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# Examining the Ratio of Obstetric Beds to Births, 2000–2019

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# Abstract

The number of U.S. births has been declining. There is also concern about rural obstetric units closing. To better understand the relationship between births and obstetric beds during 2000–2019, we examined changes over time in births, birth hospital distributions (i.e., hospital birth volume, ownership, and urban–rural designation), and the ratio of births to obstetric beds. We analyzed American Hospital Association Annual Survey data from 2000 to 2019. We included U.S. hospitals with at least 25 reported births during the year and at least 1 reported obstetric bed. We categorized birth volume to identify and describe hospitals with maternity services using seven categories. We calculated ratios of number of births to number of obstetric beds overall, by annual birth volume category, by three categories of hospital ownership, and by six urban–rural categories. The ratio of births to obstetric beds, which may represent need for maternity services, has stayed relatively consistent at 65 over the past two decades, despite the decline in births and changes in birth hospital distributions. The ratios were smallest in hospitals with < 250 annual births and largest in hospitals with 7000 annual births. The largest ratios of births to obstetric beds were in large metro areas and the smallest ratios were in noncore areas. At a societal level, the reduction in obstetric beds corresponds with the drop in the U.S. birth rate. However,

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Author Contributions DAG conceptualized and planned the analysis. MDB led data acquisition and data cleaning. CLD led the data analysis and writing of the first draft. MKM and ED provided expert guidance on the analysis and writing. All authors critically reviewed and revised the manuscript.

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Code Availability SAS code for this analysis is available from the first author by request.

Declarations

Conflicts of interest None.

Ethics Approval Not applicable.

Consent to Participate Not applicable.

Consent for Publication Not applicable.

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consistency in the overall ratio can mask important differences that we could not discern, such as the impact of closures on distances to closest maternity care.

#### Keywords

Hospitals; Obstetric beds; Births; Birth volume

#### Introduction

The number of U.S. births has declined every year except for one (2014) between 2007 and 2020 [1]. One potential impact of declining births is reduced utilization of hospital maternity services.

There has been growing concern about closures of obstetric units in rural areas [2, 3]. Specifically, there is concern that loss of hospital-based obstetric services may prolong travel distances and affect access to and outcomes of care during pregnancy and delivery [3–5], including increases in out-of-hospital births, births in hospitals without obstetric units, and preterm births [3]. A study using 2007–2018 data found that rural hospitals may merge with other hospitals or health systems to ease financial distress, and that merged hospitals were more likely than independent hospitals to eliminate maternal/neonatal care [6]. However, it is unclear how obstetric unit closures relate to the declines in birth over the past two decades and whether closures have resulted in a shift toward a higher proportion of births occurring in higher volume maternity settings.

There are no guidelines currently available from the American College of Obstetricians and Gynecologists (ACOG), the American Hospital Association (AHA), or other professional membership organizations that identify a recommended ratio of births to obstetric beds. However, an increase in this ratio (i.e., more births relative to obstetric beds) over time may suggest possible unmet need for obstetric beds, whereas a decrease in the ratio relative to earlier time periods may suggest a possible oversupply of obstetric beds.

To better understand the relationship between the decline in the number of births and the changing landscape of obstetric bed availability, we examined changes over time in births, birth hospital distributions (i.e., hospital birth volume, ownership, and urban–rural designation), and the ratio of births to obstetric beds during 2000–2019.

# Methods

The AHA conducts an annual survey of all hospitals in the U.S. [7]. We used AHA Annual Survey data from 2000–2019 [7]. We included hospitals located in the 50 U.S. states and Washington, D.C. with at least 25 reported births during the year. While other publications have used cut-offs of 10 or 50 births per year [8, 9], we decided to use a lower cut-off of 25 because it provides more information about very low volume facilities than a lower cut-off of 50. We also observed significant year to year instability in hospitals included in the data when using a lower cut-off of 10. Using the cut-off of 25 increased stability of hospitals included in the data, improving comparability across years.

We categorized birth volume, or the number of annual births, to identify and describe hospitals with maternity services using seven categories: 25–249, 250–499, 500–999,1000–1999, 2000–3999, 4000–6999, and 7000 annual births. These categories are similar to those used in a recent study, although that study clustered hospitals with 500 births and 2000 births into single categories [9]. We calculated the proportion of births and the proportion of hospitals in each hospital birth volume category for each year during 2000–2019, but only present data from three years (2000, 2009, 2019) in some figures for simplicity.

