

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

## ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Clinical, Behavioral and Social Factors Associated with Racial Disparities in COVID-19 Patients from an Integrated Health Care System in Georgia: A Retrospective Cohort Study
<b>AUTHORS</b>	Lobelo, Felipe; Bienvenida, Alan; Leung, Serena; Mbanya, Armand N; Leslie, Elizabeth; Koplan, Kate; Shin, S. Ryan

## VERSION 1 – REVIEW

<b>REVIEWER</b>	Don Bambino Geno Tai Mayo Clinic, USA
<b>REVIEW RETURNED</b>	26-Sep-2020

<b>GENERAL COMMENTS</b>	<p>Thank you for keeping the conversation going on this important topic about racial disparities in outcomes of COVID-19.</p> <p>Major:</p> <ol style="list-style-type: none"><li>1. The biggest weakness of this study is the inclusion of PUIs in the study design. These group of patients are not well defined and is actually the vast majority of patients in this study. So this study should be framed as "factors associated with racial disparity among persons under investigation for COVID-19." The actual COVID-19 patients are a small proportion of the total number so this will be a secondary analysis. It is either you focus on only the positive cases in the whole paper and use a separate paragraph or two to talk about the PUIs, or the other way around.</li><li>Later in the results section, it's confusing if we are talking about the confirmed patients or PUI. These should be separated by subheadings.</li><li>2. If you will only take confirmed cases, do you have the number to use multiple regression? This should be explained in the methods section.</li><li>3. It seems like LatinX and Asians were lumped together in "others". These two groups have very different outcomes. This might be skewing your results. I see you have later explained towards the end but these are important in the methods section under definitions.</li><li>4. Line 204, "More Black/AA and Other race patients lived in the Southern areas of metro Atlanta which visible correlates with more socially deprived neighborhoods". Rewrite sentence into more politically correct terms. Did you mean "visibly"? What do you mean by socially deprived? Use objective terms. At the end, give figure number "1"</li><li>5. Figure 1, please provide an explanation.</li></ol>
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	<p>6. It is better if you remove the numbers in the methods section and consolidate them all in the results section.</p> <p>7. Line 266-267 "All of these factors were associated with an increased risk of COVID-19 infection in our findings". How did you come to this conclusion? It's not a population study that screened everyone. Rephrase.</p> <p>8. Line 290, this paragraph about SDOH should include discussion of systemic racism including redlining, and its impact on SDOH in these areas. Please see literature in Clinical Infectious Diseases and Journal of Infectious Diseases to make sure this important topic is not missed and neglected.</p> <p>9. Where were these patients managed and/or hospitalized? Could the clinical outcomes of different facilities be affecting patient-level outcomes?</p> <p>Minor:</p> <ol style="list-style-type: none"> <li>1. Why did you choose the terms Black/AA? Is there a specific reason? Or can you stick to one?</li> <li>1. Line 127 "confirmed COVID-19... instead of SAR-CoV2</li> <li>2. Remove page break in line 191 before "The KPGA institutional.." What do you mean by "no additional data is available"? Can delete if not too important.</li> <li>3. Line 217, "Other race females", delete race. And all throughout the manuscript. Probably define "other females" in the methods section for use throughout.</li> <li>4. Line 222, where is exhibit 3?</li> </ol>
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<b>REVIEWER</b>	Daniel Jamorabo, MD Stony Brook Medicine, Stony Brook, New York, USA
<b>REVIEW RETURNED</b>	15-Oct-2020

<b>GENERAL COMMENTS</b>	<p>To Drs. Lobelo, Bienvenida, et al.:</p> <p>Thank you very much for the opportunity to review your manuscript. It is a detailed look at clinical and socioeconomic factors associated with COVID-19 morbidity and mortality for patients within your integrated healthcare system. I believe that there are valuable data here, especially regarding socioeconomic issues that can amplify racial disparities during this pandemic.</p> <p>I have provided my feedback below, which I hope will be helpful in your revisions and can assist your manuscript in getting published in the near future.</p> <p>1. ABSTRACT</p> <p>Introduction:</p> <ul style="list-style-type: none"> <li>- "Disproportionate" instead of "disproportioned"</li> <li>- Please give a short sentence either here on in the Methods section on the goal of the project.</li> </ul> <p>Methods:</p> <ul style="list-style-type: none"> <li>- This is not so much a "case series" as it is a retrospective cohort study of patients confirmed to have COVID-19 from 3/3/2020 to 5/12/2020.</li> <li>- My understanding is that this project is focused upon hospitalization risk for confirmed COVID-19 cases (the 448, I believe?) and associated socioeconomic, clinical, and other SDOH indicators. Including persons under investigation, particularly when their cohort size is about 7 times that of the confirmed COVID-19 cases, is a bit confusing to me as any analysis thereof would</li> </ul>
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	<p>presumably include people who did not test positive and yet wound up hospitalized (or not) for non-COVID-19 reasons.</p> <ul style="list-style-type: none"><li>- Now that 5 months have passed since the study period, there must be substantial number within the PUI cohort who have since been confirmed positive for COVID-19 and/or others who could be included with the confirmed COVID-19 cohort, particularly as numbers rose over the summer. Including such individuals would make this analysis especially up to date and would be of interest to many readers who must sift through countless COVID-19 papers that tend to be based on cohorts from the first half of the calendar year.</li></ul> <p>Results:</p> <ul style="list-style-type: none"><li>- This section is wordy and can likely be streamlined without losing track of the findings, which I understand to be that 1) most COVID-19 positive patients were non-Hispanic Black, 2) Black patients were more likely to be hospitalized regardless of sex, 3) obesity increased risk of hospitalization for men and for Black patients, 4) adequate control of diabetes, blood pressure, and lipids decreased this risk for the same group, and 5) Black patients were more likely to be hospitalized if they reported being physically inactive.</li><li>- I suggest confining analysis to the COVID-19 positive cohort and teasing out the risk factors for hospitalization, etc. from that group, otherwise the project can read like an analysis of the PUI and confirmed COVID-19 cohorts that sometimes looks at one group and at other times lumps both together.</li></ul> <p>Conclusions:</p> <ul style="list-style-type: none"><li>- Black patients were more likely to be hospitalized, yet there was no statistically significant difference in clinical outcomes or mortality. This suggests that the major issue here is exposure risk and how socioeconomic circumstances put Black patients at higher risk for contracting COVID-19 and landing in the hospital. Perhaps orienting the thrust of your paper to highlight this would help strengthen the manuscript since your goal appears to be how racial disparities are playing out at your healthcare system.</li></ul> <p>2. ARTICLE SUMMARY</p> <ul style="list-style-type: none"><li>- These statements on strengths (check spelling) and limitations are fair overall. You note that this is a retrospective cohort study of 448 consecutive patients with confirmed COVID-19, but make no mention of the 3400 people in the PUI cohort. Again, I suggest confining the project to the confirmed cases only.</li></ul> <p>3. INTRODUCTION</p> <ul style="list-style-type: none"><li>- This section can probably be cut down to two paragraphs with the first two paragraphs and first half of the third paragraph edited and combined into one simpler one.</li><li>- The second half of the third paragraph can stand on its own as a statement of what the project goals are .</li></ul> <p>4. METHODS</p> <ul style="list-style-type: none"><li>- This section is wordy and can probably be cut down by a third, if not more. Overall, it is an exhaustive and transparent discussion of your methodology.</li></ul> <p>5. RESULTS</p> <ul style="list-style-type: none"><li>- Table 1 has a clean, clear, and streamlined layout. This is a presentation of data from the confirmed cases cohort. On a side note, almost all the p-values are &lt;0.001, though this may be a bit</li></ul>
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	<p>misleading when considering that Black patients comprise 68% of the cohort while White and Other are &lt;20% each.</p> <ul style="list-style-type: none"> <li>- Table 2 is a comprehensive and impressive look at the same confirmed COVID-19 cohort. This is likewise clean and crystal-clear.</li> <li>- Table 3 is a look at the hospitalized subset of confirmed COVID-19 patients. It may help to block off columns by Black, White, Other, and Age group for visualization.</li> <li>- Table 4 now lumps together the confirmed COVID-19 and PUI cohorts with multivariable logistic regression models now looking at 4000 people as opposed to 448. As I stated above, I suggest focusing on the confirmed cases and making that the narrative thread. If the overall goal is to look at all PUI cases, then the confirmed cases should just be a subset of THAT cohort and the previous three tables should be PUI-oriented.</li> <li>- Figure 1 is a 4-in-1 diagram; I am a bit confused why there are three different maps for "# of patients." Couldn't there be one map with all these data synthesized the way Figure 1D incorporates the median NDI for all the counties simultaneously?</li> <li>- STROBE statement included.</li> <li>- The prose and tables complement each other well overall.</li> </ul> <p><b>6. DISCUSSION</b></p> <ul style="list-style-type: none"> <li>- The overarching themes of your project, as I understand, are these: Black patients are overrepresented in the confirmed COVID-19 cohort, in hospitalizations from COVID-19, in neighborhoods with low median household incomes, and among patients with multiple comorbidities. Your finding that "different comorbidity profile may influence COVID-19 disease severity across racial groups" is very interesting and not much explored or emphasized in the copious COVID-19 literature. To what do you attribute this finding? How does it link to the socioeconomic data that you have provided?</li> <li>- It is interesting as well to me that the Northeast region of Atlanta appears to have better resources, access to care, etc. In Table 1, it appears that Black comprise over half of the patients from the Northeast region, so why in your opinion isn't this shown to be similarly protective of Black patients?</li> <li>- Your incorporating self-reported physical inactivity and its effect on hospitalization risk is likewise very important since Black patients may have less access to parks, gyms, and other spaces to partake in regular exercise.</li> </ul> <p>Thank you again for the opportunity to review your work. I look forward to seeing the revisions and to your final published article.</p>
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<b>REVIEWER</b>	Alice Pressman Sutter Health, USA
<b>REVIEW RETURNED</b>	19-Oct-2020

