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CDC LOCATe: discrepancies between self-reported level of maternal care and LOCATe-assessed level of maternal care among 463 birth facilities

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Abstract

OBJECTIVE: Describe sources of discrepancy between self-assessed LoMC (level of maternal care) and CDC LOCATe®-assessed (Levels of Care Assessment Tool) LoMC.

STUDY DESIGN: CDC LOCATe® was implemented at 480 facilities in 13 jurisdictions, including states, territories, perinatal regions, and hospital systems, in the U.S. Cross-sectional analyses were conducted to compare facilities' self-reported LoMC and LOCATe®-assessed LoMC.

RESULT: Among 418 facilities that self-reported an LoMC, 41.4% self-reported a higher LoMC than their LOCATe®-assessed LoMC. Among facilities with discrepancies, the most common elements lacking to meet self-reported LoMC included availability of maternal-fetal medicine (27.7%), obstetric-specializing anesthesiologist (16.2%), and obstetric ultrasound services (12.1%).

CONCLUSION: Two in five facilities self-report a LoMC higher than their LOCATe®-assessed LoMC, indicating discrepancies between perceived maternal care capabilities and those recommended in current LoMC guidelines. Results highlight an opportunity for states to engage with facilities, health systems, and other stakeholders about LoMC and collaborate to strengthen systems for improving maternal care delivery.

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AUTHOR CONTRIBUTIONS

SM conceptualized and designed the work; acquired, analyzed, and interpreted the data; and drafted the manuscript. JB and MM conceptualized and designed the work and revised the manuscript critically for important intellectual content. AE, MB, and DG conceptualized and designed the work; acquired the data; and revised the manuscript critically for important intellectual content.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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INTRODUCTION

Risk-appropriate care is defined as regionalized systems that support patients in receiving care in a facility with the appropriate personnel and services for their health risks. Perinatal regionalization was first proposed by the March of Dimes Committee on Perinatal Health in the 1976 report, Toward Improving the Outcome of Pregnancy (TIOP), as an approach to improve maternal and neonatal health outcomes [1]. In response to TIOP, states and other jurisdictions began to develop perinatal regionalization models; however, perinatal regionalized care focused on neonatal risk and outcomes rather than fully considering the mother-infant dyad [2]. In 2015, the American College of Obstetricians and Gynecologists (ACOG) and the Society of Maternal and Fetal Medicine (SMFM) jointly released guidelines for maternity care facilities specific to maternal care needs, establishing Levels of Maternal Care (LoMC) comparable to those established for neonatal levels of care [3]. The ACOG/SMFM 2015 LoMC guidelines were updated in 2019 [4].

With rising concerns about maternal mortality in the United States, there has been increased focus on implementing regionalized systems of risk-appropriate maternal care [2, 4, 5]. However, there is currently little information on the impact regionalized maternal care has on maternal health outcomes [3, 4]. Still, an analysis of data from 9 state maternal mortality review committees (MMRC) found that one of the most common MMRC recommendations for preventing pregnancy-related deaths was to “adopt levels of maternal care/ensure appropriate level of care determination” [6].

Current ACOG/SMFM LoMC guidelines provide criteria that define four distinct levels of maternal care: Level I (basic care), Level II (specialty care), Level III (subspecialty care), and Level IV (regional perinatal health care center); each level is defined by a set of minimum facility capabilities, including available personnel and services. There is also wide variation in state implementation and monitoring of regionalized systems of care for both neonatal and maternal systems of risk-appropriate care [7–10]. A 2019 assessment of state websites identified 17 states with publicly available LoMC guidelines [9]. Among these 17 states, 12 states defined 4 levels of care and 5 defined 3 levels. Within levels, the assessment identified further variability in definition, criteria, and nomenclature between state-defined LoMC and those defined by the 2015 ACOG/SMFM LoMC guidelines [9].

The Collaborative Improvement and Innovation Network to Reduce Infant Mortality (IM CoIIN) team addressing risk-appropriate care highlighted the importance of developing a standardized method for assessing levels of care that enabled effective monitoring of risk-appropriate care among facilities [11].

