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AMERICAN SOCIETY OF ANESTHESIOLOGISTS PHYSICAL STATUS CLASSIFICATION FOR PEDIATRICS: A MULTICENTER STUDY

by

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ABSTRACT

Background: Currently there is no system with high reliability to classify pediatric patients prior to surgery based on their physical status. The American Society of Anesthesiologists Physical Status (ASA-PS) classification system focuses on adult definitions and examples which exhibit high subjectivity along with low effectiveness for the pediatric patient population. The goal of this study was to optimize the ASA–PS system for pediatric populations by measuring interrater agreement of a pediatric adapted ASA–PS system with the collaboration from national and international perspectives.

Methods: A mixed–methods, prospective study of 197 pediatric anesthesiologists from 13 hospitals in the U.S., Europe and Australia were surveyed in May and July of 2019. Participants were given 15 pediatric cases with a mix of acute and chronic health conditions undergoing a myriad of surgical and nonsurgical procedures. The participants were instructed to assign ASA–PS scores (I to V) using the previously published pediatric adapted definitions of the ASA–PS system, which were provided. Using a two-way mixed effects model to account for multiple readers assigning scores for the same set of cases, intraclass correlation coefficient (ICC) of the ASA–PS scores among survey participants and their hospitals was estimated. The survey allowed for qualitative feedback on the pediatric adapted ASA–PS system via a free-text comments section which was analyzed using line–by–line assessment.

Results: Out of 197 participants there were 165 responses to the survey which gave a response rate of 83.8%. Across all 15 clinical cases the ICC agreement among all respondents to the ASA–PS scoring survey was 0.58 (95% CI: 0.42, 0.77). There was no significant variance in ICC based on years of anesthesiology practice. ICC was variable across all hospitals with a range from 0.34 to 0.79. The lowest level of agreement occurred in cases where ASA–PS scores of II and III were assigned; cases assigned ASA–PS scores of I, IV and V had the highest level of the agreement. Qualitatively, clarification on level of control with respect to a chronic condition and scoring in the setting of an acute illness were the two most common themes suggested in order to increase the validity of the pediatric-adapted ASA–PS definitions.

Conclusions: Compared to past literature the pediatric–adapted ASA–PS scoring system resulted in an increased interrater reliability when dealing with pediatric specific cases. Overall, the pediatric – adapted ASA– PS system had moderate interrater reliability among the pediatric anesthesiologists surveyed in this study, suggesting further refinement is needed. Specifically, the lower reliability of scoring for cases assigned ASA-PS scores II and III support the necessity for optimization of a pediatric specific ASA–PS system.

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LIST OF ABBREVIATIONS

ASA ....American Society of Anesthesiologists

ASA-PS .... American Society of Anesthesiologists Physical Status

IRB ....Institutional Review Board

ACS NSQIP .. American College of Surgeons National Surgical Improvement Program

EDC .... Electronic Data Capture

ICC .... Intraclass Correlation Coefficient

INTRODUCTION

The American Society of Anesthesiologists (ASA) is a physician association with the goal of increasing the standards of the practice of anesthesiology and improving patient care. It consists of a multi-tiered governance structure which oversee changes to the practice of anesthesiology. The first effort to quantify risk in medicine was done by physicians practicing the specialty of anesthesiology (Spell et al., 2006). Drs. Saklad, Rovenstiein, and Taylor were tasked by the American Society of Anesthesiologists (ASA) committee in 1940 to devise a system using anesthesia data to determine predictors of risk during an operative episode to be used in statistical analysis, which then could be applied in a variety of clinical scenarios. When attempting to define what is considered operative risk, Saklad et al. determine that it would be best to classify and grade patients only in relation to their physical status prior to surgery (Saklad, 1941). Saklad et al. went on to devise a six–point scale which ranged from a completely healthy person, scored as class 1, to a person with an extreme systemic disorder which is an imminent threat to life, scored as class 4. Saklad et al. also include class 5 and class 6 to code for emergencies that would otherwise be classified as class 1 or 2 and class 3 or 4, respectively (Saklad, 1941)(Table 1). The system currently in use was first proposed in 1961 by Dripps et al (Aplin et al., 2007). The first official publication of the American Society of Anesthesiologists Physical Status (ASA–PS) classification system was in 1963 adopting the system proposed by Dripps et al. (Dripps et al., 1963). Class 5 and 6 were removed at this time and instead an E modifier was included for classes 1 through 4 in cases of emergency. Classes 1 through 4 remained the same, however class 5 was later redefined as a moribund patient not expected to survive 24 hours if surgery was not performed. Further modifications were made to the original publication including the addition of a class 6 for patients who were brain-dead organ donors (Mayhew et al., 2019). In 2014 further modifications were made, including the reintroduction of examples which led to the ASA-PS system which is in place today (American Society of Anesthesiologists, 2014; Mayhew et al., 2019) (Table 2).

Table 1. Original Physical State Classification by Dr. Meyer Saklad.(Saklad et al., 1941)

Classification	Definition
Class 1	No organic pathology or patients in whom the pathological process is localized and does not cause any systemic disturbance or abnormality.
Class 2	A moderate but definite systemic disturbance, caused either by the condition that is to be treated by surgical intervention or which is caused by other existing pathological processes, forms this group
Class 3	Severe systemic disturbance from any calls or causes. It is not possible to state an absolute measure of severity, as this is a matter of clinical judgment.
Class 4	Extreme systemic disorders which have already become an imminent threat to life regardless of the type of treatment. Because of their duration or nature there has already been damage to the organism that is the irreversible. This class is intended to include only patients that are in an extremely poor physical state.
Class 5	Emergencies that would otherwise be graded in Class 1 or Class 2.

Class 6	Emergencies that would otherwise be graded in Class 3 or 4.

Table 2. Current ASA-PS Definitions and ASA-Approved Examples. (ASA, 2014)

ASA PS Classification	Definition	Adult Examples, including but not limited to:
ASA I	A **normal healthy** patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with a **mild systemic disease**	Mild disease only without substantive functional limitations. Examples include: current smoker, social alcohol drinker, pregnancy, obesity, well-controlled DM/HTN, mild lung disease
ASA III	A patient with **severe systemic disease**	Substantive functional limitations; one or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with **severe systemic disease** that is a **constant threat to life**	Examples include (but not limited to): recent (< 3 months) MI, CVA, TIA, or CAD/stents, ongoing

		cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A **moribund patient** who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASAVI	A declared **brain-dead patient** whose organs are being removed for donor purposes	

In the current practice of medicine, the ASA-PS classification system is not only applied to perioperative events but also has been applied to a myriad of other areas. The intended use of the ASA-PS system is to score patients solely based on their physical status on the day they present for an operative episode, as previously stated. However, the system has also been historically used to quantify perioperative risk, determine insurance reimbursement, surgical stratification and more. Quantifying risk using this system may be inaccurate due to the exclusion of the type of surgery, age, local disease, acute illness, malignancy and other clinical elements in the calculation of the score. Because of its use for insurance reimbursement and surgical case mix it is imperative that the clinician be as accurate as possible in order to prevent any misclassification. The concern is that the measurement of the ASA-PS system is subjective. The current system allows for subjective interpretation of the definitions as well as the severity described in each example. For this reason, the interrater reliability noted in past studies addressing both adult and pediatric applications of the ASA-PS system have been suboptimal for clinical practice (Ferrari et al., 2019). More specifically, it has been shown that the current ASA-PS system has poor concurrence among pediatric anesthesiologists (Ferrari et al., 2019). A recent study resulted in an intraclass correlation coefficient, which is defined as a descriptive statistic used to describe how strongly units in the same group resemble each other, of 0.47, indicating poor measurement error in the ASA-PS classification system (Aplin et al., 2007; Koch, 1982). Another study showed that 45% of pediatric patients that were scored as ASA-PS I had at least one chronic condition, and one third of those patients were found to have a Feudtner's Complex Chronic Condition, defined as "any medical condition that can be reasonably expected to last at least 12 months (unless death intervenes) and to involve either several different organ systems or 1 organ system severely enough to require specialty pediatric care and probably some period of hospitalization in a tertiary care center", which indicated a high risk for morbidity and mortality (Ferrari et al, 2020; Feudtner et al., 1997). Through these past studies it can be seen that further work and optimization is needed to obtain a classification that diminishes subjectivity and can lead to agreement more often than not by clinicians.

Although there is much debate on the reliability of the ASA-PS score it is still widely used in clinical anesthesiology practice around the world. Due to the lack of pediatric specific examples in the ASA-PS scoring system and the sole inclusion of disease examples more common in adult patients, there is a risk of mis-scoring pediatric patients. Using the ASA-PS system to score pediatric patients can be challenging even to the most seasoned pediatric anesthesiologists. The subjectivity and lack of pediatric specific examples are the main contributors to the challenge of using the adult based ASA-PS system in pediatric practice. The current ASA-PS system does not have pediatric specific chronic health conditions or any associated comorbidity included in the examples. This lack of pediatric specificity is what leads to the subjectivity and ambiguity on scoring pediatric patients prior to an operative episode.