<b>GENERAL COMMENTS</b>	<p>General comments:</p> <p>This is a very timely and important topic, and studying COVID-19 racial disparities in at Kaiser Georgia provides plenty of statistical power to address important questions, as KPGA's membership is 43% Black. The manuscript could benefit from a clear set of goals or hypotheses to guide the reader. The results section was a bit confusing to follow – I believe that if you start with the goals, everything will flow.</p> <p>Most of your models were for the cohort that included PUI's. It is hard to understand exactly what this means, and you need a better</p>
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	<p>justification for including them. It was also surprising that race was not significantly associated with hospitalization in your COV+ only cohort.</p> <p>As you state, more than once, this is the only study to include “multiple measures of SDOH and pre-pandemic comorbidity management”. Those are great concepts on which to shine a spotlight, however they were a bit lost in the other data.</p> <p>Your discussion section is full of statements, but could be much stronger. Do you have theories? Recommendations? Does any of the disparity result from structural or system racism? I noticed that you didn’t use the word “racism” until the 3rd word from the end. That seemed a bit odd for a paper on racial disparities in COVID-19.</p> <p>Specifics about the manuscript in general:</p> <ol style="list-style-type: none"><li>1. <b>SARS-CoV2</b> is the virus that causes <b>COVID-19</b> (the disease). Unless you have a specific reason for discussing one or the other, please choose either COVID-19 or SARS-CoV2, and be consistent. It gets a little confusing when you go back and forth.</li><li>2. Please be consistent about number of decimal places.</li><li>3. Please choose and be consistent with case for each different racial group, I believe the latest recommendations are to capitalize the ‘B’ in Black, but not the ‘w’ in white, as white does not represent a culture.</li></ol> <p>Abstract</p> <ol style="list-style-type: none"><li>1. Line 47-48 states that you “found no significant differences in clinical outcomes or mortality across race/ethnicity groups”. Isn’t hospitalization a clinical outcome?</li></ol> <p>Intro:</p> <ol style="list-style-type: none"><li>1. The intro does not set up the study as well as it could. What drove you to conduct this particular study? Why are you best suited to do so? What are your goals?</li><li>2. Why does the COVID-19 distribution by race/ethnicity for the state of GA only sum to 76.6% of the cases?</li><li>3. Much of the message in lines 92-103 might be happier in the methods section. (description of membership, the study design and analytic approaches)</li></ol> <p>Methods:</p> <ol style="list-style-type: none"><li>1. Please provide some detail about KPGA’s system, and how the EHR works and describe how many hospitals and clinics serve the 300,000 members. Is it a closed system? Do you have complete records for all members?</li><li>2. As I am sure you are aware, it is not trivial to determine which patients are COVID-19 positive, and even more difficult to ascertain PUI status. How did you count patients who might have been COV+ from a test conducted outside of KPGA (at work, or at a local lab or drive-thru testing center, etc...)? For example, did you count any patients as COV+ if they showed up in your emergency departments with a positive test result in hand? At what point did your hospitals begin requiring all admitted patients to be tested?</li><li>3. Your definition of PUI is a little confusing. Was a PUI someone with symptoms who did not test positive? Or did not get tested at all? Did you rule out those who were positive for the flu or other non-COVID-19 respiratory infections?</li><li>4. Did you have access in your EHR to patient-reported symptoms?</li><li>5. Are the four geographic regions meaningful? Or would it be more appropriate to break it up by zip code or census tract. Also, are the other community-level variables (NDI, composite SDOH</li></ol>
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	<p>measure) assigned according to those four regions or by some other method?</p> <p>6. Please expand the explanation of the composite SDOH measure.</p> <p>7. What time period did the CCI cover?</p> <p>8. HEDIS HTN and DM variables need a bit more clarity. What happens if some measures are above the cut point and others are below?</p> <p>9. Is the EVS administered at each encounter? What happens if a person had no recent encounters?</p> <p>10. Are you able to capture all hospitalizations?</p> <p>11. Please specify if readmission was all-cause, or if it was only counted for specific reasons. Do readmission count if they are to a different hospital or hospital system?</p> <p>12. Statistical analysis: If you are comparing medians, then a t-test would not be appropriate. Perhaps consider a Mann-Whitney (AKA Wilcoxon Rank Sum) to test for a difference in mean rank.</p> <p>13. For the 7 different models, they are really just 2 different cohorts: (1) COV+ and (2) COV+ plus PUI. And for the second cohort, you are stratifying all analyses. That second cohort is of concern because it is a fairly nebulous group. What really defines the PUI? Isn't it only those who feel ill enough to come to the doctor thinking they have COVID-19? And during the early days of the pandemic, isn't it likely that this group might somehow be biased – more so than the group who tested positive? And over the course of the study period, this group likely shifted as we became more aware of new symptoms.</p> <p>14. Line 187 – I believe you meant a subset of the “<b>independent</b> variables”, and in line 189, “final independent variable selection”</p> <p>Results:</p> <p>1. It's fabulous that you can report about percentage of frontline and healthcare workers. These fields should be described in the methods.</p> <p>2. As this is a paper about racial disparities, it is appropriate to keep Race in all models except for those stratified by race. I would recommend keeping Age and Sex as well.</p> <p>3. In addition to the point above, when you have different variables included for each stratum, you will not be able to compare odds ratios across these models, because the interpretation is completely bound to the model form.</p> <p>4. Clinical characteristics: please state the values of the groups to which you are comparing. (e.g. Black/AA patients had higher rates of obesity...compared to what?)</p> <p>5. Are the HEDIS measures of control only measured among those with the condition? If Black patients had highest rates of hypertension, but also had highest rates of control was that because they had more opportunity for control? It's just a bit confusing to think about, and would be easier to have some more context around the HEDIS measurement.</p> <p>6. For Clinical outcomes of hospitalization, it would be helpful if you were clearer about which statements are unadjusted and which are adjusted. It also seems like you just compared everything to everything – again, having stated goals from the start will help to guide this text.</p> <p>7. Is “other” the right group to use for comparison for the differences by race?</p> <p>8. If you choose to report P-values, please provide exact values until they are truly very small (<math>P &lt; 0.001</math> or <math>P &lt; 0.0001</math>)</p> <p>Discussion</p>
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	<ol style="list-style-type: none"> <li>1. Again, when you make a statement that one group has a higher representation, please add the “than what...” part. (e.g. lines 250-251)</li> <li>2. On line 312, what is a “hard” risk factor?</li> <li>3. As you state, your analysis includes those who already have health insurance, and therefore access to preventive care. Do all your members actually utilize regular preventive care? Is it possible to stratify the analysis in some way as to consider those with regular care versus those who do not partake?</li> </ol>
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<b>REVIEWER</b>	Silvia Munoz-Price Medical College of Wisconsin
<b>REVIEW RETURNED</b>	20-Oct-2020

