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Assessing Impact of COVID-19 Pandemic on Receipt and Timeliness of Newborn Hearing Screening and Diagnostic Services Among Infants Born in Four States

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Abstract

The study compares receipt and timeliness of newborn hearing screening and follow-up diagnostic services between the pre-pandemic birth cohort and the pandemic birth cohort in four participating states. Findings from this study will help inform state Early Hearing Detection and Intervention (EHDI) programs in the future should a major public health event occur again.

Keywords: pandemic, hearing loss, newborn hearing screening, audiology, EHDI, diagnostic evaluation

Acronym: EHDI = Early Hearing Detection and Intervention

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On March 13, 2020, the United States declared a national emergency in response to the COVID-19 pandemic (Federal Emergency Management Agency, 2020). Across the nation, lockdowns and stay-at-home orders were issued to reduce the spread of COVID-19. This caused disruption to the U.S. health care system, specifically the delivery and receipt of health care services due to closures or reduced hours of facilities and, in at least some cases, families declining or delaying in-person appointments. One study published in May 2020 found the total diagnostic imaging volume significantly declined by 12.3% during the first 16 weeks of 2020 compared with 2019 (Naidich et al., 2020). A different study found that emergency department visits declined by 42% during early months of the COVID-19 pandemic, compared to the same period in 2019 (Hartnett et al., 2020).

The purpose of this study was to assess the impact of the COVID-19 pandemic on Early Hearing Detection and Intervention (EHDI) services, specifically timeliness and receipt of newborn hearing screening and follow-up audiological diagnostic services among infants born in 2020. Findings from this study are intended to inform efforts at the state level as well as provide partners with a better understanding of how the COVID-19 pandemic impacted the EHDI process and to help guide future program improvement activities.

Method

Four states (Georgia, Louisiana, Minnesota, and North Carolina) were selected to participate in this study for their successful experience in reporting detailed child-level data to the Centers for Disease Control and Prevention (CDC). Child-level, de-identified datasets were extracted from the states' EHDI information systems and submitted to the CDC for analysis. Within each state, two cohorts of births were identified. The pre-pandemic birth cohort consists of 373,058 infants born between November 1, 2018 and October 31, 2019. The pandemic cohort consists of 364,530 infants born between November 1, 2019 and October 31, 2020. Although this predates the start of the pandemic, children with hearing loss born at the end of 2019 would have been impacted in early 2020 when many would typically be receiving diagnostic evaluations.

Analysis

We assessed the monthly percentage of (a) hearing screening by one month of age among newborns and (b) receipt of diagnostic evaluation by three months of age among infants who referred (e.g., failed) the hearing screen, before and during the pandemic. Screening and diagnostic evaluation by one and three months of age were examined because they represent key national benchmarks within the EHDI process (JCIH, 2007, 2019). We also examined the refer rate from the newborn hearing screen for each state, before and during the pandemic. Additionally, we generated Kaplan–Meier curves to assess receipt and timeliness to the start of the diagnostic evaluation process among infants who referred from the newborn hearing screening (see Appendix). If the diagnostic evaluation date was available, the time to diagnostic evaluation was calculated as the number of days from the most recent referred hearing screen to the date of the first reported diagnostic evaluation. The time to event was set at 180 days (i.e., censored at 180 days). Although the recommended benchmark for infants to receive a diagnostic evaluation after referral from the hearing screen is by 90 days of age, we added an additional 90 days to allow for capturing infants who may have received an evaluation beyond the recommended 90 days of age. Infants who died ($n = 3{,}168$) or moved out of their birth state ($n = 736$) were excluded from the study because the date of when they died or moved was not available, hence it was not possible to censor them at appropriate times for the Kaplan–Meier analyses. The pre-pandemic and pandemic curves were constructed and compared using the log–rank test. P-values < 0.05 were considered statistically significant. Data analyses were performed using SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA).

Results

As illustrated in Figure 1, the percentage of newborns screened by one month of age was largely unaffected by the pandemic, with rates of 95.1% to 96.7% pre-pandemic and 94.6% to 96.1% during the pandemic. However, while screening rates were minimally impacted by the pandemic, a significant increase in refer rates was observed ($z = 9.598$, $p < .0001$; see Table 1). Overall, prior to the pandemic 1.39% of screens in the participating states resulted in a referral. During the pandemic this grew to 1.66%, with increases in three of the four states.

