Psychiatr. Pol. 2019; 53(4): 753–770
PL ISSN 0033-2674 (PRINT), ISSN 2391-5854 (ONLINE)
www.psychiatriapolska.pl
DOI: https://doi.org/10.12740/PP/99163

National Professional Development Center on Autism Spectrum Disorders (NPDC) model – an integrated model of evidence-based practices for autism spectrum disorder

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Summary

Autism spectrum disorder (ASD) as a serious neurodevelopmental condition requires intensive and comprehensive interventions, particularly interventions found to be effective through rigorous research. The National Professional Development Center on Autism Spectrum Disorders (NPDC) was formed in the USA in order to conduct a comprehensive review of ASD-related evidence-based practices (EBPs) and to create a model of implementing such practices for children, adolescents and young adults (from preschool to high school education level). The NPDC final review, being the most comprehensive to date (the initial search included 29,105 articles) identified 27 ASD-focused EBPs. In addition to the resulting matrix of the autism-related EBPs, and the e-learning modules on the identified interventions, the NPDC model includes as well *the Autism Program Environment Rating Scale* (APERS) for external evaluation and self-assessment, goal attainment scaling (GAS) and coaching program manual. To date, the model has been implemented in 12 states in the USA and is being introduced in several other countries including Australia, Sweden, Saudi Arabia, and Poland. The purpose of this article is to present the NPDC model and its components, along with the relevant research.

Key words: evidence-based practice, Autism Spectrum Disorder, early intervention

Interventions for autism spectrum disorder and medical standards

Interventions for children and youth with autism spectrum disorder (ASD) face the discrepancy between evidence-based medicine (EBM), and the reality of psychoeducational interventions. Medical standards developed by the American Academy of Pediatrics (AAP) [1] refer to research-based interventions for children with autism spectrum disorder as early, intensive and complex. The desirable characteristics of such educational and behavioral interventions have also been identified (see [2, p. 118] for a brief description in Polish). Medical treatment, on the other hand, has so far been saved for the management of only some of secondary characteristics of autism (such as concomitant aggressive or auto-aggressive behaviors), or other nervous system disorders present in an individual with ASD [3]. This means that when recommending an intervention for a newly diagnosed child, a diagnostician steps beyond the field of psychology, psychiatry or – even broader – medicine. Knowledge of studies on the efficacy of various psychoeducational interventions for those with autism spectrum disorder may be helpful to guide such recommendations. However, the knowledge on such non-medical research (e.g., [4]) is not complete not only in the psychiatric milieu, but also among professionals and organizations involved in delivering autism intervention [5]. Additionally, parents have been found to seek treatment options with no or little evidence of efficacy [6–8]. Therefore, the inconsistent choices and recommendations regarding autism therapy may be confusing not only for parents, but also for professionals. These issues are common – including in the United States (US), where research of interventions for autism is particularly advanced.

In the US, the National Professional Development Center on Autism Spectrum Disorder (NPDC) was established in order to provide answers to the following questions: how to describe evidence-based interventions for autism in a brief and concise manner and how to increase the uptake of evidence-based practices by schools. The work of the NPDC was a collaboration among three universities – the University of North Carolina at Chapel Hill, the University of Wisconsin at Madison, and the MIND Institute – University of California-Davis. The role of the NPDC was to integrate the interdisciplinary research data on interventions for autism and to develop a model enabling a widespread implementation of evidence-based practices for individuals with ASD in schools delivering nursery, primary, secondary and further education provision.

The current article presents the NPDC as a model for integrating interdisciplinary research and implementation science aiming at optimizing collaboration between researchers, clinicians and educators involved in autism research and service provision. It seems particularly relevant, as the NPDC model (implemented so far in over 200 schools across the USA) is currently being implemented in many countries,

including Poland. The model boasts several unique features: (1) It is based on the largest review of autism intervention literature, carried out by NPDC team and collaborators [9]; (2) It incorporates a comprehensive quality assessment tool, the Autism Program Environment Rating Scale (APERS) developed as a good practice-based consensus [10], (3) It uses coaching as a means to promote implementation of evidence-based practices, and (4) It uses the Goal Attainment Scaling methodology to assess learner progress.

