

FOR NON-CLINICAL RESEARCH USE ONLY

Product Description

LifeNet Health's TruVivo All-Human 2D+ Hepatic System consists of prequalified cryopreserved primary human hepatocytes, primary human feeder cells, and optimized media components. All cells are isolated from donated human tissue, resulting from the generous gift of an individual or their family.

Indications for Use

For research use only. Not for use in diagnostic procedures nor for implantation into humans.

Warnings and Precautions

Observe universal precautions when handling human-derived tissues and cells as they are potentially biohazardous. Refer to the guidelines set forth in Occupational Safety and Health Standards for handling blood, tissues, body fluids, or other potentially infectious materials. Follow institutional guidelines for the collection and disposal of all solid and liquid waste that has been in contact with these products.

Transfer or resale of any LifeNet Health cells or products is prohibited without the written consent of LifeNet Health.

Donor Screening and Testing

Donor authorization for non-clinical research use of these cells was appropriately obtained and documented by LifeNet Health. All donors are tested and confirmed negative for the following infectious diseases: Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Syphilis, Toxoplasmosis, and beginning March 2020 SARS-CoV-2 (COVID-19).

Storage Requirements

The distributor, intermediary and/or end-user is responsible for storing TruVivo components under appropriate conditions prior to further distribution or use. LifeNet Health ships frozen cells in the vapor phase of liquid nitrogen (-135°C to -190°C). On receipt, immediately transfer frozen cells to storage in the vapor phase of liquid nitrogen (-135°C to -190°C) until ready for experimental use. Do not thaw and refreeze. LifeNet Health ships media either on dry ice (-10°C to -30°C) or on refrigerated cold packs (2°C to 8°C) depending on the appropriate storage condition. On receipt, immediately transfer media to the appropriate storage condition as indicated on the product label until ready for experimental use.

Final Product Testing

Each primary human hepatocyte and feeder cell lot is qualified for use in the TruVivo system. Hepatocyte performance in the system meets minimum specifications for plateability, monolayer confluency, morphology, albumin, and urea secretion over a 14-day culture period. A Certificate of Analysis (COA) is available for each lot and includes donor demographics, comprehensive medical and social history, histopathological scoring and images, as well as reported data for cell performance, recommended seeding densities, and culture images over time.

Complaints and Returns

For further information or returns or to report a complaint, please contact LifeNet Health Client Services (available 24 hours a day) at 1-888-847-7831 (inside the U.S.) or 00+1-757-464-4761 ext. 2000 (outside the U.S.) and have the product code and lot number available (see COA or Order Confirmation).

TruVivo All-Human 2D+ Hepatic System Protocol, 96-well Format

It is important to read and understand the following instructions prior to use. Improper handling may adversely affect cell quality and performance. Before handling any materials don appropriate personal protective equipment (PPE) for liquid nitrogen (LN₂) and cryovial handling.

I. Receiving and Storage

Cryopreserved Cells:

1. Transport the shipping container containing the cryopreserved hepatocyte and feeder cell vials next to the cryogenic storage freezer.
2. Fill insulated laboratory ice tray with enough LN₂ to submerge only a few millimeters of a cryovial storage box.
3. Unseal the shipping container by opening the flaps and removing the cap/plug of the inner dewar. **NOTE:** You may notice a small amount of vapor rising from the dewar.
4. Open the cryogenic storage freezer and remove the appropriate rack and box for storing the received vials. Place the storage box in the LN₂-containing tray.
5. Using forceps or tongs, transfer the vials from the shipping box to the storage box.
6. Repeat Step 5 until all vials have been transferred to the cryogenic storage freezer.
7. Follow the instructions provided with the shipping dewar for disposal or return shipment.

Frozen Medium (Green Labeled):

1. Quickly transfer bag containing Feeder Cell Thawing Medium (FCTM) and Supplements A, B, and C from shipping box to a -20°C freezer until ready to use. **NOTE:** All media should be protected from light.

Refrigerated Medium (Orange Labeled):

1. Quickly transfer bag containing TruVivo Culture Medium (TCCM), TruVivo Plating Medium (TCPM), and Human Hepatocyte Thawing Medium (HHTM) from shipping box to 4°C refrigerator until ready to use. **NOTE:** All media should be protected from light.

