METHODOLOGY BRIEF
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An Enhanced Method for Identifying Hospital-Based Obstetric Unit Status, Version 2 with Addendum

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Key Findings

- We developed an enhanced, two-stage method for identifying hospital-based obstetric unit status. This method involved 1) single-year assessments using four American Hospital Association (AHA) variables and one Provider of Services (POS) variable, followed by 2) multi-year assessments to check for and correct status inconsistencies over time and account for hospital mergers.
- There were 529 (11.2%) hospitals that had inconsistencies in obstetric unit status across the study period (2010-2018), resulting in obstetric unit status changes in 200 of those hospitals (37.8%).
- We compared our method to a primary survey sample of rural hospitals asking about their obstetric unit status. Had we only used POS data, we would have captured 61.0% of obstetric unit closures, on average two years late, and incorrectly identified one additional closure. Had we only used AHA data, we would have captured 87.8% of closures, on average one year late, and incorrectly identified eight additional closures. Our enhanced method was the most accurate, capturing 92.7% of closures 0.3 years late with six incorrectly identified additional closures.
- Had we ignored hospital mergers, we would have identified 32 fewer hospitals with current obstetric services, but 44 additional hospitals would have looked like they had experienced an obstetric unit closure when in fact they had not.

Purpose

Health services research has used a range of methods for measuring whether hospitals have an obstetric unit. Variation across methods may lead to inaccurate or inconsistent findings and to different conclusions about access to obstetric services. Having a clear and consistent measurement of obstetric care access is important for policymaking on rural health as well as maternal and infant health. As such, there is a need for a transparent and replicable process for consistently defining whether a hospital has an obstetric unit. The purpose of this methodology brief is to describe an enhanced method for identifying hospital-based obstetric unit status and for identifying closures of obstetric units.

Background and Policy Context

Provision of hospital-based obstetric services has been consistently declining since the early 2000s, specifically in rural communities, with important consequences for maternal and infant health.[1–3] Prior research indicates important differences between rural hospitals that provide obstetric care and those that do not; hospitals without obstetric units tend to be located in more remote rural areas and have lower patient volume.[4] A wide range of methods have been used to identify the presence of obstetric units in hospitals, but these methods have not been validated. One approach uses individual indicators of obstetric services in the American Hospital Association (AHA) Annual Survey of Hospitals (i.e., self-reported provision of obstetric services or number of annual births); another approach uses data from the Centers for Medicare & Medicaid Services (CMS) Provider of Services (POS) File. Yet another approach leverages administrative data from hospital discharges including International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) codes associated with childbirth hospitalizations.[5–7] From

a policy perspective, it is essential to use a consistent and accurate measure to identify whether hospitals have obstetric services available, as well as the levels of maternal and neonatal care provided. Such information will improve programming and targeting of resources designed to ensure access to high-quality obstetric care and contribute to efforts to address the U.S. maternal health crisis.

Approach

To identify the presence of hospital-based obstetric units and obstetric unit closures, we developed and implemented an enhanced method that uses annual hospital survey data from the AHA in addition to annual administrative data on hospitals from the CMS POS files. We collected primary survey data for validation. In brief, this enhanced method involved identifying short-term acute care hospitals, then conducting a two-stage assessment: 1) single-year assessments of obstetric unit status using four AHA variables and one variable from the POS data, then 2) multi-year assessments to check for and correct obstetric unit status inconsistencies. This method is summarized in **Figure 1**. The details of and rationale for this enhanced method are as follows.

Using AHA data from 2010 through 2018, we first restricted our data to hospitals that were classified as non-federal short-term acute care hospitals or obstetrics and gynecology specialty hospitals throughout the study period (primary service code [SERV] 10 or 44, respectively). This step excludes facilities where measurement of obstetric service availability is not relevant (e.g., psychiatric hospitals, rehabilitation centers, or other specialty treatment centers). Federally-run hospitals (e.g., Indian Health Service, military hospitals, etc.) were excluded in this assessment because they have different funding models and patient populations. However, the same process could be used including these hospitals, if the topic or research question warrants inclusion.

Hospital service type can change over time, therefore we also included hospitals that indicated these primary service codes (10 and 44) for all years except for one year in the middle of the study period. If the AHA data indicated those services for all but one end year, or if indicators changed multiple times throughout the study period, we verified services using website searches. If hospitals provided those services consistently for part of the study period, then converted to a different service type for the rest of the study period, we assumed that hospital service type changed; in effect, these changes amounted to a hospital closure.

First Stage: Single-Year Assessment (Hospital-Year Level)

AHA Criterion

In the first stage, we conducted single-year assessments of obstetric unit status at the hospital-year level. We did this first using four AHA variables and then comparing certain cases against POS data. Specifically, the four AHA criteria were:

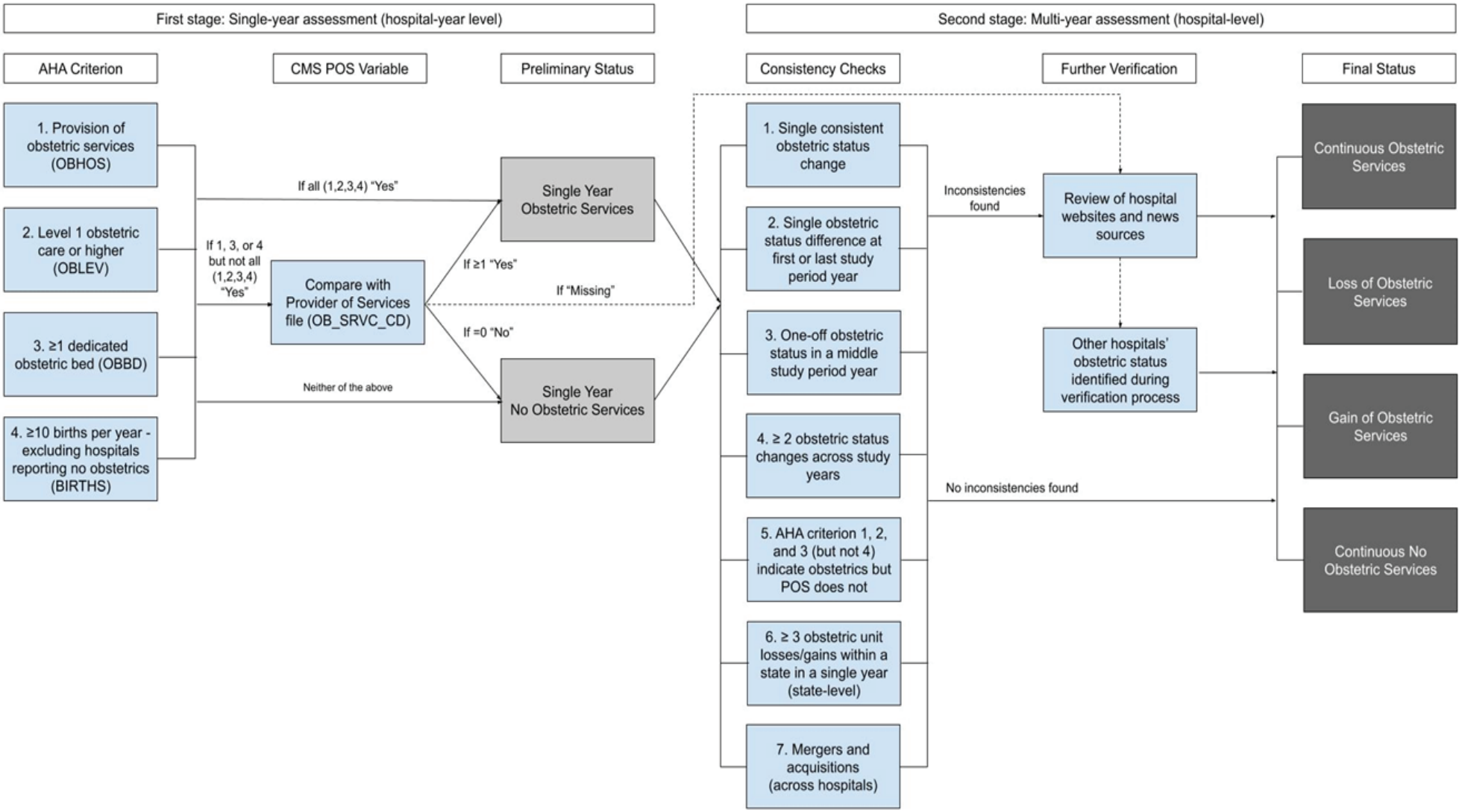
1. Provision of obstetric services [OBHOS = 1]
2. Level 1 (routine provision of basic obstetric care) or higher obstetric care[8] [OBLEV ≥ 1]
3. At least one dedicated obstetric bed in the hospital [OBBD ≥ 1]
4. At least 10 births per year (excluding hospitals that indicated no provision obstetric services) [BIRTHS ≥ 10 if OBHOS ≠ 0]