Evidence-based practice in interventions for autism spectrum disorders and the NPDC model

In psychology and education it is necessary to differentiate the research-based interventions and high quality program features, enabling for a successful implementation of the evidence-based practices (EBPs). Focused evidence-based interventions often stem from a specific (e.g., behavioral, or social-developmental) approach, whereas high quality program features refer to universal properties of quality ASD interventions and school environments, regardless of the represented approach. The high quality program features will therefore be close to the concept of the 'common characteristics' in psychotherapy [11, 12]. The NPDC model includes both evidence-based focused interventions (and their selection by outcome and age group), and high quality program features, relevant in any approach. The individual elements of the model address different areas.

It should be noted that in the field of autism therapy, the approaches gradually converge (which was as well noted in the AAP standards [1, 2]). This means that interventions developed within a specific approach (e.g., behavioral – such as prompting) are included as a part of other comprehensive treatment models due to their effectiveness. This is also confirmed by comparative research of different comprehensive treatment models. Professionals delivering different comprehensive treatment models reported using most of the focused interventions equally often [13].

Therefore, the NPDC model does not compare the effectiveness of different comprehensive treatment models, which combine multiple focused interventions based on a specific theory-derived treatment approach (e.g., Lovaas Model based on behavioral approach). Instead, the NPDC model reviews published research relative to individual focused interventions, which produce specific behavioral, educational, and developmental outcomes for a child and may or may not be used in different comprehensive treatment models[1]. As a result, the NPDC model offers technical eclecticism, with the choice of focused interventions being guided by scientific evidence. Such technical

[1] A more detailed description of differences between comprehensive treatment models and focused interventions in Polish is available in: [14, p. 21].

eclecticism differs substantially from free eclecticism (where the therapist chooses the interventions to be used based on their individual experience).

To sum up, the assumptions of the NPDC model apply both to: high quality program features, i.e. 'common characteristics' important in the therapy and education of people with ASD, and individual focused interventions of research-proven efficacy. At the same time, the NPDC model does not refer directly to any specific treatment approach or potential discrepancies between different approaches.

Structure and components of the NPDC model

The NPDC model combines multiple components. Its full implementation, which enables effective uptake of evidence-based practices, requires introducing and using all components.

The key components of the NPDC model include:

a) *Autism Program Environment Rating Scale* (APERS). The NPDC Autism Program Environment Rating Scale assesses the quality of the program, measuring the adoptions of practices that represent high quality in programs. The practices included as APERS domains is derived from an extensive literature review, other similar quality measures, such as *Early Childhood Environment Rating Scale* (ECERS), and the assumptions of the Individuals with Disabilities Education Improvement Act (IDEIA) [10]. The available reviews of comprehensive treatment models for ASD provide for an external assessment as one of the key characteristics of high quality interventions [15].

APERS evaluations include: (1) direct observation of individual staff members and teams teaching children and youth with ASD; (2) interviews with educators and other team members; (3) interviews with parents; and (4) review of the Individualized Education Program, and other documents (such as functional behavior assessment and intervention plan). All observations and interviews are carried out by trained and certified evaluation teams (raters). Next, the observation and interview findings are scored across 10 to 11 domains (depending on age of children).

Each domain consists of items addressing individual aspects of effective practice [10]. The example domains include positive learning climate and communication. In the domain of communication items include assessing whether the staff support student's communication attempts and consistently respond to them, whether communication systems or supports (such as AAC)[2] are available and accessible across all settings, and whether the team members create opportunities within classroom activities for students to respond or initiate communication. Importantly, one of the domains as-

[2] Alternative and augmentative communication.

