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Remote Use of *Individual Growth and Development Indicators* (IGDIs) for Infants and Toddlers

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Abstract

Universal screening and progress monitoring are evidence-based practices in early intervention/early childhood special education (EI/ECSE). Individual Growth and Development Indicators (IGDIs) for infants/toddlers are measures that programs can use for universal screening, progress monitoring, intervention decision-making, and accountability. Prior to the COVID-19 pandemic, IGDIs were administered and scored exclusively in person by certified early educators. Because of COVID-19, EI/ECSE practitioners could no longer conduct in-person assessments. We report how two early intervention programs implemented IGDIs using remote protocols that included (a) preparation of parents for IGDI administration at home, (b) session observation by program staff using videoconferencing, and (c) remote coding of the child's performance by program staff when interacting with a parent/caregiver play partner using the standard toy set. The remote protocols are described, and uptake by the programs is compared before and during the pandemic. Equivalence of children's scores from in-person versus remote protocols is reported, as well as caregivers' and program staff's preferences. Implications for remote early childhood services are discussed.

Keywords

COVID-19, remote assessment, infants/toddlers, universal screening, progress monitoring, Individual Growth and Development Indicators (IGDIs)

Stay-at-home orders related to the COVID-19 pandemic, school and program closures, and social distancing to mitigate infections dramatically changed child-life in the United States (Farmer et al., 2020) and the world (de Araújo et al., 2020; Yoshikawa et al., 2020). Although thought short-term, it has continued. The adverse effects on the general population of children have delayed children's development and placed increased stress on families (de Araújo et al., 2020; Fisher et al., 2020). The effects have been disproportionally greater for the disadvantaged (Khalatbari-Soltani et al., 2020), racially/ethnically diverse (Holmes et al., 2020), and children with disabilities (Dhiman et al., 2020) who have historically endured reduced access.

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In this pandemic environment, early intervention/early childhood special education (EI/ECSE) programs have been prevented from providing face-to-face intervention services and child assessments (Pica & Barnett, 2021). Research has only begun to examine how the pandemic has affected early childhood educators' engagement with children and families (Hanno et al., 2020; Tate, 2021), their emotional and financial well-being (Bassok et al., 2020a, 2020b), and rise in remote service delivery (Szente, 2020). Although progress has been made in telehealth services (Behl et al., 2017; Landry et al., 2021; Poole et al., 2020), there have been fewer advances in remote assessments essential to determine children's progress and outcomes due to services. Only 8% ($N = 788$) of early educators reported administering an assessment or screener during March to June 2020 closures (McKenna et al., 2021).

Progress monitoring is a recommended, evidence-based practice in EI/ECSE (McLean et al., 2020). The four *Individual Growth and Development Indicators* (IGDIs) for infants and toddlers (aged 6–36 months) are instruments that programs can use for universal screening, progress monitoring, intervention decision-making, and accountability (Greenwood et al., 2011a). They include the Early Communication Indicator (ECI; Greenwood et al., 2010), Early Movement Indicator (EMI; Greenwood et al., 2018), the Early Problem-Solving Indicator (EPSI; Greenwood et al., 2006), and the Early Social Indicator (ESI; Greenwood et al., 2020). All are supported and accessible via the multifunction IGDI web application (app; Buzhardt et al., n.d.). The secure IGDI app allows infant-toddler program directors to manage staff, and their program staff to manage child IGDI data collection, screen universally, monitor children's progress, and make data-driven decisions at the individual child and program levels.

Like most early childhood measures, IGDIs were designed for in-person administration. IGDI developers selected an observation method consistent with the authentic settings and emerging skills of infants and toddlers when interacting with a familiar adult partner and toy set during a brief, 6-min play session as the standard protocol (Carta et al., 2010). These observational data provide a unique view of child performance compared with the preponderance of data from checklists and ratings. Standard adult IGDI play partners have been teachers in child care and home visitors or parents/caregivers at home, taught to interact with a "follow-the-child's-lead" style, allowing a child to demonstrate their best skills (Carta et al., 2010). Children's target behaviors are assessed depending on the outcome (i.e., communication, movement, social, and cognitive problem-solving). Target behavior examples include single words (the ECI), vertical locomotion (the EMI), requesting (the ESI), and toy solutions (the EPSI).

The frequency of occurrence of an IGDI target behavior is recorded by a certified staff observer during a session, either live or from video, with the raw scores entered into the IGDI web app for processing (Buzhardt et al., 2020). Scores for each target behavior and a total composite are calculated as response rates (i.e., responses per minute per month of age) and charted. A single score reflects performance at a month of age, and a time-series (trajectory) reports a child's growth. Each IGDI is reliable and sensitive to growth (Greenwood & Walker, 2010).

As many programs have become increasingly virtual or hybrid, there has been a press for teleassessment or telehealth alternatives. Teleassessments include online audio and video communications between program staff (assessors) and parents/caregivers at home (e.g., Zoom, WebEx). To meet the growing demand, publishers have been quick to provide guidelines for conducting remote administration (Farmer et al., 2020). Similar guidance has been forthcoming for early childhood instruments, for example, the Preschool Language Scale (https://wwwpearsonassessments.com/professional-assessments/digital-solutions/telepractice/telepractice-and-the-pls-5.html), IGDIs for preschoolers (https://renaissance.widen.net/s/5czfq2d5sp), and IGDIs for infants and toddlers (https://igdi.ku.edu/virtual-igdis/). In their haste to provide alternatives to in-person assessments, developers have been challenged with providing evidence that scores obtained remotely are equivalent to in-person administration (Farmer et al., 2020). In a very few cases, researchers have done so (Waite et al., 2010; Wright, 2020).

There are many challenges to overcome when using online assessments (see review by Farmer et al., 2020). Technological challenges include access to videoconferencing applications in the home. Logistical challenges include access to assessment materials/devices and their care and return for sanitation and reuse. Procedural challenges include adapting the standard, in-person protocol for remote use so as not to add unwanted variance to children's scores. Educational challenges include the additional training/support of those managing the online assessment, the caregiver at home, and the EI/ECSE provider.

Contribution of This Report

Early childhood leaders are struggling to provide guidance in the use of remote procedures and need useful information to overcome these challenges. Practitioners need safe, equivalent remote measurement protocols for assessing the progress of children receiving EI/ECSE services. With the onset of the pandemic, IGDI data collected by two local community-based early childhood programs (one Part C and one Early Head Start [EHS]) offered us a natural experiment on the effects of the pandemic on IGDI measurement. In this context, we asked four research questions, three of which were common to both programs (RQs 1, 2, and 4) and one unique to the Part C Program (RQ3).

