THE UNIVERSITY OF CALGARY

The Design and Evaluation of a Curriculum in Developmental Pediatrics for Use in a Pediatric Residency Program

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF MEDICAL SCIENCE

CALGARY, ALBERTA

JUNE, 2000

Abstract

Developmental pediatrics is a subspecialty of pediatrics that is recognized to be important in clinical pediatric practice. However, pediatric resident training generally does not meet resident needs for education in this area. This document describes a process of curriculum improvement for pediatric resident education in developmental pediatrics.

The curriculum described is based upon identified resident needs, principles of adult education and cognitive psychology. The development, implementation and evaluation of the curriculum for pediatric residents at the University of Calgary are outlined.

The results presented in this document provide support that an integrated curriculum in developmental pediatrics that provides learning opportunities over a longitudinal period of time is feasible and improves resident education in this area. The success of this implementation will provide guidance to other programs seeking to similarly improve their curricula in this discipline.

Acknowledgements

The author wishes to acknowledge the Alberta Children's Hospital Foundation for providing financial support for this project.

The author's supervisory committee, Drs. Jean-Gaston DesCôteaux, Margaret Clarke, and Tom Gougeon have generously given of their time and wisdom throughout the course of her Master's program. The author wishes to extend her gratitude to these people for their guidance and supervision over the past two years. She wishes to specifically thank Dr. Clarke for her mentorship throughout her training program and for arranging her clinical responsibilities to permit completion of this research project.

Several other people have provided assistance to the author during the course of this project. Pediatric Residency Training Directors, Drs. Taj Jadavji and Jean-François Lemay, and Pediatric Department Head, Dr. Brent Scott, have provided support for the curriculum implementation within the pediatric residency program at the University of Calgary.

The enthusiasm, cooperation, and feedback of all of the participants, both faculty and residents in pediatrics, have been essential to the success of the project. The list of individuals is extensive, but the author wishes to acknowledge the contributions of each participant and to extend her thanks to all those who participated.

In addition to their roles mentioned above, Drs. Margaret Clarke and Jean-François Lemay assisted in the review of the written examination and the curriculum content. Their time and effort in this area is sincerely appreciated.

Drs. Candice Bjornson, Anna Karwowska, and Mark Zucker donated their time to participate in the pilot test of the written examination. Dr. Wayne Woloschuk is acknowledged for his assistance in the statistical analysis of the needs assessment survey. Drs. John Baumber, Peter Harasym, and Penny Jennett are thanked for their feedback regarding the specific portions of this Thesis discussed in their respective courses.

Ms. Avril Boss and Mrs. Shirley Poirier have provided secretarial assistance to the author, which has been invaluable in managing the logistics of this project.

Finally, Dr. Alan Tiessen has provided technical assistance with data collection and manuscript preparation. However, his greatest contribution has been in the encouragement and support of the author throughout her education.

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List of Abbreviations

Abbreviation	Definition	Page Number of First Appearance
RRC	Residency Review Committee	4
US	United States	4
MANOVA	Multiple Analysis of Variance	36
DP	Developmental Pediatrics	38 (Table 3)
R Level	Residency Level	46 (Table 5)
R0	Medical Student	
R1	First Year Resident	
R2	Second Year Resident	
R3	Third Year Resident	
R4	Fourth Year Resident	
OSCE	Objective Structured Clinical Examination	46 (Table 5)
CUBE	CUrriculum dataBase for medical Education	57
K	Knowledge	62 (Table 6)
S	Skills	
A	Attitudes	
Dev	Developmental Pediatric Rotation	62 (Table 6)
Amb	Ambulatory Pediatric Rotation	
Res	Pediatric Resident Clinic	
Gen	Genetics Rotation	
Neuro	Pediatric Neurology Rotation	
MPL	Minimum Performance Level	77
ANOVA	Analysis of Variance	82
ADHD	Attention Deficit Hyperactivity Disorder	119 (Table 18)
PDD	Pervasive Developmental Disorder	

CHAPTER ONE. INTRODUCTION

Background

Developmental pediatrics is a subspecialty of pediatrics that addresses problems related to child development and behavior that may exist in isolation or in combination with other congenital or acquired conditions. Approximately fifteen percent of children have a chronic disorder that impacts their development [1].