To address the need for a standardized assessment tool, the Centers for Disease Control and Prevention (CDC) worked with the American Academy of Pediatrics (AAP), ACOG, and SMFM to develop the CDC Levels of Care Assessment Tool (LOCATe®), which aligns with AAP guidelines for assessing neonatal levels of care and ACOG/SMFM guidelines for assessing levels of maternal care [12, 13].

A fundamental part of conversations about improving risk-appropriate care is understanding where guideline elements that define levels may differ from facilities’ understanding. In

addition, there is little information on variations in the ways that personnel and services are available between and within levels of maternal care, which can be helpful for facilitating peer-level hospital conversations and collaborations. The objective of this analysis is to describe personnel and services that contribute to discrepancies between self-reported LoMC and CDC LOCATe-assessed LoMC to describe variations in available personnel and services (e.g., various types of ultrasound, laboratory testing, blood bank) between and within CDC LOCATe-assessed LoMC.

METHODS

States, U.S. territories, perinatal regions, and other organizational bodies (e.g., hospital systems), henceforth referred to as "jurisdictions," implement LOCATe® with technical assistance from the CDC Division of Reproductive Health. Jurisdictions self-select to implement LOCATe® by contacting the CDC [12, 13]. Information about implementation is available on the CDC website [13]. LOCATe® is administered within each jurisdiction by implementing agencies (e.g., perinatal quality collaboratives, states health departments, hospital associations) using web-based survey tools; including SurveyMonkey (SurveyMonkey Inc, San Mateo, California, USA) and REDCap (Vanderbilt University, Nashville, Tennessee, USA) [12]. Upon completion of LOCATe®, jurisdictions hold ownership of the data; use of the data is decided upon by the jurisdiction. Typically, jurisdictions' perinatal quality collaboratives, health departments, and/or hospital associations collaborate to implement LOCATe®. LOCATe® is not a comprehensive assessment of personnel and services or a regulatory tool, but is a data collection strategy intended for the purpose of generating information that can facilitate conversation among stakeholders committed to improvements in systems for maternal and neonatal risk-appropriate care. The 13 jurisdictions included in this analysis completed LOCATe® between 2016 and 2019. LOCATe® was completed by 480 facilities in 9 states (state-wide), 1 U.S. territory, 1 hospital system, and perinatal regions within 2 states. Included facilities do not overlap between jurisdictions. Facilities with incomplete data, as well as children's hospitals, were excluded from this analysis.

LOCATe® implementation

During LOCATe® implementation, a jurisdiction coordinator, often referred to as the "champion," is identified and trained on best practices in LOCATe® implementation [12]. This coordinator communicates with facilities in order to ensure that all facilities within their jurisdiction are aware of the process and the aims of LOCATe® prior to the facility receiving the tool. During this phase of implementation, facilities are typically sent a letter from the implementing agency, along with a detailed list of information that will be requested to complete LOCATe®. This allows facilities to identify appropriate respondents and gather information in advance, facilitating readiness and decreasing respondent burden. Facility respondents are determined by each facility using their judgment of those with the most relevant knowledge to provide the assessment responses. On average, 3 different people at each facility contribute to responses, and more than half of those who contribute responses are maternity and/or obstetric unit directors. Other common facility respondents include nurse managers, labor and delivery coordinators, and medical directors. Facilities are

encouraged to have a confirmatory review of responses by relevant facility staff not involved in initial reporting before submission, in order to maximize response accuracy [14].

LOCATe® contains questions about facility personnel and services, including sub-specialists and their availability, volume of services, drills and protocols for emergent situations, transports, facility-level statistics (e.g., total deliveries, maternal deaths prior to discharge), and self-reported levels of neonatal and maternal care [12]. Once a jurisdiction completes data collection, the implementing agency then sends the CDC an export of their LOCATe® data.

