

Integrative Pediatric Examination (EIP). Presentation of an experience.

Examen integrador de pediatría (EIP). Presentación de una experiencia.

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Abstract: The evaluation of learning is a fundamental part of the medical residency system and includes theoretical, practical aspects and academic performance. A formative evaluation tool was designed with the purpose of evaluating the application of theoretical knowledge and guiding the learning process at each pediatric training site according to its strengths and weaknesses. The exam consisted of a multiple-choice test composed of 100 questions in which 72 residents participated. 58% of the participants achieved the established cut-off point. This examination gave us information about which areas residents faced the greatest difficulties. It could be a complementary tool to continually improve the theoretical aspects of the residency training program and contribute to quality pediatric care.

Keywords: Evaluation, Pediatrics, Residency

Resumen: La evaluación del aprendizaje es parte fundamental del sistema de residencias médicas e incluye aspectos teóricos, prácticos y desempeño académico. Se diseñó una herramienta de evaluación formativa con el propósito de evaluar la aplicación de los conocimientos teóricos y orientar el proceso de aprendizaje en cada sede de formación pediátrica según sus fortalezas y debilidades. El examen consistió en una prueba de selección múltiple compuesta por 100 preguntas en el que participaron 72 residentes. El 58% de los participantes lograron el punto de corte establecido. Este examen nos brindó información acerca de cuáles son las áreas en las que los residentes enfrentaron mayores dificultades. Podría ser una herramienta complementaria para mejorar continuamente los aspectos teóricos del programa de formación de la residencia y contribuir con una atención pediátrica de calidad.

Palabras clave: Evaluación, Pediatría, Residencia

1. Introduction

The Health Team Residences constitute in-service training systems and postgraduate professional training with programmed and supervised activities that are part of the Health system of the Autonomous City of Buenos Aires (CABA) (1). The pediatric residency program establishes the competencies that residents will acquire throughout their training, recognizes the areas and levels of responsibility, and establishes the common profile expected for all residents of the same specialty (2). Among the objectives set for fourth-year residents are: deepening the knowledge, skills and attitudes acquired in previous years to play the role of coordinator and supervisor of residents in lower years. In addition, they must be able to actively use the available information resources, select and analyze bibliographic information related to their area of interest (2).

The evaluation of both the learning and the program is a fundamental part of this system and includes theoretical aspects, practical and academic performance. To do this, various procedures are used, such as objective multiple-choice tests or structured oral exams, as well as instruments that involve direct observation such as the ECEO (3-4) and the Mini-Cex (5-6). All evaluation must be accompanied by a feedback process with the resident that allows the learning process to be improved. Evaluations in health training systems have three main objectives: optimizing the professional competencies and skills of residents, generating motivation for their future learning; provide an advanced training base and ensure the training of suitable health personnel for the population. Questions with rich descriptions in clinical context invite complex cognitive processes, characteristic of clinical practice, more precisely evaluating the diagnostic reasoning process and focusing on critical decisions in specific clinical situations (7).

The Pediatric Integrative Examination (EIP) was designed as a formative and non-summative evaluation tool, it does not imply approval or suspension. Its purpose is to guide the theoretical learning process in each location according to its strengths and weaknesses (7). The objective of this exam is to evaluate the knowledge applied to the resolution of clinical problems and subsequently offer a return of the results to the different headquarters of the Government of the City of Buenos Aires (GCBA), with the purpose of improving the acquisition of the aspects theoretical studies contemplated in the pediatric residency program. In this case, a multiple-choice exam has been chosen according to current quality indices and standards (8-9). This type of evaluation makes it possible to cover a wide field of knowledge and evaluate the theoretical aspects of the program (7). In addition, the correction of the exam is automatically what mitigates the risk of error typical of manual correction. Teamwork both in the preparation and in the correction of the test allows constructive criticism of the questions and their subsequent analysis, which increases their reliability and validity (8-9). The objective of the work is to communicate an experience of an integrative exam for pediatric residents who are in the final stage of their training.