Research Questions

Research Question 1 (RQ1): Did both programs' uptake of the remote IGDI protocol reach pre-pandemic numbers of in-person administrations?
Research Question 2 (RQ2): Were children's IGDI total rate mean scores comparing the two methods (in-person vs. remote) equivalent?
Research Question 3 (RQ3): Were the Part C Program's IGDI-ECI age-based score trajectories equivalent?
RQ3a: Did children's trajectories differ across assessment modes (in-person, remote, and hybrid) during COVID-19?
RQ3b: Did children's trajectories on the IGDI-ECI differ before versus during COVID-19?
Research Question 4 (RQ4): What were home visitors' and parents'/caregivers' experiences and preferences?

Method

Overview

Each participating program was an experienced, program-wide user of IGDIs and its web app. Thus, it was possible to document use of remote IGDIs and conduct a number of comparisons of IGDI scores between the standard in-person versus remote protocols. The Part C–Early Intervention Program specialized in serving children with special needs. The EHS Program served low-income eligible families. The Part C Program used only the ECI, whereas the EHS Program used the ECI plus the EMI and EPSI. Both programs provided center- and home-based services. Working from the IGDI developer's guidelines for remote administration, each program created and implemented a protocol adapted to their needs and resources.

Design

Each program served as a separate study and replication of the use of IGDIs for children receiving services. In both programs, data were available for two nonoverlapping groups of children (cohorts) for comparisons. The Pre-COVID-19 Cohort had received services and exited program

services prior to COVID-19. Their assessments were entirely in-person. All COVID-19 Cohort children were receiving services and experienced the COVID-19 shutdown and remote IGDIs.

With the onset of the pandemic, children, parents/caregivers, and program staff in each programs' COVID-19 Cohort experienced a natural experiment, with the pandemic serving as the independent variable creating a void in children's progress information. A natural experiment is one where variation in explanatory variables is generated by changes in laws, policies, or other exogenous factors (i.e., COVID-19 virus; Meyer, 1995). This natural context resembled an A-B_1-B_2 design, where A = before pandemic with in-person IGDI protocol (i.e., baseline), B_1 = pandemic shutdown, and B_2 = pandemic shutdown plus remote IGDIs. These conditions were manipulated naturally by COVID-19 mitigation policies and the two local program's adaptive responses to it (Phase B_2). Because program staff entered all IGDI assessments into the IGDI app and were required to designate each assessment as either in-person or remote, it was possible to document the change in IGDI usage and uptake of the remote protocol using teleconferencing as described later. We were also able to make score comparisons between methods (in-person vs. remote) and survey participant satisfaction.

Measurement

Each program's staff were trained and certified by the developers, or their local certified trainer, to administer and score the IGDIs. Staff training and certification involved a 1-day workshop, additional training tasks in the field, and use of calibration tools in the web app. During the workshop, staff learned the rationale for using IGDIs for progress monitoring, how to administer the assessments, and each IGDI's scoring definitions. To achieve certification on an IGDI measure, staff were required to meet calibration standards on two tasks: (a) fidelity of IGDI administration and (b) agreement reliability when coding children's communication skills from videotaped administrations (Walker & Buzhardt, 2010). IGDI trainees submitted a video of themselves administering an IGDI (e.g., ECI, EMI, and EPSI). The video was evaluated by a certified trainer using a standard checklist of administration steps. For example, the ECI has 16 administration steps involving setting up and arranging the environment, playing and interacting with the child, and shutting-down and cleaning-up. Trainees also were required to code two master assessment videos and achieve 85% or greater agreement on key skills and total score. IGDI trainers provided individual feedback to trainees on their administration and scoring as needed to certify on subsequent trials. Following training, staff were encouraged to conduct annual reliability checks between each other using their own videos prepared for this purpose by their IGDI coordinator. These certified staff coded all remote and in-person IGDIs for their program. Because the amount of time a child receives program services varies depending on when they begin and exit services, the number of IGDIs an individual child receives also varies.

Standard in-person IGDI administration method. Prior to COVID-19, administration of the IGDIs occurred at the center, at home, and, occasionally, other settings (e.g., grandmother's home). Standard administration occurred in a 6-min play session with a familiar adult partner using one of two alternative toy sets (see Table 1). The play partner typically was the early educator (center) or home visitor or parent/caregiver (home or other setting). The play partner used a nondirective interaction style, giving the child the opportunity to demonstrate their best, unprompted communicative performance. In home settings, the certified home visitor trained and coached the parent to serve as play partner and to use the nondirective style of following the child's lead. This training occurred in-person prior to the pandemic and virtually thereafter. Staff coders had the option of scoring the child's communications live in the home or from video later at the office.

Scoring entailed directly observing the session and recording the occurrence of a child's key skills. For the ECI, these were Gestures, Vocalizations, Single Words, and Multiple Words; for

Table 1. IGDI Administration Procedures.

		Remote protocols	
Procedures	In-person	Part C Program	Early Head Start Program
Scheduling	Scheduling is completed at the end of the previous home visit, or by phone (voice or text)	Same as in-person	Same as in-person
Toy sets	IGDI-specific toy sets provided at left or brought to the home and returned by home visitor	ECI toy sets are delivered to parents' home and returned post-session for reuse. Parents may purchase/provide their own toy set.	Toy sets are purchased for each family. Program 2 uses three IGDIs (ECI, EMI, and EPSI), and they have each toy set.
Play partner	Assessor or parent	Parent/caregiver	Parent/caregiver
Setting	left, home, other	Home, other	Home, other
Set-up preparations	Assessor prepares per protocol	Toys delivered to home, parent sets-up, staff wait for session to complete, returns toys to left. Home visitor teaches parent how to set up toys remotely if needed.	Parent/caregiver sets-up for session. Home visitor teaches parent how to set up toys remotely if needed.
Take-down	Sanitized and put-away per protocol	Toys placed outside following session, picked up by staff, sanitized, and returned to left	Parent/caregiver takes toys down, putting away at home
Digital device	Video camera if not scoring live	Loan smartphone, tablet, notebook device with Internet connectivity if needed	No loaning, use their own device and connectivity
Observation platform	Via in-person, live	Via videoconferencing or parent records video and sends in recording	Via videoconferencing or parent records video and sends in recording
Video recording	Optional	Optional	Optional
Coding/scoring	Live or from video	Live from app or video sent in by parent/caregiver	Live from app or video sent in by parent/caregiver
Data entry	Web or mobile app	Web or mobile app	Web or mobile app
Results/reporting	Web app	Web app	Web app

Note. IGDIs = Individual Growth and Development Indicators; ECI = Early Communication Indicator; EMI = Early Movement Indicator; EPSI = Early Problem-Solving Indicator.

the EMI, these were Transitional Movement, Grounded Locomotion, Vertical Locomotion, Catching/Trapping, and Rolling/Throwing; for the EPSI, these were Looks, Explores, Functions, and Solutions. In cases were the coder decided the assessment was not valid for any reason, scores were not entered and the assessment repeated on another occasion.