Apart from pediatrics, obstetric patients also experience the discrepancies in scoring associated with the current ASA-PS system. Pregnant patients present with increased physiological factors that are not seen in the average patient (Barbeito et al., 2006). These different physiological factors can have significant implications during surgical encounters. Pregnant patients typically require special attention as their risk of adverse events during an anesthesia event is increased (Barbeito et al., 2006). When the original ASA-PS system was published and implemented in 1963 these special factors were not included in the stratification of disease states (Barbeito et al., 2006). There has been much deliberation on creating a system which is specific to women who are pregnant and in need of anesthesia. Barbeito et al. conducted a study in 2003 where the letter "G" (for gravid) was added to the current ASA-PS system in an attempt to diminish the discrepancy found with the system in place today. The simple modifier was added to the already established number system. With this modification, a pregnant woman scored as ASA I would instead be scored as ASA IG. The argument to include this modifier was made on the basis of the ASA-PS system already having the modifier "E" for emergency cases, therefore the "G" modifier would appropriately be used to classify pregnant patients. In the study by Barbeito et al. the use of the "G" modifier diminished the discrepancy for healthy patients. However, in more complex cases the "G" modifier did not significantly reduce the disagreement between anesthesiologists on the scoring of pregnant patients. This study by Barbeito et al. highlights the broad discrepancies associated with the current ASA-PS classification system. Since the ASA-PS system is broadly applied within the practice of anesthesiology, a system where there is more agreement than disagreement in all types of situations is needed in order to deliver the best care to patients.

The ASA-PS classification system is limited to systemic chronic diseases. It contains no input of surgery type or acute surgical pathology. Even so the ASA-PS system is used by many clinicians as a tool to quantify operative risk, something the classification system was not originally intended for. Saklad et al. stated in their original publication of the ASA-PS system that a calculation of risk must consider many factors and not just the physical status of the patient at the time of induction. They specifically mentioned factors such as surgical procedure, surgeon skill in the particular surgery, postoperative care quality and anesthesiologists experience in similar circumstances (Saklad et al., 1941). Today's clinical practice of anesthesiology has somewhat veered away from the original standard set by Saklad et al. and the ASA-PS system is often used to predict surgical risk, length of stay, readmission rate and other possible postoperative events. The original ASA-PS system was designed as a simple tool to communicate the state of the patient prior to the operative episode to the surgical team. Moving forward it would be imperative to solidify the distinction between the ASA-PS classification system and other surgical risk calculators such as the American College of Surgeons National Surgical Improvement Program (ACS NSQIP) surgical risk calculator. The NSQIP risk calculator takes many factors into account relating to the patients current state of health as well as the procedure being done. One of those factors is the ASA-PS of the patient prior to surgery. The inclusion of the ASA-PS to the NSQIP risk calculator was found to increase its power to predict surgical outcome (Davenport et al., 2006). ASA-PS system on its own has been shown to be a strong predictor of surgical outcome on its own, however it was not a stronger predictor than the NSQIP risk variables without the ASA-PS (Davenport et al., 2006). As a whole, the inclusion of the ASA-PS system in surgical risk calculators can help to establish a strong predictor of surgical outcome, however, there should be a cautious approach when using the ASA-PS classification system as the sole predictor of operative risk and postoperative course.

For the past few years insurance has played and continues to play an increasing role in the care provided at health institutions. With the implementation of Electronic Medical Records, insurance companies have been able to better track and reimburse interventional and surgical procedures, office visits, and many other aspects of healthcare. Accurate documentation has become a big part of a physician’s life to insure proper reimbursement and payment. When thinking about the practice of anesthesiology, billing can only occur for operative episodes of care. Private insurance in the United States reimburse anesthesia services on the basis of sum of base units, modifiers for intensity of care delivered, and time units (Schonberger et al., 2016). It is therefore important for anesthesiologists to maintain an accurate record of all the relevant events in the operating room. Part of the documentation, or charting, anesthesiologists perform is the ASA-PS score of the patient. This is perhaps one of the more critical aspects of care that gets recorded billing wise. In the operative setting, care intensity is quantified, partly, by using the ASA-PS classification system (Schonberger et al., 2016). Commercial insurance reimburses at a higher rate for cases with a higher burden of comorbidity (Schonberger et al., 2016). In other words, patients given an ASA-PS score from 3-5 will be billed at a higher level than those patients scored as ASA-PS 1 or 2. These aspects of insurance coding apply to both adult and pediatric practice. Therefore the ASA-PS classification system not only impacts the care given to patients but also the reimbursement for hospitals and physicians. For this reason, having an accurate ASA-PS system is important not only for the clinical aspects of care but also for the administrative area of care which helps to assure proper reimbursement for clinical expertise.

In this study we specifically looked at the ASA-PS as it applied to pediatric populations. In a previous study we had proposed pediatric specific ASA-PS definitions and examples which lead to an increased interrater reliability among pediatric anesthesiologists at Boston Children's Hospital (table 3) (Ferrari et al., 2019). The immediate goal of this study was to externally validate this pediatric modified ASA-PS system in order to optimize the ASA-PS system for pediatric patients. We sought validation from pediatric anesthesiologists from 13 different institutions all around the world. The broader goal of this study was to provide a starting point for further revision and betterment of the ASA-PS system for pediatric patients. To this effect we considered feedback and comments from the anesthesiologists to help initiate a dialogue on where improvements can be made. The hope in the long run is to engage the pediatric anesthesiology community in order to establish a modified ASA-PS classification system that is specific to children and their comorbidities, with the goal of improving patient care, surgical outcomes, and provider collaboration with a more objective and agreeable system than the one that is currently used.

Table 3. Pediatric Population Examples of the American Society of Anesthesiologists Physical Status (ASA-PS) Classification System.(Ferrari et al., 2019)

ASA-PS Category	Definition	Pediatric Population Examples (Including but NOT limited to)
ASA I	A normal **healthy** patient.	Healthy, normal BMI for age with no chronic disease.
ASA II	A patient with a **mild** systemic or acute disease; no functional limitations.	Corrected congenital cardiac abnormality; well controlled dysrhythmias, asthma without exacerbation, seizures, non-insulin dependent diabetes mellitus; abnormal BMI for age.
ASA III	A patient with a **severe** systemic or acute disease that is not life-threatening; some functional limitation	Uncorrected congenital cardiac abnormalities, chronic heart disease, chronic renal failure, epilepsy, muscular dystrophy, cystic fibrosis, asthma not well controlled, chronic respiratory disease, history of organ transplantation, brain and spinal cord malformation, malnutrition , insulin dependent diabetes mellitus, premature infant PCA < 60 weeks.

ASA IV	A patient with a severe systemic or acute disease that is a **constant threat to life;** functional limitation from severe, life-threatening disease.	Symptomatic congenital cardiac abnormalities, cerebral hemorrhage at birth, active sequelae of prematurity, hypoxic-ischemic encephalopathy, implanted devices, morbid obesity for age, hydrocephalus, ventilator dependence, gastrostomy, endocrinopathies, and metabolic diseases.
ASA V	A **moribund** patient who is not expected to survive beyond the next 24 hours without surgery.	Massive trauma, intracranial hemorrhage with mass effect, patients on ECMO, respiratory failure or arrest, malignant hypertension, congestive heart failure, hepatic encephalopathy, disseminating intravascular coagulation.

Abbreviations: BMI = body mass index; ECMO = extracorporeal membrane oxygenation, PCA = post-conceptual age

METHODS

Study Design

The study was approved by the Institutional Review Board (IRB) at Boston Children's Hospital by the method of exemption and the requirement of informed written consent was waived by the IRB. A mixed methods survey study was performed. 197 anesthesiologists from 13 academic institutions in the United States and Australia were surveyed (Ferrari et al., 2020). The institutions involved were: Children's Hospital of Philadelphia, Geneva University Hospital, Johns Hopkins All Children's Hospital, Lucile Packard Children's Hospital, Lurie Children's Hospital of Chicago, Mayo Clinic Jacksonville, Nationwide Children's Hospital, Nemours Children's Health System, Perth Children's Hospital, Texas Children's Hospital, The Children's Hospital at Westmead, and Women's and Children's Health Network South Australia (Ferrari et al., 2020). Attached to the survey invitation there was a cover letter with details on what the questionnaire was about, survey instrument and a copy of the pediatric adapted ASA-PS with pediatric specific example (Table 3) (Ferrari et al., 2020). Survey time ran from May to July 2019. RedCap survey software was used to capture the responses. Weekly reminders were sent out for participants who had not yet completed their responses during the first month of collection.

RedCap Software

RedCap is a browser based, meta-driven Electronic Data Capture (EDC) software released in 2004, for designing clinical and translational research databases (Harris, 2009). Developed by Vanderbilt University with the support of NCRR and NIH grants (Harris, 2009).