2. Methods

In June 2023, the EIP was implemented for the first time for 4th year residents of the Pediatric Clinic and Articulated Medical Residences (RMA) of Neonatology and Pediatric Intensive Care of the GCBA system. 72 of the total of 111 residents of CABA belonging to 11 of the 14 training sites showed up to take the exam (see table 1).

The exam consisted of a multiple-choice test composed of 100 questions following the standards established for the preparation of multiple-choice exams (9-10). For its creation, learning objectives related to the theoretical aspects of the GCBA pediatric training program were chosen (2). The length of the exam was established based on the existing literature which indicates that 100 questions would be sufficient to evaluate subjects with broad content, since they would also guarantee very acceptable internal consistency reliability (10). Regarding the distribution of questions by area, it was carried out based on the concept that the content of the exam must coincide with the objectives of the program, giving more weight to the prevalent topics (9) (see table 2). The exam was carried out in person through a virtual platform (11) and the Safe Exam Browser (SEB) program (12) was used as a security measure.

Table 1 . Location and number of residents who participated in the EIP

Campus	Pediatric Residency	Articulated Medical Residence	Total
General Acute Hospital Dr. Teodoro Alvarez	3	-	3
General Acute Hospital Dr. Cosme Argerich	1	-	1
Carlos G. Durand Acute Care General Hospital	2	-	2
Pedro de Elizalde Children's General Hospital	10	9	19
Dr. Juan A. Fernández General Acute Hospital	3	-	3
Children's General Hospital Dr. Ricardo Gutiérrez	27	5	32
Parmenio Piñero Acute Care General Hospital	2	-	2
General Acute Hospital Dr. Ignacio Pirovano	3	-	3
Bernardino Rivadavia Acute Care General Hospital	2	-	2
General Hospital for Acute Francisco Santojanni	2	-	2
General Hospital for Acute Dalmacio Vélez Sarsfield	3	-	3

Table 2 . Contents evaluated in the EIP.

Category	Total Questions
Growth and development	fifteen
Adolescence	6
Pathophysiology of Body Fluids and Hydroelectrolyte Treatment and Critical Patient/Emergencies	eleven
Genetics and Neonatology	6
Toxicology - Legal - Accident Prevention	6
Nutrition	4
Immunology and Rheumatology	2
Infectology and Immunizations	13
Gastroenterology and Hepatology	5
Respiratory and ENT	5
Cardiovascular	4
Hemato-oncology	4
Nephrology and Urology	3
Neurology	4
Dermatology	3
Orthopedics and Traumatology	3
Surgical Pathology	4
Investigation methodology	2

Four months before the exam, instructions were sent for registration on campus and for the installation and use of the SEB. In addition, a test questionnaire was provided on the platform, which was available for the entire remaining time so that the participants could familiarize themselves with the tools. On the day of the exam, the participants were divided into 3 classrooms and the total duration of the exam was 120 minutes. At the end, the participants had immediate access to the review with feedback that consisted of the appearance of the question with the correct answer, its justification and the bibliography for each of them (see Annex 1). It is important to note that, once the final submission of the exam was made, the answers could not be modified. The established cut-off score was 65 correct answers, calculated based on 80% of the average of the 10 highest scores (13).

After analyzing the EIP results, written feedback was provided to each of the participating hospitals on the overall performance of each site and the detailed individual

performance of each resident, to evaluate weaknesses and strengths of performance in each area. Based on the analysis carried out, each GCBA pediatric residency will have the possibility of evaluating the necessary strategies to enrich the teaching of the theoretical aspects of the program that involve learning content. Following the exam, an optional self-administered survey on participant satisfaction was conducted, sent by email to all residents who participated. Once the results were obtained, measures of central tendency (mean, median) and dispersion (standard deviation) of the global score were calculated. In addition, global difficulty and discrimination indices were extracted, as well as for each question, using the tools provided by the Moodle system (learning platform that allows data to be collected and stored) (14). For data management, all parameters included in the outcome variables were entered into a database designed for this purpose in Microsoft® Excel®365.