Of note, we restricted criterion 4 (births) to only those hospital-years reporting (or missing response) for provision of obstetric services (criterion 1) to better capture obstetric unit closures because of the estimation process that AHA employs for this variable. If a hospital does not respond to the survey or does not report births for that year, AHA conducts an estimation process, described in the Technical User Notes of the Survey documentation. In short, AHA uses either (1) a regression model to predict number of births based on previous year's data and estimation status, percent change in state median, Metropolitan Statistical Area size, and bed size, or (2) a matrix of estimators through a stratification process based on hospital control, service, bed size, and length of stay. Thus, this estimation process may result in misclassification of obstetric unit status in a particular year if a hospital has recently closed its obstetric unit.

CMS POS Variable

If all four AHA criteria were met, we categorized the hospital-year as providing obstetric services. If criterion 1, 3, or 4 were met, we checked the hospital-year against the POS data. We did not include criterion 2 on its own because maternal levels of care are not consistently measured or assessed by hospitals; indeed, the initial scheme for maternal levels of care was just introduced in 2015[8] and has not consistently been in use or been validated

Figure 1. Algorithm for the enhanced method for identifying hospital-based obstetric unit status



over time. We defined obstetric service provision in the POS data as provision by staff or by arrangement.

Preliminary Status Designation

For hospitals meeting AHA criterion 1, 3, or 4, we categorized hospital-year obstetric service provision as follows:

- If the POS data indicated obstetric services [OB_SRVC_CD ≥ 1], we categorized the hospital-year as providing obstetric services.
- If the POS indicated no obstetric services [OB_SRVC_CD = 0], we categorized the hospital-year as not providing obstetric services.
- If the POS data was missing, it was flagged for further evaluation in the second-stage, multi-year assessment (e.g., using other years in AHA and POS, checking hospital websites and news sources).

Second Stage: Multi-Year Assessment (Hospital-Level)

Consistency Checks

In the second stage, we used the preliminary status identified in the first-stage, single-year assessment at the hospital-year level to implement a multi-year assessment at the hospital level, checking for and correcting obstetric unit status inconsistencies over time within each hospital. We identified seven types of obstetric unit status changes (types 1-5 at the hospital level, types 6-7 at the system level).

First, if a hospital's obstetric unit status changed only once during any middle year in the study period, we took this change as indicated. For example, if a hospital provided obstetric services consistently for part of the study period, then reported no obstetric services for the rest of the study period, we counted this change as an obstetric unit closure. Conversely, if a hospital provided no obstetric services at the beginning the study period, then reported obstetric services for the rest of the study period, we counted this change as an obstetric unit opening.

Second, if a hospital's obstetric unit status was consistent for all but one year at the beginning or end of the study period, the hospital was flagged for further verification.

The third type was if a hospital's obstetric unit status was consistent for all but one year in the middle of the study period. If all years but one indicated obstetric service provision, we corrected the middle year so that there was consistent provision throughout the study period. If all years but one indicated no obstetric services, the hospital was flagged for further verification.

Fourth, if a hospital's obstetric unit status changed multiple times in the study period, the hospital was flagged for further verification.

Fifth, we examined concordance between each AHA criterion and the POS data on obstetric service provision and noticed a decrease in concordance between the sources when all AHA criteria indicated obstetric services except for criterion 4 (births) and POS indicated no obstetric services (**Appendix Figure 1**). For these cases, we conducted a detailed examination of the AHA and POS data and the hospital was flagged for further verification.

Sixth, we examined large and sudden changes in obstetric service provision as a possible indicator of systematic data errors (**Appendix Figure 2**). If within any single state, between two consecutive years, the number of hospitals with obstetric units decreased or increased by three or more, the hospitals involved were flagged for further verification.

Seventh, we examined obstetric unit status changes among hospitals involved in mergers and acquisitions. Hospital IDs in the AHA can change over time in the case of a merger or acquisition, obscuring the presence of or changes in obstetric unit status over time. When two hospitals merge, they often get one consolidated AHA ID (either by both pre-merged IDs being dropped and an entirely new ID showing up in post-merger years, or by one of the pre-merged IDs being dropped and the other subsuming data from both hospitals in the post-merger years). In post-merger years, individual hospital-year level data for the four AHA criteria used to determine obstetric service provision cannot be observed. Being aware of such cases is important because ignoring mergers can lead to misclassification of hospital-based obstetric services and incorrect assessments of obstetric unit closures. I.e., the raw data may indicate that there is a closure when one has not actually occurred, or a closure of one hospital's obstetric unit may be obscured by the continuation of the other hospital's obstetric unit. This is especially important in rural hospitals, as hospital mergers may be followed by decreases in services provided, including obstetric services,[9,10] and since rural hospitals have experienced higher rates of hospital mergers

and of obstetric unit closures than urban hospitals.[3,6]

In order to assess individual hospital-year level obstetric unit status in these cases, we created hospital IDs that are consistent over time by "undoing" the ID consolidation, following the approach of Cooper et al.[11] We maintained pre-merger IDs in all years after the merger, unless a hospital had closed. We then imputed obstetric unit status by leveraging the obstetric variables in the pre-merger year, plus post-merge changes in obstetric variables at the level of the consolidated ID. We identified four different cases of mergers related to obstetric services, each with a different imputation approach, listed below:

- Case A: An obstetric hospital merged with another obstetric hospital; the merged entity also indicated obstetric services.
  - Solution: All were flagged for further verification.
- Case B: A non-obstetric hospital merged with another non-obstetric hospital; the merged entity had no obstetric services.
  - Solution: No assumptions necessary; both hospitals continued without obstetric services.
- Case C: An obstetric hospital merged with a non-obstetric hospital; the merged entity had obstetric services:
  - Solution: We assumed that the original obstetric hospital continued to provide obstetric services and the original non-obstetric hospital continued to not provide those services.
- Case D: An obstetric hospital merged with a non-obstetric hospital; the merged entity did not have obstetric services:
  - Solution: No assumption necessary; the original obstetric hospital closed their obstetric services, and the original non-obstetric hospital made no change.

Further Verification

For all hospitals that were flagged for further verification, a thorough review of hospital websites and relevant news sources (e.g., state and local newspapers) was conducted to determine current obstetric unit status and timing of any obstetric unit closure. All corrections to obstetric unit status from this further verification process were made at the hospital-year level.

Final Status

At the end of the two-stage assessment, all hospitals were given a final obstetric unit status based on their hospital-year level results:

- Continuous obstetric services: All study years indicated obstetric services.
- Loss of obstetric services: One or more consistent study years indicated obstetric services and no obstetric services were indicated at the end of the study period. The last year that obstetric services were reported in our data was considered the obstetric unit closure year.
- Gain of obstetric services: Similarly, one or more consistent early study years indicated no obstetric services and obstetric services were indicated at the end of the study period.
- Continuous no obstetric services: All study years indicated no obstetric services.

We conducted a series of sensitivity checks for our algorithm decisions at each stage of the assessment process, which are described in the results section below.

To validate our enhanced method for identifying hospital-based obstetric unit status, we compared our results to a primary survey sample of currently open rural hospitals with current obstetric services and those that had recently closed their obstetric units,[12] as rural hospitals are where the plurality of obstetric unit closures are occurring.[3,13] The primary survey sample frame included 200 randomly selected hospitals with current obstetric services in majority white rural counties (23% of the total 876 hospitals in this category), all 110 hospitals with current obstetric services in majority non-white rural counties, and all 132 rural hospitals that closed their obstetric units but were still open and operating as hospitals. Hospitals with obstetric unit closures that we sampled were those with closures during the years that we could determine loss of obstetric services during our study period (i.e., 2010 through 2017, as we needed data from the subsequent year to determine loss of services). In the primary survey sample, current obstetric unit status and year of obstetric unit closure (when applicable) was reported by the Obstetric Nurse Manager/Coordinator, Chief Nursing Officer, or Chief Executive Officer via an online survey.

