screening at the national level: Polish example. *Translational lung cancer research*, 8: 95-105.

The Polish model focused for the recruitment of patients on GPs. According to the project team's information, this GP-centered approach led to a low participation rate and is currently reconsidered.

<sup>18</sup> <https://www.cancerresearchuk.org/about-cancer/lung-cancer/getting-diagnosed/lung-health-checks>, last accessed: October 7, 2020.

<sup>19</sup> Field J. K., deKoning H., Oudkerk M., et al. (2019): Implementation of lung cancer screening in Europe: challenges and potential solutions: summary of multidisciplinary roundtable discussion. *ESMO Open*, 4:e000577.

cancer screening.<sup>20</sup> Within this guide, a variety of existing lung cancer screening models are described, and topics to be considered when clinics are planning lung cancer screening in the USA are reported. For example, the implementation guide provides guidance on how to centrally organize a lung cancer screening program. In this case, program coordinators are responsible for the organization of the program, e.g., recruitment, smoking cessation and tracking of clinical outcomes. In contrast, a decentralized approach places all responsibilities on the referring provider. Furthermore, the implementation guide describes how to approach the introduction of a lung cancer screening, starting with engaging local leadership, forming a governance structure and establishing a business plan (or the definition of the quality metrics), which are followed in the program. Just very recently, the US Preventive Services Task Force (USPSTF), the government's influential guidelines panel, has updated its recommendations on lung cancer screening, broadening eligibility to include younger and lighter smokers.<sup>21</sup> The publication of the recommendations is accompanied by a series of articles in the same issue of the JAMA journal, including an updated evidence report and systematic review.<sup>22</sup>

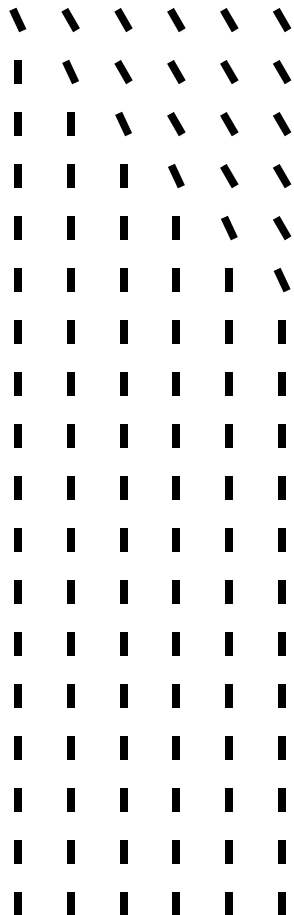
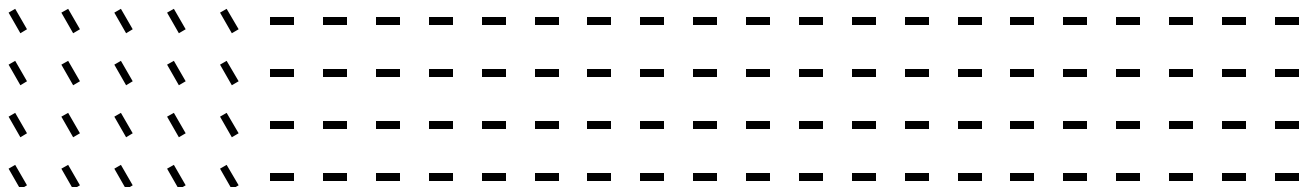
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<sup>20</sup> American Thoracic Society and American Lung Association. Implementation Guide for Lung Cancer Screening.

<sup>21</sup> US Preventive Services Task Force (2021): Recommendation statement. Screening for Lung Cancer. JAMA. 325(10):962-970.

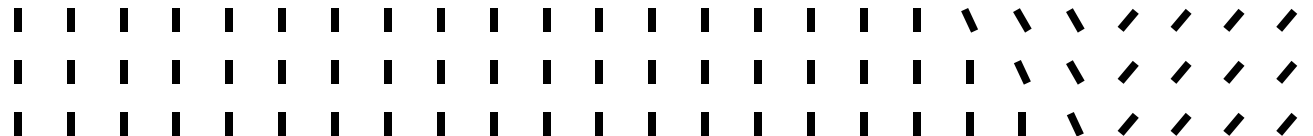
<sup>22</sup> JAMA. 2021;325(10).





## **4. Description of international initiatives**

**What is the current implementation of LDCT screening in Austria, Italy and the UK?**



In this chapter, three initiatives from other countries are described. These initiatives are from Austria, Italy and Manchester, UK:

- In *Austria*, there is no LDCT lung cancer screening in place. Currently, there are open discussions on whether screening should be implemented. However, the *Onkologiebeirat*<sup>23</sup> expressed skepticism about the cost/effectiveness of lung cancer screening. The *Onkologiebeirat* is a multiprofessional, interdisciplinary committee advising the health minister regarding the prevention and treatment of cancer. By mid-2021, a lung cancer screening trial is expected to provide the basis for a cost-effective LDCT screening program.
- In *Italy*, there is no national screening program in place. In 2020, the development of a pilot trial was underway. There have been several trials implemented across Italy, with the National Cancer Institute in Milan being the hub. The most recent RCT was the Multicentric Italian Lung Detection (MILD) trial. Unless explicitly stated, the following descriptions of an initiative in *Italy* refer to the MILD trial.
- In *Manchester, UK*, the NHS implemented Lung Health Checks in 15 areas in England in autumn 2019.<sup>24</sup> Lung Health Checks are restricted to individuals who are active or past smokers; they consist of a general health and lung check including spirometry, smoking cessation and well-being support, and if necessary, LDCT screening. The organization of the checks varies among regions, but they are based on the Lung Health Check of Greater Manchester, which was initiated in a pilot in 2016.

In the following sections, these three initiatives are described in more detail. These descriptions are mostly based on insights gained during the interviews with representatives of each initiative.

#### 4.1 Recruitment strategy

Reaching out to individuals who are potentially at risk is a major challenge of LDCT screening. General practitioners (GPs) and organisations in direct contact with eligible individuals play an important role.

