

A Quality Improvement Network for Interdisciplinary Training in Developmental Disabilities

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on behalf of the LEND QUALITY IMPROVEMENT NETWORK

Children with developmental disabilities (DD), such as autism spectrum disorder (ASD), have complex health and developmental needs that require multiple service systems and interactions with various professionals across disciplines. The growing number of children and youth identified with ASD or DD, including anxiety and depression, has increased demand for services and need for highly qualified pediatric providers. Federally funded Leadership Education in Neurodevelopmental and related Disabilities (LEND) programs across the United States address today's health care shortages by providing comprehensive, interdisciplinary training to providers from multiple pediatric disciplines who screen, diagnose, and treat those with ASD and DD. Each LEND program develops training methods independently, including quality improvement efforts. In 2014, LEND programs began designing and validating common measures to evaluate LEND training. The LEND Program Quality Improvement (LPQI) Network was established in 2016. Participating LEND programs in the LPQI Network administer validated trainee self-report and faculty-observation measures that address skills in key competency domains of Interdisciplinary or Interprofessional Team Building, Family-Professional Partnerships, and Policy. This study reports data from faculty and trainees from 22 LEND programs that participated in the LPQI Network across the 5-year data collection period. The main outcome of this study was the change in trainee knowledge, skills, and attitudes scores in key competency domains across programs. Overall, trainees made significant knowledge, skills, and attitude gains based on both self-report and faculty observation scores for all 3 competency domains. Data demonstrate the value of LEND programs and feasibility of a national quality improvement approach to evaluate interdisciplinary training and systems-level improvement.

About 1 in 6 children in the United States have 1 or more developmental disabilities (DD) or other developmental delays,¹ defined as an impairment in physical, learning, language, or behavior areas.² The prevalence of DD, such as autism spectrum disorder (ASD), continues to rise,³ and the Centers for Disease Control and Prevention recently released materials designed to improve

developmental surveillance and subsequent early identification and intervention of DD.⁴ Mental health conditions have also garnered national attention: according to 1 recent review of child well-being, the increased prevalence of anxiety and depression represents the most dramatic change in child health in the United States in the last 5 years.⁵ Despite the increasing

abstract



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prevalence, half of youth with developmental or behavioral conditions do not receive appropriate interventions.⁶ The coronavirus disease 2019 (COVID-19) pandemic has exacerbated this situation, and the American Academy of Pediatrics (AAP) and the US Surgeon General have both issued alerts⁷ that we are facing a crisis in the well-being of children and youth in our nation.

The American Board of Pediatrics recently reported that the current physician workforce is not equipped to address these challenges,⁸ and in the last several years the AAP has published guidelines⁹ calling on pediatric providers to improve their skills in a wide range of developmental and behavioral disorders, including ASD. Other professional organizations have noted the lack of well-trained professionals to address developmental and behavioral disorders. Estimated supply and demand for behavioral health practitioners (eg, psychologists, psychiatrists, nurse practitioners, etc) predict major shortages of practitioners¹⁰ by the year 2025.

For decades, the Health Resources Services Administration's Maternal and Child Health Bureau (MCHB) has funded the Leadership Education in Neurodevelopmental and related Disabilities (LEND) programs¹¹ to "train future leaders in a variety of disciplines to improve the health of children who have, or are at risk of, developing neurodevelopmental disabilities or other similar conditions such as autism and intellectual disabilities." This training includes cooccurring mental health diagnoses, which are especially common in children and youth with DD.¹² Currently there are 60 LEND programs at universities and children's hospitals across the United States providing graduate-level training in interprofessional

settings to individuals in more than a dozen disciplines, including pediatric residents and fellows. Family members and individuals with DD participate as both faculty and trainees, and expertise in family-professional partnerships is required of LEND graduates. Like many MCHB training programs, LEND training focuses on building interdisciplinary and interprofessional team skills, given the complex needs of children and families with developmental and behavioral conditions. A unique feature of all LEND programs is policy training to promote systems-level change: graduates must be prepared to contribute to population-level improvements in access and quality of care. Leadership training is especially relevant because innovative models of care are necessary to address the increasing prevalence of developmental and behavioral conditions, especially given how social determinants of health, including but not limited to race, ethnicity, and socioeconomic status, exacerbate inequalities in access to services and health disparities.¹³ LEND goals in interdisciplinary and interprofessional team building, family-professional partnerships, and policy are based on MCHB's leadership competencies.¹⁴ For details, please see "MCH Leadership Competencies": <https://mchb.hrsa.gov/training/leadership-00.asp>.