Data analysis

To produce a CDC-assessed LoMC, the CDC applied a standard algorithm to the facility responses on questions related to personnel and services (Table 1). The algorithm was consistent with the 2015 ACOG/SMFM LoMC guidelines and is based on the minimum elements required for each LoMC. Facilities may reach some levels through multiple pathways. For example, facilities can reach Level I for maternal health providers by having any one of an obstetrician-gynecologist, midwife, or family medicine physician readily available at all times. Therefore, availability of personnel and services can vary between facilities, while still fulfilling within-level criteria. While 4 levels are defined in the ACOG/SMFM LoMC guidelines, the CDC LOCATe® algorithm includes a fifth level to accommodate facilities that do not meet the requirements of a Level I facility. If facilities do not meet the minimum requirements for Level I, they are assigned to < Level I. Accreditation of birth centers happens through a process, including registration and site visits, conducted by the Commission for the Accreditation of Birth Centers based on criteria set forth by the American Association of Birth Centers [15, 16]. In consideration of this separate and preexisting accreditation process, LOCATe® does not include a “birthing center” category in CDC-assessed level; however, birth centers are welcome to participate in LOCATe®, and to self-report as a Birthing Center. LOCATe® also asks respondents to self-report a LoMC based on the following wording, “Based on the 2015 ACOG/SMFM guidelines for maternal levels of care, what do you consider your maternal level of care to be?” Response options include “Birthing Center, I, II, III, IV, Unknown (not sure)”. While facilities cannot self-report as < Level I, they can be assessed as < Level I when not meeting Level I criteria included in LOCATe®.

Four versions of LOCATe® were implemented by the included jurisdictions; each version largely representing slight wording changes to improve clarity for respondents. While there were some incomparable data across versions due to changes in response options, only comparable data across all 4 versions were used for this analysis.

Discrepancies between CDC LOCATe®-assessed LoMC and facilities’ self-reported LoMC were described by percent agreement. Among facilities with a discrepancy between CDC LOCATe®-assessed LoMC and self-reported LoMC, and where the facility self-reported a higher LoMC, we then identified the source of the discrepancy based on ACOG/SMFM level-specific requirements for personnel and services. To understand personnel and service availability, frequencies and percentages of personnel and service availability were

calculated within each CDC LOCATe®-assessed LoMC. SAS (version 9.4; SAS Institute) was used for all analyses.

RESULTS

Data from 463 facilities were used in this descriptive analysis of cross-sectional data. Based on CDC's LOCATe® assessment, 13.4% (n = 62) of facilities did not have the elements required for a Level I, 36.1% (n = 167) assessed as a Level I, 38.4% (n = 178) as a Level II, 7.1% (n = 33) as a Level III, and 5.0% (n = 23) as a Level IV. Among all facilities, 2.6% (n = 12) self-reported as a Birthing Center, 23.3% (n = 108) as a Level I, 40.4% (n = 187) as a Level II, 15.8% (n = 73) as a Level III, and 8.2% (n = 38) as a Level IV; 9.7% (n = 45) marked self-reported LoMC as Unknown or had a missing response. Overall, for 46.4% (n = 194) of 418 facilities with non-missing facility self-reported LoMC and CDC LOCATe(r)-assessed LoMC, there was a discrepancy between the facility self-reported LoMC and the CDC LOCATe®-assessed LoMC. Among facilities with discrepancies between self-reported and CDC LOCATe®-assessed LoMC, 89.2% (n = 173) had a higher self-reported level and 10.8% (n = 21) had a lower self-reported level than their CDC LOCATe®-assessed level. Among the 173 facilities with a higher self-reported LoMC, 22.0% (n = 38) had a discrepancy from LOCATe® of two or more levels. Contributors to discrepancies, where the CDC LOCATe®-assessed LoMC were lower than the self-reported LoMC, were a lack of personnel only (n = 73, 42.2%), a lack of services only (n = 76, 43.9%), or a lack of both personnel and services (n = 24, 13.9%) (Fig. 1). Specific ACOG/SMFM guideline elements that resulted in discrepancies between self-reported LoMC and CDC LOCATe®-assessed LoMC varied by CDC LOCATe®-assessed LoMC (Table 2). Overall, the 3 most common specific ACOG/SMFM guideline elements contributing to discrepancies were a reported lack of any form of MFM availability (including telemedicine, on-call, or on-site) (27.7%), lack of availability of an obstetric-specializing physician anesthesiologist (16.2%), and lack of obstetric ultrasound services (12.1%).