- In *Austria*, recruitment is planned to be carried out via GPs. The interview partner from this initiative highlighted that GPs know their patients best and can thus appropriately

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<sup>23</sup> Among others, the following groups are part of the Onkologiebeirat: doctors, patient representatives, psychologists, health economists and health professionals. For a detailed list of the members of the Onkologiebeirat, see <https://www.sozialministerium.at/Themen/Gesundheit/nicht-uebertragbare-Krankheiten/Krebs/Onkologiebeirat.html> [last accessed: April 29, 2020]

<sup>24</sup> Southampton, Thurrock, Luton, Corby, Mansfield, Hull, Kirklees, Doncaster, Dukinfield, Blackburn, Runcorn, Liverpool, Blackpool, Newcastle, Manchester. See: <https://www.cancerresearchuk.org/about-cancer/lung-cancer/getting-diagnosed/lung-health-checks> [last accessed: May 1, 2020].

assess their eligibility for LDCT screening. Furthermore, GPs are considered to have closer relationships with more deprived individuals among health practitioners. Deprived individuals are the least likely to participate in screening but would benefit the most. Pulmonologists normally see individuals at a later stage when they suffer from symptoms. Therefore, they play a secondary role in the recruitment of mostly asymptomatic screenees.

- In *Italy*, GPs played an important role in recruitment, as they are close to potential patients. Furthermore, the recruitment strategy was based on advertisements in local and national television, railway and metro stations and radio stations. For financial reasons, post mail was not used for patient recruitment in *Italy*. One of the challenges for recruitment was that smoking status was not available in register data. For the next trials (e.g., the Parma Health Project), the recruitment should be performed by GPs who send high-risk patients to an intermediary or a coach who coordinates the recruitment.
- In *Manchester*, recruitment follows a two-step approach. First, every individual between 55 and 80 years of age is invited to contact the NHS, even if they have never smoked. Second, individuals who then declare that they have smoked more than 100 cigarettes in their lives are invited to make an appointment for a Lung Health Check by the program team. According to one of the interview partners from this initiative, approximately 10% of all individuals do not attend the Lung Health Check appointment. During the Lung Health Check, lung health and eligibility for LDCT lung cancer screening are assessed.

#### 4.2 Risk assessment

Eligibility is based mainly on age and smoking history, as well as further criteria. More elaborate inclusion criteria have been developed over the years.

- In *Austria*, the eligibility of individuals will likely be based on the Canadian model (PLCOm2012) to predict an individual's risk for lung cancer.<sup>25</sup> Furthermore, due to the current evidence indicating that women benefit more from LDCT screening, the Austrian program will try to specifically include women in screening.
- In *Italy*, inclusion in the MILD trial was based on age (49 and 80 years) and an accumulated number of pack-years of smoking of 20 or higher. Furthermore, eligible individuals either smoked or had quit smoking within the past 10 years. Individuals who had cancer in the past 5 years were not eligible. This condition was not specific to a certain type of cancer. The interview partner from this initiative, however, stated that the included age group might be more restrictive in the future. The decision will depend on the newest results on the efficiency from other current trials.
- In *Manchester*, during the Lung Health Check, eligibility for LDCT lung cancer screening is determined by PLCOm2012 to estimate the risk. The model has been slightly adapted for *Manchester* (race is not taken into account). People with a risk of  $\geq 1.5\%$  of suffering from lung cancer within the next 6 years are eligible for screening. As a part of the risk assessment, spirometry is conducted.

#### 4.3 Informed decision making

Obtaining informed consent from eligible individuals is or will be standard in all initiatives. Adequate information seems crucial.

- In *Austria*, no decision aids have been elaborated. However, it is clear that informed consent will be obtained.

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<sup>25</sup> Prorok P. C., Andriole G. L., Bresalier R. S., et al. (2000): Design of prostate, Lung, colorectal and ovarian (PLCO) cancer screening trial. *Controlled Clinical Trials*, 21(6): 2735-2795.

- In *Italy* and *Manchester*, informed consent is required. Further, detailed written information (serving as a decision aid) is given to possible participants for information purposes.
- Moreover, in the *Manchester* Lung Health Check, the communication manager’s engagement seems highly relevant for information purposes. The communication and engagement manager of the program attends churches, mosques, football matches, local community groups, etc., to motivate people to participate in a Lung Health Check and to inform them. Uptake among the invited individuals increased in certain regions from 18 to 42 percent.

#### 4.4 Smoking cessation program

The interview partners from all three initiatives insisted that smoking cessation is an important part of a screening program. Increased smoking cessation directly improves screening health. It was also highlighted that a smoking cessation program increases the political acceptance of a screening program, although its effects on lung cancer screening outcomes have not been uniformly studied to date.

- In *Austria*, smoking cessation is considered to be an essential part of a screening program for two reasons. First, increased smoking cessation directly improves the screening health. Second, a smoking cessation program increases the political acceptance of a screening program.
- In *Italy*, in the MILD trial, the scope of the smoking cessation program offered varied among the participants. At minimum, the participants received advice to stop smoking during the visits. For study reasons, a subsample of persistent smokers received a more extensive smoking cessation program consisting of a prescription medicine used to treat nicotine addiction (Varenicline) and behavioral counseling. The results of the study showed that compared to an unassisted MILD patient, a more extensive treatment had a positive effect on the probability of continuous abstinence after one year.<sup>26</sup> For the prescription of Varenicline, medical personnel is required. In MILD, approximately 20% of the participants stopped smoking within four years. This high rate of quitters may be partially explained by the self-selection of smokers who were motivated to quit. Furthermore, this smoking cessation program allowed us to demonstrate that stopping smoking significantly reduces the overall mortality of smokers enrolled in the screening program.<sup>27</sup>
- In *Manchester*, smoking cessation is part of the Lung Health Check program and is also provided on mobile Lung Health Check trucks. Apart from behavioral advice, smoking cessation can further include the prescription of medications. For non-smokers, general advice for healthy living is provided. In a pilot study in Manchester, approximately 10% of the individuals who attended a smoking cessation program were still non-smokers one year later.

#### 4.5 LDCT screening

##### 4.5.1 Screening intervals

Currently, optimal screening intervals are still being discussed.

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<sup>26</sup> Pozzi P., Munarini E., Bravi F., et al. (2015): A combined smoking cessation intervention within a lung cancer screening trial: a pilot observational study. *Tumori*, 101(3): 306–311.

<sup>27</sup> Pastorino U., Boffi R., Marchiano A., et al. (2016): Stopping Smoking Reduces Mortality in Low-Dose Computed Tomography Screening Participants. *Journal of Thoracic Oncology*, 11(5): 693-699.

- In *Austria*, the pilot will probably follow the screening guidelines of the European Expert Group.<sup>28</sup> According to the interview partner from this initiative, the screening interval should follow the most recent scientific evidence. According to evidence from the MILD trial, this might be a bi-annual interval.
- In *Italy*, in the MILD trial, the duration of the screening interval varied across participants. If the baseline CT scan was negative, participants were randomly assigned across two groups. One group received follow-up CTs every year, and the other group received follow-up CTs every second year. According to the interview partner from this initiative, bi-annual screening seems to be favorable.<sup>29</sup>
- In *Manchester* the screening interval is annual.

