Early detection of prostate cancer remains a major public health issue worldwide. With this in mind, there has been growing interest in using artificial intelligence (AI) to assess prostate tumor risk based on PSA analysis. This research work focuses on the validation of an AI-based risk calculator, offering a novel perspective for improving screening accuracy.

I. Background

Prostate cancer remains one of the most common cancers in men, and its early detection is essential to improve the chances of successful treatment. PSA, a commonly used marker, can be exploited in a more advanced way thanks to AI.

The literature has already shown the importance of identifying prostate cancer patients before the cancer becomes symptomatic. Large randomized clinical trials (Göteborg, ERSPC, PLCO) have demonstrated the benefits and limitations of PSA screening on cancer-specific survival.

Prostate cancer screening is mainly based on PSA testing. However, due to its lack of specificity, this test also leads to over-treatment of slowly progressing cancers.

The integration of AI in healthcare offers opportunities for personalized diagnosis and risk prediction. An AI-based risk calculator for prostate cancer could help reduce false alarms and identify at-risk cases more accurately.

II. Methodology

1. PROSTia test

To improve the specificity of screening, several tests have recently been developed, such as the PHI test or the 4Kscore test 4. The most recent of these tests is PROSTia. This is an "in silico" test that personalizes the interpretation of the PSA serological value thanks to the probabilistic analysis of several Machine-Learning algorithms. A series of classification runs using the Gradient Boosting technique optimize the model's hyper-parameters, resulting in the calculation of a final score: the PROSTia test result.

PROSTia is a predictive test for prostate cancer risk, based on PSA analysis, changes over time, digital rectal examination (DRE) and over 50 personal parameters. Among these parameters, PROSTia takes into account the patient's family, medical and medication history.

PROSTia has been validated on a retrospective cohort of 12,000 patients (PLCO), the results of which are currently being published.

An abstract presenting the initial results of the PROSTia algorithm will be presented as a poster at the EAU in Paris in April 2024.

An ongoing study at the Nancy CHRU shows that the test could also be used as a biopsy decision aid, leading to a potential 60% reduction in unnecessary biopsies.

3. Data collection in Canada

In recent years, the literature has begun to show the importance of lifestyle and diet in the prevention or occurrence of prostate cancer.

Prof. Fradet's team at Laval University is developing work on this subject. We hypothesize that the PROSTia test can be improved by adding parameters on lifestyle, perceived quality of life and diet to its predictive functions.

Université Laval (Quebec) is leading a multicenter study on prostate cancer diagnosis, called BioCaPPE . The study uses a prospective multi-institutional pan-Quebec design to evaluate biomarkers of prostate cancer risk in relation to lifestyle habits. It includes over 2,050 participants recruited from 5 sites across the province of Quebec. Data collection at study entry uses several validated questionnaires to measure potentially modifiable lifestyle habits, including physical activity and nutrition.

4. Model training

The PROSTia test will be trained with machine learning algorithms using the data collected. All subjects from the BioCappe cohort will be analyzed with the PROSTia test. The aim will be to validate its effectiveness in detecting prostate cancer in this Canadian population. Using the other data collected, particularly those relating to lifestyle habits, we will also try to optimize the model's performance.

III. Validation of the Risk calculator

1. Validation parameters

Accuracy, sensitivity and specificity will be assessed to measure the effectiveness of the risk calculator. Receiver Operating Characteristic (ROC) curves will be generated to assess overall model performance.

2. Comparison with Traditional Methods

The results of the AI-based risk calculator will be compared with traditional prostate cancer screening methods to demonstrate its advantage in terms of accuracy and predictive ability.

V. Objectives of my research :

Under the supervision of Professor Fradet's team (Université Laval), my objectives are to study PROSTia in these two configurations:

- Use the test on the BioCaPPE cohort to evaluate the test's performance on a Canadian population.

- PROSTia currently includes some lifestyle-related data, but it may be possible to further improve its predictive accuracy. To this end, we will be working on a new version of the algorithm that will include a greater wealth of lifestyle data and related biomarkers.

VI. Conclusion

In conclusion, the validation of a prostate tumor risk calculator, based on PSA analysis using artificial intelligence, offers a promising prospect for improving screening practices. The expected results could make a significant contribution to the advancement of prostate cancer diagnosis methods, paving the way for a more precise and personalized approach to men's health.

This work will also create an international link with Professor Vincent FRADET's team.