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SYSTEMATIC AND OTHER REVIEW

Post-graduate Medical Training in Intellectual and Developmental Disabilities: a Systematic Review

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Abstract

Objective Despite the increasing number of people with autism-spectrum disorder (ASD), intellectual disabilities (ID), and developmental disabilities (DDs), individuals with these conditions continue to have high levels of unmet physical and mental health needs. Robust training of health professionals can help bridge this gap. A systematic review was conducted to describe the features and educational outcomes of existing postgraduate medical education curricula to inform the development of future training to address the growing unmet care needs of people with intellectual and developmental disabilities (IDD) such as ASD and ID.

Methods Four major databases were searched for peer-reviewed, English-language research focusing on post-graduate training in IDD education. Educational curricula and outcomes were summarized including Best Evidence in Medical Education (BEME) Quality of Evidence and Kirkpatrick training evaluation model.

Results Sixteen studies were identified with a majority published after 2000 (69%). Pediatric departments were involved in 69%, Psychiatry 19%, Medicine-Pediatrics 19%, and Family Medicine 6.3%. Analysis of Kirkpatrick outcomes showed 31% were level 1 (satisfaction or comfort); 38% level 2 (change in objective knowledge or skills); 13% level 3 (change in behavior); and none at level 4. BEME analysis showed 19% of studies were grade 1 (no clear conclusions), 31% grade 2 (ambiguous results), and half (50%) grade 3 (conclusions can probably be based on findings), with none scoring four or higher.

Conclusions There is a paucity of objectively evaluated research in the area. Studies reviewed show clear promise for specialized, interdisciplinary, competency-based education which may be foundational for future curriculum development.

Keywords Medical education · Residency · Autism · Developmental disabilities · Intellectual disabilities

People with autism-spectrum disorder (ASD), intellectual disability (ID), and other developmental disabilities (DDs) represent a heterogenous group of diverse individuals that share unique challenges in their health. People with DDs encompass approximately 6.99–15.04% [1–3], ID 0.71–3% [1, 2, 4, 5], and those with ASD 0.47–2.76% [1, 2, 6–12] of the general population, all of which have been rising in prevalence in recent years [1, 2, 6, 8, 11]. These three groups are often described together as intellectual and developmental disabilities (IDD), and henceforth, the term IDD will be used to describe these three groups together [13]. Potential contributing reasons for this rise in prevalence include increased societal awareness, improvements in longevity, liberal changes in diagnostic classifications among other reasons [1, 3, 6, 8, 11]. These populations have been found to be at significantly inflated risk of increased contact [3, 14] with the healthcare system, medical-related financial burden [14, 15], and adverse functional and health outcomes [3, 14, 16, 17] including premature death [18, 19]. Several reports in the last couple of decades, including two Surgeon General reports and *Future of Disability in America* report, highlight the key challenges in people with intellectual and developmental disabilities such as poorly managed health outcomes, shorter lifespan, and less access to professional health care as compared to people without this condition [20]. Training of health care professionals can help meet health care needs of this population and reduce the wide societal disparities [20]. Unfortunately, the need for high-quality healthcare for this large group of people is largely unmet [21–23], and

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physicians' confidence and perceived competence in providing this specialized care appears to be low [24–28].

To bridge this gap, we must look to how we are training our physicians to address the care needs of this patient population. Given the complexity of care and multimorbidity of IDD, care of this patient population does not fit neatly into the purview of one medical specialty. Rather, multiple medical specialties are well-placed to play critical roles in treating this population including family medicine, pediatrics, and psychiatry in the community, and increasingly in emergency departments [29], which is suggested to be preventable with increased specialized service availability [30, 31].

Surveys of family medicine residencies in the USA indicate that between 32 and 60% of programs provided any instruction and 24–84% provided the opportunity for any clinical experience with intellectual disability populations [32, 33]. Casson et al. (2019) described a program designed to increase the competency of family medicine residents in caring for adults with IDD. The program uses "health check" (clinical encounter) as a learning resource and proposes "field notes" as a template for formative feedback to residents [34]. Moreover, pediatric residents reported low self-assessed competence in treating patients with ASD [35], and despite an Accreditation Council for Graduate Medical Education (ACGME)–mandated USA-wide 1-month mandatory rotation in developmental/behavioral pediatrics in 1997, graduating residents continue to report feeling inadequately prepared to manage patients with IDD [36]. Interprofessional teams are an important aspect of healthcare teams working with people with IDD. Physicians, nurses, psychologists, behavior therapists, occupational therapists and social workers, among other professionals, work as a team in caring for people with developmental disabilities, especially those presenting with clinical complexities. The need for team-based education notwithstanding, gaps in training and interprofessional practice needs have been reported [37]. Moreover, little is known about IDD training opportunities for residents within an interprofessional framework.

