Supplemental Table 1. Summary of possible tests used for microbiologic diagnosis on BAL

| Diagnostic Test                                                                 | Organisms identified                                                                 |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| BioFire® FilmArray® multiplex PCR respiratory pathogen panel (RPP) assay        | VIRUSES:                                                                           |
|                                                                                   | • Adenovirus                                                                         |
|                                                                                   | • Coronavirus HKU1                                                                  |
|                                                                                   | • Coronavirus NL63                                                                  |
|                                                                                   | • Coronavirus 229E                                                                  |
|                                                                                   | • Coronavirus OC43                                                                  |
|                                                                                   | • Human Metapneumovirus                                                            |
|                                                                                   | • Human Rhinovirus/Enterovirus                                                     |
|                                                                                   | • Influenza A                                                                       |
|                                                                                   | • Influenza A/H1                                                                   |
|                                                                                   | • Influenza A/H3                                                                   |
|                                                                                   | • Influenza A/H1-2009                                                              |
|                                                                                   | • Influenza B                                                                      |
|                                                                                   | • Parainfluenza Virus 1                                                            |
|                                                                                   | • Parainfluenza Virus 2                                                             |
|                                                                                   | • Parainfluenza Virus 3                                                             |
|                                                                                   | • Parainfluenza Virus 4                                                             |
|                                                                                   | • Respiratory Syncytial Virus                                                      |
|                                                                                   | BACTERIA:                                                                           |
|                                                                                   | • *Bordetella parapertussis*                                                       |
|                                                                                   | • *Bordetella pertussis*                                                           |
|                                                                                   | • *Chlamydia pneumoniae*                                                           |
|                                                                                   | • *Mycoplasma pneumoniae*                                                          |
| Herpes viral panel (Lab developed test, Nebraska Medicine)                      | • Cytomegalovirus                                                                  |
|                                                                                   | • Epstein-Barr virus                                                               |
|                                                                                   | • Herpes simplex virus 1 & 2                                                        |
|                                                                                   | • Human herpes virus 6                                                              |
|                                                                                   | • Varicella zoster virus                                                           |
| Fungal antigen testing                                                          | • *Aspergillus* galactomannan (BAL and serum)                                      |
|                                                                                   | • *Histoplasma* (BAL, serum, urine)                                                 |
| Bacterial antigen testing                                                       | • *Streptococcus pneumoniae* urine antigen (ARUP Laboratories)                    |
| Traditional Culture                                                             | • *Bacteria and AFB*                                                               |

(Supplement)
Supplemental Table 2. Organisms Isolated from BAL Fluid via Various Microbiological Testing