Remote IGDI administration method. Because of social distancing and other COVID-19 restrictions (Centers for Disease Control, 2020), remote videoconferencing technology was used to adapt the in-person IGDI administration (see Table 1). The IGDI development team created a set

of guidelines for remote administration and posted them on the website (Buzhardt, 2020). Guidelines were based on discussions with IGDI-certified program staff regarding how they thought they could adapt in-person administrations to remote (teleconferencing communications and observation) and still obtain scores equivalent to the in-person standard. The majority of caregivers had been trained in their play partner role prior to the pandemic, but if not, they were instructed and coached via videoconferencing by trained program staff. During a session, the home visitor cued the parent/caregiver to start and then timed the 6-min session. The home visitor either coded the occurrence of IGDI-ECI key skills live during the secure video conference, or later by viewing the video-recorded session.

The primary difference between programs/ protocols was logistical. The Part C Program delivered the IGDI materials and devices for videoconferencing (if needed) to the home and returned them to the center after completing the assessment. The EHS Program purchased the needed toy sets and provided them to parents/caregivers for use at home. The EHS Program did not provide videoconferencing devices and relied on those available with parents/caregivers. Children's performance was observed and coded using the real-time conferencing video feed or later from the recorded video.

Home visitor and parent/caregiver surveys. Two online surveys were developed to assess the participants' experiences administering and scoring IGDIs remotely: one for home visitors and one for parents/caregivers. Research staff emailed the link to the survey to home visitors in both programs. Home visitors shared the link to the survey with parents/caregivers either via email or during a home visit. Parents whose primary language was Spanish used a translated version. All surveys were completed over a 2-week period, taking an average of 10 min to complete.

The home visitor survey assessed their preferred method, likelihood of continuing post-pandemic, and confidence of using (initially and currently after practice). The parent/caregiver survey assessed their experiences with remote assessments including their perceived success in doing so, both initially and later after practice. Parents/caregivers also were asked about their preferences for in-person versus remote administration and options for sharing results with their home visitor. A total of 79 surveys (33 home visitors, 57 parents/caregivers) were completed.

Study 1—Part C Program

Participants

Children, families, and home visitors. A total of 1,812 children (aged birth to 3 years) with developmental and intellectual disabilities and their families participated, the majority being boys with English spoken at home (see Table 2). All were served by one regional Kansas Part C Program. As of this reporting, 1,544 (85%) children were in the Pre-COVID-19 Cohort, whereas 268 (15%) were in the COVID-19 Cohort. The mean age at first assessment was 20.6 months (SD = 7.7 months) for all children (Table 2). Children were majority speakers of English with some portions of other home languages.

Program. The Part C Program was the largest Part C provider in the state's capital city, serving children (aged 0–3 years) and adults with intellectual and developmental disabilities. They used the ECI as part of services sponsored by the department of health and environment working with parents/caregivers, medical providers, and EI teams to provide quality services.

Design

The conditions of the pandemic allowed for a design resembling A-B_1-B_2 to examine IGDI services for the COVID-19 Cohort who experienced the pandemic addressing RQ1. The Part C Program's

Table 2. Children's Enrollment Status.

		Age (months) @ first ECI		Gender %		IFSP status %		Home language %			
Children	*N*	*Mean*	*SD*	M	F	No	Yes	English	Spanish	Both	Other
Part C Program											
All	1,812	20.6	7.7	64.4	35.6	6.6	93.4	96.6	3.1	6	–[a]
Pre-COVID-19 Cohort	1,544	20.9	7.6	65.1	34.9	2.1	97.9	96.6	3.4	–	–
COVID-19 Cohort	268	19.0	7.8	60.4	39.6	32.5	67.5	96.6	1.1	2.2	–
Early Head Start Program											
All	1,049	17.2	10.5	50.6	49.4	95.6	4.4	47.2	45.6	0.1	7.1
Pre-COVID-19 Cohort	799	18.5	10.8	51.1	48.9	94.9	5.1	50.6	41.7	–	7.8
COVID-19 Cohort	250	12.5	7.9	56.0	44.0	98.0	2.0	36.4	58.0	–	5.2

Note. ECI = Early Communication Indicator; IFSP = Individual Family Service Plan.
[a]Home language = Sign language for two children and Arabic for one child.

Table 3. Part C Program's Use of the ECI With COVID-19 Cohort Children by Method, Location, and Phase.

			Phase			
				Pandemic		
Method	Setting	Statistic	Baseline (A)	Shutdown (B_1)	Remote (B_2)	Total
In-person	left	Count	10	6	22	38
		%	26.3	15.8	57.9	100
	Home	Count	127	17	53	197
		%	64.5	8.6	26.9	100
	Other	Count	8	0	2	10
		%	80	0	20	100
	Total	Count	145	23	77	245
		%	59.2	9.4	31.4	100
Remote	Center	Count	0	0	0	0
		%	0	0	0	100
	Home	Count	0	0	119	119
		%	0	0	100	100
	Other	Count	0	0	65	65
		%	0	0	100	100
	Total	Count	0	0	185	186
		%	0	0	100	100
Total	left	Count	10	6	22	38
		%	26.3	15.8	57.9	100
	Home	Count	127	17	172	316
		%	40.2	5.4	54.4	100
	Other	Count	8	0	67	75
		%	10.7	0.0	89.3	100
	Total	Count	145	23	261	429
		%	33.8	5.4	60.8	100

Pre-COVID-19 Cohort did not experience the pandemic and served as a comparison addressing RQs 2 and 3b. The pattern of child enrollment and frequency of assessments were dynamic as new children were enrolled over time and repeatedly assessed, while others aged-out or exited the program for typical reasons (e.g., moved away). The date separating Baseline (A) and COVID-19 Shutdown (B_1) was January 31, 2020, and between COVID-19 Shutdown B_1 and Remote ECIs (B_2) was August 17, 2020. Follow-up was conducted 3 months later on March 10, 2021.

Statistical Analyses

The Part C Program's complete data set contained 4,922 ECI scores for 1,812 children. Overall, 91% (n = 4,491) of assessments were for the Pre-COVID-19 Cohort versus 9% (n = 429) for 268 children in the COVID-19 Cohort. All Pre-COVID-19's ECIs were administered in-person in centers (5.6%), at home (91.2%), and in other settings (3.2%; Table 3). COVID-19 children received both in-person and remote ECIs. Descriptive statistics, scatterplots, and graphical displays were used to address the research questions related to uptake (RQ1), equivalence of IGDI rate scores (RQ2), ECI trajectories (RQ3), and preferences (RQ4).