Clinical Cases

In the survey 15 hypothetical pediatric cases undergoing preoperative anesthesia evaluation were presented (Table 4) (Ferrari et al., 2020). These cases were modified from the Aplin study on pediatric ASA-PS scoring, approval to use the cases was obtained (Aplin et al, 2007). Each case included patient demographics, past medical history (including any complex chronic conditions), surgery type, and any acute health issue present at the time of evaluation. Cases were given to participants in the same order. Cases represent a mixed case load with varying degrees of severity in both past medical history and current state of health. A variety of surgical procedures was also part of the case mix.

Table 4. 15 Hypothetical Pediatric Cases Undergoing Preoperative Evaluation (Ferrari et al., 2020)

1. A previously well 17 kg 2 year old presents for bronchoscopy for removal of an inhaled foreign body after an observed choking episode 2 days ago. He has had an intermittent dry cough since but is in no distress. There are decreased breath sounds in the right upper lung fields. An expiratory CXR shows hyperinflation on the right side.

2. A 23 kg 6 year old with a 24 hour history of hematemesis and melena presents for gastric endoscopy. She has known portal vein thrombosis, portal hypertension, and esophageal varices secondary to umbilical venous catheterization as a neonate born at 28-week gestation. She has no respiratory disease. Her BP is 90/55 mmHg, HR 140 b/min with cool extremities. Glasgow Coma Scale is 15. Laboratory results include Hb 8.5 g/dl, platelets 83,000, and INR 1.8. Renal function and electrolytes are normal. She has received one unit of packed red cells and 500 ml of 0.9% normal saline.
3. An 11-month old 6 kg boy newly diagnosed with acute lymphocytic leukemia is scheduled for central line placement, lumbar puncture, bone marrow aspiration and biopsy. His laboratory results include Hb 9.2 g/dl, WBC 27,000, platelets 137,000. He is afebrile, chest is clear.
4. A 7-week old girl presents for ophthalmic examination under general anesthesia to rule out congenital cataracts. She was born at 40 weeks gestation via an uncomplicated normal vaginal delivery with a weight of 3500 g.
5. A 35 kg 8-year old girl presents for insertion of an external ventricular drain for a closed head injury. She was previously well. She was a pedestrian hit by a car traveling at 30 mph. Initial Glasgow Coma Scale was 7 and she was intubated at the scene. She is now artificially ventilated, sedated, and paralyzed. Radiographs of chest, pelvis and cervical spine are normal. She is hemodynamically stable BP 100/60 mmHg, HR 90 b/min after 500 ml of crystalloid. Her abdomen is soft. She has a right tibial fracture.
6. A 22 kg 4 year old presents for brain MRI under general anesthesia. She has poorly controlled epilepsy, with seizures increasing in frequency over the last few months accompanied by associated headaches. She takes sodium valproate daily.
7. A 6-month old 6.2 kg boy presents for excision of a large cystic hygroma of the neck which extends from his right ear to right shoulder. He is in no respiratory distress and is otherwise well.

8. A 2-week old 3500 g boy is scheduled for pyloromyotomy for congenital hypertrophic pyloric stenosis. He was born at term. He was admitted 3 days ago with vomiting and dehydration. After fluid resuscitation, his urine output is 3-5 ml/h. Laboratory results include pH 7.34, Na 135 mM, Cl 95 mM, K 3.7 mM and bicarbonate 28 mM.
9. A 20 kg 5-year old boy with Hurler's Syndrome presents with a very large umbilical hernia for herniorrhaphy. There are no signs of bowel obstruction. He is severely developmentally delayed. He is known to have mild mitral regurgitation. ECG is normal.
10. A 100 kg, 160 cm tall, 13-year old boy presents for surgery for slipped upper femoral epiphysis. He snores, but his mother has not reported apnea.
11. An 8-month old 10 kg girl presents for repair of cleft palate. Her history includes bilateral club feet and a previous cleft lip repair. She presents with a wet cough but is afebrile, chest is clear.
12. An 8-week old boy is scheduled for bilateral inguinal hernia repair. He was born at 34 weeks gestation with a weight of 1800 g. He was intubated and mechanically ventilated for 1 week, and hospitalized for a total of 6 weeks with respiratory distress syndrome and periodic apnea. He requires no supplemental oxygen and has been feeding well. Current weight 3000 g, Hb 9 g/dl.
13. A developmentally delayed 33 kg, 12-year old girl with severe cerebral palsy and a previous Nissen fundoplication presents for change of gastrostomy button. She is wheelchair bound. She is fed via gastrostomy and takes thickened fluids orally. She suffers from frequent choking episodes while feeding and has had multiple episodes of aspiration pneumonia. She has well controlled epilepsy, managed with sodium valproate. There are decreased breath sounds in both lung bases on auscultation and CXR shows bilateral basal atelectasis. She is afebrile, oxygen saturation 96% on room air, respiratory rate 20 breaths/min.

14. A 20 kg 3-year old boy with Down syndrome is scheduled for hypospadias repair. He underwent an uncomplicated VSD repair at 4 months of age. His sleep study reveals moderate obstructive sleep apnea. He is currently well.
15. A 41 kg 15-year old boy with asthma presents for closed reduction of a fractured finger. He has been admitted overnight several times with acute exacerbations of his asthma, most recently 15 months ago. He had a 3-day intensive care admission for respiratory distress at 4 years of age. Medications: salmeterol xinafoate (Serevent) and salbutamol prn. He is currently well, and his chest is clinically clear.

ASA-Definitions

Survey respondents were instructed to use the previously published pediatric specific ASA-PS classification system provided to them in order to score each case according to what score they thought most accurately represented the physical status of the patient (Table 3) (Ferrari et al., 2019). The respondents scored each case as ASA-PS I, II, III, IV, or V. The modifications to the ASA-PS system included pediatric specific conditions and health issues not previously found in the ASA-PS classification system.

Free-text Feedback

Along with the empirical data gathered from the ASA-PS scores (I to V) assignment, a free-text comment section was included in the survey. Participants were indicated to add any comments they would like to communicate which included but was not limited to any suggestions to future adaptations of the pediatric ASA-PS classification system (Ferrari et al., 2020).

Outcome Measure

Outcomes were measured using the ASA-PS score (I to V). Survey participants assigned an individual score to each of the 15 cases. Intraclass Correlation Coefficient (ICC) was then calculated as the statistical measure to evaluate interrater reliability (Ferrari et al., 2020). Qualitative analysis was also performed to extract and analyze the comments provided by participants in order to optimize the pediatric ASA-PS system used in this study (Ferrari et al., 2020).

Sample Size Calculation

For this study, the target sample size was 130 respondents. The aforementioned 13 institutions were requested to provide at least 10 anesthesiologists for response of the survey (Ferrari et al., 2020). Providing ASA-PS rating to the 15 hypothetical cases, the targeted sample size of 130 respondents was calculated to allow for the estimation of a two-tailed confidence interval of 95% for the ICC with a reasonable width of 0.15 for an anticipated ICC of 0.50 (Ferrari et al., 2020). Sample size and power calculations were performed using nQuery Advisor (version 8.2, Statistical Solutions Ltd., Cork, Ireland) (Ferrari et al., 2020).

Quantitative Analysis

In order to determine the interrater agreement on ASA-PS classification scores for the 15 hypothetical pediatric cases quantitative analysis was performed. Characteristics of participants were recorded based on years in anesthesiology practice. This information is presented as frequencies, percentages and a bar graph with the number of respondents per age group shown, as well as a bar graph displaying the amount of participants per institution. The 15 hypothetical pediatric cases were ordered in descending order by percentage of most frequently assigned ASA-PS score (mode), this was depicted by the use of bar graphs divided into 3 figures grouped as best agreement, moderate agreement and worst agreement. ICC was calculated for the total cohort, by institution, and by respondent experience (Ferrari et al., 2020). ICC by institution was depicted with the use of a forest plot. The ICC by respondent experience was shown as a bar graph as well as frequencies and percentages. ICC values were calculated along with 95% confidence intervals by the use of two-way mixed effects modeling to account for the same set of cases being assigned ASA-PS scores by multiple raters (Ferrari et al., 2020). For ICC interpretation values, less than 0.5 was interpreted as poor agreement, values between 0.5 to 0.75 were interpreted as moderate, 0.75 to 0.9 was interpreted as good agreement, and an ICC of 0.9 or higher was interpreted as excellent agreement (Liljequist et al., 2019). We used Stata software (version 15.0, StataCorp LLC., College Station, Texas) for the performance of all statistical analysis (Ferrari et al., 2020).

