

Summary

Both students and faculty have consistently identified pre-clinical pediatric education at Washington University School of Medicine as an opportunity to improve preclinical education and preparation for the pediatric third year clerkship. Over the past 18 months, a robust needs assessment has been conducted to identify the validity of such concerns as well as possible solutions; this assessment has demonstrated multiple opportunities to maximize student learning of pediatric medicine. The solution proposed is conversion of the independent course into a longitudinal, integrated pediatrics curriculum (commonly referred to as a *thread* curriculum). This change utilizes medical education best practices to provide increased student exposure to critical pediatric content as well as to pediatric faculty, and would be an ideal educational intervention to improve student education in pediatric medicine. Specific educational strategies would involve beginning each course with a Survey in Pediatrics session to provide students with a roadmap to the pediatric content contained within each course that block. In addition, pediatric content within more adult-focused sessions would be highlighted in a standardized manner allowing students to easily identify and return to that content. Medical education literature on conversion of an existing pre-clinical course to a thread curriculum is lacking, especially in pediatric medicine. As such, conversion of the proposed curriculum would provide multiple opportunities for peer-reviewed scholarship. The following proposal will provide a detailed curriculum development assessment and plan for the conversion of the current pre-clinical pediatrics course into a thread curriculum.

Problem Identification

While healthcare spending rose globally in 2011, the latest published report shows that pediatric care had the greatest rise in spending as compared to any other age group.¹ Additionally, many publications have detailed the impact of adult behaviors on overall pediatric health, health care utilization and health care costs.²⁻⁴ As such, medical education has a responsibility to optimally train all future physicians in pediatric care. Specifically, medical students must be exposed to the fundamentals of pediatric care, foundational pediatric terms and the unique facets of pediatric care in the realms of health supervision, health disparities, common pathologies and systems-based impact on healthcare. Additionally pediatrics is a realm of medicine which remains relevant to every future physician because of the inevitable questions regarding their own children as well as advice sought by family and friends.

The current approach to pre-clinical pediatric education is a single pediatric course (recently moved to the fall of 2nd year) with a total of 15 course hours divided amongst didactic and Team-Based Learning Sessions. Other pre-clinical courses do contain some pediatric content, but generally this comprises <10% of each course; and this content is not consistently taught by a pediatric faculty member. An evaluation of the preclinical core curriculum at comparable schools demonstrated an integrated approach focusing on essential principles of medicine and organ-based courses with no specific mention of any pediatric content aside from a minority of schools which had one course on child and adolescent development.⁵ While our independent course allows a unique exposure to pediatrics and a limited introduction to the fundamental nature of pediatrics, students have insufficient time to address key learning objectives.

Targeted Needs Assessment

In order to determine if a problem with the current pediatric curriculum truly existed, those affected, and the extent of the problem if one existed; a rigorous needs assessment was performed (Figure 1). The first step was to determine if a problem existed with the current pre-clinical pediatrics course. To address this question, student responses on the end-of-course, end-of-clerkship, and graduation evaluations were reviewed. Over the past several years, frequent references to gaps and redundancies were identified as well as concerns about

limited preparation for licensing exams and the clerkship (see Table 1 for full quotes). Some pediatric topics were covered in several courses, often by the same presenter, while other topics were absent from the curriculum at large. On-going course modifications have been made to address these concerns, but the limited course hours available challenges the ability to fully address these concerns. Students continue to request more exposure to pathophysiology that could build on other second year courses, emphasize how disease processes are different in young patients compared to adults, or introduce key disease processes that are unique to pediatric populations. Additionally, students do not feel that the time allotted allows for sufficient preparation for the clerkship.