The AHA annual survey asks hospitals to report the number of beds that were provided within the hospital and set up and staffed for use. The survey defines obstetric beds as, "Provides medical and surgical treatment to pregnant women and to mothers following delivery. Also provides diagnostic and therapeutic services to women with diseases or disorders of the reproductive organs" [7]. We included facilities that reported at least one obstetric bed [9]. We examined the total proportions of births and obstetric beds by three categories of hospital ownership and control (private, for-profit; private, not-for-profit; or public) [7] and by the six standard National Center for Health Statistics (NCHS) urbanrural categories (large central metro, large fringe metro, medium metro, small metro, micropolitan, and noncore) [10]. Large central metro areas are the most urban and noncore areas are the most rural [10]. We then calculated ratios of the number of births to the number of obstetric beds overall, by the seven annual birth volume categories, by the three categories of hospital ownership and control [7], and by the six standard NCHS urban-rural categories [10]. These ratios were calculated as a way to understand possible need for maternity services. We also compared ratios to trends in overall births based on data from the National Center for Health Statistics' National Vital Statistics System [11].

Non-responding hospitals were excluded from this analysis. AHA imputes a value for births during a year for non-responders, but does not impute a value for number of obstetric beds, an important variable for this analysis because the number of obstetric beds represent the availability of maternity services within a hospital or hospital group. In 2000, responding hospitals with at least 25 births and at least one obstetric bed accounted for 83.4% of live births in the U.S.[12]; in 2019, responding hospitals with at least 25 births and at least one obstetric bed accounted for 83.1% of live births in the U.S [13].

We performed two sensitivity analyses. First, we examined the impact of lowering the annual birth volume to 10. Second, we examined the impact of excluding non-responders from the analysis. We used the value that AHA imputed for the number of births, and we used the number of obstetric beds from the most recent year the survey was completed. All results were similar. The tables and figures from the sensitivity analyses are available by written request to the first author.

#### Results

During 2000–2019, 51 394 hospital-years of data were included from 3699 distinct hospitals reporting obstetric beds and accounting for 69 103 376 total births. Hospitals contributed

a mean of 13.9 years of data (median = 16.0, standard deviation = 6.4). A total of 1074 hospitals (29.0%) contributed data for all 20 years.

Hospitals with fewer than 250 births per year decreased as a proportion of all hospitals between 2000 and 2019, from 21.7% to 16.2% (Fig. 1). The proportion of hospitals reporting 250–499 annual births remained relatively stable (17.6% in 2000, 17.8% in 2019), while those with 500–999 annual births decreased as a proportion of all hospitals, from 21.9% to 20.5%. Between 2000 and 2009, there was an increase in the proportion of hospitals with a volume of 1000–1999 births (from 20.4% to 21.8%), but by 2019 the proportion returned to approximately the same value as 2000 (20.5%). Between 2000 and 2009, there was an increase in the proportion and 2009, there was an increase in the proportion of hospitals with a volume of 2000–3999 births; this remained constant through 2019. A small, but consistent increase was observed in the proportion of birth hospitals with a volume of greater than 4000 births between 2000 and 2019. Although hospitals with very large maternity services (7000 + births per year) are large in volume, they represent a small proportion of total hospitals (1.2% in 2019).

Turning from hospital volume to the distribution of births in these hospitals, the proportion of births occurring in hospitals with less than 2000 births per year decreased from 46.0% of all births in 2000 to 36.9% in 2019, with the majority of the decrease occurring between 2000 and 2009 (Fig. 2). The decrease occurred in all four categories of smaller hospitals, with the largest absolute decrease (24.8% to 20.3%) in hospitals with 1000–1999 births. The decrease was balanced by increases in hospitals with annual birth volumes of 4000–6999 (14.3% to 20.9%) and in hospitals with annual birth volumes 7000 (6.0% to 8.5%) between 2000 and 2019.

