Supplemental digital content for Zhou B, Calkins C, Jayaraman T, Cassells S, Rotto T, Vaughan L, Srinivasan M, Schillinger E. Implementing value-added medical education: Lessons learned from the student-initiated “Stanford Frontline” COVID-19 Consult Service. Acad Med.

**Supplemental Digital Appendix 1: Example Evidence Synthesis**

**04/03/2020 Stanford Front Line – Clinical Trials and Management**

*Brief Description: Oxygen Saturation Monitoring*

Disclaimer: The statements and opinions expressed through the Stanford Front Line COVID-19 Consult Service are based on experience and the available literature as of the date posted. All responses are written by Stanford School of Medicine medical and physician assistant students and each response is reviewed by both peers and medical faculty. While we try to regularly update this content, any offered recommendations cannot be substituted for the clinical judgment of clinicians caring for individual patients. Statements and opinions are not necessarily a reflection of Stanford School of Medicine and/or Stanford Health Care guidelines.

What do we know about O2 sat monitoring at home? There are reportedly COVID positive patients who are not tachypneic but have declining O2 saturations. Is there any evidence or suggestions that this is something to monitor in order to prevent these patients from crashing quickly at home? Is there any consensus about clinical criteria for sending a patient to the ED?

**Brief Summary:**
Currently there are no established guidelines for home O2 saturation monitoring for COVID-19 illness. Based on retrospective studies of hospitalized patients in China, patients who are significantly hypoxemic (SpO2~85%) and dyspneic on arrival to the hospital had poorer prognoses. Both the World Health Organization and a guide based on the China experience recommend a cut-off level of SpO2 ~93% for classifying pneumonia as severe. In the US, the Surviving Sepsis Campaign released guidelines that suggest starting supplemental oxygen if SpO2 <92% and recommend starting supplemental oxygen if SpO2 <90%. There are no established guidelines for home O2 saturation monitoring for COVID-19 illness. Based on retrospective studies of hospitalized patients in China, patients who are significantly hypoxemic (SpO2~85%) and dyspneic on arrival to the hospital had poorer prognoses. Both the World Health Organization and a guide based on the China experience recommend a cut-off level of SpO2 ~93% for classifying pneumonia as severe. In the US, the Surviving Sepsis Campaign released guidelines that suggest starting supplemental oxygen if SpO2 <92% and recommend starting supplemental oxygen if SpO2 <90%.

*Takeaways:*
Retrospective cohort studies of hospitalized COVID-19 patients have noted a median dyspnea onset of 5-8 days from the onset of symptoms and ARDS at a median of 8 days. Reports in the US have also emerged of patients with low SpO2 (~<70%) who appear clinically well. A bioinformatics study recently published in China found that the SARSs-CoV-2 virus has binding capability to porphyrin and the 1-beta chain of hemoglobin. This study postulated that this binding could dislodge iron from heme resulting in less oxygen carrying capacity. This is a theoretical study, but could contribute to understanding the low oxygen saturation in these patients. Further studies need to elucidate this phenomenon.
For design of a new COVID-19 protocol that uses a threshold SpO2 for home monitoring, providers could consider escalating a patient’s level of care if they develop progressive dyspnea and/or oxygen desaturation to the low 90% SpO2 range. A low or declining SpO2 is particularly worrisome in older patients (>65 years old), or those with comorbidities including chronic lung disease, asthma, CVD/heart failure, immunocompromised, severe obesity (BMI ≥40), poorly controlled diabetes, renal failure, or liver failure.

Regardless of pulse oximetry, the CDC recommends that patients seek medical attention if they experience persistent shortness of breath, persistent chest pain, confusion, difficulty arousing, or cyanosis.

Evidence:

- A Chinese retrospective cohort of 138 COVID-19 hospitalized patients in Wuhan reported a median time from first onset of symptoms to dyspnea of 5 days.\(^1\)
  - The median time from symptom onset to hospitalization was 7 days.
- Another retrospective Cohort of 41 COVID-19 patients in Wuhan noted a median time from illness onset to dyspnea of 8 days.\(^2\)
- In a retrospective cohort study of 225 COVID-19 patients in China (109 fatal, and 116 recovered cases), SpO2 on admission were significantly lower in the death group as compared with the recovered group (85 [77, 91] % vs. 97 [95, 98] %, Z = 10.625, P < 0.001).\(^3\)
  - Also of note, in this study, the patients experiencing dyspnea had a poorer prognosis than those without, 70.6% vs. 24.7%, \(\chi^2 = 60.905, P < 0.001\) in the deceased and recovered cases respectively.
  - The median time from illness onset to hospitalization was 10 days in the deceased group, compared with 7 days in the recovered group.
- Intubation criteria in China, based on a review of Chinese studies, included SpO2 <93% on room air, PaO2:FiO2 ratio <300 or RR > 30/min.\(^4\)
- The WHO considers severe pneumonia in COVID-19 as a “fever or suspected respiratory infection, plus one of the following: respiratory rate > 30 breaths/min; severe respiratory distress; or SpO2 ≤ 93% on room air”.\(^5\)
- A COVID-19 critical care review by the Surviving Sepsis Campaign and the Society of Critical Care Medicine suggests starting supplemental oxygen at an SpO2 <92% and recommend starting supplemental oxygen if SpO2 <90%.\(^6\)
  - They also recommend that COVID-19 patients who are in acute hypoxemic respiratory failure on oxygen to be maintained at an SpO2 of no higher than 96% (to reduce harm and conserve resources).
- A bioinformatics study identified proteins on SARS-CoV-2 that bind porphyrin and the 1-beta chain of hemoglobin. They postulated that this binding could dislodge iron from hemoglobin resulting in less carrying capacity of O2 and CO2.\(^7\)
- The CDC recommends seeking medical attention if a patient experiences difficulty breathing, persistent pain or pressure in the chest, new confusion or inability to arouse, and bluish lips and face.\(^8\)
- The CDC identifies those at greatest risk for severe illness as those who: are ≥65 years old, live in a nursing home or long term care facility, or patients who have chronic lung disease or mod-severe asthma, cardiovascular disease, immunocompromised status, severe obesity (BMI ≥40), poorly controlled diabetes, renal failure and liver disease.\(^8\)

Sources

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Supplemental Digital Appendix 2: Student Survey Instrument

Stanford Frontline COVID-19 Consult Service Student Participation Survey

Demographics
Q1 What is your age?
- 18-24 (4)
- 25-29 (5)
- 30-34 (6)
- 35+ (7)
Q2 What is your gender?
- Male (1)
- Female (2)
- Transgender Male (3)
- Transgender Female (4)
- Gender Nonconforming (5)
- Prefer Not to Answer (6)
- Other (7) _______________________________________
Q3 Which degree program are you currently enrolled in?
- Doctor of Medicine, MD (1)
- Physician Assistant, PA (2)
Q4 What is your year in school?
- 1st Year (1)
- 2nd Year (2)
- 3rd Year (3)
- 4th Year (6)
- 5+ (7)

The following questions will only be used to code your responses across the curriculum.
Q5 What are the last two digits of your Student ID?
Q6 What are the last two digits of your cell phone number?
Q7 What is your birth month?

Learning Objectives:
Q8 Please rate your responses to the following statements.
After 8 weeks of participating in Stanford Frontline, I feel confident:
| Activity                                                                 | Strongly disagree (18) | Somewhat disagree (19) | Neither agree nor disagree (20) | Somewhat agree (21) | Strongly agree (22) | Not Applicable (23) |
|-------------------------------------------------------------------------|------------------------|------------------------|--------------------------------|---------------------|----------------------|---------------------|
| Reviewing peer-reviewed clinical literature. (1)                       | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |
| Reviewing pre-print clinical literature. (2)                           | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |
| Reviewing mainstream media and news sources. (3)                       | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |
| Identifying strengths and weaknesses in source validity. (4)           | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |
| Synthesizing peer/faculty feedback. (6)                                | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |
| In my own clinical writing skills. (7)                                  | 0                      | 0                      | 0                              | 0                   | 0                    | 0                   |

**Student Time Commitment**
Q9 On average, how many pages were your student responses?
  o 1  (1)
  o 2  (2)
  o 3  (3)
  o 4+ (4)

Q10 On average, how many hours did you spend completing each student response?
  o 1  (1)
  o 2  (2)
  o 3  (3)
  o 4  (4)
  o 5+ (5)

Q11 On average, how many hours per week did you dedicate to Stanford Front Line (writing responses, editing based on peer and faculty feedback, uploading your responses, attending meetings, etc.)?
  o 1  (1)
  o 2  (2)
  o 3  (3)
  o 4  (4)
  o 5  (5)
  o 6+ (6)

**Overall Frontline Program Evaluation:**

Q12 Please rate your response to the following statements.