Developmental pediatrics has evolved relatively recently as a sub-specialty of pediatrics. In 1988, the Canadian Pediatric Society established a Section of Developmental Pediatrics. The discipline focuses on children's development, primarily those children who face congenital or acquired disorders that affect their physical, motor, cognitive, sensory and socio-emotional development. The overall goal in developmental pediatrics is to promote and maintain the wellbeing and health of all children, especially those who are most vulnerable, and to promote preventive strategies which minimize the prevalence and impact of disorders of development [1].

Clinical problems in the domain of developmental pediatrics appear to be more frequent in recent years and have been described as the "new morbidity" in pediatrics as medical advances have significantly decreased the prevalence of serious illness and premature death of children due to infectious diseases [2]. In the past two decades, this clinical area has become more prominent as an area of importance for pediatricians [3-6]. However, training of pediatric residents in developmental pediatrics has not adequately met the needs of pediatricians [6-10].

In the United States in the 1980's, developmental pediatric curricula were developed to meet the recommendations of the American Academy of Pediatrics Task Force on Pediatric Education [11-14]. Other reports of novel curricula encompassing topics germane to the area of developmental pediatrics have also been described [15-17]. In 1988, the Society for Developmental and Behavioral Pediatrics published *A Curriculum Guide for Developmental-Behavioral Pediatrics* [18]. This document described the rationale for implementation of a curriculum in this area, the requirement of a multidisciplinary "teaching staff", requirements for implementation, and general objectives for various levels of training. However, this document did not outline specific steps in the process of curricular reform and provided only general guiding principles. The document was well received, but prompted a request for more information regarding content, learning objectives, references, resources and techniques for providing the required experiences [19]. Recently, The Society for Developmental and Behavioral Pediatrics published curricular guidelines for residency training in developmental-behavioral pediatrics to assist programs in the United States to fulfill the requirements of the Residency Review Committee for Pediatrics [19]. Despite these efforts to standardize training in developmental pediatrics, many pediatricians and pediatric residents feel that once they are in clinical practice, they are unprepared to manage patients with problems in this area [6, 9, 10, 20-22].

In 1996, The Section of Developmental Pediatrics of the Canadian Pediatric Society suggested residency teaching guidelines for developmental pediatrics as a part of their proposal for accreditation to the Royal College of Physicians and Surgeons of Canada (Canadian Guidelines) [1]. To date, there has been no translation of these or

other objectives into a formal curriculum that would be used in a Canadian residency training program. Ideally, such an education process would occur over the entire residency program. Previous curricula described in the United States have taken the form of short term, "block rotation" structures [8, 23].

Pediatric residency training programs in North America generally follow a similar structure of multiple consecutive block rotations. Common rotations include inpatient pediatrics, pediatric emergency medicine, pediatric intensive care medicine, outpatient pediatrics, and subspecialty pediatrics (pediatric cardiology, pediatric neurology, etc.)

Prior to the implementation of this Thesis project, resident education in developmental pediatrics at the University of Calgary was formally taught to pediatric residents during a four-week block rotation in developmental pediatrics and psychiatry. The rotation lacked structure and organization. There were no specific learning objectives for the rotation and no overall plan or guide to ensure that the residents participated in an appropriate variety of learning activities. The residents attended clinic activities and primarily observed. Thus the residents received a variable quality and quantity of learning experiences. Resident evaluation was difficult as the residents worked with multiple preceptors in a short period of time; therefore the preceptors generally only interacted with each resident on one or two occasions. Both residents and preceptors had expressed frustration regarding the format of the rotation.

It is clearly apparent that in order for residents to learn about problems in child development, longitudinal exposure to normal and abnormal child development must be available. Thus educational experiences in this clinical area must extend beyond the traditional block rotation. Effective in February 1997, the Residency Review Committee

(RRC) of the Accreditation Council for Graduate Medical Education (US) outlined a revised set of program requirements for residency education in pediatrics. As cited in the Guidelines for Residency Training in Developmental-Behavioral Pediatrics [19], one of the specific components of the RRC Requirements is the provision of "an integrated experience that incorporates behavioral developmental issues into ambulatory and inpatient experiences throughout the three years (of residency training)".

