Enhancing Radiopharmaceutical Decision Support with Telix's AutoML and CDSS (Clinical Decision Support System) Platform

David Han[1], Simon Wail[1], Laszlo Papp[2], Lubos Dolezel[1], Markus Hacker[2]

1. Telix Pharmaceuticals
2. Medical University of Vienna

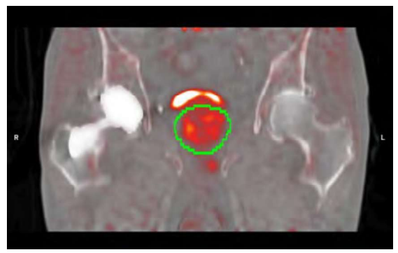
Clinical Decision Support System (CDSS) Designed for Nuclear Medicine

Two major components of the platform:

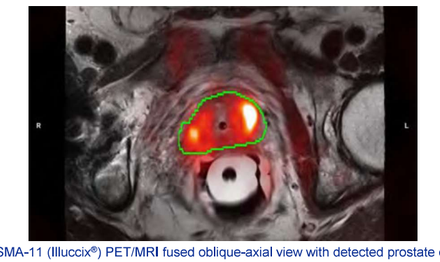
- **Clinical Decision Support System**: Rapidly generates indication-specific applications from available datasets
- **Automated Machine Learning (AutoML)**: "Zero code" approach greatly reduces time, cost and level of expertise required to build, test and validate AI models from raw data

The proof of concept developed for prostate, breast and lung cancer [1].

Lesion Detection and Segmentation



^{68}Ga-PSMA-11 (Illuccix®) PET/CT fused coronal view with detected prostate overlaid (green border)



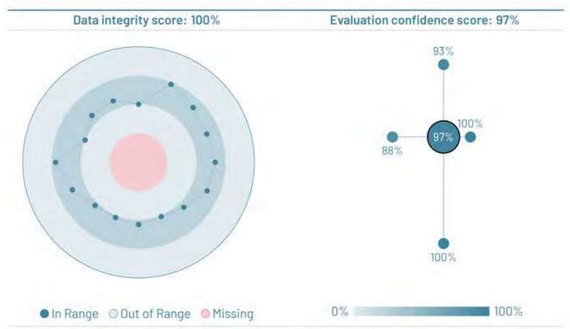
^{68}Ga-PSMA-11 (Illuccix®) PET/MRI fused oblique-axial view with detected prostate overlaid (green border)

Predict the presence and risk associated with prostate cancer:

- Deep Learning (DL) segmentation model to identify prostate gland from CT or MRI
- Combine radiomics and deep learning to identify lesion within prostate gland and ignore "normal" non-disease uptake of the PET tracer

Gleason Score Report with Radiomics and DL

^{68}Ga-PSMA-11 (Illuccix®) PET/CT cinematic volume rendering (CVR) view with detected prostate, lesion probability map and Gleason Score prediction



Quality control report (part) representing data integrity and evaluation confidence certainties made for prediction, indicate similarity and prediction ability of inference data

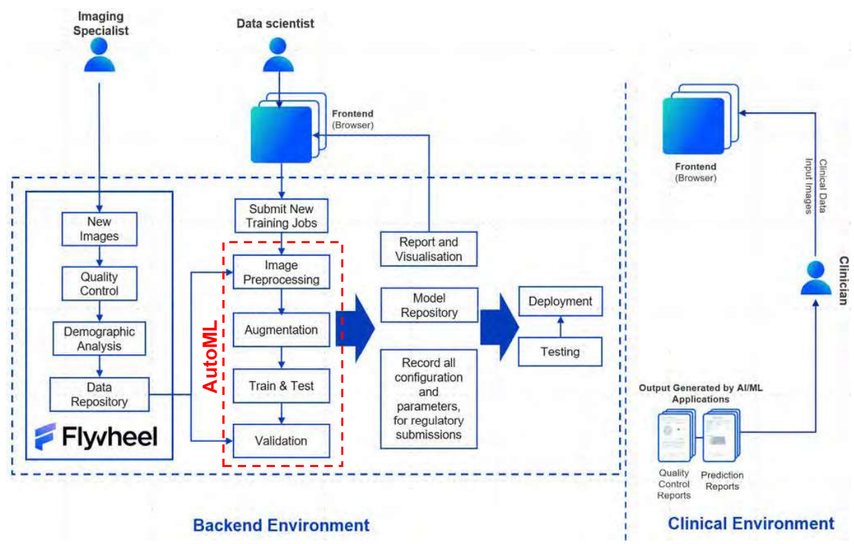
Prediction from diagnostic report:

- Predicted value (e.g. Gleason Score) with confidence level
- Lesion risk probability map from the PET signal and extracted radiomic features.

Quality control report includes

- Risk probability maps at ROI
- Data integrity score and evaluation confidence score
- Radiomic feature values (IBSI[2])

AutoML combined with MLOps



- **Zero-code training**
- **Ensemble Learning:** Combines multiple ML models for robust predictions.
- **Super Learners**[3]**:** mixed-stack of machine learning algorithms improves accuracy by leveraging the strength of different models.
- **100-fold Cross-Validation:** Ensures consistent, reliable performance and reduces the risk of overfitting.
- **GMLP:** All development activities, performance scoring and process are monitored and tracked automatically with FDA's Good Machine Learning Practice (GMLP) to ensure sufficient traceability. This combined with zero-coding to provide consistency across all projects within the organizations.

Gleason Prediction Results – Primary Prostate Cancer CDSS

Top 5 features (name)	Mean Rank
PSMA-TBR.01.ih.entropy	10
PSMA-SUV.01.stat.iqr	8
PSMA-TBR.01.cm.joint.entr	7
PSMA-TBR.01.cm.inv.diff.mom.norm	6
PSMA-TBR.01.ngt.coarseness	6

Training: 50 PET/CT with 31 Radiomic Features extracted
Test: 24 PET/MR
Balanced dataset:

- 50% Gleason ≤ 7
- 50% Gleason > 7

Model Performance:

- Sensitivity (SNS): 88%
- Specificity (SPC): 82%
- Area Under the Curve (AUC): 0.89

1. Papp, L et al. Journal of Nucl Med. 2018; Papp, L et al. European Journal of Nucl Med and Mol Imaging. 2021; Zhao, M et al. European Radiology. 2022; Krajnc, D et al. Cancers. 2021; Papp, L, Journal of Nucl Med. 2019.
2. Zwanenburg, A et al., "The Image Biomarker Standardization Initiative: Standardized Quantitative Radiomics for High-Throughput Image-based Phenotyping," Radiology, vol. 295, no. 2, 2020
3. M. van der Laan, E. Polley and A. Hubbard, "Super Learner," Statistical Applications in Genetics and Molecular Biology, vol. 6, no. 1, 2007