Appendix Figure 1: Aggressive Respiratory Intervention (ARI) Protocol Flowchart

COVID-19 RESPIRATORY PATHWAY
Awake proning is beneficial
Early intubation may not be needed
Permissive hypoxemia is ok: Target O₂ saturation ≥88%
See text for information and references

Does the patient with suspected or confirmed COVID-19 have O₂ ≥88%?

Yes →

Start O₂ Up to 6 L via face mask

O₂ ≥88% →

Continue supplemental O₂, Monitor qh then q4h

O₂ <88% →

Escalate respiratory support AND awake proning (if appropriate) to maintain O₂ ≥88% based on work of breathing and patient tolerance

Escalate Respiratory Support
Prefer use of HFNC (≤50 LPM) + Surgical Mask or Nonrebreather < 15 LPM
Alternative: NIV in negative pressure room, if available
CPAP preferred over BiPAP in absence of significant hypoxemia

Initiate awake proning
Patient must meet following criteria
Respiratory rate ≤30
No contraindications
Alert, oriented, follow instructions (no AMS)
Patient able to tolerate rolling over (or on side)
No additional contraindications

1. Remove chest leads / electrodes
2. Place cardiac leads on back
3. Assist patient rolling over
4. Ensure leads, wires, lines, O₂ in place
5. Continue oxygen or HFNC
6. Ensure call bell in patient's hand / reach
7. Consider rotating bed for visualization of patient if feasible / needed
8. Maintain sedation

RN reassess after 15 minutes

Is the patient tolerating respiratory support ± proning? (O₂ ≥88%)
No respiratory distress/AMS signs of poor perfusion

Yes →

Escalate respiratory support based on patient's work of breathing/mental status/perfusion

↑ HFNC to: FiO₂ 0.8 + 30 LPM
or
NIV: EPAP 10cmH₂O and FiO₂ 0.6
or
Intubation

In general, consider these patients for intubation:

- Respiratory distress and/or shock
- HFNC FiO₂ ≤0.8
- NIV EPAP = 10cmH₂O, FiO₂ ≤0.6, or no improvement after 48 h
- FOX index < 3.85 predicts high likelihood of failure of HFNC
Can be measured if clinician judgment is uncertain and patient is not improving

Worsening

- Patient can remain prone or side-lying for as long as they tolerate up to 3 hours, and rotate as needed
- RN Visual or intercom assessment minimum qh and PRN
- Encourage incentive spirometry
- Physician reassessment minimum 30 min. 2 h then q4h

† Pressing Absolute contraindications: Respiratory distress (RR ≥35, accessory muscle use), immediate need for intubation based on clinician judgment, Hemodynamic instability (SBP <90 mmHg or arrhythmia), agitation, unstable spine-injured/traumatic, chest or pericardial surgery

Pressing Relative contraindications: Facial injury, neurological issue (e.g. frequent seizures), homeopathy, marked obesity, pregnancy (3rd trimester), pressure sores/ulcers
Appendix 2. Data Collection Form

Chart Review

Record ID

Identifying Information

Double check the information below

COVID status from chart review
- Positive test resulted
- Negative test resulted
- No test resulted

If no test in system, does a clinician’s note clearly document a positive test elsewhere (such as at a nursing home or outside facility)?
- Yes
- No
- Unsure

If patient does not have a positive test or a mention of a positive test outside of the hospital, STOP HERE.

Site
- BMC
- BNHI
- BFM
- BWH
- BMEH

Was the patient a direct transfer from another facility? (not SNF, but other hospital)
- Yes
- No

Account Number

Inpatient Admit Date/Time

(Double check that this is the admission for COVID and not a different admission)

Name

CMRN

Date of Birth

Sex
- Female
- Male

07/31/2020 8:20pm
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Confidential

Race
(This can be found in Patient Information)
- White
- Black
- Asian
- Native American
- Pacific Islander

Ethnicity
(This can be found in Patient Information)
- Hispanic
- non-Hispanic
- Russian

Primary Language
(This can be found in Patient Information)
- English
- Spanish
- Other

Other Language
______________________________

What type of insurance does this patient have?
- MedCARE
- MedCAID (mass health)
- private (blue cross, aetna, cigna, health new england)
- VA
- self-pay
- other

If other, list name
______________________________

Reason for Visit
______________________________

ED Information

Date of data collection or update
(Date you are entering this data - click today)
______________________________

Date/Time of ED arrival
(Start of triage)
______________________________

Triage Vitals

BMI
______________________________

Systolic BP
______________________________

Diastolic BP
______________________________

Heart Rate
______________________________

Temp
______________________________

07/31/2020 8:26pm

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3
Respiration Rate

On any supplemental O2
- Yes
- No

Type of supplemental O2
- NC < 3L
- NC 3-6L
- NC > 6L
- NC - flow unknown
- NRB
- HFNC
- NIV
- Intubated