The Problem

Developmental pediatrics forms a significant part of pediatric practice, thus it is essential that pediatricians develop adequate knowledge, skills and attitudes during their residencies to allow them to competently manage clinical problems in this area. Despite increased awareness of this subspecialty over the last two decades, in general, residency training in developmental pediatrics is not meeting the needs of pediatricians. Curriculum guidelines are now available to assist residency programs in improving resident training, but results of successful implementation of these guidelines are lacking.

The typical structure of pediatric residency programs is that of a series of individual block rotations. Traditional disciplines are relatively well suited to this organization, but it is difficult to provide adequate clinical experience to trainees in developmental pediatrics within this structure.

Purpose

The main purpose of this project is to develop, implement and evaluate a curriculum in developmental pediatrics that is incorporated throughout the pediatric residency training program. This statement of purpose contains the following components:

1. To review the current residency training in developmental pediatrics at the University of Calgary
2. To compare the program at the University of Calgary with other Canadian residency training programs
3. To develop specific educational objectives based upon existing recommendations from the Section of Developmental Pediatrics, Canadian Pediatric Society and the Society for Developmental and Behavioral Pediatrics
4. To develop and assess teaching methods to achieve these objectives
5. To develop a reliable and valid evaluation for pediatric residents in the area of developmental pediatrics
6. To evaluate the process of curriculum implementation in the first year

Research Question

Can a formal curriculum in developmental pediatrics that is integrated over the four-year residency program and provides learning opportunities over a longitudinal period of time be successfully implemented into the existing pediatric residency program

at the University of Calgary to improve the quality of residency training in this discipline?

CHAPTER TWO. LITERATURE REVIEW

The focus of this project is curriculum implementation, but prior to discussion of the implementation process, it is important to review the principles supporting the curricular design. Throughout this document, relevant literature is cited related to the individual steps of curriculum improvement. The development of the curriculum has been based upon current understanding of cognitive psychology and principles of adult learning. Thus the purpose of this chapter is to review these as they form the theoretical basis for the remainder of the project.

Learning is a concept that is difficult to define. Webster's Dictionary [24] defines learning as "the acquiring of knowledge or skills". However, this definition does not seem to adequately capture the essence of the learning process. A more complete definition is offered by MacKeracher [25] as "a process of making sense of life's experiences and giving meaning to whatever 'sense' is made; using these meanings in thinking, solving problems, making choices and decisions; and acting in ways which are congruent with these choices and decisions as a means for obtaining feedback to confirm or disconfirm meanings and choices". The common definition that learning is "a change in behavior" [26] simplifies this considerably, yet MacKeracher's definition does emphasize the use of learning to guide actions (behavior). Thus "a change in behavior" will be used as the working definition of learning throughout this Thesis. This definition may be criticized for limiting the concept of learning, but it is useful as a practical definition in that it allows determination of whether learning has occurred based on

observation of behavior. The limitations of this definition will be discussed further in the next section.

Curriculum may be simply defined as "a planned educational experience" [27] or "a set of all learning experiences" [28]. The purpose of the educational experience is to bring about learning as reflected in a behavioral change [29]. Learning goals may be clustered into elements of knowledge, skills and attitudes. Training activities that are amenable to inclusion in written descriptions of curricula are almost always reflective of content (knowledge and skills) rather than process (attitude) components [19]. However, in developmental pediatrics, there is a strong belief that the discipline encompasses both approaches to working with children and their families and knowledge of the subject area [19].

