Omics and AI in breast cancer

Omics driven radiotherapy approaches

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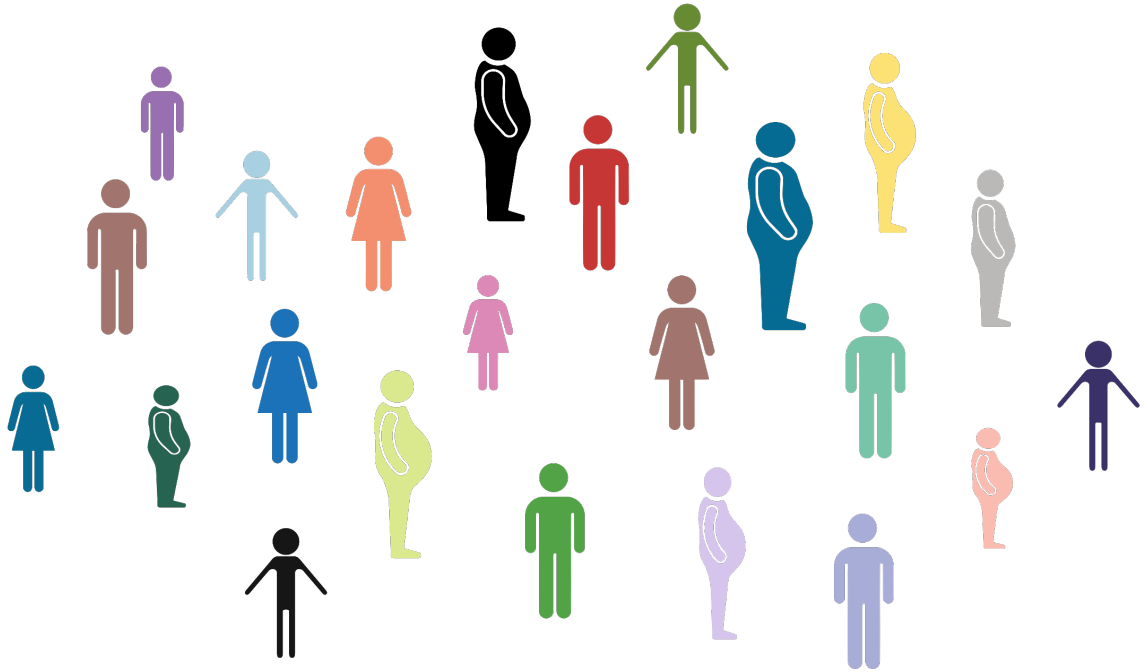
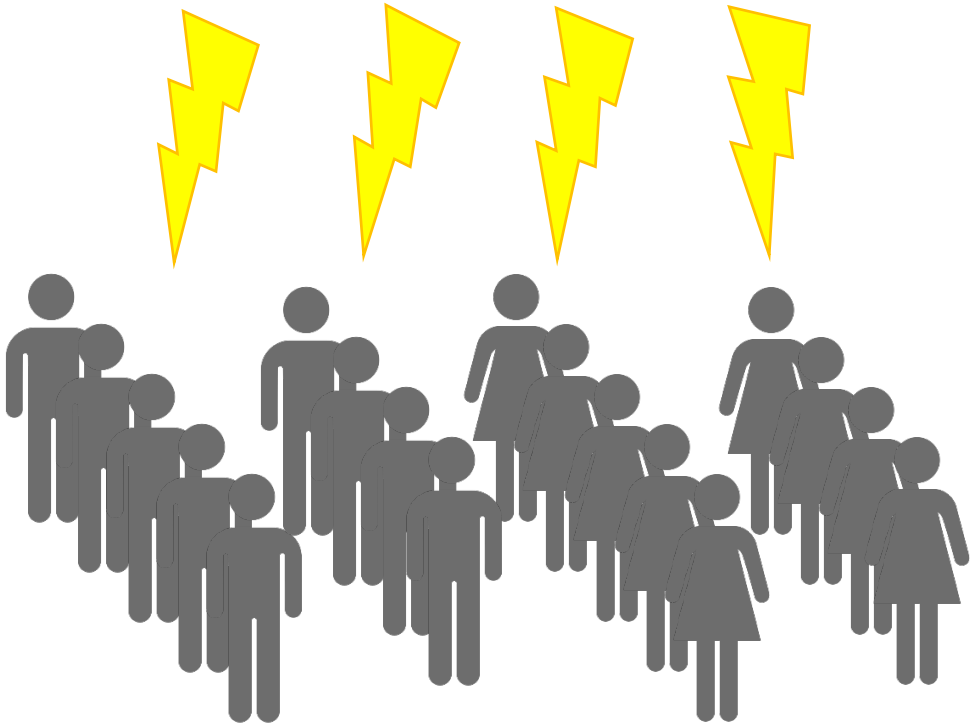
Clinical considerations