Consistent with guidelines, there was an increase in the provision of specialized care with increasing levels of maternal care (Table 3). For example, facilitates reported that cardiologists were available among 37% of facilities that LOCATe® assessed as < Level I, 52% that assessed at Level I, and 92% that assessed at Level II. The LOCATe® data also describe variation in how facilities meet the LoMC requirements for provision of specialized care within LoMC (Table 3). For example, while complex cardiothoracic surgery is provided by 91.3% (n = 21) of Level IV facilities, and organ transplant is provided by 78.3% (n = 18) of Level IV facilities, 69.6% (n = 16) provide both guideline elements. Among all LoMC, the most common service was laboratory testing (99.1%, n = 459) and the least common was organ transplant (10.2%, n = 47). Among all LoMC, the most common subspecialty was general surgery (82.1%, n = 380) and the least common was neonatology (46.2%, n = 214).

DISCUSSION

Almost half (46.4%) of the facilities included in the present study had a discrepancy between their self-reported LoMC and CDC LOCATe®-assessed LoMC, based on 2015 ACOG/SMFM LoMC guidelines. It is possible that discrepancies arise due to limited or

lack of knowledge of LoMC guidelines. Specifically, a potential source of discrepancy may be a self-reported LoMC based on other regionalized systems of care guidelines, such as levels of neonatal and trauma care, as these level of care systems have existed longer than LoMC systems [17, 18]. Most (89.2%) discrepancies reflected a higher self-reported LoMC than CDC LOCATe®-assessed LoMC. A consequence of inaccurate self-assessment may be that facilities treat or accept transfers of patients who require care beyond what the facility is able to provide. Lack of familiarity with LoMC guidelines may drive discrepancies; future research regarding personnel awareness of LoMC and appropriate education about LoMC in personnel training could potentially address this issue. The prevalence of discrepancies described in our analysis supports recommendations of maternal mortality review committees [6] and the IM CoIIN [11] for standardized assessment and implementation of LoMC. For birth facilities to effectively create a network in which women receive care appropriate for their health risk and appropriate transports can occur as needed, facilities need an accurate understanding of the level of care they can provide as well as the level of care provided by other facilities in their network; implementing a standardized assessment of LoMC facilitates this understanding.

Discrepancies between facilities' self-reported LoMC and CDC LOCATe®-assessed LoMC occurred most often for 3 specific ACOG/SMFM LoMC guideline elements: a reported lack of MFM availability, lack of availability of an obstetric-specializing physician anesthesiologist, and lack of obstetric ultrasound services. Further, there is still a gap in the evidence to understand the ways that variations in availability of specific personnel and services may impact health outcomes among women with high-risk health conditions. Using LOCATe®, jurisdictions can map the availability of personnel and services to inform infrastructure and policy changes that strengthen regionalized systems of maternal care. For example, ACOG's Level of Maternal Care Verification Pilot indicated that standardized assessment processes can lead to specific conversations and consultations about facility needs based on geographic location and capabilities [14]. As LOCATe® is not a regulatory tool, once jurisdictions receive their LOCATe® data, they have authority over how the data is used within their jurisdiction to improve maternal care delivery. Often, LOCATe® data leads to stakeholder discussions to strengthen regionalized systems of maternal care.