As the sub-specialty of developmental pediatrics has developed, the focus has shifted toward the academic development of the field in both research and training domains [1]. As stated by Dr. William Carey at the Annual Meeting of the Society for Behavioral Pediatrics [30], "The present situation ... is one of great unmet needs of children in the developmental and behavioral sphere and of pediatric programs that are doing too little to prepare the pediatricians of tomorrow to deal with them". At the same time, medical education in general has begun to shift toward a more humanistic orientation focusing on how medicine should be practiced in relation to the needs that it serves [31]. This educational and professional climate places high expectations on training programs not only to produce competent physicians, but also to do so in a way that reflects current understanding of principles of adult learning and cognition.

Adult Learners

This section describes different approaches to learning in general and, more specifically, the assumptions and principles of adult learning. Different perspectives are then described which teachers may use when applying principles of adult learning. Focus has been placed upon the Developmental Perspective, as this is the dominant perspective used in this Thesis project.

Approaches to Learning

Over time, several different approaches to learning have emerged based upon an evolving understanding of learning. These include behaviorism, cognitivism, humanism and constructivism. The working definition of learning as "a change in behavior" proposed earlier will be examined with each approach.

The behavioristic approach is based on the premise that learning occurs primarily through the reinforcement of desired rewards. Learning is considered to be "the objective perception of the world as it is, unmediated by personal interpretation or distortion" [26]. The definition of learning as a change in behavior fits well with a behavioristic approach to learning.

The cognitivistic approach is an academic approach based on the principle that learning occurs primarily through exposure to logically presented information [32]. Similar to the behavioristic approach, knowledge is considered to be objective, and

learner's behavior is expected to change based upon the cognitive assimilation of that knowledge.

In contrast, the humanistic approach is founded on the theory that learning occurs primarily through reflection on personal experience. This approach focuses upon the learner as a whole person, on learning that involves body, mind and spirit and cognitive, affective and motor components [25]. The emphasis is shifted towards the learning process. Learning according to a humanist approach is "the construction of meaning through experience" [26]. Learning becomes "an interactive process of interpretation, integration and transformation of one's experiential world" [26]. However, this process is extremely difficult to define and evaluate within a curriculum. The attention is focussed away from correct answers, achievement levels, extrinsic reward systems (such as grades and certifications), reinforcement schedules, cognitive processes and education technologies. In fact, "humanistic models do not work well in contexts constrained by the prescriptive demands of occupations" [25]! A difficult dilemma thus arises in the area of developmental pediatrics. While on one hand, the intent is to train residents to consider the "whole" patient and family in a very humanistic orientation, it is extremely difficult to design a curriculum with a similar orientation. One of the important purposes of resident training programs is the development and assessment of competence that must remain a high priority. As a humanistic approach is most relevant to the affective and social dimensions of learning [25], it is likely that inclusion of a humanistic approach to learning activities will result in learning in this area. Again, however, this is extremely difficult to evaluate, but one assumes that a change in the learner's behavior will result.

Another approach is that of constructivism. In this view, reality is less an objective fact and more a subjective construction by individuals and societies. Knowledge is a construction that human beings make rather than an objective truth that they discover [26]. This knowledge is personally constructed but socially mediated. Constructivist theory does not distinguish knowledge as separate from the knower and the culture in which learning is to occur. A curriculum is embedded in culture and can not be separated from the culture which includes other learners, the shared knowledge of the culture, myths, customs, taboos, history and social-political-economical milieu [28]. If one reflects on the "culture" of medicine, then consideration of learning from a constructivist theory includes the "hidden curriculum" as described by Hafferty and Franks [33] and by Wear [34]. The hidden curriculum includes the accepted values, beliefs and attitudes implicit in the replication of the culture of medicine. Learning by construction implies a change in prior knowledge, where change can mean replacement, addition or modification of extant knowledge [28]. The construction of knowledge takes place in the context of the learner's evolving assumptions about knowledge itself and the learner's role in creating it [35]. While a change in knowledge may result in a change in behavior, again, this is an assumption. If learners are constrained by cultural norms or taboos, a change in knowledge may not be reflected in a change in behavior. Conversely, change in behavior may not be reflective of a change in the learner's knowledge or attitude, but of external cultural expectations.