II. Week 1 Medium Preparation

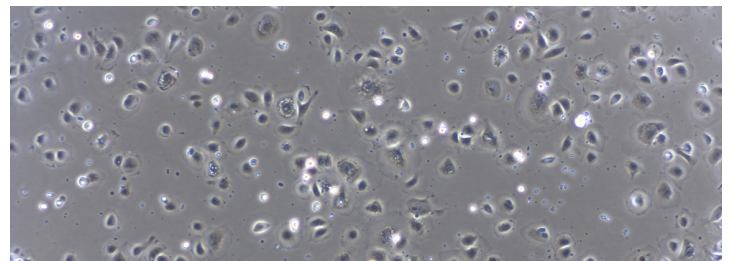
1. One day before use, transfer FCTM and Supplements A, B, & C from -20°C to 4°C storage and thaw overnight. **OPTIONAL:** Thaw at room temperature or 37°C prior to use.
2. Spray and wipe all reagent bottles (FCTM, HHTM, TCPM, TCCM, and Supplements A, B, & C) with 70% (v/v) alcohol and place in Biological Safety Cabinet (BSC).
3. Prepare TCPM by adding 11 mL of Supplement A and 4.5 mL of Supplement B to the bottle of TCPM. **NOTE:** If desired, an antibiotic can be added to TCPM. Penicillin/Streptomycin, at a final concentration of 50 units/mL and 50 µg/mL, respectively, is recommended.
4. Prepare TCCM by aliquoting 150 mL of TCCM and adding 22 mL Supplement A and 1.5 mL Supplement C. **NOTE:** If desired, an antibiotic can be added to TCCM. Penicillin/Streptomycin, at a final concentration of 50 units/mL and 50 µg/mL, respectively, is recommended.
5. Transfer FCTM into a sterile 15 mL conical tube and gently invert 3 times to mix thoroughly.
6. Invert HHTM bottle to evenly mix, then filter HHTM through a 0.2 µm filter. Transfer filtered HHTM to a sterile 50 mL conical tube. Cap 50 mL tube and gently invert 3 times to mix thoroughly.
7. Prior to use, warm reagents in 37°C water bath for 20-30 minutes.
8. Following addition of supplements to basal mediums, re-freeze Supplements A and C in a -20°C freezer until week 2 of culture.

III. Thawing and Plating Human Feeder Cells

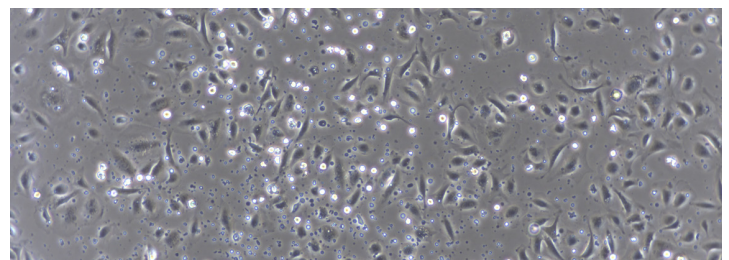
NOTE: Primary Human Hepatocytes should be thawed approximately 60 minutes following completion of this section.

1. Remove 15 mL conical tube of FCTM from 37°C water bath, spray, and wipe with 70% (v/v) alcohol, and place in BSC.
2. Wear appropriate PPE for handling liquid nitrogen (LN₂) and biohazardous materials (Refer to OSHA Standard 29CFR1910.132).
3. Fill a suitable container with enough LN₂ to submerge a cryovial to at least half of its height.
4. Place a small, insulated laboratory ice tray filled with ice, for transporting cells, next to 37°C water bath.
5. Quickly remove cryovial of feeder cells from LN₂ storage and place in the portable LN₂ container.
6. Carefully transport frozen cryovial in the LN₂ container to the 37°C water bath.
7. Using forceps or tongs, QUICKLY remove cryovial of feeder cells from the LN₂, loosen the cryovial cap slightly to release pressure and then re-tighten. **NOTE:** Do NOT completely remove the cryovial cap.
8. Partially submerge cryovial vertically in 37°C water bath to thaw for 90 seconds. Ensure the water level is at least even with the top of the frozen cell suspension, being careful to keep the neck of the cryovial above the water.
9. Remove cryovial from 37°C water bath and gently invert. The cell suspension should be somewhat liquefied and slide freely without tapping or shaking the cryovial. If the frozen suspension does not slide freely, return cryovial to upright position and place back in water bath for an additional 5 seconds. Recheck the movement of the cell suspension.
10. Quickly place cryovial in ice tray to prevent the cells from reaching room temperature. Transport to the BSC. Wipe the cryovial with 70% (v/v) alcohol prior to placing in BSC.
11. Transfer thawed feeder cells to 15 mL conical tube containing FCTM.
12. Using a 1000 µL serological pipette, rinse the cryovial once with approximately 1000 µL of FCTM from the tube. Transfer the FCTM back to the tube.
13. Gently pipette 2-3 times to uniformly resuspend the feeder cells.
14. Centrifuge the feeder cells at 400 x g for 4 minutes at room temperature.
15. Return to BSC and gently aspirate the supernatant without disturbing the cell pellet in the bottom of the tube.
16. Resuspend the cell pellet in 2 mL of warm supplemented TCPM taking care to not create bubbles.
17. Count the feeder cell suspension by either the trypan blue exclusion method on a hemocytometer and/or AO/PI staining with an automated cell counter to determine yield and viability. **NOTE:** Use a 10-fold dilution for the trypan blue exclusion method or a 2-fold dilution for the AO/PI staining.
18. Add additional warm supplemented TCPM to cell suspension to dilute the feeder cell suspension to 100,000 cells/mL.
19. Pipette the entire feeder cell suspension into a sterile reagent reservoir.
20. Using a multi-channel pipette, transfer 100 µL of cell suspension (10,000 cells) from the reservoir to each well of the Collagen I pre-coated 96-well plate.
21. Remove culture plate from the BSC and place in a humidified incubator (37°C, 5% CO₂).
22. Visually inspect feeder cell attachment 60 minutes post-plating, prior to start of hepatocyte handling. Feeder cell attachment should be similar to the images provided in Figure 1.