Figure 1

Receipt of Hearing Screening by One Month of Age by Birth Month and Cohort

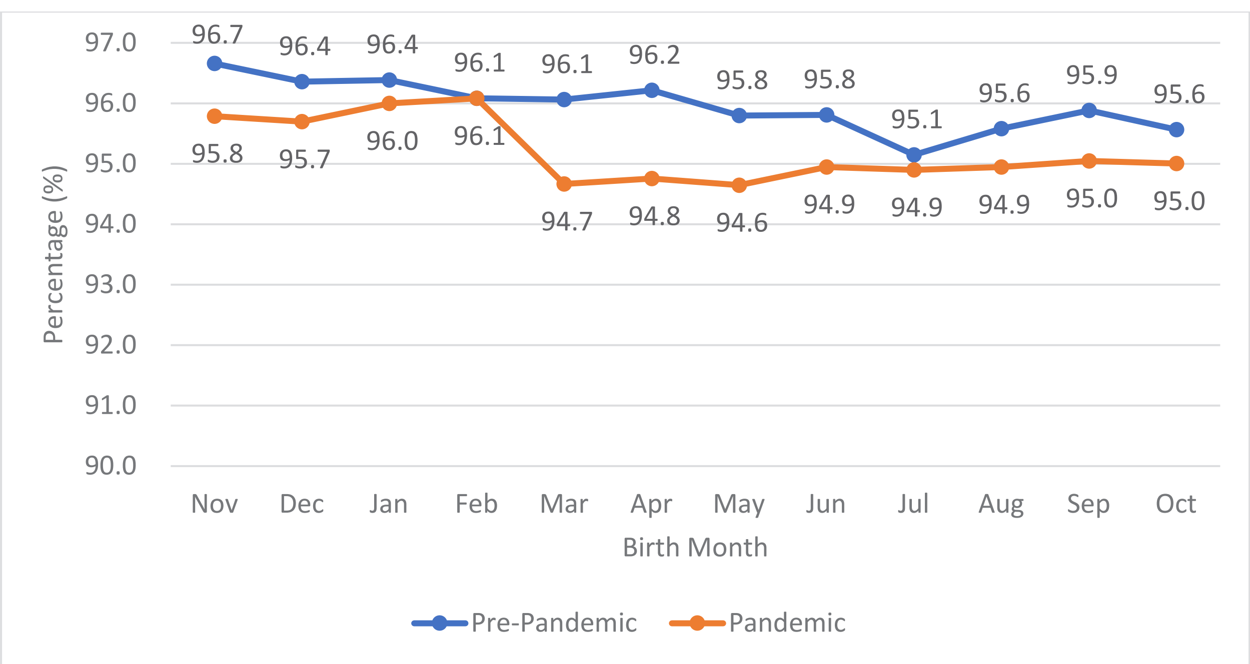


Table 1

Refer Rate from Newborn Hearing Screening by State and Cohort

	Pre-Pandemic				Pandemic			
	Total Births	Infants Screened	Infants Referred	Percent Infants Referred	Total Births	Infants Screened	Infants Referred	Percent Infants Referred
Georgia	128,945	123,681	2,106	1.7%	125,732	119,260	2,543	2.1%
Louisiana	58,545	58,292	1,140	2.0%	57,006	56,597	868	1.5%
Minnesota	65,469	64,825	834	1.3%	63,005	62,358	1,333	2.1%
N. Carolina	120,099	119,816	1,000	0.8%	118,787	118,387	1,184	1.0%

Note. Refer Rate (%) = (Infants Referred/Infants Screened) x 100.

As summarized in Table 2, this increase in referral rates was also associated with an increase in the time between referral and diagnostic evaluation for each of the four states (all p values < .05). For three of the states, the median time between referral and diagnostic evaluation increased by 11 to 31 days. In Georgia, less than half of referrals received a documented diagnostic evaluation making the median uninformative. Therefore, Table 2 reports time-to-evaluation in Georgia based on the 25th percentile—with the time more than doubling during the pandemic.

Figure 2 illustrates the percentage of newborns referred for diagnostic testing who received their diagnostic evaluation by the recommended three months of age. This is presented based on a child's birth month and cohort. For example, 35.9% of the children born in January 2020 who referred on their newborn hearing screen received their diagnostic evaluation by three months of age, while 46.2% of similar children in 2019 did so.

Finally, a Kaplan-Meier curve was generated showing the cumulative rate (percent) of diagnostic evaluation after referring from the most recent hearing screening for babies in the four states combined. Infants who received a diagnostic evaluation beyond 180 days of age, as well as those with no documented evaluation (i.e., either the baby never received an evaluation or they received an evaluation but it was not documented) were censored at 180 days. Separate curves are presented based on pre-pandemic/pandemic cohort.

As seen in Figure 3, pre-pandemic babies were evaluated sooner than babies impacted by the pandemic. Nearly half (49%) of the pre-pandemic infants compared to around 40% of the infants impacted by the pandemic were evaluated by three months of age ($p < 0.0001$).

