

Automated assessment of lesion heterogeneity for metastatic prostate cancer patients using [⁶⁸Ga]Ga-PSMA-11 PET/CT images

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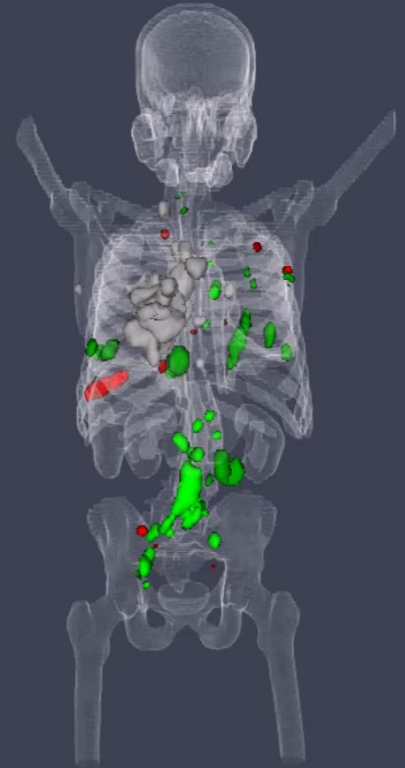
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Disclaimer: Mikaela Dell'Oro holds an AIQ Research Fellowship as part of the Australian Centre for Quantitative Imaging (ACQI), The University of Western Australia

Introduction



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Example [^{68}Ga]Ga-PSMA PET/CT scan

- [^{68}Ga]Ga-PSMA PET/CT is emerging as a tool to direct precision-based therapy for men with metastatic prostate cancer
- Radiomic biomarkers in PSMA PET/CT could help in lesion selection for stereotactic ablative radiation therapy (SABR)
- Forestalling systemic therapy initiation and improving overall survival



Current Practice



- Manually establish longitudinal or cross-modality lesion concordance
- Nuclear Medicine Physician interprets findings and provides clinical report

Artificial Intelligence Supported Practice



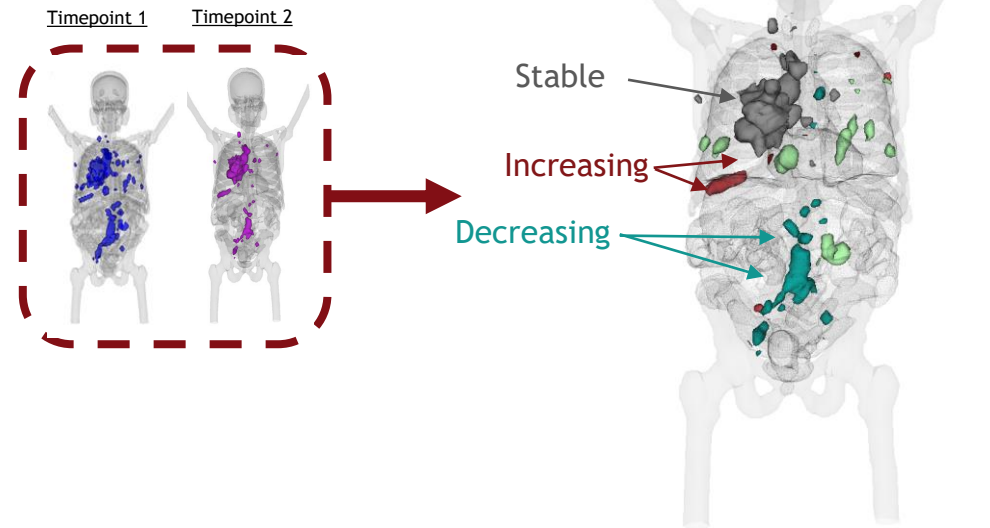
- Deformable image registration for automatic lesion concordance
- Provide support in interpretation of findings

Context



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Artificial intelligence (AI) and machine learning models can support clinicians in identifying oligoprogressing disease to target



Treatment response for
each individual lesion

- Quantifying lesion-specific heterogeneity on [^{68}Ga]Ga-PSMA PET/CT scans of patients with relapsed prostate cancer
- Identify proportion of oligoprogressing patients who would potentially benefit from targeted radiotherapy (SABR)