3. Results

A total of 72 residents of the total of 111 (65%) from CABA belonging to 11 of the 14 training centers presented themselves to submit. Twenty-four of the 35 residents who did not participate in the exam were on leave, they reported. The cut-off point established was 65 correct answers (it was calculated based on 80% of the average of the first 10 scores), with 42 residents (58%) reaching the cut-off point. The mean of the overall score was 67, the median 67 and the mode 73; the calculated standard deviation was 10.46. The global ease index of the exam was 67.2% and the discrimination index was 20.8%. Based on these data, a low difficulty test is considered (8).

Of the total of 72 residents who attended the examination, 58 belong to the pediatric residency and 14 to the RMA. Among pediatric residents, 64% managed to exceed the established cut-off point, while in the RMA group, it was 35% (χ^2 3.5, $p=0.055$). With respect to pediatric hospitals, 74.5% managed to reach the cut-off point while in general hospitals, only 19% reached it (Fisher's exact test $p=0.00001$). Regarding the percentage of correct answers by category (see table 3), the areas where the highest degree of correct answers was observed were the areas of dermatology (86.1%), respiratory pathology and otorhinolaryngology (80.5%). These questions had an ease rate between 66%-100%. On the other hand, the area where the highest degree of difficulty was observed was the area of nephrology and urology (42% correct answers) where the ease index was between 11% - 34% (see table 4).

Table 3. Percentage of correct answers by category .

CATEGORY	CORRECT ANSWERS (%)
Growth and development	67.9
Adolescence	69.6
Pathophysiology of body fluids and hydroelectrolyte treatment and critical/emergency patients	65.9
Genetics and neonatology	64.4
Toxicology - legal - accident prevention	71.1
Nutrition	63.8
Immunology and rheumatology	56.6
Infectology and immunizations	63.6
Gastroenterology and hepatology	73.8
Respiratory and ENT	80.5
Cardiovascular	59.7

Hemato-oncology	70.4
Nephrology and urology	42.1
Neurology	76.7
Dermatology	86.1
Orthopedics and traumatology	53.2
surgical pathology	69.7
Investigation methodology	53.4

Table 4 . Question ease index.

Ease Index %	Interpretation	Number of questions
5 or less	Extremely difficult/something is wrong with the question	0
6-10	Very difficult	0
11-20	Difficult	3
21-34	Moderately difficult	7
35-65	Correct for the average student	33
66-80	Quite easy	33
81-89	Easy	7
90-94	Very easy	eleven
95-100	Extremely easy	6
Total		100

Indices obtained through the MoodleMoot Global platform (nd). Moodle (14).

Only 57% of residents completed the optional user satisfaction survey. 78% of those who responded to the survey considered that the content of the exam was representative and in line with their training during residency. The level of difficulty perceived globally was considered intermediate by 90.2% of the participants. The perception of the residents who answered the survey contrasts with the previously mentioned objective calculated indices (ease index). This index is calculated based on the percentage of residents who have answered each question correctly (8). 70.7% of the participants who responded to the survey found the EIP useful as a tool in their training. Regarding the feedback on the questions at the end of the exam, 95.1% considered it useful.

4. Discussion

This study shows an experience of an exam that integrated theoretical concepts from the pediatric residency program of the Autonomous City of Buenos Aires in fourth-year residents. A search was carried out in the available bibliography and no similar experiences were found.

According to the indices used, the difficulty was low. However, it was evidenced that 42% of the residents who attended did not achieve the established cut-off point. This study revealed that residences with more seniority in the GCBA training system performed better, with a statistically significant difference compared to younger residences. Although the exam evaluated the theoretical contents of the GCBA pediatric residency program, this difference may be due, among other factors, to the presence of a larger pediatric population and, as a consequence, to more complex and heterogeneous scenarios. A study conducted in the United States found a similar association, concluding that, in addition to lecture attendance and structured reading, increased number of patient encounters may contribute to improving residents' training exam scores (fifteen). On the other hand, no differences in performance were observed between the residents of the pediatric residency

and those of the RMA. This could be explained by the fact that RMA residents complete their training in pediatric hospitals for 3 years.

