

OBSTETRICS & GYNECOLOGY



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- Comments from the reviewers and editors (email to author requesting revisions)
- Response from the author (cover letter submitted with revised manuscript)*

**The corresponding author has opted to make this information publicly available.*

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Questions about these materials may be directed to the *Obstetrics & Gynecology* editorial office:
obgyn@greenjournal.org.

Date: Sep 24, 2021
To: "Ndidiama Amutah-Onukagha"
From: "The Green Journal" em@greenjournal.org
Subject: Your Submission ONG-21-1775

RE: Manuscript Number ONG-21-1775

Using a Longitudinally Linked Database to Reconsider the Measurement of Severe Maternal Morbidity

Dear Dr. Amutah-Onukagha:

Your manuscript has been reviewed by the Editorial Board and by special expert referees. Although it is judged not acceptable for publication in Obstetrics & Gynecology in its present form, we would be willing to give further consideration to a revised version.

If you wish to consider revising your manuscript, you will first need to study carefully the enclosed reports submitted by the referees and editors. Each point raised requires a response, by either revising your manuscript or making a clear and convincing argument as to why no revision is needed. To facilitate our review, we prefer that the cover letter include the comments made by the reviewers and the editor followed by your response. The revised manuscript should indicate the position of all changes made. We suggest that you use the "track changes" feature in your word processing software to do so (rather than strikethrough or underline formatting).

Please be sure to address the Editor comments (see "EDITOR COMMENTS" below) in your point-by-point response.

Your paper will be maintained in active status for 21 days from the date of this letter. If we have not heard from you by Oct 15, 2021, we will assume you wish to withdraw the manuscript from further consideration.

REVIEWER COMMENTS:

Reviewer #1:

This manuscript presents the results of an analysis where the authors sought to expand the currently used construct for identifying women with severe maternal morbidity (SMM) by going beyond the delivery hospitalization and including prenatal and postpartum hospitalizations. To accomplish this, they used an apparently state-based longitudinally-linked database where birth and fetal death records were linked to hospitalization events for individual women. This allowed for a person-based analysis instead of the usual discharge-based analysis available with hospital discharge databases. They focused on the period 2009-2018 and allowed for the conversion to ICD-10 for discharge coding beginning October 2015. The authors found that indications of SMM increased across the time period and that adding prenatal and postpartum periods increased the estimate of the SMM rate by 22%. The authors conclude that enhancing surveillance to include the entire peripartum period provides opportunities to further improve quality of care throughout this longer cycle in hopes of preventing maternal morbidity and mortality.

This paper is a good example of how existing surveillance can be enhanced and demonstrates the dynamic nature of using quality improvement to improve the surveillance system as well as the outcomes that are the targets of the system.

I have several comments:

1. Abstract, line 4; "mortality" should be "morbidity."
2. Introduction, line 40; It is more precise to use the term "categories" as opposed to "codes." There are 25 categories composed of far more than 25 codes.
3. Introduction, line 41; A better reference than 4 would be Callaghan et al. Obstet Gynecol 2012;120:1029-36 as that was the basis for the initial 25 category construct and used for web-based reporting.
4. Methods, line 80; Can the authors be a bit more specific about "questionable ICD-10 coding?"
5. Methods, line 85; Again, "categories" is a more precise term when referring to the 25 versus 21 in ICD-9 to ICD-10.
6. Methods, lines 102-103; You might cite the CDC SMM website to justify reporting SMM with and without transfusions as it is reported as such there as well as elsewhere in the literature.
7. Results, line 127; I am less impressed that the trend in Figure 1 reveals two patterns. The initial change with ICD-10 is very small and the overall trend tells the story.
8. Discussion, first paragraph; You should cite Callaghan et al. (2010) referred to in comment #3. Those authors also looked at postpartum SMM hospitalizations. Although their method cannot be applied to ICD-10 and they were unable to separate individual women from the event of hospitalization, the addition of postpartum SMM was proportionately similar to those you found and this adds credibility to your findings.

9. Somewhere toward the end of the discussion, it would be good to make an advocacy call out to encourage more states to develop longitudinally linked perinatal databases. You demonstrate their power and utility, yet there are precious few routinely linked databases outside of special studies.

Reviewer #2:

The authors' objective was to determine the impact on the number of cases of severe maternal mortality (SMM) when applying the standard algorithm to the prenatal and postpartum (42 days) periods as well as the delivery event. To accomplish this they performed a cohort analysis on data from a population-based data system that links records from live birth and fetal death certificates to corresponding delivery hospital discharge records and non-birth hospital utilization records for birthing individuals over time. They focused on deliveries from January 1, 2009 to December 31, 2018, distinguishing between ICD-9 (2009-2015Q2) and ICD-10 (2016Q4-2018) coding. They applied the modified CDC algorithm for SMM used by the Alliance for Innovation on Maternal Health based on 21 conditions and procedures. They found that SMM at birth increased steadily across both ICD-9 and ICD-10 from 129.4 in 2009 to 214.3 per 10,000 in 2018. Adding prenatal and postpartum hospitalizations increased the number of cases by 21.9% under both ICD-9 and ICD-10 resulting in a 2018 rate of 258.7 per 10,000. The largest increase was from sepsis cases. They conclude that an inpatient or delivery only focused intervention is insufficient to adequately recognize, prevent or respond to significant morbidity during the antepartum period.