Results

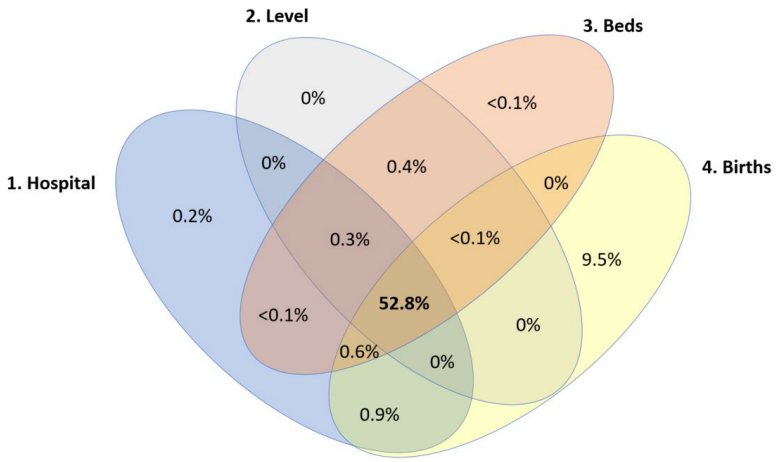
During 2010 through 2018, there were 41,252 hospital-years (representing 4,739 unique hospitals IDs) in the AHA that met our inclusion criteria (where measurement of obstetric service availability is relevant). Of these, 41.4% of hospital years (16,969) and 40.7% of hospitals (1,928) were rural. This included the 2,099 hospital-years (236 hospitals) involved in mergers, approximately 13% of which were rural.

First-Stage Assessment

At the start of the first-stage assessment, we examined the four AHA obstetric criteria in isolation, which included 40,583 hospital-years (4,739 hospitals) that had individually reported AHA survey data (i.e., hospital-years that were not during or after a merger). We found that 52.8% of hospital-years met all four AHA criteria while 35.3% reported none (**Figure 2**). Of note, no hospitals reported obstetric care level in isolation and 9.5% reported births as the only criterion.

After AHA criteria assessment, AHA findings were combined with data from POS, when indicated – i.e., when criteria 1, 3, or 4 were met but all indicators were not satisfied (11.9% of hospital-years) (**Table 1**). The POS data indicated obstetric services for 4,417 hospital-years (10.9%), bringing the total to 63.6% of hospital-years indicating obstetric services.

Figure 2. Concordance of the four AHA obstetric criteria in the first-stage, single-year assessment (N=40,583; hospital-years)



Hospital-years N (%)	1. Hospital (OBHOS = 1)	2. Level (OBLEV ≥ 1)	3. Beds (OBBD ≥ 1)	4. Births (Births ≥ 10 if OBHOS ≠ 0)
		All four indicators		
21414 (52.8)	X	X	X	X
		Three indicators		
108 (0.3)	X	X	X	
0	X	X		X
245 (0.6)	X		X	X
4 (0.0)		X	X	X
		Two indicators		
0	X	X		
3 (0.0)	X		X	
347 (0.9)	X			X
181 (0.4)		X	X	
0		X		X
0			X	X
		One indicator		
89 (0.2)	X			
0		X		
11 (0.0)			X	
3842 (9.5)				X
		No indicators		
14339 (35.3)				

To check our first-stage assumptions, we examined what would have happened had we not allowed estimated births to act the same as reported births, given the estimation process for the births conducted by AHA described above. In our data, 20.1% (n=8,168) of hospital-years had estimated births. If only reported births were accepted in our algorithm, 517 (1.3%) hospital-years would have fallen out of the four AHA criteria category and moved to POS review, and all 3,842 (9.5%) hospital-years where births were the only AHA criteria that was met would not have met the criteria for POS review and would have been classified as no obstetric unit. Thus, we would have categorized 54.2% of hospital-years as having obstetric units. However, in examining the POS data for these cases, all but 273 hospital-years indicated obstetric services via POS.

Second-Stage Assessment

In the second-stage, multi-year assessment, there were 4,739 unique hospital IDs (41,252 hospital-years) after "undoing" the ID consolidation as a result of mergers and acquisitions. In total, 529 (11.2%) hospitals were found to have inconsistencies in obstetric unit status across the study period that required further verification and/or corrections based on the criteria provided above. A summary of these inconsistencies is provided in **Table 2**, which resulted in 472 (1.1%) hospital-year changes in obstetric unit status across 200 hospitals. Almost one fifth of hospitals with inconsistencies were flagged under multiple criteria, while 54 (10.2%) hospitals were not flagged by any of our checks but were discovered during news searches of one of our flagged hospitals.

At the end of the second-stage assessment, we found that 63.7% of hospital-years indicated obstetric services and 36.3% did not (**Appendix Table 1**). From the first stage to the second stage, 138 hospital-years moved from obstetric services to no obstetric services, while 334 moved from no obstetric services to obstetric services. In our final obstetric unit status classification described earlier, we found 56.6% of hospitals had continuous obstetric services during the study period, while 6.9% experienced a loss of obstetric services (either the obstetric unit closed or the hospital – including the obstetric unit – closed entirely), and 2.6% experienced a gain of obstetric services (**Table 3**).

As further checks of our assumptions after the second-stage assessment, we examined the impact of 1) the birth estimation process, 2) our restricted used of the POS data for obstetric unit identification on final obstetric unit status, and 3) how the different sources and "undoing" mergers impacted identified timing of obstetric unit closures.

Of the 9.5% of hospital-years where births were the only AHA criterion that indicated obstetric services (all of which were estimated), almost all (92.6%) indicated obstetric services in the POS data, and 91.1% remained classified as providing obstetric services as their final status (**Appendix Table 2**). We also examined cases where birth was the only AHA criteria not to indicate obstetrics (**Appendix Table 3**). In most of these cases (44%), there was single-year discordance between the sources because it occurred around a gain or loss of an obstetric unit; 19% occurred in a very low birth volume hospital (<20 births annually), 27% were from likely reporting errors in the AHA survey (i.e., all other indicators and years in AHA and POS showed consistent obstetric or no obstetric services), and 10% seemed related to an error in the AHA birth estimation process (i.e., where the hospital-year estimated birth was 0 but preceding and subsequent years had reported births >0). We then examined what would happen if we allowed the POS individually (separate from the AHA criteria) to indicate obstetric service provision in our enhanced method. We found that 15.3% of hospital-years (2,189 of 14,339) that did not meet any of the AHA criteria had an indication of obstetric services in the POS data (**Appendix Table 4**). After the second-stage, multi-year assessment

Table 1. Preliminary obstetric status: Results from first-stage, single-year assessment (N=40,583; hospital-years)

Algorithm component	N (%)	Preliminary obstetric unit status
All four AHA criteria	21414 (52.8)	25,831 (63.6%) with obstetric services
AHA Criterion 1, 3, or 4 but not all	4830 (11.9)	
POS indicated obstetrics	4417 (10.9)	
POS missing	34 (0.1)	34 unknown
POS indicated no obstetrics	379 (0.9)	14,718 (36.3%) without obstetric services
No AHA Criteria	14339 (35.3)	

Table 2. Summary of inconsistency checks during the second-stage, multi-year assessment and associated obstetric unit status changes (N=4,739; hospital-level)