In addition to pediatrics training, a Canadian survey [38] of IDD across psychiatry residency training programs found that just 31% of programs provided more than 6 h of teaching, less than half had mandatory rotations, and 56% offered elective rotations. In child and adolescent psychiatry fellowship programs, while the ACGME has made a policy change towards mandating clinical experience with IDD [39], survey data after this change indicated that learners received 7 h per year in instruction on IDD, and most commonly saw 1–5 of such cases per year in outpatient and inpatient settings [40]. Nearly half of programs surveyed endorsed a need for additional resources, including availability of specialized clinics or physicians to provide training in IDD [40]. This is in contrast to the psychiatric training of DDs in the UK, which has its own DD higher specialist training program [41]. While we can glean some limited cross-sectional data regarding training programs' inclusion of IDD into their curricula, publications examining education intervention outcomes are lacking.

Given the dearth of literature on training programs for this patient population, we aimed to conduct a systematic review to describe the features of current IDD training programs and to assess their educational outcomes. The goal of this review is that the synthesis of the literature will help guide the way forward for residency programs to develop evidence-based curricula in IDD with which to train physicians capable of addressing the growing and yet unmet need of this population.

Methods

We employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement, checklist, and supporting documents [42] as well as the Best Evidence Medical Education Guide (BEME) systematic review guide [43] to assist in conducting this review.

Search Strategy

The literature search was conducted on December 17, 2018, with the assistance of University of Toronto librarians in locating full-length copies of identified publications. Ovid search web software was employed to search the Medline, Embase, and PsycINFO databases using subject keyword 'or' combinations of 'ASD', 'autis*', 'learning disab*', 'intellectual disab*', 'developmental disab*', 'mental retard*', and 'asperger*' with 'or' combinations of 'post-graduat*', 'residency', and 'internship'. The search was limited to English-language, peer-reviewed articles published from 1980 to current, with the start date as 1980 in concordance with the first formal recognition of the diagnosis of autism-spectrum illness with the publication of the DSM 3 in this year. Following the initial database search, identified articles' references were perused for further applicable publications. The literature search was then updated to expand on dates from December 17, 2018, to August 20, 2020, utilizing the identical parameters.

Inclusion and Exclusion Criteria

Studies were included if they focused on an educational intervention for post-graduate medical trainees of any specialty intended to ameliorate knowledge, skills, competence, or attitudes regarding IDD evidenced by formally evaluated outcomes. Those studies which primarily focused on other participants such as psychology interns or nurses were not included in this review as the focus was on medical training. No sample size cut-off was employed, due to the anticipated relative paucity of work in this research area.

Excluded studies included those that described an intervention but did not formally evaluate it and those that evaluated trainees' knowledge, skills, competencies, or attitudes but did not describe an IDD educational program associated with it.

Title and Abstract Review

The initial database search identified 332 publications, in which, after removing duplicates, reviewing abstracts yielded 66 articles. Following imposition of the inclusion/exclusion criteria, and searching reference lists of included articles for additional relevant papers, 16 core papers [36, 44–58] were included in the final analysis of this review (Fig. 1) [59]. The updated search yielded a further 65 articles, which, following imposition of inclusion/exclusion criteria, did not yield any additional core papers.

Full-Text Review, Data Extraction, Synthesis, and Analysis

Two authors (Z.A., A.T.) independently analyzed the core papers, and classified data from the 16 publications into a Microsoft Excel (Microsoft, Redmond, Washington) spreadsheet with particular focus on areas of interest which included the following: (i) author names; (ii) year of publication; (iii) country of origin; (iv) postgraduate training specialty; (v) learner level of participants in intervention; (vi) instructors; (vii) setting of instruction; (viii) timeline; (ix) pedagogical method; (x) focus of content; (xi) evaluation methodology; (xii) evaluation outcomes; (xiii) Kirkpatrick effectiveness of intervention score [60]; (xiv) BEME quality of evidence score [43]. Number and percentages for each category are summarized in Table 1.

We organized the instructor data into the following categories: (1) faculty members or staff physicians; (2) other specialized non-physician instructors; and/or (3) patients, parents, or caregivers. We classified the setting as one of the following: (a) specialized clinical setting; (b) non-specialized clinical setting and sub-stratified into (i) inpatient; (ii) outpatient; and (i) continuity-clinic based; (ii) non-clinical respectively. Curricula timelines were subtyped into (i) single-session; (ii) short-term less than 1 month; (iii) 1–3 months; and (iv) longitudinal of longer than 3 months. The pedagogical (instructional) methods are described in Table 1. Focus of content was transcribed as follows: (i) perspective/awareness; (ii) medical and clinical knowledge; (iii) other or unclear.

Evaluation methodology was organized as follows: (i) intervention evaluation (participant evaluation of the experience of the intervention); (ii) participant evaluation (participant of intervention assessing their benefit from the intervention); (iii) learning assessment (assessment of perspective/knowledge/skills gained during intervention); (iv) clinical change (monitoring of clinical practice after intervention). The evaluation outcomes were summarized uniquely for each paper, and Kirkpatrick [60] and BEME [43] classification was applied to each publication. Kirkpatrick classification is widely used in evaluation of training programs in medical education [61–66].