I have a few questions for the authors:

1. The authors are correct that CDC/AIM has developed the SMM index to use in delivery hospitalization data because that is their QI outcome of interest, but others use the CDC SMM index outside of delivery events and have used longitudinal datasets. Can the authors comment or elaborate on any such related literature more fully?
2. I also think that the CDC has held back on including postpartum in their official SMM definition because it's harder to know if it was pregnancy-related (i.e., a postpartum patient could have an injury, etc. not related to their pregnancy or delivery). Can the authors comment on this dimension more fully?
3. One technical point is that CDC/AIM apparently recently revised the SMM index to better address ICD-9/ICD-10 conversion issues. Can the authors clarify which version they used?
4. The issue of "antepartum SMM" is complex. In reviewing Table 1, can the authors be sure that these aren't cases that are then transferred and hospitalized through delivery. For some of these conditions it is hard to believe that a pregnant patient is discharged home after having one of these events (mostly acute major organ system failure), with the possible exception of blood transfusion.
5. Because of the difficulties with transfusion coding and the lack of association with transfusions alone and death, there is also a national conversation to drop transfusion from the SMM measure. The authors elaborate on this issue in the discussion but could further clarify how it would affect the 21.9% of additional cases identified when both prenatal and postpartum periods are included?
6. The nature of this population database is somewhat opaque, so it is unclear how these findings apply to the U.S. situation. The authors allude to this issue in their discussion of limitations, but perhaps can expound further on this dataset.
7. The authors' call to action around prenatal and postpartum considerations is a valid one, but perhaps the linkage to the findings in this study could be tempered given the study limitations.

Reviewer #3:

This is a very well-written and thoughtfully described study which examines the impact of incorporating events occurring during pregnancy and in the postpartum period to measures of severe maternal morbidity. The authors find that adding prenatal and postpartum hospitalizations significantly increased detection of SMM, with the largest increase represented by cases of sepsis and venous thromboembolism.

This work provides additional evidence that in order to improve the rates of SMM, we must think more broadly about pregnancy-associated morbidity/mortality as something which doesn't just occur during or immediately following delivery. This is an important and timely message in the era of "the fourth trimester".

I have the following comments:

1. The authors briefly touch on drug overdose and suicide as causes of SMM. These may be even more significant in the postpartum period. Are there associated ICD codes that reflect these outcomes, or are they largely excluded from the analysis in this study? Complications of hypertensive disorders of pregnancy are also conspicuously absent, although these may be accounted for by the intracranial hemorrhage codes, etc. ACOG and SMFM have published an obstetric care consensus regarding screening and review of severe maternal morbidity, in which they list suggested diagnoses and complications that constitute severe maternal morbidity. Please comment regarding these coding considerations and how they may affect the findings in this study.
2. The authors report that the demographics of the study population are different than the general population. However, the demographic breakdown is not reported in the results section. This would be helpful to see and to discuss further.
3. Please comment on how, or if, inconsistencies in coding among different providers/institutions/regions may affect your results, and possibly the generalizability of your results to other institutions.
4. Why was the 42 day (6 week) timeframe selected for postpartum analysis, rather than 12 weeks, for example?
5. Although not incorrect, I believe the title could be more compelling. This is a very interesting and timely study.

STATISTICS EDITOR COMMENTS:

Lines 16-22: In the abstract and in main text, need to include CIs with SMM rates per 10,000 deliveries.

lines 59-62: Need to explain (could be in supplemental), the distinction between deterministic and probabilistic matching. How accurately were records matched to assure that an SMM event occurred in the same individual registered in delivery and non-birth discharges?

lines 72-81: Should include a flow diagram to summarize the analytic sample vs the total sample.

General: Since this was a multi-year study, how many individual mothers were included among the 594,056 deliveries, how many non-singleton births were included in the analytic sample and to what extent were the SMM metrics potentially influenced by (1) non-singleton births and (2) multiple events for an individual woman?

Table 1: While it is informative to have a summary of a large body of information, should have some measure of context for what otherwise are formatted as exact estimates. Should include CIs for the % cases added, esp since some of these events are rare and would have wider CIs than others.

EDITORIAL OFFICE COMMENTS:

1. The Editors of Obstetrics & Gynecology have increased transparency around its peer-review process, in line with efforts to do so in international biomedical peer review publishing. If your article is accepted, we will be posting this revision letter as supplemental digital content to the published article online. Additionally, unless you choose to opt out, we will also be including your point-by-point response to the revision letter. If you opt out of including your response, only the revision letter will be posted. Please reply to this letter with one of two responses:

- A. OPT-IN: Yes, please publish my point-by-point response letter.
- B. OPT-OUT: No, please do not publish my point-by-point response letter.