Discussion

Figure 2 shows that overall, 15% more pre-pandemic infants who were referred from the hearing screen received a diagnostic evaluation by three months of age, compared to infants impacted by the pandemic. The

Table 2

Median time between Referred Hearing Screen and Diagnostic Evaluation Based on State and Cohort

	Pre-Pandemic	Pandemic
Georgia		
	(n = 2,034)	(n = 2,486)
Median (days)	n/a	n/a
25th Percentile (days)	74	166
Number of events	635	632
Number censored	1,399	1,854
Louisiana		
	Pre-Pandemic (n = 1,117)	Pandemic (n = 849)
Median (days)	37	48
25th Percentile (days)	21	23
Number of events	796	575
Number censored	321	274
Minnesota		
	Pre-Pandemic (n = 795)	Pandemic (n = 1,279)
Median (days)	42	75
25th Percentile (days)	19	25
Number of events	533	709
Number censored	262	570
North Carolina		
	Pre-Pandemic (n = 948)	Pandemic (n = 1,137)
Median (days)	48	69
25th Percentile (days)	21	25
Number of events	677	694
Number censored	271	443

Figure 2

Receipt of Evaluation by Three Months of Age Among Referred Newborns, by Birth Month and Cohort

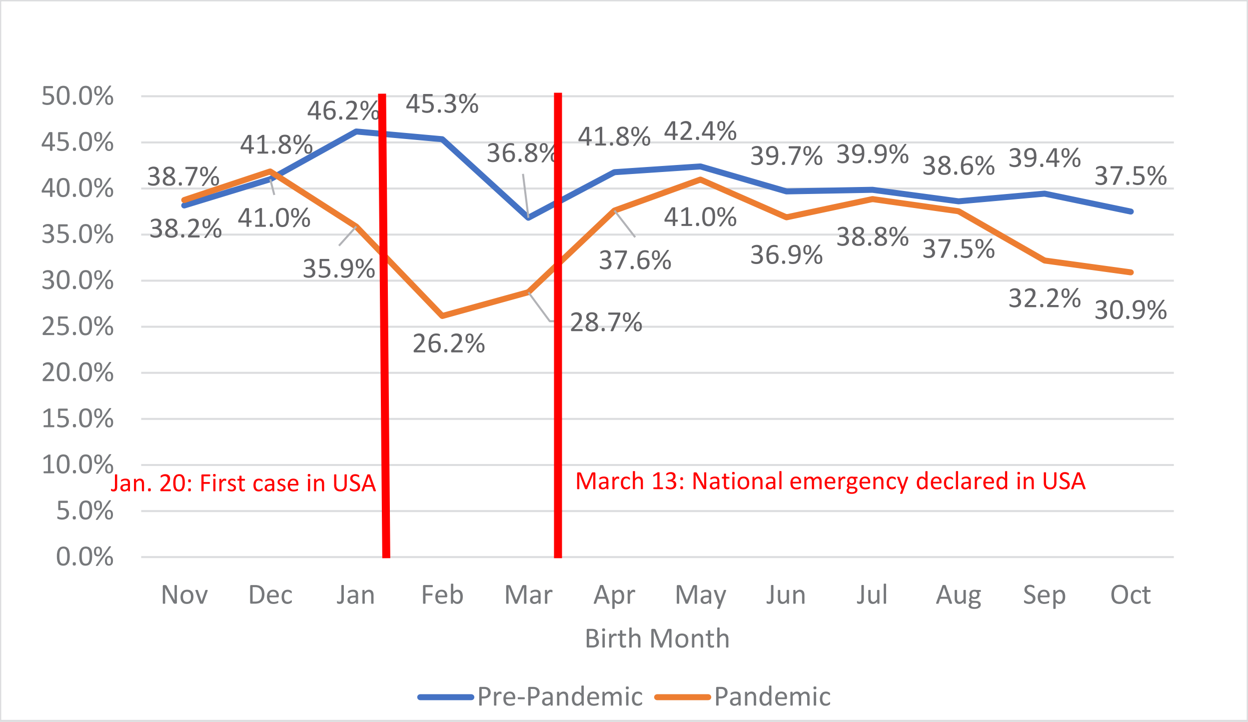
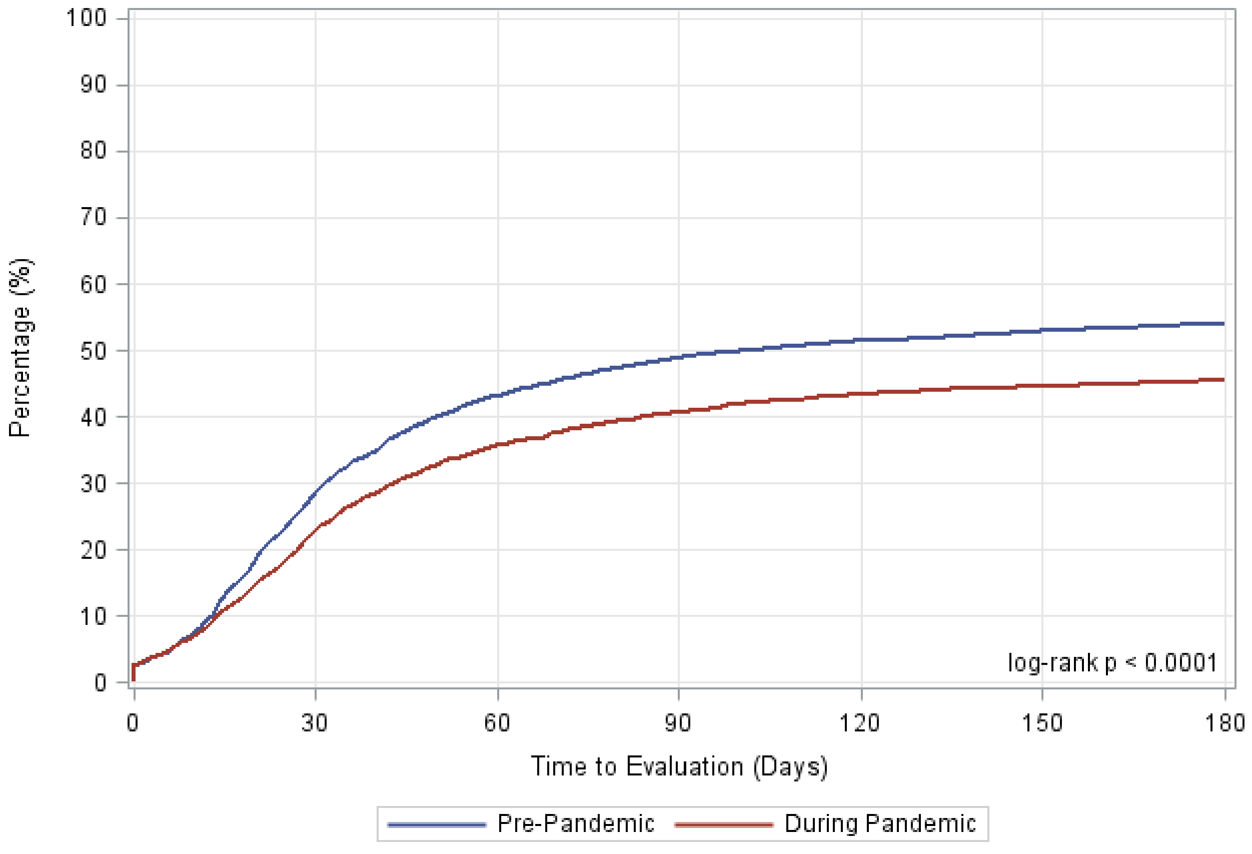


