QUANTITATIVE IMAGING WORKSHOP XX:

Annual chest CT screening—visualizing the full impact of 20-plus years of smoking

November 2-3, 2023 | Virtual

EXECUTIVE SUMMARY

Supported by a growing body of evidence, lung cancer screening has been recommended by major international bodies as a life savings approach for those individuals who currently or previously had prolonged exposure to tobacco and are now at least fifty years old. The more recently reported European lung cancer screening validation trial, the NELSON, used a quantitative imaging approach as a core component of their efficient and economical cancer screening management approach. A number of countries now implementing lung cancer screening are also using a quantitative imaging approach but moving this imaging process from research setting to routine clinical implementation is a complex process. For the last twenty years, the Prevent Cancer Foundation has sponsored a thoracic CT **Quantitative Imaging Workshop (QIW)** to catalyze progress in reliably measuring early lung cancer to allow more effective interventions to cure early lung cancer. Over the last several years, the American Lung Association has joined to co-sponsor this Workshop. This year's **QIW XX** was held virtually on November 2-3.

Over this interval, there have been remarkable improvements in chest imaging performance including better resolution of the acquired CT image as well as with improved computer analysis capabilities. At the same time, systematic efforts by CT manufacturers have allowed the acquisition of a high-quality thoracic CT screening image using markedly lower doses of medical radiation which reduces the theoretical harm of this screening service.

It is now evident that the heavily tobacco-exposed screening cohorts are also frequently found with evidence of emphysema. Similarly, the lung cancer screening eligible cohort is also frequently detected to have evidence of coronary calcium. From a public health perspective, this additional clinical information detected on screening thoracic CT scans could extend the benefit of thoracic CT screening.

However, while clinical radiologists are now frequently detecting emphysema as well as coronary calcifications, it is important to determine how this information can be reliably obtained and then how to best apply this added information to improve clinical outcomes with these three major lethal diseases.

With the evolution of lung cancer screening, the balance of benefits and harms is dynamic. Ongoing research is essential to ensure that new activities within the screening process are carefully evaluated so the favorable balance of potential harms and benefits is preserved. It is timely to consider these opportunities in greater depth. During **QIW XX**, we explored the status of lung cancer screening using imaging and computational innovations emerging with the thoracic screening process to realize the full benefit of the annual visualization of the thoracic cavities in individuals with long term tobacco exposure.

INFLAMMATION AND THE SHARED PATHOGENESIS OF TOBACCO-RELATED DISEASES

Thoracic CT is emerging as an informative tool for visualizing major tobacco-related diseases. This reflects that the chest is the target for the direct impact of cigarette smoke and therefore the logical site of early tobacco injury. This common denominator to three major, tobacco-related diseases (lung cancer, emphysema, and coronary artery disease) is the host immune response to the deposition of tobacco combustion products. As thoracic CT screening is conducted on an annual basis, we are considering how to best utilize the comprehensive thoracic CT imaging data routine generated during lung cancer screening.

Currently tobacco-exposed individuals receive organ-specific or disease-specific care. The limitation of this narrowly focused care is rapidly emerging as a real barrier to fully leveraging the capabilities of current thoracic CT performance in detecting early thoracic disease. We are advocating for integrated care of early lung cancer, emphysema, and coronary artery disease during this annual screening process. This is epidemiologically sound since all three of these diseases are known to be the result of extensive tobacco exposure with overlapping peak age distributions. Collectively, the risk of premature death related just to these three diseases accounts for 44%. The growing understanding of host factors relative to the pathogenic contribution of chronic inflammation to tobacco-related disease provides a strong rationale for this approach for both early detection as well as coordinating pharmacologic interventions.

