CLAIMS

What is claimed is:

1. A method of analyzing an ex vivo solid cell culture over time, the method comprising:

determining a first response of a solid cell culture to a growth media including a treatment agent, the solid cell culture held in a cell culture chamber of a microfluidic chip by determining first location coordinates of at least a first single cell of the solid cell culture including a first x location coordinate, a first y location coordinate, and a first z location coordinate;

determining a second response of the solid cell culture to the growth media by determining second location coordinates of the at least first single cell of the solid cell culture including a second x location coordinate, a second y location coordinate, and a second z location coordinate; and

comparing the first response and the second response to determine a treatment efficacy,

wherein comparing the first response and the second response comprises comparing the first location coordinates to the second location coordinates to determine a difference between the first location coordinates and the second location coordinates, and wherein the difference between the first location coordinates and the second location coordinates is between at least one of the first x location coordinate and the second x location coordinate, the first y location coordinate and the second y location coordinate, or the first z location coordinate and the second z location coordinate, the difference representing a cell migration distance of the at least first single cell over time.

2. The method of claim 1, wherein one or both of the first response or the second response comprises at least one of a color or multiple colors of the solid cell culture, a pixel intensity of an image of the solid cell culture, a shape of the solid cell culture, a size of the solid cell culture, a position of cells of the solid cell culture, or a quantity of cells of the solid cell culture.

3. The method of claim 1, wherein the treatment efficacy is indicative of a viability of cells of the solid cell culture in response to the treatment agent.

4. The method of claim 1, wherein determining the first response comprises capturing an image of the solid cell culture.

5. The method of claim 4, further comprising

determining a cell viability from the image, and

predicting a patient response to the treatment agent based on the cell viability.

6. The method of claim 4, further comprising

determining a cell proliferation from the image, and

predicting a patient response to the treatment agent based on the cell proliferation.

7. The method of claim 4, further comprising

determining a cell position from the image, and

predicting a patient response to the treatment agent based on the cell position.

8. The method of claim 4, wherein

the image is a first image, and

determining the second response comprises capturing a second image of the solid cell culture.

9. The method of The method of wherein determining the cell migration distance of the at least first single cell over time includes comparing the first image and the second image, and the method further comprises predicting a patient response to the treatment agent using the cell migration distance.

10. The method of claim 8, further comprising comparing the first image and the second image to determine a cell migration speed of the at least first single cell of the solid cell culture over time, and predicting a patient response to the treatment agent using the cell migration speed.

11. The method of claim 8, further comprising

comparing the first image and the second image to determine a migration distance of a plurality of cells that define all cells or a subset of cells of the solid cell culture over time, and

predicting a patient response to the treatment agent using the migration distance.

12. The method of claim 8, further comprising

comparing the first image and the second image to determine a migration speed of a plurality of cells that define all cells or a subset of cells of the solid cell culture over time, and

predicting a patient response to the treatment agent using the migration speed.

13. The method of claim 11, wherein the plurality of cells comprises the subset of cells being the 5% most aggressive cells of the plurality of cells.

14. The method of claim 11, wherein the plurality of cells comprises the subset of cells being less than 2% most aggressive cells of the plurality of cells.

15. The method of claim 11, wherein the plurality of cells comprises the subset of cells expressing a specific biomarker.

16. The method of claim 8, further comprising

comparing the first image and the second image to determine a cell having a maximum migration vector of the solid cell culture over time, and

predicting a patient response to the treatment agent using the maximum migration vector.

17. The method of claim 8, further comprising

comparing the first image and the second image to determine a cell having a maximum migration speed of the solid cell culture over time, and

predicting a patient response to the treatment agent using the maximum migration speed.

18. The method of claim 1, wherein the determining the first response comprises determining characteristics of the at least first single cell at a first time, the determining the second response comprises determining characteristics of the at least first single cell at a second time

subsequent to the first time, and predicting a patient response to the treatment agent based on a comparison of the measured characteristics of the at least first single cell at the first time and the second time.

19. The method of claim 8, wherein

one or both of the first image or the second image comprises a composite and/or a weighted cell measurement, and

the method further comprises predicting a patient response to the treatment agent based on the composite and/or weighted cell measurement.

20. The method of claim 19, wherein

the first image comprises a first composite and/or weighted cell measurement, the second image comprises a second composite and/or weighted cell measurement, and

predicting a patient response to the treatment agent based on a comparison of the first composite and/or weighted cell measurement and the second composite and/or weighted cell measurement.

21. The method of claim 8, wherein

one or both of the first image or the second image comprises information associated with a radius, a diameter, or a circumference of a spheroid or an organoid, and

the method further comprises predicting a patient response to the treatment agent based on the radius, the diameter, or the circumference of the spheroid or the organoid.

22. The method of claim 21, wherein

the first image comprises a first radius, a first diameter, or a first circumference of the spheroid or the an organoid,

the second image comprises a second radius, a second diameter, or a second circumference of the spheroid or the organoid, and

predicting a patient response to the treatment agent based on a comparison of the first radius, the first diameter, or the first circumference with the second radius, the second diameter, or the second circumference.

23. The method of claim 8, wherein

one or both of the first image or the second image comprises information associated with one or more of a length, a width, or a height of a surgical resection, tissue slice, xenograft, or core needle biopsy, and

the method further comprises predicting a patient response to the treatment agent based on the length, a width, or a height of a surgical resection, tissue slice, xenograft, or core needle biopsy.

24. The method of claim 23, wherein

the first image comprises a first length, a first width, or a first height of a surgical resection, tissue slice, xenograft, or core needle biopsy,

the second image comprises a second length, a second width, or a second height of the surgical resection, tissue slice, xenograft, or core needle biopsy, and

predicting a patient response to the treatment agent based on a comparison of the first length, the first width, or the first height with the second length, the second width, or the second height.

25. The method of claim 1, wherein the comparing comprises executing instructions of a non-transitory computer-readable media, with one or more processing elements of a computer, to determine the treatment efficacy, wherein the treatment efficacy corresponds to a treatment option applied to a patient from which the solid cell culture originated.

26. The method of claim 1, further comprising:

determining a third response of the solid cell culture to the growth media; and

comparing the first, second and/or third responses to determine a treatment efficacy.

27. The method of claim 26, further comprising:

determining a fourth response of the solid cell culture to the growth media; and

comparing the first, second, third and/or fourth responses to determine a treatment efficacy.

28. The method of claim 27, further comprising:

determining a fifth response of the solid cell culture to the growth media; and

comparing the first, second, third, fourth and/or fifth responses to determine a treatment efficacy.

29. The method of claim 1, further comprising forming the solid cell culture by:

isolating target cells from a patient sample;

forming stained cells from the isolated cells by staining the isolated cells with a light-responsive dye that causes a color change in the stained cell when the stained cell transitions from a living cell to a dead cell; and

encapsulating the stained cells in a hydrogel.