By combining information on births and obstetric beds as a ratio, it is possible to examine patterns that may represent responses to changes in market demand for maternity services over time. Overall, between 2000 and 2019, the ratio of births to obstetrical beds varied between a low of 63.6 in 2012 and a high of 69.0 in 2007 finally settling at a ratio in 2019 (64.2) similar to that in 2000 (64.8) (Supplemental Fig. 1). As the number of U.S. births rose by 6.3% between 2000 and 2007, we observed a 6.5% relative increase in the ratio of births to obstetric beds (from 64.8 to 69.0). However, between 2008 and 2019, there was an 11.8% decrease in the number of U.S. births and a corresponding 6.8% relative decrease in the ratio (from 68.9 to 64.2).

The trend in the ratio of births to obstetric beds varied by hospital birth volume (Fig. 3). Throughout 2000–2019, hospitals with fewer than 250 births had the lowest ratios (overall ratio of 29.0). The ratio of births to obstetric beds increased by birth volume category. Hospitals with 4000 births had the largest ratios (overall ratio of 83.8 for hospitals with 4000–6999 annual births and overall ratio of 85.5 for hospitals with 7000 + annual births). Hospitals with birth volumes between 1000 and 6999 deliveries a year showed a small but steady decline in the ratio of births to beds between 2000 and 2019, while hospitals with the largest volume (7000 +) increased their ratio slightly.

Overall, during 2000 to 2019, 14.3% of obstetric beds were in public hospitals, 72.8% were in private not-for-profit hospitals, and 12.9% were in private for-profit hospitals

(Supplemental Table 1). Similarly, 13.9% of births occurred in public hospitals, 74.2% occurred in private not-for-profit hospitals, and 11.9% occurred in private for-profit hospitals. The pattern of change over time was slightly different for the three types of hospitals (Fig. 4). The not-for-profit hospitals had the least variation across time; their ratio only varied between 65.3 and 70.0. Public hospitals had the largest increase between 2001 (59.7) and 2008 (69.9), a 17.1% increase, though, after a rapid drop during 2008–2010 (8.9% decrease) their ratio remained relatively steady and closed our study period with a ratio similar to that of 2000 (62.5 in 2019). Private, for-profit hospitals showed less increase in ratio from 2000 to 2006 but had a comparable decrease of 11.0% after their 2006 peak (64.4), resulting in the lowest ratio of 57.3 in 2019.

During 2000 to 2019, 37.4% births occurred in large central metropolitan areas, 19.8% occurred in large fringe metropolitan areas, 22.6% occurred in medium metropolitan areas, 10.4% occurred in small metropolitan areas, 7.7% occurred in micropolitan areas, and 2.1% occurred in noncore areas, and the distribution of beds was comparable (Supplemental Table 1). In the noncore areas, nearly all hospitals had < 500 births per year (7208 of 7508 noncore hospitals, 96.0%) (Supplemental Table 2). While the noncore areas did not have any hospitals with 2000 annual births, the metropolitan areas had hospitals with low annual birth volumes. Of the 9255 hospitals with < 250 annual births, 59.0% were in noncore areas, while 1.1% were in large central metropolitan areas and 5.5% were in large fringe metropolitan areas.

The largest ratios of births to obstetric beds were identified in large central metro areas, (Fig. 5) with a peak in 2007 at 78.0 and a ratio of 71.2 in 2019 (8.7% decrease from peak). The peak ratios for large fringe metropolitan areas, medium metropolitan areas, small metropolitan areas, and micropolitan areas all occurred between 2005 and 2008. Noncore areas (e.g., frontier or rural counties not part of metropolitan or micropolitan counties) experienced a peak ratio of births to obstetric beds in 2013 at 41.9, declining to a ratio of 39.1 in 2019 (6.7% decrease from peak). Between 2000 and 2019, an overall net increase in the births to obstetric beds ratio was only observed for 2 geographies: small metro (ratio of 58.0 in 2000, 60.9 in 2019; 5.0% relative increase) and noncore (33.5 in 2000, 39.1 in 2019; 16.7% relative increase).

# Discussion

The results of this analysis may inform discourse about recent obstetric unit closures [14]. While there was a decline in obstetric beds, with a loss of almost 5400 (10.0%) obstetric beds between 2007 and 2019 among hospitals in our analysis, the reduction corresponded to an even faster decline of more than 570 000 births (13.2%) from 2007 to 2019. Preliminary 2020 birth data shows the trend has continued, with a drop of an additional 140 000 births, to the lowest U.S. total since 1979 [1]. Therefore, when placed in the context of births per obstetric beds, the overall ratio has changed little.