<b>GENERAL COMMENTS</b>	<p>This is a retrospective cohort of patients evaluated at Kaiser Permanente Georgia. The study has the capacity to bring additional knowledge to the field.</p> <p>Major comments for the authors consideration:</p> <ol style="list-style-type: none"> <li>1. Please clearly state your specific aims and objectives prior to Methods. These sentences are vague.</li> <li>2. Based on 1. above, please consider removing PUIs from your analysis. Adding PUIs fogs the interpretation of your results given the uncertainty of the final diagnoses of these patients.</li> <li>3. The number of different combination of analyses seems excessive. Did the authors adjust for this high number of exploratory analyses?</li> <li>4. Based on the data you have available, instead of repeating what others have done, consider doing stratification based on HEDIS blood pressure and diabetes control to see if the effect of race disappears.</li> <li>5. Consider not stratifying based on gender.</li> <li>6. Tables have too much information. Consider simplifying them. Maybe removing gender?</li> <li>7. Figure legend was not attached. The county borders were not present in all sub-figures making comparisons difficult.</li> <li>8. Please tell us what is your definition of PUI.</li> </ol>
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### VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Comments to the Author

Thank you for keeping the conversation going on this important topic about racial disparities in outcomes of COVID-19.

Major:

1. The biggest weakness of this study is the inclusion of PUIs in the study design. These group of patients are not well defined and is actually the vast majority of patients in this study. So this study should be framed as "factors associated with racial disparity among persons under investigation for COVID-19." The actual COVID-19 patients are a small proportion of the total number so this will be a secondary analysis. It is either you focus on only the positive cases in the whole paper and use a separate paragraph or two to talk about the PUIs, or the other way around.

Later in the results section, it's confusing if we are talking about the confirmed patients or PUI. These should be separated by subheadings.

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients in all analyses. We have an updated population of 5721 confirmed COVID-19 patients.

2. If you will only take confirmed cases, do you have the number to use multiple regression? This should be explained in the methods section.

Thank you for the comment. Our current number of confirmed cases gives us the numbers to use a multiple regression using only confirmed COVID-19 patients. Our updated population is 5721 confirmed COVID-19 patients.

3. It seems like LatinX and Asians were lumped together in "others". These two groups have very different outcomes. This might be skewing your results. I see you have later explained towards the end but these are important in the methods section under definitions.

Thank you for the comment. Our updated manuscript looks at Asians and Hispanic populations separately.

4. Line 204, "More Black/AA and Other race patients lived in the Southern areas of metro Atlanta which visible correlates with more socially deprived neighborhoods". Rewrite sentence into more politically correct terms. Did you mean "visibly"? What do you mean by socially deprived? Use objective terms. At the end, give figure number "1"

Thank you for the comment. The language has been adjusted and figure 1 has been referenced.

5. Figure 1, please provide an explanation.

Thank you for the comment. Please find legend attached to the figure.

6. It is better if you remove the numbers in the methods section and consolidate them all in the results section.

Thank you for the comment. The method section has been updated to reflect this where possible.

7. Line 266-267 "All of these factors were associated with an increased risk of COVID-19 infection in our findings". How did you come to this conclusion? It's not a population study that screened everyone. Rephrase.

The statement has been rephrased

8. Line 290, this paragraph about SDOH should include discussion of systemic racism including redlining, and its impact on SDOH in these areas. Please see literature in Clinical Infectious Diseases and Journal of Infectious Diseases to make sure this important topic is not missed and neglected.

We agree with your comment and had mentioned systemic racism in the conclusion of the original manuscript. We have included additional language on system racism in the revised manuscript discussion section

9. Where were these patients managed and/or hospitalized? Could the clinical outcomes of different facilities be affecting patient-level outcomes?

Thank you for the question. All patients were hospitalized in a KPGA core (5400 patients) or a non-

core (321 patients) hospital

Minor:

1. Why did you choose the terms Black/AA? Is there a specific reason? Or can you stick to one?

These terms were based on the NIH disparities race/ethnicity definitions.

[https://case.edu/nursing/sites/case.edu.nursing/files/2018-06/Racial\\_Ethnic\\_Categories\\_Definitions\\_NIH\\_Diversity.pdf](https://case.edu/nursing/sites/case.edu.nursing/files/2018-06/Racial_Ethnic_Categories_Definitions_NIH_Diversity.pdf)

We are now using one term for each group consistently through the revised manuscript.

2. Line 127 "confirmed COVID-19... instead of SAR-CoV2 2. Remove page break in line 191 before "The KPGA institutional.." What do you mean by "no additional data is available"? Can delete if not too important.

The manuscript has been revised to reflect your comments.

3. Line 217, "Other race females", delete race. And all throughout the manuscript. Probably define "other females" in the methods section for use throughout.

The method section has been revised to reflect the new race groups. The "Other" race group has been excluded from analyses (n=XX) given the limited sample size and the heterogeneity of that group

4. Line 222, where is exhibit 3?

The reference has been updated to figure 3.

Reviewer: 2

Comments to the Author

Thank you very much for the opportunity to review your manuscript. It is a detailed look at clinical and socioeconomic factors associated with COVID-19 morbidity and mortality for patients within your integrated healthcare system. I believe that there are valuable data here, especially regarding socioeconomic issues that can amplify racial disparities during this pandemic.

I have provided my feedback below, which I hope will be helpful in your revisions and can assist your manuscript in getting published in the near future.

#### 1. ABSTRACT

Introduction:

- "Disproportionate" instead of "disproportioned"

- Please give a short sentence either here on in the Methods section on the goal of the project.

Thank you for your comments and feedback. The introduction has been revised to 'disproportionate' and a goal statement has been included.

Methods:

- This is not so much a "case series" as it is a retrospective cohort study of patients confirmed to have COVID-19 from 3/3/2020 to 5/12/2020.

- My understanding is that this project is focused upon hospitalization risk for confirmed COVID-19

cases (the 448, I believe?) and associated socioeconomic, clinical, and other SDOH indicators. Including persons under investigation, particularly when their cohort size is about 7 times that of the confirmed COVID-19 cases, is a bit confusing to me as any analysis thereof would presumably include people who did not test positive and yet wound up hospitalized (or not) for non-COVID-19 reasons.

- Now that 5 months have passed since the study period, there must be substantial number within the PUI cohort who have since been confirmed positive for COVID-19 and/or others who could be included with the confirmed COVID-19 cohort, particularly as numbers rose over the summer. Including such individuals would make this analysis especially up to date and would be of interest to many readers who must sift through countless COVID-19 papers that tend to be based on cohorts from the first half of the calendar year.

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients in all analyses from 3/3/2020 to 10/29/2020. The study design has been edited as well in the manuscript.

#### Results:

- This section is wordy and can likely be streamlined without losing track of the findings, which I understand to be that 1) most COVID-19 positive patients were non-Hispanic Black, 2) Black patients were more likely to be hospitalized regardless of sex, 3) obesity increased risk of hospitalization for

men and for Black patients, 4) adequate control of diabetes, blood pressure, and lipids decreased this risk for the same group, and 5) Black patients were more likely to be hospitalized if they reported being physically inactive.

- I suggest confining analysis to the COVID-19 positive cohort and teasing out the risk factors for hospitalization, etc. from that group, otherwise the project can read like an analysis of the PUI and confirmed COVID-19 cohorts that sometimes looks at one group and at other times lumps both together.

Thank you for your comments and feedback. Our result section has been edited to reflect our findings from confirmed COVID-19 patients only.

#### Conclusions:

- Black patients were more likely to be hospitalized, yet there was no statistically significant difference in clinical outcomes or mortality. This suggests that the major issue here is exposure risk and how socioeconomic circumstances put Black patients at higher risk for contracting COVID-19 and landing in the hospital. Perhaps orienting the thrust of your paper to highlight this would help strengthen the manuscript since your goal appears to be how racial disparities are playing out at your healthcare system.

We agree and the revised version of the manuscript includes this in the discussion.