Discharge status from ED
- Transfer to In-patient
- Home
- SNF
- Expired

Admission Information

Initial admission unit
(no need to check this)

Initial admission level of care
(Can be found in Orders, check date of order)
- Floor (acute)
- Intercare
- ICU

Was level of care escalated to intercare during the admission
- Yes
- No

Date and time care was escalated to intercare

During Entire Hospital visit, did the patient use any of the following? (If intubated, only "YES" if used PRIOR to intubation, not post-intubation)
(This can be found in All Results: Respiratory/Pulmonary Data; except proning will be in clinician notes or orders)

Oxygen by nasal cannula
- Yes
- No

Date/time oxygen by nasal cannula started

High flow nasal cannula
- Yes
- No

Date/time high flow nasal cannula started

AWAKE Proning (not intubated) attempted
- Yes
- No
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awake Prone Tolerated? (See physician note for whether they were able to tolerate prone)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date/time prone started</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIV (CPAP or BIPAP)</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time NIV started</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-rebreather started</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time non-rebreather started</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At any time, did the patient get intubated</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time intubated</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>At any time prior to ICU care, did patient have an RRT</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time RRT called</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At any time prior to ICU care, did patient have an unexpected cardiac arrest (Note: Select 'No' if patient was made DNR/DNI before cardiac arrest or was in ICU, because then cardiac arrest was expected. We are looking for decompensation on floor or intercare leading to cardiac arrest)</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time cardiac arrest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was cardiac arrest within 2 hours before or after an intubation?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>At any time, did patient have an ICU consult</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time ICU consult</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At any time, did patient get moved to the ICU</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Date/time move to ICU</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Goals of Care

At any time during their stay, did the patient have a GOALS OF CARE conversation?

- Yes
- No
- Unsure

Who did they have a conversation with, check all that apply?

- with ED doc
- with hospitalists
- with ICU
- with palliative care

Was the patient DNR/DNI prior to the ED visit?

- Yes
- No

Was the patient made DNR/DNI during this stay?

- Yes
- No

Date/time patient made DNR/DNI during this stay:

How was DNR/DNI decided?

- patient/family with care team
- physician-directed (two physicians)
- other

Other method to decide DNR/DNI:

Was the patient CMO prior to the ED visit?

- Yes
- No

Was the patient made CMO during this stay?

- Yes
- No

Date/time patient made CMO during this stay:

How was CMO decided?

- patient/family with care team
- other

Other method to decide CMO:

Patient’s status 5 days post admission (morning of 5th day)
(Leave blank if 5 days has not passed since admission)

- admitted floor
- admitted intercare
- intubated or in ICU
- discharged
- dead

Patient’s status 7 days post admission (morning of 7th day)
(Leave blank if 7 days has not passed since admission)

- admitted floor
- admitted intercare
- intubated or in ICU
- discharged
- dead

Patient’s status 14 days post admission (morning of 14th day)
(Leave blank if 14 days have not passed since admission)

- admitted floor
- admitted intercare
- intubated or in ICU
- discharged
- dead
<table>
<thead>
<tr>
<th>Patients' status reviewed 30 days post admission (Leave blank if 30 days have not passed since admission)</th>
<th>admitted floor</th>
<th>admitted intercare</th>
<th>intubated or in ICU</th>
<th>discharged</th>
<th>dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge (includes death) date/time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge Disposition</td>
<td>Still IP</td>
<td>Home</td>
<td>Expired</td>
<td>SNF</td>
<td>Other facility</td>
</tr>
<tr>
<td></td>
<td>IP Rehab</td>
<td>LTC</td>
<td>Hospice</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Other discharge disposition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Comments</td>
<td></td>
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</tbody>
</table>
Appendix 3. Patient Flow Diagram

Patients with positive or pending COVID-19 PCR tests or an admission discharge diagnosis of COVID-19 admitted 3/15/20 - 4/15/20 (electronic data pull) n=610

Excluded duplicate charts n=90

Discovered via data source triangulation n=1

n=469 patients with confirmed COVID-19 + PCR test

Pre-implementation (3/15-4/2) n=254

Post-implementation (4/3-4/15) n=215

Met exclusion criteria: age <18, admission for unrelated reason (induction of labor/surgery), or no test or mention of COVID-19 in clinician notes n=52
Appendix 4. Revised Standards for Quality Improvement Reporting Excellence (SQUIRE 2.0)  
September 15, 2015

Squire standards and where to find elements (or explanation for missing elements)

