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Structure in Brazilian maternity hospitals: key characteristics for quality of obstetric and neonatal care

Estrutura das maternidades: aspectos relevantes para a qualidade da atenção ao parto e nascimento

Estructura de los hospitales de maternidad: aspectos relevantes para la calidad de la atención durante el parto y el nacimiento

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Abstract

This study aimed to evaluate key characteristics of structure in a sample of maternity hospitals in Brazil. Structure was evaluated according to Ministry of Health criteria and included: geographic location, obstetric volume, presence of ICU, teaching activities, staff qualifications, and availability of equipment and medicines. The results showed differences in staff qualifications and availability of equipment in obstetric and neonatal care according to type of financing, region of the country, and degree of complexity. The North/Northeast and Central-West regions presented the most serious problems with structure. The public and mixed hospitals were better structured in the South/Southeast, reaching satisfactory levels on various items, similar or superior to the private hospitals. The current study contributes to the debate on quality of structure in Brazil's hospital services and emphasizes the need to develop analytical studies considering process and results of obstetric and neonatal care.

Maternity Hospitals; Structure of Services; Quality of Health Care

Resumo

Avaliar aspectos da estrutura de uma amostra de maternidades do Brasil. A estrutura foi avaliada tendo como referências as normas do Ministério da Saúde e englobou: localização geográfica, volume de partos, existência de UTI, atividade de ensino, qualificação de recursos humanos, disponibilidade de equipamentos e medicamentos. Os resultados evidenciam diferenças na qualificação e na disponibilidade de equipamentos e insumos dos serviços de atenção ao parto e nascimento segundo o tipo de financiamento, regiões do país e grau de complexidade. As regiões Norte/Nordeste e Centro-oeste apresentaram os maiores problemas. No Sul/Sudeste, os hospitais estavam melhores estruturados, atingindo proporções satisfatórias em vários dos aspectos estudados, próximas ou mesmo superiores ao patamar da rede privada. O presente estudo traz para o debate a qualidade da estrutura dos serviços hospitalares ofertados no país, e sublinha a necessidade de desenvolvimento de estudos analíticos que considerem o processo e os resultados da assistência.

Maternidades; Estrutura dos Serviços; Qualidade da Assistência à Saúde

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Introduction

Recent decades have witnessed important strides in women's healthcare as a result of collective efforts, with the important participation of social movements. The inclusion of maternal death as a serious human rights violation definitely helped to include the reduction in maternal mortality as one of the *Millennium Development Goals* ¹.

During this period, maternal mortality decreased significantly in Brazil, although the targeted reduction of 75% by 2015 (compared to the rate in 1990) will not be reached ². Infant mortality has also decreased significantly, especially due to the post-neonatal component ². Most of these maternal and neonatal deaths are known to be avoidable ³ and occur (mainly) in hospitals ⁴.

The quality of obstetric services thus plays an important role in improving maternal and child health. However, quality assessment of obstetric services is not simple, since two patients are involved, sometimes with conflicting needs, and this balance requires complex and careful calculation ⁵.

To measure quality of healthcare, Donabedian ⁶ proposed a theoretical framework based on structure, process, and outcomes, a triad that has been widely used in health services research ⁷. Structure refers to the relatively stable characteristics of services, including the availability of human and financial resources, equipment, and inputs, in addition to their organizational format. Structure alone does not determine quality of care, but its deficiencies can interfere in the results, as studies have shown for some time. Stilwell et al. ⁸ analyzed maternity hospitals in a region of England and demonstrated a relationship between number of pediatricians and perinatal mortality rate.

Studies in Brazilian maternity hospitals showed deficiencies in the availability of equipment, surgical instruments, staff training, and presence of intensive care units (ICU) ^{9,10,11,12,13}, thereby revealing gaps and potentialities in the health system for providing care during labor and delivery with appropriate case resolution.

This study intends to provide a broad overview of structure issues in the sample of healthcare facilities participating in the survey *Birth in Brazil* ¹⁴.

Method

Birth in Brazil was a nationwide hospital-based cohort study on labor and birth ¹⁴, the aim of which was to evaluate labor and childbirth con-

ditions in Brazil from February 2011 to October 2012.

The study included healthcare facilities that had assisted more than 500 births in the year 2007 according to the Brazilian Information Systems on Live Births (SINASC).

The sample was stratified according to Brazil's five major geographic regions, location (State capital versus non-State capital), and type of facility according to funding of the deliveries (private, public, or mixed). Mixed facilities were defined as those listed as private in the National Registry of Healthcare Establishments, but which also had beds outsourced by the public sector. Together with the public facilities, these mixed facilities had the Brazilian Unified National Health System (SUS) as their funding source.