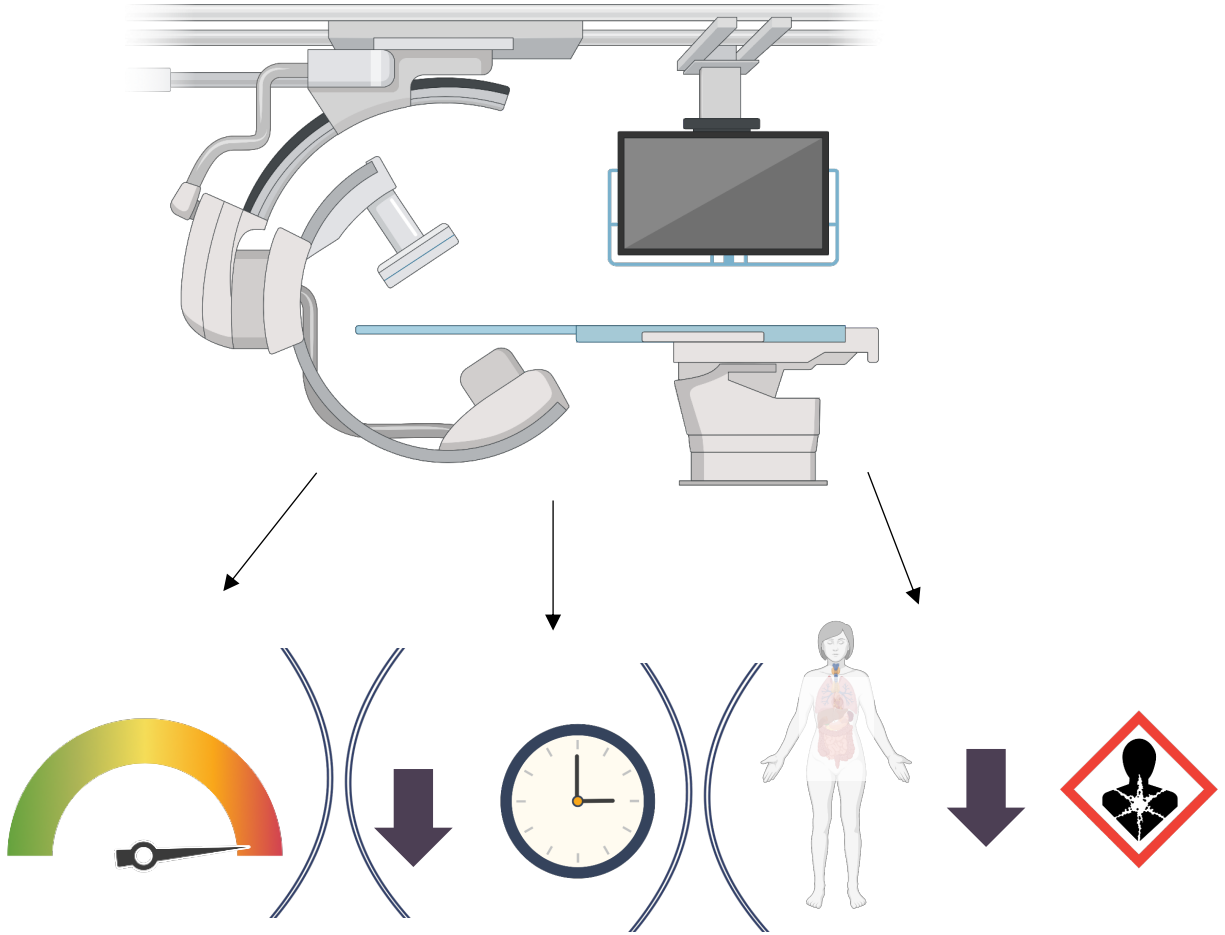


Clinical considerations

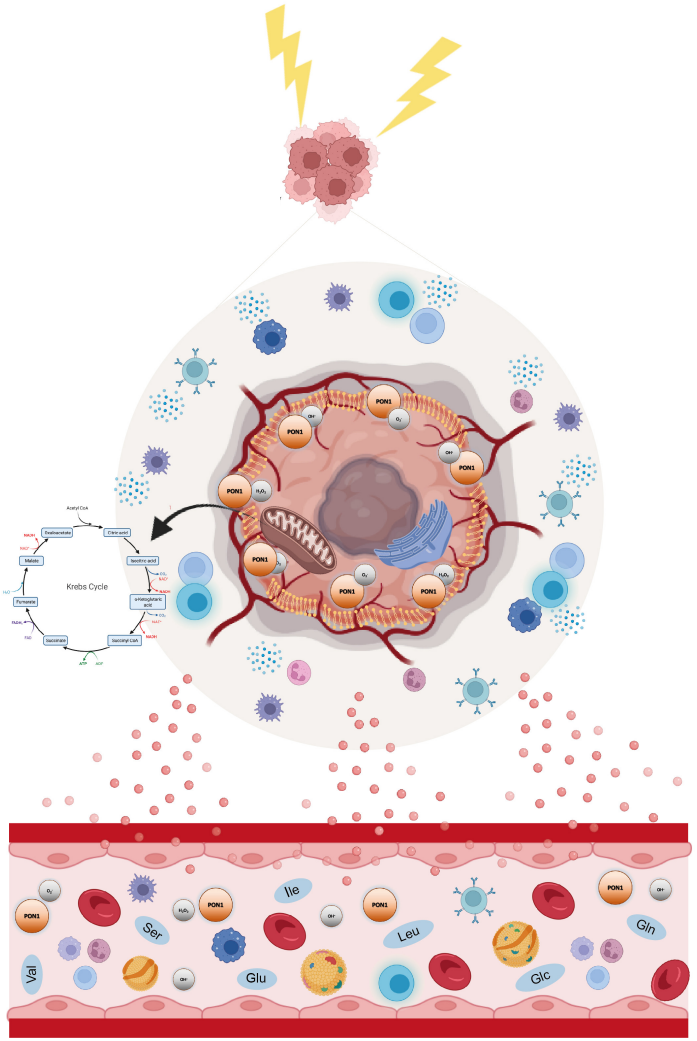


STANDARD TREATMENT

Advances in radiotherapy



Radiotherapy gaps



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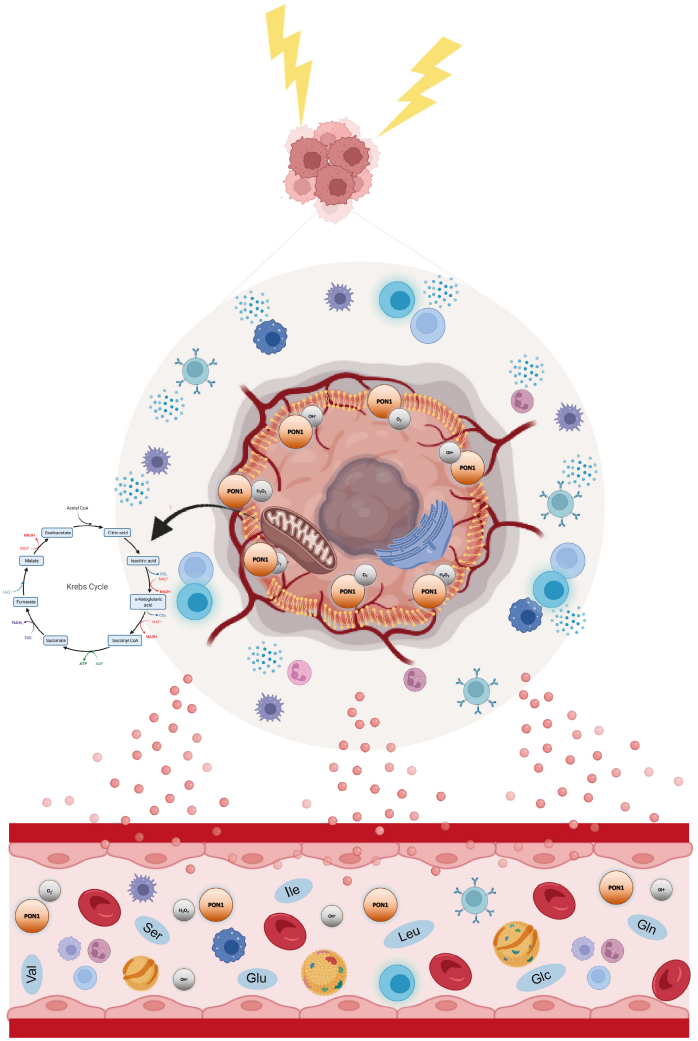
Radiotherapy gaps



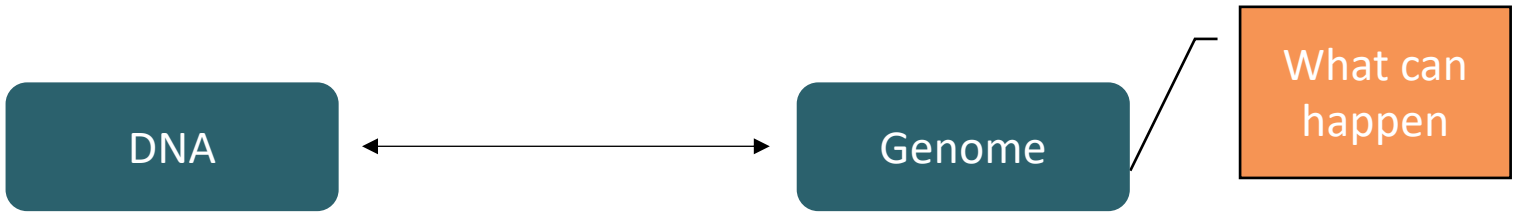
BIOMARKER → **PERSONALIZED THERAPY**

State of art: The future of omics and big data

Molecular techniques help understand how biological entities work

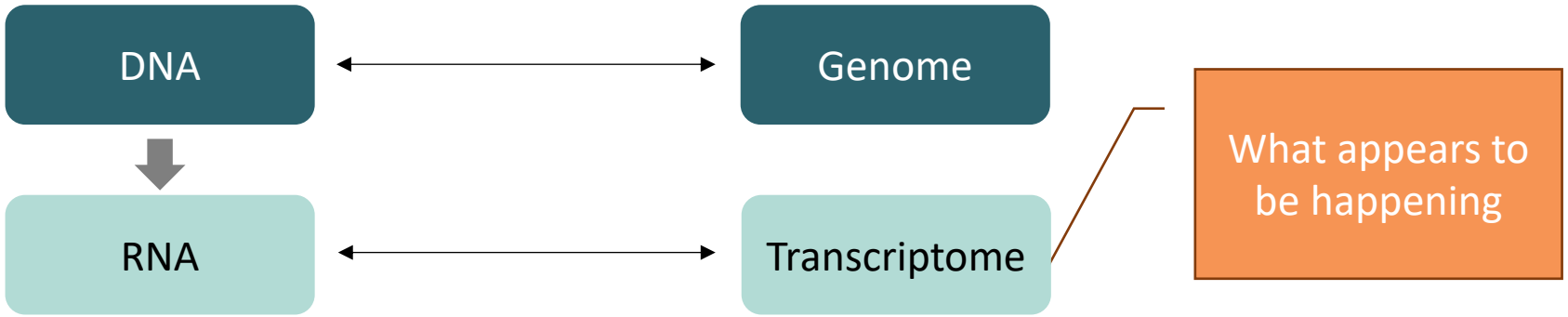
State of art: The future of omics and big data

Molecular techniques help understand how biological entities work



State of art: The future of omics and big data

Molecular techniques help understand how biological entities work



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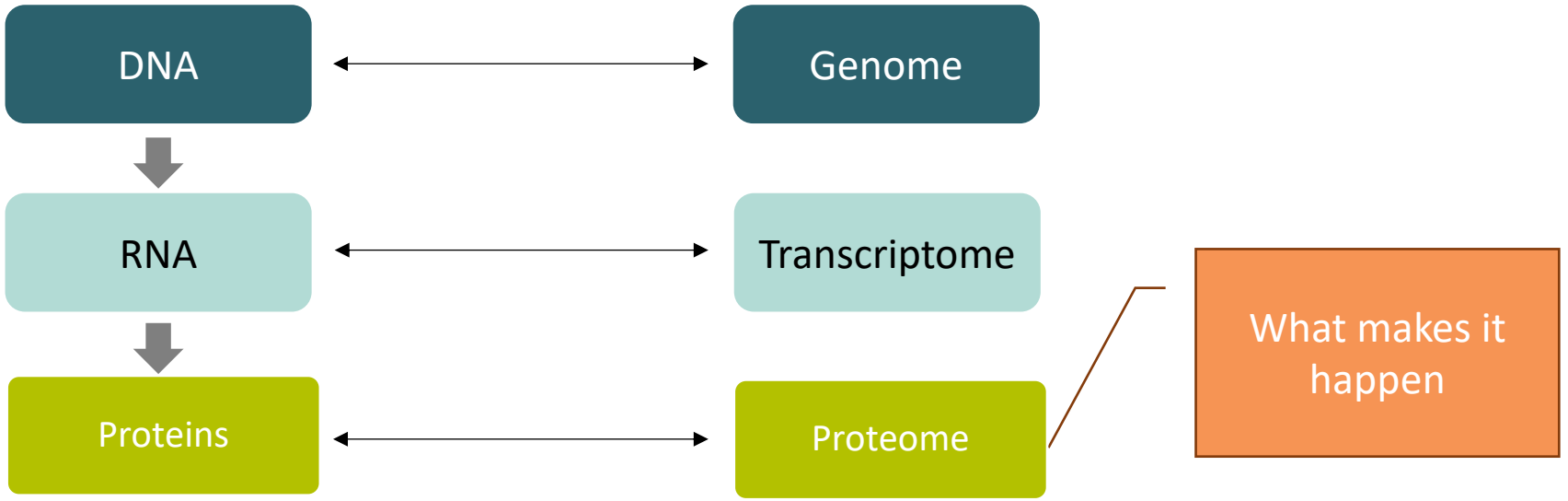