Figure 3

Four States Combined: Receipt and Timeliness of Diagnostic Evaluation After Referring from the Most Recent Hearing Screening



largest difference in the evaluated-by-three-months rates between the pre-pandemic and pandemic period was observed for February births. February was the birth month having the lowest reported receipt of evaluation by three months of age (26.2%) during the pandemic period, compared to 45.3% of pre-pandemic February births. This difference was likely due to audiology facilities being closed or operating at limited hours, which occurred across the nation during the pandemic. It may also reflect safety concerns among families about bringing infants for in-person appointments, especially during the first few months of the pandemic. The pandemic trend picks up relatively quickly for infants born after March 2020 and appears to stabilize for infants born between May and August 2020, possibly as states started to ease restrictions/lifted the stay-at-home orders. The trend fell off with September and October 2020 births, coinciding with large spike in COVID-19 cases at the end of the year.

Minnesota's refer rate increased noticeably during the pandemic period compared to before the pandemic (Table 1). According to a nationally representative study, short birth hospital stays (vaginal birth < 2 nights' stay; cesarean birth < 3 nights' stay) among new mothers and infants was 51% more common during the pandemic period than pre-pandemic (Handley et al., 2022). Short hospital stays can translate to a lower probability of infants who do not pass their initial screen receiving a rescreen before discharge. This could in part explain the high refer rate for Minnesota during the pandemic period. Staffing issues are another possible explanation. Hospitals across the country experienced staffing issues during the pandemic period. Staffing issues include staff being sick or having to quarantine due to exposure, staff calling out because of exhaustion, or reassignments. The aforementioned issues can potentially result in less experienced or different staff performing the newborn screens (Koracin et al., 2022), which could have played a role in the observed high refer rate during pandemic.