Six strata were generated for each of the five regions: location in State capitals (private/mixed/public) and outside State capitals (private/mixed/public). The final sample consisted of 30 strata. For each stratum, a two-stage probabilistic sample was selected. The healthcare establishments were selected in the first stage and the postpartum women and their infants in the second.

Sampling weights were based on the inverse probability of inclusion in the sample. To ensure that the total estimates were equal to the number of hospitals in the sample, in 2011 a calibration process was used in each stratum. The results shown are estimates for the study's total universe of hospitals (1,402), based on the sample of 266 hospitals visited.

To meet the study's objectives, in addition to the questionnaires applied to the 23,940 selected postpartum women, a questionnaire on hospital structure was completed by the field supervisors during interviews with sampled healthcare facility administrators.

The data collection instrument was developed according to the prevailing Brazilian legislation: *RDC/Anvisa n. 36* June 3, 2008 ¹⁵; *RDC/Anvisa n. 50* of February 21, 2002 ¹⁶; *Ruling GM/MS n. 1,091* of August 25, 1999 ¹⁷; *Ruling GM/MS n. 3,432* of August 12, 1998 ¹⁸; *Ruling GM/MS n. 2,048* of November 5, 2002 ¹⁹; *Ruling n. 1,071* of July 4, 2005 ²⁰; and *Ruling GM/MS n. 2,418* of December 2, 2005 ²¹.

Hospitals were classified as follow: according to obstetric volume or number of deliveries per year ²², categorized as low (≤ 999 deliveries), medium (1,000 to 2,999), and high ($\geq 3,000$); existence of an adult and/or neonatal intensive care unit (ICU); provision of teaching activities; and whether the facility was a referral hospital for high-risk pregnancy, via a referral call center.

Questions on human resources verified whether there were head physicians and

nurses with specialized training in obstetrics and neonatology.

According to the structure required by Brazilian legislation, the study verified the existence of emergency equipment for treating the mother (mechanical respirator/ventilator, manual resuscitator, laryngoscope, and endotracheal tube) and newborns (laryngoscope and neonatal endotracheal tube, valve-less neonatal suction catheters, meconium aspirator, aspirator with manometer and oxygen, gastric aspiration tube, and material for ventilation). The questionnaire also checked the existence of a blood bank or transfusion service, clinical pathology laboratory, and the availability of an ambulance for mothers and newborns.

The questionnaire also asked about the availability of the following drugs in the hospital: anti-hypertensive drugs, anxiolytics/hypnotics, steroids, oxytocin, uterine contraction inhibitors, coagulants/hemostatic drugs for the woman and newborn, and specifically magnesium sulfate (anticonvulsant), surfactant (to induce neonatal pulmonary maturation), solution or ointment for the prevention of neonatal conjunctivitis, and anti-D immunoglobulin for Rh-negative women.

The analysis included distribution of the relative frequency of the target variables according to type of financing (public, mixed, and private). Within each of these three strata, hospitals were grouped by similarity into three macro-regions: North/Northeast; South/Southeast, and Central. Finally, structure data were observed according to two groups of hospitals, those with higher complexity, defined as having a neonatal ICU with six or more beds, plus ICU beds for adults, while the rest were defined as having lower complexity.

The research project was approved by the Institutional Review Board of the National School of Public Health/Fiocruz (review n. 92/10). There was no conflict of interest with the research methods or any financial conflict of interest for the researchers.

Results

Of all the healthcare establishments studied, 36.1% were public, 45.7% mixed, and the rest private (18.2%). When analyzing the three macro-regions, in the North/Northeast slightly more than half of the hospitals were public, compared to 43% in the Central and 23.5% in the South/Southeast. Mixed hospitals accounted for 24.6% in the North/Northeast, 34% in the Central, and 60.9% in the South/Southeast. Private hospitals varied from 15.5% in the South/Southeast

(the lowest proportion) to 23% in the Central, the highest.

According to Table 1, nearly 30% of the public and private maternity hospitals were located in State capitals, as compared to 13.4% of mixed hospitals. The pattern changed in the Central, with most public and mixed hospitals in the State capitals (63% and 68%, respectively), suggesting coverage problems outside the capital cities in this region.

The study also analyzed the obstetric volume or number of deliveries per maternity hospital. For the country as a whole, most hospitals performed a medium volume (from 1,000 to 2,999 deliveries per year). The exception was the Central region, where most facilities performed fewer deliveries, both in mixed (56%) and private hospitals (61%).

Table 1 also shows that hospitals with ICU beds were more common in the South/Southeast (69% of public, 67% of mixed, and 98% of private maternity hospitals) and were also more common in private hospitals (86%). The most common situation was to have both neonatal and adult ICU beds.

Teaching was conducted mostly in public (77%) and mixed hospitals (74%), and was especially common in hospitals in the Central (100% of public and 85% of mixed hospitals).