## 2. ARTICLE SUMMARY

- These statements on strengths (check spelling) and limitations are fair overall. You note that this is a retrospective cohort study of 448 consecutive patients with confirmed COVID-19, but make no mention of the 3400 people in the PUI cohort. Again, I suggest confining the project to the confirmed cases only.

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients in all analyses.

### 3. INTRODUCTION

- This section can probably be cut down to two paragraphs with the first two paragraphs and first half of the third paragraph edited and combined into one simpler one.
- The second half of the third paragraph can stand on its own as a statement of what the project goals are .

The introduction has been edited to reflect your comments.

### 4. METHODS

- This section is wordy and can probably be cut down by a third, if not more. Overall, it is an exhaustive and transparent discussion of your methodology.

Thank you for the comment. The methods section has been streamlined.

### 5. RESULTS

- Table 1 has a clean, clear, and streamlined layout. This is a presentation of data from the confirmed cases cohort. On a side note, almost all the p-values are <0.001, though this may be a bit misleading

when considering that Black patients comprise 68% of the cohort while White and Other are <20% each.

- Table 2 is a comprehensive and impressive look at the same confirmed COVID-19 cohort. This is likewise clean and crystal-clear.
- Table 3 is a look at the hospitalized subset of confirmed COVID-19 patients. It may help to block off columns by Black, White, Other, and Age group for visualization.
- Table 4 now lumps together the confirmed COVID-19 and PUI cohorts with multivariable logistic regression models now looking at 4000 people as opposed to 448. As I stated above, I suggest focusing on the confirmed cases and making that the narrative thread. If the overall goal is to look at all PUI cases, then the confirmed cases should just be a subset of THAT cohort and the previous three tables should be PUI-oriented.
- Figure 1 is a 4-in-1 diagram; I am a bit confused why there are three different maps for "# of patients." Couldn't there be one map with all these data synthesized the way Figure 1D incorporates the median NDI for all the counties simultaneously?
- STROBE statement included.
- The prose and tables complement each other well overall.

Thank you for your questions, comments and feedback. The recommended visualization edits have been made to table 3. PUIs are no longer included in the analyses as shown in the updated table 4. Figure 1 has been revised to include a synthesized diagram.

### 6. DISCUSSION

- The overarching themes of your project, as I understand, are these: Black patients are overrepresented in the confirmed COVID-19 cohort, in hospitalizations from COVID-19, in neighborhoods with low median household incomes, and among patients with multiple comorbidities. Your finding that "different comorbidity profile may influence COVID-19 disease severity across racial groups" is very interesting and not much explored or emphasized in the copious COVID-19 literature.

To what do you attribute this finding? How does it link to the socioeconomic data that you have provided?

- It is interesting as well to me that the Northeast region of Atlanta appears to have better resources, access to care, etc. In Table 1, it appears that Black comprise over half of the patients from the Northeast region, so why in your opinion isn't this shown to be similarly protective of Black patients?
- Your incorporating self-reported physical inactivity and its effect on hospitalization risk is likewise very important since Black patients may have less access to parks, gyms, and other spaces to partake in regular exercise.

We have addressed the interplay of socio-economic and geographic indicators in relation to hospitalization risk by races in the revised version of the discussion.

-Thank you again for the opportunity to review your work. I look forward to seeing the revisions and to your final published article.

Thank you!

Reviewer: 3

Comments to the Author

General comments:

This is a very timely and important topic, and studying COVID-19 racial disparities in at Kaiser Georgia provides plenty of statistical power to address important questions, as KPGA's membership is 43% Black. The manuscript could benefit from a clear set of goals or hypotheses to guide the reader. The results section was a bit confusing to follow – I believe that if you start with the goals, everything will flow.

Most of your models were for the cohort that included PUI's. It is hard to understand exactly what this means, and you need a better justification for including them. It was also surprising that race was not significantly associated with hospitalization in your COV+ only cohort.

As you state, more than once, this is the only study to include “multiple measures of SDOH and pre-pandemic comorbidity management”. Those are great concepts on which to shine a spotlight, however they were a bit lost in the other data.

Your discussion section is full of statements but could be much stronger. Do you have theories? Recommendations? Does any of the disparity result from structural or system racism? I noticed that you didn't use the word “racism” until the 3rd word from the end. That seemed a bit odd for a paper on racial disparities in COVID-19.

Thank you for your questions and feedback. We agree with your comments and had mentioned systemic racism in the conclusion of the original manuscript. We have included additional language on system racism in the revised manuscript discussion section

Specifics about the manuscript in general:

1. **SARS-CoV2** is the virus that causes **COVID-19** (the disease). Unless you have a specific reason for discussing one or the other, please choose either COVID-19 or SARS-CoV2, and be consistent. It gets a little confusing when you go back and forth.

Thank you for your comment. We used SARS-COV-2 when referring to testing and COVID-19 when referring to the clinical manifestations/disease consistently in the revised manuscript.

2. Please be consistent about number of decimal places.

Thank you. Results are presented to 1 decimal place except p-values (4 decimal places) and very small numbers (2 decimal places).

3. Please choose and be consistent with case for each different racial group, I believe the latest recommendations are to capitalize the 'B' in Black, but not the 'w' in white, as white does not represent a culture.

Thank you for your comment. We followed the the NIH disparities race/ethnicity definitions.

[https://case.edu/nursing/sites/case.edu.nursing/files/2018-06/Racial\\_Ethnic\\_Categories\\_Definitions\\_NIH\\_Diversity.pdf](https://case.edu/nursing/sites/case.edu.nursing/files/2018-06/Racial_Ethnic_Categories_Definitions_NIH_Diversity.pdf)

We are now using one term for each group consistently through the revised manuscript.

#### Abstract

1. Line 47-48 states that you "found no significant differences in clinical outcomes or mortality across race/ethnicity groups". Isn't hospitalization a clinical outcome?

Thank you. Our abstract has been edited to reflect our findings with confirmed COVID-19 patients only.

#### Intro:

1. The intro does not set up the study as well as it could. What drove you to conduct this particular study? Why are you best suited to do so? What are your goals?

Thank you for the feedback. We have edited the introduction to show why KPGA is a unique setting for a study on racial disparity considering the racial breakdown of our member population. We have also stated our aims/goals.

2. Why does the COVID-19 distribution by race/ethnicity for the state of GA only sum to 76.6% of the cases?

As of November 20th, the Georgia Department of Public Health (DPH) reported 399,410 confirmed COVID-19 with the following breakdown by race/ethnicity: 37% White, 27.5% Black, 12.5% Hispanic, 1.9% Asian, 2.6% other race (American Indian/Alaska Native, Native Hawaiian/Pacific Islander) and 18.5% unknown or no data. This information has been added to the revised manuscript

3. Much of the message in lines 92-103 might be happier in the methods section. (description of membership, the study design and analytic approaches)

Thank you. Your comments have been reflected in our updated introduction and methods section.

#### Methods:

1. Please provide some detail about KPGA's system, and how the EHR works and describe how many hospitals and clinics serve the 300,000 members. Is it a closed system? Do you have complete records for all members?

Thanks for your comment. KPGA is a closed healthcare system with 2 core hospitals and 43 non-core hospitals serving 300,000 members. We have complete records for all KPGA members. This information has been added to the revised manuscript

2. As I am sure you are aware, it is not trivial to determine which patients are COVID-19 positive, and even more difficult to ascertain PUI status. How did you count patients who might have been COV+ from a test conducted outside of KPGA (at work, or at a local lab or drive-thru testing center, etc...)? For example, did you count any patients as COV+ if they showed up in your emergency departments with a positive test result in hand? At what point did your hospitals begin requiring all admitted patients to be tested?

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients (N=5721) in all analyses. In terms of typical testing flow, patients were evaluated either via in person or telemedicine (phone/video) visits and when recommended,

PCR testing occurred via drive-thru and/or tents at one of the four KPGA facilities located across metro Atlanta. This information has been added to the revised manuscript

3. Your definition of PUI is a little confusing. Was a PUI someone with symptoms who did not test positive? Or did not get tested at all? Did you rule out those who were positive for the flu or other non-COVID-19 respiratory infections?

Thank you for your questions. As mentioned above, we focused strictly on confirmed COVID-19 patients in all analyses.