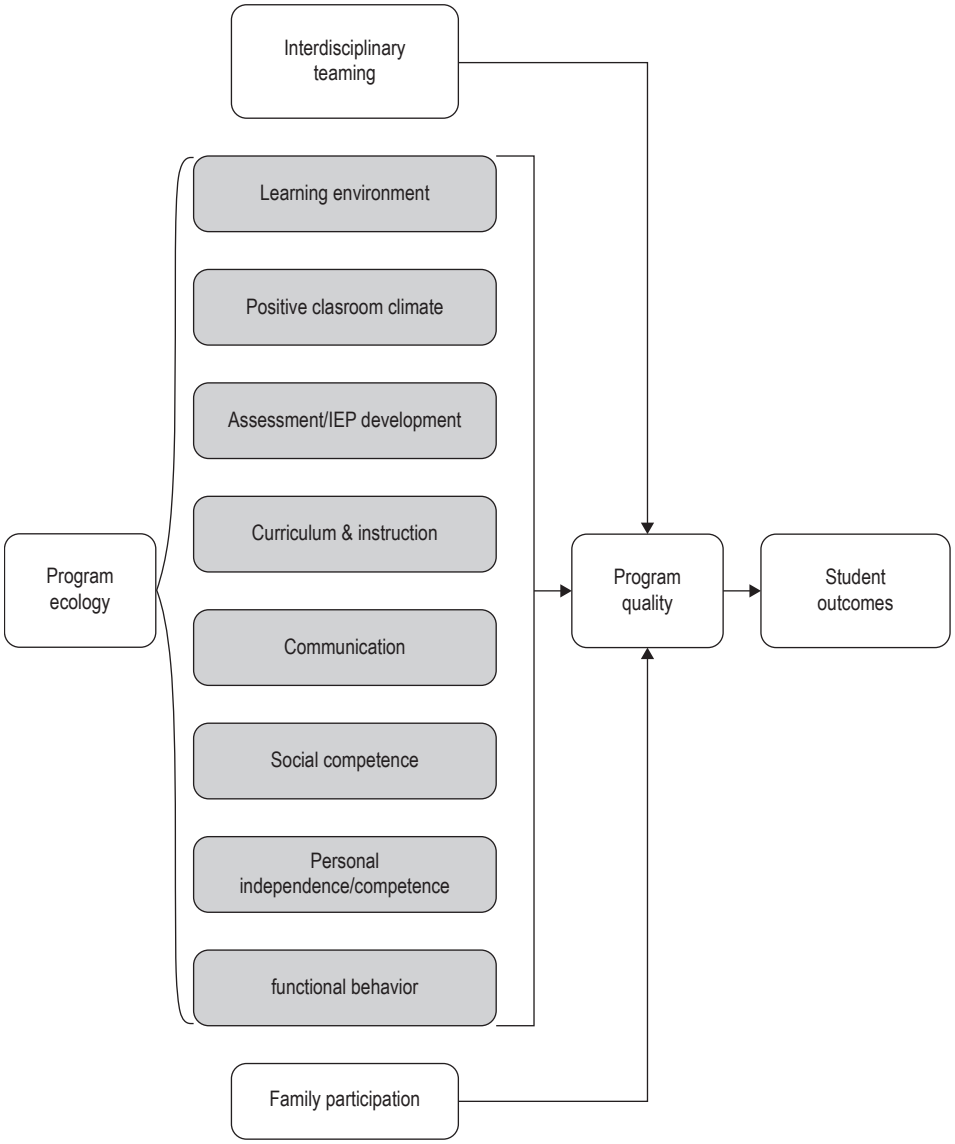

Figure 1. **The structure and domains of the APERS**

sesses the inclusion of student and their family's involvement in selecting evidence-based practice and planning an intervention (just as it is the case with evidence-based medicine) [16]. Another essential domain assessed is the collaborative relationship between staff members in terms of consistently regular team meetings and qualitative

aspects of cooperation, which reflects the criterion of a consistent treatment plan and its subsequent delivery as outlined by AAP [1].

Each APERS item scores between 1 and 5. The lowest score indicates that none of the key aspects of the program quality indicator have been implemented in a given team. The highest score usually indicates that all key aspects of such program features have been implemented consistently across the team.

Being an observational measure, the APERS ascertains the level of actual implementation of effective practices, rather than simply the knowledge of the team related to EBP and their use. Research has shown that knowledge and understanding of high quality program features and evidence-based interventions do not automatically translate into their actual implementation [17]. Hence, the APERS aims at evaluating real actions in this area in a given facility, as well as to assess whether the team's activity in this area improves over time.

Having completed their observations and interviews, evaluators write up a report, which highlights the areas where high quality elements are present as well as areas requiring subsequent development. The report also suggests which evidence-based interventions (addressed more broadly in item (c) below) can be used for the identified areas for improvement. The APERS report forms a basis for initial feedback as part of an evolving coaching relationship supporting team members in their professional development.