| Organism                        | n  |
|---------------------------------|----|
| **AFB**                         | 9  |
| *M. arupense*                   | 2  |
| *M. avium complex*              | 2  |
| *M. gordonae*                   | 2  |
| *M. kansasii*                   | 1  |
| *M. septicum*                   | 1  |
| *M. tuberculosis*                | 1  |
| **Bacteria**                    | 343|
| *Achromobacter xylosoxidans*    | 2  |
| *Acinetobacter spp*             | 8  |
| *A. baumannii* (6)              |    |
| *A. Iwoffii* (2)                |    |
| *Aggregatibacter spp*           | 1  |
| *Bordetella bronchiseptica*     | 1  |
| *Burkholderia cepacia*          | 1  |
| *Chlamydia pneumoniae*          | 1  |
| *Chryseobacterium indologenes*  | 1  |
| *Citrobacter spp*               | 5  |
| *C. freundii* (4)               |    |
| *C. koseri* (1)                 |    |
| *Corynebacterium spp*           | 10 |
| *C. pseudodiphtheriticum* (2)   |    |
| *C. striatum* (7)               |    |
| *Delfia acidovorans*            | 1  |
| *Eikenella corrodenes*          | 3  |
| *Enterobacter spp*              | 23 |
| *E. aerogenes* (12)             |    |
| *E. cloacae* (9)                |    |
| *Escherichia coli*              | 15 |
| *Haemophilus spp*               | 34 |
| *H. influenzae* (33)            |    |
| *H. parainfluenzae* (1)         |    |
| *Klebsiella spp*                | 24 |
| *K. oxytoca* (11)               |    |
| *K. pneumoniae* (13)            |    |
| *Legionella spp*                | 1  |
| *Moraxella catarrhalis*         | 6  |
| *Pantoea agglomerans*           | 1  |
| *Pasteurella multocida*         | 1  |
| *Proteus spp*                   | 2  |
| *P. mirabilis* (1)              |    |
| *P. spp* (1)                    |    |
| *Pseudomonas aeruginosa*        | 43 |
| *Salmonella Group C*            | 1  |
| Microorganism                      | Count |
|-----------------------------------|-------|
| Serratia spp                      | 14    |
| S. marcescens                     | (13)  |
| S. odorifera                      | (1)   |
| Staphylococcus aureus             | 92    |
| Methicillin resistant S. aureus   | (35)  |
| Methicillin sensitive S. aureus   | (57)  |
| Stenotrophomonas maltophilia      | 15    |
| Streptococcus spp                 | 37    |
| S. Group A                        | (2)   |
| S. Group B                        | (4)   |
| S. Group C                        | (7)   |
| S. Group F                        | (2)   |
| S. pneumoniae                     | (20)  |
| Fungi                             | 268   |
| Absidia spp                       | 1     |
| Acremonium spp                    | 1     |
| Aspergillus spp                   | 10    |
| A. flavus                         | (2)   |
| A. fumigatus                      | (7)   |
| A. terreus                        | (1)   |
| Blastomyces dermatitidis          | 1     |
| Blastoschizomyces capitus         | 1     |
| Candida spp                       | 232   |
| C. albicans                       | (173) |
| C. famata                         | (1)   |
| C. glabrata                       | (43)  |
| C. guilliermondii                 | (1)   |
| C. kefyr                          | (1)   |
| C. krusei                         | (3)   |
| C. parapsilosis                   | (4)   |
| C. tropicalis                     | (5)   |
| Cryptococcus neoformans           | 1     |
| Doratomyces spp                   | 1     |
| Emmonsia spp                      | 2     |
| Fusarium spp                      | 1     |
| Geotrichum spp                    | 1     |
| Histoplasma capsulatum            | 4     |
| Mucor spp                         | 1     |
| Penicillium spp                   | 8     |
| Saccharomyces spp                 | 1     |
| Sporotrichum spp                  | 1     |
| Trichosporon spp                  | 1     |
| Viruses                           | 253   |
| Adenovirus                        | 4     |
| Coronavirus (229E, HKU1, NL63, OC43) | 8   |
| Cytomegalovirus                   | 42    |
| Epstein-Barr Virus                | 73    |
| Herpes Simplex Virus              | 47    |
| Organization                        | Count |
|------------------------------------|-------|
| Human Herpes Virus 6               | 18    |
| Human Metapneumovirus              | 3     |
| Human Rhinovirus/Enterovirus       | 29    |
| Influenza Virus A & B              | 13    |
| Parainfluenza Virus (2, 3, 4)      | 11    |
| Respiratory Syncytial Virus        | 4     |
| Varicella Zoster Virus             | 1     |

Note: Organisms reported as resulted, species included when available.
AFB (acid-fast bacilli), BAL (bronchoalveolar lavage), spp (species).
Abbreviated Description of BAL and Non-BAL bronchoscopies used in during the study period.

“Mini” (Non-Bronchoscopic) Bronchoalveolar Lavage (BAL) Procedure

To provide a non-bronchoscopic method of attaining a sample of bronchoalveolar fluid in the patients with an artificial airway of either an endotracheal Tube (ETT) or trach is at least 7.5 mm in internal diameter (ID).

Equipment:
- Mini-BAL catheter kit. Catheter noted in Image 1 below.
- Ten 10 ml pre-filled/pre-packaged Non-bacteriostatic 0.9% sodium chloride syringes for injection ONLY
- Sterile specimen cup
- Sterile gloves

Procedure:
- Confirm electronic order for Mini-Bronchoalveolar Lavage with labs (quantitative cultures).
- This procedure is performed by two people; either two LRCP’s or one LRCP and one Registered Nurse (RN). Strict adherence to hand hygiene and standard infection control guidelines are required per hospital protocol.
- Review latest chest radiograph (determine if right or left lung should be sampled).
- Oxygenate the patient at 1.0 FiO2 for 2 minutes before the procedure.
- For tracheostomy tubes: Before starting the procedure, utilize a same size spare tracheostomy tube to measure the distance to insert the BAL catheter to be at the end of the trach tube, or refer to suction depth references for the given tracheostomy tube.
- Immediately terminate the procedure with evidence of any complication of sustained oxygen desaturations, cardiac ectopy or bradycardia, hemoptysis or other concerning event.
- Open the BAL catheter package without touching the inside of the package to maintain a sterile field.
- Open up the first 6 - 10 ml 0.9% sodium chloride syringes (for injection only) and place them on a clean field (recommend opposite opened side of the BAL catheter package).
- Don sterile gloves and utilize sterile-aseptic technique for the next following steps:
  - Retrieve the catheter assembly and the access port elbow vent circuit adapter.
  - Pass the BAL Catheter through the access port elbow adapter (about 2 cm).
  - Next the assistant disconnects the ventilator.
  - Place the access port adapter onto the patient’s endotracheal tube (ETT) or tracheostomy tube and have the assistant LRCP/RN attach the ventilator circuit to the access port elbow.
  - Turn the catheter so the O2 adaptor is in the 12:00 position (this will help prevent the catheter from catching on the Murphy port of the ETT as it advances down the length of the ETT).
  - Advance the outer catheter into the ETT until the numbers on the catheter and ETT match. This will place the end of the catheter at the end of the ETT.
For tracheostomy tubes: Advance the BAL Catheter until the number at the flange is the same as the measured number (or suction catheter depth obtained from Airway Suction Policy TX19). This will place the end of the catheter at the end of the tracheostomy tube.