The EIP could be a tool that allows residents to be evaluated on the theoretical contents of the program. This transversal evaluation was directed to all the headquarters of the Autonomous City of Buenos Aires where the program is taught. It provided information about the theoretical contents in which the residents faced greater difficulties and those in which they demonstrated a higher level of mastery. Knowing these specific strengths and weaknesses will allow you to adapt teaching strategies and provide specific resources to improve the resident's training, promoting growth in their clinical practice with the aim of strengthening their training and promoting continuous growth in their practice.

One of the strengths of the EIP was the review with feedback, which was reflected in the satisfaction survey. Through this feedback format, residents have the valuable opportunity to learn from their mistakes and, if they wish, deepen their knowledge of a specific topic. In addition, feedback and self-analysis are promoted as integral and fundamental components of the training process (16-18). On the other hand, after the exam, written feedback was provided to each of the participating hospitals about the overall performance of each location and the individual performance of each resident. Another strength to highlight is that when preparing the exam, a distribution of questions by area was carried out based on the concept that the content of the exam must coincide with the objectives of the program, giving more weight to the prevalent topics.

As weaknesses of the study, it is important to highlight that the exam was developed by a single training center and was not subjected to peer review. In addition, the Galofré index (19) was not used in the creation of the exam for the multiple choice questions. However, it should be noted that general rules and technical recommendations were taken into consideration to avoid defects in the formulation of the questions, as detailed in the specialized literature (9-10).

In the comments section of the satisfaction survey, ideas were raised about the limitation of the exam format to evaluate areas related to the communication of bad news, the doctor-patient relationship, ethics, among others. These aspects are evaluated with the OCEO and the MiniCex, which are evaluation tools located at the tip of Miller's pyramid (20). This limitation applies not only to this particular exam, but also to other instances of objective written assessment. These assessments may not be fully representative of the wide range of care activities, however it is important to note that the choice to use a multiple-choice exam format has specific advantages. This approach allows for a standardized assessment that covers a wide field of knowledge and efficiently assesses various aspects of the residency program. In addition, it guarantees greater objectivity in the evaluation, which is especially useful when working with a large number of participants (9). Complementing multiple-choice examinations with other forms of assessment may be useful to circumvent some of these limitations and provide a comprehensive and representative assessment of clinical skills required in practice.

5. Conclusions

- The experience of the integrative exam for pediatric residents has provided valuable insight into the theoretical areas in which residents have faced significant challenges and those in which they have demonstrated a high level of proficiency. This will allow participating hospitals to receive detailed feedback on the performance of each site and of each individual resident.

- This formative evaluation can be a tool to guide the theoretical learning process in each location, capitalizing on its strengths and working on its weaknesses.
- For future editions, it could be organized by a committee comprised of representatives from multiple sites and reviewers who are experts in the topics tested on the exam, which will ensure unbiased and rigorous assessment of knowledge and promote continuous improvement in pediatric education.

Supplementary material : Annex 1, Contents evaluated in the EIP and Question 1 model with justification.

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APPENDIX 1.

Contents evaluated in the EIP.

