

WHAT IS CLAIMED IS:

1. A method for classifying a test organoid, said method comprising the steps of:
 - (a) imaging a test organoid to provide an organoid image; and
 - (b) analyzing the organoid image with a trained neural network that has been trained to assign a classification to the test organoid, wherein the classification comprises disease phenotype or non-disease phenotype.
2. The method of claim 1, wherein the cells of the organoid having a disease phenotype comprise one or more mutations that confer the disease phenotype.
3. The method of claim 1, wherein the test organoid comprises cells differentiated from:
 - i) stem cells, ii) pluripotent cells, iii) induced pluripotent cells, iv) human embryonic stem cells, v) adult stem cells, vi) totipotent stem cells, or vii) non-embryonic cell.
4. The method of claim 1, wherein the disease phenotype is a Huntington's disease phenotype.
5. The method of claim 1, further comprising staining the test organoids for one or more markers.
6. The method of claim 5, wherein the one or more markers comprise an organelle marker, a cell differentiation markers, a cell compartment markers, or a combination thereof.
7. The method of claim 5, wherein at least two organoid images of the test organoid are analyzed, each corresponding to a different marker and a different color channel.
8. The method of claim 1, wherein the trained neural network is a neural network trained with a plurality of images of organoids belonging to a non-disease classification and a

plurality of images of organoids belonging to a disease classification, wherein said neural network comprises a plurality of layers and a last layer comprising two nodes.

9. A method for identifying a test molecule that is biologically active against a disease, comprising:

- (a) culturing a first mammalian cell population under organoid formation conditions to obtain a first organoid, wherein the organoid formation conditions include exposure to a test molecule, and wherein the first mammalian cell population, when cultured under the organoid formation conditions in the absence of a biologically active molecule, results in an organoid with a disease phenotype;
- (b) imaging the first organoid following exposure to the test molecule;
- (c) analyzing one or more images of the first organoid using a neural network that has been trained to assign a probability score of disease or non-disease ranging between 0% and 100%; and
- (d) assigning the first organoid a probability score ranging between 0% and 100%;

wherein the test molecule is biologically active against the disease if the probability score of the first organoid is greater than a cutoff probability score of non-disease or lower than a cutoff probability score of disease, optionally wherein the first mammalian cell population contains one or more mutations that confer the disease phenotype.

10. The method of claim 9, wherein the neural network has further been trained to assign a probability score of toxicity or non-toxicity ranging between 0% and 100%, and wherein the method optionally further comprises assigning the first organoid a probability score of toxicity or non-toxicity ranging between 0% and 100%.

11. The method of claim 9, which further comprises verifying the accuracy of the neural network, optionally wherein verifying accuracy of the neural network comprises:

(a) culturing a second mammalian cell population of the same cell type(s) as the first cell population under organoid formation conditions to obtain a second organoid, wherein the second mammalian cell population, when cultured under the organoid formation conditions in the absence of a biologically active molecule, results in an organoid without the disease phenotype;

(b) imaging the second organoid; and

(c) assigning the second organoid a probability score ranging between 0% and 100%,

wherein the neural network is deemed to be accurate if the probability score of the second organoid is greater than a cutoff probability score of non-disease or lower than a cutoff probability score of disease.

12. The method of claim 9, wherein the first mammalian cell population encodes a Huntingtin protein with an expanded polyglutamine repeat, optionally wherein the expanded polyglutamine repeat contains 42-150 glutamine residues.

13. The method of claim 9, wherein the probability score is given on a scale of 0 to 1 and/or wherein the cutoff probability score is 95%.

14. A method of screening a collection of test molecules to identify a molecule that is biologically active against a disease, comprising performing the method of claim 9 for each test molecule in the collection, optionally wherein the test molecules are screened individually or screened in pools.

15. A system comprising:

(a) a processor; and

(b) a non-transient storage medium including processor executable instructions implementing the analyzing step of claim 1.

16. A system comprising:
- (a) a processor; and
 - (b) a non-transient storage medium including processor executable instructions implementing step (c) of claim 9.
17. A non-transient storage medium including processor executable instructions for: (a) receiving organoid images and (b) utilizing a neural network to (i) analyze one or more images of an organoid using a neural network and (ii) assign a probability score of disease or non-disease ranging between 0% and 100%.
18. A method of training a neural network to analyze one or more images of an organoid and assign a probability score of disease or non-disease ranging between 0% and 100%, said method comprising the steps of:
- (a) receiving a first training set of input images of organoids having a disease phenotype and a second training set of input images of organoids having a non-disease phenotype;
 - (b) comparing probability scores of disease or non-disease for the input images to their true values; and
 - (c) updating weights of nodes in the neural network during a backpropagation process through the neural network.
19. A system comprising:
- (a) an imaging device capable of imaging an organoid;
 - (b) a processor configured for:
 - (i) receiving organoid images from the imaging device; and
 - (ii) utilizing a neural network to analyze one or more images of the organoid using a neural network and assign a probability score of disease or non-disease ranging between 0% and 100%.

20. A system comprising:
- (a) an imaging device capable of imaging an organoid;
 - (b) a processor configured for:
 - (i) receiving organoid images from the imaging device; and
 - (ii) training a neural network to analyze one or more images of an organoid and assigning a probability score of disease or non-disease ranging between 0% and 100% according to the method of claim 18.
21. A system comprising:
- (a) an imaging device capable of imaging an organoid;
 - (b) a processor configured for:
 - i. receiving organoid images from the imaging device;
 - ii. training a neural network to analyze one or more images of an organoid and assigning a probability score of disease or non-disease ranging between 0% and 100% according to the method of claim 18; and
 - iii. utilizing the neural network to analyze one or more images of the organoid using a neural network and assign a probability score of disease or non-disease ranging between 0% and 100%.
22. A method of determining the toxicity of a test molecule, said method comprising:
- a) performing the method of claim 9;
 - b) removing the distance between wild type and disease from the latent space;
 - c) calculating the distance from the mean vector of the wild type phenotypes and disease phenotype;
 - d) comparing the distance calculated from step (c) and the standard deviation of the wild type phenotype and disease phenotype; and
 - e) determining a toxicity value.

23. The method of claim 9, which further comprises verifying the accuracy of the neural network, optionally wherein verifying accuracy of the neural network comprises:

(a) culturing a third mammalian cell population of the same cell type(s) as the first cell population under organoid formation conditions to obtain a third organoid, wherein the third mammalian cell population, when cultured under the organoid formation conditions in the absence of a biologically active molecule, results in an organoid with the disease phenotype;

(b) imaging the third organoid; and

(c) assigning the third organoid a probability score ranging between 0% and 100%,

wherein the neural network is deemed to be accurate if the probability score of the third organoid is lower than a cutoff probability score of non-disease or greater than a cutoff probability score of disease.