The next step was an evaluation of accrediting body expectations for educational objectives in pre-clinical and clinical pediatrics. The Liaison Committee on Medical Education (LCME) educational objectives for an MD degree were reviewed. While many objectives were identified for the pediatric clerkship, no objectives specific to pre-clinical pediatric education were identified.⁶ With no specific guidance for pre-clinical pediatric educational objectives, we turned to the Council on Medical Student Education in Pediatrics (COMSEP), United States Medical Licensing Exam (USMLE) Step 1 learning objectives and pediatric clinical experts as resources. COMSEP is the national organization which outlines curriculum competencies and objectives for pediatric clerkships and, as such, offered a unique opportunity to identify potential pre-clinical objectives through a thorough evaluation of prerequisite knowledge needed for each competency.⁷ Some of the prerequisite knowledge is not pediatric specific and was therefore not included, but the remaining knowledge laid the foundation for development of the pre-clinical pediatrics curricular objectives. These potential objectives were then discussed with the pediatric clerkship co-directors to ensure, within the time constraints of the current course, appropriate exposure to the prerequisite clerkship knowledge chosen to become the pre-clinical course's learning objectives. This also ensured a seamless transition between the pre-clinical pediatric course and the clerkship thus beginning the process of longitudinal integration.

The final step was to identify, via a literature search, educational best practices. First, a search was conducted for educational best practices in pre-clinical pediatrics but this did not identify any relevant articles (see Figure 2). Subsequent searches did identify several articles in educational best practices in adult learning theory and their application to medical education. These articles, in addition to other resources in medical education, were utilized in choosing and developing the instructional methods for the proposed curriculum.⁹⁻¹¹

Goals and Objectives

Our proposed approach would be to develop a longitudinal pediatric course with appropriate vertical and horizontal integration. In choosing this educational strategy, students would have improved exposure to key pediatric concepts and pathophysiology via an educational best practice approach. An integrated curriculum allows for strategically placed repetition of key concepts and demonstrates the connections between disciplines, between the classroom and practical world, and between knowledge and skill; all of these have been shown to increase retention.⁸

The general goal of our pediatric curriculum will be to (1) provide a foundation in pediatric medicine that will allow students to develop the knowledge, skills, and attitudes necessary to successfully apply this understanding during their pediatric clerkship and (2) increase student exposure to pediatrics as a subspecialty. A longitudinal, integrated pediatric curriculum would allow pediatric thread masters to coordinate with each course master to ensure appropriate pediatric content is covered within *each* course. Joint decisions would be made regarding the pediatric faculty chosen to facilitate these sessions. In total, this would increase students' overall exposure to pediatric content, as well as to pediatric faculty committed to excellence in medical education. In total, a longitudinal, integrated pediatric curriculum would allow students to better understand the unique specialty of

pediatrics with its focus on health supervision, in addition to its focus on common and/or life-threatening pathologies in each pediatric subspecialty.

Educational Strategies – Content and Methods

The pediatric content chosen for the thread curriculum was identified through the needs assessment, specifically by determining what content was already covered, what content was considered most important by the USMLE, and what content was considered most important by the clerkship directors and clinical experts in each subspecialty area. Some of this content would be included in more adult-focused sessions, while other content would require individual sessions. With the new thread curriculum, a minimum of 30% of the total content (current plus proposed content) of each course will be pediatrics. Full details and descriptions of the current and proposed pediatric content can be found in Table 2.

Many of the failures identified in the development of other integrated curricula are linked to (1) the thread content being too imbedded, therefore decreasing student ability to accurately identify the content as belonging to the thread or (2) remaining too independent, thus decreasing student ability to identify the integration.⁹⁻¹⁰ To address these concerns, the pediatric thread curriculum will use two unique procedures. First, an introductory session at the start of each block will be delivered by the thread master(s). These sessions will also allow students to see how the curriculum progresses throughout the academic year. The purpose of this session will be as follows:

1. to root the global thread curriculum into the 3 focuses of health supervision – prevention, assessment, and promotion
2. to provide a road-map to students to identify major pediatric content within each course
3. to introduce the students to the pediatric faculty providing sessions during the block

Developing a standardized means by which to identify pediatric content delivered within adult-focused sessions will be the second way to address previous integration concerns. In this way, the pediatric thread will allow for pediatric topics to be integrated without loss of recognition of the unique nature of the specialty or loss of the learning benefits provided through integration.

Specific instructional methodologies will require continued partnerships between the pediatric thread master(s) and the other course master(s) developed during the needs assessment process. Currently, most of the instructional methods focus on didactic delivery of the content objectives with some small-group case-based and/or Team-Based Learning sessions to achieve content, skill, and attitudinal objectives. Once the curriculum is in place, more opportunities to provide active and cooperative learning will be determined as these opportunities can increase vertical integration as well as assessment of Professionalism, Practice Based Learning and Improvement, and Systems Based Practice competencies.