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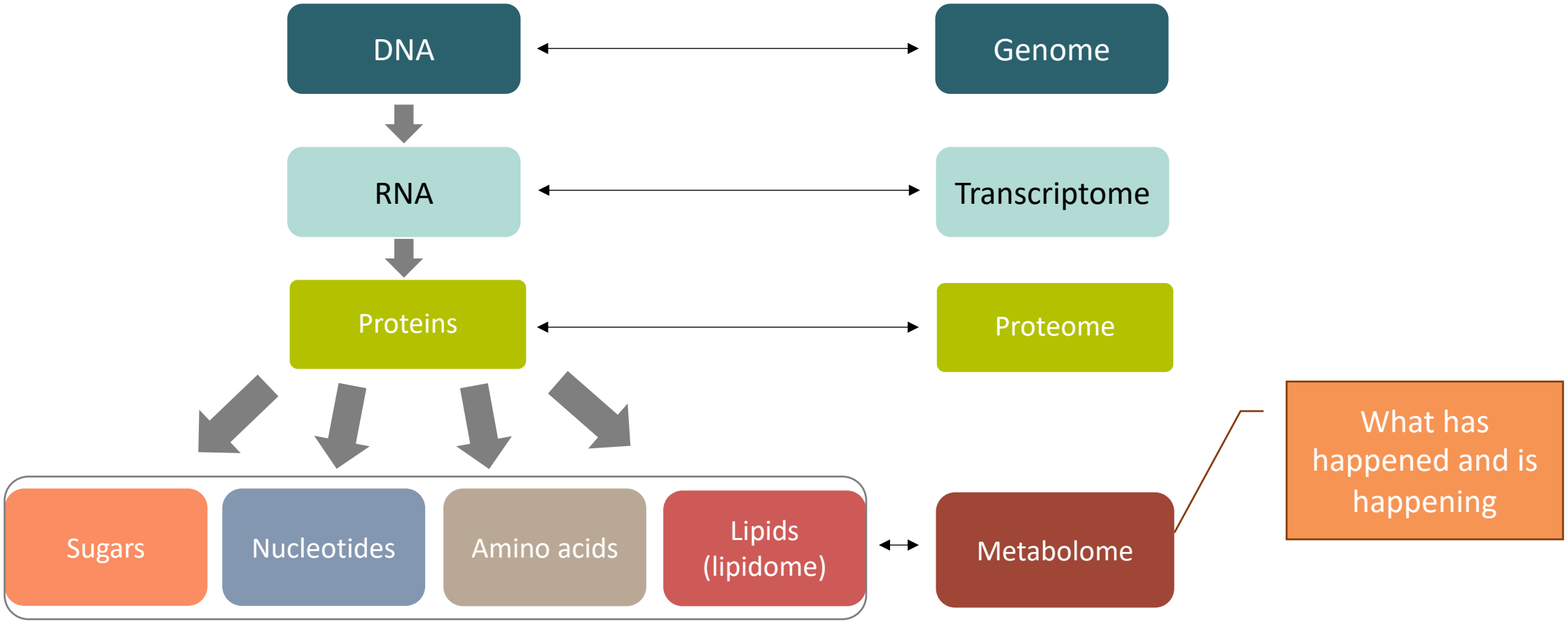
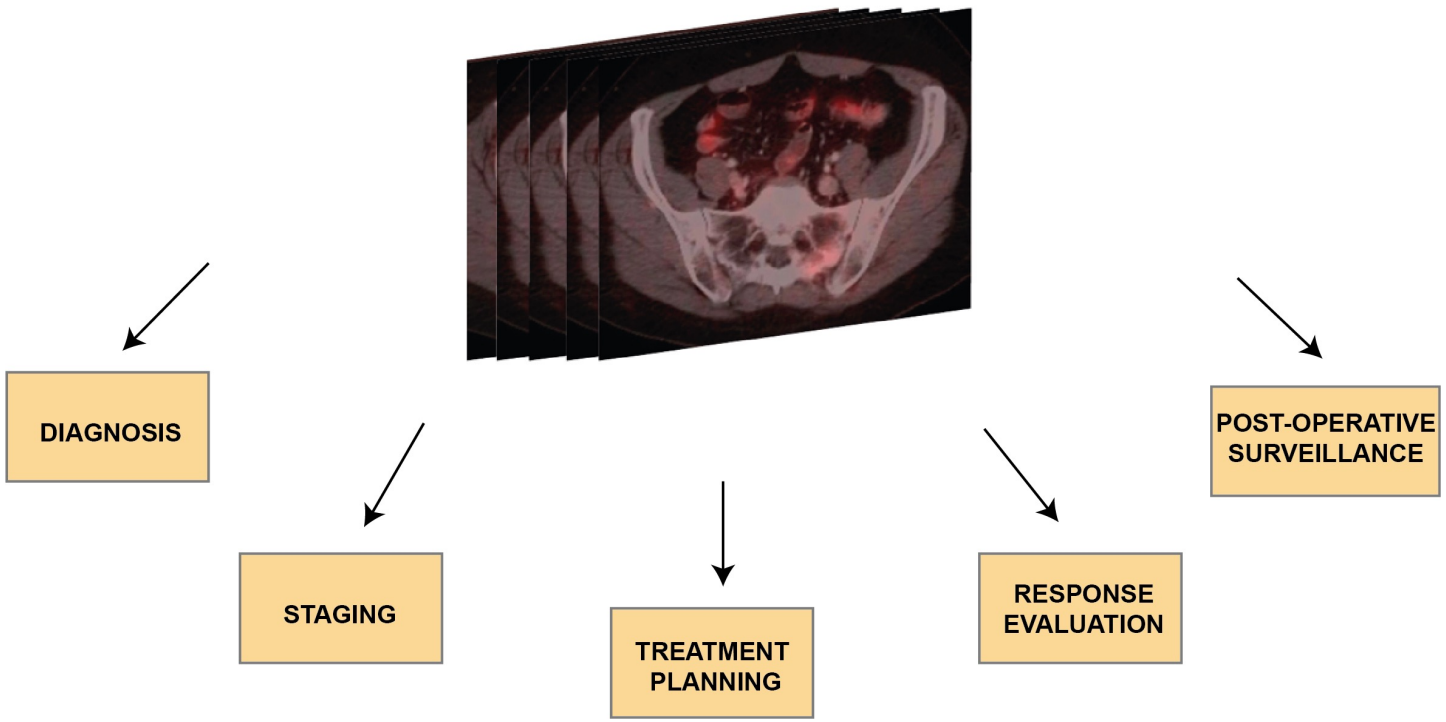


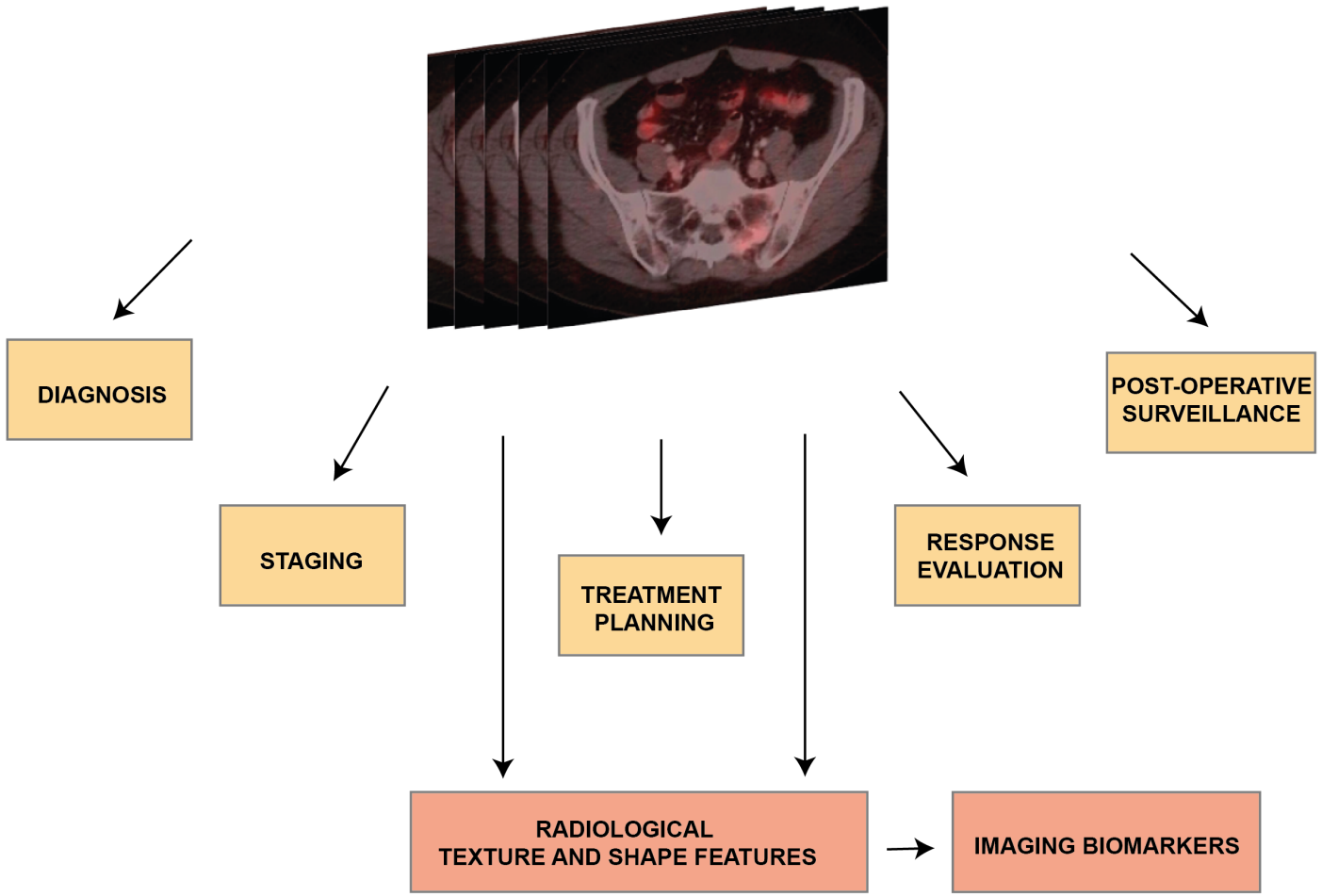
State of art: The future of omics and big data