Like in the case of any assessment tool, for a valid implementation of the APERS in any other country, it is necessary to adapt the domains and items of the scale for the relevant cultural and administrative context [18].

b) APERS Self-Assessment Companion Tool. The APERS Self-Assessment Companion Tool is an integral assessment element included in the model, which reflects the team members' perspective of high quality programming across the same domains as in externally assessed APERS. Using it (and comparing with the APERS assessment carried out by external raters) coaches and team members can better explore the teams' understanding of high quality programming. Further, use of self-assessments clarify when team perceptions of their practices are different than those of assessors.

Using external raters for assessing program environment in general education context has attracted researchers' attention [19, 20]. Research on another self-assessment tools has found discrepancy demonstrated between self-assessment and external rater assessment of the same teams [21]. Teams tended to self-assess themselves higher than the external raters did [22]. The above findings are consistent with those observed in medicine in terms of evidence-based practice – the awareness of its importance significantly exceeds the actual implementation [23, 24]. Given

the potential for lack of congruity between self-assessment and external assessment, educational organizations may fail to see the need to improve the quality of provision they deliver, even if significant deficits were identified. The joint use of the APERS in external assessment and self-assessment may help address this challenge. By ensuring a common view of use of high quality practices, self-assessment may also support coaching by promoting dialogue on priority areas to address [25]. The role of coaching in professional development as a part of the NPDC model will be discussed in detail in item (e) below.

c) Matrix of Evidence-Based Practices (EBP Matrix).

In order to identify interventions that have evidence of efficacy, the NPDC team with numerous collaborators carried out the largest so far systematic literature review of focused interventions for children and youth with autism spectrum disorder [9]. The number of research articles included in the first round of screening was 29,105. A multi-round process followed, which identified publications reporting methodologically robust empirical studies according to the set of predefined criteria [26–30]. The criteria were developed so as to combine the constructs of evidence-based medicine and evidence-based practice adjusting the requirements to the specificity of social science research. As a result, 456 studies were identified, which met the criteria and described a total of 27 interventions classified as evidence-based[3].

A broader description of the review and its results has already been published in Polish [14]. Hence, in this paper we will include the EBP matrix only, which contains all 27 identified evidence-based practices (focused interventions), classified by expected outcome and age of learners with ASD.

All focused interventions included in the matrix were found to be effective through robust research methodologies. The color-filled box next to a focused intervention means that the efficacy of this focused intervention for a given outcome and age group was demonstrated in at least one study. In terms of age groups, the NPDC matrix includes focused interventions for learners with ASD aged from the earliest age to early adulthood (approx. 22 years). This age span was divided into three life stages, (a) birth through 5 years, (b) 6 to 14 years, and (c) 15–22 years of age.

It should be noted that the structure of the NPDC model enables for more evidence-based interventions to be included in the matrix should they be identified

[3] In order to be classified as evidence-based, the efficacy of a focused intervention had to be confirmed by: (a) at least two high quality experimental group or quasi-experimental design studies conducted by at least two different researchers or research groups, or (b) at least five high quality single case design studies (e.g., ABAB), conducted by at least three different researchers or research groups, having a total of at least 20 participants across studies, or (c) a combination of at least one high quality group experimental or quasi-experimental design study and at least three high quality single case design studies, conducted by at least two different research groups.

Table 1. **Matrix of evidence-based practices by outcome and age**

Matrix of evidence–based practices by outcome and age																																				
EBP – Evidence–based practice	Social			Communication			Joint attention			Behavior			School–readiness			Play			Cognitive			Motor			Adaptive			Vocational			Mental			Academic		
	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22	0–5	6–14	15–22
Antecedent-based Interventions (ABI)																																				
Cognitive Behavioral Intervention (CBI)																																				
Differential Reinforcement of Alternative, Incompatible, or Other Behavior (DRA/I/O)																																				
Discrete Trial Training (DTT)																																				
Exercise (ECE)																																				
Extinction (EXT)																																				
Functional Behavior Assessment (FBA)																																				
Functional Communication Training (FCT)																																				
Modeling (MD)																																				
Naturalistic Intervention (NI)																																				
Parent-implemented Interventions (PII)																																				