Traditionally, medical education has followed a cognitivistic approach. However, it is also clear that different approaches are more appropriate for different learning tasks [32]. In the development of the curriculum described in this document, components of

each of the approaches described above have been included. This allows the strongest features of each to be exploited without restrictions imposed by the limitations inherent in each approach. For example, the learning objectives and written evaluation follow primarily behavioral and cognitive approaches as these apply best to the development of an objective evaluation. However, the learning activities apply several principles inherent in a humanistic approach as this best reflects the curricular goals of developmental pediatrics. The constructivist approach applies widely throughout the Thesis as many of the constraints encountered are due to the "culture of medicine".

In part, confusion regarding the most appropriate approach to apply can be clarified by considering different components of learning. MacKeracher [25] describes five components: (1) cognitive or mental, (2) social or relational, (3) affective or emotional, (4) motor or physical, and (5) spiritual or transpersonal. For example, behavioral theory applies best to the first and fourth, and humanism theory applies best to the third. In fact, one of the difficulties when applying theories of learning to different settings is accounting for the application of the theory to all the different components of learning.

Assumptions and Principles of Adult Learning

When considering adult learners, several key assumptions are generally accepted. Adults tend to be intrinsically motivated based on their experiences and often use their experience as a rich resource for learning, thus the core methodology of adult education is the analysis of experience. Adults may be self-directing, thus the role of the teacher is

to engage in a process of mutual inquiry with the learner. Individual differences among people increase with age, thus adult education must make optimal provision for differences in style, time, place and pace of learning [36].

The distinction of andragogy and pedagogy is an interesting debate. Traditionally, child learners are felt to be dependent and submissive to the teacher and adult learners to be self-directing. Adults bring important experience to the educational activity and require intrinsic motivation to learn as opposed to children who have relatively little experience and are externally motivated [37]. However, it is also apparent that adults may require assistance in making the transition from dependent to independent learners. In fact, pedagogy-andragogy represents a continuum ranging from teacher-directed to student-directed learning and both approaches may be appropriate with children and adults depending on the situation.

The generalizations regarding differences between adult and child learners may or may not hold true for an individual learner. For example, many adults are primarily externally motivated and children may have significant experiences that are relevant to their learning. In fact, as noted in Knowles' book, The Adult Learner: A Neglected Species, Lindeman's conceptualization of adult learning did not include a dichotomy of adult versus youth education, but rather adult versus "conventional" education, thus implying that youth might learn better too, when their needs and interests, life situations, experience, self-concepts, and individual differences are taken into account [36].

In pediatrics, the concept of "developmental milestones" is used to describe changes in children's abilities as they mature. A similar concept is relevant to learning. Learners may progress through a series of stages beginning with a dependent, externally

motivated state and finishing with an independent, self-directed, internally motivated state. In fact, learners may move back and forth between these states depending on the context of learning and their experiences [26].

Knowles refers to an "andragogical process design" which includes seven elements: (1) climate setting, (2) involving learners in mutual planning, (3) involving participants in diagnosing their own needs for learning, (4) involving learners in formulating their learning objectives, (5) involving learners in designing learning plans, (6) helping learners carry out their learning plans, and (7) involving learners in evaluating their learning (Knowles, 1984, in [38]). The emphasis is clearly placed upon active involvement of the learners at all stages and creation of an environment where this learner involvement is facilitated. Focus on these principles for process design provides a useful starting point when considering curriculum reform.

Active involvement in learning activities encourages students to actively link new information to what has been previously learned. In addition, attempts must be made to provide opportunities for learning in the context in which it will be most useful, thus matching the learning and application environments [39].

While some of the concepts in andragogy are new to the field of medicine, the related concept of self-directed learning has been present for some time. Spencer and Jordan [40] describe how the principles of adult learning are consistent with the key features of self-directed learning in medicine.

Perspectives for Application of Principles

There are several different perspectives that may be applied in teaching adult learners. Pratt and associates describe a useful classification of these perspectives that includes The Transmission Perspective focussing on effective delivery of content, The Apprenticeship Perspective focussing on modeling ways of being, The Developmental Perspective focussing on cultivating ways of thinking, The Nurturing Perspective focussing on facilitating self-efficacy, and the Social Reform Perspective focussing on seeking a better society [41]. Each of these perspectives does have relevance to medical education.

