**Blood Processing (All Patients)**

**Note: For blood draws use at least a 21G needle to minimize hemolysis. Also avoid aggressive suction during phlebotomy for this same reason.**

**PEth Card**

**Notes:**

* **DO NOT USE ETHANOL NEAR THE PEth CARDS.**
* **Use a purple top blood tube.**
* **When storing and shipping, do not use a plasticized envelope or airtight plastic specimen bag.**

1. Label a PEth card (USDTL) with the patient ID, the collection day (if applicable), and the date. Place a corresponding barcode label on a drying box.
2. Open the PEth card and lay on a new kimwipe.
3. PRIOR TO CENTRIFUGATION, load 0.5mL of whole blood from a purple top (EDTA) blood tube into a pipet tip.
4. Slowly pipet a large drop of blood at the end of the pipet tip. The drop should be big enough to fill a collection circle of the PEth card in a single attempt. Allow the drop of blood to come into contact with the center of a collection card and wick to fill the circle. DO NOT touch the card with the pipet tip or layer successive drops.
5. Repeat to fill the remaining collection circles.
6. Pipet any remaining whole blood back into the purple top tube and re-cap.
7. Close the PEth card to cover the blood spots and place the specimen in a barcode labeled drying box and close the ends.
8. Store at room temperature until shipment.

**Blood Draw for Serum, Plasma, and Buffy Coat Collection**

**Notes:**

* **Centrifuge tubes at 1000X g for 10 min at room temperature.**
* **After collection, store all tubes at -80°C.**

**Green top (sodium heparin; AUDs, Controls, and Cannabis Users only)**(BD Vacutainer 4mL #367871, 6mL #367878) **-** aliquot 0.25-0.5mL aliquots of plasma off the top phase into 4 of the 1.8mL cryotubes (Nunc #375418) with green cap inserts (Nunc #355018), then collect red blood cells (RBCs) from the bottom phase and divide them into two 1.8mL cryotubes with yellow cap inserts (Nunc #355077). A 4mL green top will typically yield between 1 and 3mL of plasma.

**Red top** (BD Vacutainer 4ml #367812, 6mL #367815, 10mL #367820) **–** aliquot 0.25-0.5mL aliquots of serum off of the top phase into 8 of the 1.8mL cryotubes with red cap inserts (Nunc #354968). A 6mL red top will typically yield between 1 and 4mL of serum.

**Purple top (EDTA)**(BD Vacutainer 4mL #367861, 6mL #367863) **–** aliquot 0.25-0.5mL aliquots of plasma off the top phase into 8 of the 1.8mL cryotubes with purple cap inserts (Nunc #375922). A 4mL purple top will typically yield between 1 and 3mL of plasma. Then collect the buffy coat by pipetting the white layer of cells between the top phase and the red blood cell (RBC) bottom layer and pipetting it into a 1.8mL cryotube with a pink cap insert (Nunc #375884). Collect the RBC layer and pipette it into a 1.8mL cryotube with a grey cap insert (Nunc #375906).

**Blood draw for PBMC collection (AUDs, Controls, Cannabis Users)**

1. Centrifuge CPT tubes (BD #362761) at 1800X g for 30 min at room temperature.
2. Pipet off the top half of the supernatant. Collect the bottom half of the supernatant containing the PBMC layer and place into a 15mL conical tube. Bring the volume up to 15mL with 1XDPBS and centrifuge at 450 X g for 5 minutes.
3. Discard the liquid and resuspend the PBMC pellet in 1mL of 1XDPBS.
4. Count cells and check viability:
5. ***BioRad TC20 Automated Cell Counter:*** Dilute 10μl of sample with 10μl trypan blue (Bio-Rad #**1450021**), gently mix by pipetting up and down 10 times, and apply 10μl of the dilution to one side of a disposable cell counting slide (Bio-Rad #1450011). Insert the solution containing side into the cell counter for the automated cell count and viability. Print the count. Gate the cells at 6µm and 40µm. Print the count.
6. Divide up the cells according to need below.