Although all LEND programs are responsive to the same federal guidance, each training program develops training methods independently, including quality improvement efforts and measures of training effectiveness. In 2014, LEND programs began designing and validating common measures¹⁵ that could be used by LEND programs across the country to evaluate the effectiveness of their individual training programs. The LEND Program Quality Improvement

(LPQI) Network was formed in 2016 and now consists of 32 LEND programs and the Association of University Centers on Disability (AUCD); the latter provides technical support to LEND programs through a cooperative agreement with MCHB. Participating LEND programs administer validated trainee self-report¹⁵ and faculty-observation¹⁶ measures that address skills in key competency domains of interdisciplinary and interprofessional team building (IDTB), family-professional partnerships (FPP), and policy. AUCD analyzes data from individual LEND programs to create national benchmarks; each LEND program has access to a personalized dashboard comparing their outcomes to national means for pre and post training measures. AUCD is also responsible for on-boarding new LEND programs and hosting monthly meetings of LPQI participants to solicit general feedback about programmatic differences to inform processes and improve the overall function of the network. The goal of LPQI is for participating LEND programs to use each year's LPQI data reports to determine areas for improvement, devise and implement a quality improvement plan, and measure outcomes in subsequent years.¹⁷ (See <https://www.aucd.org/lpqi> to view the measures and learn more about the LPQI network.)

In this study, we report data from the 22 programs that participated in the first 5 years of the LPQI Network. We hypothesized that trainees would demonstrate improvements in each of the 3 core competency domains of training: IDTB, FPP, and policy. In addition, we anticipated that gains in policy would be greater than the other 2 competency domains, given that many disciplinary training programs from which LEND trainees are chosen (eg, pediatric residents, psychology

interns) already provide sufficient training in IDTB and FPP.

METHODS

The data for this quality improvement initiative were drawn from faculty and trainees from 22 LEND training programs that participated in the LPQI Network across the 5-year data collection period. The LEND training programs that participated in this study were from 21 states throughout the United States and represented urban, suburban, and rural geographic areas. The LEND training programs in this study included clinical, nonclinical, and family or advocate training disciplines. Given the nature of the quality improvement initiative and survey procedures used, this study did not require review by an Institutional Review Board (IRB).

The main outcome of this initiative was the change in trainee knowledge, skills, and attitudes scores in key competency domains across programs. We examined knowledge, skills, and attitude change using trainee self-report measures and faculty observation measures. Measures were completed in 2 competency domains (IDTB and FPP) for the first 4 years, with an additional competency domain of policy added in the 2021 training year. LEND trainees completed self-report measures at the beginning (Time 1) and end (Time 3) of their 1-year LEND training period. Trainees completed these measures based on their self-perceptions of their knowledge, skills, and attitudes in these competencies at the start and end of their training. LEND faculty completed faculty-observation measures after trainees were ~30%

of the way through their LEND training period (Time 2) and at the end of their training period (Time 3). Time 2 was chosen by each training program to allow sufficient time for faculty to observe trainees and rate their “baseline” performance. Ratings were based on multiple direct observations over time.

Trainee Self-report Measures

Items on the IDTB and FPP trainee self-report measures are from the Core Competency Measure,¹⁵ a reliable and valid measure of MCHB core competencies. The policy trainee self-report measure was modeled after the MCH Leadership Competencies¹⁴ and developed by members of the LPQI Network, including LEND directors and a policy specialist. This was the first time this measure has been used;