#### 4.5.2 Reading strategies

Currently, single reading with computer-assisted diagnosis (CAD) by experienced radiologists is becoming the preferred first-line reading strategy. A centralized reading strategy is a central issue.

- In *Austria*, the reading strategy adopted will be single reading by a radiologist with CAD. The quality of the CAD increases with the availability of data that it can rely on. Therefore, it would be favorable for the CAD to be based on a large pool of European data. A double reading strategy does not seem to be feasible. Any decision leading to an intervention due to positive findings should be discussed among a multidisciplinary board that itself strictly follows the guidelines.
- In *Italy*, the MILD trial images were double-read. One of the two readers applied CAD. If the two readers disagreed, a third read was performed. According to the interview partner from this initiative, for future trials, single reading with CAD will be preferred if the radiologist has enough experience. In a new radiologist's first three to six months of practice, double reading should be performed. This approach should avoid false positives by new radiologists due to a lack of reading experience. Furthermore, according to the interview partner, it would be possible to introduce a centralized reading strategy, where screening is performed in multiple hospitals but CTs are only read in one hospital.
- The *Manchester* Lung Health Check follows a two-step approach. First, a CAD is used. Then, the images undergo a single read by a radiologist. The report is structured. If nothing is found, the report is kept short. Second, indeterminate images are read a second time by a senior radiologist.

#### 4.6 Communication of results

The communication of the results may vary depending on the results and the screening organization.

- It is not yet defined how communication will be organized in *Austria*.
- In the *MILD* trial, the results were communicated by specialized administrative staff and radiologists. GPs are not experienced with LDCT screening, and they were therefore considered not suitable for providing communication.
- In *Manchester*, indeterminate or positive results are communicated by the program nurse via telephone. In the pilot, the results were communicated by mail, which was not well received. Currently, the nurse never states that someone has cancer; she only

<sup>28</sup> Oudkerk M., Devaraj A., Vliegenthart R., et al. (2017): European position statement on lung cancer screening. *The Lancet Oncology*. DOI: 10.1016/S1470-2045(17)30861-6.

<sup>29</sup> Silva M, Milanese G, Sestini S, et al. (2020): Lung cancer screening by nodule volume in Lung-RADS v1.1: negative baseline CT yields potential for increased screening interval. *Eur Radiol*. doi: 10.1007/s00330-020-07275-w. Epub ahead of print. PMID: 32997182.

informs that further investigation is required. The patient is scheduled for an appointment at the hospital. The Lung Health Check addresses the findings and the administrative management of patients. GPs are informed, but their involvement is reduced to a minimum. Approximately four weeks can pass between the check and the notification of the results. Two weeks are calculated for the reading, and another two weeks are calculated between the reading and communication. In the meantime, anxious patients have access to nurses by telephone.

#### 4.7 Management of abnormalities

The management of abnormalities is heterogeneous across the studied initiatives.

- In *Austria*, the management of abnormalities will strictly follow the guidelines of the European Expert Group presented in the European position statement of 2017.<sup>30</sup> PET-CT might be used for further investigations of nodules.
- In *Italy*, in the MILD trial, the applied procedure depended on the nodule size:
  - If nodules with a size of 60-250 mm<sup>3</sup> were detected, rescreening was performed three months after the first screening to analyze nodule growth in an indeterminate situation. If nodules larger than 250 mm<sup>3</sup> were detected, the individual was referred to multidisciplinary discussion, and work-up was discussed.
  - Malignant growth: Computer-aided detection of volumetric growth of 25% or higher in a three-month interval was used as the threshold to determine malignant growth by calculating the volume doubling time.
  - Positive findings were treated depending on the type of nodule. If a nodule had solid components, the patient was sent for a PET scan. Before surgical resection, biopsy of the nodule was performed, most frequently through transthoracic CT-guided sampling. For future trials, rescreening might be planned for six months after an indeterminate CT scan, as proposed by Lung-RADS. Three months might be too short of an interval compared to a moderately larger interval that allows for the observation nodule dynamics.
- In *Manchester*, the management of abnormal findings is performed as follows:
  - Undetermined results: If there are undetermined results, screening is repeated after three months. The image is also read by a senior radiologist.
  - Positive results: If there is a positive finding, the RAPID program starts. It is a fast lane access for further diagnoses and treatments. The first treatment of lung cancer is performed within two weeks in the best case.
  - Incidental findings: A protocol for incidental findings exists. Seventy-five percent of incidental findings are emphysema, in which case there is no further action in an asymptomatic patient.

#### 4.8 Quality assurance

It is of utmost importance to ensure the quality of the screening program. A registry to monitor outcome and patient data seems indispensable, and the training of providers must also be ensured.

- According to the *Austrian* interview partner, it seems essential to standardize processes across Europe. Such standardization would include the use of already existing screening protocols, such as that of the European Expert Group. The interview partner from *Italy* agreed that structured, comparable reporting is important for analytical reasons and quality assurance. One such report was provided by European Society of Thoracic

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<sup>30</sup> Oudkerk M., Devaraj A., Vliegenthart R., et al. (2017): European position statement on lung cancer screening. *The Lancet Oncology*. DOI: 10.1016/S1470-2045(17)30861-6.

Imaging (ESTI).<sup>31</sup> Furthermore, some CT scanner providers established structured automatic reporting tools, with further options being available from third parties. With regard to the training of the screening providers, Austria will probably follow the guidelines, and the workshop materials provided by the ESTI will be used.<sup>32</sup>

- Further, the *Austrian* and *Italian* interview partners favored a European registry including patient outcomes. Such a registry would allow benchmarking between countries. National benchmarking is not seen to be sufficient because of reservations that one country might be underperforming compared to other nations. The patients would need to agree to participate in this European registry. The social security number could serve as an identifier in the European registry.
- In *Manchester*, the national quality assurance board is responsible for the quality assurance of the program. Patient data are managed through the electronic patient record, which is not uniquely defined for the Lung Health Check. A registry for positive findings that collects data on nodules, etc., is managed by the Veolity system (by MeVis Medical Solutions AG).

With regards to staff training, the *Manchester* Lung Health Check is operated by specifically trained nurses. Furthermore, the images are read by trained radiologists, as well as by senior radiologists if the results are unclear.

#### 4.9 Organization

The organization of the screening programs varies between the initiatives.