2. When you submit your revised manuscript, please make the following edits to ensure your submission contains the required information that was previously omitted for the initial double-blind peer review:

- * Include your title page information in the main manuscript file. The title page should appear as the first page of the document. Add any previously omitted Acknowledgements (ie, meeting presentations, preprint DOIs, assistance from non-byline authors).
- * Funding information (ie, grant numbers or industry support statements) should be disclosed on the title page and in the body text. For industry-sponsored studies, the Role of the Funding Source section should be included in the body text of the manuscript.
- * Include clinical trial registration numbers, PROSPERO registration numbers, or URLs at the end of the abstract (if applicable).
- * Name the IRB or Ethics Committee institution in the Methods section (if applicable).
- * Add any information about the specific location of the study (ie, city, state, or country), if necessary for context.

3. Obstetrics & Gynecology uses an "electronic Copyright Transfer Agreement" (eCTA), which must be completed by all authors. When you uploaded your manuscript, each co-author received an email with the subject, "Please verify your authorship for a submission to Obstetrics & Gynecology." Please check with your coauthors to confirm that they received and completed this form, and that the disclosures listed in their eCTA are included on the manuscript's title page.

4. Our journal requires that all evidence-based research submissions be accompanied by a transparency declaration statement from the manuscript's lead author. The statement is as follows: "The lead author* affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained."

*The manuscript's guarantor.

If you are the lead author, please include this statement in your cover letter. If the lead author is a different person, please ask him/her to submit the signed transparency declaration to you. This document may be uploaded with your submission in Editorial Manager.

5. If you use an administrative database, the database used must be shown to be reliable and validated. In your response, please tell us who entered the data and how the accuracy of the database was validated. This same information should be included in the Materials and Methods section of the manuscript.

6. Your study uses ICD-10 data, please make sure you do the following:

- a. State which ICD-10-CM/PCS codes or algorithms were used as Supplemental Digital Content.
- b. Use both the diagnosis and procedure codes.
- c. Verify the selected codes apply for all years of the study.
- d. Conduct sensitivity analyses using definitions based on alternative codes.
- e. For studies incorporating both ICD-9 and ICD-10-CM/PCS codes, the Discussion section should acknowledge there may be disruptions in observed rates related to the coding transition and that coding errors could contribute to limitations of the study. The limitations section should include the implications of using data not created or collected to answer a specific research question, including possible unmeasured confounding, misclassification bias, missing data, and changing participant eligibility over time.
- f. The journal does not require that the title include the name of the database, geographic region or dates, or use of database linkage, but this data should be included in the abstract.
- g. Include RECORD items 6.3 and 7.1, which relate to transparency about which codes, validation method, and linkage were used to identify participants and variables collected.

7. Standard obstetric and gynecology data definitions have been developed through the reVITALize initiative, which was convened by the American College of Obstetricians and Gynecologists and the members of the Women's Health Registry Alliance. Obstetrics & Gynecology has adopted the use of the reVITALize definitions. Please access the obstetric data definitions at <https://www.acog.org/practice-management/health-it-and-clinical-informatics/revitalize-obstetrics-data-definitions> and the gynecology data definitions at <https://www.acog.org/practice-management/health-it-and-clinical-informatics/revitalize-gynecology-data-definitions>. If use of the reVITALize definitions is problematic, please discuss this in your point-by-point response to this letter.

8. Because of space limitations, it is important that your revised manuscript adhere to the following length restrictions by manuscript type: Original Research reports should not exceed 5,500 words. Stated word limits include the title page, précis, abstract, text, tables, boxes, and figure legends, but exclude references.

9. Specific rules govern the use of acknowledgments in the journal. Please note the following guidelines:

- * All financial support of the study must be acknowledged.
- * Any and all manuscript preparation assistance, including but not limited to topic development, data collection, analysis, writing, or editorial assistance, must be disclosed in the acknowledgments. Such acknowledgments must identify the entities that provided and paid for this assistance, whether directly or indirectly.
- * All persons who contributed to the work reported in the manuscript, but not sufficiently to be authors, must be acknowledged. Written permission must be obtained from all individuals named in the acknowledgments, as readers may infer their endorsement of the data and conclusions. Please note that your response in the journal's electronic author form verifies that permission has been obtained from all named persons.
- * If all or part of the paper was presented at the Annual Clinical and Scientific Meeting of the American College of Obstetricians and Gynecologists or at any other organizational meeting, that presentation should be noted (include the exact dates and location of the meeting).
- * If your manuscript was uploaded to a preprint server prior to submitting your manuscript to Obstetrics & Gynecology, add the following statement to your title page: "Before submission to Obstetrics & Gynecology, this article was posted to a preprint server at: [URL]."

10. Provide a short title of no more than 45 characters (40 characters for case reports), including spaces, for use as a running foot.

11. Provide a précis on the second page, for use in the Table of Contents. The précis is a single sentence of no more than 25 words that states the conclusion(s) of the report (ie, the bottom line). The précis should be similar to the abstract's conclusion. Do not use commercial names, abbreviations, or acronyms in the précis. Please avoid phrases like "This paper presents" or "This case presents."

12. The most common deficiency in revised manuscripts involves the abstract. Be sure there are no inconsistencies between the Abstract and the manuscript, and that the Abstract has a clear conclusion statement based on the results found in the paper. Make sure that the abstract does not contain information that does not appear in the body text. If you submit a revision, please check the abstract carefully.