Implementation

Pending approval, we anticipate implementing the longitudinal course at the start of the next academic year. Meetings with individual course masters will occur prior to development of the syllabus to solidify pediatric learning objectives and again at the time of examination development to identify appropriate pediatric examination questions. We anticipate regular meetings with the student Medical Education Representative, student class president as well as Pediatric Student Liaisons to discuss student perspectives and with the Associate Dean, Dr. Awad, to ensure students are being served by the implementation and no unforeseen or unrecognized problems are developing.

Implementation will increase the level of administrative support needed to implement, evaluate, and maintain the curriculum. While literature supports the fact that students and teachers believe integration is important for learning, faculty often cite support for time and personnel (administrative assistance) required to develop and maintain such a curriculum as a leading concern for ultimate curricular success.^{9,11,12} These administrative needs will need to be addressed prior to implementation of the pediatric thread curriculum.

Evaluation and Assessment

Program Evaluation:

At the completion of the 3rd year pediatric clerkship, students are asked if their 2nd year pediatric course prepared them for the clerkship. Students will continue to answer similar questions pertaining to the ability of pre-clinical courses to prepare them for clinical work and the level of integration of basic and clinical sciences on the ACGME graduation questionnaire. We will continue to monitor the change in responses to these questions with the expectation that more students will answer in a positive direction. Focus groups will be conducted with clerkship students before and after the pediatric clerkship rotation three times during this year (gathering data from students prior to the course conversion) and next year (after the course conversion) to gather qualitative information on perceptions of preparedness, strengths and limitations of the course will be conducted. Additionally, faculty with frequent and longitudinal exposure to clerkship students will be interviewed looking at similar perceptions of preparedness. In a “no harm” fashion, we will continue to monitor the number of students entering pediatrics as a residency.

Student Assessment:

Pediatric learning objectives, having been jointly identified by the pediatric thread and individual course masters, will be assessed on each end-of-course examination with a proportional number of examination questions. These questions will not be included in the course grade. The pediatric grade will be a cumulative score from all pediatric questions across the second year. Students will have formative feedback on their pediatric grade through a cumulative pediatric score reported each block.

Dissemination and Scholarship

The opportunities for scholarship, however, are vast. Currently, the literature focuses on integrated curriculum in the subjects of pathology, pharmacology, and medical humanities including diversity, quality, and safety topics for pre-clinical medical education. A singular nursing education article was identified describing the development of a longitudinal, integrated curriculum in geriatrics.¹³ This demonstrates the paucity of literature on the topic, with complete absence of scholarship focusing on the description of and outcomes in a longitudinal, integrated pre-clinical pediatric curriculum. Publication of descriptive articles detailing the development and implementation of a pediatric thread curriculum could be tailored for pediatric-focused journals as well as medical education journals. Qualitative and quantitative outcomes such as student/faculty perceptions of confidence entering pediatric clerkship, changes in the ACGME graduation questionnaire regarding preparation and pre-clinical/clinical integration, and percentage of students entering pediatrics as a specialty would all be measures of effectiveness that are reportable and important for demonstration of generalizability.

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Figure 1: Needs Assessment Process