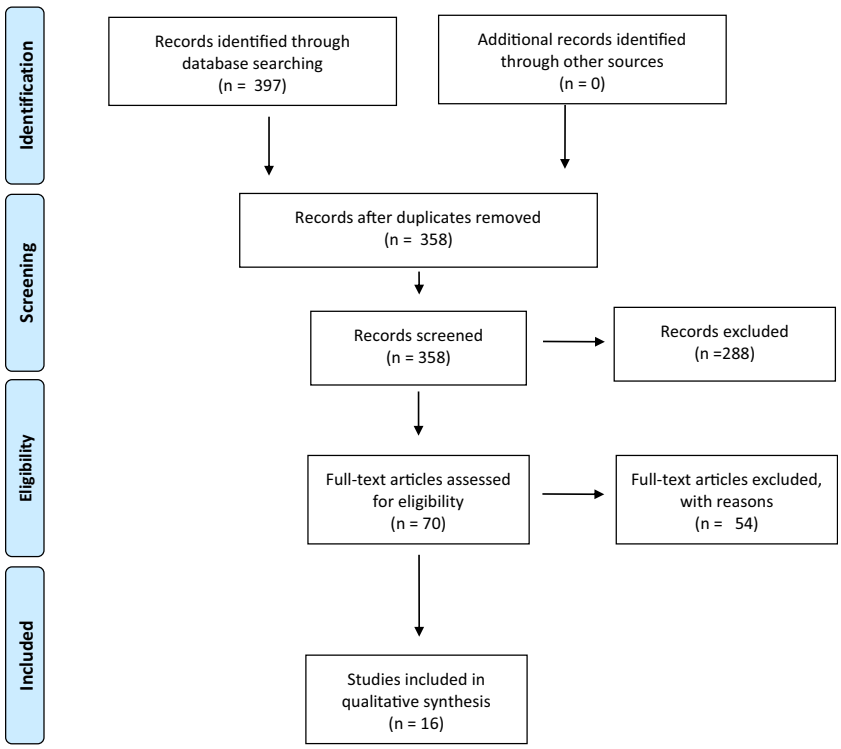

Fig. 1 PRISMA flow diagram

Table 1 Summary of reviewed literature on IDD teaching in residency training

i) Year of publication	a) 1980s—25% (4)
	b) 1990s—6% (1)
	c) 2000s—38% (6)
	d) 2010s—31% (5)
ii) Country of Origin	a) USA—88% (14)
	b) Canada—13% (2)
iii) Postgraduate training specialty	a) Pediatrics—75% (12)
	a) General Pediatrics — 69% (11)
	b) Medicine-Pediatrics 19% (3)
	c) Developmental and Behavioral Pediatrics 6% (1)
	b) Psychiatry—19% (3)
	a. General Psychiatry 19% (3)
	b. Child and Adolescent Psychiatry 6% (1)
	c) Family Medicine — 6% (1)
iv) Learner level of participants	a) Multiple levels of training—88% (14)
	b) PGY1—56% (9)
	a. Pediatrics (8)
	b. Family Medicine (1)
	c) PGY2—81% (13)
	a. Pediatrics (10)
	b. Psychiatry (2)
	c. Family Medicine (1)
	d) PGY3—75% (12)
	a. Pediatrics (10)
	b. Psychiatry (2)
	e) PGY4—6% (1)
	a. Psychiatry (1)
	f) Clinical fellows—13% (2)
	a. Pediatrics (1)
	b. Psychiatry (1)
v) Instructor type	a) Faculty or staff physician—63% (10)
	b) Specialized non-physician—25% (4)
	c) Patient, parent or caregivers—13% (2)
vi) Setting of intervention	a) Specialized IDD clinical setting—56% (9)
	a. Pediatrics (6)
	b. Psychiatry (3)
	b) Non-specialized setting 44% (7)
	a. Pediatrics (6)
	b. Family Medicine (1)
vii) Timeline of intervention	a) Single-session — 19% (3)
	b) Short-term <1mth — 6% (1)
	c) 1—3mths — 59% (9.5)
	d) Longitudinal/>3mths — 16% (2.5)
viii) Pedagogical methodology	a) Experiential—69% (11)
	a. Specialized IDD clinical setting (9)
	b. Non-specialized setting (2)
	b) Theoretical—88% (14)
	a. Specialized IDD clinical setting (8)
	b. Non-specialized setting (6)
	c) Immersive—44% (7)
	a. Specialized IDD clinical setting (6)
	b. Non-specialized setting (1)
	d) Interactive—31% (5)
	a. Specialized IDD clinical setting (2)
	b. Non-specialized setting (3)
ix) Focus of content	a) Perspective/awareness/comfort—38% (6)
	b) Medical and clinical knowledge—81% (13)
	c) Other/unclear—6% (1)
x) Evaluation methodology	a) Intervention evaluation—19% (3)
	b) Participant evaluation—56% (9)
	c) Learning assessment—81% (13)
	d) Clinical changes—13% (2)
	e) Behavioral changes—6% (1)
xi) Kirkpatrick scores	0: No significant change in learning found, or exclusively explored learner views on satisfaction with the intervention itself—19% (3)
	1: Alteration in learner perspective or comfort with the topic being learned—31% (5)
	2: Significant amelioration of learning or skills—38% (6)
	3: Changes in behavior or practice from the learning—13% (2)
	4: Change in trackable results or outcomes due to the behavior change—0% (0)
xii) BEME scores	1: No clear conclusions—19% (3)
	2: Ambiguous results, but trend present—31% (5)
	3: Conclusions can probably be based upon results—50% (8)
	4: Results are clear and highly likely to be true—0% (0)
	5 – Unequivocal results—0% (0)