Imaging techniques



State of art: The future of omics and big data

Imaging techniques: RADIOMICS



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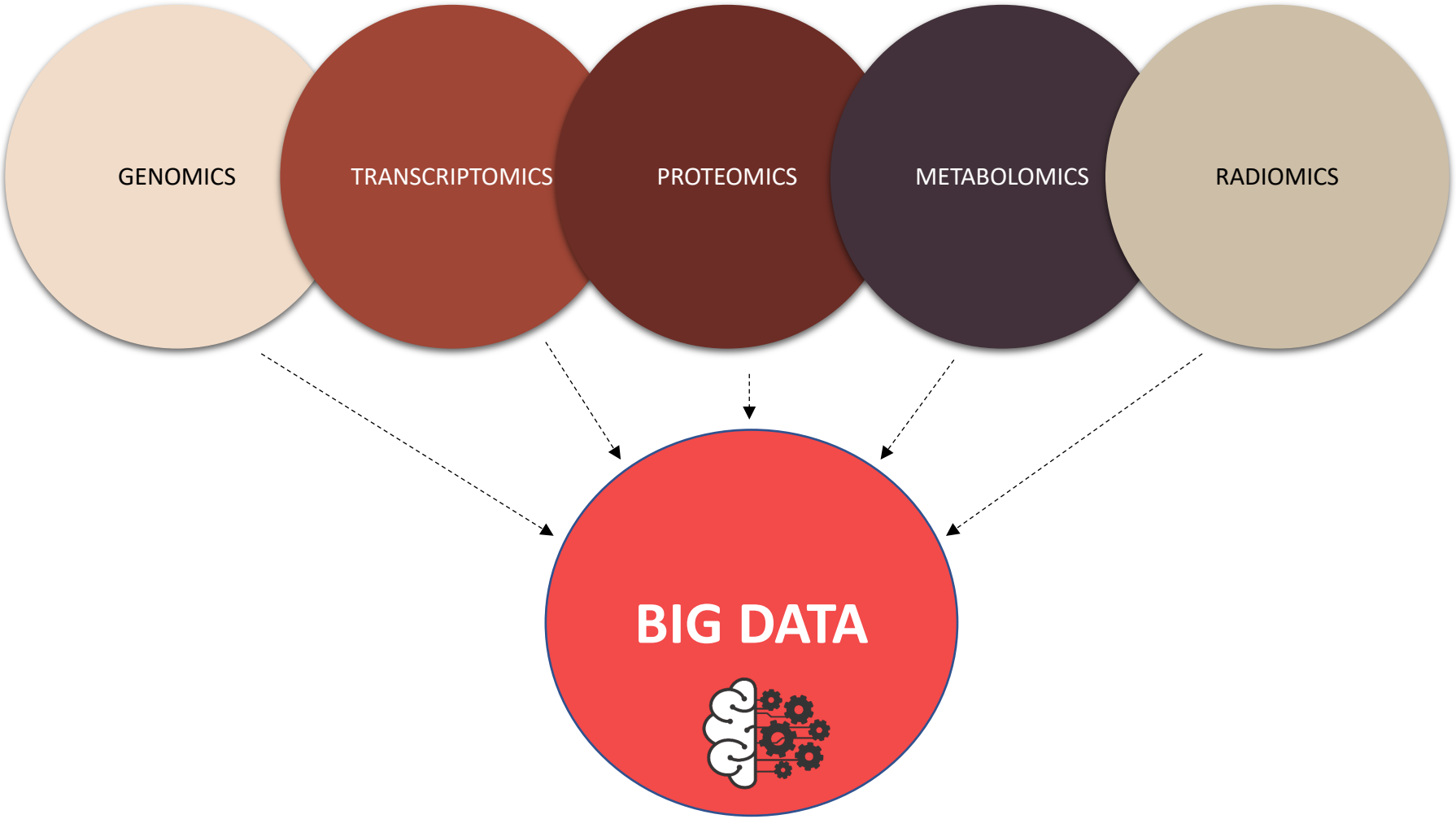
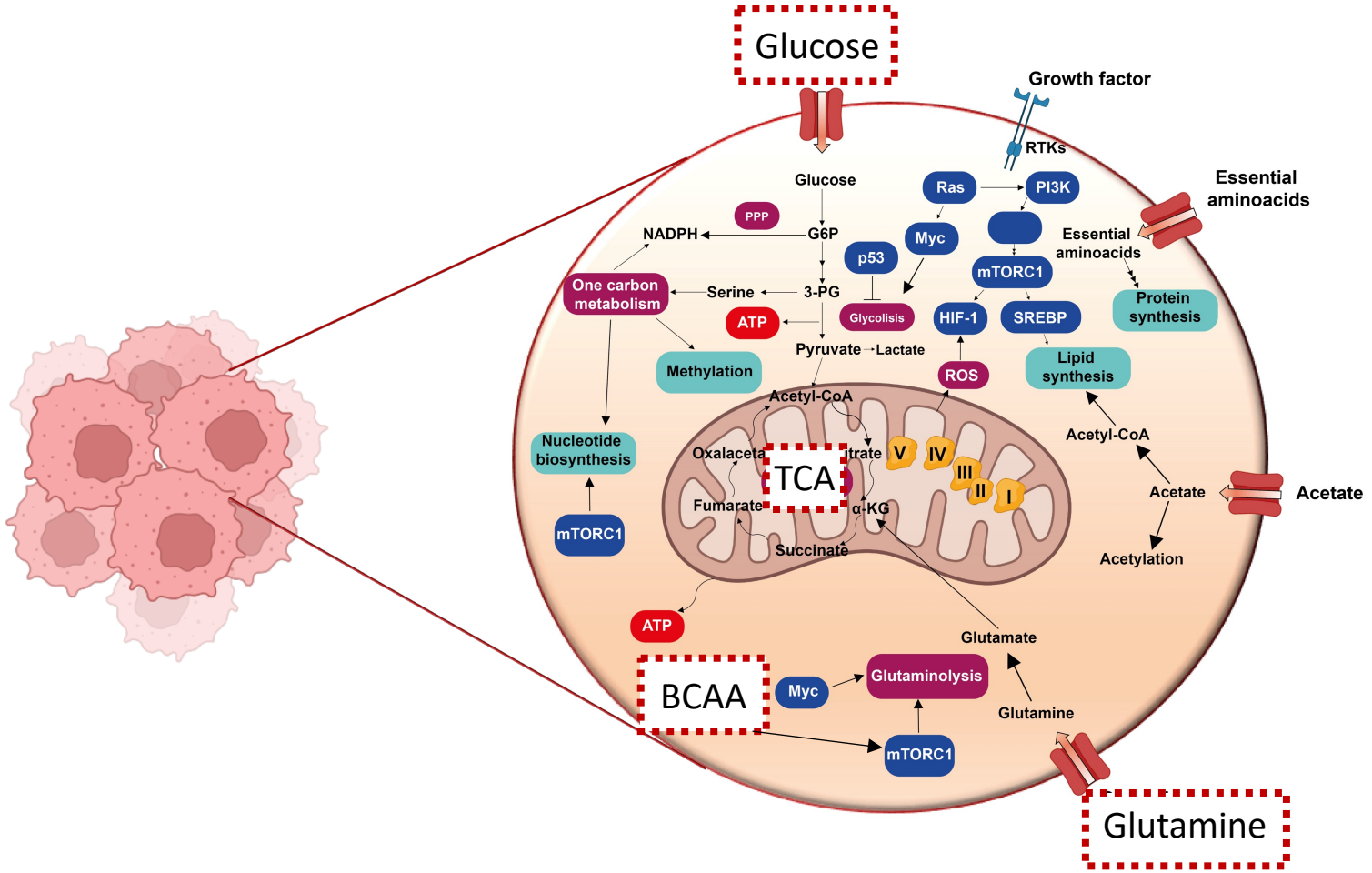
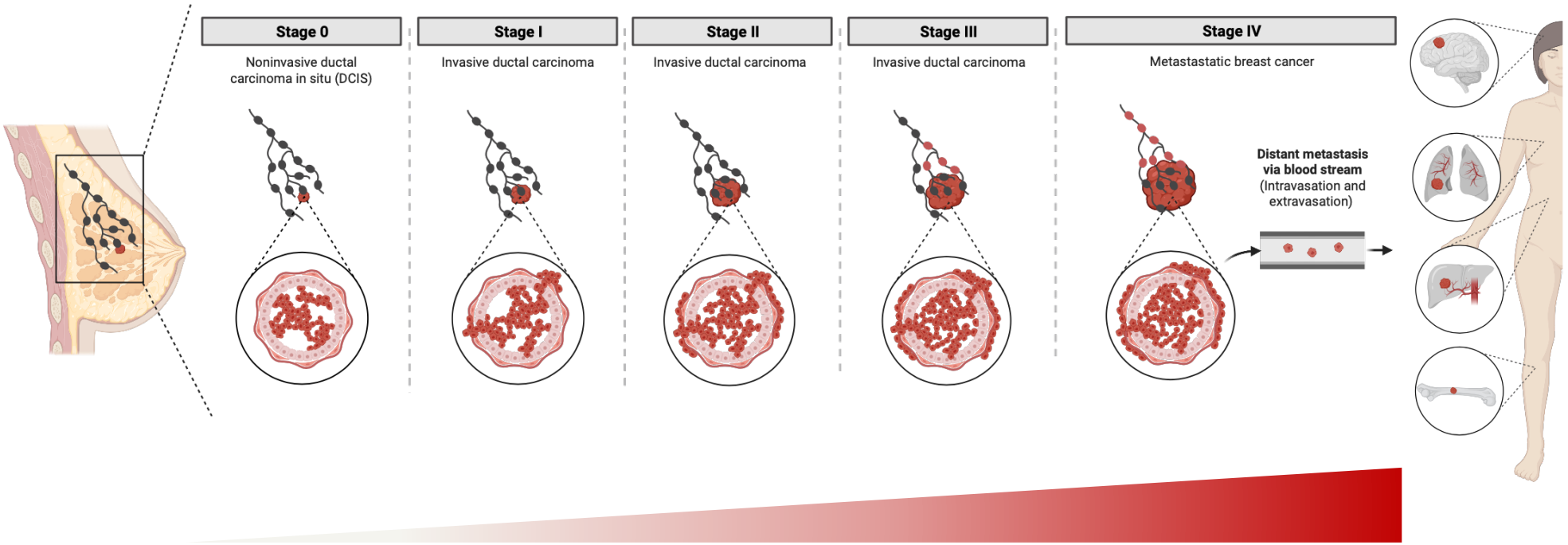