**SNAP FROZEN ALIQUOTS:**

**PBMCs for RNA Extraction or Protein:** Pipette 1x10 6 or 2x10 6 aliquots of cells into labelled microcentrifuge tubes. The number of aliquots will be determined by the total number of cells available. Centrifuge at 14000 X g for 2 minutes to pellet the cells. Aspirate off and discard the supernatant, and then immediately freeze and store the cell pellets at -80°C.

**CRYOPRESERVED ALIQUOTS:**

**Cryopreservation of PBMCs for Flow Cytometry and other applications:**

1. After cells have been counted, make an aliquot of 1x106 - 4x106.
2. Pellet cells at 400 X g for 5 minutes and remove supernatant.
3. Resuspend in freezing media at a final concentration of 10 x 106 cells/mL (Freezing Media: 10% DMSO - Sigma #D2650 + 90% FBS - Atlanta Biologicals #S11550H, filter sterilized -Corning #430320). For 1 x 106 cells, resuspend in 100ul of freezing media, for 4 x 106 cells, resuspend in 400ul of freezing media.
4. Place them in a freezing container (Nalgene Cryo 1°C Freezing Container or Biocision Cool Cell) and store at -80°C for 24 hours. Store the cells in a liquid nitrogen storage tank long term.

**Bronchial Brushings Processing (AUDs, Controls, Cannabis Users)**

**Cytology Brush – DNA/RNA Shield**

1. One cytology (ConMed, #129R) brush will arrive in the lab in a labeled clear sterile 2mL microcentrifuge tube containing 0.7mL 0.7mL DNA/RNA Shield (Zymo Research R1100-50).
2. Vortex the tube and store without removing brush at -80°C.

**Cytology Brush – Cytospins**

1. One cytology brush will arrive in the lab in a labeled clear sterile 2mL microcentrifuge tube containing 1mL 1XDPBS (Cellgro #21-031-CV).
2. Vortex the cytology brush in 1XDPBS
3. Create 2 cytospins using 200ul of the cells in 1XDPBS for each slide.
4. Fix the cytospins in methanol for 2 minutes at room temperature.
5. Store the cytospins in 1XDPBS at 4°C.

**Cytology Brush—Cryopreservation**

cryo medium: 50% growth medium + 40% FBS + 10 % DMSO

1. Make medium ahead of time and keep in fridge (or cold room in dark) in cryovials for no more than 1 month (1 ml medium in 2 ml vial)

2. Place brush into medium, cut brush handle and tightly close vial

3. Gently invert**, do not vortex**

4. Place in Mr. Frosty or similar cryochamber

5. Store at -80C for at least 24h but no more than 1 wk

6. Transfer to liquid nitrogen

**Nasal Brushings Processing (AUDs, Controls, Cannabis Users)**

**Nasal Brush—Cryopreservation**

cryo medium: 50% growth medium + 40% FBS + 10 % DMSO

1. Make medium ahead of time and keep in fridge (or cold room in dark) in cryovials for no more than 1 month (1 ml medium in 2 ml vial)

2. Place brush into medium, cut brush handle and tightly close vial

3. Gently invert**, do not vortex**

4. Place in Mr. Frosty or similar cryochamber

5. Store at -80C for at least 24h but no more than 1 wk

6. Transfer to liquid nitrogen

**Nasal Cytology Brush – Cytospins-**

1. One cytology brush will arrive in the lab in a labeled clear sterile 2mL microcentrifuge tube containing 1mL 1XDPBS (Cellgro #21-031-CV).
2. Vortex the cytology brush in 1XDPBS.
3. Create 2 cytospins using 200ul of the cells in 1XDPBS for each slide.
4. Fix the 2 cytospins in methanol for 2 minutes at room temperature.
5. Store the cytospins in 1XDPBS at 4°C.