Qualitative Analysis

We provided an opportunity for feedback via a free-text comment section provided to all anesthesiologists from the 13 participating institutions. There were 68 comments provided by 58 anesthesiologists out of a total of 165 survey responses (83.8% response rate) during the three month period of the study (Ferrari et al., 2020). Any unique information given by an anesthesiologist in the designated section of the survey was considered 1 comment (Ferrari et al., 2020). At the end of the study 3 clinical experts performed the qualitative analysis by sorting, categorizing, and identifying common themes within the responses given from the participants (Ferrari et al., 2020). Data was then categorized as well as assigned properties and patterns. From the responses, group categories were created for pediatric ASA-PS related comments which included any suggestions or inclusions needed to be added to the modified system. Twelve categories were created by the free-text comments made by anesthesiologists. The categories and the amount of times the comment was made were as follows: Obstructive Sleep Apnea had 3 comments; Oncologic State had 6 comments; Emergent Classification had 11comments; Autism had 3 comments; Age/ Prematurity had 6 comments; Syndromes had 4 comments; Long-term Parenteral Nutrition had 1 comment; BMI/Obesity had 8 comments; Congenital Heart Disease had 2 comments; Implanted Devices had 7 comments; Acute Illness vs. Previously Healthy had 15 comments and Seizure/Epilepsy had 2 comments (Ferrari et al., 2020). Data was collected using the RedCap survey system thus providing descriptive validity and accurate documentation. We reviewed the comments and compared them to create a consistent system of assignment and categorization of the comments. The categories are depicted by a pie-chart with the associated percentage as a factor of the total volume of comments. Modifications to the previously published pediatric specific ASA-PS classification system were made according to the qualitative data gathered. Overall, there were 24 modifications made, unequally spread out between ASA-PS I to ASA-PS IV. A new table was created with the modifications and descriptions of what was changed (Table 5).

Table 5. Modified Pediatric ASA-PS Classification System with Suggestions from Qualitative Analysis (Ferrari et al., 2020)

ASA Physical Status	Definition	Examples, including but NOT limited to
ASA I	A normal **healthy** patient	Healthy (no acute or chronic disease), normal BMI for age.
ASA II	A patient with a **mild, well controlled** systemic or acute disease; no functional limitations.	Corrected congenital cardiac abnormality, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations.
ASA III	A patient with a **moderate to severe** systemic or acute disease that is not life-threatening; some functional limitation	Uncorrected congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA < 60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition.

ASA IV	A patient with a **severe** systemic or acute disease that is a **constant threat to life;** functional limitation from severe, life-threatening disease.	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress.
ASA V	A **moribund** patient who is not expected to survive beyond the next 24 hours without surgery.	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.
ASA VI	A **brain-dead** patient whose organs are being removed with the intention of transplanting them into another patient.	

RESULTS

Study Population Characteristics

The survey was sent to 197 anesthesiologists worldwide, 165 responses to the survey were received, or a 84% response rate (Ferrari et al., 2020). The amount of years each anesthesiologist was in practice was divided into brackets as follows: 0-5 years, 6-10 years, 11-20 years, and over 20 years of experience. Fifty-seven (35%) of anesthesiologists had 11-20 years of experience, 48 (29%) had over 20 years of experience, 48 (29%) had 6-10 years of experience, and 12 (18%) had 0-5 years of experience as an anesthesiologist (Figure 1) (Ferrari et al., 2020).

Hypothetical Cases

Depicted in Figures 2,3, and 4 is the percent agreement of most frequently assigned ASA-PS score per each of the 15 cases in descending order, respectively. The figures are categorized as best agreement, moderate agreement, and worst agreement (Figure 2, 3, and 4 respectively) (Ferrari et al., 2020).

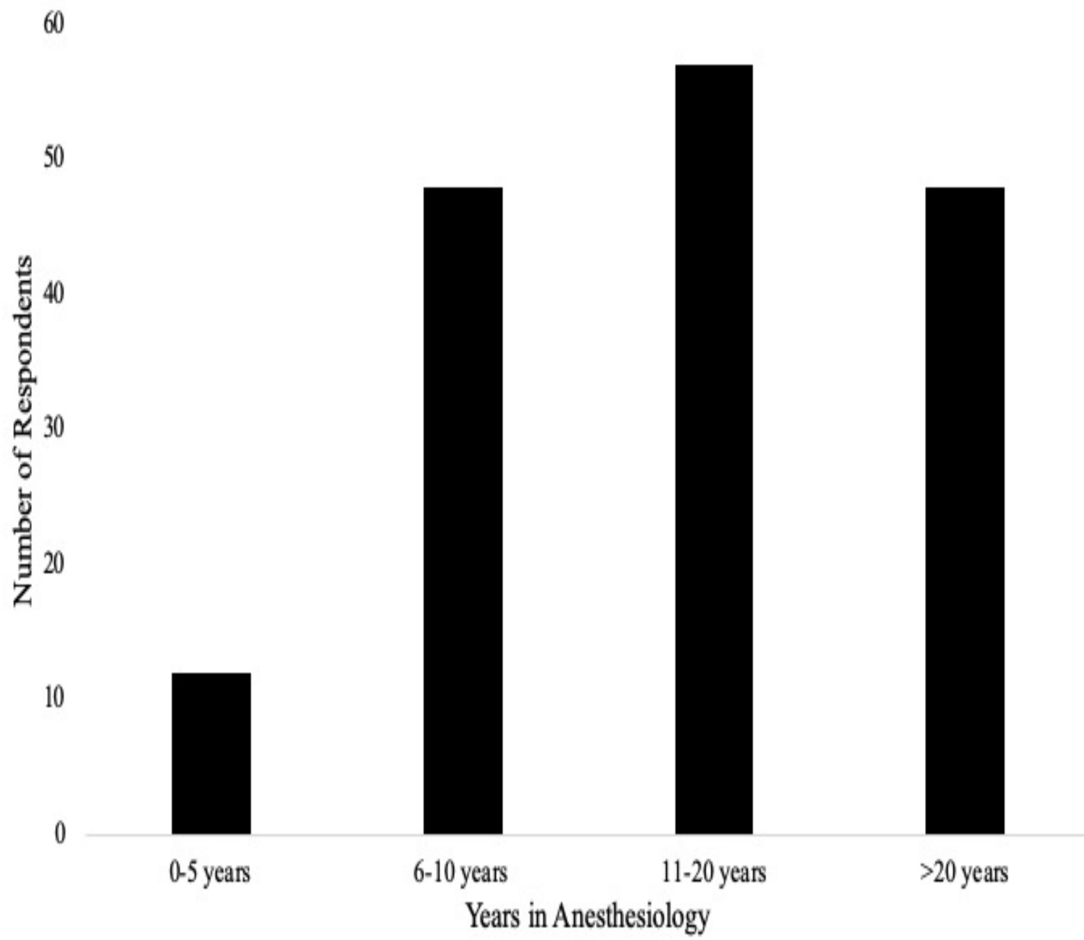
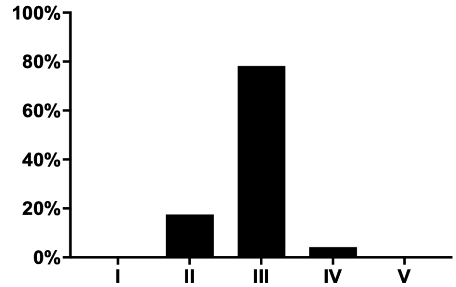
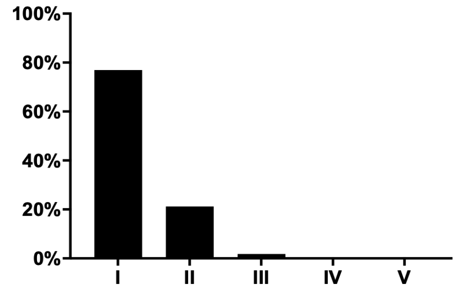


Figure 1. Number of Anesthesiologists per Age Group (n=165)

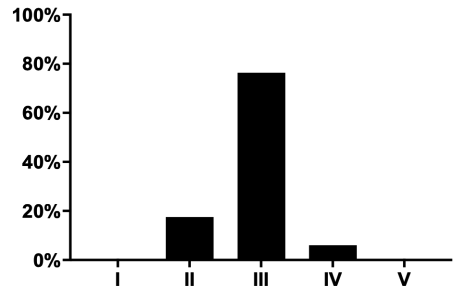
A 22 kg 4 year old presents for brain MRI under general anesthesia. She has poorly controlled epilepsy, with seizures increasing in frequency over the last few months accompanied by associated headaches. She takes sodium valproate daily.



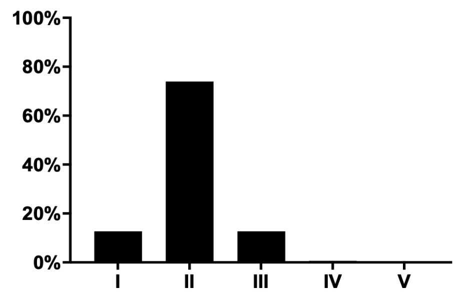
A 7-week old girl presents for ophthalmic examination under general anesthesia to rule out congenital cataracts. She was born at 40 weeks gestation via an uncomplicated normal vaginal delivery with a weight of 3500 g.



An 11-month old 6 kg boy newly diagnosed with acute lymphocytic leukemia is scheduled for central line placement, lumbar puncture, bone marrow aspiration and biopsy. His laboratory results include Hb 9.2 g/dl, WBC 27,000, platelets 137,000. He is afebrile, chest is clear.