State of art: The future of omics and big data

Cancer metabolism under the spotlight



Breast cancer metabolism under the spotlight



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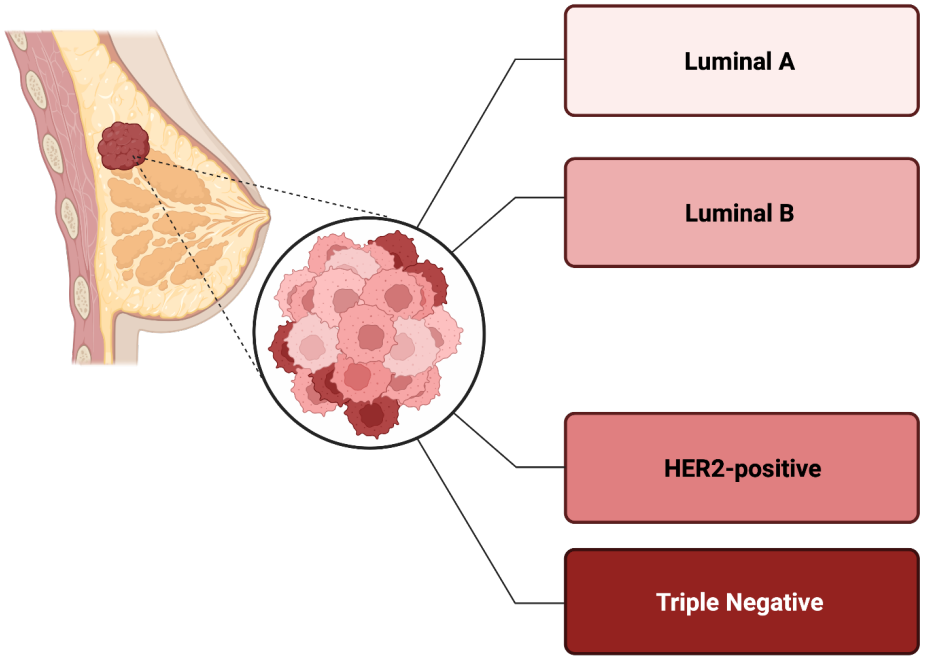

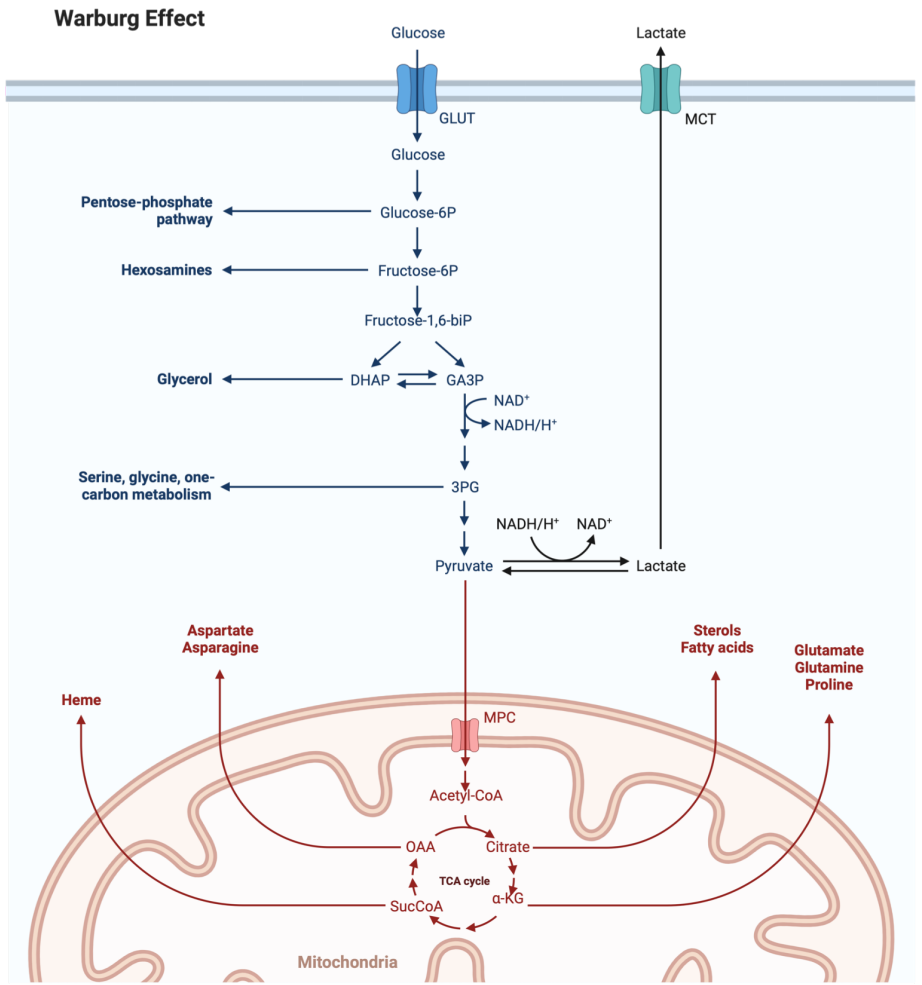

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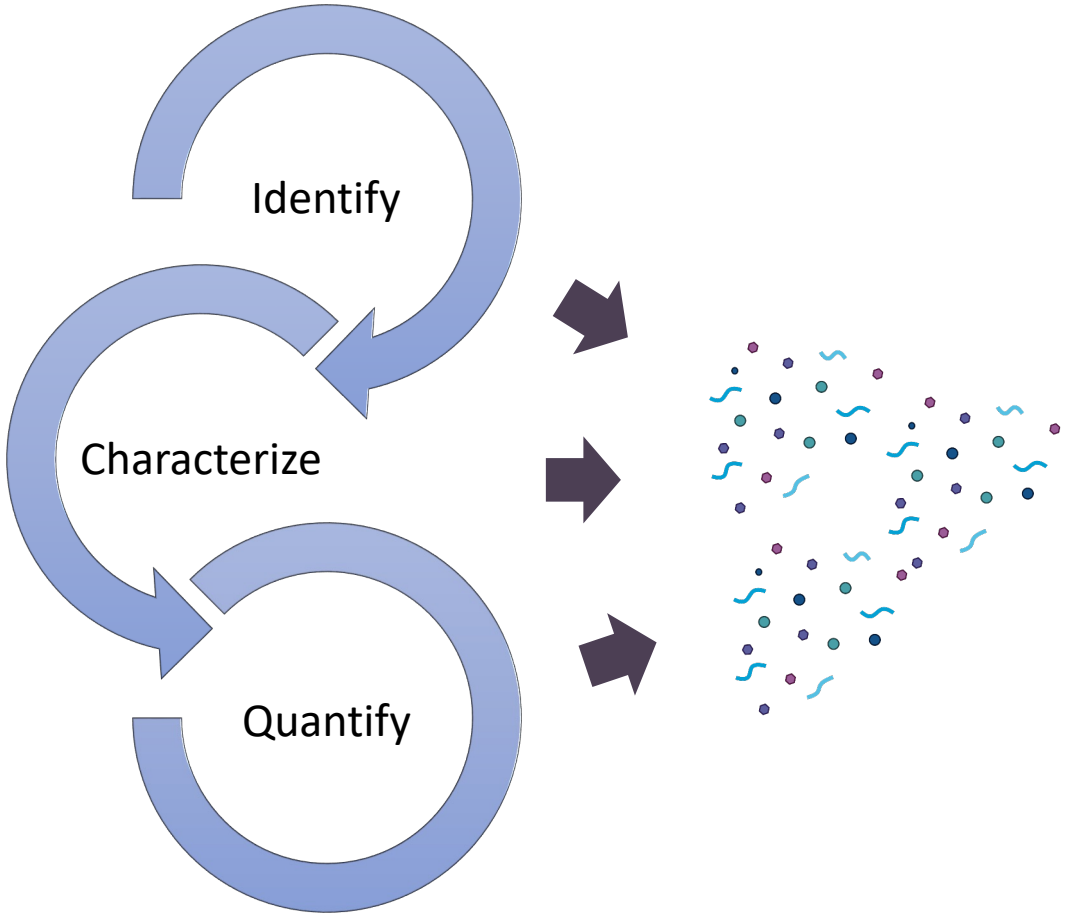
Cancer research focus: Targeted metabolomics



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Research goals

- Investigate circulating alterations in energy-balance-related metabolites.

- Correlate these changes with:
  - Clinicopathological characteristics
  - Response to radiation treatment and toxicity

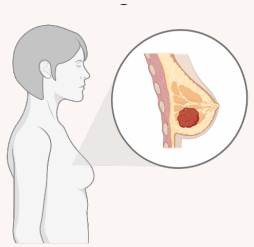
- Identify potential biomarkers that could be implemeted for diagnosis, prognosis and response towards treatment.