Inconsistency type	Total N (col %)	Other consistency checks flagged N (row %)	Change in any year obstetric unit status N (row %)	No. of obstetric unit status hospital-years changed within hospital	
				Mean ± SD	Median [IQR]
Further verification not indicated					
All indicated obstetrics except 1 middle year	51 (9.6)	7 (13.7)	51 (100)	1.2 ± 1.0	1 [1-1]
Case B, C, or D mergers*	157 (29.7)	22 (14.0)	17 (10.8)	2.9 ± 2.7	1 [1-3]
Further verification indicated					
Single difference at first or last year	75 (14.2)	50 (66.7)	36 (48.0)	2.3 ± 2.6	1 [1-2]
None indicated obstetrics except 1 middle year	8 (1.5)	3 (37.5)	8 (100)	3.6 ± 2.9	3 [1-6]
Multiple status changes	61 (11.5)	16 (26.2)	58 (95.1)	2.8 ± 1.6	3 [2-4]
AHA and POS discordance criteria met	50 (9.5)	22 (44.0)	18 (36.0)	2.6 ± 1.9	2 [1-3]
State-specific trends (3+ losses/gains in 1 year)	75 (14.2)	41 (54.7)	27 (36.0)	2.0 ± 2.0	1 [1-2]
Case A mergers*	79 (14.9)	14 (17.7)	16 (20.3)	3.1 ± 2.8	2 [1-4]
Associated news stories	72 (13.6)	18 (25.0)	28 (38.9)	2.5 ± 2.3	2 [1-3]
Total with inconsistencies	**529 (11.2)†**	**99 (18.7)**	**200 (37.8)**	**2.3 ± 2.1**	**1 [1-3]**

*Merger types: A = Two obstetric hospitals merged and the merged entity also had obstetrics; B = Two non-obstetric hospitals merged and the merged entity had no obstetrics; C = An obstetric hospital merged with a non-obstetric hospital and the merged entity had obstetrics; D = An obstetric hospital merged with a non-obstetric hospital and the merged entity did not have obstetrics.

†The total N is less than the sum of individual inconsistency checks because hospitals could be flagged via multiple inconsistency types. Percent for total inconsistencies is out of the 4,739 unique hospital in the AHA data, while percent for individual inconsistencies is out of the 529 total hospitals with inconsistencies.

Table 3. Final obstetric unit status classification after second-stage, multi-year assessment (N=4,739; hospital-level)

Final obstetric status	N (%)
Continuous obstetric services	2682 (56.6)
Loss of obstetric services	328 (6.9)
Gain of obstetric services	124 (2.6)
Continuous no obstetric services	1605 (33.9)

using our enhanced method, only 172 hospital-years with only POS indication moved to the obstetric services category.

The final obstetric unit status using our enhanced method identified 328 obstetric unit closures (including those when the hospital remained open, or when the hospital closed – in turn closing the obstetric unit) during the study period (**Appendix Table 5**, **Appendix Figure 3**). Had we only used POS data, we would have captured 57.9% of those closures an average of 0.8 years after the final enhanced method closure date, but also incorrectly identified an additional 189 closures. Had we only used AHA but ignored POS, we would have captured 89.9% of those closures 0.2 years later but also incorrectly identified an additional 143 closures. Had we only completed the first stage of the enhanced method (the preliminary status), we would have captured 94.2% of those closures 0.1 years later but also incorrectly identified an additional 39 closures. For most alternate methods, from the first to last study years, the number of closures not captured increased, but the accuracy of the closure date also increased.

We examined the impact of merger hospital treatment on our findings, comparing how ignoring the presence of mergers, excluding mergers, and "undoing" mergers changed the number of hospitals we found with obstetric units and those that experienced obstetric unit closures (**Appendix Table 6**). Compared to "undoing" mergers, had we excluded all hospitals involved in mergers, we would have identified 132 fewer hospitals with current obstetric services and 27 fewer hospitals that experienced obstetric unit closures; had we ignored hospital merger status and taken the data as given, we would have identified 32 less hospitals with current obstetric services but 44 additional hospitals would have looked like they had experienced an obstetric unit closure when in fact they had not.

Primary Survey Sample Comparison

Our primary survey sample comparison included 174 rural hospitals with current or recently closed obstetric units (Table 4). Our enhanced method underestimated the total number of hospitals with current obstetric services by 2.3% (130 vs. 133 hospitals), while it overestimated the total number of obstetric unit closures by 6.8% (44 vs. 41 closures).

We also examined differences in the year of obstetric unit closure in our primary survey sample to different identification methods (**Table 5**, **Figure 3**). Had we only used POS data, we would have captured 61.0% of primary survey reported obstetric unit closures an average of 2.0 years after the reported closure year, but also incorrectly identified an additional one closure. Had we only used AHA but ignored POS, we would have captured 87.8% of closures 1.0 years later but also incorrectly identified an additional eight closures. Had we only completed the first stage of the enhanced method (the preliminary status), we would have captured 92.7% of closures 0.9 years later but also incorrectly identified an additional eight closures. With both stages of our enhanced method (the final status), we captured 92.7% of closures 0.3 years later but also incorrectly identified an additional six closures. There were an additional 32 hospitals in our primary sample that reported having obstetric services in 2018 that were identified as obstetric unit closures in one of the alternate methods examined (30 using all AHA criteria, eight using any AHA criteria, one using POS, one using all AHA or POS, eight using preliminary enhanced status, six using final enhanced status).

Discussion and Implications

Key Findings

We developed and described an enhanced method for identifying hospital-based obstetric unit status, and for identifying closures of hospital-based obstetric units. Our method consists of a two-stage assessment: 1) single-year assessments of obstetric unit status using four AHA variables and one POS variable, followed by 2) multi-year assessments to check for and correct obstetric unit status inconsistencies. Between 2010 and 2018 there were 4,739 hospitals in the United States. Our enhanced method indicated that 56.6% of those hospitals had continuous obstetric services, 6.9% experienced an obstetric unit closure, 2.6% gained obstetric services, and 33.9% never had obstetric services during the study period.

We identified 529 (11.2%) hospitals that had inconsistencies in obstetric unit status across the study period, resulting in 472 (1.1%) hospital-year changes in obstetric unit status (an average of 2.3 years changed per hospital). When comparing our enhanced method against a primary survey sample of rural hospitals, we found that the enhanced method slightly overestimated the number of obstetric unit closures, but was more accurate than other methods, especially related to the

Table 4. Comparison of enhanced obstetric unit status identification method to a primary survey sample of rural hospitals with current or recently closed obstetric units (N=174; hospital-level)

Obstetric unit status	Enhanced identification method (N)	Primary survey sample (N)	Under (-) / overestimation (+) by enhanced method (%)
Current obstetric services (2018)	130	133	-2.3
Obstetric unit closures	44	41	6.8

Note: In total, seven hospitals differed between our enhanced method and the survey response (enhanced method showed no obstetrics in four hospitals where survey said current obstetrics; enhanced method showed obstetrics in three hospitals where survey said obstetrics closed [one in 2008, two in 2017]). An additional six hospitals had closed their obstetrics units after we could assess obstetrics status in the AHA data (between 2018 and 2021).

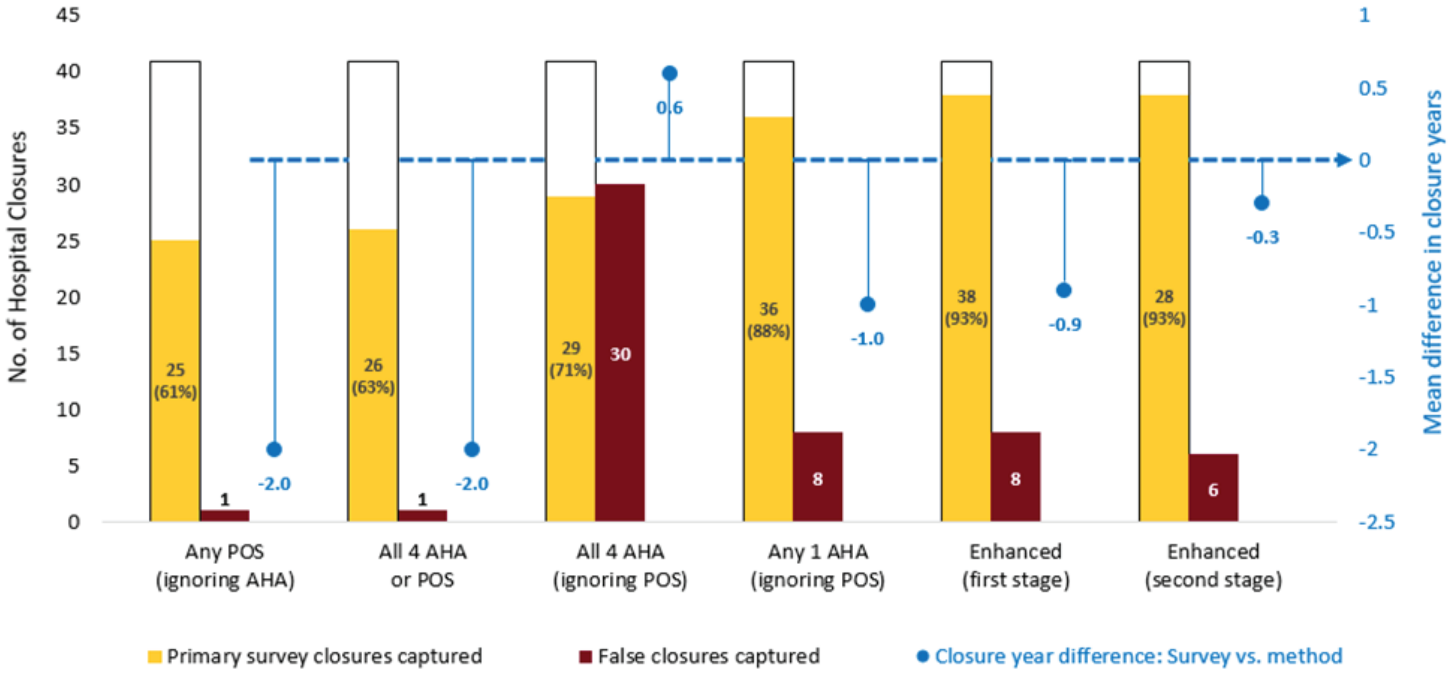
Table 5. Comparison of obstetric unit status identification method to a primary survey sample of rural hospitals, by obstetric unit closure year (N=41; hospital-level)