Figure 3 and Table 2 show increase in time to diagnostic evaluation after referring from the hearing screen. This could be due to state lockdown policies, diagnostic facilities being closed or operating at limited hours (especially early in the pandemic), and families' preference to delay in-person appointments due to exposure concerns.

Conclusion

All four participating states reported a decline in the receipt of infant audiological evaluation services and longer time to audiological evaluation after not passing the hearing screen during the first year of the COVID-19 pandemic. This information is of critical importance because there are long-term consequences for young children with unidentified or late identified permanent hearing loss, such as delayed language and cognitive development (JCIH, 2000). Should major public health events occur again in the future, state EHDI programs can work with partners to help minimize these consequences and expand follow-up efforts to ensure infants not passing the hearing screen receive recommended services in a timely manner. These include developing specific guidance establishing that newborn hearing screening and follow-up should be considered an essential service and should not be delayed by the event, upgrading their EHDI information systems to improve the timeliness of referrals and better support child-find activities, and actively reaching out to primary care physicians about the importance of knowing the newborn hearing screen results on infants born during the event. Health care providers (e.g., physicians, hearing screeners) can continue to take the time to educate families about the importance of seeking recommended follow-up services as soon as possible when infants fail the hearing screening. In addition, use of tele-audiology services, where audiological evaluations are provided remotely, can be increased in the next public health event. However, use of tele-audiology needs improvement as it does not address families' concern about exposure during in-person appointments. The families of infants needing diagnostic evaluation would still have to travel to a location with the appropriate equipment so that a technician could place the necessary electrodes on the infant for the audiologist to be able to remotely conduct the necessary evaluation(s) from their office. This issue should be further explored because, if resolved, families may be comfortable in using tele-audiology services and we may see increase in use of these services should the next public health event occur. Finally, there are currently no similar published studies assessing timeliness from any type of newborn screening to follow-up care before and during the pandemic. To our knowledge, our study is the first of its kind. Consequently, these findings may inform other newborn programs beyond hearing screening.

Limitations

There are at least four limitations of this study. First, the study is not nationally representative as it reflects only data from four states. Future analyses including more states may be of interest. Second, the infants who died or moved out of the participating state were excluded from the study due to dates of death or when unavailable due to a family move. If this information were available, the affected infants would be censored at appropriate times in the Kaplan-Meier analysis and the curves may change (e.g., higher curve to reflect higher receipt of diagnostic evaluation). Third, there may be infants who did receive services, but it was not documented in the state EHDI information system (e.g., lost to documentation). Loss to documentation contributed to an unknown portion of missing data in diagnostic information. All missing diagnostic data were treated as negative responses (e.g., not evaluated) and therefore these findings report a lower-end estimate of the true diagnostic evaluation rate. And lastly, we were not able to assess the possible impact of COVID-19 pandemic on the receipt and timeliness of early intervention enrollment in the four participating states because complete early intervention information for infants born in 2020 were not yet available at the time of the study.