- The MILD was initially designed as a national program for multicenter-recruitment of 10 000 participants. Because of difficulties with the funding and local authorities, the program was finally realized with 4099 participants in the region of Lombardy
- In *Austria*, the initiative will likely be organized as a regional pilot in the area of Innsbruck. The pilot will be organized as a scientific study, as was the MILD trial in *Italy*.
- In *Manchester*, the Lung Health Check is organized as a pilot that is financed by the NHS. Currently, the pilot is financed until 2021. The University Hospital of *Manchester* (Wythenshawe Hospital) is leading this pilot and hosts program management. Whereas the screening organization is decentralized, the reading and any further diagnostics/treatments are centrally organized in Wythenshawe Hospital.

#### 4.10 Financing

Financing depends heavily on the context, governance of the health care system and extent of screening (trial vs. general introduction of a program).

- In *Austria*, it is currently unclear how the trial will be financed. However, full coverage of costs would be appropriate, as national insurance generally also reimburses other health care expenditures. One possible approach is to increase cigarette taxes to cross-finance the screening.
- In *Italy*, the *MILD* trial was financed by research grants and included public funding.
- The *Manchester* Lung Health Check is fully financed by the NHS, and there are no costs for participants. According to the interview partners, the calculated costs per day amounted to 4,500£ for the Lung Health Check truck trailers, but actual costs were lower.

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<sup>31</sup> See: <https://www.myesti.org/lungcancerscreeningcertificationproject/> [last accessed: April 30, 2020]

<sup>32</sup> See e.g., <https://www.myesti.org/csworkshops/>, last accessed: June 8, 2020.

#### 4.11 Ethical issues and equity

Equal access is a major issue in screening programs. During the interviews, it was mentioned that access to screening should be equal for all individuals in the at-risk group, which is also the main reason for minimizing individual out-of-pocket expenditures. At the time of the site visit, the *Manchester* Lung Health Check was available only in certain regional areas with the highest need. This restricted availability led to unequal access. However, it was planned to expand the Lung Health Check to further areas of *Manchester* to minimize unequal access.

Furthermore, it was mentioned that the privacy of data is important and must especially be accounted for in the process of establishing registries.

#### 4.12 Facilitators

The interviews with international experts revealed the following facilitators of LDCT lung cancer screening:

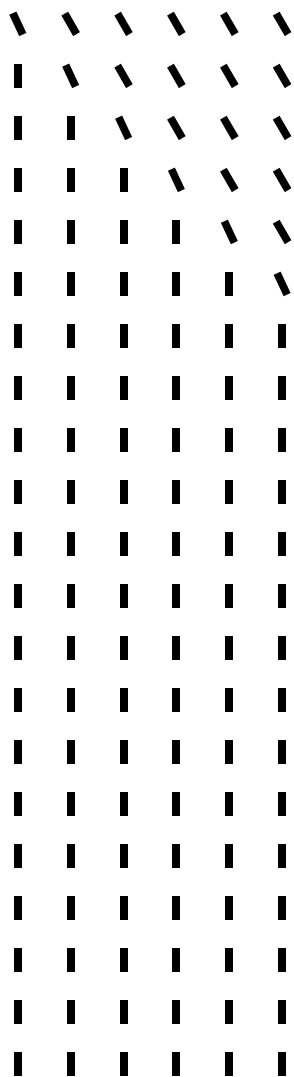
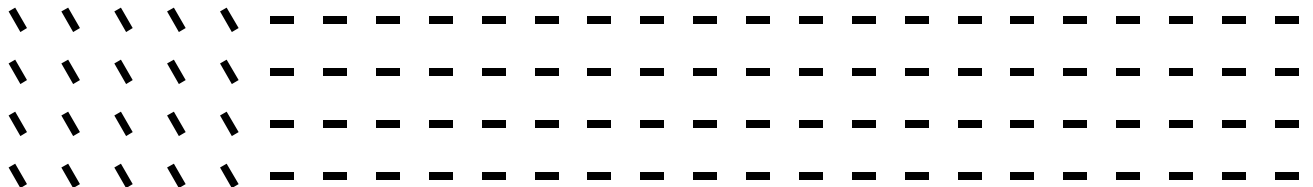
- *Interest of stakeholders:* There is interest in the prevention of lung cancer in general and the subject of lung cancer screening receives attention among stakeholders in Austria.
- *Personal promotion by means of a communication manager:* In *Manchester*, the communication and engagement manager seems to be highly effective. The communication and engagement manager of the program attends churches, mosques, football matches, local community groups, etc., to motivate individuals to participate in a Lung Health Check and to inform about the checks. The communication and engagement manager increased the uptake of the screening in certain regions from 18 to 42 percent.
- *Involvement of key persons/ambassadors/promoters:* In addition to the communication manager, the involvement of key persons/ambassadors/promoters, such as imams or priests, may further help motivate individuals to participate in the screening.

#### 4.13 Barriers

Several barriers were mentioned during the interviews.

- *Legal implications regarding smoking prevention:* The legal situation regarding smoking prevention must be up to date. In Austria, the legal situation around smoking is extremely liberal. For example, smoking in restaurants was not prohibited until 2019.
- *Assessment as self-infliction:* There is a general opinion that lung cancer is self-inflicted because of its connection to smoking. This opinion may decrease political support for a screening program, potentially generating a public health area of unmet needs.
- *Difficulty in reaching the target group:* Reaching the individuals who suffer most from lung cancer may represent a key challenge. Often, these are deprived individuals from a lower social class who have less access to information and who are less willing to participate in screening, fearing a potential cancer diagnosis. Furthermore, smoking status is often missing in the available data, which makes it more difficult to reach the target group. In *Manchester*, the main barriers are deprivation, language problems, distrust, mobility issues and the stigmatization of smoking. In addition, many individuals have relevant anxiety to consult a doctor for an abstract concept such as prevention, as in their understanding a contact with their GP is only warranted when a serious health issue arises. Engagement managers, GPs, and Nurses on the health check program may help overcome this problem.