**BAL Processing (AUDs, Controls, Cannabis Users)**

**Notes:**

* **In general, 150-200mL sterile isotonic saline will be used for bronchoalveolar lavage, instilled in 50mL aliquots. We have used hand aspiration to more carefully control suction amount in the lung.**
* **The first 50mL aliquot instilled/aspirated is reflective of the airways, and is kept separate from the subsequent aliquots and should be marked ‘Upper’. The volume aspirated from this first aliquot (assuming 50mL instilled) is generally only 10-20mL.**
* **The second, third, and any subsequent aliquots reflect distal airway/alveolar sampling and should be marked ‘Lower’.**
* **Aliquot cell free BAL in a biosafety cabinet (hood).**

1. Record volume received for the Upper BAL and the Lower BAL.
2. Centrifuge at 1000 X g for 10 minutes at room temperature to pellet the cells.
3. Aliquot 2 mL of Upper BAL into 4mL cryotubes (Simport #T310-4A). Add Halt proteinase inhibitor (100X ThermoScientific #78429) to half the tubes at 10uL/mL
4. Aliquot 3.5mL of the Lower BAL into 4mL cryotubes. Add Halt proteinase to half the tubes at 10uL/mL
5. Store Upper and Lower BAL aliquots at -80°C

**BAL Cell Processing (AUDs, Controls, Cannabis Users)**

1. In a biosafety cabinet (hood), resuspend the cells from the above aliquots (‘Upper’ and ‘Lower’) in a total of 10mL 1XDPBS. Place 2-3mL of 1XDPBS in each 50mL conical tube, gently resuspend the cells, and then combine all of the resuspended cells into one tube.
2. Count cells and check viability:
3. ***BioRad TC20 Automated Cell Counter:*** Dilute 10μl of sample with 10μl trypan blue (Bio-Rad #**1450021**), gently mix by pipetting up and down 10 times, and apply 10μl of the dilution to one side of a disposable cell counting slide (Bio-Rad #1450011). Insert the solution containing side into the cell counter for the automated cell count and viability. Print the count. Gate the cells at 6µm and 30µm. Print the count.
4. Divide up the cells according to assay need below.

**Cytospins:** Resuspend 240,000 macrophages in 1.6ml of 1XDPBS (Cellgro #21-031-CV). Cytospin 4 slides (Fisher Scientific #12-544-7) at 30,000 cells per slide, following the equipment’s instructions. Immediately after cytospin, fix 1 slide in the methanol fixing solution from the Protocol Hema 3 kit (Fisher Scientific #22-122-911) for 10 minutes, and do H&E staining from the Protocol Hema 3 kit, dry, and store in a slide box at room temperature for subsequent tabulation of differentials.

1. Fix 2 of the cytospins in 4% paraformaldehyde for 15 minutes at room temperature.
2. Fix 1 of the cytospins in methanol for 2 minutes at room temperature.
3. Store these 3 cytospins in 1XDPBS at 4°C.

**SNAP FROZEN ALIQUOTS:**

**Cells for RNA Extraction or Protein:** Pipette 1x10 6 or 2x10 6 aliquots of cells into labelled microcentrifuge tubes. The number of aliquots will be determined by the total number of cells available. Centrifuge at 14000 X g for 2 minutes to pellet the cells. Aspirate off and discard the supernatant, and then immediately freeze and store the cell pellets at -80°C.

**CRYOPRESERVED ALIQUOTS:**

**Cryopreservation of BAL Cells/AMs for Flow Cytometry:**

1. After cells have been counted, make an aliquot of 2x106 - 4x106.
2. Pellet cells at 400 X g for 5 minutes and remove supernatant.
3. Resuspend in freezing media at a final concentration of 10 x 106 cells/mL (Freezing Media: 10% DMSO - Sigma #D2650 + 90% FBS - Atlanta Biologicals #S11550H, filter sterilized -Corning #430320). For 2 x 106 cells, resuspend in 200ul of freezing media, for 4 x 106 cells, resuspend in 400ul of freezing media.
4. Place them in a freezing container (Nalgene Cryo 1°C Freezing Container or Biocision Cool Cell) and store at -80°C for 24 hours. Store the cells in a liquid nitrogen storage tank long term.

**Tracheal Aspirate Processing (Burn and Respiratory Failure Patients)**

1. Add 0.75 mL of collected tracheal aspirate to 0.75 mL RNA/DNA Shield, vortex and store at -80°C.

**Additional Protocols**

**Fecal Aliquot Straw Technique (FAST) Protocol**

Modified from: Romano et al. Microbiome (2018) 6:91

***Materials***:

* "Straws" = UV-treated polypropylene spatulas (VWR 80081-190) with spatula end previously trimmed off (Figure 1) then rinse (including through interior channel) with 10% sodium hypochlorite (bleach) for a 10-minute exposure. Thoroughly rinse/flush with 70% alcohol then allow to air dry. Store aseptically until use.