A specific question for public and mixed hospitals was whether they were referral facilities for high-risk pregnancy and were connected to a call center for high-risk beds. Public hospitals showed the highest proportion of high-risk referral facilities (35%), compared to 25% in mixed hospitals. In the South/Southeast, 56% of public hospitals and 30% of mixed hospitals received high-risk referrals.

Technical responsibility for care in the various specialties should generally fall to individuals with the appropriate leadership and training in order to keep the services up-to-date in terms of knowledge, technology, and other quality-of-care issues. Specialization should ensure that staff will manage these issues properly. As shown in Table 2, all three types of financing showed a lower proportion of head physicians and nurses with specialized training in obstetrics in the North/Northeast. More head physicians had received specialized training in obstetrics when compared to head nurses. The difference was even greater in neonatology, ranging from 32% of head pediatricians in public maternity hospitals in the North/Northeast and in mixed maternity hospitals in the Central to 100% of private hospitals in the North/Northeast. As for head nurses with specialized training in neonatology, the proportion ranged from 35% in public maternity hospitals

Table 1

Proportion of maternity hospitals according to type of financing and major geographic region, location in State capital, and key infrastructure characteristics. Brazil, 2010*.

| | Public (%) | | | Mixed (%) | | | Private (%) | | | Brazil (%) | | |
|-----------------------------|------------|------|-------|-----------|------|------|-------------|------|------|------------|-------|---------|
| | N/NE | S/SE | C | N/NE | S/SE | C | N/NE | S/SE | C | Public | Mixed | Private |
| Located in State capital | 16.9 | 38.7 | 62.8 | 18.4 | 8.1 | 67.6 | 32.4 | 23.0 | 39.1 | 28.8 | 13.4 | 28.3 |
| Obstetric volume | | | | | | | | | | | | |
| High | 15.1 | 36.0 | 7.1 | 28.0 | 10.0 | 17.6 | 3.7 | 14.8 | 0.0 | 22.3 | 13.9 | 8.7 |
| Medium | 46.4 | 53.8 | 76.2 | 52.8 | 51.8 | 26.5 | 49.1 | 50.8 | 39.1 | 51.7 | 50.6 | 48.8 |
| Low | 38.5 | 10.2 | 16.7 | 19.2 | 38.3 | 55.9 | 47.2 | 34.4 | 60.9 | 26.0 | 35.5 | 42.5 |
| ICU | 32.9 | 69.2 | 48.8 | 55.6 | 67.2 | 42.4 | 76.1 | 97.6 | 69.6 | 47.7 | 63.7 | 86.2 |
| Type of ICU | | | | | | | | | | | | |
| Adult ICU | 29.7 | 3.9 | 23.8 | 57.1 | 38.0 | 14.3 | 0.0 | 15.8 | 0.0 | 15.4 | 40.4 | 8.7 |
| Neonatal ICU | 29.7 | 15.6 | 0 | 2.9 | 3.1 | 7.1 | 9.6 | 14.2 | 31.3 | 19.6 | 3.2 | 13.7 |
| Adult and neonatal ICU | 40.7 | 80.5 | 76.2 | 40.0 | 59.0 | 78.6 | 90.4 | 70.0 | 68.8 | 65.0 | 56.4 | 77.6 |
| Teaching hospital | 69.4 | 82.8 | 100.0 | 52.4 | 79.2 | 85.3 | 0.0 | 21.1 | 13.0 | 76.9 | 74.1 | 11.4 |
| High-risk referral hospital | 20.1 | 56.1 | 32.6 | 7.1 | 30.1 | 20.6 | 0.0 | 0.0 | 0.0 | 34.5 | 25.2 | 0.0 |

C: Central; N: North; NE: Northeast; S: South; SE: Southeast; ICU: intensive care unit.

* Values weighted according to sampling plan.

in the North/Northeast to 82% in mixed facilities in the Central. The proportion of maternity hospitals where all four coordinators had specialized training (both head physicians and nurses in both obstetrics and neonatology) was higher in the South/Southeast and in public hospitals and was especially low in the North/Northeast, possibly due to the lack of such specialists in that macro-region.

Table 3 shows the availability of essential and strategic equipment for maternal and neonatal survival in emergencies. For maternal emergencies, the availability was greater in private (99%) and mixed (89%) and lower in public hospitals (71%), with a greater need in the North/Northeast, where only 56% of public hospitals had such equipment. For neonatal emergencies as well, the availability was higher in private hospitals (88%), compared to 82% in mixed and 68% in public hospitals. Again, the gaps were greater in hospitals in the North/Northeast: only 45% of public hospitals and 64% of mixed hospitals had

all the necessary equipment. The availability of a blood bank or transfusion service varied from 48% in mixed hospitals in the North/Northeast to 84% in mixed hospitals in the South/Southeast; overall, it was 75% in mixed, 69% in public, and 67% in private hospitals. Clinical pathology laboratories existed in 70% of mixed hospitals in the North/Northeast and 100% of public hospitals in the Central; the overall figures were 92% in public, 87% in private, and 85% in mixed hospitals. The availability of an ambulance for the woman varied from 50% in private hospitals in the North/Northeast to 100% in various regions and types of financing; overall, it was 97% in public, 88% in mixed, and 61% in private hospitals. Ambulance availability for the newborn varied from zero in private hospitals in the Central to 100% in public hospitals in the Central; overall, it was 67% in public, 51% in mixed, and 17% in private hospitals.