Patient Population



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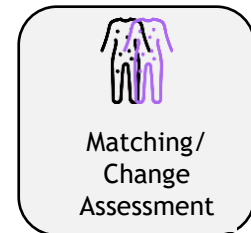
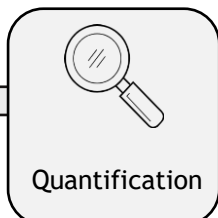
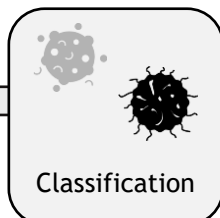
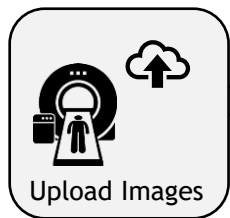
185 metastatic prostate cancer patients
(mean age of 70) underwent therapy
according to standard clinical care

Selection Criteria

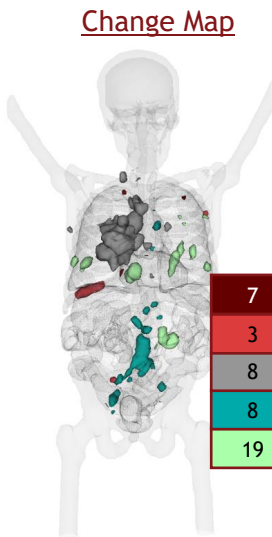
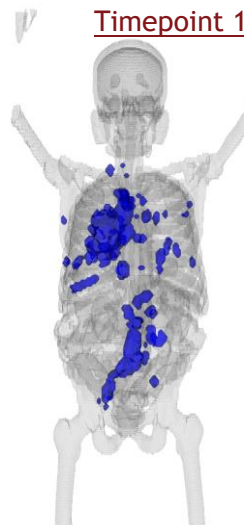
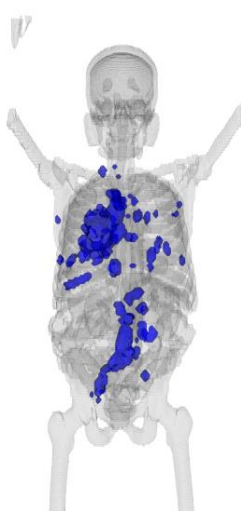
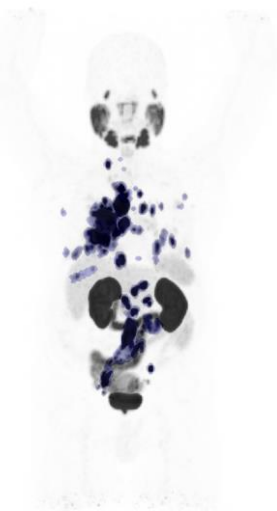
- Biochemical recurrence (PSA)
- Negative or oligometastatic disease (< 3 lesions) on bone scintigraphy and abdominal CT staging scans.
- Baseline and follow up [^{68}Ga]Ga-PSMA PET/CT scans available (~ 6 months apart)

Treatment received	%
ADT alone or with chemotherapy/surgery	44%
Observation	30%
Radiation therapy	26%