The Transmission Perspective is that a teacher's primary goal is to effectively transmit the content to the learners. Teachers are expected to be experts in the field of study [41]. This style is common within undergraduate medical schools.

The Apprenticeship Perspective is that the teacher and the content are inseparable and are expected to embody the knowledge and values of their community of practice. This view of teaching is fundamentally committed to locating teaching and learning within authentic contexts with a gradation of responsibility [41]. This style is almost exclusively used during post-graduate medical training (residency).

The Developmental Perspective is also prevalent in medical teaching. This perspective is more "learner centered" than the previous two perspectives. Prior knowledge forms the basis of each learner's approach to new content, and learning is the process of considering new knowledge, skills and attitudes with existing cognitive structures and revising or replacing those structures [41]. Teachers with this perspective

work to help learners think and problem solve in ways that resemble the performance of experts.

The Nurturing Perspective has not been widely applied to medicine. This view is based on the belief that learning is most affected by a learner's self-concept and self-efficacy [41]. This may have value in medical education, particularly if one considers limitations in physician learning, but typically, either Transmission or Apprenticeship Perspectives are followed.

The Social Reform Perspective has an explicit ideal or set of principles linked to a vision of a better society [41]. This has some application, particularly in the fields of community medicine and medical ethics, but again, traditionally this viewpoint has not been prominent in medical teaching.

In this Thesis project, no one perspective is followed to the exclusion of others, but the aim is to develop a "learner-centered" curriculum. The structure of the learning activities throughout the training program provides multiple opportunities for learners to build on previous experience. The dominant perspective is thus the Developmental Perspective with its goal to help the learners think and problem solve like expert physicians. The conceptual understanding of medical knowledge is complex and will be discussed in the next section.

Arseneau and Rodenberg [42] describe seven principles of cognitive learning from the Developmental Perspective.

1. Prior knowledge is key to learning.
2. Prior knowledge must be activated.

3. Learners must be actively involved in constructing personal meaning (i.e. understanding) – the links are more important than the elements.

4. Making more, and stronger, links requires time.

5. Context provides important cues for storing and retrieving information

6. A. Intrinsic motivation is associated with deep approaches to learning.

B. Extrinsic motivation and anxiety are associated with surface approaches to learning.

7. Teaching should be geared toward making the teacher increasingly unnecessary: that means, the development of learner autonomy as well as the intellect.

In summary, principles of adult learning are based upon several key assumptions. These assumptions lead to a specific series of steps referred to as the andragogical process design. These steps are directly applicable to design of curricula for adult learners. Several different perspectives may guide the application of principles of adult learning to learning activities. Each perspective has merits that are appropriate in medical education but the dominant perspective followed in this Thesis project is the Developmental Perspective.

Cognitive Psychology

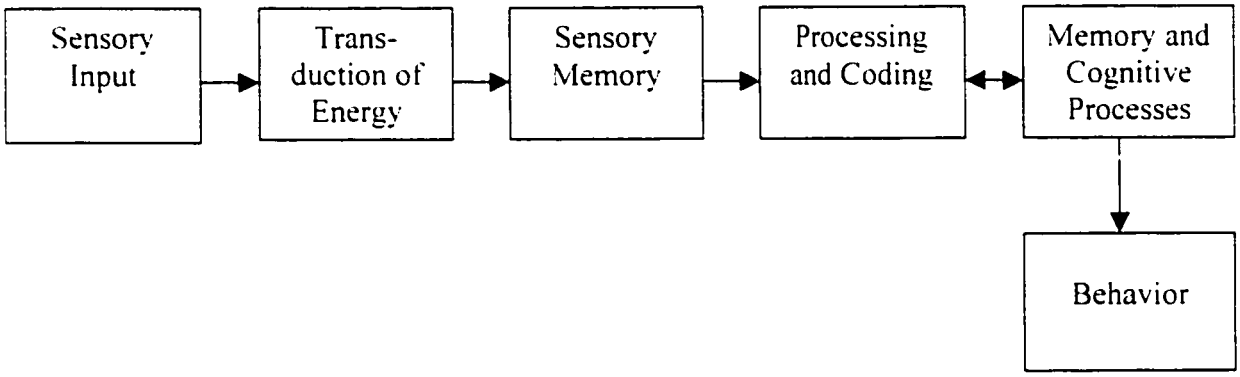
Cognitive psychology is an empirical research science that has as its primary goal the understanding of the processes that underlie the workings of the human mind [43]. As the purpose of curriculum development and improvement is to assist students to learn,