Percentages and number of studies are tabulated under each category including studies which incorporated multiple elements of a category. Therefore, the percentages and numbers may sum greater than 100% or 16, as they are not mutually exclusive)

This model assesses the effectiveness of programs at various levels: trainee's experience of the program is evaluated at the first level; changes in knowledge, skills, and attitude are assessed at the next level; transfer of knowledge to practice at a third level and at level 4, the overall impact of the program on broader organizational goals and objectives is evaluated. The model was adapted for this paper to (0) no change in learning or explored learner views on the quality of the learning experience itself; (1) alteration in learner perspective or comfort on the topic being learned; (2) amelioration of learning or skills; (3) changes in behavior or practice from the learning; and (4) difference in tractable results or outcomes due to the behavioral change. The BEME level of evidence grading [43] was employed to assess the strength of paper findings according to grades: (1) no clear conclusions can be

Table 2 Study findings with a focus on pedagogy and evaluation outcomes

Authors, year of publication, country of origin	Postgraduate training specialty	Learner level of participants	Instructor type	Setting of intervention	Timeline of intervention
Bauer et al. [41], 2009, USA	Pediatrics	PGY1, PGY3	Non-physician specialist	Non-specialized setting (non-clinical)	Longitudinal (> 6 months)
Bennett et al. [40] 1984, USA	Pediatrics	PGY1-PGY3	Faculty or staff physician	Specialized setting (unclear)	1–3 months
Boreman et al. [34] 2007, USA	Pediatrics	PGY1–3	Faculty or staff physician	Specialized setting (varied)	1–3 months
Guralnick et al. [42], 1987, USA	Pediatrics	PGY1–3	Faculty or staff physician	Specialized setting (unclear)	1–3 months
Kawamura et al. [43], 2016, Canada	Pediatrics (Dev. and Beh. Pediatrics), Clin. Psychology	PGY4–5, Clin. Psychology interns	Faculty or staff physician, non-physician instructor	Non-specialized setting (non-clinical)	< 1 month
Keisling et al. [44], 2017, USA	Pediatrics and Medicine-Pediatrics	PGY2 (Pediatrics), PGY3 (Medicine-Pediatrics)	Patients, parents or caregivers	Specialized setting (unclear)	1–3 months
Kube et al. [45], 2013, USA	Pediatrics, Medicine-Pediatrics	PGY2 (Pediatrics), PGY3 (Medicine-Pediatrics)	Patients, parents or caregivers	Specialized setting (unclear)	1–3 months
Kennedy et al. [46], 2004, Canada	Family Medicine	PGY1–2	Faculty or staff physicians	Non-specialized setting (non-clinical)	Single-session
Major et al. [47], 2013, USA	Pediatrics, Medicine-Pediatrics, medical students	Medical student, PGY1–3	Faculty or staff physicians	Non-specialized setting (non-clinical)	Single-session
Nalven et al. [48], 1997, USA	Pediatrics	PGY1–3	Unclear	Non-specialized setting (continuity clinic)	Single-session
Reinblatt et al. [49], 2004, USA	Psychiatry	PGY2	Faculty or staff physicians	Specialized setting (inpatient)	1–3 months
Ruedrich et al. [50], 2007, USA	Psychiatry	PGY3–4	Faculty or staff physicians, non-physicians specialists	Specialized setting (outpatient)	1–3 months
Szeftel et al. [51], 2018, USA	Psychiatry, Psychiatry (Child and Adolescent)	PGY2–3 (Residents), PGY5–6 (Fellows)	Faculty or staff physician	Specialized setting (outpatient tele-medicine)	1–3 months (Residents), > 3months/longitudinal (Fellows)
Thompson et al. [52], 2010, USA	Pediatrics	PGY1–3	Faculty or staff physician	Non-specialized setting (continuity clinic)	> 3months/longitudinal
Wolraich et al. [53], 1980, USA	Pediatrics	PGY2	Unclear	Specialized setting (inpatient)	1–3 months
Wysocki et al. [54], 1987, USA	Pediatrics	PGY1–3	Non-physician specialist	Non-specialized setting (ambulatory clinic), residents in study also had specialized setting (not part of study)	1–3 months