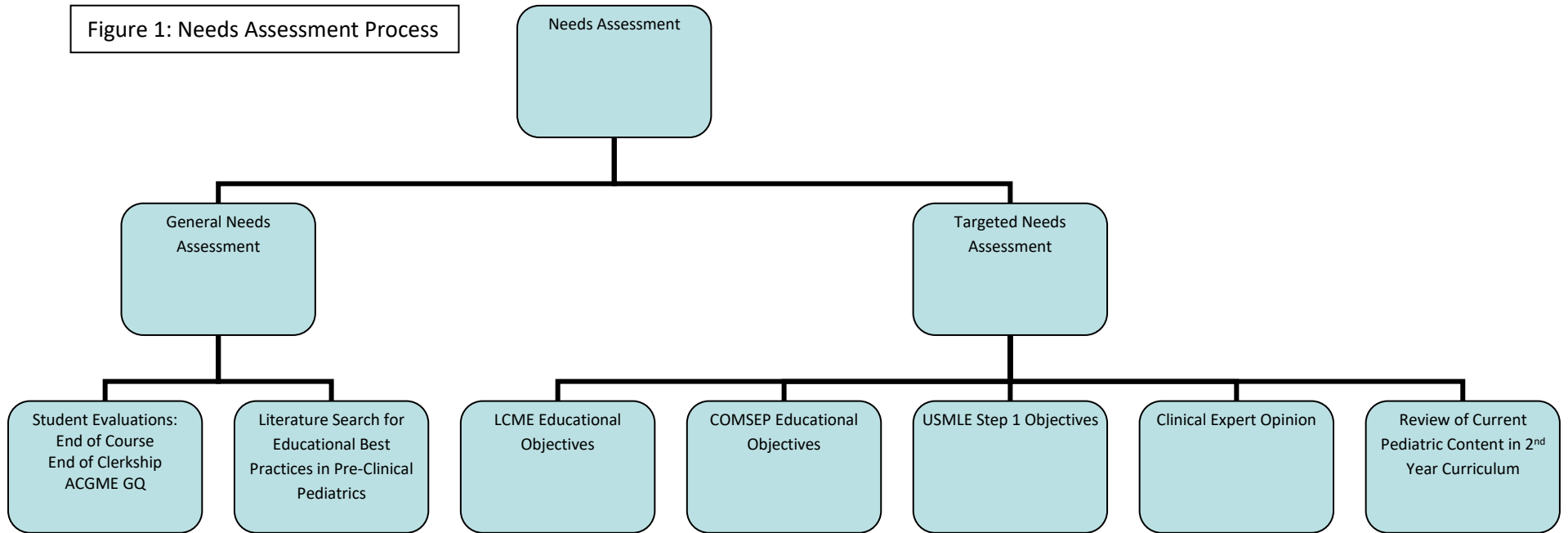


Table 1_Student Comments Identifying Concerns with the Current Pre-Clinical Pediatric Course

Academic Year	Student Comments
2009-2010	Was uncertain as to the survey vs specific topic nature of this course. I would suggest switching to doing lectures on all pathophysiology.
2010-2011	Having so few lecture hours forces the course to be somewhat fragmented.
2011-2012	While they [lecture topics] cover important aspects of pediatrics, it seems like there are many gaps in our knowledge both for Step 1 and the wards.
2012-2013	Overall the MS2 curriculum, and this course, do not cover many important pediatric diseases
2013-2014	I really wish there was more time in this course. After talking about this class with a friend, since most of this material relates with healthy children, would it be possible to add this to the first year curriculum, and then focus on childhood diseases in second year (tying together all the organ systems)?

Table 2 Current and Proposed Course Hours by Block					
Block	Course	Current Hours (total)	Current Pediatric Hours [topics covered]	Additional Pediatric Hours [specific topics]	Change
1	General Pathology	15			
	Pharmacology	28	0	0	+0
	Otolaryngology	8	1	0	+0
	POM II	17.5	0	0	+0
	Pediatrics	17	17	2	-15
Totals		85.5			-15
2	Cardiovascular	39.5	1	1	+1
	Renal/GU	53	1	1	+1
	Pulmonary	62	0	2	+2
	POM II	14.5	0	0	+0
Totals		169			+4
3	Endocrine	35	2	0 – unless adding a TBL	+0
	GI & Liver	46.5	0	3	+3
	Dermatology	12	0	1	+1
	POM II	10	0	0	+0
Totals		103.5			+4
4	Diseases of the Nervous System	55	1	4	+4
	Nervous System/Psych	42	5	0	+0
	POM II	12.5	1	2 for an adolescent session	+2
Totals		109.5			+6
5	Rheumatology	17	1	2 [pediatric vasculitis TBL]	+2
	Infectious Disease	51	0	3	+3
	Laboratory Medicine	8	0	0	+0
	POM II	14.5	0	2 [pediatric exam session]	+2
Totals		90.5			+7
6	Heme/Onc	49	0	0	+0
	OB/GYN	28	0	4	+4
	POM II	17	0	0	+0
Totals		94			+4
Grand Totals:		652			+10