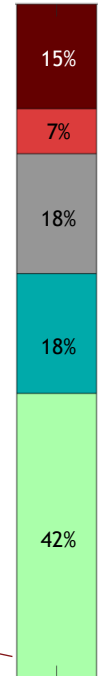
Response Map Generation



SUV_{total}



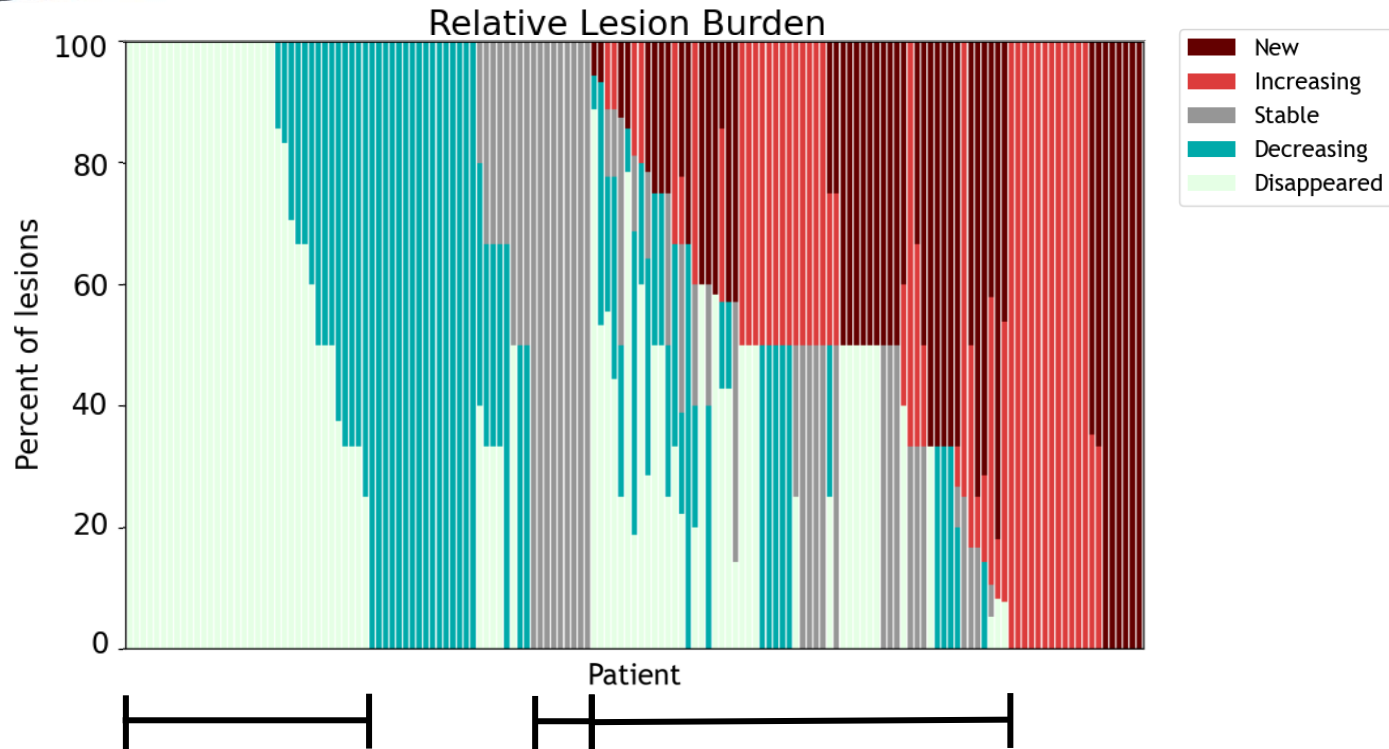
7	New
3	Increasing
8	Stable
8	Decreasing
19	Disappeared



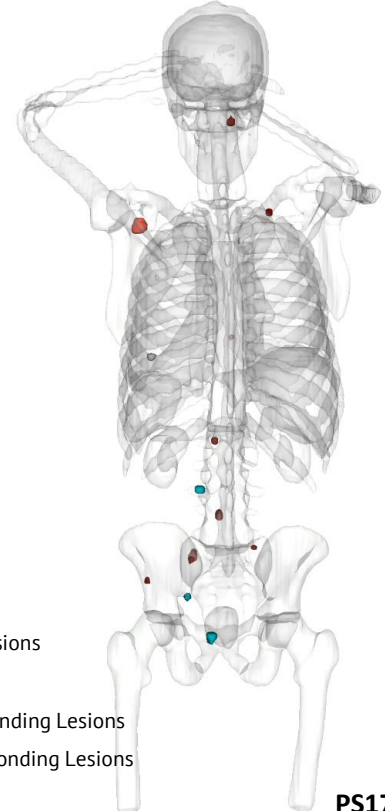
- Perk et al. *Phys Med Biol.* 2018
- US Patent 10,445,878

- Yip et al. *Phys Med Biol.* 2014
- US Patent 9,603,567
- Lin et al. *J Nuc Med.* 2016

Lesion Level Heterogeneity



- 81/150 (54%) patients had ≥ 1 progressing/new lesion
 - 73/81 patients had between 1 to 5 lesions and would have been potential candidates for SABR
 - 8 patients had ≥ 5 progressing/new lesions