Authors, year of publication, country of origin	Pedagogical methodology	Focus of content	Evaluation methodology	Evaluation outcomes	Kirkpatrick scores	BEME scores
Bauer et al. [41], 2009, USA	Theoretical (didactic)	Perspective/awareness, medical and clinical knowledge	Learning assessment, clinical change	Benefit on knowledge of development, increased clinical use of screening questionnaires	3	2
Bennett et al. [40] 1984, USA	Experiential (clinical), theoretical (didactic, readings), interactive (journal club discussions), immersive (school visits, clinic visits)	Perspective/awareness, medical and clinical knowledge	Participant evaluation, learning assessment	Benefit on knowledge, learners' confidence	2	3
Boreman et al. [34] 2007, USA	Experiential (clinical), unclear further	Unclear	Participant evaluation	No difference/change in knowledge/comfort in management of these conditions from implementation of USA-wide mandated rotation	0	3
Guralnick et al. [42], 1987, USA	Experiential (clinical), theoretical (didactic, readings), interactive (journal club discussions), immersive (school visits, clinic visits)	Perspective/awareness, medical and clinical knowledge	Participant evaluation, learning assessment	Benefit on knowledge, learners' confidence	2	3
Kawamura et al. [43], 2016, Canada	Experiential (simulation), interactive (discussion)	Medical and clinical knowledge, other (communication skills)	Unclassified (qualitative observed assessment)	Change in learner behavior towards more adaptive model in communicating diagnosis to parents of children with ASD	3	2
		Perspective/awareness	Participant evaluation		1	2

Table 2 (continued)

Authors, year of publication, country of origin	Pedagogical methodology	Focus of content	Evaluation methodology	Evaluation outcomes	Kirkpatrick scores	BEME scores
Keisling et al. [44], 2017, USA	Experiential (clinical), Theoretical (didactic), Immersive (home visits)			Learners' describe increased awareness of family-oriented outcomes		
Kube et al. [45], 2013, USA	Experiential (clinical), theoretical (didactic), immersive (home visits)	Perspective/awareness	Intervention evaluation	Learners found experience valuable and relevant to practice	0	3
Kennedy et al. [46], 2004, Canada	Theoretical (seminar), interactive (workshop)	Medical and clinical knowledge	Learning assessment	Learners scored better on post-intervention written test, ongoing difficulty in translating this to clinical change in post-intervention semi-structured clinical encounter test	2	3
Major et al. [47], 2013, USA	Theoretical (readings), interactive (modules)	Medical and clinical knowledge	Participant evaluation, intervention evaluation, learning assessment	Learners scored better on post-intervention tests, found intervention useful, instructors rated intervention as engaging	2	3
Nalven et al. [48], 1997, USA	Theoretical (didactic, readings), unclassified (chart reminder)	Medical and clinical knowledge	Learning assessment, clinical change	No clear benefit of lecture intervention on knowledge, no benefit of chart reminders for developmental referrals	0	1
Reinblatt et al. [49], 2004, USA	Experiential (clinical), theoretical (readings)	Medical and clinical knowledge	Participant evaluation, intervention evaluation	Learners' found rotation important, influenced their future practice, multidisciplinary aspect, contact with staff psychiatrists most valued, ideal time identified as PGY2	1	2
Ruedrich et al. [50], 2007, USA	Experiential (clinical), theoretical (didactic, reading), immersive (multidisciplinary site visits)	Medical and clinical knowledge	Participant evaluation, intervention evaluation	Learners' valued rotation, cited as strong influence in increased capacity to take care of patients	1	2
Szeftel et al. [51], 2018, USA	Experiential (clinical), theoretical (didactic)	Medical and clinical knowledge	Learning assessment	Learners' improved in knowledge	2	3
Thompson et al. [52], 2010, USA	Experiential (clinical practicum), theoretical (didactic)	Medical and clinical knowledge	Participant evaluation, learning assessment	Learners' had increased knowledge with single developmental screener, increased comfort using developmental screeners	1	1
Wolraich et al. [53], 1980, USA	Experiential (clinical), theoretical (didactic, reading), immersive (school visits)	Medical and clinical knowledge	Learning assessment	Learners' improved with intervention, after intervention scored higher than practicing pediatricians	2	3
Wysocki et al. [54], 1987, USA	Theoretical (didactic, reading), immersive (school visits, multidisciplinary site visits)	Perspective/awareness, medical and clinical knowledge	Participant evaluation	Learners' felt more able and knowledgeable mainly in communication, multidisciplinary work, little change in perceived competency	1	1

deduced; (2) ambiguous results, although appearance of a trend; (3) conclusions can probably be based on the findings; (4) results are clear and highly likely to be true; (5) unequivocal results.

Results

The results can be seen in coalesced form in Table 2.

Study Characteristics

Table 1 summarizes study characteristics for the 16 included publications. Twenty-five percent (4/16) were published in the 1980s [44, 46, 57, 58], 6% (1/16) in the 1990s [52], 38% (6/16) in the 2000s [36, 45, 50, 53–55], and 31% (5/16) in the 2010s [47–49, 51, 56]. All studies included were undertaken in North America, with 88% (14/16) conducted in the USA of America [36, 44–46, 48, 49, 51–58], and 13% (2/16) in Canada [47, 50]. Pediatric departments were involved in 75% (12/16) of the studies [36, 44–46, 48, 49, 51, 52, 56–58], Psychiatry 19% (3/16) [53–55], Medicine-Pediatrics 19% (3/16) [48, 49, 51], Family Medicine 6% (1/16) [50], Child and Adolescent Psychiatry 6% (1/16) [55], and Developmental and Behavioral Pediatrics 6% (1/16) [47]. Further in this paper, for simplicity, when pediatrics or psychiatry are mentioned they are in reference to pediatrics or psychiatry and subspecialty variants. The most commonly employed instructors were faculty members or staff physicians (63%; 10/16) [36, 44, 46, 47, 50, 51, 53–56], with other

specialized non-physician instructors (25%; 4/16) [45, 47, 54, 58], and patients, parents, or caregivers (13%; 2/16) [48, 49] playing roles in two interventions each. In two studies [52, 57], it was not entirely clear on who provided the instruction.