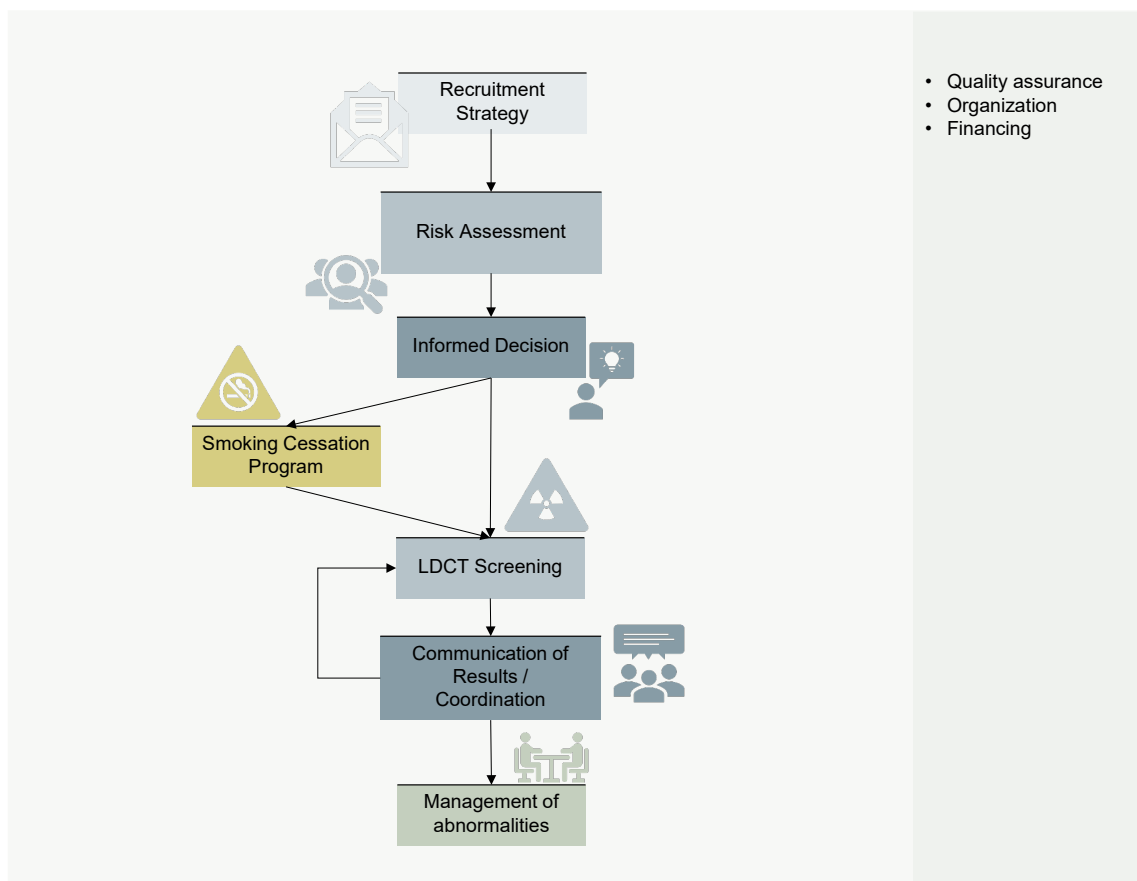


## **5. National stakeholders' perspectives on a potential Swiss program**

**What are the national stakeholders' perspectives on a Swiss LDCT screening program?**

In this chapter, the results of the national stakeholder consultation are summarized. The aim of the consultation was to assess the national stakeholders' opinions on the potential introduction of an LDCT lung cancer screening program in Switzerland. The interviews covered topics related to the patient pathway, which is illustrated in D 5.1.

#### D 5.1: Patient pathway of an LDCT lung cancer screening program



Source: own illustration

#### 5.1 Recruitment strategy

Reaching out to the individuals who are potentially at risk is seen as a major challenge in LDCT lung cancer screening. In contrast to other types of screening, it might be more difficult to motivate individuals for lung cancer screening. According to some stakeholders, this is an issue, as individuals with a high risk for lung cancer may be smokers who have a more fatalistic attitude towards their health.

A broad approach is therefore recommended for the recruitment of screenees, and potential channels/actors are described in the following sections.

### 5.1.1 Health professionals and leagues

Regarding health professionals, GPs, pulmonologists and pharmacists were specifically mentioned by the interview partners as potential actors in the recruitment process. Furthermore, health leagues were identified as being able to play a leading role in the recruitment of screenees:

- *GPs*: The view on the role of GPs varied among interviewees. Some stakeholders saw the GP as the key person in recruiting screenees, as he/she best knows the patient's (smoking) history and may inform the patient about the screening during a regular check-up. Others stated that GPs may lack the time and financial incentives or reimbursements to recruit and inform potential screenees. Furthermore, it was mentioned that a homogeneous information flow might be difficult due to the large number of GPs.
- *Pulmonologists* have the most contact with patients who have already symptoms. Therefore, they may have a subordinate role in the recruitment process.
- *Pharmacists* may also act as a first contact person who could technically perform a prescreening and refer eligible individuals to an LDCT screening.

Health leagues are a Swiss feature not known in other countries. They play an important role in certain fields of health care and prevention. They are organized at the cantonal level.

- *Lung League*: The Lung League is already involved in the early detection of lung diseases. For example, the Lung League of Zurich tours through the canton with a bus called "Luftibus", providing easily accessible population-oriented services such as mobile lung function tests. Acceptance and uptake are exceptional, according to the Lung League of Zurich. Within this existing program, an individual's risk for lung cancer could also be assessed, and screenees could be recruited.

### 5.1.2 Media

The media can be employed to raise awareness for lung cancer screening and to recruit screenees:

- *Newspapers*: Advertisements and reports in newspapers may also be used for the recruitment of screenees.
- *TV spots*: With regard to TV spots, the interview partners were in part skeptical, as experience shows that the advertisement of screening on TV may lead to an overreaction of the target population.
- *Website*: A website including detailed information on the screening and a tool to assess one's own risk for lung cancer (in the sense of a quick prescreening) may be goal oriented.

### 5.1.3 Registry data

Registry data may represent a comprehensive source to recruit screenees. However, access to such data may be difficult, and necessary information may be missing.

- *Population registry*: In Switzerland, mammography screening receives contact information for all individuals between 50-65 years from the population registry. The first invitation is sent to all individuals that are 50 years of age. The invitation also includes information material. Afterwards, the participants are invited for screening every other

year. Similarly, the population within a certain age range could also be invited for prescreening for LDCT lung cancer screening.

- *Registries of insurers:* Health insurers have information on individuals' backgrounds as well as their treatments, medications and laboratory data. Therefore, health insurers would have all necessary information to recruit individuals. However, the legal situation would need to be assessed to determine if these data could be used for the recruitment of the target population.

#### **5.1.4 Apps of health insurers**

The use and provision of apps for the management of an individual's health are currently increasing. Health insurer apps could be used for recruitment. For example, the health insurer SWICA has two apps: BENEVITA, which provides individualized information on health and health-oriented lifestyle, and BENECURA, which provides services such as the "SymptomCheck" or the "PreventionCheck", proposing tailored preventive measures to the user.