In terms of the distribution of hospitals by birth volume, the greatest absolute increase was in hospitals with 2000–3999 births annually, which occurred between 2000 and 2009. Although hospitals with 4000–6999 and 7000 + births annually represent a small proportion

Overall, there was a relationship between hospital birth volume and the ratio of births to obstetric beds, with lower volume hospitals having lower ratios. Analysis of the trends by location found that small metropolitan and noncore areas both experienced relative increases in the ratio of births to obstetric beds during 2000–2019; however, the 2019 ratios have declined from the peak ratios during this period. Examination by type of hospital ownership found a slightly faster decline in the ratio of births per obstetric bed after 2006 among private for-profit hospitals.

This analysis suggests that at a societal level, the reduction in obstetric beds after 2007 largely corresponded to the drop in the U.S. birth rate. The consistency of the ratio of roughly 65 births per obstetric bed for the past two decades is striking (mean = 65.7, median = 65.2). However, consistency in the overall ratio can mask subtle but important differences that we were unable to discern even with the subgroups examined. We could not analyze, for example, the impact of closures on distances to closest maternity care [15]. In one 2013 national survey, mothers reported traveling on average 14 miles to the place they gave birth, with more than a quarter reporting a 20 + mile distance from their birthing hospital [16]. In general, residents of rural areas have higher rates of infant mortality and severe maternal morbidity compared to residents of metropolitan areas [17, 18]. Ratios of births per obstetric bed for very rural areas increased, as did all other areas from 2000 to 2008, but unlike larger areas, did not experience the sharp decline after 2008. We could not determine if distances to birthing hospitals increased with the overall loss of obstetric beds. However, a recently published article using the same data source for 2010-2018 examined distances between hospitals and found that more than one-third of births occurred in hospitals that were not within either 30 miles of another obstetric hospital or a higher-volume obstetric hospital [9]. Several efforts have been proposed to enhance access to maternity care for families in rural communities, including increasing the number of programs that provide incentives for physicians to practice in rural areas [19], expanding the role of obstetric-trained family medicine physicians [20], developing state policies to provide reimbursement for maternal transport [21], and implementing strategies to support risk-appropriate care [22]. Hospitals with higher volumes and higher ratios of births to obstetric beds may generally be able to staff hospital deliveries more efficiently, whereas in lower-volume hospitals, staff often float to other units when maternity census is low [20, 23]. A recent survey of rural hospitals providing obstetric care, administrators reported needing at least 200 annual births for safety and financial viability [24].

This analysis has some important limitations. First, we excluded non-responders from this analysis, which may limit the generalizability of our findings. Approximately 75% of non-responders had imputed values for number of annual births < 1000. Additionally, modulation of birth volume annually causes the number of hospitals in each category to shift over the study period. Together, the non-responders and the changes in annual birth volume complicate the evaluation of whether maternity services are truly lost within a given community. Further, AHA data are self-reported. Additionally, this analysis could

not account for the number of births in a given community that occurred out of hospital, including home births and birth center births. The number of out-of-hospital births increased from 2004 to 2017, with variations by state [25]. This upward trend has continued into 2020 [26]. Finally, this analysis was unable to examine perinatal outcomes.

### Conclusions

Further research is necessary to understand several key elements of obstetric bed distribution. These include the association between the ratio of births to obstetric beds and perinatal outcomes, implications of mergers and demergers on the distribution of hospitals, and the impact of closures on distances travelled. Until more nuanced analyses can be done, our study of national trends suggests a relatively stable ratio of births to obstetric beds over time, but with slight variation by hospital ownership and urbanicity.

#### **Supplementary Material**

Refer to Web version on PubMed Central for supplementary material.

# Data Availability

American Hospital Association Annual Survey data are available for purchase from: https:// www.ahadata.com/aha-annual-survey-database

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**Fig. 2.** Distribution of births by annual hospital birth volume category, 2000, 2009, and 2019

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Ratio of births to obstetric beds by hospital ownership and control type, 2000-2019