10	New Lesions
1	Progressing Lesions
1	Stable Lesions
3	Partially Responding Lesions
0	Complete Responding Lesions

Patient Heterogeneity

PS136

PS016

PS170

PS019

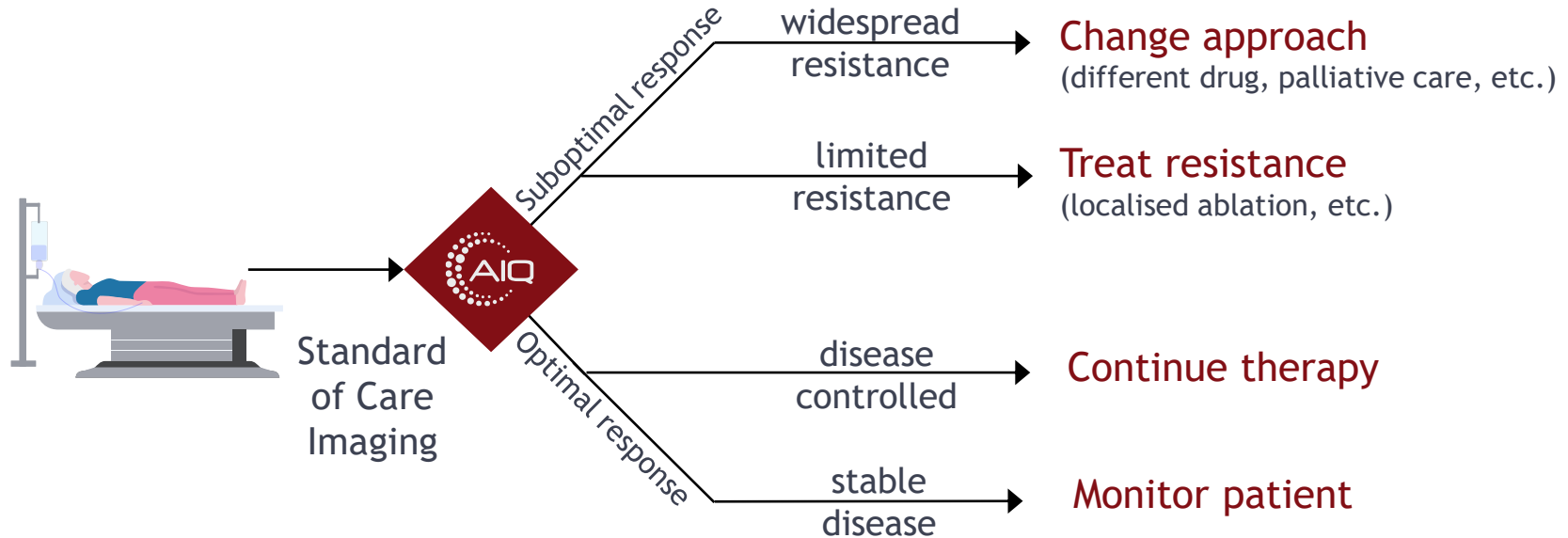
0	New Lesions
0	Progressing Lesions
0	Stable Lesions
0	Partially Responding Lesions
5	Complete Responding Lesions

1
0
0
1
16

10
1
1
3
0

3
1
2
0
0

Potential clinical application of understanding heterogenous response



Future work



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- Apply the AI model in a prospective setting to help prognose oligometastatic prostate cancer patients
- Train an AI model to correlate heterogeneous response across time points with treatment intervention and survival data
- Expand to other patient diagnoses and treatment interventions

Summary



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- 73 patients could have been potential candidates for SABR based on oligoresistant disease
- Automated analysis tools such as AIQ Technology can assist mapping lesion response on PSMA PET/CT images
- Important to understand the response of each lesion

References



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- Phillips R, Shi WY, Deek M, et al. Outcomes of Observation vs Stereotactic Ablative Radiation for Oligometastatic Prostate Cancer: The ORIOLE Phase 2 Randomized Clinical Trial. *JAMA Oncol.* 2020;6(5):650-659. doi:10.1001/jamaoncol.2020.0147
- Palma DA, Olson R, Harrow S, et al. Stereotactic Ablative Radiotherapy for the Comprehensive Treatment of Oligometastatic Cancers: Long-Term Results of the SABR-COMET Phase II Randomized Trial. *J Clin Oncol.* 2020;38(25):2830-2838. doi:10.1200/JCO.20.00818
- Ost P, Reynders D, Decaestecker K, et al. Surveillance or Metastasis-Directed Therapy for Oligometastatic Prostate Cancer Recurrence: A Prospective, Randomized, Multicenter Phase II Trial. *J Clin Oncol.* 2018;36(5):446-453. doi:10.1200/JCO.2017.75.4853
- Boellaard R, Delgado-Bolton R, Oyen WJ, Giammarile F, Tatsch K, Eschner W, et al. FDG PET/CT: EANM procedure guidelines for tumour imaging: version 2.0. *Eur J Nucl Med Mol Imaging.* 2015;42(2):328-54.

Thank you for listening

Are there any questions?

acqi



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