An 8-month old 10 kg girl presents for repair of cleft palate. Her history includes bilateral club feet and a previous cleft lip repair. She presents with a wet cough but is afebrile, chest is clear.



A 20 kg 5-year old boy with Hurler's Syndrome presents with a very large umbilical hernia for herniorrhaphy. There are no signs of bowel obstruction. He is severely developmentally delayed. He is known to have mild mitral regurgitation. ECG is normal.

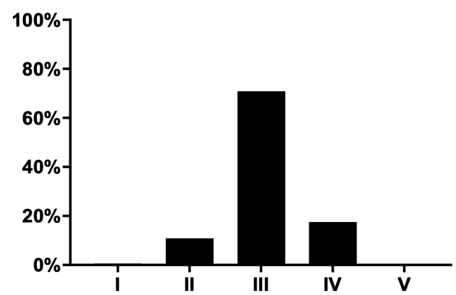
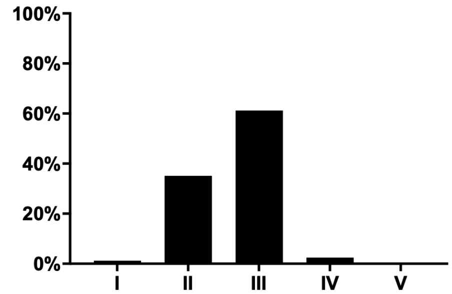
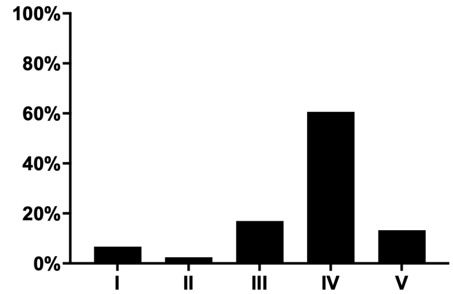


Figure 2. Cases Showing Best Agreement of ASA-PS Score (Ferrari et al., 2020)

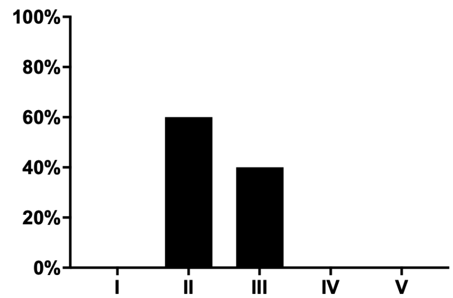
An 8-week old boy is scheduled for bilateral inguinal hernia repair. He was born at 34 weeks gestation with a weight of 1800 g. He was intubated and mechanically ventilated for 1 week, and hospitalized for a total of 6 weeks with respiratory distress syndrome and periodic apnea. He requires no supplemental oxygen and has been feeding well. Current weight 3000 g, Hb 9 g/dl.



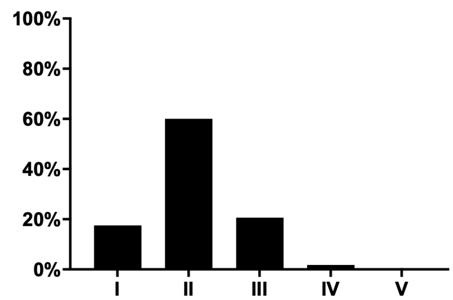
A 35 kg 8-year old girl presents for insertion of an external ventricular drain for a closed head injury. She was previously well. She was a pedestrian hit by a car traveling at 30 mph. Initial Glasgow Coma Scale was 7 and she was intubated at the scene. She is now artificially ventilated, sedated, and paralyzed. Radiographs of chest, pelvis and cervical spine are normal. She is hemodynamically stable BP 100/60 mmHg, HR 90 b/min after 500 ml of crystalloid. Her abdomen is soft. She has a right tibial fracture.



A 41 kg 15-year old boy with asthma presents for closed reduction of a fractured finger. He has been admitted overnight several times with acute exacerbations of his asthma, most recently 15 months ago. He had a 3-day intensive care admission for respiratory distress at 4 years of age. Medications: salmeterol xinafoate (Serevent) and salbutamol prn. He is currently well, and his chest is clinically clear.



A 2-week old 3500 g boy is scheduled for pyloromyotomy for congenital hypertrophic pyloric stenosis. He was born at term. He was admitted 3 days ago with vomiting and dehydration. After fluid resuscitation, his urine output is 3-5 ml/h. Laboratory results include pH 7.34, Na 135 mM, Cl 95 mM, K 3.7 mM and bicarbonate 28 mM.



A 20 kg 3-year old boy with Down syndrome is scheduled for hypospadias repair. He underwent an uncomplicated VSD repair at 4 months of age. His sleep study reveals moderate obstructive sleep apnea. He is currently well.

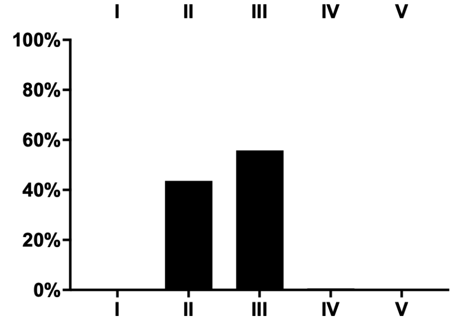
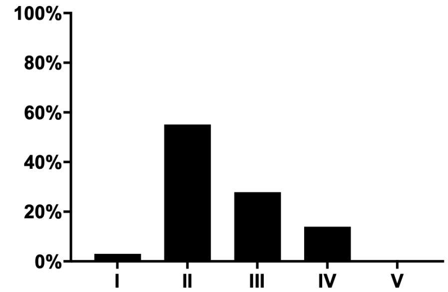
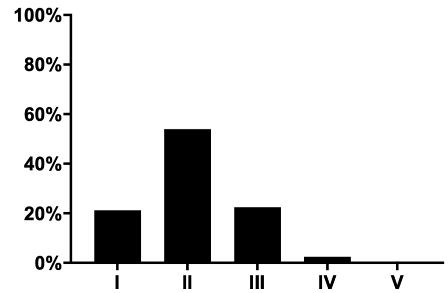


Figure 3. Cases Showing Moderate Agreement of ASA-PS Score (Ferrari et al., 2020)

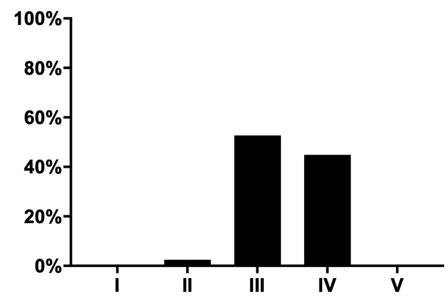
A 100 kg, 160 cm tall, 13-year old boy presents for surgery for slipped upper femoral epiphysis. He snores, but his mother has not reported apnea.



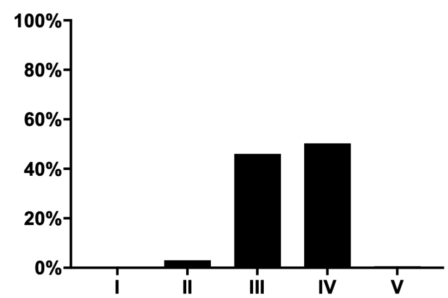
A 6-month old 6.2 kg boy presents for excision of a large cystic hygroma of the neck which extends from his right ear to right shoulder. He is in no respiratory distress and is otherwise well.



A developmentally delayed 33 kg, 12-year old girl with severe cerebral palsy and a previous Nissen fundoplication presents for change of gastrostomy button. She is wheelchair bound. She is fed via gastrostomy and takes thickened fluids orally. She suffers from frequent choking episodes while feeding and has had multiple episodes of aspiration pneumonia. She has well controlled epilepsy, managed with sodium valproate. There are decreased breath sounds in both lung bases on auscultation and CXR shows bilateral basal atelectasis. She is afebrile, oxygen saturation 96% on room air, respiratory rate 20 breaths/min.



A 23 kg 6 year old with a 24 hour history of hematemesis and melena presents for gastric endoscopy. She has known portal vein thrombosis, portal hypertension, and esophageal varices secondary to umbilical venous catheterization as a neonate born at 28-week gestation. She has no respiratory disease. Her BP is 90/55 mmHg, HR 140 b/min with cool extremeties. Glasgow Coma Scale is 15. Laboratory results include Hb 8.5 g/dl, platelets 83,000, and INR 1.8. Renal function and electrolytes are normal. She has received one unit of packed red cells and 500 ml of 0.9% normal saline.



A previously well 17 kg 2 year old presents for bronchoscopy for removal of an inhaled foreign body after an observed choking episode 2 days ago. He has had an intermittent dry cough since but is in no distress. There are decreased breath sounds in the right upper lung fields. An expiratory CXR shows hyperinflation on the right side.