In addition, the abstract length should follow journal guidelines. The word limit for Original Research articles is 300 words; Reviews is 300 words; Case Reports is 125 words; Current Commentary articles is 250 words; Executive Summaries, Consensus Statements, and Guidelines are 250 words; Clinical Practice and Quality is 300 words; Procedures and Instruments is 200 words. Please provide a word count.

13. Only standard abbreviations and acronyms are allowed. A selected list is available online at <http://edmgr.ovid.com/ong/accounts/abbreviations.pdf>. Abbreviations and acronyms cannot be used in the title or précis. Abbreviations and acronyms must be spelled out the first time they are used in the abstract and again in the body of the manuscript.

14. The journal does not use the virgule symbol (/) in sentences with words. Please rephrase your text to avoid using "and/or," or similar constructions throughout the text. You may retain this symbol if you are using it to express data or a measurement.

15. In your Abstract, manuscript Results sections, and tables, the preferred citation should be in terms of an effect size, such as odds ratio or relative risk or the mean difference of a variable between two groups, expressed with appropriate confidence intervals. When such syntax is used, the P value has only secondary importance and often can be omitted or noted as footnotes in a Table format. Putting the results in the form of an effect size makes the result of the statistical test more clinically relevant and gives better context than citing P values alone.

If appropriate, please include number needed to treat for benefits (NNTb) or harm (NNTh). When comparing two procedures, please express the outcome of the comparison in U.S. dollar amounts.

Please standardize the presentation of your data throughout the manuscript submission. For P values, do not exceed three decimal places (for example, "P = .001"). For percentages, do not exceed one decimal place (for example, 11.1%).

16. Please review the journal's Table Checklist to make sure that your tables conform to journal style. The Table Checklist is available online here: http://edmgr.ovid.com/ong/accounts/table_checklist.pdf.

17. Please review examples of our current reference style at <http://ong.editorialmanager.com> (click on the Home button in the Menu bar and then "Reference Formatting Instructions" document under "Files and Resources"). Include the digital object identifier (DOI) with any journal article references and an accessed date with website references. Unpublished data, in-press items, personal communications, letters to the editor, theses, package inserts, submissions, meeting presentations, and abstracts may be included in the text but not in the reference list.

In addition, the American College of Obstetricians and Gynecologists' (ACOG) documents are frequently updated. These documents may be withdrawn and replaced with newer, revised versions. If you cite ACOG documents in your manuscript, be sure the references you are citing are still current and available. Check the Clinical Guidance page at <https://www.acog.org/clinical> (click on "Clinical Guidance" at the top). If the reference is still available on the site and isn't listed as "Withdrawn," it's still a current document.

If the reference you are citing has been updated and replaced by a newer version, please ensure that the new version supports whatever statement you are making in your manuscript and then update your reference list accordingly (exceptions could include manuscripts that address items of historical interest). If the reference you are citing has been withdrawn with no clear replacement, please contact the editorial office for assistance (obgyn@greenjournal.org). In most cases, if an ACOG document has been withdrawn, it should not be referenced in your manuscript.

18. When you submit your revision, art saved in a digital format should accompany it. If your figure was created in Microsoft Word, Microsoft Excel, or Microsoft PowerPoint formats, please submit your original source file. Image files should not be copied and pasted into Microsoft Word or Microsoft PowerPoint.

When you submit your revision, art saved in a digital format should accompany it. Please upload each figure as a separate file to Editorial Manager (do not embed the figure in your manuscript file).

If the figures were created using a statistical program (eg, STATA, SPSS, SAS), please submit PDF or EPS files generated directly from the statistical program.

Figures should be saved as high-resolution TIFF files. The minimum requirements for resolution are 300 dpi for color or black and white photographs, and 600 dpi for images containing a photograph with text labeling or thin lines.

Art that is low resolution, digitized, adapted from slides, or downloaded from the Internet may not reproduce.

19. Authors whose manuscripts have been accepted for publication have the option to pay an article processing charge and publish open access. With this choice, articles are made freely available online immediately upon publication. An information sheet is available at <http://links.lww.com/LWW-ES/A48>. The cost for publishing an article as open access can be found at <https://wkauthorservices.editage.com/open-access/hybrid.html>.

If your article is accepted, you will receive an email from the editorial office asking you to choose a publication route (traditional or open access). Please keep an eye out for that future email and be sure to respond to it promptly.

If you choose open access, you will receive an Open Access Publication Charge letter from the Journal's Publisher, Wolters Kluwer, and instructions on how to submit any open access charges. The email will be from publicationservices@copyright.com with the subject line, "Please Submit Your Open Access Article Publication Charge(s)." Please complete payment of the Open Access charges within 48 hours of receipt.

If you choose to revise your manuscript, please submit your revision through Editorial Manager at <http://ong.editorialmanager.com>. Your manuscript should be uploaded as a Microsoft Word document. Your revision's cover letter should include the following:

- * A confirmation that you have read the Instructions for Authors (<http://edmgr.ovid.com/ong/accounts/authors.pdf>), and
- * A point-by-point response to each of the received comments in this letter. Do not omit your responses to the Editorial Office or Editors' comments.