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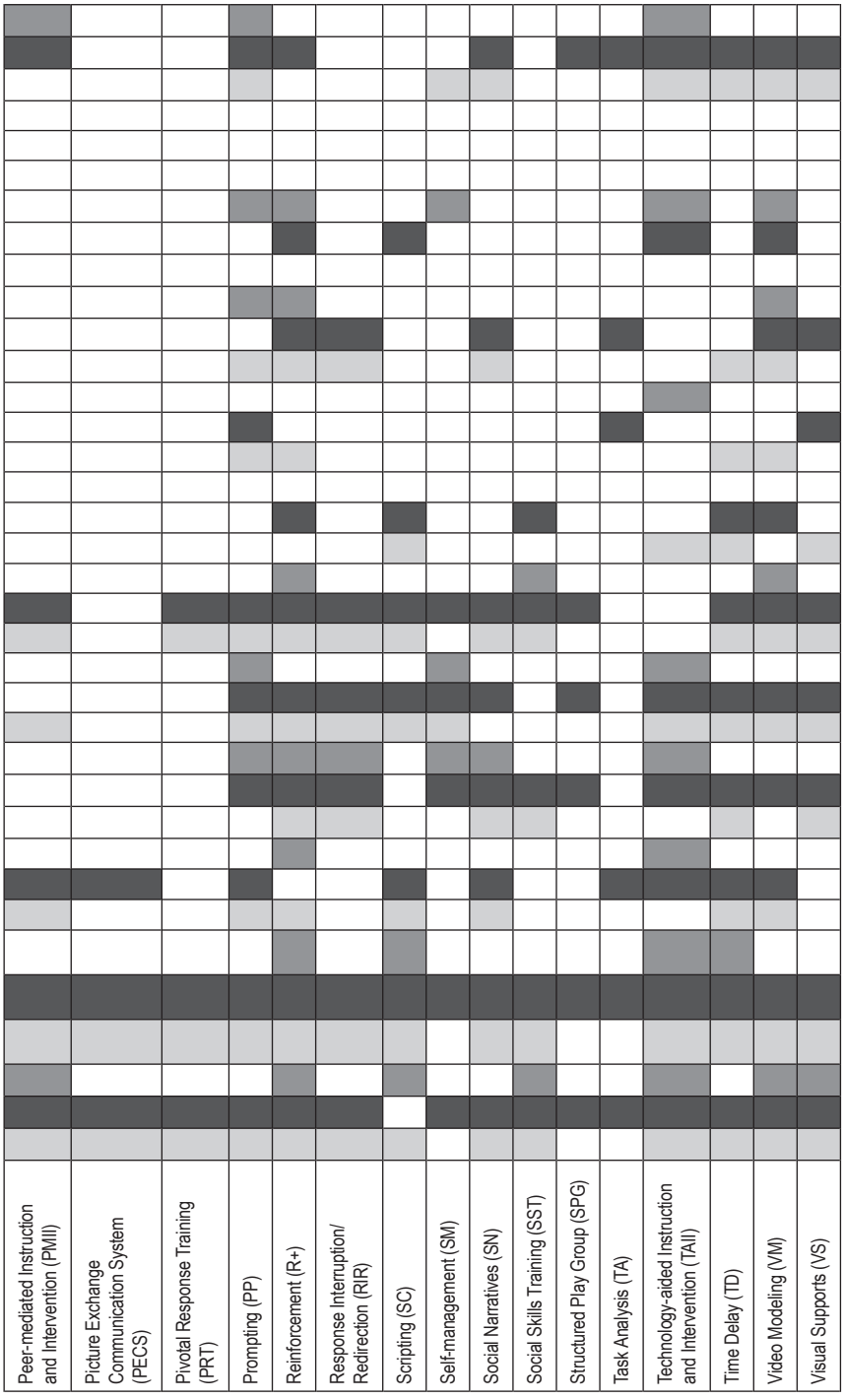
Peer-mediated Instruction and Intervention (PMII)
Picture Exchange Communication System (PECS)
Pivotal Response Training (PRT)
Prompting (PP)
Reinforcement (R+)
Response Interruption/ Redirection (RIR)
Scripting (SC)
Self-management (SM)
Social Narratives (SN)
Social Skills Training (SST)
Structured Play Group (SPG)
Task Analysis (TA)
Technology-aided Instruction and Intervention (TAII)
Time Delay (TD)
Video Modeling (VM)
Visual Supports (VS)

in the subsequent reviews as having satisfactory research evidence of effectiveness. The National Clearinghouse on Autism Evidence and Practice (NCAEP) is conducting a systematic review of the current intervention literature targeting individuals on the autism spectrum as a continuation of the evidence review completed by the NPDC.[4]

d) E-learning Autism Focused Interventions, Resources and Modules (AFIRM)