Regarding essential medicines, as shown in Table 4, the situation was the opposite, with

Table 2

Proportion of maternity hospitals according to type of financing, major geographic region, and head physicians and nurses with specialized training. Brazil, 2010*.

| Service | Public (%) | | | Mixed (%) | | | Private (%) | | | Brazil (%) | | |
|--------------------------------------------|------------|-------|-------|-----------|-------|-------|-------------|-------|-------|------------|-------|---------|
| | N/NE | S/SE | C | N/NE | S/SE | C | N/NE | S/SE | C | Public | Mixed | Private |
| Obstetrics | | | | | | | | | | | | |
| Physician | | | | | | | | | | | | |
| Médico | | | | | | | | | | | | |
| Coordinator | 50.4 | 95.7 | 93.0 | 73.6 | 91.9 | 54.6 | 69.4 | 73.8 | 73.9 | 70.6 | 86.3 | 71.8 |
| With specialized training | 85.7 | 100.0 | 100.0 | 82.6 | 100.0 | 88.9 | 100.0 | 100.0 | 100.0 | 94.4 | 96.7 | 100.0 |
| Nurse | | | | | | | | | | | | |
| Coordinator | 63.3 | 71.5 | 83.7 | 74.6 | 92.1 | 100.0 | 61.1 | 63.4 | 73.9 | 68.0 | 89.1 | 63.4 |
| With specialized training | 55.7 | 67.7 | 36.1 | 45.7 | 51.7 | 23.5 | 90.9 | 47.4 | 23.5 | 58.0 | 49.0 | 62.7 |
| Neonatology | | | | | | | | | | | | |
| Physician | | | | | | | | | | | | |
| Coordinator | 31.5 | 72.0 | 76.2 | 54.0 | 64.0 | 32.4 | 100.0 | 80.5 | 82.6 | 50.2 | 60.3 | 89.0 |
| With specialized training | 85.2 | 100.0 | 93.8 | 64.7 | 91.2 | 100.0 | 52.3 | 100.0 | 100.0 | 94.1 | 86.8 | 77.0 |
| Nurse | | | | | | | | | | | | |
| Coordinator | 34.9 | 72.0 | 69.0 | 52.0 | 50.7 | 81.8 | 64.2 | 68.0 | 73.9 | 51.4 | 52.6 | 66.9 |
| With specialized training | 47.4 | 79.1 | 55.2 | 32.3 | 43.0 | 18.5 | 61.4 | 75.9 | 54.1 | 64.4 | 39.2 | 71.8 |
| All coordinators with specialized training | 9.4 | 29.2 | 18.6 | 7.2 | 18.7 | 8.8 | 4.5 | 11.4 | 12.5 | 17.4 | 15.9 | 8.7 |

C: Central; N: North; NE: Northeast; S: South; SE: Southeast; ICU: intensive care unit.

* Values weighted according to sampling plan.

lower proportions in the private sector, except for surfactant and coagulant/hemostatic drugs for the woman. Still, concerning the availability of all drugs listed as essential, there was a reversal, with the following rates: private (71%), mixed (59%), and public (43%). Again, the largest gaps appeared in the North/Northeast, where only 37% of public and 35% of mixed hospitals had the complete list.

Table 5 shows that hospitals with higher complexity, defined here as having six or more neonatal ICU beds plus adult ICU beds, comprised 30% of the public and mixed and 59% of the private hospitals. They were generally located in State capitals, especially in the case of public maternity hospitals (64%). There were proportionally more hospitals with higher complexity in the mixed financing category (80% in the North/Northeast

and 64% in the South/Southeast) and in the private category (68% in the South/Southeast and 57% in the Central). Hospitals with higher complexity tended to have a medium obstetric volume, while those with lower complexity mostly performed fewer deliveries. Higher-complexity hospitals frequently included teaching activities, served as high-risk referral, and had head physicians and nurses with specialized training. These were also the hospitals that tended to have essential maternal and neonatal emergency equipment. Except for the private hospitals, the higher-complexity facilities were also more likely to have blood banks or transfusion services, clinical pathology laboratories, and ambulances for mothers and newborns.