Closure year in primary survey sample	All 4 AHA criteria (ignoring POS)		Any individual AHA criteria (ignoring POS)		POS (ignoring AHA)		All 4 AHA criteria or POS		Enhanced method: First stage (preliminary status)		Enhanced method: Second stage (final status)	
	Mean ± SD Median [IQR] years off	Not found	Mean ± SD Median [IQR] years off	Not found	Mean ± SD Median [IQR] years off	Not found	Mean ± SD Median [IQR] years off	Not found	Mean ± SD Median [IQR] years off	Not found	Mean ± SD Median [IQR] years off	Not found
Prior to 2010 (n=3)	-1 ± 0 -1 [-1,-1]	2	-6.7 ± 3.2 -8 [-9,-3]	0	-6.0 ± 2.6 -7 [-8,-3]	0	-6.0 ± 2.6 -7 [-8,-3]	0	-6.0 ± 2.6 -7 [-8,-3]	0	-4.0 ± 4.2 -4 [-7,-1]	1
2010 (n=2)	-1.5 ± 2.1 -1.5 [-3,0]	0	-2.5 ± 2.1 -2.5 [-4,-1]	0	-3.0 ± 2.8 -3 [-5,-1]	0	-3.0 ± 2.8 -3 [-5,-1]	0	-2.5 ± 2.1 -2.5 [-4,-1]	0	-2.5 ± 2.1 -2.5 [-4,-1]	0
2011 (n=2)	0.5 ± 0.7 0.5 [0,1]	0	-2.0 ± 2.8 -2 [-4,0]	0	—	2	—	2	-2.0 ± 2.8 -2 [-4,0]	0	-0.5 ± 0.7 -0.5 [-1,0]	0
2012 (n=8)	0.4 ± 1.3 1 [-1,1]	3	-0.7 ± 2.3 0 [-1,1]	2	-2.0 ± 2.1 -1.5 [-4,0]	2	-2.0 ± 2.1 -1.5 [-4,0]	2	-0.6 ± 1.9 0 [-1,0.5]	0	-0.1 ± 0.8 0 [-1,0.5]	0
2013 (n=1)	1 ± 0 1 [1,1]	0	0	0	-1 ± 0 -1 [-1,-1]	0	-1 ± 0 -1 [-1,-1]	0	0	0	0	0
2014 (n=2)	4 ± 0 4 [4,4]	1	-1 ± 0 -1 [-1,-1]	0	0 ± 1.4 0 [-1,1]	0	0 ± 1.4 0 [-1,1]	0	0 ± 1.4 0 [-1,1]	0	0 ± 1.4 0 [-1,1]	0
2015 (n=6)	1.2 ± 1.2 1 [0,2]	0	0.7 ± 0.8 0.5 [0,1]	0	-0.4 ± 0.9 -1 [-1,0]	1	-0.6 ± 0.5 -1 [-1,0]	1	0.7 ± 0.8 0.5 [0,1]	0	0.5 ± 0.8 0 [0,1]	0
2016 (n=6)	0.5 ± 0.5 0.5 [0,1]	0	0.2 ± 0.8 0 [0,1]	0	0	5	0	5	0.2 ± 0.8 0 [0,1]	0	0.2 ± 0.8 0 [0,1]	0
2017 (n=4)	0	3	0	3	—	4	—	4	0	3	1.5 ± 2.1 1.5 [0,3]	2
Overall (n=41)*	0.6 ± 1.4 1 [0,1]	12	-1.0 ± 2.6 0 [-1,0]	5	-2.0 ± 2.5 -1 [-3.5,0]	16	-2.0 ± 2.5 -1 [-3.5,0]	15	-0.9 ± 2.4 0 [-1,1]	3	-0.3 ± 1.7 0 [-1,1]	3
Obstetric services, 2018 (n=133)	n=98		n=130		n=145		n=147		n=128		n=130	

Note: Negative values indicate that the closure year per the specified method was later than the closure year reported in the survey. 'Not found' indicates the number of obstetric unit closures identified in the primary survey sample that were not identified using the particular method.

*Seven hospitals in the primary survey sample reported obstetric unit closures but did not report closure year, and thus are not included in closure year difference calculations.

Figure 3. Comparison of obstetric unit closure identification methods to a primary survey sample of rural hospitals (N=41; hospital-level)



timing of obstetric unit closure. Had we only used POS data we would have captured 61.0% of obstetric unit closures 2.0 years late and incorrectly identified one additional closure, and had we only used AHA data we would have captured 87.8% of closures 1.0 year late and incorrectly identified eight additional closures. Our enhanced method captured 92.7% of closures 0.3 years late with six incorrectly identified additional closures. The method used for identifying hospital-based obstetric unit status can greatly impact results.

Limitations

Identification of obstetric service provision is a complex process, and the enhanced method and findings presented here are clearly subject to limitations. Among hospitals with closed obstetric units in our primary survey sample, one third (33%) of respondents had worked at their current institution for 0-5 years, which may have impacted their knowledge about the exact year of obstetric unit closure as some closures may have occurred before their arrival. However, the majority (46%) of respondents had worked at their current institution for more than 10 years and likely had accurate knowledge of the obstetric unit closure.

Further, measuring the exact year of closure is difficult because of inconsistencies in reporting periods across hospitals and because there is not a standard way to report a mid-year closure. For example, in the AHA survey, respondents are asked to report data on the full 12-month period (preferably their last completed fiscal year). Not all fiscal years follow the calendar year, which may impact timing of obstetric unit closure reporting. Further, if the obstetric unit closed any time other than the end of the 12-month period, this could impact how respondents reported provision of obstetric services. For instance, if two obstetric units closed in February, one respondent might consider this providing obstetric services anytime during the reporting period, while the other might consider this not providing obstetric services for the full reporting period. These two instances could result in identification of a different year of obstetric unit closure, when in reality, they closed at the same time. Similarly, in our rural hospital primary survey sample, we asked respondents, "What year did your hospital cease providing inpatient labor and birth services?," which may not exactly align with interpretation in the AHA survey.

Conclusion and Implications

In summation, these findings support the use of an enhanced method using AHA data along with an external dataset (POS) to verify obstetric unit status and

to accurately identify obstetric unit closures. Multiple years of data are needed to check for reporting inconsistencies, which should be measured in a variety of ways. Further, ignoring the impact of hospital mergers or excluding mergers altogether can lead to incorrect findings. Being aware of the strengths and limitations of the different methods used for identifying which hospitals and communities currently have or have lost obstetric services is important for policymakers, journalists, state health departments, and hospital associations to ensure that needs and resources around obstetric services are accurately assessed and addressed. Further, consistency and replicability of obstetric service measurement by researchers is needed to better track trends in obstetric service availability and associated patient outcomes as well as in assessments of the impact of policies created to address the loss of obstetric services, particularity in rural communities.