If you submit a revision, we will assume that it has been developed in consultation with your co-authors and that each author has given approval to the final form of the revision.

Again, your paper will be maintained in active status for 21 days from the date of this letter. If we have not heard from you by Oct 15, 2021, we will assume you wish to withdraw the manuscript from further consideration.

Sincerely,
Torri D. Metz, MD
Associate Editor, Obstetrics

2020 IMPACT FACTOR: 7.661
2020 IMPACT FACTOR RANKING: 3rd out of 83 ob/gyn journals

In compliance with data protection regulations, you may request that we remove your personal registration details at any time. (Use the following URL: <https://www.editorialmanager.com/ong/login.asp?a=r>). Please contact the publication office if you have any questions.



Editors,
Obstetrics and Gynecology

October 10, 2021

Dear Editors,

We are resubmitting our paper, “Using a Longitudinally Linked Database to Reconsider the Measurement of Severe Maternal Morbidity” to *Obstetrics and Gynecology*. This research has not been presented or submitted elsewhere. I hereby submit this revised manuscript for consideration in *Obstetrics & Gynecology* along with a point-by-point response to comments from reviewers and editors. We list the ICD-9 and ICD-10-CM/PCS codes or algorithms we used as Supplemental Digital Content. We used both the diagnosis and procedure codes and, since we presented trends over time, we distinguished cases identified by ICD-9 from those identified by ICD-10 and discuss the implications of those differences. We note that the algorithm developed for severe maternal morbidity (SMM) under ICD-9 had been validated while the ICD-10 version has not, and validation of the newer algorithm is one of our recommendations. The study on which this is based has received IRB approval from the Massachusetts Department of Public Health. It was funded by NIH Grant number RO1 MD016026-01. We have also submitted a completed STROBE checklist.

We continue to believe the paper addresses an important issue in contemporary maternal health care – the limitation of the very widely used measurement of severe maternal morbidity (SMM) to the birth event. We use a longitudinally linked population-based dataset to apply the SMM algorithm to a birthing individual’s prenatal and postpartum hospitalizations and find an additional 21.9% cases of severe morbidity. Since we also bring the period covered more up to date (through 2018) than current CDC data, which ends in 2014, we can develop a more complete picture of the contemporary scope of the problem and our findings suggest that current estimates may need to be revised well beyond the familiar “50,000 cases of SMM,” to something closer to 90,000 cases nationally. We hope the editors and reviewers agree with our judgment about the quality and importance of this paper.

Eugene Declercq affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained. The author has read the Instruction for Authors.

Sincerely,

A handwritten signature in black ink that reads "Eugene Declercq". The script is cursive and fluid, with the first name "Eugene" and last name "Declercq" clearly distinguishable.

Eugene Declercq, PhD
Professor, Community Health Sciences

Comment	Response
<p>This manuscript presents the results of an analysis where the authors sought to expand the currently used construct for identifying women with severe maternal morbidity (SMM) by going beyond the delivery hospitalization and including prenatal and postpartum hospitalizations. To accomplish this, they used an apparently state-based longitudinally-linked database where birth and fetal death records were linked to hospitalization events for individual women. This allowed for a person-based analysis instead of the usual discharge-based analysis available with hospital discharge databases. They focused on the period 2009-2018 and allowed for the conversion to ICD-10 for discharge coding beginning October 2015. The authors found that indications of SMM increased across the time period and that adding prenatal and postpartum periods increased the estimate of the SMM rate by 22%. The authors conclude that enhancing surveillance to include the entire peripartum period provides opportunities to further improve quality of care throughout this longer cycle in hopes of preventing maternal morbidity and mortality.</p> <p>This paper is a good example of how existing surveillance can be enhanced and demonstrates the dynamic nature of using quality improvement to improve the surveillance system as well as the outcomes that are the targets of the system.</p>	
1. Abstract, line 4; "mortality" should be "morbidity."	Done
2. Introduction, line 40; It is more precise to use the term "categories" as opposed to "codes." There are 25 categories composed of far more than 25 codes.	Done
3. Introduction, line 41; A better reference than 4 would be Callaghan et al. Obstet Gynecol 2012;120:1029-36 as that was the basis for the initial 25 category construct and used for web-based reporting.	Agree. Reference was added.
4. Methods, line 80; Can the authors be a bit more specific about "questionable ICD-10 coding?"	We added language to clarify the problem with the data provided by one of the hospitals
5. Methods, line 85; Again, "categories" is a more precise term when referring to the 25 versus 21 in ICD-9 to ICD-10.	DONE – we changed the terms
6. Methods, lines 102-103; You might cite the CDC SMM website to justify reporting SMM with and without transfusions as it is reported as such there as well as elsewhere in the literature.	Done. Line 104
7. Results, line 127; I am less impressed that the trend in Figure 1 reveals two patterns. The initial change with ICD-10 is very small and the overall trend tells the story.	Language was adjusted (Line 151)
8. Discussion, first paragraph; You should cite Callaghan et al. (2010) referred to in comment #3. Those authors also looked at postpartum SMM hospitalizations. Although their method cannot be applied to ICD-10 and they were unable to separate individual women from the event of hospitalization, the addition of postpartum SMM was proportionately similar	Language added reflecting the concern raised by the comment (Lines 194-96)