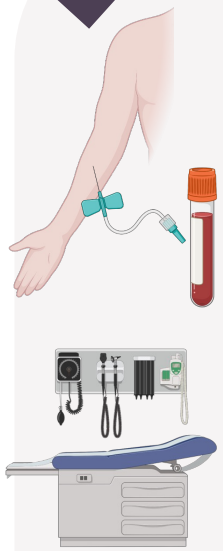
Methodology

PATIENTS RECRUITMENT

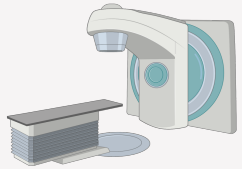
SAMPLE AND CLINICAL DATA COLLECTION

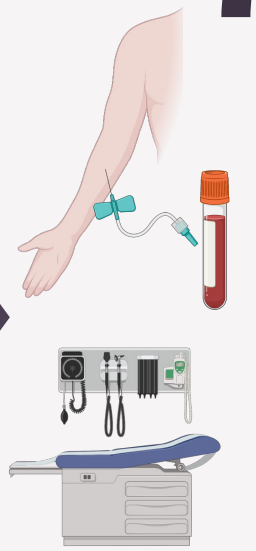
SAMPLE AND COMPUTATIONAL ANALYSIS



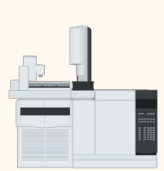


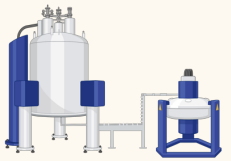
Pre-RT



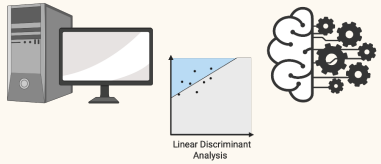


Post-RT (1 month)





Targeted metabolomic analyses (GC-MS)



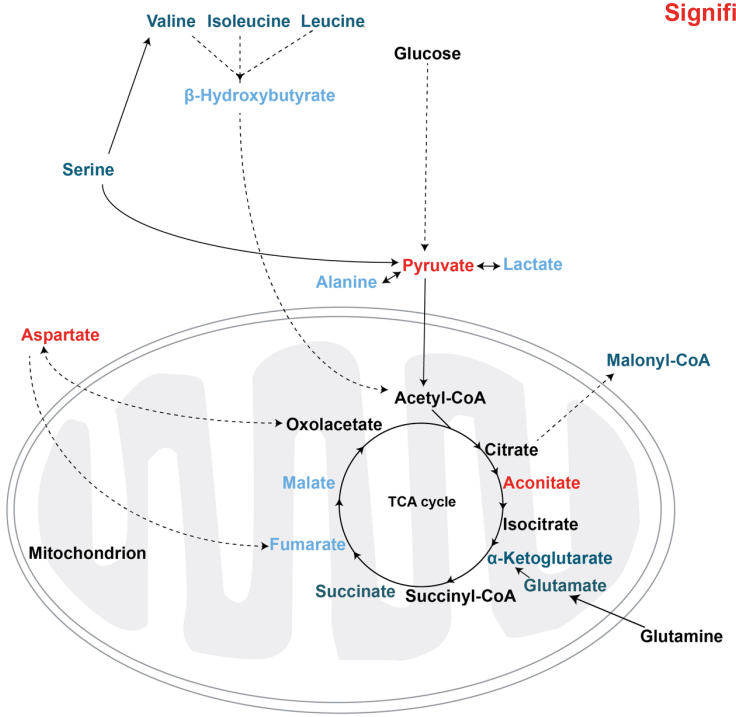
Multivariate analyses and machine learning algorithms

Metabolite normalization with local radiotherapy following breast tumor resection

Breast cancer (n= 151)
Controls (n= 44)

Significant decrease

Significant increase



BC patient pre-RT vs controls

BC patient post-RT vs controls

Arenas M, Rodríguez E, *et al*. PLoS One. (2018)

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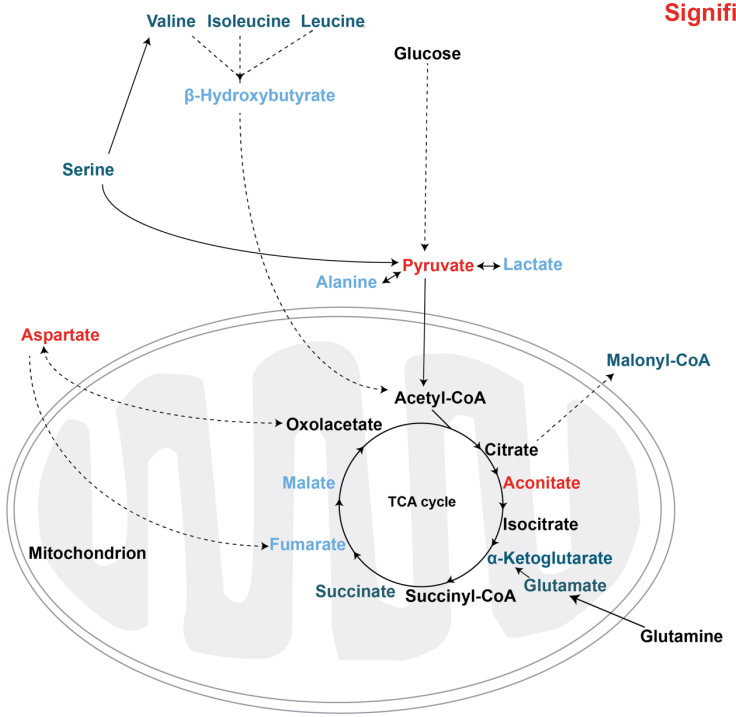
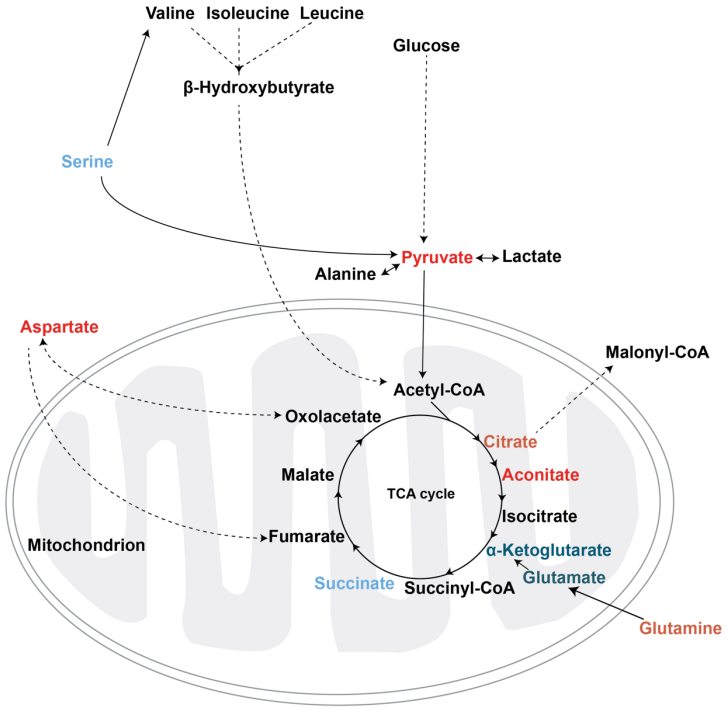


BC patient pre-RT vs controls



BC patient post-RT vs controls

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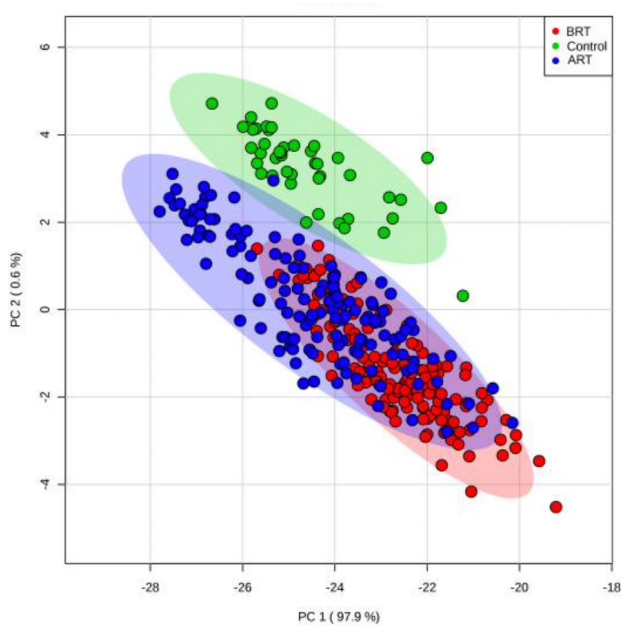

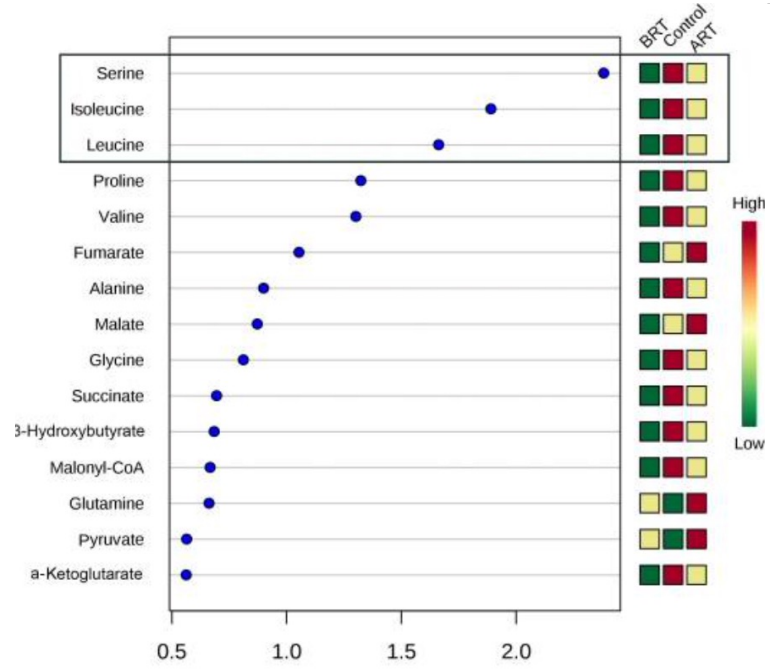

VIP scores

BRT: before radiotherapy
ART: after radiotherapy

Arenas M, Rodríguez E, *et al*. PLoS One. (2018)