This analysis has limitations. While LOCATe® takes neonatologist availability into consideration under subspecialist availability, implementation of the maternal portion of LOCATe® does not take overall neonatal care into consideration. Implementation and analysis of both the maternal and neonatal portions of LOCATe® are necessary for gaining maximum insight into care provided to the mother-infant dyad. Since the 2015 ACOG/SMFM LoMC guidelines, and subsequently LOCATe®, did not provide specific definitions for provider availability responses, misclassification of LoMC is possible in both how facilities self-reported their LoMC and how their reported personnel and services were used by LOCATe® to assess LoMC. The updated ACOG/SMFM LoMC guidelines, and subsequently updated LOCATe®, now include specific definitions for provider availability and expanded examples of personnel and risk conditions that will decrease this potential bias in analyses of future LOCATe® data. While not a limitation to the interpretation of this analysis, it should be noted that the study period and data included in this analysis do not reflect the most current guidelines that were updated in August 2019 [3]. Further,

the authors reviewed differences in current and previous guidelines and applied them to the data and found that the 2019 updates to LoMC did not result in any changes in LOCATe®-assessment. It is possible that some discrepancies between CDC LOCATe®-assessed LoMC and self-reported LoMC were due to the fact that facilities could not self-report as < Level I and could not be assessed as a birthing center. For example, 23 facilities assessed by LOCATe® as < Level I self-reported their LoMC as Level I; it is possible that these facilities selected Level I because there was no survey option to self-report as < Level I. It is also possible that these self-reports reflect a true discrepancy in awareness and knowledge of the facilities' LoMC. Future versions of LOCATe® will address this issue by providing a < Level I option for self-reported LoMC as well. There may also be value in further describing facilities within assessed Level I and < Level I facilities, including identifying birthing centers and federal designations of low-volume or rural hospitals (e.g., critical access hospital, sole community hospital) in future versions of LOCATe® based on established national criteria [15, 16, 19, 20]. Finally, generalizability of these findings beyond the 13 jurisdictions may be limited. Five of the 12 jurisdictions excluding the U.S. territory (42%) have a publicly available state policy describing levels of maternal care; this is higher than the 34% of all states that have such a policy. In addition, it is possible that jurisdictions that self-selected into participating in LOCATe® may differ from other jurisdictions in terms of awareness and knowledge about levels of maternal care.

Accurate and shared knowledge of healthcare facilities' maternal healthcare capabilities can support regionalized maternal care. While a previous study compared publicly available state-defined LoMC to regionalization policies and guidelines, the current study describes differences between facilities' perceived LoMC relative to the 2015 ACOG/SMFM LoMC guidelines as measured by LOCATe® [9]. As more states implement LOCATe® or other assessment processes consistent with ACOG/SMFM LoMC guidelines, the immediate goal is a more accurate common understanding of the maternal risk-appropriate care landscape for use by facilities, public health agencies, and other maternal care stakeholders (e.g., maternal care providers, maternal care non-profits, perinatal quality collaboratives). Ultimately, this could lead to pregnant persons and their families being better able to participate in shared decision-making with their care providers. A broader understanding of ACOG/SMFM LoMC guidelines and facility-level capabilities can improve collaborative work across and within states to promote systems of risk-appropriate maternal care which can aide in efforts to reduce pregnancy-related morbidity and mortality.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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DISCLOSURE

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the Health Resources and Services Administration.