Figure 1. Feeder Cell attachment



TruVivo Human Feeder Cells 60 minutes post-plating



TruVivo Human Feeder Cells 90 minutes post-plating

IV. Thawing and Plating of Human Hepatocytes

NOTE: Proceed with this section once feeder cells have successfully attached.

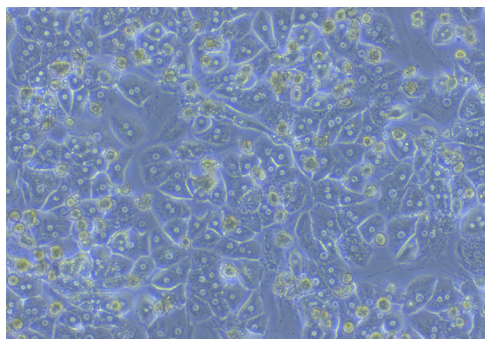
1. Remove 50 mL conical tube of HHTM from 37°C water bath, spray, and wipe with 70% (v/v) alcohol, and place in BSC.
2. Gently invert the tube 3 times to mix HHTM thoroughly.
3. Refer to TruVivo Hepatocyte COA for stated optimal seeding density.
4. Refill portable LN₂ container with enough LN₂ to submerge a cryovial to at least half of its height.
5. Place small, insulated laboratory ice tray filled with ice, for transporting cells, next to 37°C water bath.
6. Quickly remove cryovial of human hepatocytes from LN₂ storage and place in the portable LN₂ container.
7. Carefully transport frozen cryovial in the LN₂ container to the 37°C water bath.
8. Using forceps or tongs, QUICKLY remove cryovial of human hepatocytes from the LN₂, loosen the cryovial cap slightly to release pressure and then re-tighten. **NOTE:** Do NOT completely remove the cryovial cap.
9. Partially submerge cryovial vertically in 37°C water bath to thaw for 90 seconds. Ensure the water level is at least even with the top of the frozen cell suspension, being careful to keep the neck of the cryovial above the water.
10. Remove cryovial from 37°C water bath and invert. The cell suspension should be somewhat liquefied and slide freely without tapping or shaking the vial. If frozen cell suspension does not slide freely, return cryovial to upright position and place back in water bath for an additional 5 seconds. Recheck the movement of the cell suspension.
11. Quickly place cryovial in ice tray to prevent the cells from reaching room temperature, and transport to BSC. Wipe the cryovial with 70% (v/v) alcohol prior to placing in BSC.
12. Remove the cryovial cap and pour hepatocytes into tube containing HHTM. Using a 1000 µL pipette, rinse the cryovial once with approximately 1000 µL of HHTM from the tube. Transfer the HHTM back to the tube.
13. Tighten the tube cap and gently invert the tube 3 times to uniformly resuspend the hepatocytes.
14. Centrifuge the hepatocytes at 100 x g for 8 minutes at room temperature.
15. Return to BSC and gently aspirate the supernatant without disturbing the cell pellet in the bottom of the tube.
16. Add 5 mL of warm supplemented TCPM to hepatocytes. Gently rock the tube to resuspend the hepatocytes. **NOTE:** Do NOT pipette or vortex to mix or swirl vigorously.
17. Add 3 mL of additional warm supplemented TCPM to hepatocytes and count the suspension by either trypan blue exclusion method on a hemocytometer and/or AO/PI staining with an automated cell counter to determine yield and viability. **NOTE:** Use a 10-fold dilution for the trypan blue exclusion method or a 2-fold dilution for the AO/PI staining.
18. Multiply the COA optimal seeding density by ten.
19. Add additional warm supplemented TCPM to cell suspension to dilute hepatocytes to ten times the optimal seeding density.

