

Improving Pediatric Resident Awareness of Inborn Errors of Immunity (IEI): A Quality Improvement Initiative

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INTRODUCTION

Inborn Errors of Immunity (IEI), formerly known as Primary Immune Deficiencies (PID), are a group of rare, yet profoundly impactful, conditions that compromise immune function, leading to recurrent infections, autoimmunity, and malignancies. Early recognition and diagnosis are essential for improving patient outcomes, but remain challenging due to the wide spectrum of clinical presentations.

While early diagnosis is critical to improving outcomes, awareness of the Jeffrey Modell Foundation's "10 Warning Signs of PID" remains insufficient among healthcare professionals. Despite their importance, studies conducted outside the United States have consistently shown poor PID awareness among healthcare providers; yet data on knowledge within U.S. pediatric residency programs—particularly in urban academic centers—remain limited.

This study explores the knowledge and preparedness of pediatric residents at SUNY Downstate Health Sciences University to identify and manage IEIs.

Objectives

- Assess baseline knowledge of IEI among pediatric residents
- Identify key knowledge gaps in recognizing warning signs and understanding management
- Implement and evaluate the impact of targeted educational interventions
- Promote sustained knowledge retention through follow-up assessments

MATERIALS & METHODS

This study was conducted in two phases at SUNY Downstate Health Sciences University:

Pre-Intervention Phase:

Residents completed a baseline anonymous questionnaire evaluating their awareness of the 10 warning signs, general PID knowledge, and common misconceptions.

Intervention Phase:

A series of scheduled educational interventions—including small-group lectures and interactive workshops—were delivered to pediatric residents. These sessions focused on:

- Recognition of the 10 warning signs
- Overview of common IEIs and clinical red flags
- Clarifying frequent misconceptions regarding diagnosis, treatment, and vaccines

Educational posters were also distributed in outpatient and inpatient clinical areas to reinforce learning.

Post-Intervention Phase:

The same questionnaire was re-administered following the interventions.

Data were collected and analyzed using SPSS to assess knowledge improvement, stratified by training level and prior Allergy/Immunology rotation.

Results

Prior to the intervention, correct answer rates improved progressively with residency level: PGY-1 residents answered 67.5% of questions correctly, PGY-2 residents 71%, and PGY-3 residents 79%. Residents with previous Allergy/Immunology (AI) rotations demonstrated higher accuracy (79.5%) compared to those without (69%). Common misconceptions identified during the pre-intervention phase included live vaccine safety (only 30.2% answered correctly) and universal need for immunoglobulin therapy (correct in just 18%).

Post-intervention analysis showed statistically significant improvements in several key areas (figure 1). Recognition of recurrent ear infections improved from 69.8% to 88.6% ($p = .045$), recurrent sinusitis from 60.5% to 97.1% ($p < .001$), and pneumonia requiring hospitalization from 41.9% to 91.4% ($p < .001$). Knowledge about CVID diagnosis age improved from 41.9% to 74.3% ($p = .004$), CD markers as diagnostic tools from 31.0% to 60.0% ($p = .011$), and live vaccine contraindications from 30.2% to 60.0% ($p = .008$). However, knowledge decreased for the item on recurrent cold sores, dropping from 88.4% to 64.7% ($p = .013$).

Overall, PGY-3 residents and those with prior AI rotations performed better (figure 2). The intervention led to a statistically significant improvement in overall scores ($p < .001$), with the median increasing from 70% (IQR=60-75%) before intervention to 85% (IQR=70-95%) after intervention, indicating a meaningful increase in knowledge and diagnostic confidence.

CONCLUSIONS

This study highlights important knowledge gaps among pediatric residents in identifying and managing Primary Immunodeficiencies (PIDs), particularly in recognizing subtle clinical signs and understanding diagnostic pathways. Following a focused educational intervention, residents demonstrated significant improvement in diagnostic awareness, particularly in recognizing common clinical indicators such as recurrent infections and the appropriate use of diagnostic markers. Self-reported confidence and perceived knowledge also improved, reflecting the value of brief, targeted educational sessions.