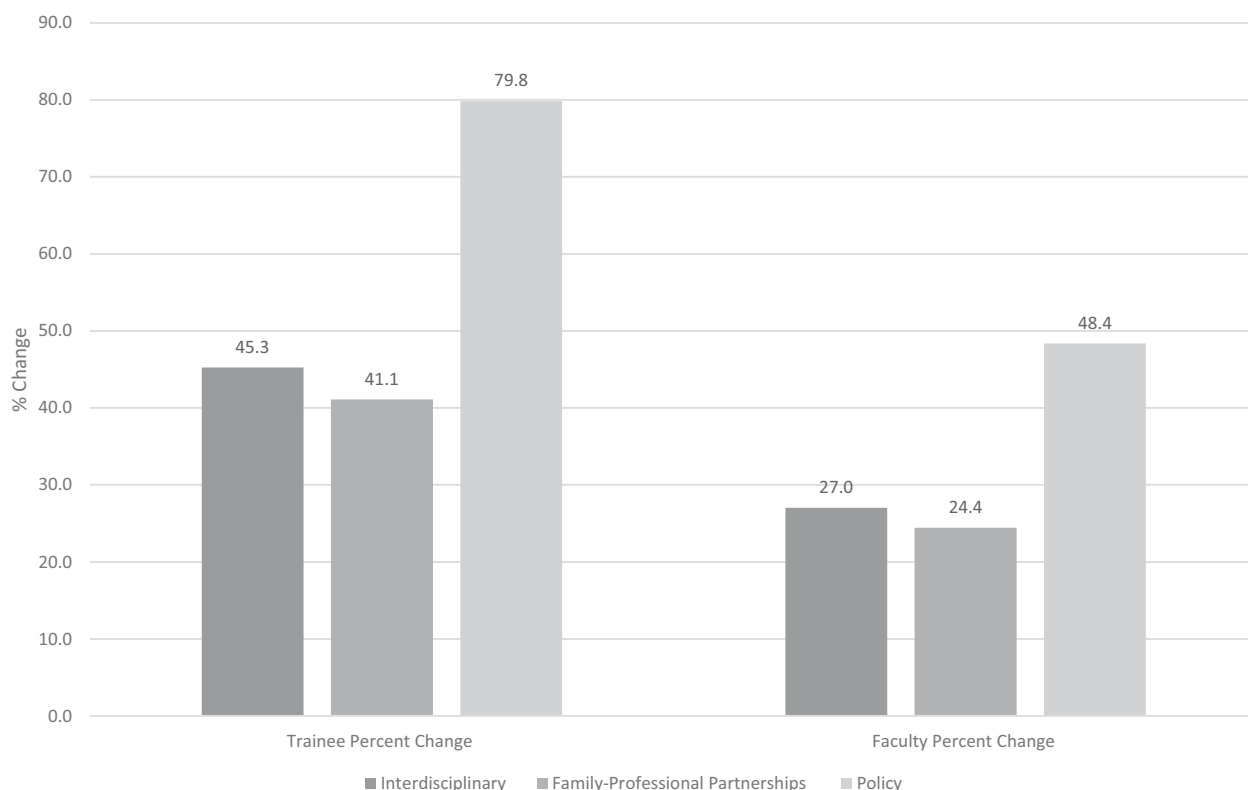


FIGURE 1

Percent change in scores for trainees from Time 1 to Time 3 and for faculty from Time 2 to Time 3 by each competency domain (IDTB, FPP, and policy).

therefore, there are no preliminary data.

Interdisciplinary and interprofessional team building (IDTB): trainees rated their own level of knowledge, skills, and attitudes needed to support an interdisciplinary team process. The 5 items were rated on a 4-point scale ranging from disagree (1), somewhat agree (2), agree (3), and strongly agree (4) for a total possible score of 20.

Family-professional partnerships (FPP): trainees rated their own knowledge of the central importance of the family and the ability to provide family-centered and culturally sensitive services. The 7 items were rated on a 4-point scale from disagree (1), somewhat agree (2), agree (3), and strongly agree (4) for a total possible score of 28.

Policy: trainees rated their own knowledge, skills, and attitudes regarding policy in changing and competitive economic and political environments. The 6 items were rated on a 4-point scale from disagree (1), somewhat agree (2), agree (3), and strongly agree (4) for a total possible score of 24.

Faculty Observation Measures

Items from the IDTB and FPP faculty observation measures are modified from the Interprofessional and Family-Centered-Care observation Rubric,¹⁶ which has demonstrated good internal consistency (Cronbach's $\alpha > 0.93$) and test-retest reliability (Interprofessional: $r = 0.86$, Family-Centered-Care: $r = 0.82$, $P < .001$). The Policy faculty observation measure was modeled after the MCH Leadership Competencies¹⁴ and developed by members of the LPQI Network, including LEND directors and a policy specialist.

Interdisciplinary and interprofessional team building (IDTB): faculty rated

trainees on 6 items representing interdisciplinary milestones with observable anchors ranging from 1 to 4 for a total possible score of 24.

Family-professional partnerships (FPP): faculty rated trainees on 6 items representing FPP milestones with observable anchors ranging from 1 to 4 for a total possible score of 24.

Policy: faculty rated trainees on 6 items representing Policy milestones in the areas of process, policies, story-telling, methods, practice, and partnerships with observable anchors ranging from 1 to 4 for a total possible score of 24.