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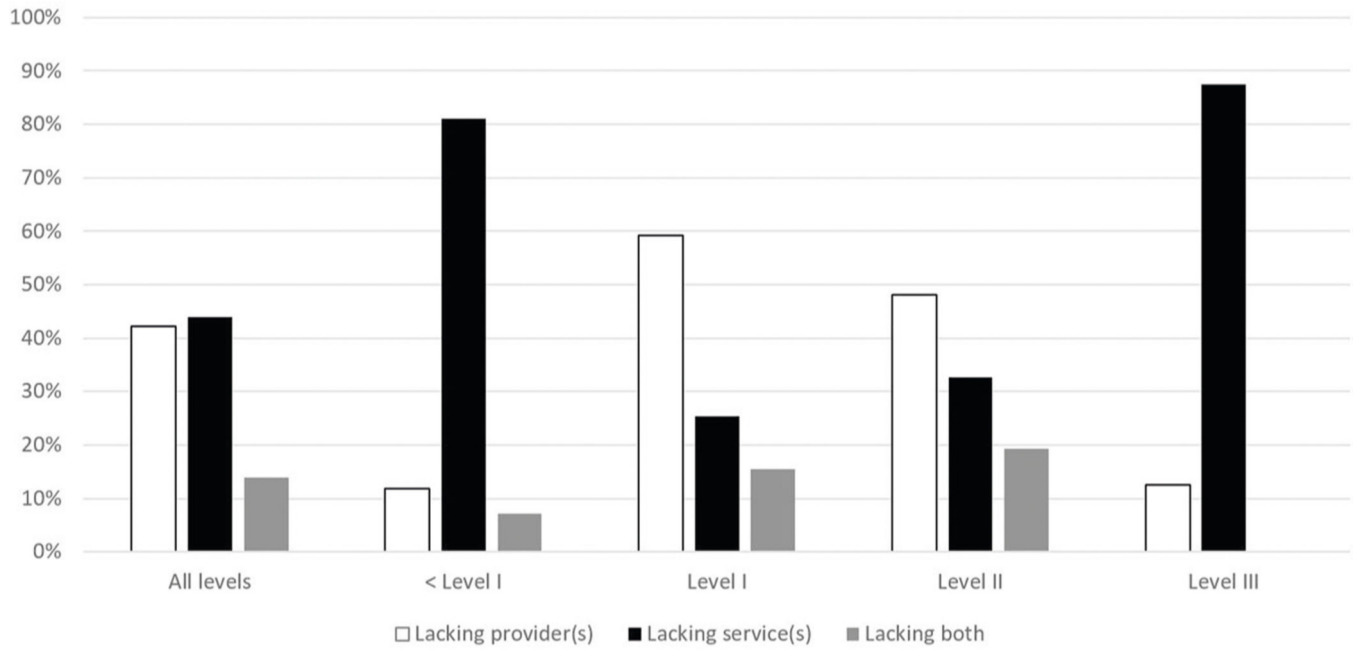

Fig. 1. Reason for Discrepancy among Facilities where Self-assessed Level of Maternal Care (LoMC) was Higher than LOCATe-assessed LoMC.

The figure shows grouped reasons for discrepancy between self-assessed LoMC and LOCATe-assessed LoMC across all levels and within each LOCATe-assessed level. White shading indicates lack of providers as the reason for discrepancy, black shading indicates lack of services as the reason for discrepancy, and grey shading indicates a lack of both providers and services as the reason for discrepancy.

Table 1.

Personnel and service requirements for maternal levels of care based on 2015 ACOG/SMFM guidelines [*].

	Level I	**Level II**	**Level III**	**Level IV**
Services				
Laboratory testing	X	X	X	X
Blood bank	X	X	X	X
Computerized tomography			X	X
Magnetic resonance imaging			X	X
General radiology			X	X
Obstetric ultrasound	X	X	X	X
Interventional ultrasound			X	X
Nuclear medicine			X	X
Complex cardiothoracic surgery				REQUIRES COMPLEX CARDIOTHORACIC SURGERY OR ORGAN TRANSPLANT
Organ transplant				
Personnel				
Obstetric providers				
Obstetrician-gynecologist	REQUIRES OBSTETRICIAN-GYNECOLOGIST OR MIDWIFE OR FAMILY MEDICINE PHYSICIAN	X	X	X
Midwife				
Family medicine physician				
Maternal-fetal medicine		X	X	X
Anesthesiology				
Certified registered nurse anesthetist	REQUIRES CERTIFIED REGISTERED NURSE ANESTHETIST OR PHYSICIAN ANESTHESIOLOGIST			
Physician anesthesiologist		X	X	X
Obstetric specializing			X	X
Subspecialists				
Cardiology			X	X
Critical care			X	X
General surgery			X	X
Hematology			X	X

	Level I	Level II	Level III	Level IV
Infectious disease			X	X
Nephrology			X	X
Neurology			X	X
Neonatology		X	X	X

* Provider and service interpretation availability also play a role in level assessment but are not detailed in this table. For example, for Level IV, maternal-fetal medicine specialists are not only required, they are also required to be readily available at all times with full inpatient privileges.