With respect to learner level, the majority of the studies (88%; 14/16) [36, 44–52, 54–56, 58] offered their educational curricula to residents at multiple levels of training. PGY1s were included in 56% (9/16) of studies [36, 44–46, 50–52, 56, 58], PGY2s in 81% (13/16) [36, 44, 46, 48–53, 55–58], PGY3s in 75% (12/16) [36, 44–46, 48, 49, 51, 52, 54–56, 58], PGY4 residents just once [54] (6%; 1/16), and subspecialty residents/fellows in 13% (2/16) [47, 55]. Medical students were included in one study (6%; 1/16) [51], as well as clinical psychology interns (6%; 1/16) [47]. When separated by specialty, we see that Pediatrics interventions were quite evenly split between PGY1 (67%; 8/12) [36, 44–46, 51, 52, 56, 58], PGY2 (83.3%; 10/12) [36, 44, 46, 48, 49, 51, 52, 56–58], and PGY3 (67%; 8/12) [36, 44–46, 51, 52, 56, 58], with one study involving subspecialty Pediatric residents/fellows (8.3%;1/12) [47]. Psychiatry educational programs did not include any PGY1s, with PGY2s involved in 67% (2/3) of studies [53, 55], PGY3s included in the same number (67%; 2/3) [54, 55], one including PGY4s (33.3%; 1/3) [54], and one including subspecialty fellows (33.3% 1/3) [55]. Medicine-Pediatrics interventions focused on PGY3s (67%; 2/3), while one study did not clarify the component of Medicine-Pediatrics residents [51].

Curriculum Characteristics and Pedagogical Approach

More than half (56%; 9/16) of studies were based upon a specialized ASD/ID/DD training experience embedded with the clinical rotation [36, 44, 46, 48, 49, 53–55, 57]. Notably, all of the Psychiatry curricula (100%; 3/3) [53–55] were based in this model, with one inpatient-based (33%; 1/3) [53] and two outpatient-based (67%; 2/3) [54, 55], while half (58%; 6/12) of Pediatrics interventions were centered on specialized clinical experience [36, 44, 46, 48, 49, 57], of which one (17%; 1/6) was explicitly inpatient-based [57], with the other five being (83%; 5/6) outpatient-based or not clearly identifying [36, 44, 46, 48, 49]; however, one study although not directly evaluating a specialized IDD clinical rotation did mention that all resident participants also would have this rotation during their training [58].

Less than half (44%; 7/16) of studies were not based on specialized IDD clinical experiences [45, 47, 50–52, 56, 58]. These included half (50%; 6/12) of the pediatric interventions [45, 47, 51, 52, 56, 58], and the only family medicine program (100%; 1/1) [50]. Of these pediatric interventions, half (50%; 3/6) were based at ambulatory/longitudinal clinics [52, 56, 58], with the other half (50%; 3/5) without a clinical component [45, 47, 51] and the only family medicine program was non-clinical (100%; 1/1) [50].

The majority of the educational intervention timelines were 1–3 months in duration (59%; 9.5/16 [one study was 1–3 months for residents but longitudinal for fellows] [55]) [36, 44, 46, 48, 49, 53, 54, 57, 58]. Two interventions and a segment of another (16%; 2.5/16 [one study was longitudinal for fellows, but 1–3 months for residents] [55]) [45, 56] extended beyond 3 months, three were single-session interventions (19%; 3/16) [50–52], and a single intervention was multiple sessions occurring over less than 1 month (6%; 1/16) [47].

The vast majority of studies included a theoretical pedagogical framework (88%; 14/16) [44–46, 48–52, 54–58], most commonly didactic or seminar (86%; 12/14) [44–46, 48–50, 52, 54–58], and less often reading lists (57%%; 8/14) [44, 46, 51–54, 57, 58]. Experiential pedagogical principles of learning were frequently employed (75%; 11/16) [36, 44, 46–49, 53–57], most commonly clinical practice (91%; 10/11) [36, 44, 46, 48, 49, 53–57], although there was one simulation-based program (9%; 1/11) [47]. Immersive experiences were employed by nearly half of studies (44%; 7/16) [44, 46, 48, 49, 54, 57, 58], while a smaller number of studies included interactive (31%; 5/16) [44, 46, 47, 50, 51] approaches.