Pathophysiology hours are included with the organ-specific hours

Table 3_Description of pediatric topics, by course, currently covered and proposed recommendations for the Pediatric Thread Course			
Course	Current Pediatric Topics Covered	Recommendations for Thread Course	
		Additions to Adult-Focused Sessions	New Pediatric Sessions
ENT	Comprehensive session on pediatric ENT Comprehensive session on hearing loss	Add age-related changes in sinuses Add more on cleft palate	
Cardiovascular Diseases	Congenital Heart Disease (covers all topics listed in USMLE Step I)	How EKG changes from infant to adult Review embryology Discussion of prolong QT syndrome	A new 60 minute session to discuss acquired heart disease in pediatrics – topics would include Kawasaki’s disease, myocarditis and pediatric cardiomyopathies. Depending on time, this would be an area to discuss the use of ventricular assist devices in children.
Renal & Urinary Tract Pathophysiology	Polycystic kidney disease Fabry’s disease (USMLE Step I key pathology) Sickle cell disease Alport’s (USMLE Step I key pathology) Small amount of imaging in pediatrics Minimal change disease (USMLE Step I key pathology) FSGS (USMLE Step I key pathology) Post-strep glomerulonephritis (USMLE Step I key pathology) Broad overview of childhood disorders of the urinary tract	Changes in total body water content by age Renal etiologies of pediatric hypertension Will add embryology review	2 sessions as follows: 1. Pediatric Urinary Tract Disorders I a. Embryology b. Birth defects (all of #1 above) c. Obstruction (from current lecture) d. VUR (from current lecture) 2. Pediatric Urinary Tract Disorders II a. Voiding disorders (from current lecture) b. UTI vs pyelo i. when is it pathologic ii. impact of frequent infections c. Other infections issues affecting the kidneys i. Can refer back to other things such as PSGN in Dave’s lecture ii. HUS –mention PD as preferred method of dialysis in kids iii. TMA
Pulmonary Diseases		Add some pediatric pearls about asthma diagnosis & management Pediatric PFT differences Review of embryology during pulmonary circulation session	Cystic fibrosis as separate session to address this disease from newborn to adulthood Session on pediatric restrictive/interstitial lung disease New small group sessions around CF and pulmonary alveolar proteinosis

Endocrinology & Metabolism	Growth and Development Osteomalacia & rickets Congenital hypothyroidism Congenital adrenal hyperplasia Ambiguous genitalia Testicular feminization	Increased comparison/contrasting of type I vs type II diabetes	Separate the first session into 2 to better cover both hormonal control of growth and puberty as well as pathologies by dividing into basic physiology, assessment and pathologies of growth and puberty in 2 sessions Can move our infant with poor weight gain session here or in renal if the diagnosis becomes RTA
Gastrointestinal & Liver Pathophysiology	Mentions celiac sprue & cystic fibrosis briefly	Need to update Hirschsprung's discussion	3 sessions to mimic the organization of the adult sessions: <ul style="list-style-type: none"> • Luminal: esophageal foreign bodies, GER, general abdominal pain, pyloric stenosis, celiac disease, IBD, malrotation, Meckel's diverticulum, Hirschsprung's (remove discussion from Diseases of the Colon) • Biliary/Pancreas/Liver: focus only on bilirubin concerns – unconjugated vs conjugated (infectious, metabolic, anatomic) – and AHF in pediatrics – etiology, presentation with description of hepatic encephalopathy grading for various ages in peds & treatments • Nutrition would be our current lecture
Dermatology			1 session broken down by classification – neonatal, infectious, emergencies, drug reactions & genetic disorders (vascular, cancer prone, blistering)
Diseases of the Nervous System	Charcot-Marie-Tooth (USMLE Step I key pathology) Pediatric brain tumors Leukodystrophies (metachromatic leukodystrophy, Krabbe's, adrenoleukodystrophy) Fredreich ataxia (USMLE Step I key pathology) Current session entitled "Pediatric Neurology"	Add differential diagnosis of seizures in pediatric population Brain death examinations in pediatrics (difference in timing) Add more inborn errors of metabolism for pediatric neurodegenerative diseases	Total of 5 pediatric sessions arranged to mirror adult counterparts: <ul style="list-style-type: none"> • Pediatric Neurology as the outline describes, not as it is currently given (this would also cover pediatric movement disorders as they are based on type of movements observed & he covers this; a brief reference to the fact that ped movement d/o are based on type of movements & will be covered in Brad's lecture could be provided in the syllabus with the adult movement d/o session) – in the beginning with basic neuro evaluation of a patient • Doug's lecture about developmental milestones (from the peds course) – in the beginning with basic neuro evaluation of a patient • Neuromuscular diseases – broken down by etiology <ul style="list-style-type: none"> ○ Muscle problems (DMD, congenital myopathies) ○ NMJ (congenital myasthenia)