CATEGORY	EVALUATED CONTENT	TOTAL QUESTIONS
Growth and development	Neurodevelopment and Developmental Disorders Anthropometry and assessment of growth Lactation Supplementary feeding Vitamin supplements Dream Usual screenings by age pubertal development	fifteen
Adolescence	Suicide risk assessment Contraceptive methods Menstrual cycle disorders Gender identity Voluntary termination of pregnancy	6
Pathophysiology of body fluids and hydroelectrolyte treatment and critical/emergency patients	Acid-base status disorders Dysnatremias Dyskalemia Dehydration Calcium disorders Sme. feedback CPR Airway in emergency Shock management Burned patient Febrile neutropenia	eleven
Genetics and neonatology	Apgar Score Hyperbilirubinemia Neonatal surgical pathology: pyloric hypertrophy and esophageal atresia Smes. frequent genetics: Sme. by Turner and Sme. from Down	6
Toxicology - legal - accident prevention	CO poisoning Caustic poisoning Child restraint systems Safety in swimming pools Patient rights Gender violence	6
Nutrition	Overweight and obesity Vegetarian and vegan diets Diabetes I and II	4
Immunology and rheumatology	Selective Ig A deficiency Juvenile rheumatoid arthritis	2

Infectology and immunizations	Vaccination schedule Perinatal infections Meningitis Sme. coqueluchoid Tuberculosis Dengue infection Skin and soft tissue infection Urinary tract infection	13
Gastroenterology and hepatology	Celiac Disease Gastroesophageal reflux disease Meckel's diverticulum Bile duct atresia Non-alcoholic steatohepatitis	5
Respiratory and ENT	Ear pathology Upper airway infections IRAB ASTHMA	5
Cardiovascular	Cardiovascular semiology Congenital heart disease Arrhythmias Electrocardiogram interpretation	4
Hemato-oncology	Common solid tumors: Osteosarcoma Leukemias and Lymphomas Purples Hemolytic anemia	4
Nephrology and urology	Nephrourological malformations Interpretation of complementary exams Nephrotic and nephritic syndrome	3
Neurology	Demyelinating diseases Neuromuscular diseases Seizure management	4
Dermatology	Pharmacodermies Atopic dermatitis Hives	3
Orthopedics and traumatology	Hip semiology Semiology of lower limbs Causes of lameness	3
surgical pathology	Phimosis Acute scrotum Acute abdomen Pancreatitis and cholecystitis	4
Investigation methodology	Effect measures Study designs	2

Model question with justification.

A 12-month-old girl, previously healthy, presented severe dehydration due to acute diarrhea of 24-hour duration. Once hemodynamically stabilized, a laboratory report is obtained that reports Urea 50 mg/dl, Glucose 81 mg/dl, Uric acid 10 mg/dl, Creatinine 0.40 mg/dl, Calcium 9.2 mg/dl, Phosphorus 3.7 mg/dl, Magnesium 2.2 mg/dl, Acid-base state: pH 7.36, pCO₂ 30 mmHg, HCO₃ 17 mmol/L, Sodium 122 mEq/L, Potassium 4.3 mEq/L, Chlorine 96 mEq/L, Ionic calcium 1.21

mmol/L, Lactic acid 1.2 mmol /L. A few minutes later, the patient begins with progressive sensory depression and a generalized tonic-clonic seizure. Weight:15kg What treatment indicates?

- a) Sodium chloride 3% 60 ml intravenous
- b) Sodium chloride 3% 15 ml intravenous
- c) Lorazepam 1.5 mg intravenous
- d) Midazolam 3 mg intramuscular.

Correct answer: Sodium chloride 3% 60 ml intravenous

Justification: Nelson, treatise on pediatrics. Edition no. 20. Chapter 55, page 373

Patients with hyponatremia may present with severe neurological symptoms, such as seizures and coma. Seizures due to hyponatremia usually respond poorly to anticonvulsants (lorazepam, midazolam). The child with hyponatremia and severe symptoms needs to receive treatment that quickly reduces cerebral edema. This objective is achieved by increasing extracellular osmolality so that water moves following the osmolar gradient from the intracellular to the extracellular space. Intravenous hypertonic saline rapidly increases serum sodium. Each ml/kg of 3% sodium chloride increases serum sodium by approximately 1 mEq/l. A child with acute symptoms improves after receiving 4 to 6 ml/kg of 3% sodium chloride.



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