REFINING THE IMAGING PROCESS TO ENABLE PROGRESS

With this new thoracic imaging approach, there are critical technical imaging issues to address in implementing quantitave approaches to the evaluation of emphysema as well as to coronary calcium status in routine lung cancer screening settings. Defining easily implemented, effective quality control processes for these new quantitative evaluations is a priority. In addition, as thoracic CT screening matures, the focus will broaden from the current attention on baseline screening detection to consider the dynamic annual changes in CT parameters that are seen when screening participants return for annual repeat imaging. Screening subjects will want to know as precisely as possible about the status of their “thoracic health.” The clinical implications to a screening participant with quantitative CT findings from one year to the next has not been fully defined. A comprehensive collaborative effort to characterize such dynamic changes in screening CT images over time is a critical priority not only for lung nodules but also for changes with emphysema and coronary calcium status. The urgency of this analysis is underscored as this area has emerged as a hotbed for artificial intelligence (AI) development especially as innovation in this area entails the use of quantitative imaging methodologies. Success or failure in this effort may relate to the strategic application of AI tools in a number of areas of this more comprehensive thoracic CT-driven imaging approach.

To support such an ambitious research effort, there are a host of technical issues including with CT imaging storage, data integrity, transfer, and display that also must be addressed. Pilot studies have been published to explore how to address these challenges for optimal routine screening management for the major CT-detected diseases.

OPTIMIZING CHEST CT IMAGING TO VISUALIZE CORONARY ARTERY CALCIFICATION

Many publications have now reported on the detection of coronary calcium during lung cancer screening and its implications as it is such a dominant cause of death in this setting. A major European trial (ROBINSCA Trial) will soon report on the mortality reduction benefit of using coronary calcium evaluation to manage cardiovascular risk. Cardiovascular professional groups have already integrated coronary calcium results to manage cardiovascular risk as part of several professional society guidelines. Therefore, while there is a large literature on the measurement of coronary calcium among cardiologists, how to best introduce this information to other relevant medical specialists in an important challenge. Furthermore, there are remaining issues with quantitative measurement of coronary calcium analysis as well as with the integration of AI approaches that have not yet been standardized especially for application within the annual tobacco-related screening process. As these issues are addressed, lung cancer screening, especially as it detects other presymptomatic tobacco-related diseases, could prove to be an even more robust strategic resource in improving tobacco-related mortality outcomes.

From a population health lens, chest CT provides a unique opportunity to integrate care across the spectrum of early tobacco-related disease in the high-risk cohort for lung cancer screening. The recent proposal of the American Cancer Society extends the target cohort for lung cancer screening to include 15 million people. This window allows visualization not only for early lung cancer but also early, typically presymptomatic emphysema and coronary artery disease. As discussed in **QIW XX**, this situation constitutes both a profound opportunity as well as many potential challenges. Therefore, careful evaluation is essential in devising the optimal process to manage these three disease targets within the current lung cancer screening paradigm. Fortunately, recent publications suggest that lung cancer screening national uptake is increasing from 5% to just under 20%. Public interest in this area is growing. Fortunately, existing lung cancer screening centers currently involve multi-disciplinary teams of professionals that are already routinely engaged in addressing the consequences of chronic tobacco exposure. The existence of more capable electronic health records, AI tools, and cloud-based image storage and analysis capabilities, all could be critical assets in such an effort.

CONCLUSION

Many nations during lung cancer screening implementation are considering a number of complex variables in defining a scalable and sustainable process to improve lung cancer, but now are also considering the value of broadening the medical focus of thoracic CT screening. We anticipate many nations will include the use of quantitative imaging measurements to ensure accurate and efficient thoracic CT screening performance for a growing number of thoracic diseases. Given the complexity of these related issues, collaboration to address these challenges may accelerate progress.

With population health and many other areas of medicine there is a strong impetus to move towards a more prevention-oriented approach to healthcare. As thoracic CT screening is intended to be conducted in a cohort of symptom-free, tobacco-exposed individuals, the bulk of screen-detected disease will occur in asymptomatic individuals. This is critical from a cardiovascular perspective, as the first symptom of heart disease in many cases is still a myocardial infarction or death. Quantitative CT screening in a defined high-risk cohort can help interrupt this cycle. Furthermore, the currently approved frequency of annual lung cancer screening provides a serial opportunity to conduct pragmatic trials to rapidly evaluate management interventions, both nonpharmacological and pharmacological. The goal of this article – and of the **Quantitative Imaging Workshop** – arising from a quantitative imaging perspective is to advance progress along and invite more engagement with this opportunity.

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QUANTITATIVE IMAGING WORKSHOP – STEERING COMMITTEE

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