to those you found and this adds credibility to your findings.	
9. Somewhere toward the end of the discussion, it would be good to make an advocacy call out to encourage more states to develop longitudinally linked perinatal databases. You demonstrate their power and utility, yet there are precious few routinely linked databases outside of special studies.	Language added reflecting the concern raised by the comment by emphasizing state population based datasets. (Line 318)
Reviewer #2:	
<p>The authors' objective was to determine the impact on the number of cases of severe maternal mortality (SMM) when applying the standard algorithm to the prenatal and postpartum (42 days) periods as well as the delivery event. To accomplish this they performed a cohort analysis on data from a population-based data system that links records from live birth and fetal death certificates to corresponding delivery hospital discharge records and non-birth hospital utilization records for birthing individuals over time. They focused on deliveries from January 1, 2009 to December 31, 12 2018, distinguishing between ICD-9 (2009-2015Q2) and ICD-10 (2016Q4-2018) coding. They applied the modified CDC algorithm for SMM used by the Alliance for Innovation on Maternal Health based on 21 conditions and procedures. They found that SMM at birth increased steadily across both ICD-9 and ICD-10 from 129.4 in 2009 to 214.3 per 10,000 in 2018. Adding prenatal and postpartum hospitalizations increased the number of cases by 21.9% under both ICD-9 and ICD-10 resulting in a 2018 rate of 258.7 per 10,000. The largest increase was from sepsis cases. They conclude that an inpatient or delivery only focused intervention is insufficient to adequately recognize, prevent or respond to significant morbidity during the antepartum period.</p>	
1. The authors are correct that CDC/AIM has developed the SMM index to use in delivery hospitalization data because that is their QI outcome of interest, but others use the CDC SMM index outside of delivery events and have used longitudinal datasets. Can the authors comment or elaborate on any such related literature more fully?	Language added reflecting the concern raised by the comment. (LINES 262-269)
2. I also think that the CDC has held back on including postpartum in their official SMM definition because it's harder to know if it was pregnancy-related (i.e., a postpartum patient could have an injury, etc. not related to their pregnancy or delivery). Can the authors comment on this dimension more fully?	Despite their potential severity, the smm algorithm doesn't include injuries and to our knowledge studies have not been published linking injuries to smm, though studies of injuries and maternal mortality have been done and we cite one (LINES 266-69).
3. One technical point is that CDC/AIM apparently recently revised the SMM index to better address ICD-9/ICD-10 conversion issues. Can the authors clarify which version they used?	This study employed the ICD-9/ICD-10 codes from the AIM SMM codes list v07-01-2021, the most recent available version at the time when the analysis was conducted (for details, see supplemental table). Aim continues to update the list and publishes it at https://safehealthcareforeverywoman.org/aim/resources/aim-data-resources/ . We now note the version number in the methods.

4. The issue of "antepartum SMM" is complex. In reviewing Table 1, can the authors be sure that these aren't cases that are then transferred and hospitalized through delivery. For some of these conditions it is hard to believe that a pregnant patient is discharged home after having one of these events (mostly acute major organ system failure), with the possible exception of blood transfusion.	This study used data from a longitudinally linked data set, in which hospitalizations with delivery diagnostic or procedure codes were first pulled out from the pool as the core delivery hospitalizations (and subsequent validated with vitals records, e.g., procedure date in hospital record to match date of delivery in vitals record). All other hospitalizations by the same women were either defined as antepartum or postpartum hospitalizations based on the dates of admission. Thus, cases that are transferred and hospitalized through delivery in this study will be defined as "delivery SMM", not "antepartum SMM".
5. Because of the difficulties with transfusion coding and the lack of association with transfusions alone and death, there is also a national conversation to drop transfusion from the SMM measure. The authors elaborate on this issue in the discussion but could further clarify how it would affect the 21.9% of additional cases identified when both prenatal and postpartum periods are included?	We added language addressing this point in the Discussion. (LINES 276-282)
6. The nature of this population database is somewhat opaque, so it is unclear how these findings apply to the U.S. situation. The authors allude to this issue in their discussion of limitations, but perhaps can expound further on this dataset.	We have added a table comparing the characteristics of our analytic sample to the u.s. birthing population. Supplemental Table 1
7. The authors' call to action around prenatal and postpartum considerations is a valid one, but perhaps the linkage to the findings in this study could be tempered given the study limitations.	We have added to the discussion of limitations, but feel that there is sufficient evidence here and in related studies of linked databases to merit encouragement of more widespread use of them to further our understanding of the breadth of severe maternal morbidity.
Reviewer #3:	
<p>This is a very well-written and thoughtfully described study which examines the impact of incorporating events occurring during pregnancy and in the postpartum period to measures of severe maternal morbidity. The authors find that adding prenatal and postpartum hospitalizations significantly increased detection of SMM, with the largest increase represented by cases of sepsis and venous thromboembolism.</p> <p>This work provides additional evidence that in order to improve the rates of SMM, we must think more broadly about pregnancy-associated morbidity/mortality as something which doesn't just occur during or immediately following delivery. This is an important and timely message in the era of "the fourth trimester".</p>	
1. The authors briefly touch on drug overdose and suicide as causes of SMM. These may be	The reviewer is correct about the lack of a hypertension category. We have relied on the