Table 2.

Most common 2015 ACOG/SMFM levels of maternal care (LoMC) guideline elements contributing to discrepancies between CDC levels of maternal care assessment tool (LOCATe®)-assessed level of maternal care and facilities that self-reported a higher level of maternal care.

CDC LOCATe®-assessed level	Guideline element(s)	*N*	%
< Level I (*n* = 42)	Lack of obstetric ultrasound	33	79
Level I (*n* = 71)	Lack of maternal-fetal medicine	31	44
	Lack of magnetic resonance imaging	29	41
Level II (*n* = 52)	Lack of obstetric-specializing physician anesthesiologist	25	48
	Lack of interventional radiology	13	25
Level III (*n* = 8)	Lack of at least one subspecialist	5	63

Table 3.

Distribution of services and personnel available across CDC levels of maternal care assessment tool (LOCATe®)-assessed levels of maternal care*

	All Levels		< Level I		Level I		Level II		Level III		Level IV†	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Services												
Laboratory testing	459	99	56	90	*	*	*	*	*	*	*	*
Blood bank	454	98	52	84	*	*	*	*	*	*	*	*
Computerized tomography	435	94	46	74	154	92	*	*	*	*	*	*
Magnetic resonance imaging	370	80	25	40	110	66	*	*	*	*	*	*
General radiology	447	97	47	76	165	99	*	*	*	*	*	*
Obstetric ultrasound	419	90	17	27	*	*	*	*	*	*	*	*
Interventional ultrasound	204	44	3	5	39	23	105	59	*	*	*	*
Nuclear medicine	255	55	11	18	58	35	116	65	*	*	*	*
Complex cardiothoracic surgery	184	40	5	8	32	19	100	56	26	79	21	91
Organ transplant	47	10	1	2	3	2	18	10	7	21	18	78
Personnel												
Obstetric providers												
Obstetrician-gynecologist	437	94	49	79	153	92	*	*	*	*	*	*
Maternal-fetal medicine	299	65	16	26	48	29	*	*	*	*	*	*
Midwife‡	134	29	15	24	47	28	52	29	7	21	12	52
Family medicine	185	40	24	39	66	40	66	37	16	49	12	52
Anesthesiology												
Certified registered nurse anesthetist	384	83	52	84	151	90	142	80	22	67	16	70
Physician anesthesiologist	374	81	32	52	107	64	*	*	*	*	*	*
Obstetric specializing§	121	32	5	16	17	16	43	24	*	*	*	*
Subspecialists												
Cardiology	330	71	23	37	87	52	163	92	*	*	*	*
Critical care	293	63	20	32	64	38	152	85	*	*	*	*
General surgery	380	82	37	60	109	65	178	100	*	*	*	*

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	All Levels		< Level I		Level I		Level II		Level III		Level IV[†]	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Hematology	281	61	15	24	60	36	149	84	*	*	*	*
Infectious disease	293	63	17	27	60	36	159	89	*	*	*	*
Nephrology	293	63	20	32	64	38	152	85	*	*	*	*
Neurology	290	63	16	26	65	39	152	85	*	*	*	*
Neonatology	214	46	9	15	58	35	101	57	*	*	*	*

[*] Cells with asterisks indicate an element required for a facility to assess at that level, so variation is not possible; all shaded cells, by default, represent 100%.

[†] Level IV facilities require either complex cardiothoracic surgery or organ transplant, but not both.

[‡] Midwives include certified nurse midwives, certified practicing midwives, licensed midwives, and certified midwives.

[§] Obstetric specialization status of physician anesthesiologists was not reported for 86 facilities that reported having a physician anesthesiologist. It was confirmed in follow-up that facilities did meet the requirement if they were assessed as levels III or IV.