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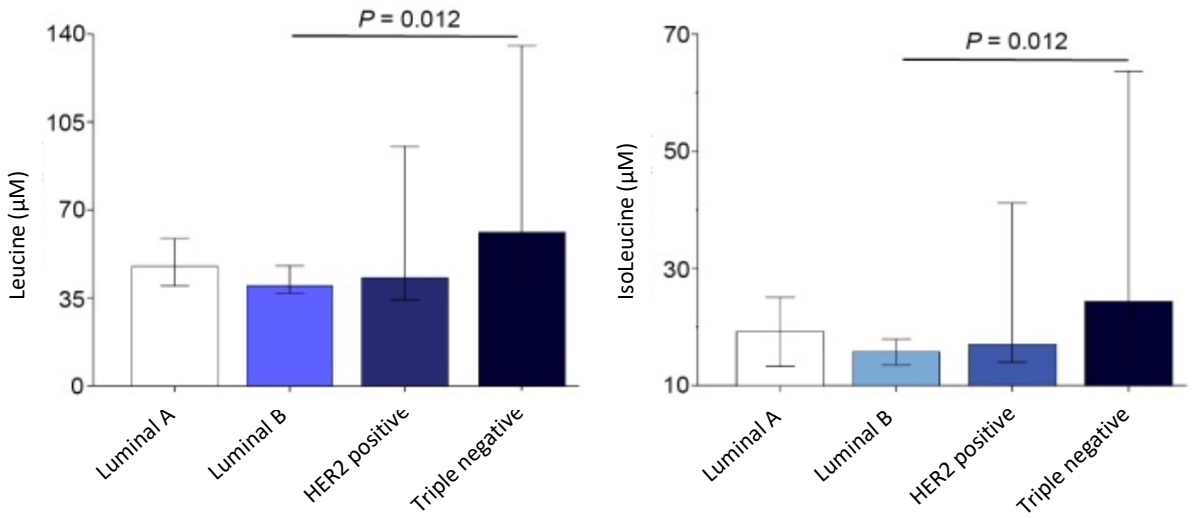
Controls (n= 44)

Post-RT



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Effects of radiotherapy on plasma energy metabolites in patients with breast cancer who received neoadjuvant chemotherapy

Breast cancer (n= 37)
Controls (n= 44)

Variable	Control group ($n=44$)	BC patients pre-RT ($n=37$)		BC patients post-RT ($n=37$)	
		Partial response ($n=24$)	Complete response ($n=13$)	Partial response ($n=24$)	Complete response ($n=13$)
Pyruvate (μm)	23.81 (12.07)	61.22 (23.24)[c]	60.86 (19.69)[c]	61.50 (31.98)[c]	86.69 (26.63)[c,d]
Lactate (μm)	559.46 (62.55)	449.74 (60.20)[c]	445.42 (29.62)[c]	508.55 (130.10)[b]	594.59 (89.67)[d]
Alanine (μm)	199.99 (66.81)	142.99 (54.71)[c]	139.31 (52.65)[c]	193.32 (86.79)	271.42 (97.18)[a,d]
Hydroxybutyrate (μm)	24.18 (18.07)	22.35 (20.47)	18.68 (12.88)	22.36 (21.30)	24.88 (16.91)
Valine (μm)	121.68 (45.37)	68.99 (23.64)[c]	61.60 (23.06)[c]	111.70 (78.37)	174.15 (93.85)[b,d]
Leucine (μm)	68.23 (26.03)	30.21 (11.42)[c]	24.17 (11.22)[c]	52.08 (34.43)[a]	88.51 (56.67)[a,d]
Isoleucine (μm)	32.77 (15.91)	10.69 (4.87)[c]	8.60 (5.57)[c]	21.38 (16.74)[a]	36.17 (27.77)
Proline (μm)	93.37 (29.73)	43.62 (20.35)[c]	39.03 (30.20)[c]	68.46 (48.44)[c]	119.30 (73.61)[a,d]
Malonyl coenzyme A (μm)	1.60 (0.31)	1.01 (0.34)[c]	0.98 (0.33)[c]	1.22 (0.35)[c]	1.59 (0.28)[e]
Glycine (μm)	135.40 (43.91)	73.68 (30.52)[c]	70.52 (27.49)[c]	97.63 (34.99)[c]	130.63 (26.69)[d]
Succinate (μm)	13.79 (4.20)	8.27 (2.35)[c]	8.41 (2.79)[c]	10.44 (3.18)[c]	12.67 (2.70)[d]
Fumarate (μm)	0.37 (0.17)	0.38 (0.23)	0.37 (0.16)	0.49 (0.31)	0.64 (0.31)[a]
Serine (μm)	56.51 (20.88)	15.75 (14.06)[c]	9.18 (9.38)[c]	28.91 (23.95)[c]	55.35 (36.10)[d]
Oxaloacetate (μm)	26.56 (7.32)	30.88 (11.70)	30.81 (17.55)	34.22 (12.65)[a]	43.31 (14.59)[c]
Malate (μm)	1.58 (0.76)	1.58 (1.21)	1.63 (0.68)	1.89 (1.03)	2.58 (1.18)
Aspartate (μm)	2.07 (0.91)	13.57 (4.07)[c]	15.51 (5.59)	13.36 (5.76)	17.17 (5.35)[c]
Ketoglutarate (μm)	7.48 (9.45)	3.52 (1.67)[a]	3.74 (1.64)	3.90 (2.35)[a]	4.61 (1.63)
Glutamate (μm)	135.47 (45.77)	46.06 (28.00)[c]	49.94 (23.39)[c]	49.18 (28.39)[c]	46.06 (20.71)[c]
Aconitate (μm)	0.12 (0.05)	0.85 (0.71)[c]	0.57 (0.53)[c]	0.61 (0.31)[c]	0.50 (0.31)[c]
Citrate (μm)	33.13 (5.86)	45.53 (6.27)[a]	43.48 (7.97)	49.57 (16.31)[b]	60.32 (11.58)[c,d]
Glutamine (μm)	36.73 (8.32)	49.15 (8.51)	52.22 (12.25)	54.60 (21.96)[a]	115.10 (21.53)[c,e]

[a] $p < 0.05$; [b] $p < 0.01$; [c] $p < 0.001$, with respect to control.

[d] $p < 0.05$; [e] $p < 0.01$, with respect to partial response.

Arenas M, Fernández-Arroyo S, Rodríguez E, *et al*. Clin Trans Oncol. (2020)

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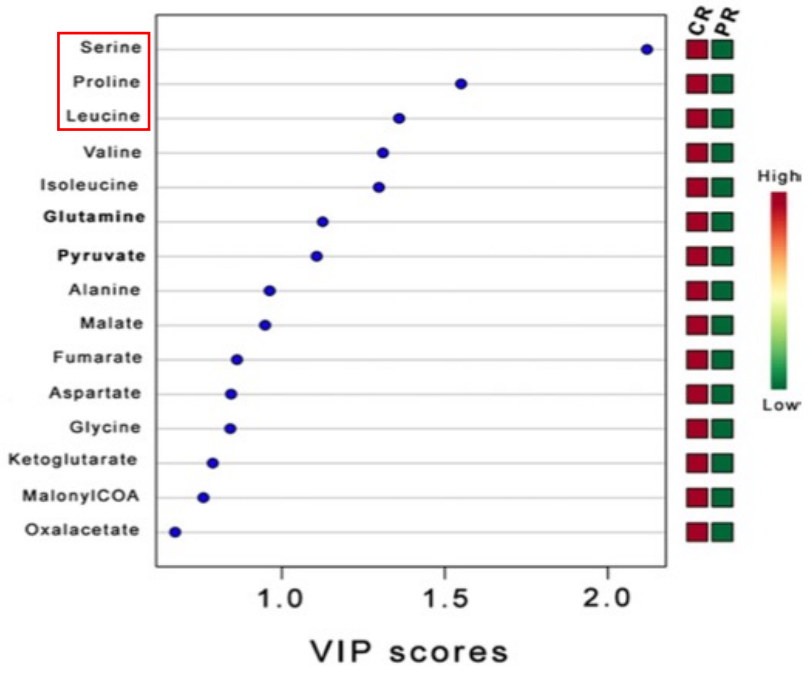
Controls (n= 44)



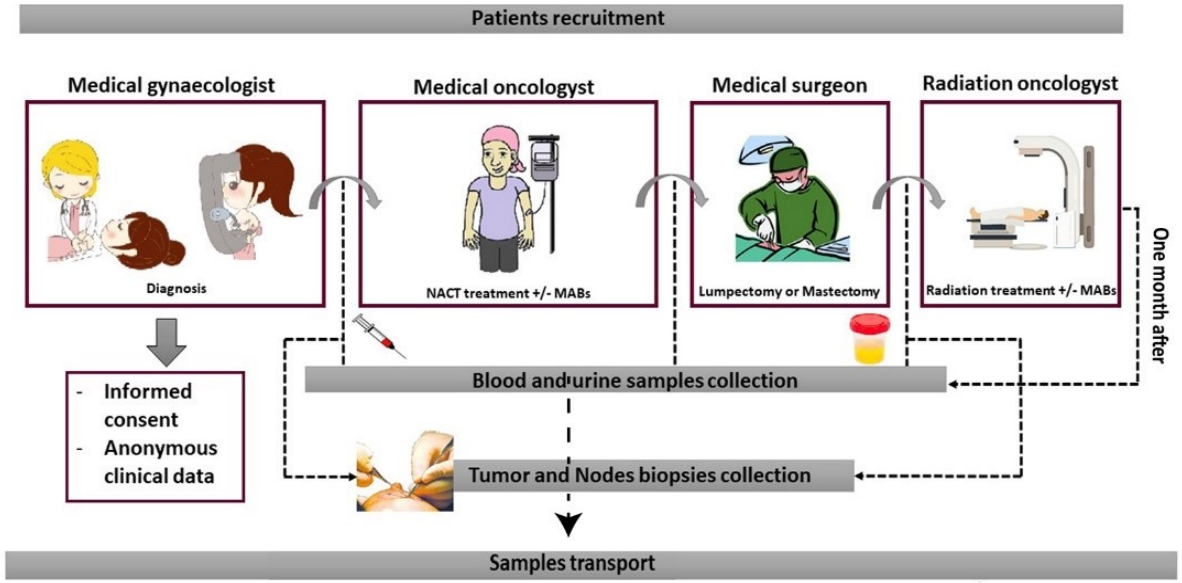
Complete response (CR) vs partial response (PR)

Arenas M, Fernández-Arroyo S, Rodríguez E, *et al*. Clin Trans Oncol. (2020)