4. Did you have access in your EHR to patient-reported symptoms?

Yes, but we chose to not include this information in the present analyses.

5. Are the four geographic regions meaningful? Or would it be more appropriate to break it up by zip code or census tract. Also, are the other community-level variables (NDI, composite SDOH measure) assigned according to those four regions or by some other method?

The NDI is a composite measure of social and economic factors such as income, education, employment and housing quality linked to the members residence. It is obtained in our study at the zip code level. Our geographic regions are meaningful given the distribution of our clinical offices in the metro Atlanta area, transit as well as racial preponderance in city quadrants as seen in figure 1.

6. Please expand the explanation of the composite SDOH measure.

The NDI was used a composite SDOH measure including income, education, employment and housing quality. The higher the NDI value, the higher the level of deprivation in the neighborhood. This information was retained from the original version of the manuscript.

7. What time period did the CCI cover?

Thank you for the question. The CCI covered the last 12 months prior the COVID-19 encounter. This is mentioned in the methods and tables in the revised manuscript.

8. HEDIS HTN and DM variables need a bit more clarity. What happens if some measures are above the cut point and others are below?

Thank you. HEDIS measures are not used in the revised manuscript given that only a subsample of our members is in this database. We have replaced HEDIS as marker of disease control with new variables that focus on blood pressure and glucose control established clinical threshold recommended by NCQA as well as clinical and scientific organizations. For BP <140/90; For glucose

HbA1c >8% and >9%

9. Is the EVS administered at each encounter? What happens if a person had no recent encounters?

Thank you for your question. EVS is patient reported weekly exercise minutes. Is typically performed at every primary care encounter. In our analyses we used the most recent EVS data

point. Patients with no recent EVS report in the last 12 months were classified under no information on table 2.

10. Are you able to capture all hospitalizations?

Yes. KPGA is a closed integrated healthcare system so we can capture all hospitalizations of our members at our core and non-core hospitals.

11. Please specify if readmission was all-cause, or if it was only counted for specific reasons. Do readmission count if they are to a different hospital or hospital system?

Thank you. We defined readmissions were defined as instances of subsequent admission to a hospital within the KPGA health system due to all causes, 30 and 60- days after the index COVID19 hospitalization. This is mentioned in the methods and tables in the revised manuscript

12. Statistical analysis: If you are comparing medians, then a t-test would not be appropriate. Perhaps consider a Mann-Whitney (AKA Wilcoxon Rank Sum) to test for a difference in mean rank.

Thank you. We now only report means. The statistical analysis section has been revised to reflect the modified analyses.

13. For the 7 different models, they are really just 2 different cohorts: (1) COV+ and (2) COV+ plus PUI. And for the second cohort, you are stratifying all analyses. That second cohort is of concern

because it is a fairly nebulous group. What really defines the PUI? Isn't it only those who feel ill enough to come to the doctor thinking they have COVID-19? And during the early days of the pandemic, isn't it likely that this group might somehow be biased – more so than the group who tested positive? And over the course of the study period, this group likely shifted as we became more aware of new symptoms.

Thank you for your questions. As mentioned above, we focused strictly on confirmed COVID-19 patients in all analyses.

14. Line 187 – I believe you meant a subset of the “**independent variables**”, and in line 189, “final independent variable selection”

Thank you for this comment. This language has been clarified in the updated analysis section and has been edited according to current analyses.

Results:

1. It's fabulous that you can report about percentage of frontline and healthcare workers. These fields should be described in the methods.

Thank you for your comment. The composition of these variables is defined and described in the legend of table 1 and methods of the revised manuscript.

2. As this is a paper about racial disparities, it is appropriate to keep Race in all models except for those stratified by race. I would recommend keeping Age and Sex as well.

Agreed it was done.

3. In addition to the point above, when you have different variables included for each stratum, you will not be able to compare odds ratios across these models, because the interpretation is completely bound to the model form.

Agreed.

4. Clinical characteristics: please state the values of the groups to which you are comparing. (e.g. Black/AA patients had higher rates of obesity...compared to what?)

Thank you. The results have been edited to reflect your comment.

5. Are the HEDIS measures of control only measured among those with the condition? If Black patients had highest rates of hypertension, but also had highest rates of control was that because they had more opportunity for control? It's just a bit confusing to think about, and would be easier to have some more context around the HEDIS measurement.

Thank you for the comment. As stated before, HEDIS measures are not used in the updated manuscript. We have replaced HEDIS as marker of disease control with new variables that focus on blood pressure and glucose control using established clinical threshold recommended by NCQA as well as clinical and scientific organizations. For BP <140/90; For glucose HbA1c >8% and >9%

6. For Clinical outcomes of hospitalization, it would be helpful if you were clearer about which statements are unadjusted and which are adjusted. It also seems like you just compared everything to everything – again, having stated goals from the start will help to guide this text.

Thank you for your feedback. Our revised manuscript takes into consideration your feedback.

7. Is "other" the right group to use for comparison for the differences by race?

Thank you for the question. Our revised race groups don't include "other" race

8. If you choose to report P-values, please provide exact values until they are truly very small (P<0.001 or P<0.0001).

Thank you. Exact P-values have been reported.

#### Discussion

1. Again, when you make a statement that one group has a higher representation, please add the "than what..." part. (e.g. lines 250-251)

Thank you for the comment. Phrasing has been edited in the revised manuscript.

2. On line 312, what is a "hard" risk factor?

The term "Hard" has been replaced for "traditional" risk factors. Language has been edited and revised.

3. As you state, your analysis includes those who already have health insurance, and therefore access to preventive care. Do all your members actually utilize regular preventive care? Is it possible to stratify the analysis in some way as to consider those with regular care versus those who do not partake?

Thank you for this very important point. This has not been done in this paper but we hope to further explore this topic in future studies.

Reviewer: 4  
Comments to the Author

This is a retrospective cohort of patients evaluated at Kaiser Permanente Georgia. The study has the capacity to bring additional knowledge to the field.  
Major comments for the authors consideration:

1. Please clearly state your specific aims and objectives prior to Methods. These sentences are vague.

Thank you for your comments, questions and feedback. Our introduction has been edited to clarify the aim of the study.

2. Based on 1. above, please consider removing PUIs from your analysis. Adding PUIs fogs the interpretation of your results given the uncertainty of the final diagnoses of these patients.

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients in all analyses.

3. The number of different combination of analyses seems excessive. Did the authors adjust for this high number of exploratory analyses?

Thank you and agreed. We have simplified by removing the age-sex analyses and comparisons.

4. Based on the data you have available, instead of repeating what others have done, consider doing stratification based on HEDIS blood pressure and diabetes control to see if the effect of race disappears.

Thank you for this great comment. To our knowledge this is the first paper including pre-pandemic quality of care metrics as predictors of hospitalization risk. Stratifications based on blood pressure and diabetes control, although not done in this study will be addressed in future studies.

5. Consider not stratifying based on gender.

Thank you. Updated analyses have removed race-sex stratifications to simplify the results

6. Tables have too much information. Consider simplifying them. Maybe removing gender?

Thank you for your comment. As above, we have removed race-sex stratifications from the tables.

7. Figure legend was not attached. The county borders were not present in all sub-figures making

comparisons difficult.

Thank you. Figure 1 has been updated and legends have been added in updated manuscript.

8. Please tell us what is your definition of PUI.

Thank you for your comments. Our updated manuscript has focused strictly on confirmed COVID-19 patients in all analyses.