| Strongly disagree (1) | Somewhat disagree (2) | Neither agree nor disagree (3) | Somewhat agree (4) | Strongly agree (5) | Not Applicable (6) |
|-----------------------|------------------------|-------------------------------|------------------|-------------------|-------------------|
|                       |                        |                               |                  |                   |                   |
The Stanford Lane Librarian didactic session was useful in helping me develop my literature review. (1)

The peer-review process was useful in helping me develop my literature review responses. (2)

Participating in the Frontline pipeline helped to prepare me for clerkships. (4)
Participating in the Frontline pipeline curriculum helped improve my literature review and clinical research skills. (5)

Overall, I am satisfied with the Frontline pipeline. (6)

Q13 Please describe how Stanford Frontline helped improve my literature review and clinical research skills.

Q14 Please describe how Stanford Frontline helped prepare you for clerkships.

Overall Evaluation of Spring Quarter
Q15 Please rate your response to the following statement.
After 8 weeks of participation in Spring Quarter:

| Statement                                                                 | Strongly disagree (1) | Somewhat disagree (2) | Neither agree nor disagree (3) | Somewhat agree (4) | Strongly agree (5) |
|---------------------------------------------------------------------------|-----------------------|-----------------------|--------------------------------|--------------------|--------------------|
| I have a focused understanding of outpatient COVID-19 clinical care. (12) |                       |                       |                                |                    |                    |
| I feel that, as a student, I have enhanced frontline patient care. (13)   |                       |                       |                                |                    |                    |
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| Q16 Please rate your response to the following statement. | Strongly disagree (6) | Somewhat disagree (7) | Neither agree nor disagree (8) | Somewhat agree (9) | Strongly agree (10) |
|----------------------------------------------------------|------------------------|------------------------|-------------------------------|--------------------|---------------------|
| It is important for me to contribute to frontline efforts with COVID-19. (15) | 0                      | 0                      | 0                             | 0                  | 0                   |
| I feel prepared for clerkships/second year. (17)         | 0                      | 0                      | 0                             | 0                  | 0                   |

Q17 Please describe how Stanford Frontline has influenced your decision to pursue a career in primary care.
Supplemental Digital Appendix 3: Faculty Survey Instrument

“Stanford Frontline” Clinical Question Consult Service: PCH Faculty Feedback

Q1 What is your age?
   o 35 years or younger (1)
   o 36-45 years (2)
   o 46-55 years (3)
   o 56-65 years (4)
   o 66 years or older (5)

Q2 What is your gender?
   o Male (1)
   o Female (2)
   o Transgender Male (4)
   o Transgender Female (5)
   o Gender Nonconforming (6)
   o Prefer Not to Answer (7)
   o Other (8) ________________________________________________

Q3 What degree do you hold?
   o MD/DO (1)
   o PA (2)
   o NP (3)
   o Other (4)

Q4 Over the last 2 months, how often did you:

| Have unanswered clinical questions regarding the COVID-19 pandemic? (1) |
|---------------------------------------------------------------|
| Never (1) | Rarely (2) | Sometimes (3) | Often (4) | Frequently (5) |
| o         | o          | o             | o         | o             | o         |
Have unanswered clinical questions in your primary care practice (outside of COVID-19)? (2)
Use Stanford Frontline answers/information with your patients? (3)

| Q5 How satisfied were you with Stanford Frontline's: | Very dissatisfied (1) | Dissatisfied (2) | Neither satisfied nor dissatisfied (3) | Satisfied (4) | Very satisfied (5) |
|---------------------------------------------------|-----------------------|------------------|---------------------------------------|--------------|-------------------|
| Information quality (1)                           | o                     | o                | o                                     | o            | o                 |
| Timeliness (2)                                    | o                     | o                | o                                     | o            | o                 |
| "Ask a Clinical Question" FAQ Smartsheet database (3) | o                     | o                | o                                     | o            | o                 |
| Overall usefulness for patient care (4)           | o                     | o                | o                                     | o            | o                 |

Q6 In the future, how often would you use “Ask a Clinical Question” consult service for:

| Never (1) | Rarely (2) | Sometimes (3) | Often (4) | Frequently (5) |
|-----------|-----------|---------------|-----------|----------------|
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| COVID-19 questions (1) | o | o | o | o | o |
|------------------------|---|---|---|---|---|
| Non-COVID-19 questions (2) | o | o | o | o | o |

Q7 Other Comments? (e.g. things you liked/did not like about Stanford Frontline, any patient anecdotes?)
Q8 May we contact you? If so, please write in your name and email.