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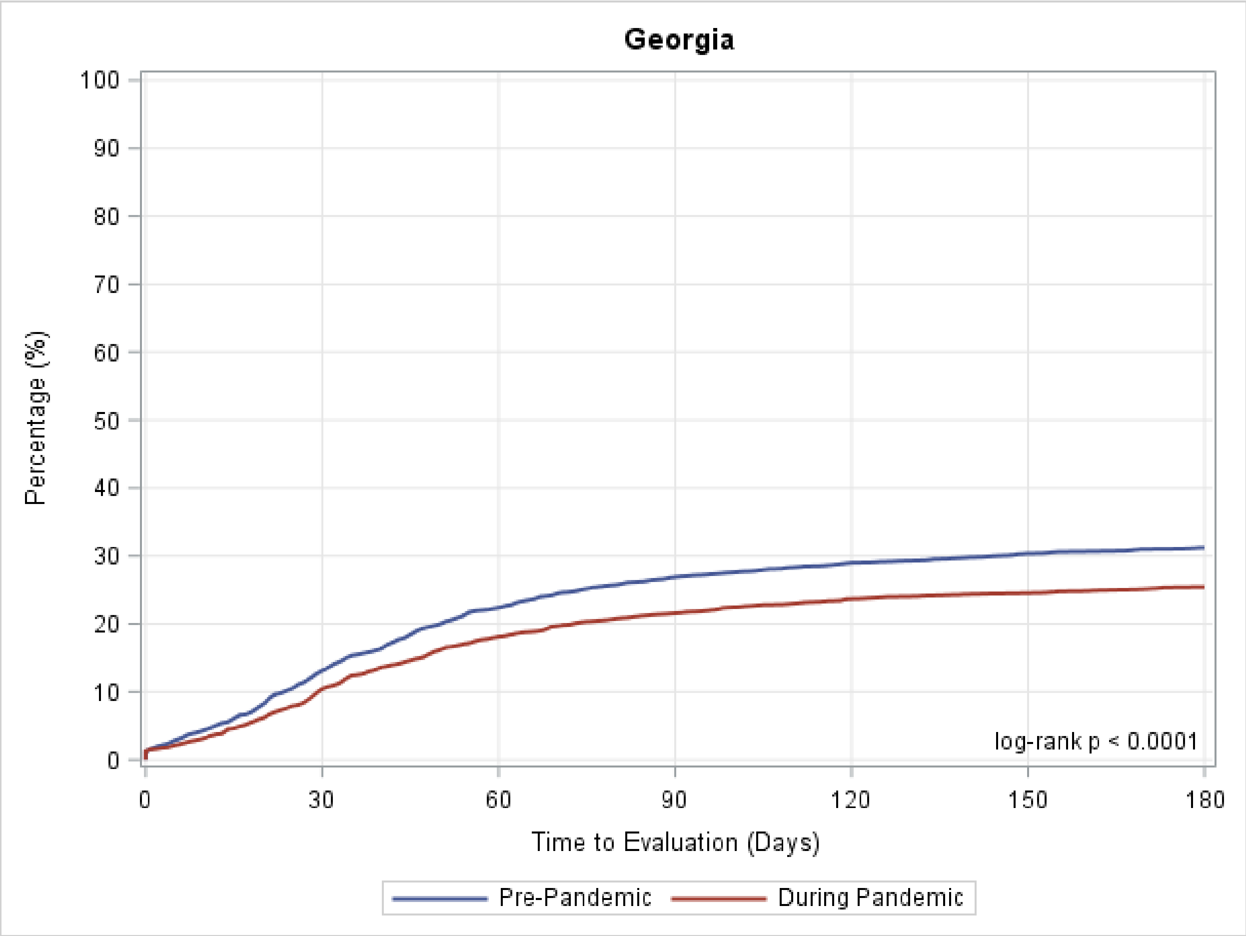
Appendix

Kaplan–Meier curves to assess receipt and timeliness to the start of the diagnostic evaluation process among infants who referred from the newborn hearing screening. Each state is represented by its own graph.



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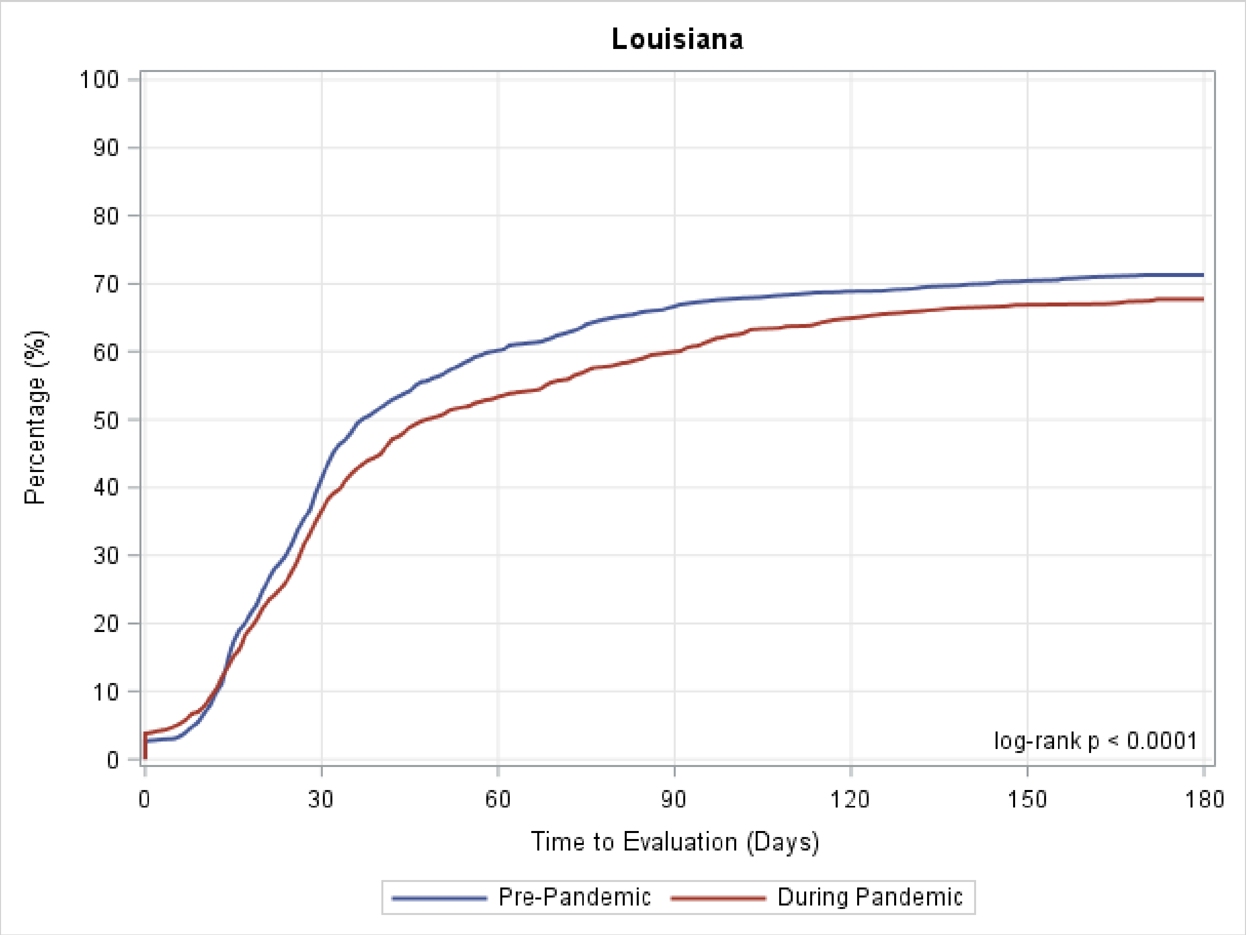