October 2025 Addendum

Since the publication of our team's initial methodology brief in January 2022 for identifying hospital-based obstetric unit status using data from 2010 to 2018, we have completed this process for five additional years of data. During these processes, we have amended our methods to improve the accuracy of the algorithm. This addendum details these additions to the previously published method, which are a result of ongoing engagement and experiences with these data and contributions of team members and collaborators. We have used these updated methods to identify hospital-based obstetric unit status using data from 2010 to 2023.

Addendum to inclusion criteria

In the 2022 methodology, we restricted our data to include only non-federal (control codes [CNTRL] < 40) short-term acute care hospitals (primary service code [SERV] = 10) and obstetrics and gynecology specialty hospitals [SERV = 44]. We have since expanded the eligibility criteria to include federal hospitals [CNTRL ≥ 40] so that military, Indian Health Service, and other federally run hospitals that may provide obstetric services are reflected in the data. Federally run hospitals account for 4% (195/4998) of the hospitals included in the 2010-2023 cohort. However, these hospitals often require additional obstetric status verification considerations (as described below). We also now include children's short-term acute care hospitals [SERV = 50] that provided obstetric services at any point during the study period (n=16, 20% of children's hospitals in the 2010-2023 cohort).

Additional consistency checks

The following seven consistency checks are described in the 2022 methodology: 1) single consistent obstetric status change; 2) single obstetric status difference at first or last study period year; 3) one-off obstetric status in a middle study period year; 4) ≥2 obstetric status changes across study years; 5) AHA criteria indicate obstetrics but POS does not; 6) ≥3 obstetric unit losses/gains within a state in a single year; and 7) hospital mergers and acquisitions. In addition to these consistency checks, we have developed four additional hospital-level consistency checks. These are as follows:

Eighth, we initially classified hospital-years as having no obstetric services if they reported at least 10 births [BIRTHS ≥ 10] but reported no provision of obstetric services [OBHOS = 0]. This decision was made because the estimation process that AHA employs for the BIRTHS variable (described in the 2022 methodology) may result in misclassification of obstetric status for a particular year. To improve accuracy, we added an additional flag for further verification for hospitals that reported births (i.e., births were reported by the hospital rather than estimated by AHA [BIRTHS ≥ 10 and EBIRTHS = 0]) but did not report the provision of obstetrics services [OBHOS = 0]. This flag was identified in 7% (325/4998) of hospitals included in the 2010-2023 cohort.

Ninth, we reviewed whether hospitals reported having higher-level neonatal care, which we defined as reporting any neonatal intermediate or intensive care beds [NINTBD ≥ 1 or NICBD ≥ 1, respectively] or reporting a neonatal intensive care unit [NICHOS = 1]), We flagged hospitals for further verification if they indicated higher-level neonatal care but 1) were not children's hospitals [SERV = 50] and 2) were not already identified as having obstetric units using the methodology described above. This decision was made because short-term acute care hospitals with higher-level neonatal care are likely to have obstetric units, apart from children's specialty hospitals. This flag was identified in 19 hospitals included in the 2010-2023 cohort where obstetric services otherwise would not have been identified in the data (19/4998, 0.4%); after further review of hospital websites and news sources, obstetric services were verified as available at some point during the study period, in all cases.

Tenth, all hospitals that reported conversion to a Rural Emergency Hospital (REH) were flagged for further verification. The new REH designation became effective on January 1, 2023,[14] and data on REH designation are available beginning in the 2023 AHA data [SERV = 18]. REH conversion and conversion timing were also compared against the North Carolina Rural Health Research Program's (NC RHRP) REH conversion tracker.[15] Under CMS rules, as of August 2025, hospitals with REH designation are allowed to provide low-risk outpatient obstetric labor and delivery services, as long as the average per patient length of stay of all REH services provided does not exceed 24 hours.[16] This flag was identified in 18 hospitals included in the 2010-2023 cohort (18/4998, 0.4%), eight of which had a prior obstetric unit closure (four of these closures were only identified because of this flag).

Eleventh, we examined AHA response rates at federal hospitals [CNTRL ≥ 40] and found that they were gen-

erally lower than non-federal hospitals, requiring further verification of obstetric service provision using hospital websites and review of relevant news sources. From 2010 to 2023, between 8% and 37% of included federal hospitals responded to the AHA survey every year, with an average response rate of 25%. In comparison, between 70% and 84% of non-federal hospitals responded every year, with an average response rate of 78%. The federal hospitals also had missing or minimal information on obstetric service provision in the POS data. In addition, while the Veterans Affairs (VA) provides maternity care coverage and care coordination, obstetric labor and delivery services are largely provided outside of VA hospitals,[17] thus we flagged any VA hospital [CNTRL = 45] identified as providing obstetric services during the first stage, single-year assessment for further verification.

Twelfth, among hospitals involved in mergers and acquisitions, the 2022 methodology describes our process of "undoing" the AHA ID consolidation and the four different cases of mergers related to obstetric services (Cases A, B, C, and D, defined above). Previously, only Case A mergers (an obstetric hospital merged with another obstetric hospital; the merged entity also indicated obstetric services) were flagged for further verification. However, upon further review of these cases and the identification of some data reporting errors, we now also flag all Case D mergers (an obstetric hospital merged with a non-obstetric hospital; the merged entity did not have obstetric services) for further verification. We identified 15 hospitals included in the 2010-2023 cohort involved in mergers as Case D mergers (15/380, 4%); further verification resulted in changes to obstetric service status in five of these flagged hospitals.

Additionally, for hospitals involved in mergers and acquisitions, closure of a full hospital may also be obscured after hospital ID consolidation in the AHA data. As part of our process of "undoing" this ID consolidation in order to follow hospital IDs over time, we verified when a full hospital closed and indicated the hospital closure in the data to ensure that obstetric service status is consistent with such a closure in the post-closure years in the data. For rural hospitals, we compared hospital closures against NC RHRP's rural hospital closures and conversions tracker.[18] For urban hospitals involved in mergers and acquisitions, we reviewed hospital websites and news sources to verify post-merger hospital operating status. These reviews identified an additional 33 hospitals (5 in rural counties, 28 in urban counties) included in the 2010-2023 cohort involved in mergers (33/380, 9%) that closed following a merger.

Addendum to final obstetric status: Timing considerations for loss of obstetric services

To ensure accurate timing of obstetric unit closure, we further verified hospitals that were given a final obstetric unit status of "loss of obstetric services" based on their hospital-year level results at the end of the two-stage assessment. For these hospitals, final obstetric unit status was verified against their AHA reporting period beginning and end dates, or against the reported closure timing on hospital websites or news sources, when available. In the AHA survey, hospitals are asked to report data for a full 12-month period consistently throughout the survey. However, hospitals' fiscal years may differ from each other, may change over time, and may not align with calendar years. As our obstetric unit status designations are based on calendar year, some closure timings may be misaligned. To rectify this, we reviewed AHA reporting period beginning [DTBEG] and end [DTEND] dates, and examined trend changes in reported BIRTHS, when available, around the time of obstetric unit closure. We also note dates of closure timing if reported on hospital websites or news sources. If an obstetric unit closure occurred prior to July 1 in the index calendar year, we indicated that obstetric services were available across the full calendar year prior to the index year, and that obstetric services were not available across the full calendar index year. Conversely, if the obstetric unit closure occurred on or after July 1, we indicate that obstetric services were available in the index year and that obstetric services were not available in the full calendar year in the year after the index year. For example, if a hospital closed its obstetric unit in April 2015, our data would indicate obstetric services in 2014, but no obstetric services in 2015; and if a hospital closed its obstetric unit in October 2015, our data would indicate obstetric services in 2015, but no obstetric services in 2016.