While improvements were evident, some misconceptions persisted, emphasizing the need for sustained and structured educational reinforcement. Future phases of this quality improvement project will include repeated interventions at 2-, 4-, and 6-month intervals to assess knowledge retention and further enhance clinical competence.

Inborn Errors of Immunity (IEI), formerly known as PIDs, are rare yet serious conditions that require timely diagnosis to prevent long-term complications. Implementing a structured educational framework based on the 10 warning signs—combined with accessible resources and clinical decision support—can significantly empower trainees to identify these conditions earlier. Continued efforts in education and system-based support are essential for improving outcomes in children with immunodeficiencies.

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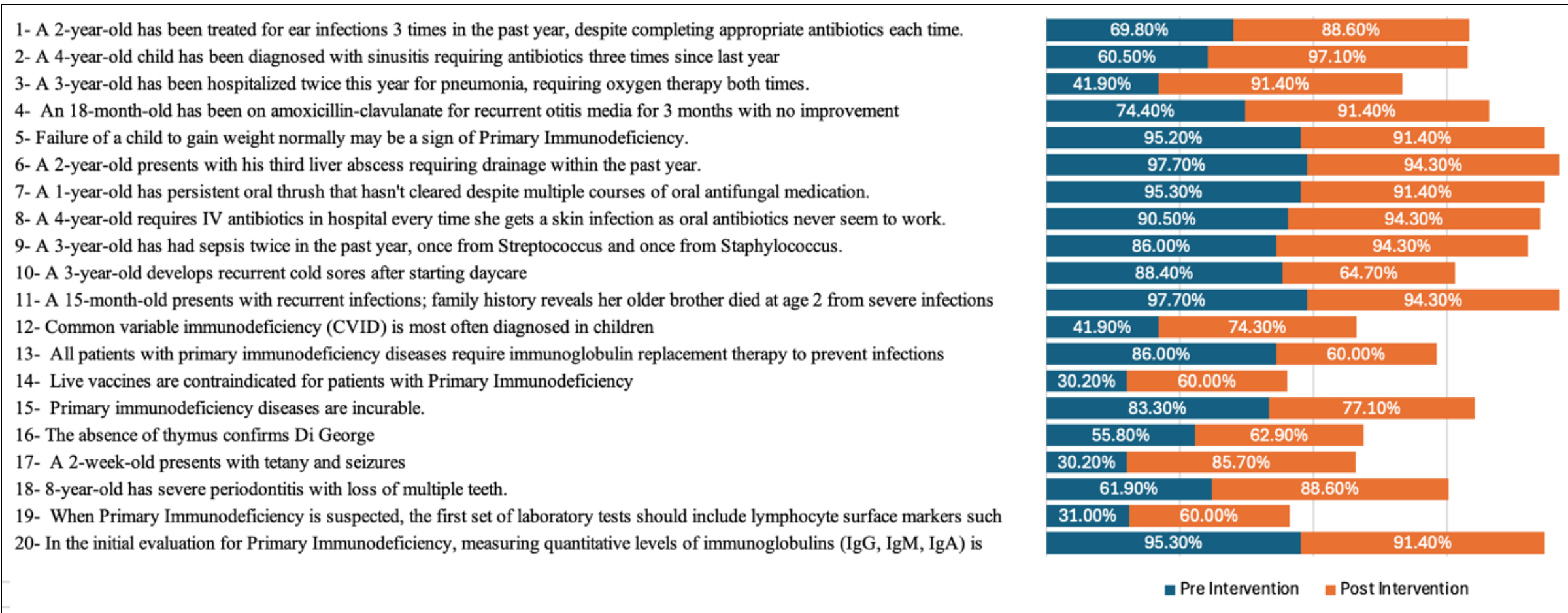


Figure 1: Comparison of correct responses to Primary Immunodeficiency knowledge questions before and after the intervention, showing significant improvements in understanding.