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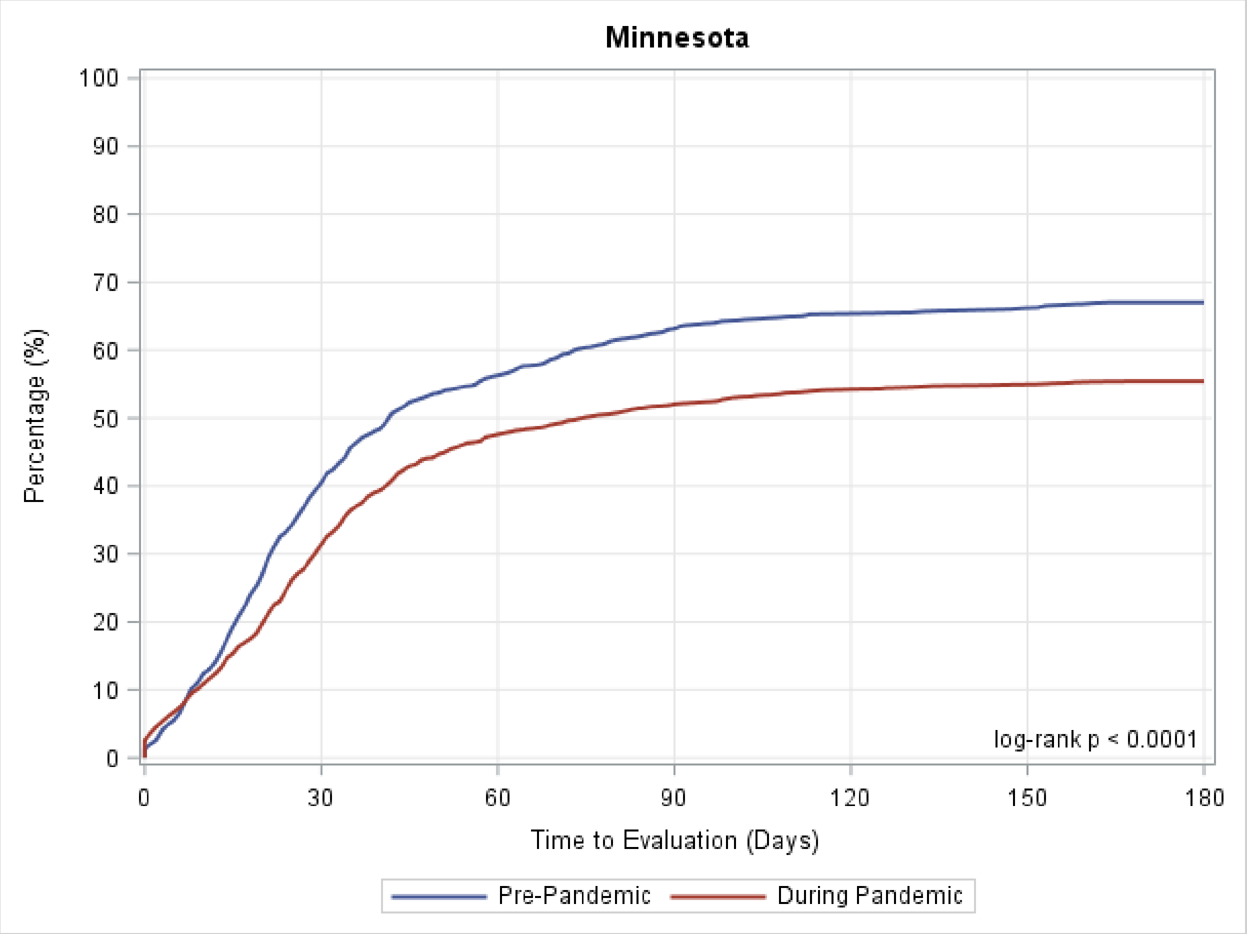