### **5.2 Risk assessment**

Through the interviews, a two-step approach for recruitment of the screenees was developed: prescreening and the actual LDCT lung cancer screening. During the prescreening, the individual's eligibility for LDCT lung cancer screening is assessed. In general, risk stratification is essential for targeted screening in a specified risk population. Such a two-stage approach is also applied for colon cancer screening in the canton of Vaud.

Prescreening may be necessary, as detailed information on the individual risk for lung cancer may be missing. All individuals within a certain age range could be invited for prescreening. Within this prescreening, the individual risk for lung cancer and eligibility for LDCT lung cancer screening could be assessed. The interviewed stakeholders mentioned that the criteria used to assess an individual's risk for lung cancer should follow the latest scientific evidence. A balance between the invested effort and identification of the individuals at risk is necessary. In addition to the risk for lung cancer, some interview partners mentioned that the physical condition for surgery should be a precondition for LDCT lung cancer screening.

Some stakeholders also mentioned that in the first phase of a screening program, eligibility criteria could also be defined based on the available (screening) capacity. In this sense, the age range could be restricted in the first phase of the screening. Once the program is established, the eligibility criteria could then be broadened. Such an approach would, however, be weighed against the risk of modifying conclusions from a database with varying entries and its scientific value.

### **5.3 Informed decision making**

For all interviewed stakeholders, sufficient and adequate information for the screenee was identified as highly important. The content of the information should cover potential advantages and disadvantages of LDCT lung cancer screening. Some interview partners stated that decision aids should also provide information about psychological effects due to false positive results.

It was stated that short information leaflets with condensed information and more in-depth information material should be provided.

The development of decision aids can draw on various experiences from related fields, such as mammography and colorectal cancer screening programs. The cancer league and the Harding Center are providers of such information material, and the Swiss Cancer

Screening has experience elaborating information material for colorectal cancer. Many different stakeholders, such as the FMH, cancer league, the target population and the Bernese Institute of Primary Care, were involved in this process. In addition, Unisanté is currently working on information material for LDCT lung cancer screening, which may also serve as a basis for the development of German and Italian versions of the material.

#### 5.4 Smoking cessation program

There was general agreement across the interview partners that a smoking cessation program should be a mandatory part of a lung cancer screening program. The stakeholders' opinions, however, varied with regard to the extent of the program and whether successful smoking cessation should be a prerequisite for LDCT lung cancer screening.

- *At least a one-hour consultation:* At the minimum, some stakeholders suggested that the smoking cessation service should include a consultation for the screenee with a health professional. Subsequently, the smoker must decide whether he/she wants to take the next steps. Such a minimum program would be a prerequisite for participating in LDCT screening. Further steps may also include the use of medication for smoking cessation.
- *Long-lasting smoking cessation:* Some stakeholders saw smoking cessation for a defined period (e.g., one year) as a prerequisite to be allowed to participate in LDCT screening (similar to the practices for liver/lung transplantations). To ensure successful smoking cessation, long-lasting attendance of a smoking cessation program may be necessary. Other stakeholders stated that it might be ethically difficult to require smoking cessation as a prerequisite for receiving treatment.

With regard to the organization of smoking cessation, some stakeholders mentioned that many providers offer smoking cessation services. Offering such services is a possibility, as existing programs could be included in lung cancer screening. However, it was also mentioned that it may be difficult to achieve uniformity among many providers of smoking cessation programs. Among others, providers of smoking cessation include GPs and cantonal Lung Leagues.

#### 5.5 LDCT screening

##### 5.5.1 Screening protocol

The screening protocol defines the screening intervals, the characterization of findings, the risk of malignancy and further management. According to stakeholders, the screening protocol should be based on the newest available scientific evidence from large studies. Such studies include the MILD, NELSON and NLST trials.

Some stakeholders also mentioned that these protocols from international studies may need to be partially adjusted for Switzerland. Such adjustments were necessary for mammography protocols. European guidelines were used to define national screening guidelines. These national guidelines were not binding, but they guided the cantonal screening protocols.

##### 5.5.2 Reading strategies

According to the interviewed stakeholders, several reading strategies are possible:

- *Single reading:* The reading of the images is performed by a single radiologist.
- *Double reading:* Each image is read by two radiologists. This method is also applied in the Swiss mammography screening.

- Reading by a group of specialists: A group of specialists such as pulmonologists, radiologists, radio-oncologists, thoracic surgery and oncologists read and/or interpret the images.
- Computer-assisted diagnosis (CAD): CAD may be applied and combined with any of the abovementioned reading strategies.

For the majority of the interviewed stakeholders, it was difficult to judge the best reading strategies, and there was no consensus. The reading strategy should both be feasible and ensure high quality. Again, in the selection of the reading strategy, the focus should be on international evidence and practices from large trials. In this sense, volumetry should be applied. Some stakeholders favored the reading of images by two specialists, others favored reading by an interdisciplinary board, and others favored CAD combined with single reading.

In addition, to date there is no uniform attitude towards centralized versus decentralized reading of imaging data. The former strategy would facilitate to maintain uniform interpretation and reporting standards, while the later would be an integrative approach, albeit with the necessity to guarantee some form of training to assure a homogenous reading of imaging data.

### **5.6 Communication of results**

A centralized registry for the administration of screenees would allow standardised communication of results. Communication should be organized by the screening program. According to stakeholders, communication should be timely, and the communication channel should depend on the findings:

- Negative findings can be communicated by letter.
- Indeterminate or positive findings should be communicated personally by a health professional.

Interview partners mentioned that the screening program should serve as a first contact for screenees and should coordinate further diagnostics and treatments. GPs, however, should be informed about the screening results.

### **5.7 Management of abnormalities**

The management of abnormal findings (positive, undetermined, or incidental) is an important issue in screening programs and must be defined in a protocol that should be based on evidence from large and international studies. For stakeholders, it was difficult to adopt the optimal approach to manage abnormalities. Health insurers fear high costs due to incidental findings; therefore, such findings are one of the major reasons for the resistance of health insurers. Therefore, the management of incidental findings needs to be clearly defined and primarily target a strategy to closely monitor indeterminate finding based on the approach adopted by the protocol employed by the NELSON trial to reduce the false positive rate, thus avoiding unnecessary procedure that may increase the financial burden of the screening program.

### **5.8 Quality assurance**

Quality assurance was a crucial aspect for all the interviewed stakeholders. To ensure quality, several measures need to be defined and taken. The guidelines of existing programs and mammography and colorectal screening may serve as a reference in the development of guidelines for quality assurance. Furthermore, it was mentioned that the evaluation of a first phase of a screening program is crucial to ensure quality and to improve

the program. In this sense, Plan Do Check Act (PDCA) cycles might be appropriate to implement.