Of the educational interventions based at specialized IDD clinical rotation, most were supplemented by theoretical pedagogy (89%; 8/9) [44, 46, 48, 49, 53–55, 57] followed by immersive methodology (67%; 6/9) [44, 46, 48, 49, 54, 57]. Studies where learning was based at continuity clinics were always supplemented with theoretical teaching cases (100%; 3/3) [52, 56, 58], in one case additionally with immersive methods (33%; 1/3) [58], and in one case with an unclassifiable tool of clinical reminders in charts [52]. In terms of the non-clinical interventions, we see that most incorporated theoretical (75%; 3/4) [45, 50, 51] and interactive components (75%; 3/4) [47, 50, 51], and just one emphasized experiential learning in the form of simulation (25%; 1/4) [47].

The experiential learning ranged from classical rotation-based service-oriented experiences, a telepsychiatry clinic, observation of physicians' work, to simulation-based models. Theoretical teaching included didactic lecture and seminar series, annotated notes provided to learners, and assigned readings. Interactive learning included discussions with and without facilitators, case-based modules, and journal rounds discussions. Immersive learning ranged from home visits, school visits, to placements with specialized allied-health staff in multi-disciplinary IDD support facilities.

The vast majority of studies (81%; 13/16) [44–47, 50–58] explicitly focused their interventions on medical and clinical knowledge, while 38% (6/16) [44–46, 48, 49, 58] mentioned an intent on broadening learners' perspectives and awareness of the conditions and their contexts, two of which only focused on this aspect (13%; 2/16) [48, 49]. One study did not have a clear content description [36].

Educational Outcomes

Studies used a range of measures to assess educational outcomes. In just over half of the educational interventions, direct assessments of knowledge (56%; 9/16) [44–46, 50–52, 55–57] or learner's evaluations of their own learning (56%; 9/16) [36, 44, 46, 48, 51, 53, 54, 56, 58] were employed. In fewer studies, learner and instructor evaluations of the intervention itself (18.8%; 3/16) [49, 51, 53, 54] were looked at, two studies looked at clinical changes associated with the intervention (13%; 2/16) [45, 52], and one study looked at qualitative observed behavioral change [47].

A variety of outcomes were found upon application of the Kirkpatrick model for evaluating education program outcomes. Nineteen percent (3/16) [36, 49, 52] were graded level 0 due to lack of change demonstrated or only assessment of satisfaction levels, 31% (5/16) [48, 53, 54, 56, 58] were level 1 indicating an alteration in perspective or comfort following the intervention, 38% (6/16) [44, 46, 50, 51, 55, 57] were level 2 demonstrating alteration in objective knowledge or skills, and 13% (2/16) [45, 47] were assessed as level 3 showing an alteration in behavior as a result of the intervention. No studies were scored a level 4 showing a clear systems or outcome benefit.

Applying the BEME evidence-based scoring system to our collection of publications, the mean and median scores are 2.31 and 2.5 respectively. We found three studies (19%; 3/16) [52, 56, 58] were BEME grade 1—no clear conclusions can be deduced; five studies (31%; 5/16) [45, 47, 48, 53, 54] were BEME grade 2—ambiguous results, although appearance of a trend; and half of the studies (50%; 8/16) [36, 44, 46, 49–51, 55, 57] were scored a 3—conclusions can probably be based on the findings. Of the studies graded 2 and above, we see that only one was significant in its negative findings for benefits of educational interventions. No studies were deemed appropriate for BEME gradings of 4 or 5, due to generally small samples, somewhat low attendance of intervention learning opportunities, large reliance on questionnaires with relatively low participation, and challenging ways of evaluating.

Discussion

In conducting this systematic review, we aimed to summarize the literature for the current state of evidence for post-graduate medical training in the growing population of IDD. This analysis illuminates several noteworthy points of discussion. We found that just half of publications (8/16; 50%) [44–47, 50, 51, 55, 57] achieved a Kirkpatrick [60] level 2 or higher, with just 38% (6/16) achieving level 2 outcomes [44, 46, 50, 51, 55, 57] which corresponds to objective knowledge or skills benefit and just two studies (2/16; 13%) [45, 47] achieving a level 3 outcome, specifically a change in behavior or practice as a result of the teaching. The low number of educational interventions showing improvement in learner outcomes beyond level 2 is further buttressed by our finding that only just over half of the educational interventions directly assessed learner knowledge or skills before and after the intervention (56%; 9/16) [44–46, 50–52, 55–57] and two recent studies [48, 49] were limited to changing perspectives, attitudes, and values. Given the limited advancement of learner outcomes related to DD educational programs in the literature in recent years, we are left to consider that curriculum development for this population is in its infancy. This is consistent with previous survey-based research indicating a diversity of, and lack of, consistent application of curricula for treating patients with IDD in multiple postgraduate medical education specialties [32, 33, 35, 36, 38], and in medical students [67]. There is a great societal need for training in DD but limited consistency in the types of curricula and outcomes.