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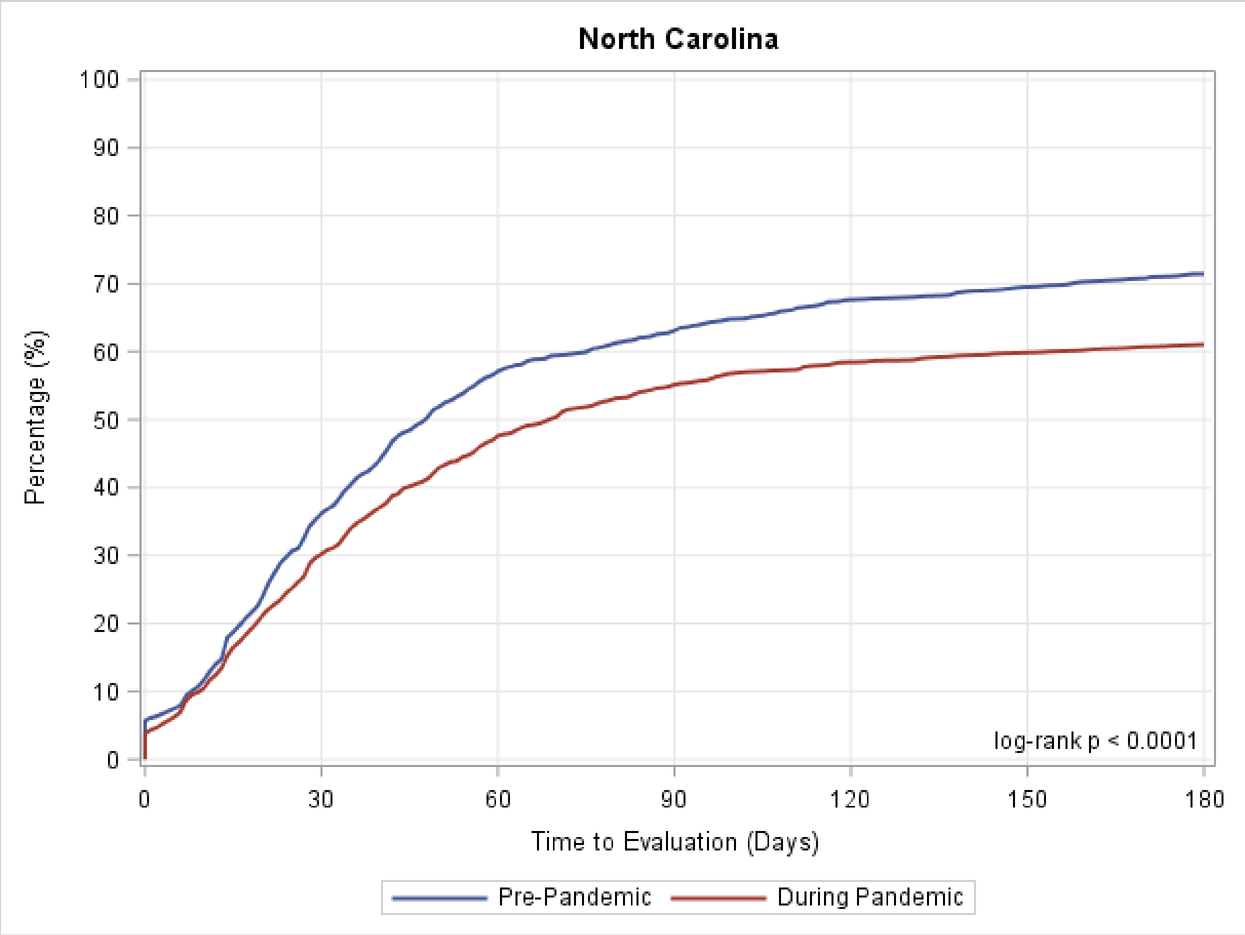

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