Any organization (school) implementing the NPDC model actually goes through two parallel processes. One of them involves better understanding and implementation of the features of high quality programs with regular progress assessment, as shown in items (a) and (b) above.

The other involves better understanding and selection of specific focused intervention to facilitate achieving predefined educational, developmental or behavioral outcomes. To sum up, whereas the high quality practices included in the APERS are universal across settings, children, and youth, the EBP matrix includes focused interventions, which need to be appropriately matched (algorithmic features) to the needs.

Therefore, an organization (school) delivering interventions based on a behavioral approach, is likely to be familiar with ABA-based focused interventions from the EBP matrix but may need support in learning other evidence-based practices. Another school may need support implementing these behavioral interventions, particularly since some (e.g., prompting, time delay, reinforcement) are foundational given their presence in the implementation procedures of many other EBPs. Additionally, as learning to use new EBPs takes time, there is a need to prioritize first those that match the needs of learners. Importantly, learning and implementing EBPs takes flexibility and the necessity to return to ensuring knowledge and use of fidelity as needed, e.g., when a new team member joins. This flexibility in implementing the EBPs in schools is supported by the e-learning Autism Focused Interventions, Resources and Modules. These modules aim at practical application of planning, using, and monitoring across each focused intervention. Interactive teaching methods used in the modules help build engagement throughout training.

e) NPDC coaching standards

The NPDC assumes that the team of practitioners (psychologists, educators, speech and language pathologists) working with children and youth with autism need and should receive professional development support. As a part of such support, coaching is meant to strengthen their skills in implementing high quality program features and EBPs. Research has shown that training which includes elements of coaching/mentoring improves actual implementation of evidence-based interventions [31].

[4] The NCAEP is a project supported by funds from the Frank Porter Graham Institute (University of North Carolina, Chapel Hill).

Coaching can include a professional's self-identification of areas for improvement, followed by a discussion about the implementing EBPs, modeling by the coach of the implementation of EBPs technical aspects of individual focused interventions. The NPDC has created a Coaching Manual to describe the standards and forms of coaching [25].

f) Goal Attainment Scaling (GAS)

Recently, Goal Attainment Scaling (GAS) has been explored in research and practice in special education in the USA [32, 33]. The purpose of Goal Attainment Scaling (GAS) is to assess progress that students make on two learning goals. When observable and measurable goals are organized in this way, they can be used to assess the effects of individualized intervention practices. Similar goal individualization was required in the autism treatment standards by the AAP [1]. As described by Ruble et al. [33] as a part of GAS, the team identifies priority goals and outcomes with the family and describes these along a scale. The first level represents the current level of performance of a behavior or skill, the next two rating represent two objectives towards an annual goal, next is the annual goal, and the final level represents the skill or behavior if the child exceeds the goal before expected [34]. Scaling learner's attainment across the desired outcomes/goals enables progress monitoring, ensuring that the goals match the learner's capabilities (i.e., that they are attainable), and preparing teams to change the intervention if the learner is not progressing towards the skill or behavior as expected.

g) Operationalization of implementation of evidence-based interventions and practices, and quality assessment of program environment

The NPDC model provides for constant implementation of evidence-based focused interventions in schools and regular monitoring of intervention quality. The EBP implementation cycle presented below should be by definition repeated on a regular basis (e.g., annually), often in conjunction with reviewing the Individualized Education Program (IEPs). In Poland, the closest counterpart of the American Individualized Education Program (IEP) is referred to as an Individual Education and Therapy Program (pl. *Indywidualny Program Edukacyjno-Terapeutyczny; IPET*). Therefore, for the sake of clarity, we choose to use the IEP/IPET abbreviation consistently throughout this article, whenever the concept of a comprehensive scheme of educational interventions tailored to a learner's needs is mentioned[5]. Figure 2 depicts the operationalization of the selection of EBPs to be implemented based on a learner's needs, their family's preferences and priorities, and the team's strengths, with annual quality assessment of interventions.