it is critical to consider the cognitive process that underlies learning. A comprehensive discussion of cognitive psychology is beyond the scope of this Thesis, however, an overview of the concepts that are relevant to the design of the curriculum is presented with emphasis on the organization of medical knowledge in memory and the facilitation of memory retrieval.

There have been multiple influences that have refined the field of cognitive psychology leading to the contemporary era. One of the most basic assumptions in the field of cognitive psychology that has guided its evolution is that knowledge is organized into cognitive models [44]. The organization of medical knowledge in memory is a critical element in the development of expertise [45]. The ultimate goal of medical training is to develop medical experts. Curricula should be designed to assist trainees to become experts, thus a discussion of current understanding of the organization of medical knowledge in memory is presented in the following section.

Cognition refers to all processes by which sensory input is transformed, reduced, elaborated, stored, recovered and used (Neisser, 1967, in [43]). Tolman introduced the notion of an internal representation of the world or "cognitive map" in 1948. Cognitive psychologists have continued to work to refine understanding of the process of cognition. This process can be conceptualized as a generic information processing model such as described by Payne and Wenger [43]. An example of such a generic model is provided in Figure 1. While each of these steps is critical to the process of cognition, the processing and memory steps are of greatest importance in planning curricula.

Figure 1. Generic Information Processing Model



Medical Knowledge in Memory

The understanding of the organization of medical knowledge in memory has rapidly evolved over recent years. In the 1970's, the Hypothetical-deductive model was proposed to explain physicians' problem solving and diagnostic strategies. Unfortunately, this model proved inadequate in differentiating excellent from weaker diagnosticians, thus the emphasis in research then shifted to the organization and availability of medical knowledge stored in the clinician's memory [46]. Several models have been proposed including prototype models, exemplar models and connectionist models [43]. None of these are completely satisfactory in explaining storage of complex medical knowledge, but they are worthy of mention as each has some relevance to learning in medicine.

First, prototype models assume that information is stored in a categorical format where similar items are grouped together in categories. The basis of prototype theories is

that an abstraction process is used to construct a common memory trace of two or more experienced episodes, or, translated to medicine, of two or more patients seen with the same disease [45]. Thus, the only information retained is the summary representation of the category, similar to an average or central tendency of the category [43]. The classical view of a concept or category of knowledge is that of a series of features that are individually necessary and jointly sufficient to define the category [45]. For example, in medicine, a disease could be definitively diagnosed on the basis of a conjunction of signs, symptoms and findings, which all have to be present in a particular patient for the diagnosis to be applicable. Another term for prototype models is "pattern recognition strategies". There is obvious application of this theory to medical practice in that there are well-recognized "classic cases" or "typical features" of specific diseases. However, there are also common atypical presentations that must be explained.

In the early 1980's, Bordage and Zacks [47] presented evidence that medical knowledge is not structured in simple categories with key defining criteria, but rather the knowledge is structured around a prototype example which captures the meaning of the category.

An extension of the prototype models is exemplar models that apply a similar concept to particular episodes of encounter with a stimulus. Applied to medical practice, this type of model assumes that there is an instance-based framework that is used by the physician as memories of previously encountered patients are stored and used to diagnose new cases [45]. Unfortunately, the best application of this model is to rare and peculiar cases that are encountered infrequently in medical practice.