A picture containing drawing

Description automatically generated*Figure 1*:

* Commode Stool Collection Device. Either of these are acceptable:
  + <https://www.vitalitymedical.com/covidien-commode-specimen-collector.html>
  + <https://www.fishersci.com/shop/products/fisherbrand-commode-specimen-collection-system-commode-specimen-collection-system/02544208#tab3>
* Toilet tissue or sanitary wipes
* 70% Isopropyl Alcohol Spray

***Human Fecal Sample Collection***:

Self-collection using a flying nun style receptacle with associated container. Collection of spontaneous expelled feces [may receive assistance if required] using a Commode Specimen Collector that incorporates a separate container with lid for transportation to the laboratory.

Risk to Donor: Risks include embarrassment, stress, contamination of clean surfaces.

1. The collection container is labelled with the study ID # and date of collection.
2. Confirm signed & dated consent form
3. Inform subject that we need a stool collection at his/her convenience
4. Place commode specimen collector over commode or bedpan.
5. Insert labelled stool container into collector
6. If s/he cannot produce a specimen, inform patient that a member of the study team will return collect a specimen when it becomes available
7. Provide tissues or wipes to subject
8. Cap stool container
9. Discard collector
10. Sanitize stool container after exiting patient room with 70% isopropyl alcohol.
11. Transport container to lab for processing.

***Human Fecal Sample Processing***:

All processing should be performed in a BSL-2 Hood with appropriate Universal Precautions and PPE

Samples are stored at 4 °C and processed within 12 h of collection without evidence of freezing.

Repeatedly & vigorously insert the straw throughout the fecal material in order to fill straws with a homogenized mixture and minimal air pockets. (Figure 2)

Repeat sampling with new straws until fecal material is exhausted.

If stool samples are too soft or watery to fill a straw, a sterile 1 ml syringe should be used.

*Figure 2*:



Filled straws (or syringes) are frozen on dry ice, inserted into 50 ml conical tubes (maximize straws/tube without crushing)

Stored at −80 °C until later use.

Between samples, decontaminated the working space using Trifectant or equivalent and change gloves.

***Human Fecal Sample Retrieval for Use***:

FAST-processed samples are removed from the freezer and subsampled by slicing 1 cm sections with a sterile razor blade while keeping the straw on a weigh boat on top of dry ice to prevent thawing.

**BSL2+ Processing for COVID-19 Positive Biospecimens**

1. Once PPE is on, set up the biosafety cabinet (BSC), without the blower on, with the following items.

**PEth Card**

**Notes:**

* **DO NOT USE ETHANOL NEAR THE PEth CARDS.**
* **Use a purple top blood tube.**
* **When storing and shipping, do not use a plasticized envelope or airtight plastic specimen bag.**

1. Label a PEth card (USDTL) with the patient ID, the collection day (if applicable), and the date. Place a corresponding barcode label on a drying box.
2. Open the PEth card and lay on a new kimwipe.
3. PRIOR TO CENTRIFUGATION, load 0.5mL of whole blood from a purple top (EDTA) blood tube into a pipet tip.
4. Slowly pipet a large drop of blood at the end of the pipet tip. The drop should be big enough to fill a collection circle of the PEth card in a single attempt. Allow the drop of blood to come into contact with the center of a collection card and wick to fill the circle. DO NOT touch the card with the pipet tip or layer successive drops.
5. Repeat to fill the remaining collection circles.
6. Pipet any remaining whole blood back into the purple top tube and re-cap.
7. Close the PEth card to cover the blood spots and place the specimen in a barcode labeled drying box and close the ends.
8. Store at room temperature until shipment.

**Blood Draw for Serum, Plasma, and Buffy Coat Collection**

**Notes:**

* **Centrifuge tubes at 1000X g for 10 min at room temperature.**
* **After collection, store all tubes at -80°C.**

**Green top (sodium heparin; AUDs, Controls, and Cannabis Users only)**(BD Vacutainer 4mL #367871, 6mL #367878) **-** aliquot 0.25-0.5mL aliquots of plasma off the top phase into 4 of the 1.8mL cryotubes (Nunc #375418) with green cap inserts (Nunc #355018), then collect red blood cells (RBCs) from the bottom phase and divide them into two 1.8mL cryotubes with yellow cap inserts (Nunc #355077). A 4mL green top will typically yield between 1 and 3mL of plasma.