Further validation: Comparison to another primary survey sample of Critical Access Hospitals

In addition to the validation of our enhanced method against a primary survey sample of rural hospitals described in the 2022 methodology, we now also validate against an annual assessment of all Critical Access Hospitals (CAHs) collected by the Flex Monitoring Team.[19] Among hospitals included in the 2010-2023 cohort, 28% (1419/4998) were designated as CAHs at any point during the study period; ensuring accurate obstet-

ric unit status for these hospitals is important for measurement of rural obstetric service availability. We first ensured that all CAHs were included in our data as eligible hospitals for the measurement of obstetric service availability as short-term acute care hospitals [where MAPP18 = 1 or the 2nd and 3rd digits of MCRNUM = 13]. We then verified this list against the Flex Monitoring Team's CAH list.[20] Beginning in 2023, the CAH Assessment asks these hospitals whether their facility provides labor and delivery services. Comparison of our updated algorithm findings with the 2023 CAH Assessment showed obstetric service status concordance for 98% of CAHs that responded to the Assessment (over 94% of all CAHs). We further reviewed discordant cases using hospital websites and news sources and updated these hospitals' final obstetric service status accordingly.

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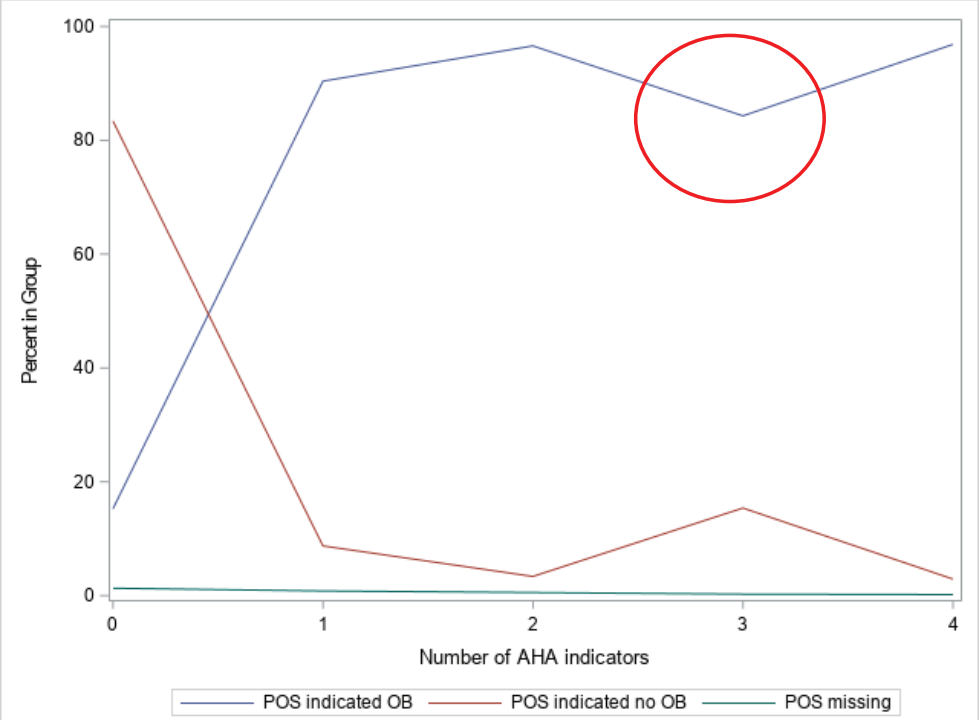
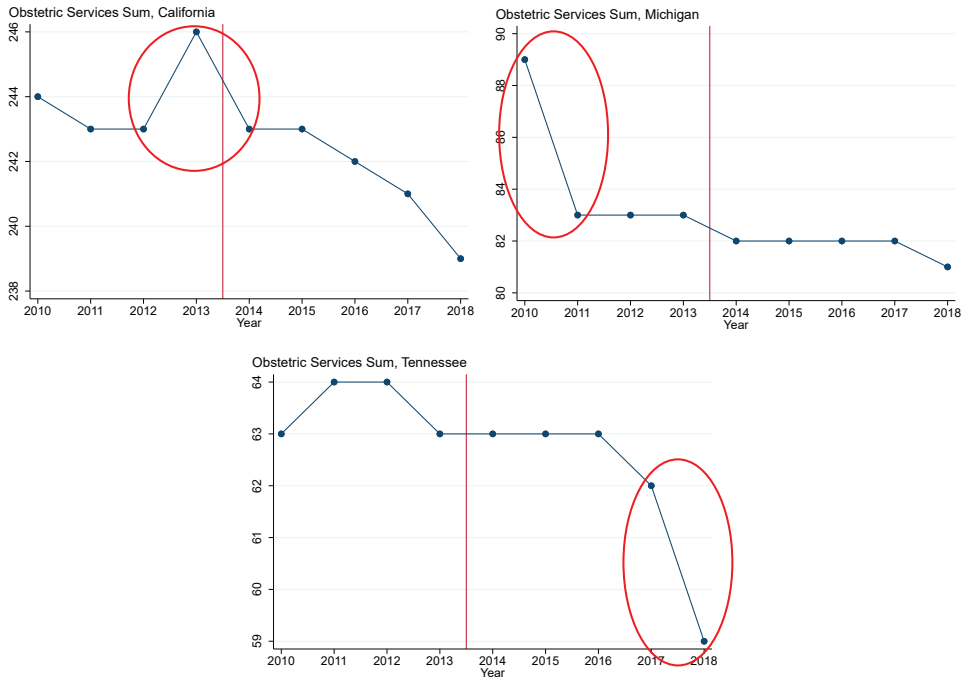
APPENDIX TABLES AND FIGURES

Appendix Figure 1. Concordance between number of AHA indicators and POS indication for obstetric service provision (hospital-years)

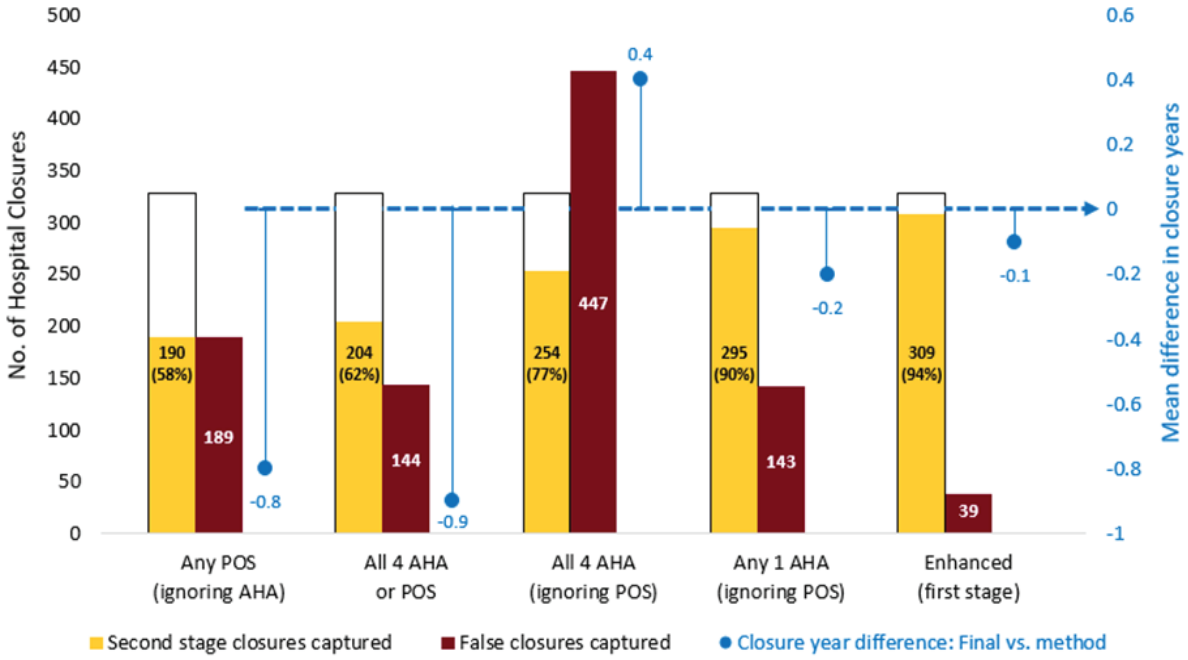


Note: Red circle highlights the decrease in concordance between the sources when all AHA criteria indicated obstetric services except for criterion 4 (births) and POS indicated no obstetric services.