### VERSION 2 – REVIEW

<b>REVIEWER</b>	Tai, Don Mayo Clinic
<b>REVIEW RETURNED</b>	05-Dec-2020

<b>GENERAL COMMENTS</b>	<p>The manuscript has been greatly improved. Some parts need to be rewritten for clarity.</p> <p>Line 222: 66% were admitted at our two core Hospitals and 44% at non-core hospitals. Did not add up to 100%.</p> <p>Line 241: Race Black (1.43 [1.13,1.83]) and race Hispanic... Does not sound right. It could be improved by rewriting. Blacks and Hispanics had increased odds of hospitalization..</p> <p>Line 242: Within the female model.. This is unclear. Better rewrite this to reflect what you want to convey. Among females, Blacks have... COPD, CHF, etc increases the risk for hospitalization due to covid.</p>
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<b>REVIEWER</b>	Jamorabo, Daniel Stony Brook Medicine, Gastroenterology and Hepatology
<b>REVIEW RETURNED</b>	05-Dec-2020

<b>GENERAL COMMENTS</b>	<p>Thank you for the opportunity to review your manuscript revisions and for considering my feedback from your initial submission. Your paper is, in my opinion, much stronger with a larger and updated cohort, and the result is an important and relevant discussion of clinical and socioeconomic factors associated with COVID-19 morbidity and mortality. Furthermore, your analysis is more focused and manuscript is a valuable addition to the literature.</p> <p>I believe all of my concerns from the initial submission have been addressed appropriately at this time. I look forward to seeing the final version in print in the near future.</p>
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<b>REVIEWER</b>	Pressman, Alice Sutter Health, Center for Health Systems Research
<b>REVIEW RETURNED</b>	21-Dec-2020

<b>GENERAL COMMENTS</b>	<p>General This manuscript is much improved, however there are still a number of major points to address. First, there seem to be 2-3</p>
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	<p>really critical learnings that are glossed over. If they are not important for some reason, then this needs to be clarified in the discussion. For example, Asian patients who were hospitalized had nearly 2x the length of stay as every other racial group. Their rates of ICU admission and ventilation were also much higher. Isn't that huge news? Hispanic patients with uncontrolled HbA1c had nearly 6 times the likelihood of being hospitalized as their "controlled" counterparts. That sounds REALLY important to me.</p> <p>Second, there are quite a number of results that appear for the first time in the Discussion section. And finally, at the end, I am still left wondering what the main point is of the study. There is a lot of weight and discussion given to disparities for Black patients. If it is indeed a study of racial disparities for Black patients, then perhaps this should be in the title, but as it stands, it is about racial disparities in general (or for all racial groups)</p> <p>Specifics</p> <p>Abstract:</p> <p>The Objective and the Title are little misleading. Aren't you really teasing out the drivers of the racial disparities in hospitalization for COVID-19? How are you addressing disparities in outpatient COVID-19 cases?</p> <p>There is no Methods section to your abstract, so it's a bit confusing to follow the results. In the absence of such a section, please be more specific about the statistical models that the results are coming from. (e.g. the following statement is a bit hard to follow: "...higher hospitalization odds in the All-patients (1.08 [1.03, 1.13]) and Black models (1.09 [1.03, 1.16]), while residence in northeast Atlanta (0.64 [0.43, 0.95]) and in zip-codes with high incomes (0.24 [0.08, 0.78]) associated with lower hospitalization odds among White and Asian patients, respectively." I assume that you stratified by race.)</p> <p>Mortality as an outcome is not even mentioned until the Conclusion section. And "compared to other race groups" implies that you ran models comparing Black and Hispanic patients to each other racial group.</p> <p>The Conclusion does not align with the results.</p> <p>Article Summary:</p> <p>Mortality should not be included in this summary unless it is added as an objective of this study.</p> <p>On the other hand, the objectives do state a goal of determining racial disparities in patients with COVID-19, and as a second goal, to consider drivers for disparities in hospitalization. In fact, the paper does seem to focus not only on risk factors for hospitalization, but also other factors associated with hospitalization (ICU, LOS, Vent).</p> <p>Introduction:</p> <ol style="list-style-type: none"> <li>Line 90 page 4 – the racial/ethnic breakdown of Georgia sums to &gt;100% and there are no missing or other groups. If this is because the Hispanic group overlaps with the other groups, it should be stated as such. Note: this is not how it is reported in the next sentence, so please be consistent.</li> <li>Line 91 page 4 – missing a word - should be "confirmed COVID-19 cases with..."</li> <li>Line 98 page 5 – percentages should be consistently reported to one decimal place unless they are from a published source.</li> </ol>
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	<p>4. Objectives – Thank you for adding. But there are only two objectives – to look at disparities among people with COVID-19 and to look for disparities for hospitalization. There is no mention of the risk of contracting COVID-19 (nor do I believe you can address that with your data), and there is no mention of other hospital-related outcomes (LOS, ICU, vents, death, re-admission). I think you are on the right track, but the objectives do not yet align with the results you present.</p> <p>Methods:</p> <ol style="list-style-type: none"> <li>1. Thank you for adding the explanation of the testing protocol at KPGA. I am still a bit unclear about how you classified patients who showed up with a positive test from an outside lab. Did you only include those who were tested at one of the four KPGA testing facilities?</li> <li>2. For the Patient race/ethnicity, are the non-white categories of race also Non-Hispanic? Or is there overlap?</li> <li>3. Line 149 page 7 - ICD stands for "International Classification of Diseases", no "Statistical".</li> <li>4. Line 150 page 7 – I believe this is the Deyo-Charlson Comorbidity Index.</li> <li>5. Clinical outcomes section: Were patients required to have a discharge diagnosis (or cause of death) of COVID-19? If the LOS=1, does that mean they were only in the Emergency Department (ED)? Did you count ED admission?</li> <li>6. Line 187 page 9 – following up with reviewer 4, comment #5, what is the purpose of stratifying by Sex. Are you also studying Sex disparities?</li> <li>7. Although you state that you kept Age, Sex, and Race/ethnicity in all multivariable models, they do not show up consistently for all models in Table 4. I also strongly encourage you to present the same models across race (for your stratified models) so that the Odds ratio comparisons can be made.</li> <li>8. Table 4 is missing Asian race. Is that intentional? Is white the comparison group?</li> </ol> <p>Results: Throughout the results there are still a number of places with <math>P &lt; 0.05</math>. Please check for consistency. Also please take care to identify the Table number that corresponds to the analysis being reported. It is a bit difficult to follow sometimes.</p> <ol style="list-style-type: none"> <li>1. Demographics: As race is the main focus of your paper, I would suggest reporting the main outcome(s) by race, and if sex is important then by sex as well.</li> <li>2. Also in the demographics paragraph, lines 201-203, I found it difficult to track what you were reporting. Do you mean Black patients with COVID-19? The remainder of the paragraph is also a bit confusing.</li> <li>3. Comorbidities: First sentence – do you mean compared with all other racial/ethnic groups? And does that mean the P-Value was for an ANOVA? Or pair-wise t-tests?</li> <li>4. For the blood pressure control is the denominator ALL patients? Or just those with HTN? Same question for Diabetes – what happens to patients who do not have these conditions? Are they considered to be under control?</li> <li>5. Hospitalizations: It is rather odd that 66% of all hospitalizations occurred at only 2 hospitals while the rest (34%???) - I think there must be a typo as they sum to 110%) happened in 43 other hospitals. Perhaps a sentence in the methods to explain the difference between the core and non core hospitals would help.</li> </ol>
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	<p>6. Lines 229-232: Are these overall ANOVA P-Values? Or pair-wise t-tests?</p> <p>7. Lines 232-235: If death data are to be reported, then they should be incorporated into the objectives.</p> <p>8. For the multivariable models, the section is a little choppy, perhaps outline the points you want to make and then list them in order.</p> <p>9. Line 252: cough/cold medication was associated... that seems rather random. Why was this medication considered and not hundreds of other medications - even if you just consider respiratory meds, that might make sense. Did you consider other meds? Please clarify in the methods - currently it just says you used pharmacy dispensing data to compile the frequency of outpatient medications used by patients. That does not sound like what you used in this model.</p> <p>10. There are several places where you report results from some racial subgroups by not others. It is difficult to work out how you chose. If there are no significant differences, please state that, or at the very least, refer us to the appropriate table.</p> <p>11. Lines 261-276: this is confusing. What does it mean that the aORs are ranging in descending order? Which Table contains these data?</p> <p>Discussion: In general, there are data in the discussion that did not appear in the results. Please add them to the results section.</p> <p>1. First sentence: Where in the results did you demonstrate that your data show an over-representation of Black and Hispanic patients in outpatient phase of care?</p> <p>2. What does "phases of care" mean?</p> <p>3. Lines 299-304: Where did the c-statistic come into this? It is not in the methods or the results, and it is not shown in any table. Further, your logic does not follow.</p> <p>4. Line 311: Is 0,03 a high NDI?</p> <p>5. Line 317-320: these two sentences do not flow properly.</p> <p>6. Lone 334 – 337: When discussing pre pandemic factors, it is remarkable that among Hispanic patients having uncontrolled blood glucose is associated with nearly SIX times the ODDS of being hospitalized compared with those in control.</p> <p>7. Line 336: just after the above statement, the conversation switches to the perspective of controlled blood pressure. Why not consider them both from the uncontrolled perspective. It gets confusing to have to switch back and forth.</p> <p>8. Line 351: Zip codes with high unemployment had a relatively small effect with less than 10% increase in odds of hospitalization. This should at least be noted – most of the effect sizes you are reporting are much greater than these.</p> <p>9. Line 396: Although you are studying a somewhat long time period, this is not really a longitudinal study in the true sense of the word. You are not considering time as a factor in any of the models.</p> <p>10. Line 402 and 406: you have not done any analysis that can speak to "risk of infection"</p> <p>11. Line 404: is the lack of difference possibly due to power?</p>
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**VERSION 2 – AUTHOR RESPONSE**

Reviewer: 1  
Dr. Don Tai, Mayo Clinic  
Comments to the Author:

The manuscript has been greatly improved. Some parts need to be rewritten for clarity.