**Red top** (BD Vacutainer 4ml #367812, 6mL #367815, 10mL #367820) **–** aliquot 0.25-0.5mL aliquots of serum off of the top phase into 8 of the 1.8mL cryotubes with red cap inserts (Nunc #354968). A 6mL red top will typically yield between 1 and 4mL of serum.

**Purple top (EDTA)**(BD Vacutainer 4mL #367861, 6mL #367863) **–** aliquot 0.25-0.5mL aliquots of plasma off the top phase into 8 of the 1.8mL cryotubes with purple cap inserts (Nunc #375922). A 4mL purple top will typically yield between 1 and 3mL of plasma. Then collect the buffy coat by pipetting the white layer of cells between the top phase and the red blood cell (RBC) bottom layer and pipetting it into a 1.8mL cryotube with a pink cap insert (Nunc #375884). Collect the RBC layer and pipette it into a 1.8mL cryotube with a grey cap insert (Nunc #375906).

2. Turn the BSC blower and light on.

Open the PEth card all the way. Open the purple top and pipette 0.4mL of the whole blood onto the PEth card circles.

Spray a couple of kimwipes with hydrogen peroxide disinfectant, wipe off the PEth cardboard box and place it to the left “clean” side.

Centrifuge 1000xG for 10 min

3. For BAL/mini-BAL/TA processing (RF only):

**Notes:**

* **BAL or Mini-BAL will be immediately transported on ice to the lab.**
* **Aliquot BAL in a biosafety cabinet (hood).**

1. Record volume received.
2. Filter the raw sample through a BD Falcon 100 micron cell strainer (BD #352360) into a 50mL conical tube (BD Falcon #352098). The sample only needs to be filtered once, but more than 1 filter may be necessary due to the particulate matter or mucous in the sample.
3. Centrifuge at 900 X g for 10 minutes.
4. Aliquot supernatant in 4mL cryotubes (Simport #T310-4A) and store BAL at -80°C.
5. Resuspend pellet in 5mL ACK RBC lysis buffer (Gibco #A10492).
6. Incubate at room temperature for 2 minutes then add 10mL of 1XDPBS.
7. Centrifuge at 900 X g for 10 minutes.
8. If needed, repeat the RBC lysis, steps 5-7.
9. Resuspend the cells in 1-3mL of 1XDPBS, depending on size of cell pellet.
10. Count cells and check viability:
11. ***BioRad TC20 Automated Cell Counter:*** Dilute 10μl of sample with 10μl trypan blue (Bio-Rad #**1450021**), gently mix by pipetting up and down 10 times, and apply 10μl of the dilution to one side of a disposable cell counting slide (Bio-Rad #1450011). Insert the solution containing side into the cell counter for the automated cell count and viability. Print the count. Gate the cells at 6µm and 30µm. Print the count.
12. Aliquot the remaining cells into labelled microcentrifuge tubes, preferably in 1 million or 2 million cell aliquots, then centrifuge at 13000 X g for 2 minutes to pellet the cells. The media is aspirated off and discarded, and then the cells are immediately frozen and stored at -80°C.

If the sample is less than 1mL, add 1 volume of Zymo DNA/RNA Shield (Zymo Research, Cat# R1100) to the sample, transfer to a collection tube labelled DNA/RNA Shield and freeze at -80℃.

If the sample is greater than 1mL, transfer up to 0.75mL to the collection tube labelled DNA/RNA Shield. Add 1 volume of Zymo DNA/RNA Shield to the collection tube and freeze at -80℃.

Place a 750uM pluriSelect cell strainer on top of the 50mL conical tube labelled with the subject ID. (If sample looks super thick, use the 1000uM cell strainer, if thin, use the 500uM. Multiple filters can be used if one gets clogged).

Bring the volume of the remaining BAL/mini-BAL/TA up to 5mL in 1XDPBS using a seriological pipette and slowly transfer the volume on top of the cell strainers.