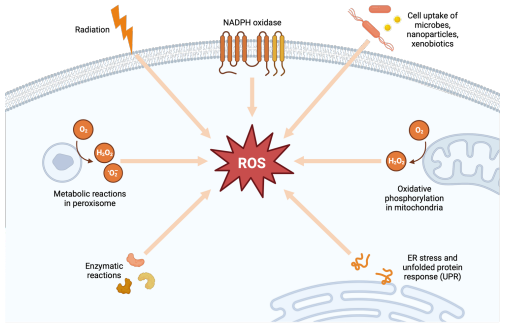
MAMACOR study

WORK IN PROGRESS

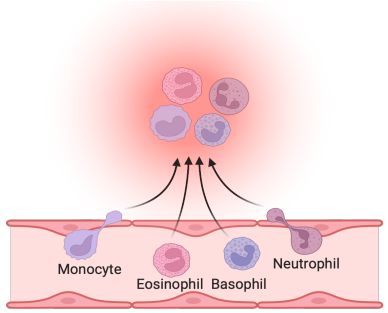
Breast cancer (n= 87)
Controls (n= 50)



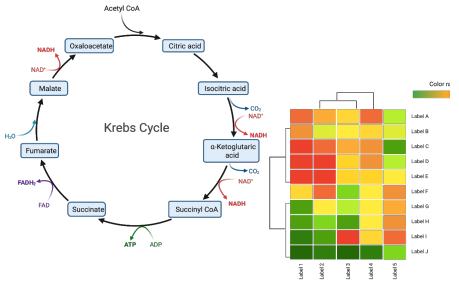
Oxidative stress markers analysis



Inflammatory markers analysis



Metabolomics analysis



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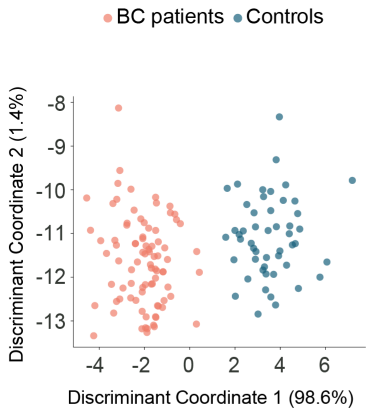

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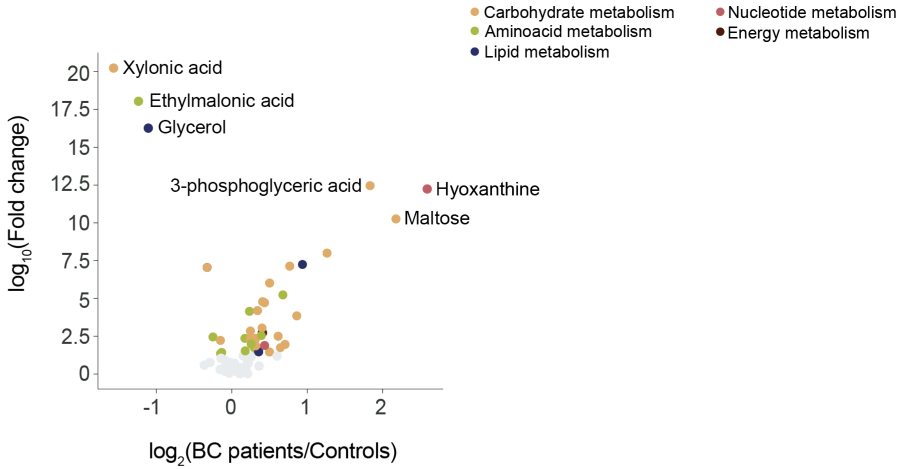

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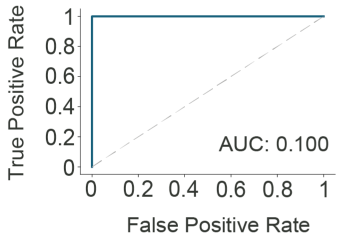

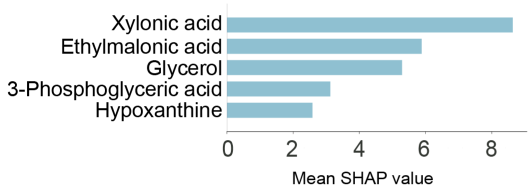

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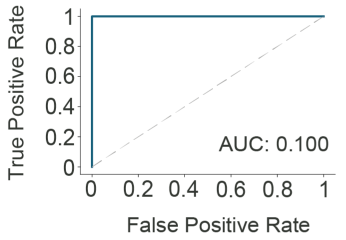
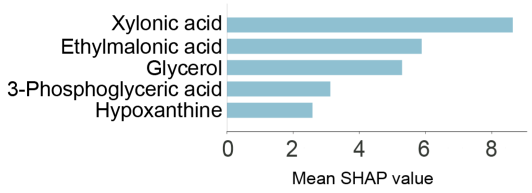
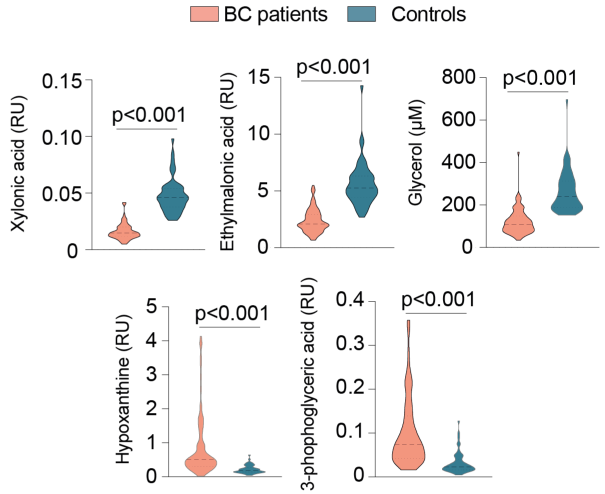
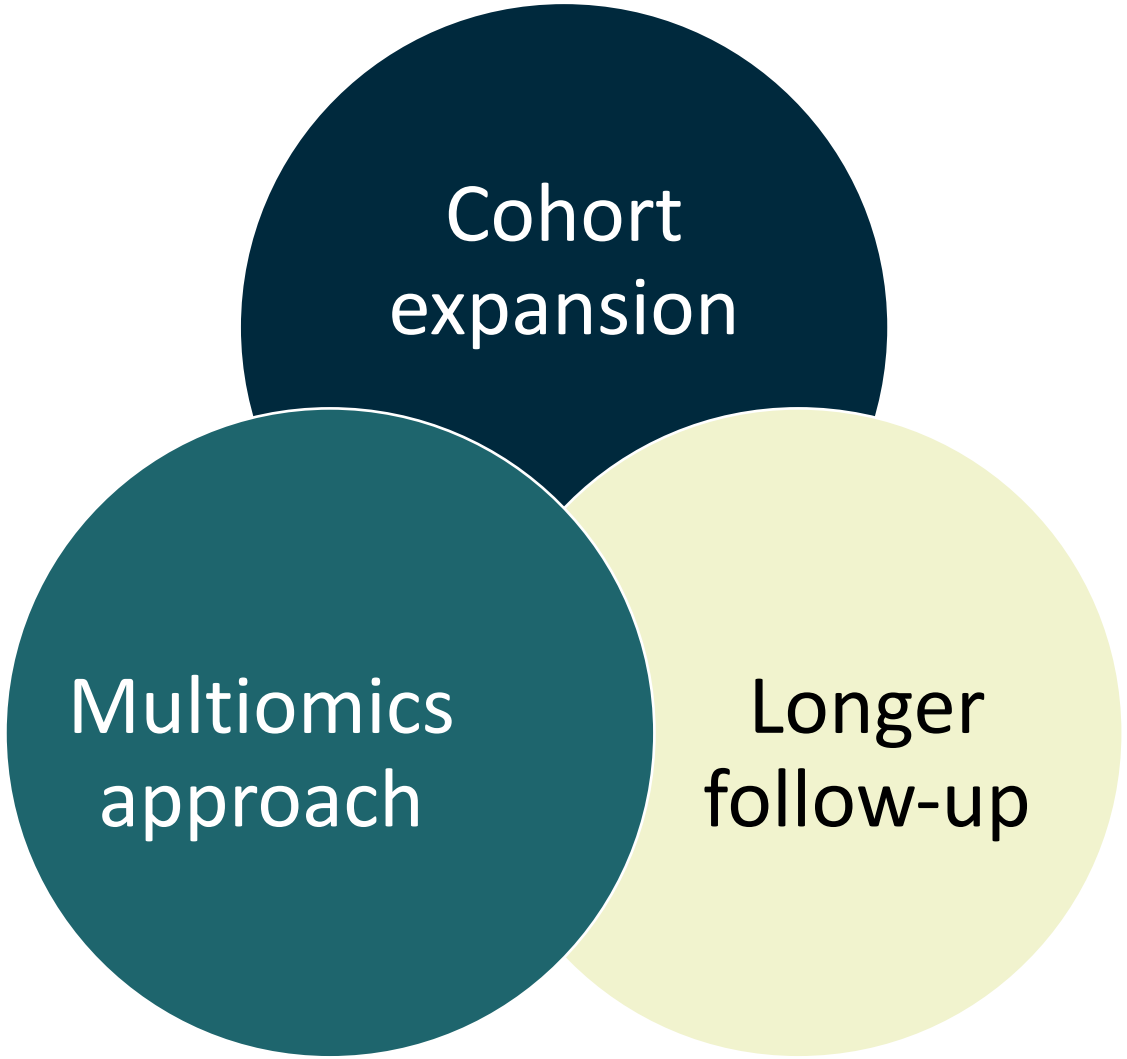






Next steps in our research group



Aknowledgements

MRO organizers

Dr. Meritxell Arenas from the Radiation Oncology Department in the Universitary Hospital Sant Joan in Reus

Dr. Jorge Joven and Dr. Jordi Camps from the Biomedical Research Unit in the Universitary Hospital Sant Joan in Reus

Omics and AI in breast cancer

Omics driven radiotherapy approaches

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