<p>even more significant in the postpartum period. Are there associated ICD codes that reflect these outcomes, or are they largely excluded from the analysis in this study? THE SMM ALGORITHM DOES NOT INCLUDE THESE. Complications of hypertensive disorders of pregnancy are also conspicuously absent, although these may be accounted for by the intracranial hemorrhage codes, etc. ACOG and SMFM have published an obstetric care consensus regarding screening and review of severe maternal morbidity, in which they list suggested diagnoses and complications that constitute severe maternal morbidity. Please comment regarding these coding considerations and how they may affect the findings in this study.</p>	<p>algorithm developed jointly by CDC/HRSA/AHRQ/AIM to reflect what is presumably the most recent thinking about SMM. Perhaps hypertensive disorders will be included in a subsequent version of the algorithm, but for now we chose to apply the most widely used measure of SMM.</p>
<p>2. The authors report that the demographics of the study population are different than the general population. However, the demographic breakdown is not reported in the results section. This would be helpful to see and to discuss further.</p>	<p>Thank you. We added such a table as SUPPLEMENTARY TABLE 1.</p>
<p>3. Please comment on how, or if, inconsistencies in coding among different providers/institutions/ regions may affect your results, and possibly the generalizability of your results to other institutions.</p>	<p>We now discuss this issue further. (LINES 289-94).</p>
<p>4. Why was the 42 day (6 week) timeframe selected for postpartum analysis, rather than 12 weeks, for example?</p>	<p>We now address this question in LINES 135-36</p>
<p>5. Although not incorrect, I believe the title could be more compelling. This is a very interesting and timely study.</p>	<p>We discussed this possibility, but found alternatives were generally too long and chose to keep the original title.</p>
<p>STATISTICS EDITOR COMMENTS:</p>	
<p>Lines 16-22: In the abstract and in main text, need to include CIs with SMM rates per 10,000 deliveries.</p>	<p>We added CIs to the table and whenever a figure was mentioned was mentioned in the narrative.</p>
<p>lines 59-62: Need to explain (could be in supplemental), the distinction between deterministic and probabilistic matching. How accurately were records matched to assure that an SMM event occurred in the same individual registered in delivery and non-birth discharges?</p>	<p>We have added the following sentences as a footnote to the study sample flow diagram. Our study sample was linked using an integrated SAS application system, Linkpro 3.01, for probabilistic and deterministic record linkage. The system links records where no unique identifiers exist. It calculates and applies probabilistic weights in order to estimate the likelihood that a pair of records</p>

	from separate files corresponds to the same individual. Since the linkage launched in 1998, more than 99% of birth and fetal death certificates have been linked to their delivery hospital discharge records.
lines 72-81: Should include a flow diagram to summarize the analytic sample vs the total sample.	Done – SUPPLEMENTAL FIGURE 1.
General: Since this was a multi-year study, how many individual mothers were included among the 594,056 deliveries, how many non-singleton births were included in the analytic sample and to what extent were the SMM metrics potentially influenced by (1) non-singleton births and (2) multiple events for an individual woman?	The unit of analysis for this study is delivery not infant. While having non-singleton births or having more than one births may increase the risk of having SMM, it is not the scope of this study. We will examine risk factors in our other analyses. There are a total of 449,272 women contributing to the 594,056 deliveries. More than a quarter (28%) of them had more than 1 delivery during the study period. Of the 11,690 SMM deliveries, less than 2% were from same women.
Table 1: While it is informative to have a summary of a large body of information, should have some measure of context for what otherwise are formatted as exact estimates. Should include CIs for the % cases added, esp since some of these events are rare and would have wider CIs than others.	We have added cis to table 1 for the increase of cases of SMM. On the whole the CIs were not very wide.
EDITORIAL OFFICE COMMENTS	
1. The Editors of Obstetrics & Gynecology have increased transparency around its peer-review process, in line with efforts to do so in international biomedical peer review publishing. If your article is accepted, we will be posting this revision letter as supplemental digital content to the published article online. Additionally, unless you choose to opt out, we will also be including your point-by-point response to the revision letter. If you opt out of including your response, only the revision letter will be posted. Please reply to this letter with one of two responses:	WE OPT-IN
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Include your title page information in the main manuscript file. The title page should appear as the first page of the document. Add any previously omitted Acknowledgements (ie,	Done

meeting presentations, preprint DOIs, assistance from non-byline authors).	
Funding information (ie, grant numbers or industry support statements) should be disclosed on the title page and in the body text. For industry-sponsored studies, the Role of the Funding Source section should be included in the body text of the manuscript.	Done
Include clinical trial registration numbers, PROSPERO registration numbers, or URLs at the end of the abstract (if applicable).	NA
Name the IRB or Ethics Committee institution in the Methods section (if applicable).	Done
Add any information about the specific location of the study (ie, city, state, or country), if necessary for context.	Done
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4. Our journal requires that all evidence-based research submissions be accompanied by a transparency declaration statement from the manuscript's lead author. The statement is as follows: "The lead author* affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained." *The manuscript's guarantor.	Done – see cover letter
5. If you use an administrative database, the database used must be shown to be reliable and validated. In your response, please tell us who entered the data and how the accuracy of the database was validated. This same information should be included in the Materials and Methods section of the manuscript.	The data is drawn from an established population-based dataset linking birth certificate and hospital discharge data. The linkage process is described in the article and the response to reviewer queries.