For questions comparing in-person versus remote IGDI scores across children in the COVID-19 Cohort, we used Univariate General Linear Modeling with age at assessment as a covariate

(RQ2). Our predictor in this analysis was the ECI method used, coded as 0 = *in-person* versus 1 = *remote*. For questions comparing within children's age-based growth trajectories from 6 to 36 months, we used Multilevel Linear Mixed Modeling (Snijders & Bosker, 2012) to account for the structure of repeated ECI measurements nested within children (RQ3). Exploration of the Part C Program's children's trajectories identified three patterns within children: all in-person (74, 27.9%), mixed or hybrid (52, 19.6%), and all remote (139, 52.5%); thus, we compared these trajectory groups within children where groups were coded as –1 = *in-person*, 0 = *hybrid*, and 1 = *remote* (RQ3a). In comparisons between the Part C Program's cohorts within child trajectory differences, our predictors were coded as 0 = *Pre-COVID-19*, 1 = *COVID-19* (RQ3b). At Level 1 (unconditional model), we included mean intercept, slope, and acceleration parameters as we reported in prior ECI publications (Greenwood et al., 2011a, 2011b); At Level 2 (conditional model), we included predictors and covariates. In all models for RQ2 and RQ3, we also included gender (0 = *female*, 1 = *male*) and child's month of age as covariates.

Results

RQ1. Did the Part C Program's Uptake of the Remote IGDI-ECI Protocol Reach Pre-Pandemic Numbers of In-Person Administrations?

All ECIs administered during Baseline (A) were in-person and conducted at home, center, and other settings in rank order (see Table 3). During the COVID-19 shutdown (B_1), administration of all ECIs plummeted; those few occurring were in the center and home. Remote IGDI administration in Phase B_2 jumped to 71% of the 262 ECIs administered at home. In-person ECIs also rebounded in homes and centers.

Prior to COVID-19, program staff were producing a gradual uptick in rate of ECI administrations as new Cohort 2 children were enrolled in services (see Figure 1). The rate of ECIs administered increased more rapidly after June 2019 with the addition of new enrollees plus enrolled children receiving additional ECIs, increasing the program's workload and productivity through January 2020. Administrations nearly stopped in February 2020 (Phase B_1), with onset of nation- and state-wide COVID-19 mitigation (i.e., center closings, social distancing practices). The first remote administrations (Phase B_2) started on August 17, 2020, (see Figure 1) and increased rapidly (linear slope of 37.2 ECIs per month), overtaking the in-person lower slope (19.2 per month) over the next 4.5 months. Thereafter, it dropped off during November and early December 2020. Follow-up indicated an additional 97 remote ECIs.

RQ2. Were Children's ECI Total Rate Mean Scores Between Methods Equivalent?

Comparative statistics are shown in Table 4. Overall, Phase B_2 ECI mean scores produced by the two methods during this phase were equivalent. The correlation of ECI scores with age was positive and moderately strong. Linear slopes over age were also positive ranging from .42 (remote) to .49 (in-person) responses per minute.

RQ3. Were Part C Program's Age-Based ECI Score Trajectories Equivalent?

Differences across assessment modes (in-person, remote, hybrid). Results indicated no significant differences in linear growth, acceleration, or mean intercepts at 36 months of age between remote, in-person, and mixed/hybrid methods (see Table 5 and left panel of Figure 2). There were no covariate effects for gender or age at start.

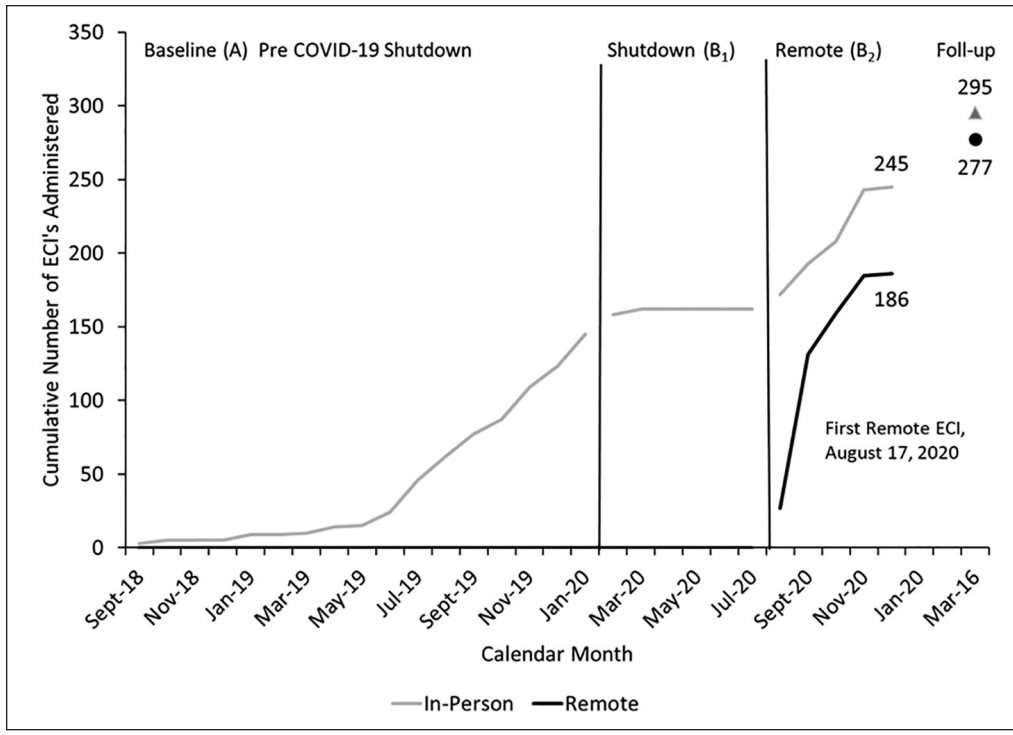

Figure 1. Part C Program's trends in ECI use with the COVID-19 Cohort by phase.

Table 4. Programs' Phase B_2 IGDI Score Comparisons by Methods During the Pandemic.

		Statistics					
IGDI	Method	*N*	*Age adjusted M*	*SE*	*Effect size*[a]	*Correlation with age*	*Linear slope (RPM)*
Part C Program							
ECI	In-person	77	7.2	.62	.001	.45	.49
	Remote	185	7.2	.40	–	.54	.42
Early Head Start Program							
ECI	In-person	86	10.2	.220	.003	.69	.72
	Remote	56	8.8	.840	–	.61	.42
EMI	In-person	47	12.7	.212	.007	.44	.22
	Remote	36	11.0	.921	–	.65	.40
EPSI	In-person	59	20.6	.991	.015	.55	.60
	Remote	40	19.3	.958	–	.80	.49

Note. IGDI = Individual Growth and Development Indicator; ECI = Early Communication Indicator; EMI = Early Movement Indicator; EPSI = Early Problem-Solving Indicator.
[a]Partial eta squared (η^2) = effect size where .01 is small, .06 is medium, and .14 is large.