Table 3

Proportion of maternity hospitals according to type of financing, major geographic region, availability of emergency equipment, blood bank, clinical pathology laboratory, and ambulances. Brazil, 2010 *.

| Emergency equipment | Public (%) | | | Mixed (%) | | | Private (%) | | | Brazil (%) | | |
|--------------------------------------------------------------------|------------|-------|-------|-----------|-------|-------|-------------|-------|-------|------------|-------|---------|
| | N/NE | S/SE | C | N/NE | S/SE | C | N/NE | S/SE | C | Public | Mixed | Private |
| Obstetric | | | | | | | | | | | | |
| Mechanical respirator/ Ventilator | 62.9 | 91.4 | 74.4 | 69.0 | 95.0 | 97.1 | 97.2 | 100.0 | 100.0 | 74.4 | 90.0 | 98.8 |
| Laryngoscope and endotracheal tube | 85.6 | 100.0 | 100.0 | 89.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 92.1 | 98.0 | 100.0 |
| Manual resuscitator | 94.2 | 100.0 | 100.0 | 98.4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 96.8 | 99.7 | 100.0 |
| All equipment | 56.3 | 91.4 | 74.4 | 64.3 | 95.0 | 97.1 | 97.2 | 100.0 | 100.0 | 70.6 | 89.1 | 98.8 |
| Neonatal | | | | | | | | | | | | |
| Laryngoscope and endotracheal tube | 83.8 | 100.0 | 100.0 | 85.7 | 100.0 | 100.0 | 100.0 | 95.9 | 100.0 | 91.1 | 97.2 | 98.0 |
| Valve-less neonatal suction catheters | 73.2 | 99.5 | 100.0 | 86.5 | 97.2 | 100.0 | 100.0 | 95.9 | 100.0 | 85.3 | 95.2 | 98.0 |
| Meconium aspirator and aspirator with manometer and O ₂ | 55.0 | 94.1 | 100.0 | 86.5 | 90.6 | 73.5 | 100.0 | 76.2 | 95.7 | 73.2 | 88.9 | 88.2 |
| Material for ventilation manual resuscitator) | 88.5 | 100.0 | 100.0 | 92.1 | 100.0 | 100.0 | 100.0 | 95.9 | 100.0 | 93.8 | 98.4 | 98.0 |
| All equipment | 44.8 | 93.5 | 100.0 | 64.3 | 87.7 | 73.5 | 100.0 | 75.6 | 95.7 | 67.7 | 82.1 | 87.8 |
| Blood bank or transfusion service | 62.2 | 77.0 | 74.4 | 47.6 | 83.6 | 58.8 | 56.5 | 74.6 | 75.0 | 68.8 | 75.2 | 66.9 |
| Clinical pathology laboratory | 91.7 | 89.8 | 100.0 | 69.6 | 87.6 | 97.1 | 79.8 | 91.1 | 95.7 | 91.9 | 84.6 | 86.6 |
| Ambulance for mothers | 95.3 | 100.0 | 100.0 | 77.0 | 90.9 | 88.2 | 49.5 | 62.6 | 100.0 | 97.4 | 88.1 | 60.6 |
| Ambulance for newborns | 64.7 | 63.1 | 100.0 | 60.3 | 46.4 | 87.9 | 28.7 | 8.9 | 0.0 | 67.1 | 51.3 | 16.5 |

C: Central; N: North; NE: Northeast; S: South; SE: Southeast.

* Values weighted according to sampling plan.

Discussion

By producing an overview of key structure issues in Brazilian maternity hospitals, this study aimed to identify the potentialities and deficiencies of the country's health system in obstetric and neonatal care. This subject has drawn increasing attention from Brazilian researchers, given the country's persistently and unacceptably high maternal and perinatal mortality rates, despite

the increasing coverage of in-hospital deliveries^{4,10,22,23,24,25}.

Although this article did not consider the quality of obstetric and neonatal care in the selected maternity hospitals, evidence of the association between professional staff supply and adequate setting for providing safe care for women and newborns and the occurrence of favorable outcomes reaffirm the importance of singly evaluating structure^{12,26}.

Table 4

Proportion of maternity hospitals according to type of financing, major geographic region, and availability of medicines. Brazil, 2010*.