ANALYSIS

Descriptive statistics were used to report characteristics of the study sample by training discipline and year of enrollment in LEND. Our primary objective was to estimate the mean change in trainee knowledge, skills, and attitudes scores in the key competency domains across programs (IDTB, FPP, and policy) using paired t tests and calculating Cohen's d to quantify the effect size. Specifically, paired t tests estimated the mean difference and 95% confidence intervals between Time 1 and Time 3 for trainees in all 3 competency domains (IDTB, FPP, and Policy) and Time 2 and Time 3 for faculty scores in all 3 competency domains for the entire study sample. Normality was assessed by generating Q-Q plots and histograms. Based on these visualizations, data followed a normal distribution.

The primary analyses were repeated stratified by discipline subtype (clinical, nonclinical, family-advocate) as background in IDTB, FPP, and policy before LEND likely varies based on trainee discipline. Finally, as the number of questions differed for each domain for trainee

and faculty scores, we also calculated the percent change in the mean scores for each competency domain to allow for comparison of changes by trainee $[(T3-T1)/T1]*100\%$ vs. faculty $[(T2-T1)/T1]*100\%$ to aid interpretation of results.

RESULTS

Data were collected from 951 trainees across the 22 participating LEND programs. The analytic sample included trainees who had complete data sets (trainee self-report and faculty observation measures for both time points) for a total $n = 816$. Policy competency domain was added in the last year with data from 163 trainees included.

A majority of trainees were from clinical subtypes ($n = 669$; 84.9%), followed by family or advocate ($n = 62$; 7.9%), and nonclinical ($n = 57$; 7.2%), with 28 trainees missing discipline data. Of note, there were fewer trainees and programs participating in 2017 compared with later years because of it being the first year of the LPQI Network. See Table 1 for detailed information regarding types and frequencies of disciplines represented in the analyses.

Overall, trainees made significant knowledge, skills, and attitude gains based on both their self-report and faculty observation scores for all 3 competency domains based on mean scores (Table 2). There was a significant difference in trainees' mean scores from Time 1 to Time 3 in all 3 competency domains (IDTB T3 versus T1 mean difference = 5.7; 95% CI: 5.5–5.9; FPP T3 versus T1 mean difference = 7.3; 95% CI: 7.0–7.6 and policy T3 versus T1 mean difference = 8.1; 95% CI: 7.5–8.8) for the entire study sample. Similarly, there was a significant difference in faculty mean scores from Time 2 to Time 3 in all 3

TABLE 1 Types, Subtypes, and Frequencies of Disciplines and Year

	Frequency	Percentage
Clinical	669	84.9
Audiology	62	9.3
Dentistry-pediatric	11	1.6
Education	60	9.0
Genetics and genetic counseling	46	6.9
Medicine	35	5.2
Nursing	27	4.0
Nutrition	21	3.1
Occupational therapy	68	10.2
Physical therapy	50	7.5
Psychology	163	24.4
Social work	51	7.6
Speech-language pathology	75	11.2
Nonclinical	57	7.2
Health administration	6	10.5
Law	6	10.5
Other	25	43.9
Public health	20	35.1
Family or advocate	62	7.9
Family member	46	74.2
Person with a disability	16	25.8
Year		
2017	71	8.7
2018	169	20.7
2019	169	20.7
2020	235	28.8
2021	172	21.1

Total *N* = 816. Missing data on discipline type for 28 trainees.

competency domains (IDTB T3 vs T2 mean difference = 4.4; 95% CI: 4.2–4.6; FPP T3 versus T2 mean difference = 4.2; 95% CI: 4.0–4.5; policy T3 vs T2 mean difference = 6.1; 95% CI: 5.6–6.6) for the entire study sample. Large effect sizes were observed for all competency domains, with the largest effect observed for policy (trainee and

faculty Cohen's *d* = 1.9). Results are summarized in Table 3. When examining scores by discipline subtype, similar results were observed. For clinical and family-advocate subtypes, trainee and faculty scores indicated the largest gains in the policy domain, and among nonclinical trainees the effect size for gains in IDTB and policy

were equal. Table 4 summarizes the mean difference for each domain by discipline subtype.