Differences before versus during COVID-19. Regarding cohort differences in ECI score trajectories, results indicated significantly greater growth in ECI total communication rate for COVID-19 Cohort with a mean intercept at 36 months that was 5.8 responses per minute ($SE = 1.09$, $t = 5.34$, and $p = .001$) higher than Pre-COVID-19 Cohort (see Table 6). Linear slope ($p = .001$) was

Table 5. Part C Program's COVID-19 Cohort Growth Model Comparing Method Modes (All In-Person vs. Remote vs. Hybrid).

						95% confidence interval	
Parameter	*Est.*	*SE*	*df*	*t*	*p*	*Lower bound*	*Upper bound*
Intercept	21.154	3.843	366.1	5.51	0.000	13.60	28.71
Slope	1.383	0.383	329.4	3.61	0.000	0.63	2.14
Acceleration	0.023	0.010	211.7	2.39	0.018	0.00	0.04
Method mode	2.092	1.549	618.1	1.35	0.178	–0.95	5.13
Age@Start	–0.203	0.149	341.7	–1.37	0.172	–0.50	0.09
Gender	0.842	2.427	703.9	0.35	0.729	–3.92	5.61
Slope × Cohort	0.216	0.179	370.1	1.20	0.230	–0.14	0.57
Acceleration × Cohort	0.006	0.005	109.3	1.21	0.231	0.00	0.02
Slope × Age@Start	–0.013	0.018	516.7	–0.72	0.471	–0.05	0.02
Acceleration × Age@Start	0.000	0.001	66.0	–0.09	0.928	0.00	0.00
Slope × Gender	0.105	0.269	207.4	0.39	0.698	–0.43	0.64
Acceleration × Gender	0.002	0.007	77.6	0.33	0.743	–0.01	0.02

Note. Est. = Estimate. Dependent Variable: ECI Total Communication Rate. ECI = Early Communication Indicator.

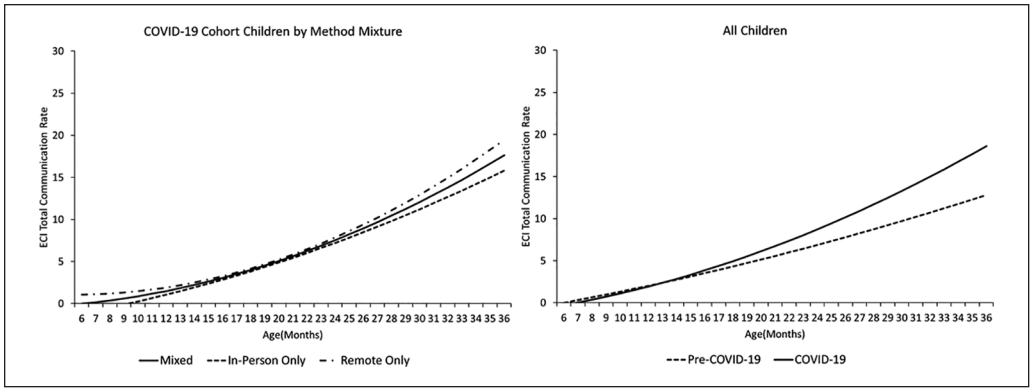

Figure 2. Part C Program's fitted ECI total communication rate trajectories within COVID-19 Cohort children (left panel) and between Pre-COVID-19 versus COVID-19 Cohort children (right panel).
Note. ECI = Early Communication Indicator.

statistically significant, and acceleration ($p = .055$) was nearly significant (see the right panel, Figure 2). The age at start covariate had a greater slope ($p = .001$) and acceleration ($p = .001$) for COVID-19 Cohort. Gender was not significant.

RQ4. What Were the Reported Experiences and Preferences?

Home visitors. Nine Part C Program home visitors completed the survey (see Table 7). When asked which method they preferred (in-person, remote, or hybrid using both), none reported preferring remote. Otherwise, preferences were for *in-person* (4), *hybrid* (3), and *no preference* (2). Regarding continuation of remote post-pandemic, respondents were mostly favorable: *somewhat likely* (4), *likely* (3), *very likely* (1), and *not likely at all* (1). Initial confidence in administering remote IGDIs was *somewhat confident* (7) and *confident* (2). After experience, confidence improved: *somewhat* confident (1), *confident* (5), and *very confident* (3).

Table 6. Part C Program's Growth Model Comparing Scores Between Pre-COVID-19 Versus COVID-19 Cohorts.

						95% confidence interval	
Parameter	*Est.*	*SE*	*df*	*t*	*p*	*Lower bound*	*Upper bound*
Intercept	12.823	0.774	15,537.0	16.56	0.000	11.31	14.34
Slope	0.540	0.084	5,478.2	6.46	0.000	0.38	0.70
Acceleration	0.004	0.002	4,040.9	1.55	0.122	0.00	0.01
Cohort (Pre-COVID-19 vs. COVID-19)	5.812	1.088	10,883.1	5.34	0.000	3.68	7.94
Age@Start	–0.042	0.030	18,141.9	–1.38	0.168	–0.10	0.02
Gender	0.278	0.473	16,751.4	0.59	0.557	–0.65	1.21
Slope × Cohort	0.415	0.129	6,281.1	3.23	0.001	0.16	0.67
Acceleration × Cohort	0.007	0.004	4,656.5	1.92	0.055	0.00	0.01
Slope × Age@Start	0.013	0.004	5,354.4	3.48	0.001	0.01	0.02
Acceleration × Age@ Start	0.001	0.000	2,175.3	4.60	0.000	0.00	0.00
Slope × Gender	0.060	0.056	5,245.6	1.07	0.285	–0.05	0.17
Acceleration × Gender	0.002	0.002	3,633.1	1.02	0.310	0.00	0.01

Note. Est. = Estimate. Dependent Variable: ECI Total Communication Rate. ECI = Early Communication Indicator.

Parents. In total, 17 parents/caregivers from Part C Program completed the survey (see Table 7). Regarding the success of their first remote ECI, 14 respondents agreed that it was successful (*agreed* [7] or *strongly agreed* [7]). They also agreed that they improved with experience, 10 (*agreed* [6] or *strongly agreed* [4]) that they had become more successful, and 7 were *neutral/undecided* (4) or *not more successful* (3). And, 13 (76%) reported previously serving as a play partner during in-person IGDI administrations at home. Of the 13 parents/caregivers who experienced both in-person and remote assessments, 12 preferred in-person over remote, while one had no preference. Regarding data sharing received by 17 parents/caregivers, only one preferred remote sharing, nine in-person, five no preference, and two no response.