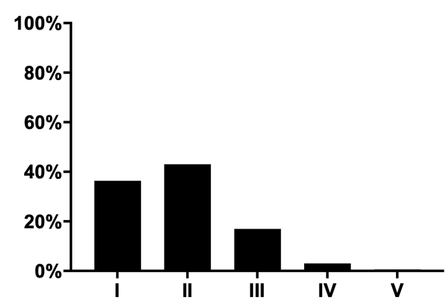


Figure 4. Cases Showing Worst Agreement of ASA-PS Score (Ferrari et al., 2020)

Interrater Reliability of the Overall Study

The overall Intraclass Correlation Coefficient (ICC) for the study was 0.58 (95% CI: 0.42, 0.77) which is rated as moderate (Ferrari et al., 2020). The ICC was used as a measurement of agreement for all cases on the ASA-PS scoring between all participants in the study from the 13 institutions. There was similarity for ICC values when categorized by years of anesthesiology practice (0.61 for 1 to 5 years in practice, 0.58 for 6 to 10 years in practice, 0.56 for 11 to 20 years in practice, and 0.59 for more than 20 years in practice) (Ferrari et al., 2020). ICC per year of anesthesiology practice is also presented visually in Figure 5.

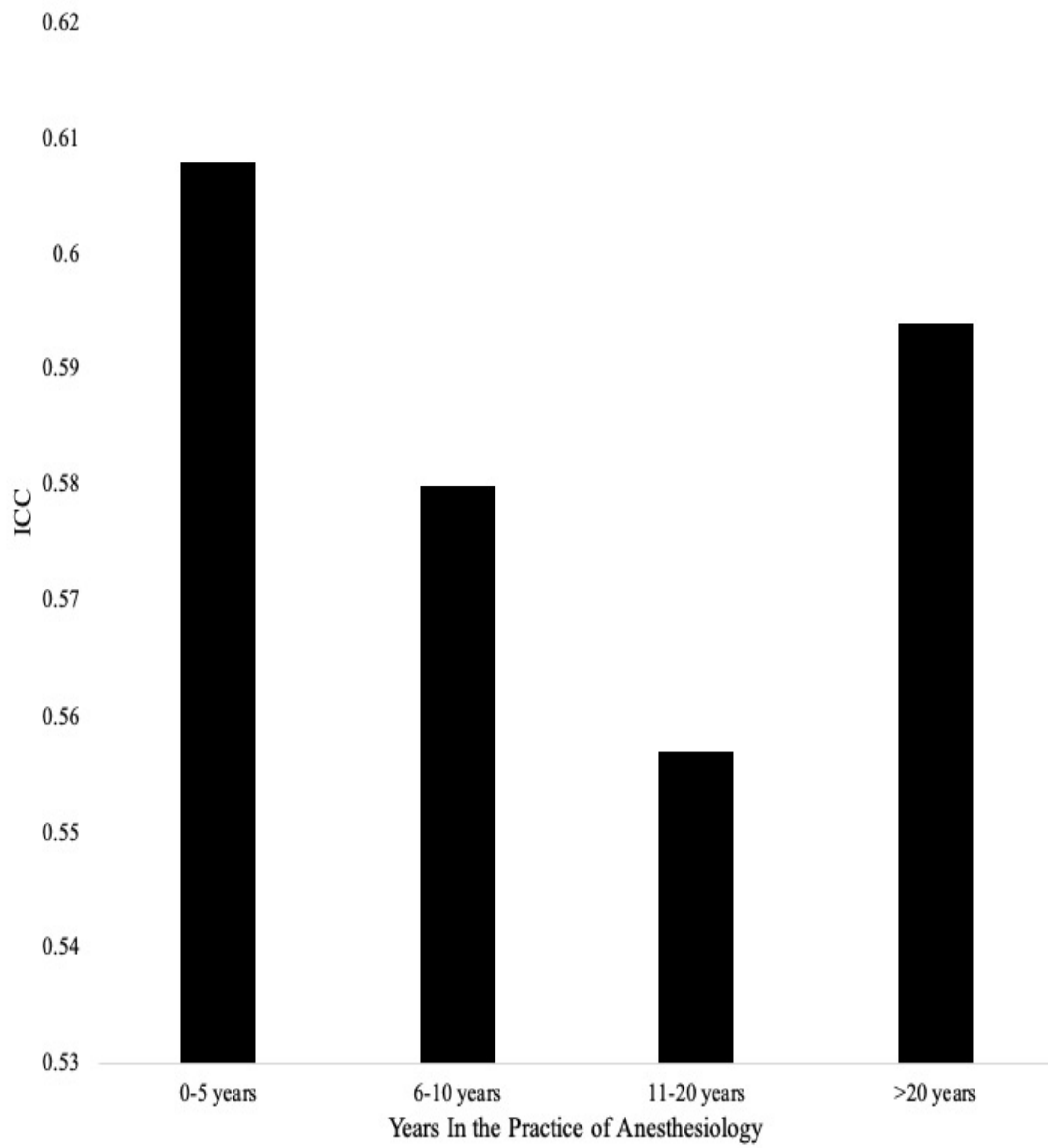


Figure 5. Intraclass Correlation Coefficient (ICC) by Years of Anesthesiology Practice

ASA-PS Score Reliability by Institution

ICC range for within-institution ASA-PS scoring was 0.34 (95% CI: 0.122, 0.626) to 0.79 (95% CI: 0.658, 0.907) (Ferrari et al., 2020). The lowest performing institution was Nationwide Children's Hospital with an ICC of 0.34 (95% CI: 0.122, 0.626) (Ferrari et al., 2020). This institution had 5 total participants in the study, which was the second lowest amount, yet no complete agreement on ASA-PS score for any of the 15 cases. The highest performing institution was Nemours Children's Health System with an ICC of 0.79 (95% CI: 0.658, 0.907) (Ferrari et al., 2020). This institution had 13 total participants in the study, which was the third highest amount, and accord on one ASA-PS score was achieved in 9 of the 15 cases. Width variability for the 95% confidence interval was in relation to the amount of respondents per institution (Ferrari et al., 2020). ICC per institution is visibly displayed in Figure 6, and number of participants per institution is visually represented by Figure 7.

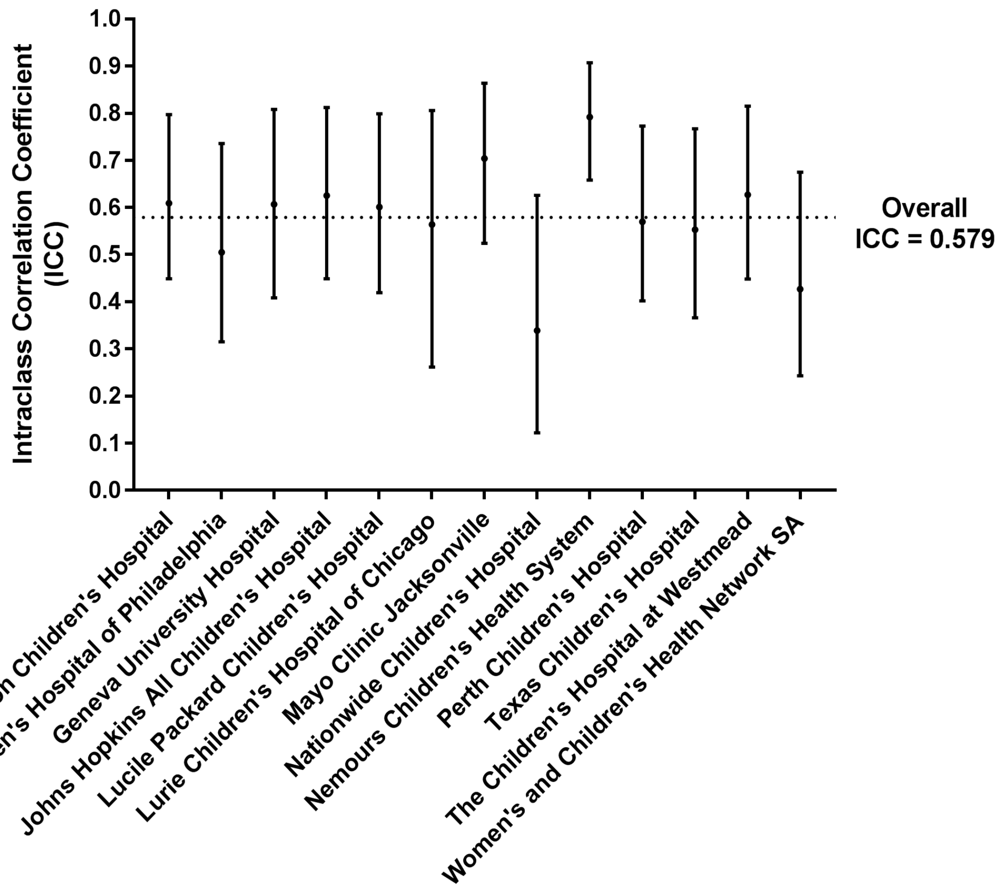


Figure 6. Overall ICC for ASA-PS Scoring per Institution (n=165)