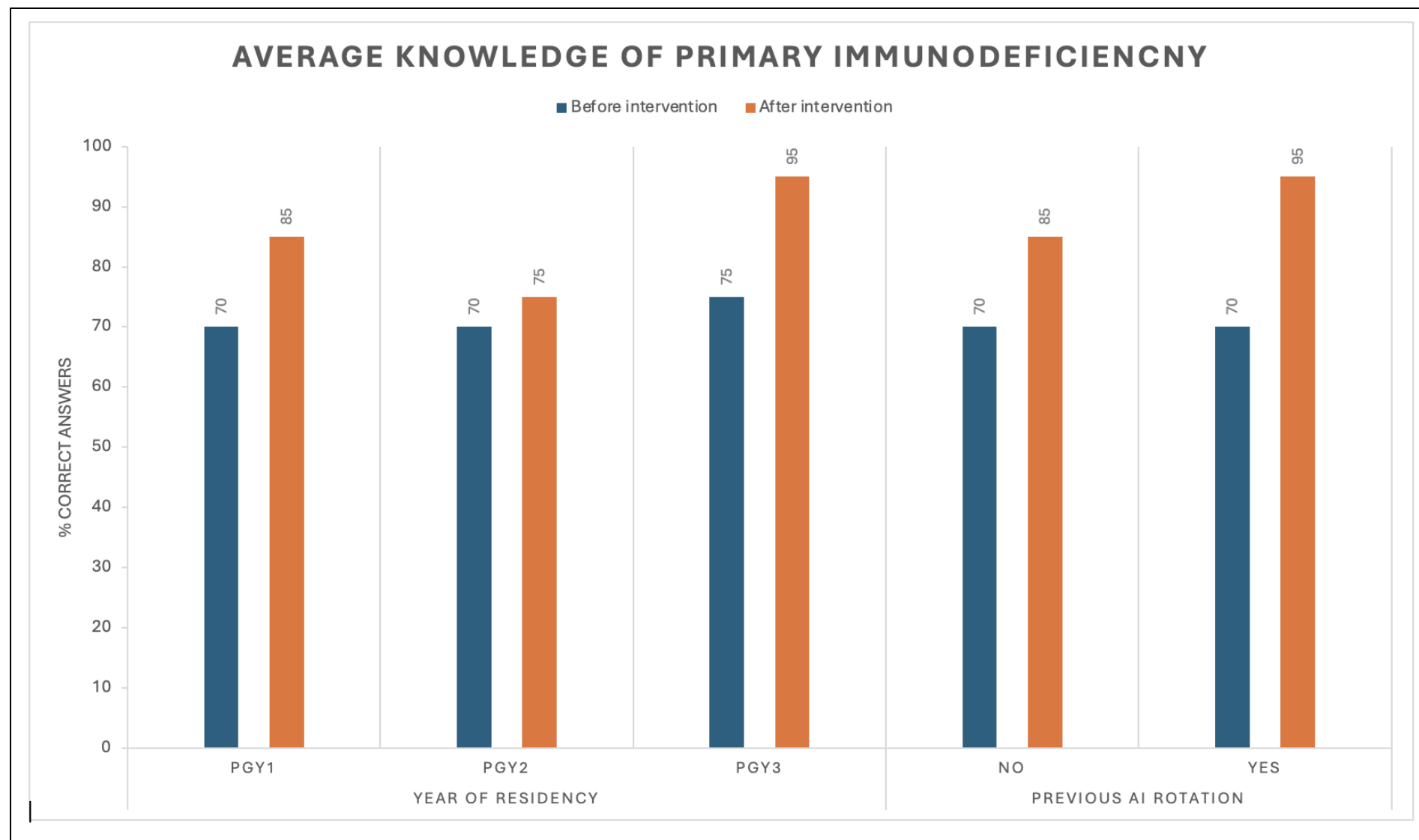


Figure 2: Knowledge of PID pre and post-intervention based on PGY and Previous AI rotation