| | Public (%) | | | Mixed (%) | | | Private (%) | | | Brazil (%) | | |
|----------------------------------------------------|------------|-------|-------|-----------|-------|-------|-------------|------|-------|------------|-------|---------|
| | N/NE | S/SE | C | N/NE | S/SE | C | N/NE | S/SE | C | Public | Mixed | Private |
| Medicines | | | | | | | | | | | | |
| Anti-hypertensives | 100.0 | 99.5 | 100.0 | 100.0 | 100.0 | 100.0 | 92.7 | 89.4 | 100.0 | 99.8 | 100.0 | 92.1 |
| Anxiolytics/Hypnotics | 97.1 | 94.7 | 88.4 | 92.9 | 95.8 | 100.0 | 92.7 | 87.7 | 100.0 | 95.7 | 95.5 | 90.9 |
| Steroids | 97.1 | 100.0 | 100.0 | 93.6 | 100.0 | 100.0 | 97.2 | 89.4 | 100.0 | 98.4 | 98.8 | 94.1 |
| Oxytocin | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 90.7 | 89.4 | 100.0 | 100.0 | 100.0 | 90.9 |
| Uterine contractility inhibitors | 100.0 | 97.3 | 100.0 | 98.4 | 97.7 | 100.0 | 97.2 | 89.4 | 100.0 | 99.0 | 98.0 | 94.1 |
| Magnesium sulfate | 100.0 | 98.4 | 95.3 | 100.0 | 97.7 | 100.0 | 97.2 | 89.4 | 100.0 | 99.0 | 98.3 | 94.1 |
| Surfactant | 58.6 | 88.2 | 83.3 | 39.2 | 73.7 | 64.7 | 97.2 | 87.0 | 87.0 | 71.6 | 66.6 | 91.3 |
| Coagulants/Hemostatic drugs for woman | 87.5 | 70.4 | 76.2 | 92.9 | 89.2 | 100.0 | 97.2 | 85.2 | 95.7 | 80.3 | 90.5 | 91.3 |
| Coagulants/Hemostatic drugs for newborn | 98.6 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 97.2 | 89.4 | 100.0 | 99.2 | 100.0 | 94.1 |
| Solution for prevention of neonatal conjunctivitis | 87.8 | 81.7 | 88.4 | 96.0 | 93.3 | 100.0 | 97.2 | 84.6 | 100.0 | 85.8 | 94.2 | 91.7 |
| Anti-D immunoglobulin | 74.8 | 95.7 | 88.4 | 96.0 | 93.3 | 100.0 | 97.2 | 84.6 | 100.0 | 83.6 | 93.6 | 79.5 |
| All medicines | 37.3 | 48.1 | 53.5 | 34.9 | 64.2 | 64.7 | 66.1 | 71.8 | 83.3 | 42.6 | 58.6 | 70.6 |

C: Central; N: North; NE: Northeast; S: South; SE: Southeast.

* Values weighted according to sampling plan.

The study's sampling design allowed a more in-depth investigation of variations in the structure of maternity facilities according to type of financing and geographic location.

The study showed that the largest network of obstetric and neonatal care is outsourced by the SUS, corroborating similar studies in Rio de Janeiro^{3,7}, Greater Metropolitan São Paulo²², and Santa Catarina State²⁷.

For maternity hospitals with mixed financing, the study did not determine the proportions of users of the SUS versus clientele of private health plans or out-of-pocket users. However the results confirmed that the proportionally larger network of public maternity hospitals of SUS in the North/Northeast is due to the low population contingent covered by private health plans in that macro-region. Meanwhile, the concentration of the clientele covered by private health plans or paying out of pocket in the South/Southeast may indicate different patterns of health plans between the mixed and private maternity hospitals, besides expressing the organization of the supply in some locations with fewer public facilities, the need to hire private services, and the need for private facilities to complement their revenue through service provision agreements with the SUS.

The greater availability of healthcare facilities outsourced by the SUS outside the State capitals was expected, given the population's dispersal in large numbers of small cities and towns, especially in the North/Northeast. The different pattern in the Central region of Brazil is worrisome, with an over-concentration of maternity hospitals in the State capitals. Unlike other regions, in the South/Southeast nearly all of the maternity hospitals with mixed financing were located outside the State capitals, suggesting that in smaller cities the availability must be diversified for the two clienteles to avoid multiplying services, which would be cost-ineffective; meanwhile, the public hospitals were concentrated in the State capitals, with a similar distribution to that of the private sector. The percentages of private hospitals located outside the State capitals varied little between regions, suggesting a private network organized according to its own logic.

The analysis of maternity hospitals according to complexity (whether they had a neonatal ICU with six or more beds and an adult ICU) showed evidence of a difference in organization according to the three types of financing. The private network was better equipped, and there was no difference in the distribution of hospitals classified according to complexity between

Table 5

Proportion of maternity hospitals according to type of financing, level of complexity, location in State capital, and structure. Brazil, 2010 *.