Discussion

Within a short period (Phase B_2), there was an increase in the Part C program's remote and in-person ECIs. The increase in use at grandparents' homes and other locations reflected staff taking advantage of available opportunities to assess a child at a distance compared to before COVID-19 (Phase A). This was achieved despite the extra cost in time and effort to prepare the family with the remote protocol including the need for extra technology, delivery of materials to the home, and coaching on setting up and taking down the assessment. The Part C Program created assessment teams responsible for delivery, coordination, and support.

ECI score comparisons within Part C Program's COVID-19 Cohort indicated no differences between the in-person versus remote methods, both of which produced similar means, standard errors, and effect sizes. Scores from both methods were positively correlated with age at test, and slopes were positive accelerating over months of age as expected. Important to making inferences about individual children's growth over time, analyses showed that ECI trajectories from the three methods (all in-person, hybrid, or all remote) were no different. The remote protocol did not appear to introduce unwanted variance to mean scores or to trajectories, supporting the conclusion that scores could be used interchangeably as part of intervention decision-making by program staff and parents/caregivers. Anecdotally, Part C Program staff reported that scores for

Table 7. Survey Participants' Demographics.

Characteristic	Variable	Part C Program	EHS Program	Total
Home visitors (*n*)		9	13	22
Gender	Female	9	12	21
	Male	0	1	1
Race/ethnicity	African American	0	2	2
	Latinx	0	4	4
	Multiethnic	0	3	3
	White/Caucasian	9	4	13
Education level	Some college, up to BA degree	0	6	6
	Some graduate school, up to MA	8	7	15
	PhD	1	0	1
Mean years of early childhood experience		18	8.8	
Mean years as certified IGDI assessor		1.4	4.4	
Mean rating of prior videoconferencing experience[b]		3.3	2.9	
Families reporting (*n*)		17	40	57
Gender	Female	16	40	56
	Male	1	0	1
Primary caregiver Education	Some high school	1	18	19
	High school degree or GED	4	10	14
	College, up to BA degree	10	9	19
	Not reported	2	3	5
Race/ethnicity	African American	1	5	6
	Asian American	0	2	2
	Latinx	1	29	30
	Multiethnic[a]	2	1	3
	White/Caucasian	13	3	16
Mean rating of prior videoconferencing experience[b]		3.2	2.9	

Note. EHS = Early Head Start; IGDI = Individual Growth and Development Indicator; GED = General Educational Diploma.
[a]Multiethnic were African American and White and African American and Latinx. [b] 4-point scale with 4 = *the most experience*.

individual children obtained remotely were comparable to those in-person. Staff noted that when a child did not perform well, they appeared sick, tired, or in a changed home environment. However, similar events happened with the in-person protocol.

The comparison of Pre-COVID-19 versus COVID-19 Cohorts within child growth trajectories, ignoring administration method differences, did suggest significant outcomes. Children in Cohort 2 had a significantly larger mean intercept at 36 months of age, as well as greater positive slope and acceleration after controlling for age at first ECI and gender. The lack of method differences within COVID-19 children appeared to rule it out as explanation. Age at start differences was also ruled out by its inclusion as covariate, and there were no gender differences. The definitions of ECI key skills did not change, nor did training/certification. A possible explanation could be improved intervention practices experienced by children in the COVID-19 Cohort.

Survey findings for the Part C Program indicated that both home visitors and parents/caregivers independently had strong preferences for in-person ECI administration over remote. They also preferred in-person data sharing. These preferences were expected given the additional technology and response costs parents/caregivers and home visitors needed for remote administration. Both parents/caregivers and home visitors indicated that their confidence and comfort

participating in remote administrations did improve with experience over time. Their increasing confidence may have contributed to the majority of home visitors reporting that they would be likely to conduct remote assessments if needed post-pandemic.

Limitations

Overall, results were based on a small sample of remote ECI observations from one program. Larger samples and more rigorous comparative designs are needed in the future to draw more generalizable conclusions. It was the case that Part C's growth models did not converge even after data quality checks were conducted. An explanation could be the small number of assessments for each individual child. Findings should be considered with caution and replicated in larger samples.

Study 2—EHS Program

Design

The same design was used in Study 2. Dates separating (a) Baseline (A) and the COVID-19 shutdown (B_1) were February 1, 2020, and (b) between COVID-19 shutdown and the start of remote IGDIs (B_2) was October 13, 2020. Unlike the Part C Program, which only used the ECI, the EHS Program used multiple IGDIs: the ECI, EMI, and EPSI.

Participants

Children, families, and home visitors. Consistent with EHS eligibility policy, this program served low-income qualifying families and their children (aged birth to 3 years; $N = 1{,}049$, see Table 1). As of this reporting, 799 (76.1%) Pre-COVID-19 Cohort children had completed service and exited the program, whereas 250 (23.8%) children were being served and experienced the COVID-19 interruption of services. The mean age at first assessment was 17.2 months ($SD = 10.5$ months) for all children (see Table 1). COVID-19 children were, on average, 6 months younger than the Pre-COVID-19 Cohort and predominately male. Children were equivalent in gender and predominately typically developing, with a small proportion of children with Individual Family Service Plans (IFSPs). The EHS Program served nearly equivalent numbers of native English, Spanish, and speakers of other languages (e.g., Arabic). Just more than 4% also had IFSPs (4.4%).

Program. The EHS Program was a provider in a large metropolitan area, offering both home-visiting and center-based services. EHS is a national child development program serving low-income families with infants and toddlers. EHS policies make 10% of openings available to children receiving Part C services under the Individuals for Disabilities Education Act (IDEA).

Statistical Analysis

Analyses of the EHS Program data were conducted as described for the Part C Program with two major exceptions: (a) within children's growth modeling of score trajectories were not conducted due to the infrequency of repeated assessments, and (b) comparisons were not made between cohorts because of the program's use of multiple IGDIs. The EHS Program's COVID-19 Cohort database of 250 children contained 2,422 assessments: ECI (869, 36%), EMI (716, 29%), and EPSI (817, 35%). These assessments were conducted in-person or remotely. There were 132 remote assessments, distributed as ECI = 56, EMI = 36, and EPSI = 40.

Results

RQ1. Did the EHS Program's Uptake in Use of Remote IGDIs Reach Pre-Pandemic Numbers of In-Person Administrations?

During baseline (A), all three IGDIs were administered in-person predominantly in the center and home for the COVID-19 Cohort as shown in Table 8. During the shutdown (B_1), use of IGDIs nearly stopped entirely, with only a few conduced in the center and none occurring at home. In the remote phase (B_2), in-person administrations increased in the center and home as did the uptake in the use of remote assessments, all conducted at home (Table 8). The cumulative trend in IGDI use over months by phases is seen in Figure 3. Like the Part C Program, the EHS Program increased use of remote IGDIs from zero beginning in Phase B_2, along with in-person IGDIs. The first remote ECI occurred on October 13, 2020, followed by the EMI and EPSI each separated by a month. Unlike the Part C Program, the uptick in remote IGDIs during Phase B_2 did not outpace in-person IGDIs.