Line 222: 66% were admitted at our two core Hospitals and 44% at non-core hospitals. Did not add up to 100%.

Thank you for finding this typo. This has been corrected to reflect the right percentages (66% and 34%)

Line 241: Race Black (1.43 [1.13,1.83]) and race Hispanic... Does not sound right. It could be improved by rewriting. Blacks and Hispanics had increased odds of hospitalization.

Thanks. The sentence has been rewritten to be clearer.

Line 242: Within the female model. This is unclear. Better rewrite this to reflect what you want to convey. Among females, Blacks have...  
COPD, CHF, etc increases the risk for hospitalization due to covid.

Thanks. The sentence has been rewritten to clarify this point.

Reviewer: 2  
Dr. Daniel Jamorabo, Stony Brook Medicine Comments to the Author:

Thank you for the opportunity to review your manuscript revisions and for considering my feedback from your initial submission. Your paper is, in my opinion, much stronger with a larger and updated cohort, and the result is an important and relevant discussion of clinical and socioeconomic factors associated with COVID-19 morbidity and mortality. Furthermore, your analysis is more focused, and manuscript is a valuable addition to the literature.

I believe all of my concerns from the initial submission have been addressed appropriately at this time. I look forward to seeing the final version in print in the near future.

Thank you very much for your comments and suggestions to strengthen this manuscript.

Reviewer: 3  
Dr. Alice Pressman, Sutter Health  
Comments to the Author:

General

This manuscript is much improved, however there are still a number of major points to address. First, there seem to be 2-3 really critical learnings that are glossed over. If they are not important for some reason, then this needs to be clarified in the discussion. For example, Asian patients who were hospitalized had nearly 2x the length of stay as every other racial group. Their rates of ICU admission and ventilation were also much higher. Isn't that huge news?

Hispanic patients with uncontrolled HbA1c had nearly 6 times the likelihood of being hospitalized as their "controlled" counterparts. That sounds REALLY important to me.

Second, there are quite a number of results that appear for the first time in the Discussion section.

And finally, at the end, I am still left wondering what the main point is of the study. There is a lot of weight and discussion given to disparities for Black patients. If it is indeed a study of racial disparities for Black patients, then perhaps this should be in the title, but as it stands, it is about racial disparities in general (or for all racial groups)

Thank you for these comments. Our focus was primarily in the comparison between black and white patients because of the larger sample sizes for these two groups. However, we agree other disparities for Hispanics and Asians are important and we have expanded on these in the revised discussion section. Lines 381, 422, 452, 463

Specifics

Abstract:

The Objective and the Title are little misleading. Aren't you really teasing out the drivers of the racial disparities in hospitalization for COVID-19? How are you addressing disparities in outpatient COVID-19 cases?

Thank you for the comment. The abstract has been rewritten taking into consideration your comments. Our objective is not limited to hospitalization, but rather looks at all KPGA members who had laboratory-confirmed COVID-19. The title was also edited and now reads: "Clinical, Behavioral and Social Factors Associated with Racial Disparities in COVID-19 Patients from an Integrated Health Care System in Georgia: A Retrospective Cohort Study"

There is no Methods section to your abstract, so it's a bit confusing to follow the results. In the absence of such a section, please be more specific about the statistical models that the results are coming from. (e.g. the following statement is a bit hard to follow: "...higher hospitalization odds in the All-patients (1.08 [1.03, 1.13]) and Black models (1.09 [1.03, 1.16]), while residence in northeast Atlanta (0.64 [0.43, 0.95]) and in zip-codes with high incomes (0.24 [0.08, 0.78]) associated with lower hospitalization odds among White and Asian patients, respectively." I assume that you stratified by race.)

Mortality as an outcome is not even mentioned until the Conclusion section. And "compared to other race groups" implies that you ran models comparing Black and Hispanic patients to each other racial group.

Thank you. The abstract has been rewritten following the journal recommended structure for more clarity and fluidity. We consider clinical outcomes to include health care utilization (hospitalization, ICU, LOS, vent) and mortality as presented in table 3 of the manuscript.

The Conclusion does not align with the results.

Thanks for your comment. The methods and conclusion sections of the abstract have been re-written based on your suggestions.

Article Summary:

Mortality should not be included in this summary unless it is added as an objective of this study. On the other hand, the objectives do state a goal of determining racial disparities in patients with COVID-19, and as a second goal, to consider drivers for disparities in hospitalization. In fact, the paper does seem to focus not only on risk factors for hospitalization, but also other factors associated with hospitalization (ICU, LOS, Vent).

Thanks for your comments. In the updated version of the abstract and manuscript we have clarified the main study objective is to explore racial disparities regarding clinical outcomes in patients with COVID 19. We consider clinical outcomes to include health care utilization (hospitalization, ICU, LOS,

vent) and mortality.

Introduction:

1. Line 90 page 4 – the racial/ethnic breakdown of Georgia sums to >100% and there are no missing or other groups. If this is because the Hispanic group overlaps with the other groups, it should be stated as such. Note: this is not how it is reported in the next sentence, so please be consistent.

Thank you for this comment. Our reporting is directly from the United States Census Bureau <https://data.census.gov/cedsci/profile?q=Georgia&g=0400000US13&tid=ACSDP1Y2018.DP05>

The US Census Bureau presents Hispanic ethnicity percentages irrespective of race. This has been clarified in the revised version of the manuscript (line 153)

2. Line 91 page 4 – missing a word - should be “confirmed COVID-19 cases with...”

Thanks. This has been corrected.

3. Line 98 page 5 – percentages should be consistently reported to one decimal place unless they are from a published source.

Thanks for this suggestion. All percentages not from a published source have been adjusted to one decimal place.

4. Objectives – Thank you for adding. But there are only two objectives – to look at disparities among people with COVID-19 and to look for disparities for hospitalization. There is no mention of the risk of contracting COVID-19 (nor do I believe you can address that with your data), and there is no mention of other hospital-related outcomes (LOS, ICU, vents, death, re-admission). I think you are on the right track, but the objectives do not yet align with the results you present.

Thanks for your comment. We have modified the objectives in the introduction to explicitly indicate that we consider clinical outcomes to include health care utilization (hospitalization, ICU, LOS, vent) and mortality. Line 171

Methods:

1. Thank you for adding the explanation of the testing protocol at KPGA. I am still a bit unclear about how you classified patients who showed up with a positive test from an outside lab. Did you only include those who were tested at one of the four KPGA testing facilities?

We included any KP member with a documented laboratory-confirmed COVID-19 PCR test in their EMR which also incorporated tests performed in lab facilities outside of our health care system. We have added this clarification in the revised methods section. Line 179

2. For the Patient race/ethnicity, are the non-white categories of race also Non-Hispanic? Or is there overlap?

In our EMR data collection protocols the Hispanic ethnicity category includes both white and non-white Hispanics. For our race categories, White refers to individuals self-reporting to be white of non-Hispanic ethnicity.

3. Line 149 page 7 - ICD stands for "International Classification of Diseases", no "Statistical".

Thank you for this comment. The full/official name for ICD is "International Statistical Classification of Diseases and Related Health Problems (ICD)" as per WHO

(<https://www.who.int/standards/classifications/classification-of-diseases>) which maintains this classification system.