The total number of questions for trainees and faculty differed, therefore we are unable to directly compare mean changes between those groups. Calculating percent change standardizes mean change scores, which allows examination of whether trainees and faculty reported similar changes over time. For all domains, trainees self-reported greater increase in knowledge and skills than faculty observation scores (Fig 1). The Policy domain demonstrated the greatest percent change for both trainees (79.8% change) and faculty scores (48.4% change), followed by IDTB (45.3% for trainees and 27.0% for faculty) and FPP (41.1% for trainees and 24.4% for faculty).

DISCUSSION

Analysis of the first 5 years of the LPQI network showed substantial trainee gains across the 3 core measures of IDTB, FPP, and policy. These gains occurred across all trainee subtypes for both self-report and faculty observation measures. These results impart confidence that the gains are significant and consistent with previous studies,^{18–21} demonstrating that LEND training enhances trainees' leadership

TABLE 2 Mean Scores by Time Point for Trainees and Faculty

	Entire Sample, Mean	Clinical Discipline, Mean	Nonclinical Discipline, Mean	Family or Advocate, Mean
Trainee scores				
IDTB T1	12.5	12.5	12.7	12.7
IDTB T3	18.2	18.2	18.4	18.2
FPP T1	17.8	17.8	18.4	18.1
FPP T3	25.1	25.2	25.4	24.8
Policy T1	10.2	10.0	11.2	12.1
Policy T3	18.3	18.2	18.9	19.4
Faculty scores				
IDTB T2	16.4	16.4	16.7	16.7
IDTB T3	20.8	20.9	21.1	21.0
FPP T2	17.4	17.3	17.7	18.0
FPP T3	21.6	21.6	21.9	21.7
Policy T2	12.6	12.8	11.5	11.5
Policy T3	18.7	18.7	19.0	18.7

IDTB, Interdisciplinary and Inter-professional Team Building; FPP, Family-Professional Partnerships.

TABLE 3 Mean Differences Between Time Points for Trainees and Faculty for Entire Sample

Measure	Mean Difference*	95% CI	Effect Size (Cohen's d)
Trainee report			
IDTB T3 vs T1	5.7	5.5–5.9	1.8
FPP T3 vs T1	7.3	7.0–7.6	1.7
Policy T3 vs T1	8.1	7.5–8.8	1.9
Faculty report			
IDTB T3 vs T2	4.4	4.2–4.6	1.6
FPP T3 vs T2	4.2	4.0–4.5	1.4
Policy T3 vs T2	6.1	5.6–6.6	1.9

Sample size = 816, **P* value <.001 for all measured domains. IDTB, interdisciplinary and interprofessional team building; FPP, family-professional partnerships.

competence and value for engaging in interdisciplinary work and family-professional partnerships.

Each year ~1500 trainees complete LEND training across the country, and 5 years later >80% of graduates demonstrate field leadership serving MCH populations in academic, clinical, public policy, and public health activities.²² As such, our findings that trainee gains in policy were larger than those for IDTB and FPP is particularly relevant. IDTB and FPP are often a component of disciplinary training (eg, psychology, pediatrics, allied health), so there is likely a higher baseline and lower resultant change over the LEND training period. In contrast, few graduate programs provide formal training in policy. LEND trainees likely enter their LEND training year with minimal knowledge and skills in this area and leave LEND training with a stronger

foundation. The potential for LEND graduates to transform systems of care by receiving training in policy is especially salient given the challenges facing our nation regarding developmental and behavioral conditions.

This study supports the feasibility of a national quality improvement approach to evaluate interdisciplinary training. The QI approach encouraged programs to implement standard assessment measures for IDTB, FPP, and policy domains. This implementation helped ensure that faculty as well as trainees understood exactly what was meant by IDTB, FPP, and policy, and that valid methods exist to ensure trainees with varied disciplinary and professional backgrounds exhibit competency in these domains. Additionally, the LPQI project allowed LEND programs to examine their clinical, research, and policy activities to ensure that

they were appropriately modeling IDTB, FPP, and policy for exemplary training.

Limitations

Although there was a substantial sample size, approximately 135 trainee scores were not included because only complete data sets were included in the analysis. A closer analysis could provide valuable information regarding the reasons for missing data, such as trainees or faculty not completing the measures or trainees not completing the entirety of their LEND training. Because the policy measure was added during the 2019 to 2020 year, the sample size for this domain is limited. The Policy measure was designed for use in the LPQI network. It will need to be evaluated more extensively for psychometric properties of validity and reliability. The most significant gains were demonstrated by trainees and faculty in this competency domain. Future data collection will be necessary to determine whether gains in policy vary from the other domains in future years or if this finding was limited to the 2019 to 2020 training year.