RQ2. Were Children's IGDI Total Rate Mean Scores Between Methods Equivalent?

Comparative method statistics for EHS Program are shown in Table 4. In all cases, in-person and remote IGDI scores were positively correlated with age, ranging from $r = .44$ to .80 and slopes were positive, ranging from .29 to .78 responses per minute per month of age. Like the Part C Program, age-adjusted IGDI total communication mean score differences for EHS Program were small in magnitude. All effect sizes were small, suggesting equivalence.

RQ4. What Were the Home Visitor's and Parent's/Caregiver's Experiences and Preferences?

Home visitors. In total, 13 EHS Program home visitors completed the survey (see Table 7). Their preferred approaches (in-person, remote, or hybrid) were similar to Part C Program in that none preferred remote, but in-person (11) and hybrid (2) instead. However, they were less certain about continuing remote assessments post-pandemic: *unsure* (4), *not likely at all* (3), *somewhat likely* (3), *likely* (2), and *very likely* (1). Rating their confidence when administering their first remote IGDI, respondents were *not confident at all* (3), *somewhat* (9), and very *confident* (1), compared to after practice *not confident at all* (1), *somewhat confident* (1), *confident* (5), and *very confident* (3). In both programs, confidence increased with practice.

Parents/caregivers. In total, 40 EHS Program parents/caregivers completed the survey (see Table 5). Regarding the success of their first remote IGDI, 31(78%) *agreed* (17) or *strongly agreed* (14) that it was successful, compared with 33 (83%) who *agreed* (23) or *strongly agreed* (10) that they had become more successful with experience. Six indicated *no change* in success (1) or equivalence (*neutral/undecided* [5]) with experience. Of 30 parents/caregivers who reported prior experience as a play partner during in-person IGDI assessments, one preferred remote, one did not respond, 15 preferred in-person administration, and 13 had no preference. Of 37 parents/caregivers whose home visitor usually shared data with them, only three preferred remote sharing, four did not respond, 12 preferred in-person sharing, and 21 had no preference.

Table 8. EHS Program's Use of IGDIs With COVID-19 Children by Method, Location, and Phase.

				Phase			
					Pandemic		
Method	Location	IGDI	Statistic	Baseline (A)	Shutdown (B_1)	Remote (B_2)	Total
In-person	Left	EMI	Count	240	9	35	284
			%	90	3	13	100
		ECI	Count	251	2	43	296
			%	91	1	16	100
		EPSI	Count	257	3	39	299
			%	91	1	14	100
		Total	Count	748	14	117	879
			%	91	2	14	100
	Home	EMI	Count	382	0	11	393
			%	99	0	3	100
		ECI	Count	468	0	43	511
			%	94	0	9	100
		EPSI	Count	491	0	20	511
			%	98	0	4	100
		Total	Count	1,341	0	74	1,415
			%	95	0	5	100
	Other	EMI	Count	2	0	1	3
			%	67	0	33	100
		ECI	Count	6	0	0	6
			%	100	0	0	100
		EPSI	Count	7	0	0	7
			%	100	0	0	100
		Total	Count	15	0	1	16
			%	100	0	7	100
Remote	Left	EMI	Count	0	0	–[a]	3
			%	0	0	100	100
		ECI	Count	0	0	–[a]	3
			%	0	0	100	100
		EPSI	Count	0	0	–	3
			%	0	0	100	100
		Total	Count	0	0	–[a]	9
			%	0	0	100	100
	Home	EMI	Count	0	0	33	33
			%	0	0	100	100
		ECI	Count	0	0	53	53
			%	0	0	100	100
		EPSI	Count	0	0	37	37
			%	0	0	100	100
		Total	Count	0	0	123	123
			%	0	0	100	100
	Other	EMI	Count	0	0	0	0
			%	0	0	0	0
		ECI	Count	0	0	0	0
			%	0	0	0	0
		EPSI	Count	0	0	0	0
			%	0	0	0	0
		Total	Count	0	0	0	0
			%	0	0	0	0
Grand total			Count	2,104	14	324	2,442
			%	86	1	13	100

Note. IGDIs = Individual Growth and Development Indicators; ECI = Early Communication Indicator; EMI = Early Movement Indicator; EPSI = Early Problem-Solving Indicator.

[a]Nine center-based remote IGDIs were staff trials and not used information.

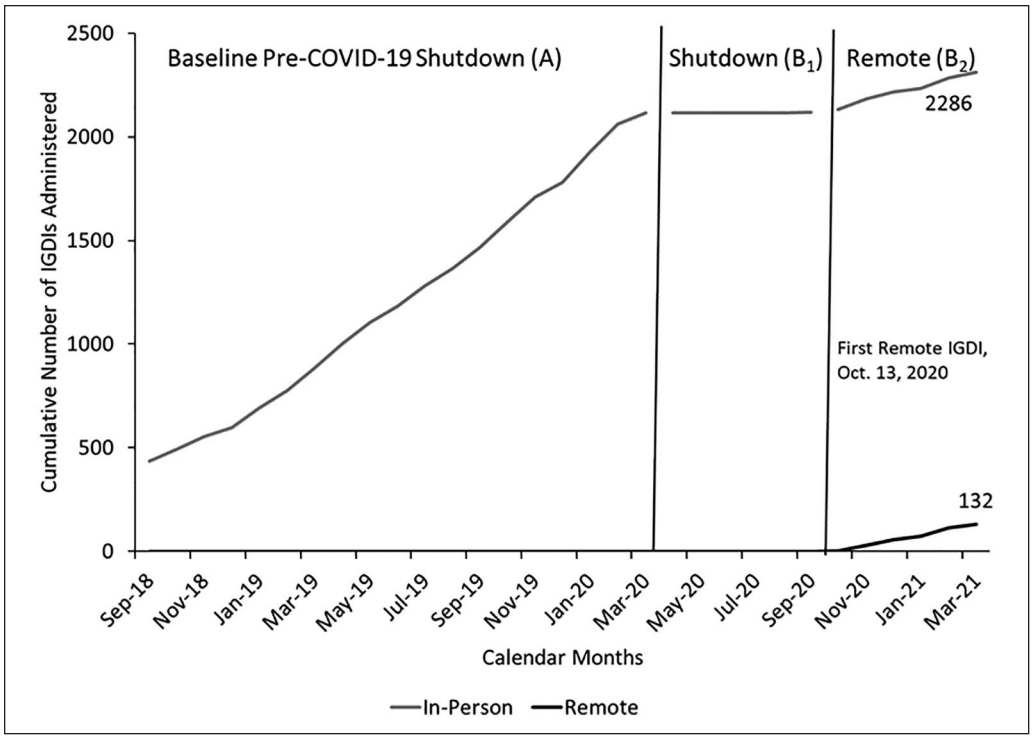

Figure 3. Early Head Start Program's trends in All IGDI use with the COVID-19 Cohort by phases.