<table>
<thead>
<tr>
<th>Text Section and Item Name</th>
<th>Section or Item Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title and Abstract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Title</td>
<td>Indicate that the manuscript concerns an initiative to improve healthcare (broadly defined to include the quality, safety, effectiveness, patient-centeredness, timeliness, cost, efficiency, and equity of healthcare)</td>
<td></td>
</tr>
</tbody>
</table>
| 2. Abstract                | 1. Provide adequate information to aid in searching and indexing  
2. Summarize all key information from various sections of the text using the abstract format of the intended publication or a structured summary such as: background, local problem, methods, interventions, results, conclusions |      |
<p>| Introduction               | Why did you start?                                                                            | Page 4|
| 3. Problem Description     | Nature and significance of the local problem                                                  | Page 4|
| 4. Available knowledge     | Summary of what is currently known about the problem, including relevant previous studies    | Page 4|
| 5. Rationale               | Informal or formal frameworks, models, concepts, and/or theories used to explain the problem, any reasons or assumptions that were used to develop the intervention(s), and reasons why the intervention(s) was expected to work | Page 4|
| 6. Specific aims           | Purpose of the project and of this report                                                     | Page 4 and 5 |</p>
<table>
<thead>
<tr>
<th>Methods</th>
<th>What did you do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Context</td>
<td>Contextual elements considered important at the outset of introducing the intervention(s)</td>
</tr>
<tr>
<td>8. Intervention(s)</td>
<td>a. Description of the intervention(s) in sufficient detail that others could reproduce it&lt;br&gt;b. Specifics of the team involved in the work</td>
</tr>
<tr>
<td>9. Study of the Intervention(s)</td>
<td>a. Approach chosen for assessing the impact of the intervention(s)&lt;br&gt;b. Approach used to establish whether the observed outcomes were due to the intervention(s)</td>
</tr>
<tr>
<td>10. Measures</td>
<td>1. Measures chosen for studying processes and outcomes of the intervention(s), including rationale for choosing them, their operational definitions, and their validity and reliability&lt;br&gt;2. Description of the approach to the ongoing assessment of contextual elements that contributed to the success, failure, efficiency, and cost&lt;br&gt;3. Methods employed for assessing completeness and accuracy of data</td>
</tr>
<tr>
<td>11. Analysis</td>
<td>a. Qualitative and quantitative methods used to draw inferences from the data&lt;br&gt;b. Methods for understanding variation within the data, including the effects of time as a variable</td>
</tr>
<tr>
<td>12. Ethical Considerations</td>
<td>Ethical aspects of implementing and studying the intervention(s) and how they were addressed, including, but not limited to, formal ethics review and potential conflict(s) of interest</td>
</tr>
</tbody>
</table>

Page 4 and 5

Page 5 and Appendix 1

Page 5

Page 5 and 6

Page 5 and 6

Page 4: The IRB reviewed the plan and deemed it not human subjects research. A full description of the many discussions around medical ethics that occurred during early COVID is not possible in the...
<table>
<thead>
<tr>
<th>Results</th>
<th>What did you find?</th>
<th>13. Results</th>
<th>Page 6 and tables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial steps of the intervention(s) and their evolution over time (e.g., time-line diagram, flow chart, or table), including modifications made to the intervention during the project</td>
<td>Details of the process measures and outcome</td>
<td>Due to the length restrictions, we could not report these results in as much details as we would like. Our mortality analysis is our attempt to evaluate unintended consequences.</td>
</tr>
<tr>
<td></td>
<td>Contextual elements that interacted with the intervention(s)</td>
<td>Observed associations between outcomes, interventions, and relevant contextual elements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Details about missing data</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unintended consequences such as unexpected benefits, problems, failures, or costs associated with the intervention(s).</td>
<td></td>
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</tr>
<tr>
<td>Discussion</td>
<td>What does it mean?</td>
<td>14. Summary</td>
<td>Page 7 and 8</td>
</tr>
<tr>
<td></td>
<td>a. Key findings, including relevance to the rationale and specific aims b. Particular strengths of the project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Interpretation</td>
<td>Nature of the association between the intervention(s) and the outcomes Comparison of results with findings from other publications Impact of the project on people and systems Reasons for any differences between observed and anticipated outcomes, including the influence of context Costs and strategic trade-offs, including opportunity costs</td>
<td></td>
<td>Page 7 and 8</td>
</tr>
</tbody>
</table>
| 16. Limitations | a. Limits to the generalizability of the work  
b. Factors that might have limited internal validity such as confounding, bias, or imprecision in the design, methods, measurement, or analysis  
c. Efforts made to minimize and adjust for limitations | Page 8 |
|-----------------|---------------------------------------------------------------------------------|------|
| 17. Conclusions | 1. Usefulness of the work  
2. Sustainability  
3. Potential for spread to other contexts  
4. Implications for practice and for further study in the field  
5. Suggested next steps | Page 8 – due to space, we were not able to comment on all of these points |
| Other information | - | |
| 18. Funding | Sources of funding that supported this work. Role, if any, of the funding organization in the design, implementation, interpretation, and reporting | No funding for this study |