Once the BAL Catheter is inserted to the end of the airway tube, turn the oxygen adapter of the catheter right or left for whichever lung is to be sampled.

Advance the outer catheter 5 cm further into the airway or until a gentle wedge or resistance is felt. Once this is done, lock the BAL Catheter into place with the blue slide lock on the access elbow.

Advance the inner catheter until resistance is felt. This should place the catheter in a wedge position.

Gently but quickly instill three 10 ml (30 ml total) of the 0.9% sodium chloride syringes (for injection only) and aspirate after the 3rd syringe. Leave the three-way-stop-cock open to the port you are using for the instillation and aspiration.

Aspiration is performed by pulling back on the syringe plunger immediately after the 30 ml have been instilled. NOTE: If no solution is aspirated manipulate the inner catheter by pulling it back gently about 1 cm at a time, but no more than 3 cm. This will usually alleviate the catheter tip from being blocked by the airway tissue and allow for a small sample to be obtained. Do not pull the inner catheter out more than 3 cm otherwise large airway contaminate is likely to be obtained.

Set aside the sample syringe on a clean field so it can be combined in the sterile specimen cup later with any other samples obtained.

Repeat 3 more of the 10 ml of 0.9% sodium chloride syringes (for injection only) and aspirate after 30 ml has been instilled. IMPORTANT: A minimum of 60 ml of saline must be utilized to ensure an adequate sample.

If 5 ml or greater have not been obtained after 60 ml, instill 1 - 10 ml 0.9% sodium chloride syringe (for injection only) at a time and aspirate after each syringe. Discontinue after a total of 100 ml of saline have been instilled, regardless of the accumulated aspirated sample size.

Open the blue slide lock on the access elbow and pull out the entire catheter assembly until the last number (16) on the catheter is at the access elbow.

The LRCP/RN assistant will disconnect the ventilator circuit while the access elbow is removed from the patient’s ETT. The LRCP/RN assistant will then connect the patient’s ventilator circuit back onto the ETT.

Combine all aspirated samples into the sterile specimen cup and label the cup for appropriate lab notification.

Sample size for analysis should be approximately 5 ml. If between 1-5 ml obtained, still send to lab for analysis.

Titrate FiO2 to previous ventilator settings and observe for any adverse effects.

Image 1: Telescopic catheter used during study period
ICU Bedside Bronchoscopy BAL Procedure Used During Study Period

Bedside bronchoscopy may be performed in all ICUs within the organization. The ordering provider will collaborate with the Intensive Care Unit (ICU) Nurse and Respiratory Care Practitioner (RCP) to coordinate the procedure.

- Obtain Bronchoscopy video monitor with flexible bronchoscope
- Confirm the emergent bedside bronchoscopy (ICU) with Respiratory Therapy (RT) staff order is entered in by the ordering provider and notify the RCP of the procedure.
- Confirm the emergent bedside bronchoscopy (ICU) with RT staff order, verifying correct bronchoscope size needed to perform the procedure.
- Set up bronchoscopy equipment and supplies at bedside.
- Set up suction (if not already available) and ensure proper function. Connect suction tubing to the suction port on the bronchoscope. Place the double swivel elbow adapter in line with the ventilator circuit at the end of the endotracheal or tracheostomy tube, if applicable.
- Fill a sterile bowl with 0.9% sodium chloride. Draw up 20 mLs of 0.9% sodium chloride in each 20 mL slip tip syringe (add some air to the syringe). Label the syringes.
- Pre oxygenate the patient. Manage oxygenation and ventilation throughout the procedure.
• Assist the provider with the emergent bedside bronchoscopy procedure. Instill 1 ml of 1% lidocaine followed by 3 mls of air into the bronchoscope. Repeat as directed by the provider. Instill a total of 5 aliquots of 0.9% normal saline (20 mls each = 100 mls total), suction sample in between aliquots. Switch from trap #1 (junk trap) to trap #2 (BAL) before instilling the second aliquot. Send trap #2 (BAL) and trap #3, if utilized, for full spectrum of studies ordered via the post-op bronch order set. Record of the amount of saline and lidocaine administered during the procedure and provide those amounts to the provider to document in their procedure note.
• Post procedure, inspect the bronchoscope for missing parts (bending section, lens and insertion cord) per the manufacturer’s guidelines.
• Post-procedure bronchoscope device management according to the proper infection control procedures.
• Document cares provided, including pre and post bronchoscopy vent check (if applicable), and charge for the procedure in the electronic health record (EHR).
• Clean the bronchoscopy video monitor and emergent bedside bronchoscopy box according to infection control guidelines.