[5] And, in the Polish version of the article, only "IPET" abbreviation is used in this context.

The initial work with a school involves external and internal assessment of program environment using the APERS and (if deemed necessary) team discussion on improving the quality of delivered interventions. Based on the APERS feedback, focused interventions may be identified to be implemented across the team from the EBP matrix. By definition, these need to be matched with learners' goals (assessed using GAS – see item (f) above). Next, team members are trained in using selected focused interventions (assessed to ensure their implementation with fidelity through coaching) and start adopting them in their practice. The process is additionally supported by coaching provided by internal and/or external coaches and supervisors, as well as focus on further strengthening internal communication and building team independence. After 9–12 months since the beginning of the implementation process, the APERS assessment and self-assessment is repeated along with GAS[6], to assess changes taking place as a result of adopting high quality intervention features and implementing evidence-based practices. The process described above is constant – it can ensure maintaining high quality provision when facing staff turnover, unusual needs of learners or the need to make the team effort more consistent.

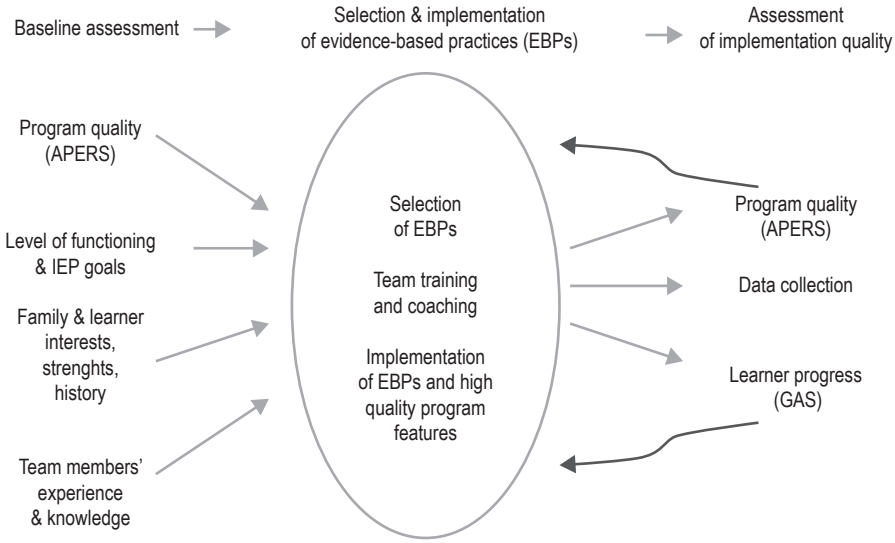

Figure 2. **Operationalization of EBP implementation process as a part of the NPDC model**

Source: own work based on [34].

[6] Goal attainment scaling (GAS) is carried out routinely four times during the NPDC model implementation: at the beginning of implementation, twice mid-process to ensure matching the goals to learner's needs, and finally at the end of implementation.

NPDC implementation in the United States

A standard implementation process of the NPDC model in schools in individual US states was described and published in a scientific journal [34]. The framework of the implementation process involved the following steps:

1. The state formed an Interagency Autism Planning Group (IAPG) to develop the competitive application for partnership. Once the state was selected to work with the NPDC, a meeting between IAPG and NPDC staff was convened to create a strategic plan and establish an autism training team (A-Team). A week-long summer training institute was provided by the NPDC for each state to train coaches and A-Team members on the process.
2. Selected schools within the state (model schools) formed their A-Team (Autism Team) which included an administrator, a local coach, along with implementing teachers and related service providers (therapists). During the summer institute, A-Team members received training in using the APERS, implementing high quality practices and evidence-based focused interventions, as well as other components of the NPDC model.
3. Next, the 2-year implementation phase followed, which included embedding model elements in own practice (the NPDC provided technical assistance during the first year while training state and local coaches were replaced by the respective state and local coaches during the second year) along with professional development and training on how to replicate the model to other schools. Effectiveness was measured at the program level through the APERS, at the teacher level through EBP fidelity implementation checklists, and at the student level through Goal Attainment Scaling.
4. Afterwards, the local autism training team personnel took over delivering training to next schools in their own school districts and state.

