

Review

Heterogeneity of tumor biophysical properties and their potential role as prognostic markers

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Table S1. Most important parameters that can be extracted from impedance and how to derive them

Parameter	Equation	Main Contributor(s)
Impedance (Z)	$Z(\omega) = Z_{Re}(\omega) + jZ_{Im}(\omega)$ $j = \text{imaginary unit}$ $\omega = 2\pi f \text{ (angular frequency)}$ $f = \text{frequency [Hz]}$ $Z = Z \tan \theta; Z = Z e^{j\theta}$	Cell membrane, cytoplasm, extracellular fluid/ medium
Magnitude ($ Z $)	$ Z = \sqrt{R^2 + X^2}$	Cell membrane, cytoplasm, extracellular fluid/ medium
Phase angle (θ)	$\theta = \tan^{-1} \left(\frac{X}{R} \right)$	Cell membrane, cytoplasm,
Resistance (R)	$R = Z \cos \theta$	Cytoplasm, extracellular fluid/ medium, ion channels
Reactance (X)	$X = Z \sin \theta$	Cell membrane
Capacitance (C)	$C = -\frac{1}{\omega X}$	Cell membrane
Permittivity (ε)	$\varepsilon(\omega) = \varepsilon_{Re}(\omega) - j\varepsilon_{Im}(\omega)$	Cell membrane
Conductivity (σ)	$\sigma = \omega \varepsilon_0 \varepsilon_{Im}$ $\varepsilon_0 = 8.854 \times 10^{-12} \text{ F/m}$ $\text{permittivity in vacuum}$	Cytoplasm, extracellular fluid/ medium