Appendix Figure 2. Examples of state-specific trends in obstetric unit status that flagged further verification



Appendix Figure 3. Comparison of obstetric unit closure identification methods against the enhanced method second-stage assessment (N=4,739; hospital-level)



Appendix Table 1. Comparison of first-stage, single-year and second-stage, multi-year assessments of obstetric unit status (N=41,252; hospital-years)

		Final Status (multi-year assessment)		
		Obstetrics	No obstetrics	Total
Preliminary Status (single-year assessment)	Obstetrics	25944	138	26082 (63.2%)
	No obstetrics	334	14836	15170 (36.8%)
	Total	26278 (63.7%)	14974 (36.3%)	41252

Appendix Table 2. Obstetric unit status across assessment stages where births were the only AHA indicator of obstetric services (N=3,842; hospital-years)

		Enhanced Method		
AHA births	POS obstetric indication	Preliminary status	Final status	N (%)
Estimated	Missing	No obstetrics	No obstetrics	1 (0.0)
Estimated	Missing	No obstetrics	Obstetrics	32 (0.8)
Estimated	No obstetrics	No obstetrics	No obstetrics	187 (4.9)
Estimated	No obstetrics	No obstetrics	Obstetrics	65 (1.7)
Estimated	Obstetrics	Obstetrics	No obstetrics	57 (1.5)
Estimated	Obstetrics	Obstetrics	Obstetrics	3500 (91.1)

Appendix Table 3. Across study period examination of reason for single-year AHA/POS discordance in hospitals where all AHA variables indicated obstetric services except for births (hospital-level, excluding mergers)

POS indication of OB	Reason for individual year discordance	No. of hospitals
POS indicated OB in individual year when only AHA birth criterion indicated no OB (n=37)	Year of obstetric unit/hospital closure	12
	0 births (reported)	8
	1-9 births (reported)	4
	Very low volume (<20 births annually, individual years above/below birth criteria)	8
	First year of obstetric gain/new hospital	5
	Consecutive years with 0 births reported (continuous obstetrics)	5
	Inconsecutive years with 0 births reported (other years met AHA birth criteria)	1
	Middle year with 0 births estimated (other years met AHA birth criteria)	4
	Middle year with 0 births reported (other years met AHA birth criteria)	2
POS indicated no OB in individual year when only AHA birth criterion indicated no OB (n=15)	First year of obstetric gain/new hospital	3
	Very low volume (<20 births annually, individual years above/below birth criteria)	2
	Year of obstetric unit/hospital closure – 0 births (reported)	3
	Consecutive years with 0 births reported (continuous no obstetrics / obstetrics loss)	5
	Consecutive years with 0 births estimated (continuous no obstetrics / obstetrics loss)	1
	Consecutive years with 0 births reported (corrected as continuous obstetrics)	1

Appendix Table 4. Impact of different obstetric unit status identification methods on obstetric services indication (N=40,583; hospital-years)

Obstetric services identification method	Criteria met N (%)	Criteria not met N (%)
All four AHA criteria (ignoring POS)	21414 (52.8)	19169 (47.2)
Any AHA criteria (ignoring POS)	26244 (64.7)	14339 (35.3)
Any POS (ignoring AHA)	27349 (67.5)	13234 (32.6)
POS only with no AHA criteria	2189 (5.4)	38394 (94.6)
All AHA criteria or POS	28010 (69.1)	12573 (31.0)
Enhanced method		
First stage: single-year assessment	25821 (63.7)	14762 (36.4)
Second stage: multi-year assessment	26041 (64.2)	14542 (35.8)

Appendix Table 5. Comparison of obstetric unit closures by obstetric unit status identification method, by closure year (N=4,739; hospital-level)

Closure year (enhanced method: final status)	All AHA criteria (ignoring POS)			Any AHA (ignoring POS)			Any POS (ignoring AHA)			All AHA or any POS			Enhanced method: preliminary status		
		N closures			N closures			N closures			N closures			N closures	
	Mean ± SD Median [IQR] years off	Total per method	Not found	Mean ± SD Median [IQR] years off	Total per method	Not found	Mean ± SD Median [IQR] years off	Total per method	Not found	Mean ± SD Median [IQR] years off	Total per method	Not found	Mean ± SD Median [IQR] years off	Total per method	Not found
2010 (n=43)	-0.0 ± 0.2 0 [0,0]	60	20	-0.6 ± 1.2 0 [-0.5,0]	54	3	-1.8 ± 1.9 -2 [-3,0]	49	17	-1.5 ± 1.8 -1 [-2,0]	44	10	-0.2 ± 0.6 0 [0,0]	41	4
2011 (n=43)	0.0 ± 1.2 0 [0,0]	73	13	-0.5 ± 1.6 0 [0,0]	60	2	-1.4 ± 1.6 -1.0 [-2,0]	49	12	-1.3 ± 1.5 -1 [-2,0]	41	10	-0.3 ± 1.1 0 [0,0]	40	1
2012 (n=41)	0.4 ± 0.7 0 [0,1]	56	7	-0.1 ± 0.8 0 [0,0]	62	3	-1.2 ± 1.8 -0.5 [-3,0]	55	11	-1.3 ± 1.6 -0.5 [-3,0]	52	11	-0.1 ± 0.5 0 [0,0]	46	1
2013 (n=41)	0.3 ± 0.6 0 [0,0]	67	10	-0.2 ± 1.4 0 [0,0]	49	4	-0.3 ± 1.6 0 [-1,0]	52	15	-0.6 ± 1.2 0 [-1,0]	46	14	-0.2 ± 0.8 0 [0,0]	40	2
2014 (n=40)	0.3 ± 0.5 0 [0,0]	66	5	0.0 ± 0.2 0 [0,0]	55	4	-0.8 ± 1.3 0 [-2,0]	42	15	-0.8 ± 1.1 0 [-2,0]	38	14	-0.0 ± 0.4 0 [0,0]	45	1
2015 (n=38)	1.0 ± 1.7 0 [0,2]	112	5	-0.1 ± 0.7 0 [0,0]	45	3	-0.6 ± 1.0 -1 [-1,0]	40	16	-0.6 ± 1.0 -1 [-1,0]	33	16	-0.1 ± 0.6 0 [0,0]	38	2
2016 (n=43)	0.4 ± 0.8 0 [0,1]	123	7	0.1 ± 0.4 0 [0,0]	57	4	0.2 ± 0.9 0 [0,1]	47	28	-0.1 ± 0.5 0 [0,0]	46	27	0.0 ± 0.2 0 [0,0]	49	1
2017 (n=39)	0.6 ± 1.2 0 [0,1]	144	7	0.2 ± 1.3 0 [0,0]	56	10	0.3 ± 0.6 0 [0,0]	45	24	0	48	22	0	49	7
Overall (n=328)	0.4 ± 1.0 0 [0,1]	701	74	-0.2 ± 1.1 0 [0,0]	438	33	-0.8 ± 1.6 0 [-2,0]	397	138	-0.9 ± 1.4 0 [-2,0]	348	124	-0.1 ± 0.6 0 [0,0]	348	19
Obstetric services, 2018 (n=2806)		n=2250			n=2788			n=2926			n=3035			n=2797	

Notes: Negative values indicate the closure year per the alternate method was later than the closure year in the final enhanced method. In the 'N closures' column: 'Total per method' indicates the total number of closures within the specified year for the particular method, and 'Not found' indicates the number of closures using the final status within the enhanced method that were captured using the particular method.

Appendix Table 6. Impact of hospital merger treatment for the 236 hospitals involved in mergers on obstetric unit status

Merger treatment*	Total hospital-years	Hospital-years with obstetric units N (%)	Total hospitals	Hospitals with current obstetric units N (%)	First stage obstetric unit closures N (%)	Second stage obstetric unit closures N (%)
Ignoring	40688	25921 (63.7)	4755	2765 (58.1)	389 (8.2)	372 (7.8)
Excluding	39153	24827 (63.5)	4503	2665 (59.2)	320 (7.1)	301 (6.7)
"Undoing"	41252	26082 (63.2)	4739	2797 (59.0)	348 (7.3)	328 (6.9)
N different: excluding vs. "undoing"		-1255		-132	-28	-27
N different: ignoring vs. "undoing"		-161		-32	+41	+44

*Ignoring: overlooking hospital merger status and taking the data as given; Excluding: dropping all hospitals involved in mergers from analyses; "Undoing": Negating the ID consolidation in the AHA data after a merger by creating hospital IDs that are consistent over time through maintaining pre-merger IDs in all years after the merger, unless a hospital had closed.