The use of self-report measures introduces the possibility of bias in responding, as LEND trainees completing the measures may perceive and report themselves as making more significant gains than they truly did. It is encouraging that

TABLE 4 Mean Differences Between Time Points for Trainees and Faculty Based on Trainee Discipline Subtype

Measure	Clinical (<i>n</i> = 669)		Nonclinical (<i>n</i> = 57)		Family or Advocate (<i>n</i> = 62)	
	Mean Difference (95% CI)*	Cohen's d	Mean Difference (95% CI)*	Cohen's d	Mean Difference (95% CI)*	Cohen's d
Trainee report						
IDTB T3 vs T1	5.7 (5.5–6.0)	1.8	5.7 (4.8–6.5)	1.7	5.5 (4.8–6.3)	1.8
FPP T3 vs T1	7.4 (7.1–7.8)	1.7	7.0 (5.6–8.4)	1.4	6.7 (5.6–7.8)	1.6
Policy T3 vs T1	8.2 (7.5–8.9)	1.9	7.7 (4.1–11.2)	1.7	7.3 (5.2–9.4)	2.2
Faculty report						
IDTB T3 vs T2	4.5 (4.3–4.7)	1.6	4.4 (3.7–5.1)	1.7	4.3 (3.5–5.0)	1.4
FPP T3 vs T2	4.3 (4.1–4.6)	1.5	4.2 (3.4–5.0)	1.3	3.7 (2.9–4.5)	1.2
Policy T3 vs T2	5.9 (5.4–6.4)	1.9	7.5 (5.6–9.4)	3.0	7.2 (4.7–9.7)	1.8

**P* value <.001 for all measured domains.

IDTB, interdisciplinary and interprofessional team building; FPP, family-professional partnerships.

significant gains were also noted on all the faculty observation measures, although to a smaller degree. Given that faculty observations were completed within the first 3 months of training, it is possible that trainees had already made gains within this critical time of training, thus resulting in higher baseline scores and less opportunity for change from T2 to T3. The faculty observation measures could be subject to response biases, as LEND faculty are likely motivated to show the benefits and impact of the LEND training program. Whereas reporting biases may be considered for both faculty and trainees, this was attempted to be controlled by providing systematic instructions and guidance for completion of the survey to all programs participating in the LPQI Network.

A limitation of the data for this study relates to the differences in the trainee and faculty measures, limiting the ability to make direct comparisons. To ease the readers' interpretation of the T1 to T3 trainee scores versus T2 to T3 faculty score changes, we needed to standardize the results, thus reported the percent change and standardized effect size (Cohen's *d*). Finally, although data from the LPQI Network demonstrates the value of LEND training, comparing LEND trainees to matched peers who did not participate in LEND training could help determine if LEND training is indeed responsible for such gains.

Of note, programmatic changes related to the COVID-19 pandemic occurred during the last half of the LEND year 2019 to 2020, and throughout the entirety of LEND year 2020 to 2021. The overwhelming majority of LEND programs were completely or near completely virtual in format during at least some of this time frame. Some of the participating programs were already intentional in the decision to have a majority of virtual experiences (to serve trainees at a distance), whereas other programs were completely in-person and forced to make adjustments necessitated by the pandemic. Pandemic restrictions likely impacted training by limiting in-person opportunities for education, training, and face-to-face interactions with families, patients, and interdisciplinary team members. A future study would be beneficial to analyze if there are any differences in gains between pre-COVID, in-COVID, and post-COVID training years to help understand the impact of COVID-19 pandemic restrictions on LEND training.

CONCLUSIONS

This study offers evidence that LEND training in developmental disabilities increases knowledge and skills in the areas of IDTB, FPP, and policy. The particularly large gains in policy offer hope that our maternal and child health workforce will be able to strengthen systems of

care for children and their families. Furthermore, these results show that it is feasible for individual training programs to commit to common measures and national benchmarks that aim to improve the quality of education. As such, the LPQI offers a quality improvement model for other training programs and networks.

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ABBREVIATIONS

ASD: autism spectrum disorder
AUCD: Association of University Centers on Disabilities
DD: developmental disabilities
IDTB: interdisciplinary team building
FPP: family-professional partnerships
LEND: Leadership Education in Neurodevelopmental and related Disabilities
LPQI: LEND Program Quality Improvement
MCHB: Maternal and Child Health Bureau

final manuscript as submitted and agree to be accountable for all aspects of the work.

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