<p>6. Your study uses ICD-10 data, please make sure you do the following:</p> <p>a. State which ICD-10-CM/PCS codes or algorithms were used as Supplemental Digital Content.</p> <p>b. Use both the diagnosis and procedure codes.</p> <p>c. Verify the selected codes apply for all years of the study.</p> <p>d. Conduct sensitivity analyses using definitions based on alternative codes.</p> <p>e. For studies incorporating both ICD-9 and ICD-10-CM/PCS codes, the Discussion section should acknowledge there may be disruptions in observed rates related to the coding transition and that coding errors could contribute to limitations of the study. The limitations section should include the implications of using data not created or collected to answer a specific research question, including possible unmeasured confounding, misclassification bias, missing data, and changing participant eligibility over time.</p> <p>f. The journal does not require that the title include the name of the database, geographic region or dates, or use of database linkage, but this data should be included in the abstract.</p> <p>g. Include RECORD items 6.3 and 7.1, which relate to transparency about which codes, validation method, and linkage were used to identify participants and variables collected.</p>	<p>A. DONE – Supplementary table</p> <p>B. DONE</p> <p>C. DONE</p> <p>D. IN EARLIER VERSIONS WE USED THE ORIGINAL CDC ALGORITHM, BUT FINALLY ADOPTED THE NEW CDC/HRSA/AHRQ/AIM MEASURE THAN BETTER REFLECTS LONGITUDINAL ANALYSIS.</p> <p>E. DONE</p> <p>F. DONE</p> <p>G. Codes described in Supplementary table & linkage described in manuscript.</p>
<p>7. Standard obstetric and gynecology data definitions have been developed through the reVITALize initiative, which was convened by the American College of Obstetricians and Gynecologists and the members of the Women's Health Registry Alliance. Obstetrics & Gynecology has adopted the use of the reVITALize definitions. Please access the obstetric data definitions at https://www.acog.org/practice-management/health-it-and-clinical-informatics/revitalize-obstetrics-data-definitions and the gynecology data definitions at </p>	

management/health-it-and-clinical-informatics/revitalize-gynecology-data-definitions. If use of the reVITALize definitions is problematic, please discuss this in your point-by-point response to this letter.	
8. Because of space limitations, it is important that your revised manuscript adhere to the following length restrictions by manuscript type: Original Research reports should not exceed 5,500 words. Stated word limits include the title page, précis, abstract, text, tables, boxes, and figure legends, but exclude references.	Word Count – 4,381
<p>9. Specific rules govern the use of acknowledgments in the journal. Please note the following guidelines:</p> <ul style="list-style-type: none"> * All financial support of the study must be acknowledged. DONE * Any and all manuscript preparation assistance, including but not limited to topic development, data collection, analysis, writing, or editorial assistance, must be disclosed in the acknowledgments. Such acknowledgments must identify the entities that provided and paid for this assistance, whether directly or indirectly. DONE * All persons who contributed to the work reported in the manuscript, but not sufficiently to be authors, must be acknowledged. Written permission must be obtained from all individuals named in the acknowledgments, as readers may infer their endorsement of the data and conclusions. Please note that your response in the journal's electronic author form verifies that permission has been obtained from all named persons. DONE * If all or part of the paper was presented at the Annual Clinical and Scientific Meeting of the American College of Obstetricians and Gynecologists or at any other organizational meeting, that presentation should be noted (include the exact dates and location of the meeting). N/A * If your manuscript was uploaded to a preprint server prior to submitting your manuscript to Obstetrics & Gynecology, add the following statement to your title page: "Before submission to Obstetrics & Gynecology, this article was posted to a preprint server at: [URL]." N/A 	
10. Provide a short title of no more than 45 characters (40 characters for case reports), including spaces, for use as a running foot.	Done -- Reconsidering the Measure of Severe Morbidity
11. Provide a précis on the second page, for use in the Table of Contents. The précis is a single sentence of no more than 25 words that states the conclusion(s) of the report (ie, the bottom line). The précis should be similar to the abstract's conclusion. Do not use commercial names, abbreviations, or acronyms in the précis. Please avoid phrases like "This paper presents" or "This case presents."	Done -- Utilizing linked datasets can expand the discussion of severe maternal morbidity from birth events to the overall health of birthing individuals in the U.S.
12. The most common deficiency in revised manuscripts involves the abstract. Be sure	Done

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13. Only standard abbreviations and acronyms are allowed. A selected list is available online at http://edmgr.ovid.com/ong/accounts/abbreviations.pdf . Abbreviations and acronyms cannot be used in the title or précis. Abbreviations and acronyms must be spelled out the first time they are used in the abstract and again in the body of the manuscript.	Done
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percentages, do not exceed one decimal place (for example, 11.1%).	
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