EHS Program Discussion

The EHS Program deployed of all three IGDIs in the home. Score comparisons between in-person and remote methods, like the Part C Program, indicated no differences in means and standard errors with near zero effect sizes, positive correlations with age-at-test, and positive slopes over months of age similar to those of Part C Program for the ECI, and uniquely so for the EMI and EPSI. Results provided additional support that remote use was not adding unwanted method effects to IGDI scores, and that scores within children from mixed methods could be used interchangeably as part of individual progress monitoring and intervention decision-making. The EHS Program's survey preferences for in-person administration and data sharing were similar to the Part C Program.

Limitations

Study 2 results were based on smaller remote data samples compared with those obtained in Study 1. Larger samples in more programs will be required to confirm findings in future.

General Discussion

The purpose of this research was threefold: (a) report the development and use of remote IGDI administrations in two EI programs based on developer's guidelines, (b) evaluate the equivalence of scores collected by program staff using remote versus standard in-person methods using existing and ongoing data during the pandemic, and (c) assess and report experiences and preferences of program staff and parents/caregivers. Compared with the in-person method, remote

administration involved changes in (a) how the IGDI materials were delivered to and returned from homes, (b) the use of videoconferencing by staff to coach parents as needed to set up the assessment and play with their child with fidelity, and (c) how to observe and code a child's performance during play with the adult partner. Although both programs' remote protocols were similar, they differed in resource deployment. Toys and devices were loaned out and retrieved by a support team in the Part C Program for "just in time" assessments in the home, while the EHS Program purchased toy sets for each family, and families used their own digital resources. Results indicated both programs were successful in establishing and using remote IGDIs, and scores between the methods were equivalent and could be used interchangeably. When surveyed, home visitors and parents/caregivers preferred in-person assessments but indicated a willingness to do remote assessments. Caregivers preferred data sharing in-person.

Significance

In addition to providing EC leaders initial validation of safe, remote IGDI procedures for use during the pandemic, the work demonstrated a reasonable approach to investigating score equivalence based on existing data in the face of no other "clearly palatable solutions" (Farmer et al., 2020, p. 485). The work also informed the broader purpose of progress monitoring in EI/ECSE and extended access to all through technology regardless of distance, particularly during a pandemic, and universal social distancing.

Because progress monitoring is an evidence-based practice used in EI/ECSE (McLean et al., 2020), the remote IGDI is especially important in the context of tele-practice service delivery. Prior work using the ECI to monitor progress of an evidence-based language intervention proved useful in documenting improved intervention effects (Buzhardt et al., 2011, 2018); IGDIs also have played an important role in universal screening, identifying children likely to benefit from greater levels of individualization. IGDIs provide staff and families short-term, actionable information on the need to continue or change a child's intervention (Buzhardt et al., 2011). IGDIs provide useful data to inform progress toward IFSP goals in addition to caregiver reported data. Because individual children's progress charts are based on the Centers for Disease Control's (CDC) height and weight growth charts (Centers for Disease Control, 2000), they are readily understandable by parents and help maintain parent engagement in interventions. IGDIs are useful documenting program accountability and identifying needs for professional development.

The framework used for evaluating the success of this remote method could be replicated by other EI/ECSE programs with access to the IGDI app. Key questions that can be addressed are as follows: (a) "Is the remote method feasible, evidenced by the uptake in its use and lack of implementation failures?," (b) "Are remote scores comparable to standard in-person assessments?," and (c) "Can scores within children be combined in a time series (growth trajectory) without adding unwanted score variance?" Given the urgent need for remote assessment procedures generally, these results provide a breakthrough in developing remote alternatives for program staff to use with families.

Challenges

Home visitors and parents/caregivers reported anecdotally that involvement in an IGDI session sometimes conflicted with the need to supervise other children at home during the assessment. Using the in-person method, the home visitor often could help keep other children engaged away from the assessment, while the parent/caregiver was engaged in play with the target child. This was not true with remote assessments. More remote, compared with in-person assessment occasions, were paused for a single parent to redirect another child. When two children were present at home, coders occasionally reported difficulty knowing who was producing vocalizations

during the ECI. Some staff reported remote administrations were easier and more authentic because of fewer persons in the home and the child interacted more freely. Others reported that remote scoring from small screens was difficult due to poor audio quality.

Rural programs, in particular, would likely benefit from remote IGDI procedures that overcome the need for travel to and from homes. However, remote IGDIs are dependent on quality internet service (bandwidth). Families in rural settings or those who encounter frequent and prolonged utility outages are more likely to have interrupted service impeding remote IGDIs. For families depending on school-issued devices, IGDIs may conflict with remote learning.

Limitations and Future Research

We struggled with exactly how to make strong comparisons given available data from two programs in early stages of remote IGDIs. For example, the program controlled the pattern of administration, that is, who received IGDIs and when. Thus, some children received a mixture of in-person and remote ECI assessments over time (hybrid) while others received only one or the other exclusively. This means that children's individual trajectories (time-series) were composed of scores from mixed methods unlike in the past when all were from a single method (i.e., in-person). Investigating the equivalence of hybrid method score trajectories remains a need in future research. Future research might consider two a-priori designs: (a) case-matched samples design with children randomly assigned to alternate groups compared statistically (Wright, 2020), or (b) a design where each child experiences remote and in-person administrations simultaneously scored by two assessors for an analysis of agreement (Waite et al., 2010).

There was not a quantitative assessment of IGDI implementation fidelity conducted during the pandemic phases of the investigation. We assumed that practitioners were sufficiently prepared during the pre-pandemic phase protocol to transfer these skills, with guidance, to remote administration during the pandemic. The degree to which these skills generalize to remote procedures should be examined in future research. Use of the remote procedure in this report was short-term, reflecting early efforts to establish remote protocols in both programs and the urgency to report early stage progress. The sustained and long-term use of these procedures is presently unknown. Also, it remains to be demonstrated whether programs can successfully replicate these or other innovative approaches based on the core features established by the developers. Barriers to replication may include limited technology resources at both the family- and program-level, lack of personnel, and cost.

Conclusion

COVID-19 has challenged programs to find ways of adapting child and family services at a safe distance that often involves the use of telehealth technologies. This report contributes new information regarding developing and using a remote, observational child assessment in the home and other settings via videoconferencing and appropriate front-end parent/caregiver training and logistical support from program staff. Based on developers' guidelines, local program staff tailored their remote procedures, with emerging evidence supporting success in both programs. These findings bring some validation to the use of infant/toddler IGDIs when administered and scored remotely for universal screening and progress monitoring which could benefit many programs seeking similar solutions when in-person assessments are not available.

Authors' Note

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Supplemental Material

Supplemental material for this article is available online.

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