Pipette the mucous off of the cell strainer and aliquot up to 1.5mL of mucous into each of 2 collection tubes labelled mucous.

4. Place PEth card in the drawer for storage until shipment.

Press Program 1 (1000 X g for 10 minutes).

5a. For BAL/mini-BAL/TA processing:

With the pipet aid and a 5mL seriological pipette, carefully aim for the seam of the conical tube, remove all of the supernatant, and aliquot 1mL of the supernatant from the sample tube into each of up to 5 pre-labelled cryotubes, depending on the total volume of the sample.

Using the pipet aid and an additional 5mL seriological pipette, gently resuspend the pellet in 2.5mL ACK RBC lysis buffer, trying to minimize the production of aerosols.

Using the pipet aid and a 10mL seriological pipette, add 5mL of 1XDPBS, mix gently trying to minimize the production of aerosols.

Centrifuge 100 xG for 10 min

5b. If urine was collected, and carefully aliquot 1.5mL of urine to each of the cryotubes labelled urine. Discard the tip into the waste bag and cap the cryotubes.

With the 1000µL pipette set to no more than 250µL, carefully aliquot the serum from the red top tube into 4 cryotubes labelled serum.

With the 1000µL pipette set to no more than 250µL, carefully aliquot the EDTA plasma from the purple top tube into 4 cryotubes labelled EDTA plasma.

If the subject is enrolled in RF, set the pipette to 500 µL, put a new tip on, and carefully pipette the buffy coat into the cryotube labelled buffy coat, then remove the RBCs from the bottom of the blood tube and pipette them into the cryotube labelled RBCs.

Spray all of the cryotubes with 70% ethanol, roll them to expose the other side and spray them again. Spray a kimwipe with 70% ethanol and wipe all of the tubes off.

If BAL/mini-BAL/TA still needs to be finished processing, place the wiped down cryotubes on ice and proceed to the next step, 5c.

5c. Remaining BAL/mini-BAL/TA processing:

Press Program 1 (1000 X g for 10 minutes).

If needed, repeat the above steps for another round of RBC lysis (max 2 rounds of RBC lysis).

Using the pipet aid and a 10mL seriological pipette, aim for the seam of the conical tube and remove the supernatant.

Discard the supernatant in the waste conical tube.

Using the pipet aid and a 5mL seriological pipette, resuspend the cells in 1-3mL of 1XDPBS, depending on size of cell pellet.

Using the 200μl pipet set to 10μl, take 10μl of sample and mix very gently with 10μl trypan blue by pipetting up and down 10 times, and apply 10μl of the dilution to each side of a disposable cell counting slide.

Press Program 1 (1000 X g for 10 minutes). Make sure the centrifuge reflects the correct setting and press start, making sure the centrifuge comes up to speed.

Remove the cell counting slide from the BSC and count cells and check viability on the BioRad TC20 Automated Cell Counter by inserting one side of the cell counting slide into the cell counter for the automated cell count and viability.

Assess the total amount of cells and plan out the dilutions for the aliquots needed by writing on the sample processing log. Make at least 2, but no more than 5 aliquots per sample. There should be at least 1 aliquot at 1X106, the remaining cells should be evenly split among the other aliquots, with at least 1X106 cells per aliquot. If there is less than 1X106, only make 1 aliquot with however many total cells there are.

Using the pipet aid and 10mL seriological pipette, remove the supernatant and carefully place the supernatant into the empty 50mL conical tube labeled waste.

Place the seriological pipette back into the wrapper and place to the back of the right “dirty” side.

Using the appropriately sized pipet and pipet tip, resuspend in freezing media at a final concentration of 10X106 total cells/mL by resuspending the pellet in 100ul of freezing media for every 1X106 cells.

Aliquot the cells in freezing media to the labeled tubes.

Spray the cryotubes down with 70% ethanol and wipe with a kimwipe before placing them in a Biocision Cool Cell freezing container.

6. Remove PPE (doffing):

7. For BAL/mini-BAL/TA processing:

After the BAL/mini-BAL/TA cell aliquots have been stored at -80°C for 24 hours, store the cells in a liquid nitrogen storage tank long term.