#### **5.8.1 Training of radiologists and involved health professionals**

The training of radiologists seems important to ensure the quality of the LDCT scanner settings and the reading of images. According to interview partners, courses provided by the ESTI can serve as a standard for training. In the case of mammography, for radiologists, it is not possible to set standards with regard to education. However, it is recommended that radiologists perform at least 2,000 mammography reads annually.

Specific training should be provided not only for radiologists but also for any involved health professionals. Such training could be included in the advanced training of these health professionals.

#### **5.8.2 Quality standards/certification of centers**

Some stakeholders mentioned the certification of centers as a measure to ensure quality. Only those centers with a certification could offer the screening. With this strategy, standards for staff and technical facilities could be set.

Quality standards for breast cancer screening exist, and they are currently being developed for colon cancer screening. However, these standards are not binding in the case of breast cancer screening. If they were binding, adherence would need to be verified, and penalization in case of a violation would be necessary.

#### **5.8.3 Registry**

The registry should allow us to follow screenees (with positive or negative findings) over time. Such a registry would simplify the administration of screenees (sending invitations, sending reports of findings, etc.) and would allow to evaluate the quality of an institution. The registries and the collected data should be standardized to allow comparisons across institutions. According to one stakeholder, such registry solutions (including a link to the CAD) may also be provided by manufacturers of CT scanners. Furthermore, the interoperability of a registry with the national cancer registry should be ensured.

Swiss Cancer Screening has a multicenter screening information system for mammography and colorectal screening. This information system is specifically for the administration of the screening (e.g., invitations, invoices, and mailing). The system is, however, not the newest system, and it may be advisable not to build on this system for LDCT lung cancer screening.

A surgical database that might be used for a pilot study already exists in the French-speaking part of Switzerland. The registry of the colon cancer screening used in the canton of Vaud would not be suitable for lung cancer screening, as the cost of extending the system is estimated to be high.

### **5.9 Organization**

#### **5.9.1 Framing screening as a Lung Health Check instead of lung cancer screening**

The interviewed stakeholders were generally in favor of framing the screening program as a Lung Health Check. The main reason was the positive message of a Lung Health Check, rather than the mention of cancer that may generate anxiety in the targeted risk population. Specifically, it was mentioned that a positive framing offers the opportunity to combine prevention, smoking cessation and LDCT lung cancer screening. Furthermore, positive framing reduces potential negative effects (e.g., on the participation rate) due to

the negative stigma of lung cancer. Nevertheless, some stakeholders expressed their reservation on the terminology, as the content of a lung cancer screening is clearer than that of a healthy lung program that requires specific information on its content.

### **5.9.2 Mobile screening**

Several stakeholders were in favor of mobile screening. One of the main cited advantages was reducing the geographical distance from screenees' homes to the screening location. However, mobile screening may generate extra costs for the scanners and the buses or trucks, and the CT density is assumed to be high in Switzerland. Furthermore, some stakeholders mentioned that such buses or trucks are unknown to the Swiss health care system and questioned whether geographical distance is truly a hindering issue in Switzerland. One important advantage of for a one-stop clinic, whether mobile or hospital-based, would guarantee higher take-up rate by eligible individuals due to lower threshold to participate, as observed in the Manchester Lung Health Check program. Furthermore, the importance of having the support of the most relevant actors (e.g., GPs and pulmonologists) for such innovative ideas was highlighted. One stakeholder mentioned that mobile mammography screenings are conducted in the USA and in the Netherlands.

Mobile practices are already used in Geneva and Vaud (Bus Santé) and Zurich (Luftibus). Bus Santé is used for preventive consultations for diabetes and hypertension screenings (Geneva) and cardiovascular diseases (Vaud), and Luftibus is used to inform about lung health (Zurich).

### **5.9.3 Geographical scope**

Initiating a pilot in a limited number of cantons was positively perceived. Such an approach would allow to learn from experience and subsequently adjust processes and programs. Furthermore, screening programs are under the authority of the cantons; therefore, a top-down approach from a national level does not seem realistic. Nevertheless, a national strategy or position paper would be welcome even if the cantons ultimately decide.

The SUVA organizes a LDCT lung cancer screening for workers who were exposed to asbestos. The LDCT lung cancer screening of the SUVA has further illustrated that the complexity of the screening organization increases with the number of involved screening institutions.

### **5.9.4 Institutional capacities**

Generally, stakeholders assume that existing capacities should not be a hindering issue for the introduction of a screening program. Additionally, it was stated by several stakeholders that Switzerland has a very high density of CT scanners, which may reduce capacity issues even further.

### **5.9.5 Centralization vs. decentralization**

The degree of centralization can vary based on the levels of pre-screening, screening, and reading. Restricting the number of screening institutions may be helpful to ensure quality, but it increases the travel distance to the next screening center. This in return may negatively affect the participation rate. The preferred degree of centralization differed among the stakeholders.

- Some stakeholders preferred fully centralized LDCT lung cancer screening to ensure the quality and continuum of care.
- Other stakeholders favored a hybrid model with decentralized screening and centralized reading. Such a hybrid model may also allow mobile screening units.



- Others favoured a decentralized system (at least with respect to the actual screening), as the screening was not perceived to be complex and geographic proximity to screenees was judged to be key for a high participation rate. In the case of decentralized reading, it was mentioned that for indecisive findings, a possibility was to virtually connect to the central tumor board.

In the case of LDCT lung cancer screening organized by SUVA, 12 centers currently offer screening. In addition to the five university hospitals, these are larger cantonal hospitals (e.g., Lucerne, Bellinzona, and Saint Gall). These centers are experienced and could be included in LDCT screening.

To minimize the incentivization of screening in order to induce demand for expensive treatments, one stakeholder suggested splitting the initial diagnostic and subsequent treatment steps between participating institutions. According to this stakeholder, one possible approach is to perform diagnostics in a decentralized manner and organize treatment centrally.

#### **5.9.6 Stakeholder engagement in the elaboration of a program**

To increase the acceptance and quality of the screening program, stakeholders should be included at several stages of the elaboration of the screening program. Several stakeholders mentioned that in addition to professional stakeholders such as GPs, radiologists and pulmonologists, existing institutions and policy stakeholders should also be consulted (e.g., cantons, leagues and associations). In this context, it is also important to consider each stakeholder's purview (which actor is responsible for what).