| | Neonatal ICU with six or more beds and adult ICU (%) | | | | | |
|---------------------------------------------------------|------------------------------------------------------|-------|-------|-------|---------|-------|
| | Public | | Mixed | | Private | |
| | No | Yes | No | Yes | No | Yes |
| Location in State capital | 13.6 | 63.6 | 9.9 | 20.3 | 25.0 | 30.7 |
| Obstetric volume | | | | | | |
| High | 14.7 | 39.6 | 10.2 | 22.1 | 4.8 | 12.0 |
| Medium | 50.5 | 54.6 | 41.3 | 69.7 | 23.8 | 66.0 |
| Low | 34.8 | 5.8 | 48.5 | 8.2 | 71.4 | 22.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Teaching hospital | 70.3 | 91.6 | 67.4 | 88.0 | 2.9 | 17.3 |
| High-risk referral hospital | 12.7 | 84.4 | 5.8 | 65.7 | 0.0 | 0.0 |
| Head physician and head nurse with specialized training | 5.4 | 45.5 | 5.1 | 38.5 | 4.8 | 12.0 |
| Obstetric emergencies | | | | | | |
| All equipment | 53.3 | 100.0 | 76.1 | 94.2 | 97.1 | 100.0 |
| Neonatal emergencies | | | | | | |
| All equipment | 61.8 | 90.9 | 87.3 | 92.3 | 87.5 | 88.7 |
| Availability | | | | | | |
| Blood bank or transfusion service | 57.2 | 94.8 | 65.8 | 94.7 | 71.4 | 63.3 |
| Clinical pathology laboratory | 89.0 | 98.7 | 83.6 | 86.5 | 73.1 | 96.0 |
| Ambulance for mothers | 96.3 | 100.0 | 87.8 | 88.9 | 61.9 | 59.3 |
| Ambulance for newborns | 70.8 | 58.4 | 48.8 | 56.9 | 34.3 | 4.0 |
| Medicines | | | | | | |
| All medicines | 32.6 | 66.0 | 48.1 | 80.3 | 46.2 | 88.0 |

* Values weighted according to sampling plan.

the State capitals, countryside, or region of the country. Most of the higher complexity public hospitals were located in the State capitals, with fewer in the countryside in the regions, especially in the North/Northeast. This suggests possible gaps for the population who have exclusive access to healthcare facilities through the SUS, and who may or may not be covered by mixed hospitals, of which the ones with higher complexity are concentrated in the countryside and with an important share in the North/Northeast of the country.

Despite the study's inherent limitations, especially the lack of detailed data on the number of available beds for admissions and the size, demographic and social profile, and health needs of the childbearing-age and newborn population¹⁰, the results presented here emphasize the geographic inequality in the supply of hospital services in the SUS, especially hospitals with higher complexity. The findings also show healthcare gaps that can force patients to travel long distances for hospitalization to give birth in a context of limited

support for pregnant women, thereby increasing the risk of infant death, as shown by Almeida & Szwarcwald²⁸, in addition to confirming that the regionalization of hospital care is still a challenge for Brazil.

The indirect indicators of the degree of complexity in the study sample's maternity hospitals were the number of procedures performed, the existence of a neonatal ICU with at least six beds and/or an adult ICU, teaching activities, head physicians and nurses with specialized training in obstetrics and neonatology, and specifically for the public and mixed hospitals, being a referral hospital for high-risk pregnancies.

In relation to these characteristics, the results reconfirm the hospital network's heterogeneity. Public and mixed hospitals showed a greater supply of facilities with medium and high obstetric volume in the year 2007, where the higher-complexity hospitals were concentrated, which agrees with the tendency whereby a higher number of deliveries justifies expenditures on maintenance of equipment and staff that are trained

in the use of sophisticated medical technology for managing emergency situations^{23,29}. However, there were numerous public and mixed hospitals that performed more than a thousand deliveries in 2007 and that did not have an ICU. Meanwhile, in the private network, although there were more hospitals that performed fewer deliveries, facilities with an ICU were more common – which could be indicative of the need for intensive care for the newborns, associated with either high cesarean rates in this sector or the clientele's demands.

Many public and mixed hospitals conducted teaching activities, which could be indicative of more experienced staff and thus greater possibility for a positive impact on quality of care. With the assumption that head physicians and nurses with specialized training in obstetrics and neonatology could show greater clinical competence for decision-making to perform appropriate procedures^{13,30}, the article simply listed the existence of a head physician and/or nurse and their academic degrees. Even so, the presence of head physicians and nurses in the obstetrics and neonatology services was low, especially those with specialized training, even in higher-complexity hospitals. The most dramatic situation was in public maternity hospitals in the North/Northeast. In the other regions, head physicians and nurses were nearly two times as common in public and mixed maternity hospitals compared to the private network.

Another mechanism with the potential to expand access for patients that most need care was the regulation of hospitalization for delivery in the SUS, especially for high-risk pregnant women and newborns.

Higher-complexity public and mixed maternity hospitals predominated among those serving as high-risk referral facilities through hospital admissions call centers. Even so, a surprising percentage of these hospitals failed to inform that they served as referral facilities for other maternity hospitals, thus displaying a lack of organization in the network for high-risk pregnancies and neonatal care. Another important point was the existence of low-complexity facilities that identified themselves as referral hospitals for high-risk pregnancies. Of this total, 33% were located outside the State capitals in the Northeast.