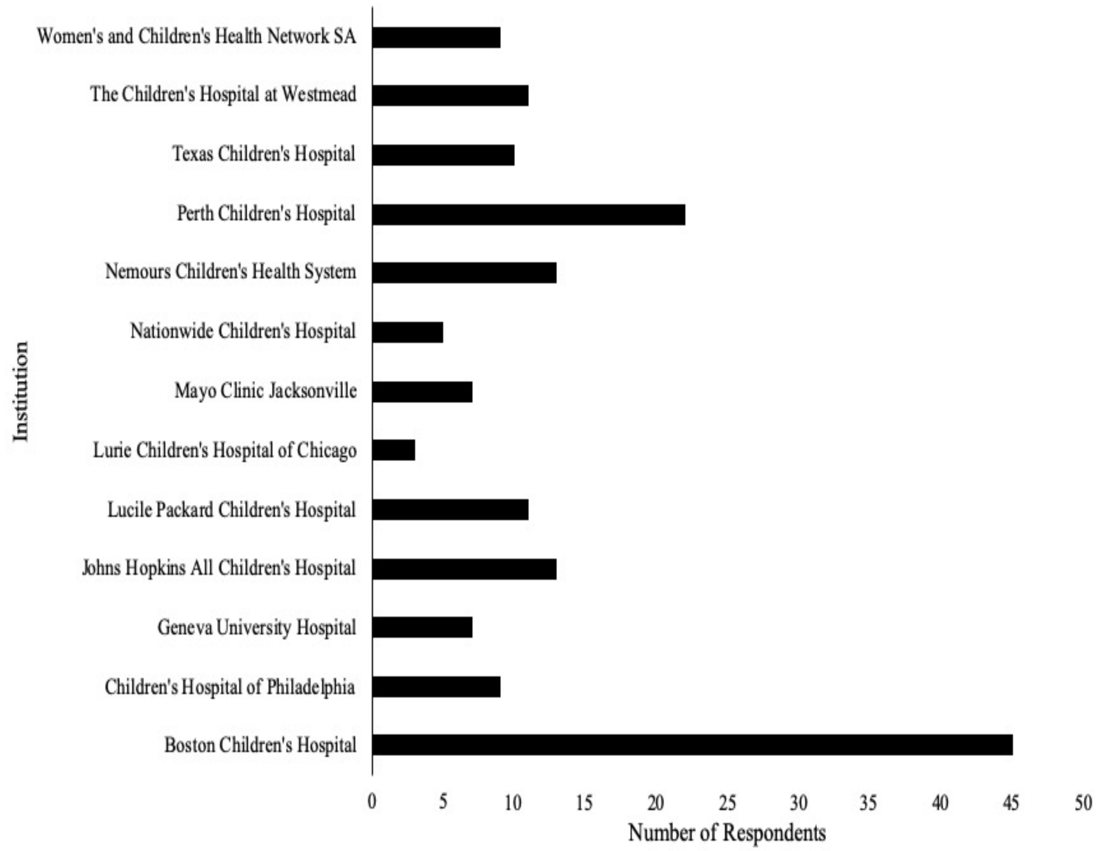


Figure 7. Number of Participants per Institution

ASA-PS Score Reliability by Institution

A total of 68 free-text individual comments were submitted; 3 providers submitted via email while 58 submitted via the comments section provided in the survey, this equaled a total of 61 participants providing comments for our study (Ferrari et al., 2020). Through these comments, 12 themes were categorized and they provided a basis for further modification of the pediatric specific ASA-PS classification system, these modifications were included in Table 5. A visual representation of the 12 themes and their associated percentage as a factor of the total amount of comments is displayed in Figure 8.

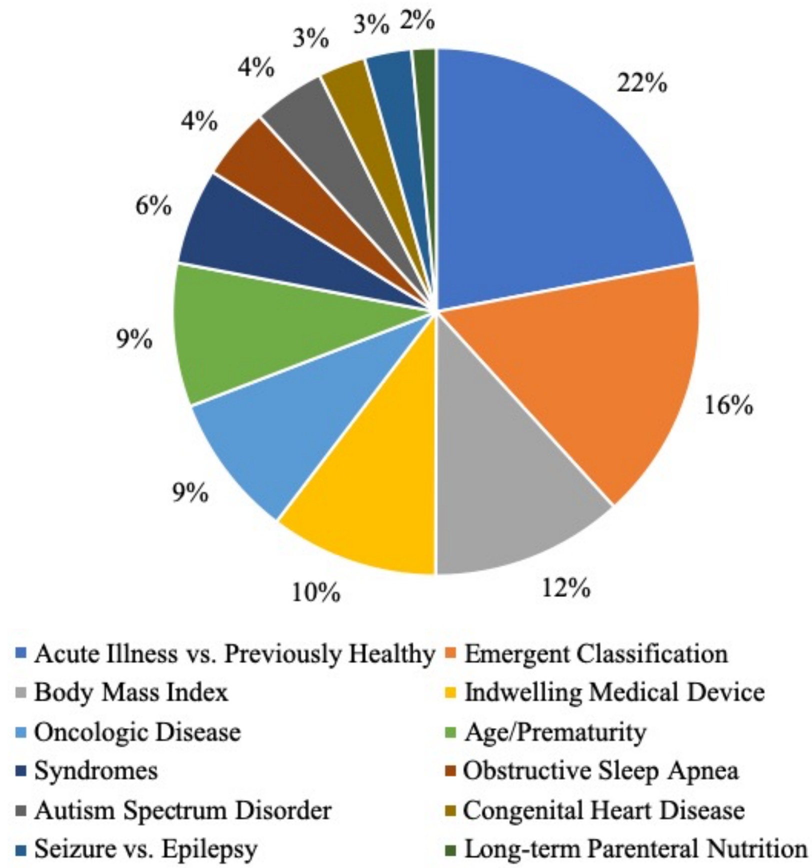


Figure 8. 12 Themes to Consider for Additional Refinement of the Pediatric ASA-PS System Based on Comments Provided by Participants

DISCUSSION

Attempting to quantify perioperative risk is a task which has challenged physicians. Currently there are few tools available to facilitate the quantification of clinical risk . The American Society of Anesthesiologists Physical Status (ASA-PS) classification system has been, at times, incorrectly applied by practitioners to be the sole factor used to assess risk in the operative setting for patients (Sweitzer, 2017). The true objective of the ASA-PS system is to assess a patient's physical status when presenting for surgery (Saklad et al., 1941). However, with its known predictive ability as a component in determining risk for surgery, risk calculators use the ASA-PS system as part of their overall perioperative risk assessment (Davenport et al., 2006). The ASA-PS scoring has been a useful tool for communication between physicians and to document the health of a patient preoperatively (Leahy et al., 2018). Since its original publication in 1961 by Dripps et al. the ASA-PS system has undergone some changes to optimize effectiveness. It is now used in many different aspects of health care such as for insurance claims, by law firms and other regulatory agencies. Due to the misplaced perception of the ASA-PS system being a risk assessment tool, misinterpretation can be a liability for outside institutions. The ASA-PS system has different billing codes in different states within the United States, for example (Johnstone & Hosaflook, 2000; Vogt & Henson, 1997). This can lead to financial implications that can have an effect on both patients and hospitals alike. Part of the importance of having a tool like the ASA-PS system is to assure a consistent definition is established and is made known to all parties who use it. This aspect of the ASA-PS system is out of the scope of our study but we would like to acknowledge its importance to the overall scheme of the system.

As described before, misinterpretation of the ASA-PS system can lead to downstream effects which can have an impact on many factors in the care of patients, as well as financial implications. The main liability when applying the ASA-PS system is the subjectivity of the scoring (Mak et al., 2002; Hurwitz et al., 2017). Although examples are available for the clinician, there is an inherent subjectivity related to anesthesiologist practice experience, personal anecdotal case experience, interpretation of the examples, or ill-defined definitions, these factors lead to a subjective system. In a study of 10 hypothetical cases distributed to 249 anesthesiologists in Finland a wide variety of classifications were found for all 10 cases (Ranta et al., 1997). One of the 10 cases was given all ASA-PS classifications at least once (Ranta et al., 1997). This subjectivity is increased in the pediatric setting. The ASA-PS classification system does not have any pediatric based examples or definitions included. This can lead to mis-scoring of pediatric patients because it leaves room for interpretation of the definitions, along with severity of the patient's current clinical status. In the study performed by Aplin et al., 15 hypothetical pediatric cases were scored by 130 anesthesiologists using the current ASA-PS classification system (Aplin et al., 2007). The study showed each case receiving at least three individual ASA-PS scores (Aplin et al., 2007). With this example in mind it is easy to see there is a need for an ASA-PS classification system which is specific to the practice of pediatric anesthesiology in order to increase reliability in the classification of patients.