The NPDC delivered training through IAPG in 12 states [34]. As a part of all research projects conducted to date, training has been provided to over 200 school teams. The implementation process combines internal (e.g., selection and practical application of focused interventions) and external (e.g., APERS assessment, reports and feedback) actions by and on behalf of an organization. As a result, the objectivity of quality assessment can be ensured. Furthermore, it is possible to adjust gradual adoption of new EBPs to the schools' and learners' needs. The ultimate aim is to maximize the effectiveness of EBP adoption as well as to increase the team's awareness of EBPs and EBP-related self-efficacy.

NPDC model and research

The model described in the current article refers to research across three dimensions. First, its components are derived from the systematic review of pooled research data. It is particularly apparent with the APERS and EBP matrix. However, other elements of the NPDC model, including its operationalized implementation [34] or coaching [25] are derived from the analysis of research data or research-based standards as well.

As a second dimension, the model's flexibility enables inclusion of new data from relevant research as it emerges. The modular structure of the model (with literature review findings, rather than theoretical assumptions guide the selection of evidence-based interventions) makes it possible to integrate subsequent systematic literature reviews within the model[7]. Owing to its flexible, modular structure, the NPDC enables inclusion of new EBPs in the matrix as the body of evidence to support their effectiveness increases. This is also how the NPDC model was developed – the previous NPDC review [35] was replaced with an updated systematic review [9], and a third review is underway.

The third dimension of reference is carrying out research to confirm the effectiveness of the NPDC model [34]. The ongoing Efficacy Study for Elementary Learners with Autism Spectrum Disorder (TESELA) follows the design of a randomized controlled trial (RCT) using schools as subjects. As part of this study, schools delivering interventions for children with ASD were randomly selected to experimental group (implementing the NPDC model) or control group. A total of 60 schools were enrolled – 30 were allocated to an experimental group and 30 to a control group (schools from a control group have their educational environment assessed using the APERS and receive training materials, yet there is no systemic implementation of the NPDC model). The results of this large-scale project should be interesting not only in terms of the NPDC, but more broadly in terms of team member ability to implement evidence-based interventions. It should be noted that the NPDC model has become the procedural foundation for the Center for Secondary Education for Students with Autism (CSESA) program [36][8]. All abovementioned aspects of reference to research in the NPDC model are of interdisciplinary nature, which seems necessary considering the complexity of autism spectrum disorder and multidimensionality of therapeutic and educational interventions.

[7] A good current example of this feature is a systematic review of the current intervention literature targeting individuals on the autism spectrum currently being conducted by the National Clearinghouse on Autism Evidence and Practice (NCAEP) as a continuation of the evidence review that was completed by the NPDC.

[8] A full list of CSESA publications can be accessed at http://csesa.fpg.unc.edu/research/articles.

NPDC model characteristic summary and implementation perspective in Poland

In summary, the NPDC model, as an advanced technical and operational solution, includes and supports dynamic development and implementation of educational and behavioral interventions for children and adolescents with autism spectrum disorder. As a result, albeit relatively recent, it has attracted attention from practitioners in a number of countries, such as Australia, Saudi Arabia, Bangladesh and in Europe – Sweden and Poland, which are currently at different stages of implementation.

In Poland, the NPDC model is currently being implemented by SOTIS Autism Therapy Center. After a preparation stage of a few years, the team of Polish APERS trainers have been formed and trained. Currently (until the end of 2019), a pilot implementation of the NPDC model is continued in SOTIS centers across the country. At the end of the process, the feedback from Polish practitioners involved in working with the model will be collected and summarized, and the next steps will be planned. For the sake of brevity, stages of NPDC implementation in Poland along with the necessary linguistic and cultural adaptation of related resources go beyond the scope of the current article and will, therefore, be addressed in a separate publication.

Through the integration of the perspective of evidence-based medicine with the reality of applied social research, which the majority of focused interventions for autism stem from, the NPDC model sets high quality standards and procedures for effective implementation across various settings. The described way of integrating research with clinical and educational practice may suggest new directions for development of interventions for autism and other neurodevelopmental disorders.

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