Furthermore, the experience of other screening programs, such as mammography and colorectal cancer screening, may be helpful during the elaboration of lung cancer screening. Relevant actors and institutions exist at the national level as well as cantonal level. There is normally one institution at the cantonal level that leads existing cancer screening programs. These institutions are usually foundations, leagues, local hospitals, tumor registers or associations. The national coordination of cantonal programs is performed by the Swiss Cancer Screening and may be especially helpful in regard to the administrative organization and coordination of several (cantonal) cancer screening programs.

#### **5.9.7 Inclusion of professional specialties in LDCT screening**

The interview partners stated that trained nurses and advanced nurse practitioners who are already working in this thematic area (e.g., within the Lung League) or nurse practitioners may be involved in a screening program. As discussed in 5.1.1, the role of the GPs in a screening program was controversial among the stakeholders.

#### **5.10 Financing**

LDCT lung screening is currently not financed by mandatory health insurance. However, when patients have symptoms (e.g., cough), LDCT is reimbursed by the mandatory health insurance. Any further treatments/diagnostics are then subject to the payment of mandatory health insurance. A private initiative/foundation that finances the first screening exists.<sup>33</sup>

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<sup>33</sup> This initiative is called Lungendiagnostik. According to one interview partner, in this private initiative approximately 30% of the screenees need further diagnostics. This share of screenees with further diagnostics is generally estimated to be high by interviewed stakeholders. See also: [www.lungendiagnostik.ch](http://www.lungendiagnostik.ch)

Independently of lung cancer screening, smoking cessation programs are available. If medical doctors offer smoking cessation, the program costs can be billed with TARME and certain medications are reimbursed by mandatory health insurance if specific conditions are fulfilled. Smoking cessation advice offered by persons other than medical doctors or over the counter nicotine-replacement therapies are financed out-of-pocket by smokers.

In the establishment of a pilot study, finances are needed for the conceptualization of the pilot, patient administration, information material, potential pre-screening and actual LDCT screening and to organize quality assurance, including a registry. Furthermore, to ensure equitable access to lung cancer screening, it would be preferable for the screening and smoking cessation program to be free of out-of-pocket expenses.

The stakeholders mentioned the following potential financing sources, which may also be applicable for financing a pilot study:

- *Cantons*: The interviewed stakeholders were generally skeptical that cantons would (currently) be willing to finance LDCT lung cancer screening or a pilot study. In the canton of Vaud, the chances for financial support might be higher than in Zurich, given a tradition of support for cancer screening programs (colon, breast).
- *Mandatory health insurance*: To ensure the sustainability of LDCT lung cancer screening, it would be important for the screening to be covered by mandatory health insurance (KVG). According to Art. 12d KLV, mandatory health insurance covers certain medical preventive measures for the detection of illnesses in specific risk populations. A precondition for mandatory health insurance to cover a screening is the efficacy, appropriateness and cost-effectiveness (Wirksamkeit, Zweckmässigkeit und Wirtschaftlichkeit) of the screening. Mandatory health insurance does not usually cover regional pilots of services. Nevertheless, mammography is generally covered by health insurance if there is a cantonal program. Hence, it might theoretically be possible to establish a program only in selected cantons, such as Zurich and Vaud. In this way, it may be feasible to finance LDCT lung cancer screening as a pilot while the program efficacy, appropriateness and cost-effectiveness are under review. In any case, the medical indication for CT screening would need to be provided by a medical doctor to be covered by mandatory health insurance.
- *Private/supplementary health insurance*: Financing LDCT lung cancer screening through private health insurance (VVG) might be simpler than financing it through the KVG, as a single health insurer has more freedom in this area. However, such financing would bear the risk of unequal access.
- *Further possible financing institutions*: Further potential institutions include establishing a specific screening levy on tobacco products by raising its cost, foundations, the Swiss National Science Foundation (SNSF), the Tobacco Prevention Fund, health leagues or the Swiss Federal Office of Public Health (FOPH).

### 5.11 Ethical issues and equality

The interviewed stakeholders mentioned the following issues that need to be considered with regard to ethics and equity:

- Equal access should be provided to all eligible individuals. Therefore, out-of-pocket payments should be avoided, as they may impose an access barrier.
- Adequate information material and high-quality services should be provided. This information should also address the issue of false positives and psychological distress.
- In addition to investment in lung cancer screening for the at-risk group, it should be ensured that preventive measures are specifically aimed at children and youths (e.g. ban on tobacco advertisements etc.).

- According to one interview partner, approximately 15-25% of all lung cancer cases cannot be attributed to earlier/current smoking. Therefore, it might be ethically difficult to restrict screening to (ex-)smokers only and future research to identify such non-smoker at-risk individuals will be essential.

### 5.12 Facilitators

There are a number of potential facilitators of LDCT lung cancer screening.

- There is strong scientific evidence showing the effectiveness of LDCT lung cancer screening in reducing lung cancer mortality.
- Strong support from a broad range of stakeholders can help achieve political acceptance and support the establishment of a program. These stakeholders include pulmonologists, GPs, the Lung League, the Swiss Lung Cancer Screening Interest Group (CH-LSIG) and pharmaceutical and medical technology companies. Further important stakeholders include the Swiss Cancer Screening and Oncosuisse (the succession institution of the Nationale Strategie Krebs).
- Experience with other types of screening can help establish LDCT lung cancer screening. The FOPH, cantons and other relevant institutions, such as Swiss Cancer Screening, are already experienced in implementing cancer screenings. Furthermore, synergies with other cancer screenings may exist (e.g., with respect to decision aids and quality control)
- Lung cancer has a large burden of disease, and awareness of this public health issue is high in the general population.

### 5.13 Barriers

Additionally, factors hindering LDCT lung cancer screening were mentioned by the interviewed stakeholders.

- The timing might not be ideal for the implementation of screening, as the focus is currently on the COVID-19 pandemic. Political support is, according to stakeholders, will be as important as scientific evidence.
- The tobacco product law (Tabakproduktegesetz) is rather liberal, and some stakeholders may therefore not support expensive LDCT lung cancer screening. According to several interviewed stakeholders, financial resources should be invested in smoking prevention instead of LDCT lung cancer screening.
- Other cancer screening programs might represent competitors, as they have not yet been developed in all cantons. Some cantons will soon implement other cancer screenings and may be hesitant to implement LDCT lung cancer screening.
- Due to increasing cost pressure, it might currently be difficult to establish new screening programs financed by health insurance providers.
- Compared to other screening populations, the lung cancer screening population may be more difficult to reach due to stigmatization.
- The widespread perception that smoking is self-inflicted might represent an obstacle for the introduction of LDCT lung cancer screening.
- Some stakeholders raised concerns that the scientific evidence might not be convincing enough to introduce LDCT lung cancer screening.