			<ul style="list-style-type: none"> ○ Nerves (inherited neuropathies, SMA) ● Pediatric neurodegenerative diseases – mostly in-born errors of metabolism there might be overlap between genetics, but I think that is OK. I would focus the pathologies on those highlighted in First Aid (Friedreich’s ataxia, Tay-Sach’s, Fabry’s, Niemann-Pick, Krabbe’s, Methachromatic leukodystrophy) and then focus some of the genetics cases on different in-born errors of metabolism ● Traumatic and environmental disorders
Psychiatry	Developmental psychopathology Autism and Mental Retardation Global & Public Health Perspectives on Child Mental Health Child Maltreatment Eating Disorders Mood & Anxiety Disorders in Children & Adolescents Disruptive Disorders, ADHD & Parenting	Mostly augmenting some of the pharmacology sessions to better reflect pediatrics	
Rheumatology	Juvenile Rheumatoid Arthritis Henoch-Schonlein Purpura Neonatal Lupus	Highlight clinical criteria for diagnosis of Kawasaki’s	TBL about vasculitis in pediatric patients
ID			Congenital and Neonatal Infections (will cover TORCHES & the neonate as a unique host) Vaccine Preventable Diseases (review of how vaccines work, vaccine theory & vaccine schedules from infants to adults as well as specific diseases)
Hematology/ Oncology	Changes in hemoglobin concentration by age Daily iron requirements by age; high risk of deficiency Hemoglobinopathies Hemolytic Disease of the Newborn Fanconi Anemia Acute Lymphoblastic Leukemia	In metabolism & disorders of iron, include dietary issues as major cause of iron deficiency anemia (cow’s milk iron deficiency) and lead poisoning	
OB, Gyn & Reproductive Endocrinology		Add component in Termination of Pregnancy session regarding MO laws about teens & pregnancy termination Maternal screening tests & common maternal complications that can	Add our amenorrhea TBL here Add (& lengthen) our session on fetal physiology, transition to extrauterine life & in-hospital care of the premature and term newborn Future ideas: add Cyanotic newborn TBL here as it would increase integration from cardiovascular course (this wasn’t accounted for in the overall hours, though)

		affect the newborn	
POM II	Some adolescent consent & confidentiality	Augment instructional method for adolescent consent & confidentiality with SPs & deconstructed role play	Move the current Pediatricians and Health Supervision session here Pediatric physical exam night will be here
Pediatrics		2 hours will still be needed to introduce the thread concept, provide the 1 st roadmap & provide the Health Supervision lecture with more details for newborn screening	

Table 4_Pathology Specific Diseases (Dr. Crouch)

Course	Pathologies Currently Covered	Pathologies to be added in the Thread Course
Renal	ARPKD Sickle cell nephropathy Alport's Minimal change disease Focal segmenting glomerular nephritis Post-strep glomerular nephritis Renal agenesis/dysplasia/ectopia Renal artery stenosis	
CV	PDA VSD Eisenmengers Hypoplastic left heart syndrome Aortic stenosis TOGV Fontan	Viral myocarditis Cardiomyopathies Kawasaki's
Neuro	CNS tumors	ADEM Leukodystrophies Krabbe's Infant IVH and PVL DMD Spinal muscular atrophy
ENT	Cleft palate Branchial cleft cysts Thyroglossal duct cyst Ectopic thyroid Pierre-Robin sequence (I've sent his slides because he includes so many pics)	
GI		Meckel's Celiac sprue Hirschsprung's Pyloric stenosis IBD Malrotation Biliary atresia
Pulmonary	CF Asthma	Pulmonary alveolar proteinosis
Heme/Onc	Hemoglobinopathies Myeloproliferative diseases Myelodysplastic syndromes ALL Iron disorders Hodgkin's/Non-Hodgkin's	
OB		Premature hyaline membrane disease Fetal circulation