While not elaborated on in Boreman et al.'s surveying study [36], we did see that all interventions based upon specialized rotations that described their curricula thoroughly were supplemented with another non-experiential form of instruction. These included theoretical pedagogy (89%; 8/9) [44, 46, 48, 49, 53–55, 57], immersive methodology (67%; 6/9) [44, 46, 48, 49, 54, 57], and interactive structured teaching (22%; 2/9) [44, 46]. Several studies in the review which used multimodal approaches in training were more likely to achieve higher level outcomes in Kirkpatrick scores [44, 46, 47, 50, 51, 57]. While there is promise that programs used multi-modal approaches to training, which have been linked to improved effectiveness of educational programs [68], the lack of evidence of provider and patient improvement in outcomes observed in our review calls for alignment of instructional methods with intended goals.

This review reveals a subtle underlying trend towards interdisciplinary learning, and a relative absence of focus on competency-based teaching. A considerable group of studies (31%; 5/16) [47–49, 51, 55] educated multiple specialties and subspecialties of physicians together, and a broader group of healthcare professionals including non-physician trainees such as clinical psychology interns as well (13%; 2/16) [47, 51]. While interprofessional education (IPE) has been found to be valuable by interdisciplinary learners working with this population [69], it is thought to be optimally valuable when combined with defined competencies based on the learner characteristics such as milestones and entrustable professional activities (EPAs) [70]. This emphasizes the importance of further development in identifying competencies and learning opportunities specific to healthcare practice with the growing population of people with IDD. The establishment of specific competencies relevant to each learner's role in supporting and treating those with IDD would provide an avenue towards unifying this area of medicine's natural interdisciplinary nature with objectively measurable effective training practices. In fact, the Association of University Centres on Disabilities

(AUCD)'s Leadership Education in Neurodevelopmental and Related Disorders (LEND) [71], an organization which provides graduate training to an interdisciplinary learner base, has been aiming towards developing such core competencies [72] for its learners in recent years, which may be a model for other training programs. Additionally, interprofessional care competencies can be integrated in the IDD curricula to equip residents with the skills to work collaboratively [73]. Advancing from competencies, robust assessment of educational interventions aimed at behavioral change and clinical outcomes is desirable [74]. Alignment of curricula to its various components such as instructional methods, assessment, faculty development, and a greater purpose of serving student and societal needs has been highlighted. This is of greater significance for underserved population such as people with IDD. Future research should continue to focus on interdisciplinary training and curricula, with more consistent assessment methods and a greater alignment with competency-based medical education.

High level education outcomes such as behavioral changes were not observed consistently in the studies reviewed. One of the possible reasons can be due to the preponderance of variation in educational delivery in this field. Secondly, there is a lack of consistent use of competencies for DD training in published curricula despite their availability. Thirdly, it may be related to unclear education outcome measures and inconsistent use of longitudinal multi-modal approaches to pedagogy. Substantial efforts to develop effective curricula standards have been made in this field which is an encouraging trend. Examples of this include the development of a specialized adult psychiatric senior residency training in learning disabilities in the UK [41], and a nationally mandated developmental/behavioral pediatrics rotation in US pediatrics residencies [75].

The findings of the study are limited by the narrowed focus on literature published in English. Additionally, the exclusion of studies which did not have a well-defined educational program or formal evaluation limited the study of educational programs in developmental disabilities in its full entirety. Moreover, as this study reviewed only published educational literature, it is likely that training curricula already in place which have not published educational effectiveness data were not captured in this review. Specifically, just one study was found in Child and Adolescent Psychiatry [55] and Developmental and Behavioral Pediatrics [47], which may be indicative of paradoxically low publications due to existing integration of IDD in the overall curricula. While this may be the case, as medical education moves further ahead towards competency-based medical education (CBME), there is greater need for further academic scholarship in this area, to ensure the effectiveness of the training in place, and to support scientific collaboration in developing tomorrow's educational models especially for programs currently developing curricula for treating the growing population of those with ASD/ID/DD.

In conclusion, this review of evaluated postgraduate medical education in IDD across all specialty programs provides a glimpse into the published community, and highlighted two overarching trends. Firstly, literature in this field is in its early days which is reflected by a diversity of curricula characteristics, a significant proportion employing more subjective evaluation methods, and a greater focus on learner satisfaction, attitudes, and values, as opposed to changes in learner behavior and patient outcomes. Secondly, our review did identify a trend towards a specialized IDD rotation which can then be supplemented with further instruction involving more experiential, theoretical, interactive, and immersive learning. Despite this trend, the effectiveness of this holistic educational model using multiple instructional methods remains unclear and represents an opportunity for future study. Future studies are needed comparing different duration and instructional methods, such as online blended formats, simulation, and patient/family co-taught sessions.

The paucity of studies calls for more research in this area, especially with the increased prevalence of IDD and the growing societal care needs of this patient population. By blending the positive aspects of the educational diversity identified in this review, with the drive towards developing a more standardized and effective curriculum, education leaders and curriculum experts have the opportunity to utilize the breadth of learner levels, instructor types, settings, timelines, and pedagogical methods identified in this review towards creating an interdisciplinary, competency-based curriculum that makes a quantifiable difference for the growing population of patients living with IDD and their families.

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Compliance with Ethical Standards

Disclosures On behalf of all authors, the corresponding author declares that there is no conflict of interest.

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