The study identified major gaps in hospital structure that can jeopardize the quality of obstetric and neonatal care, potentially increasing adverse maternal and neonatal outcomes¹².

The study showed that the minimum equipment for managing obstetric emergencies was reported as available in all hospitals in the private network and in all public and mixed facilities

with higher complexity. As for neonatal emergency equipment, a significant proportion of hospitals failed to present the complete set of necessary equipment. This situation is worrisome, especially in lower-complexity public and mixed hospitals in the North and Northeast, which can further appear in the neonatal mortality rates.

Hemorrhage is one of the main causes of maternal death in Brazil, so it is worrisome that 40% of higher-complexity maternity hospitals in the private sector lack blood banks or transfusion services, especially considering their high surgery rates. The lack of blood transfusion capability in the hospital delays treatment in these cases¹³.

Although the availability of ambulances in maternity hospitals is necessary to guarantee timely hospitalization for adequate obstetric care, the study detected a critical situation, especially in the private sector. The situation was even worse for transferring newborns from lower-complexity maternity hospitals, potentially contributing to avoidable neonatal deaths, since the most common reason for transferring newborns is the need for neonatal intensive care^{4,13}.

At the time of the interview, an important percentage of maternity hospitals reported not having one or more of the essential medicines available. The missing medicines included those for inducing pulmonary maturation in the newborn, interrupting hemorrhage, preventing Rh-negative alloimmunization, or preventing neonatal conjunctivitis. This scenario is problematic since it can directly increase rates of such complications as miscarriage, neonatal respiratory distress syndrome³¹, maternal and infant death, and Sheehan syndrome³².

The study showed a large proportion of poorly equipped maternity hospitals lacking specialized staff, and the results indicate that the distribution of higher-complexity hospitals is more unequal than that of lower-complexity facilities. Of all the regions, the North/Northeast, followed by the Central, showed the worst gaps and problems, especially in public and mixed maternity hospitals. In the South/Southeast, these hospitals had better structures, reaching similar or even higher proportions than in the private sector. The results indicate that an important share of mothers and newborns were exposed to unnecessary and avoidable risks.

Despite some uncertainties concerning the reliability of structure data provided by administrators of maternity hospitals in the sample (since the study's field supervisors did not directly verify the items in the data collection instrument), this choice guaranteed both participation by all the hospitals selected in the sample and

a low non-response rate. Importantly, the availability of equipment and inputs does not necessarily mean that the women's health needs were met when they sought care at these facilities.

Even considering the study's limitations, the results provide backing for the debate on quality of hospital services in Brazil. They point to the need to continue the evaluation of hospital structure and develop analytical studies to explore the question of variation in hospital performance, which will require more detailed information on other aspects of hospital structure, the socioeconomic profile and case severity of the clientele, and the process of obstetric and neonatal care,

based on applying questionnaires to postpartum women and retrieving data from patient files in the *Birth in Brazil* survey.

Finally, future studies should focus on the structure of regionalized perinatal care networks as the unit of analysis, since the issues of complexity, regulation, availability of blood banks and transfusion services, and others should be measured according to regional health needs, thus contributing to proposals for quality improvement and suggesting paths for the organization of regional healthcare networks¹⁴, from the perspective of backing the organization and operation of the SUS.

Resumen

El presente estudio evalúa aspectos en cuanto a la estructura de una muestra de hospitales de maternidad en Brasil. El marco ha sido evaluado en función de patrones de referencia del Ministerio de Salud y abarca: ubicación geográfica, volumen de nacimientos, presencia de IU, actividades de aprendizaje, formación de recursos humanos, disponibilidad de equipos y medicamentos. Los resultados muestran diferencias en la cualificación y disponibilidad de equipos y servicios de suministros para el parto, según regiones, y su grado de complejidad. El Norte/Nordeste y Centro-Oeste mostraron los mayores problemas. En el Sur/Sudeste, los hospi-

tales estaban mejor estructurados, alcanzando proporciones satisfactorias en diversos aspectos del estudio, cercanos o justo por encima del nivel de la red privada. Este estudio aporta al debate la cuestión la calidad estructural de los servicios hospitalarios que se ofrecen en el país, y hace hincapié en la necesidad de desarrollo de estudios de análisis que tengan en cuenta los procesos y resultados de la atención.

Maternidades; Estructura de los Servicios; Calidad de la Atención de Saúde

Contributors

S. D. A. Bittencourt participated in the study project's national coordination and collaborated in the data analysis and writing of the article. L. G. C. Reis collaborated in the elaboration of the questionnaire, data analysis, and writing of the article. M. M. Melo and P. L. Rodrigues collaborated in the elaboration of the questionnaire and writing of the article. D. Rattner, D. O. Neves and S. L. Arantes were State coordinators of the study and collaborated in the data analysis and writing of the article. M. C. Leal was the national study coordinator and collaborated in the data analysis and writing of the article.

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