The primary objective of this study was to provide a starting point for establishing a classification system appropriate for the use in pediatrics. It is acknowledged that this study is not sufficient to change the practice of anesthesiology, however we are hopeful to be able to show the positive impacts of an ASA-PS classification system which is specific to the pediatric cohort. It is a difficult task to group pediatric patients along with the adult population as the physiology and overall medical needs are substantially different. Therefore, the hope is to be able to, in the future, establish guidelines which pediatric anesthesiologists can use to have a more standardized system when scoring patients based on their physical status. It has been shown in previous studies that the use of specific examples in the ASA-PS classification system has increased the reliability of the tool (Hurwitz et al., 2017). By taking this same concept and applying pediatric examples we hoped to further enhance the reliability of ASA-PS classification. We also would like to welcome engagement on this topic by other physician anesthesiologists as well as governing bodies in the practice of anesthesiology to help create a more objective and streamlined classification system. By creating a classification system that is objective and streamlined pediatric anesthesiologists will possess a tool which will enhance the practice and the outcomes of pediatric patients. When enhancing medical practice, the benefits can be seen by both physicians and patients. A pediatric ASA-PS classification would, by helping anesthesiologists, better the patient experience during an operative episode by creating a more accurate record which assists in establishing standardized care that can be interpreted in the same way by different physicians.

This study may stimulate discussion with respect to improving the ASA-PS classification system. The qualitative portion of the study allowed for participants to give input on anything they would like to add or change. The input given demonstrated there is a need for further refinement needed for a pediatric ASA-PS classification system to be optimized for use in practice. The themes presented in Figure 8 would help to provide more pediatric specific examples. Moving forward it is felt they should be included in any discussion of a pediatric specific ASA-PS classification system. It is recognized that the addition of examples should simplify the tool and must not allow for an overcomplicated system. Use of a pediatric ASA-PS classification should be user friendly and reduce the time needed for decision making in the preoperative setting. To achieve this, it is important to limit the examples to those which are necessary when scoring patients, as well as make examples easy to understand by clinicians.

The results of our study showed consistency in themes with ASA-PS scoring as other studies have shown. The greatest agreement was found in in ASA-PS scores of I, IV, and V while the worst agreement was found in scores of II and III. The scores of II and III are what is known as the "grey zone" in ASA-PS scoring. These particular scores are difficult to differentiate because of the small difference in their definitions. Score of II is for a "mild systemic disease" while a score of III is for a "severe systemic disease". The differentiation between mild and severe can be left up to interpretation by the clinician. This interpretation can be a result of different factors for example the clinicians experience, the acuity of the cite where the clinician practices, the resources available at their home cite, and also the history given by the patient and their family. All these factors can influence how a clinician can perceive a case. An attempt to diminish the subjectivity between scores II and III was done by including "functional limitation" in the definition of an ASA-PS score of III. Unfortunately, this did not seem to have as much of a significant impact as we would have hoped, as this still gives room for a subjective interpretation of the two scores. The ultimate goal for future versions of the score would be to eliminate any room for subjectivity, a feat that has caused much debate for the anesthesia community in the past.

Having a system in place that offers consistency and objectivity can alleviate some of the gaps in knowledge available to clinicians in the operative setting. The ASA-PS classification system is a part of surgical risk calculators such as the NSQIP calculator. It is therefore imperative to optimize the ASA-PS classification system for pediatric patients in order to have accurate risk calculations and assessments. This would ultimately improve the care for patients as different clinicians would be able to reference standard information across specialties during an operative episode. As an example the anesthesiologist scoring a patient intraoperatively may classify the case as an ASA-PS I but the anesthesiologist in the post anesthesia care unit might assess the patient as an ASA-PS III allowing for variations in care. These variations in care can be costly for both the patient and their hospital experience as well as for the hospital itself as there might be a greater allocation of resources when cases are scored higher. With the increase demand in care, some hospitals have adapted multiple sites where care is delivered. Increasing the objectivity of the ASA-PS classification system will allow for greater concordance in care for all sites, as well as between different hospital systems.

The current ASA-PS classification system is not just used by physicians, but also by insurance companies for billing purposes. Commercial insurance companies compensate at a higher rate for cases with higher complexity, ASA-PS III and IV, then they do for cases of lower complexity, ASA-PS I and II (Schonberger, 2016). With this in mind, it is important to assure the ASA-PS classification system is as accurate as can be. With more standardized and accurate definitions physicians will be able to have greater agreement when classifying patients based on the ASA-PS classification system. This in turn will lead to accurate billing and compensation for both physicians and hospitals alike. A pediatric specific ASA-PS classification system will help to achieve just that. Classifications specific for children will allow physicians to bill more accurately and for insurance companies to compensate at the true level of care given to the patient. This would also become standardized across institutions. Some institutions may not be as well-versed in caring for children of high complexity as others, therefore at times they can score these cases at an overestimated level. Anesthesiologists who are not trained in pediatrics may also have to assign an ASA-PS score and this could lead to the same results. Having specific pediatric examples as part of the ASA-PS classification system will allow for accurate documentation of all cases and lead to an accurate billing rate across different hospitals. In the era of Electronic Medical Record where data is easily accessible, it is paramount that the data makes sense to everyone no matter their training or area of expertise is. This consistency will lead to a betterment in care, reimbursement, patient experience, and streamline of the processing of administrative obligations.

This study has some limitations. The hospitals involved in the study may have had varying levels of patient acuity and complexity. This can have an influence in scoring of patients using the ASA-PS classification. Anesthesiologists from hospitals with a low number of high complexity patients may have overestimated the scoring of cases solely on whether they felt the hospital was prepared for such a case or whether they themselves had the proper experience dealing with a patient with a high level of complexity. Practice parameters at individual institutions may have also played a role in the ASA-PS scoring by each anesthesiologists. Each institution may have practice parameters in place which are unique to the way they use the ASA-PS classification system and this may have affected whether a participant scored the case higher or lower. We did not include a part in the study which allowed for participants to provide their reasoning behind each score. This could have been a way in which more qualitative data could have been obtained to further refine the pediatric specific ASA-PS classification, as well as offer an insight into the thought process of each individual participant. The study was also limited to pediatric anesthesiologists. Including anesthesiologists who do not typically practice pediatric anesthesiology in the study might have added value by seeing how the pediatric specific ASA-PS classification system works with clinicians of low experience in a patient age group. Lastly, there was no assessment of whether participants used a unique past experience to score the cases. Outcomes particular to each participant could have influenced their scoring due to similarities they found between an outcome they had in the past and one of the cases presented in the survey.

To conclude, by using the pediatric specific ASA-PS classification system the inter-rater reliability when compared to previous studied has improved. However, as a whole it can only be classified as moderate agreement. This suggests further optimization and work is needed to formulate a classification system which has more consistency. The qualitative analysis of the comments gave us more data to further improve the ASA-PS classification system used in this study. We acknowledge this may be of use for further study, however, our current study's purpose was to provide a starting point for discussion rather than a final solution. What is consistent with previous studies is the ambiguity found for ASA-PS scores II and III, suggesting that defining these definitions better may lead to higher agreement. In a general sense, since improvement was shown with the pediatric specific ASA-PS classification system, it could be used in the future to better scoring consistency. We acknowledge that future iterations of the ASA-PS score must coincide with the advancements in medicine. Ultimately this study opens the door for further discussion on the ASA-PS classification system in pediatric populations, but also provides a basis for future work to take a foothold. Any further optimization and validation of the Pediatric ASA-PS classification system may be done by future prospective studies.

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CURRICULUM VITAE

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EDUCATION

Boston University, Boston, Massachusetts — August 2018 - Present
Masters of Medical Science

Florida Atlantic University, Boca Raton, Florida — May 2018
Bachelor of Science in Biological Sciences

- Honors College

Coral Glades High School, Coral Springs, Florida — June 2014
Diploma

- Graduated ranked 27th out of 550+ students, Freshman year valedictorian

CLINICAL EXPERIENCE

Anesthesia Technician Training — October 2019 – Present
Boston Children's Hospital (Pediatric Anesthesia)
Boston, Massachusetts

Clinical Shadowing — June 2017 – December 2017
Dr. Vivian Hernandez-Trujillo, M.D. (Pediatric Allergy and Immunology)
Miami Lakes, Florida

Clinical Shadowing — August 2015 – December 2016
Dr. Carlos Barbosa, M.D. (General Pediatrics)
Plantation, Florida

RESEARCH EXPERIENCE

Perioperative Surgical Home Research Group — August 2019 - Present
Boston Children's Hospital
Boston, Massachusetts

COMMUNITY SERVICE

Emergency Department Volunteer December 2017 – August 2018
Memorial Regional Hospital, Hollywood, Florida

Assistant Travel Soccer Coach September 2017 – January 2018
Coral Springs United Football Club
Coral Springs, Florida

WORK EXPERIENCE

Medical Scribe October 2019 – Present
ScribeAmerica
Urology, Massachusetts General Hospital, Boston, Massachusetts

Service Department Cashier January 2018 – May 2018
Palmetto 57 Volkswagen Service Department
Miami Lakes, Florida

Cashier August 2015 – August 2017
Armani Exchange
Sawgrass Mall, Sunrise, Florida

Market Research Manager August 2015 – December 2015
Toucan Air, LLC.
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LANGUAGES

- English – Native
- Spanish – Native
- Portuguese – Conversational