4. Line 150 page 7 – I believe this is the Deyo-Charlson Comorbidity Index.

Thank you. We now refer to it as Deyo-Charlson comorbidity index in the revised manuscript. Line 222

5. Clinical outcomes section: Were patients required to have a discharge diagnosis (or cause of death) of COVID-19? If the LOS=1, does that mean they were only in the Emergency Department (ED)? Did you count ED admission?

Thanks for this question. Hospital LOS consisted of the entire time spent in hospital from admission (including emergency department) to discharge (including death). If hospital LOS= 1 then the patient spent 1 day in the hospital/ED prior to being discharged. This has been clarified in the methods section of the updated manuscript. Line 243

6. Line 187 page 9 – following up with reviewer 4, comment #5, what is the purpose of stratifying by Sex. Are you also studying Sex disparities?

Sex (male) has been consistently reported to be a risk factor related to COVID clinical outcomes specifically hospitalization risk. This is the reason sex stratification was included in our multivariate analyses. In response to the initial comments by reviewers, we removed the sex stratification from our descriptive analyses presented in Tables 1, 2 and 3. However, we feel that the sex stratification enables a deeper and more granular understanding of the drivers of hospitalization risk and racial disparities presented in the multivariate models. However, If the reviewer and editor feel the sex stratification in table 4 detracts from the study stated objective and findings, we have no problem if those columns are removed from the table or left as supplemental material.

7. Although you state that you kept Age, Sex, and Race/ethnicity in all multivariable models, they do not show up consistently for all models in Table 4. I also strongly encourage you to present the same models across race (for your stratified models) so that the Odds ratio comparisons can be made.

Thanks for your suggestion. For better interpretation, we now include the effect estimate of sex (female) for the multivariate models among Black and White subgroups despite this variable not having achieved statistical significance in the models

On your second point, we feel that presenting the effect estimate for variables that did not achieve statistical significance in each of the stratified models makes the tables overloaded with information

that may not be as relevant and is the reason we only present effect estimates for variables that achieved statistical significance for each specific model.

8. Table 4 is missing Asian race. Is that intentional? Is white the comparison group?

Thanks for your comment. Race White is indeed the comparison group. We now present the effect estimate of race Asian for the overall model despite this variable not achieving statistical significance

Results: Throughout the results there are still a number of places with  $P < 0.05$ . Please check for consistency. Also please take care to identify the Table number that corresponds to the analysis being reported. It is a bit difficult to follow sometimes.

Thank you for these observations. Exact p values are now reported throughout the revised paper. Updated table references have been made.

1. Demographics: As race is the main focus of your paper, I would suggest reporting the main outcome(s) by race, and if sex is important then by sex as well.

The first version of the manuscript included race and sex stratifications for our demographic table, but reviewers advised to remove them. We feel the important findings are included in the sex stratification for the multivariable analyses in table 4.

2. Also, in the demographics paragraph, lines 201-203, I found it difficult to track what you were reporting. Do you mean Black patients with COVID-19? The remainder of the paragraph is also a bit confusing.

Thanks. Lines 201-203 have been rewritten

3. Comorbidities: First sentence – do you mean compared with all other racial/ethnic groups? And does that mean the P-Value was for an ANOVA? Or pair-wise t-tests?

Yes, it is compared to all other groups and the P-value reported is for an ANOVA.

4. For the blood pressure control is the denominator ALL patients? Or just those with HTN? Same question for Diabetes – what happens to patients who do not have these conditions? Are they considered to be under control?

Thank you for this comment. The denominator for blood pressure control is patients with HTN and for HbA1C control, patients with diabetes. These clarifications have been included in the Table 2 legend.

5. Hospitalizations: It is rather odd that 66% of all hospitalizations occurred at only 2 hospitals while the rest (34%???) - I think there must be a typo as they sum to 110% happened in 43 other hospitals. Perhaps a sentence in the methods to explain the difference between the core and non-core hospitals would help.

Thanks for finding this typo. Line 225 has been corrected to be 100%. Our health care system would ideally have all of our members being hospitalized in our core hospitals (for clinical quality of care and financial reasons). However, this was not possible during pandemic surges due to bed availability and restrictions regarding repatriation of our members from non-core to our core hospitals.

6. Lines 229-232: Are these overall ANOVA P-Values? Or pair-wise t-tests?

The reported p-values on those lines are comparing males to females so it is pairwise t-tests.

7. Lines 232-235: If death data are to be reported, then they should be incorporated into the objectives.

As stated above, we have modified the objectives in the introduction to explicitly indicate that we consider clinical outcomes to include health care utilization (hospitalization, ICU, LOS, vent) and mortality. Line 171

8. For the multivariable models, the section is a little choppy, perhaps outline the points you want to make and then list them in order.

Thanks for your suggestion. This section has been rewritten to be clearer. Line 323 - 377

9. Line 252: cough/cold medication was associated... that seems rather random. Why was this medication considered and not hundreds of other medications - even if you just consider respiratory meds, that might make sense? Did you consider other meds? Please clarify in the methods - currently it just says you used pharmacy dispensing data to compile the frequency of outpatient medications used by patients. That does not sound like what you used in this model.

Thanks for your comment. We are now reporting the frequency of cough/cold medication on table 2 in addition to other several relevant COVID19 medications that have been described in previous studies.

10. There are several places where you report results from some racial subgroups by not others. It is difficult to work out how you chose. If there are no significant differences, please state that, or at the very least, refer us to the appropriate table.

We have edited sentences where we reported by race group to state that where not significant and refer to the tables. Line 337-360

11. Lines 261-276: this is confusing. What does it mean that the aORs are ranging in descending order? Which Table contains these data?

Thank you. These lines have been corrected to reflect your comments and avoid the confusing language.

Discussion: In general, there are data in the discussion that did not appear in the results. Please add them to the results section.

1. First sentence: Where in the results did you demonstrate that your data show an over-representation of Black and Hispanic patients in outpatient phase of care?

Thanks for your comment. In our table 1 We indicate that 58% and 8.5% of our COVID-19 patients were Black and Hispanic, which is a higher proportion than our adult membership reported also in the introduction (43% Black and 4% Hispanic).

2. What does “phases of care” mean?

Inpatient (hospitalization) and outpatient.

3. Lines 299-304: Where did the c-statistic come into this? It is not in the methods or the results, and it is not shown in any table. Further, your logic does not follow.

Per your comment, language regarding c-statistic (ability of the variables in the model to discriminate risk of hospitalization) has been removed.

4. Line 311: Is 0,03 a high NDI?

Compared to white (mean NDI -0.4) mean NDI values of 0.03 (Hispanic) and 0.37 (Black) are higher and indicate more deprivation. We’ve replaced “high” with “higher” in the edited version of the discussion (Line 424).

5. Line 317-320: these two sentences do not flow properly.

Thanks. The sentences have been reworded to improve flow.

6. Line 334 – 337: When discussing pre pandemic factors, it is remarkable that among Hispanic patients having uncontrolled blood glucose is associated with nearly SIX times the ODDS of being hospitalized compared with those in control.

Agreed and we have included a comment reflecting this in the revised manuscript. Line 454

7. Line 336: just after the above statement, the conversation switches to the perspective of controlled blood pressure. Why not consider them both from the uncontrolled perspective. It gets confusing to have to switch back and forth.

Thanks for your suggestion. Table 4 and results/discussion sections have been updated to refer to uncontrolled blood pressure to keep it consistent with uncontrolled blood glucose.

8. Line 351: Zip codes with high unemployment had a relatively small effect with less than 10% increase in odds of hospitalization. This should at least be noted – most of the effect sizes you are reporting are much greater than these.

Thanks for your comment. A sentence to this effect is now included (Line 470)

9. Line 396: Although you are studying a somewhat long time period, this is not really a longitudinal study in the true sense of the word. You are not considering time as a factor in any of the models.

You are correct. The term longitudinal has been removed in the revised manuscript.

10. Line 402 and 406: you have not done any analysis that can speak to “risk of infection”

Thank you. This has been corrected to risk of hospitalization.

11. Line 404: is the lack of difference possibly due to power?

It is possible and something we plan to explore as our COVID-19 sample increases. A comment to this effect has been added (Line 530).