Example:
30,000 cells/well (COA value) x 10 = 300,000 cells/mL
20. Immediately prior to plating hepatocytes, remove 96-well culture plate from incubator and place in BSC.
21. Swirl or invert the tube of hepatocytes to ensure the cell suspension is homogeneously mixed, then pour the cell suspension into a sterile reagent reservoir until half full.
22. Keeping the plate flat, aspirate medium from wells containing feeder cells, taking care not to disturb the feeder cell layer.
23. Using a multi-channel pipette, transfer 100 µL of cell suspension from the reservoir to each well of the culture plate.
24. Remove culture plate from the BSC and return to the humidified incubator.
25. Place sufficient volume of supplemented TCCM in 37°C water bath at 100 minutes post-plating of hepatocytes. Allow to warm for 20-30 minutes prior to medium change. Protect from bright light.
26. At 2-4 hours post-plating, remove culture plate from incubator and inspect hepatocyte attachment. Place plate in BSC.
27. Keeping the plate flat, gently aspirate medium from the side of each well without touching the cell layer. Avoid prolonged or excessive aspiration of wells which may cause dehydration of the cells.
28. Replace medium in each well with 100 µL of warm supplemented TCCM, depositing the medium along the wall of the well, and return plate to incubator.

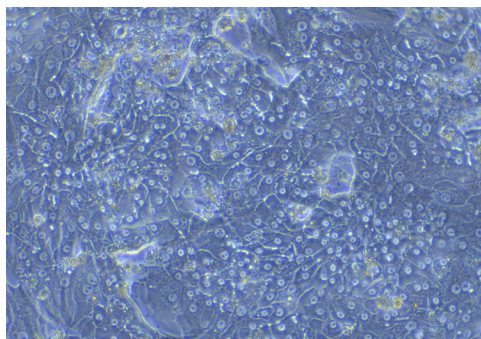
V. Maintenance of Human Hepatocytes on Feeder Cells

1. Visually inspect the culture daily.
2. Replace medium daily with 100 μ L of warm supplemented TCCM per well for the remainder of the culture period. **NOTE:** Prepared supplemented TCCM can be stored at 4°C and used for 7 days. Fresh supplemented TCCM must be made weekly.

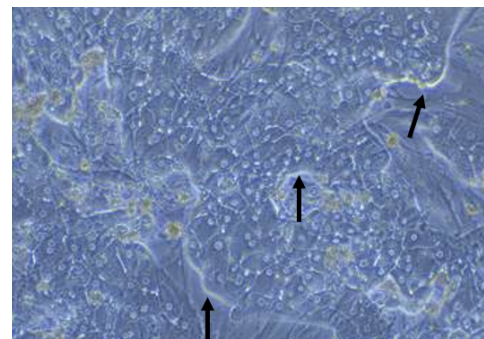
Representative Morphology During Week 1



Day 1: Hepatocytes have attached, and display expected cuboidal shape and multinucleation.



Day 4: Hepatocytes are beginning to aggregate together to form colonies.



Day 7: Hepatocytes have reached steady state and have formed well-defined colonies. Arrows indicate defined border of colonies.

VI. Week 2 Medium Preparation

1. Transfer Supplement A and Supplement C from -20°C to 4°C storage to thaw overnight. **OPTIONAL:** Thaw at room temperature or 37°C prior to use.
2. Prior to use, wipe reagent bottles with 70% (v/v) alcohol and place them in BSC.
3. Prepare TCCM by aliquoting 150 mL of TCCM and adding 22 mL Supplement A and 1.5 mL Supplement C. **NOTE:** If desired, an antibiotic can be added to the TCCM. Penicillin/Streptomycin, at a final concentration of 50 units/mL and 50 μ g/mL, respectively, is recommended.
4. Prior to use, warm only the needed amount of medium in 37°C water bath for 20-30 minutes

Appendix I. Required Equipment and Consumables:

Large Equipment:

- Biological Safety Cabinet (BSC)
- Cryogenic storage freezer capable of temperatures $\leq -150^{\circ}\text{C}$
- Portable liquid nitrogen (LN_2) dewar or other suitable container to transport frozen vials
- $37^{\circ}\text{C}/5\% \text{CO}_2$ Incubator (humidified)
- 37°C water bath
- Centrifuge capable of achieving up to 400 g (50 mL conical tube adaptors)
- -20°C freezer
- 4°C refrigerator
- Vacuum aspiration system with sterile aspiration tips (optional)

Small Equipment:

- Appropriate personal protective equipment (PPE)
- Laboratory ice tray capable of containing a small amount of liquid nitrogen and a cryovial box
- Hemocytometer or other cell-counting device
- Forceps or tongs
- Cryovial storage box
- Timer
- Pipettes (20, 200 and 1000 μL) with sterile tips
- Serological pipettor and sterile pipettes (1, 2, 5, 10, 25 mL)
- 1000 μL multichannel electronic pipette with sterile tips (optional)
- Collagen I-coated 96-well plates (Fisher cat. #A1142803 or Corning cat. #354407)
- Sterile disposable or washable media bottles (100-250 mL)
- 0.2 μm filters

Consumables:

- 70% (v/v) alcohol (ethanol or isopropyl alcohol)
- 70% alcohol wipes (or lab wipes soaked in 70% (v/v) alcohol)
- Laboratory wipes
- Ice
- Liquid nitrogen (LN_2)
- Sterile 50 mL conical centrifuge tubes
- Sterile 50 mL or 100 mL reagent reservoir (optional)
- LifeNet Health Cryopreserved Human Hepatocytes (Pre-qualified for TruVivo)
- LifeNet Health Human Hepatocyte Thawing Medium (HHTM)
- LifeNet Health Feeder Cell Thawing Medium (FCTM)
- LifeNet Health TruVivo Plating Medium (TCPM)
- LifeNet Health TruVivo Culture Medium (TCCM)
- LifeNet Health TruVivo Supplement A
- LifeNet Health TruVivo Supplement B
- LifeNet Health TruVivo Supplement C
- Antibiotic (optional; product suggestion - Penicillin/Streptomycin)
- Either Trypan blue solution or AO/PI (acridine orange/propidium iodide) stain

Appendix II. Quick Reference Guide TruVivo, 96-well Protocol:

I. Prepare Medium

1. Transfer FCTM and Supplements A, B, & C from -20°C to 4°C storage to thaw overnight. **OPTIONAL:** Thaw at room temperature or 37°C prior to use.
2. Prior to use, wipe reagent bottles with 70% (v/v) alcohol and place medium in Biological Safety Cabinet (BSC).
3. Prepare TCPM by adding 11 mL Supplement A and 4.5 mL Supplement B to the bottle of TCPM. **NOTE:** If desired, an antibiotic can be added to the TCPM. Penicillin/Streptomycin, at a final concentration of 50 units/mL and 50 µg/mL, respectively, is recommended.
4. Prepare TCCM by aliquoting 150 mL of TCCM and adding 22 mL Supplement A and 1.5 mL Supplement C. **NOTE:** If desired, an antibiotic can be added to the TCCM. Penicillin/Streptomycin, at a final concentration of 50 units/mL and 50 µg/mL, respectively, is recommended.
5. Prior to use, warm medium in 37°C water bath for 20-30 minutes.
6. Following addition of supplements to basal mediums, refreeze Supplements A and C in a -20°C freezer until week 2 of culture.

II. Thaw and Plate Human Feeder Cells

1. Thaw feeder cells in 37°C water bath and transfer to FCTM.
2. Centrifuge at 400 x g for 4 minutes at room temperature.
3. Resuspend and count feeder cells.
4. Dilute cells to 100,000 cells/mL.
5. Plate feeder cells onto collagen-coated plates (100 µL/well).
6. Incubate in humidified incubator for 60 minutes.
7. Visually inspect feeder cell attachment 60 minutes post-plating.

III. Thaw and Plate Human Hepatocytes

1. Thaw human hepatocytes in 37°C water bath and transfer to HHTM.
2. Centrifuge at 100 x g for 8 minutes at room temperature.
3. Resuspend and count hepatocytes.
4. Dilute cells to ten times the COA optimal seeding density.
5. Plate hepatocytes onto feeder cells (100 µL/well).
6. Place plate in humidified incubator.

IV. Medium Change

1. At 2-4 hours post-plating, place the plate flat in the BSC and replace medium in each well with 100 µL TCCM.
2. Return plate to humidified incubator post-medium change.
3. Repeat medium changes for the duration of culture period.