Connectionist models provide a completely different approach to memory storage. They assume that there are separate units or nodes linked in a hierarchical network with connections between the nodes. This approach can be transferred directly to the medical domain as disease knowledge can be represented by a series of biomedical and clinical concepts separated by links. As opposed to the other models, semantic networks do describe diagnostic reasoning rather than a simple "yes-no" prototype or instance-based response [45]. In 1991, Schmidt, Norman and Boschuizen described the concept of "illness scripts" used by experienced physicians to organize clinical knowledge [44]. This concept was based upon the understanding that organization of medical knowledge often involves the use of causal "propositional networks". These networks are a model consisting of a set of nodes of information connected by links representing the relations between the nodes [44]. As the knowledge is repeatedly applied to patient problems, the organization is refined and the networks are modified to illness scripts. If this model is representative of medical reasoning, then it has important implications for curricular planning as it is important to match a given problem with similar ones encountered previously. Thus the sequence of problems arguably becomes as important as the nature of the problems.

Bordage and Lemieux [46] discuss semantic structures underlying diagnostic thinking of physicians. Semantic memory information is information with general meaning that is not specific to any particular event, as opposed to episodic memory information that is specific to a particular event [43]. The semantic axes proposed by Bordage and Lemieux consist of abstract oppositional relationships used to compare and contrast diagnoses. Other versions of semantic networks have also been proposed

(reviewed in Custers, Regehr and Norman, 1996 [45]). The core aspect of these networks is the notion of activation of various nodes in the network, and the activation selectively spreading through the network by virtue of the links [45].

Custers, Regehr and Norman [45] point out that the various models of knowledge representation are useful for different diagnostic domains. For example, instance-based representations may be predominant in certain domains of medicine, such as dermatology and radiology, where holistic processing of visual stimuli dominates; while semantic networks may play a larger role in endocrinology and nephrology, where complex causal relationships among quantitative data sets are vital to understanding and diagnosis. Disease schemas or illness scripts may be most useful for cases in which knowledge of patient background is important, while low-variance, high-frequency diseases may be represented as prototypes.

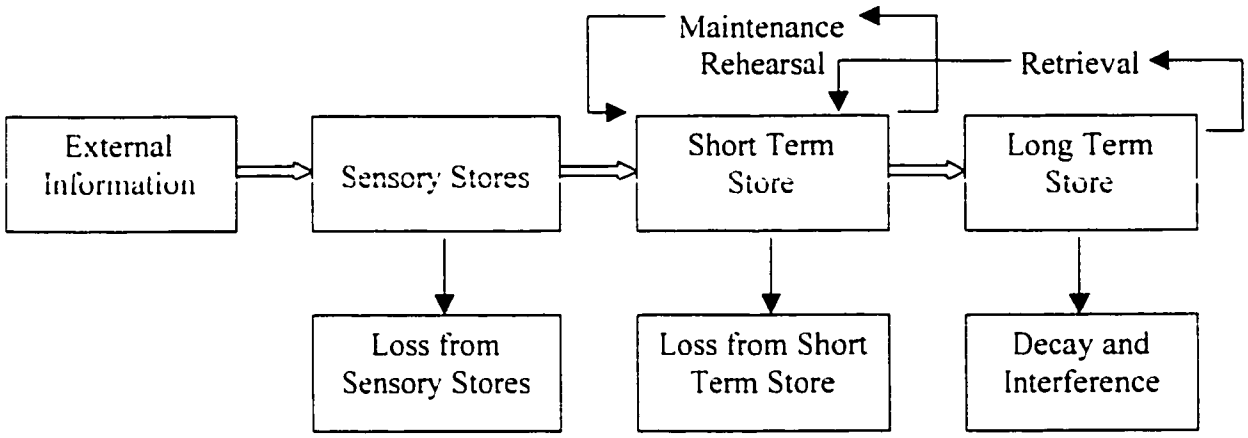
One of the difficulties with these models is the finding that problem solving requires content specificity. In other words, the biomedical knowledge can not be separated from the problem solving process, as the performance in a problem solving exercise is highly dependent on the availability of knowledge relevant to a specific problem [44]. In fact, this finding has placed the utility of Problem-Based Learning in question, as there does not seem to be broad generalization of problem solving skills. However, Eva, Neville and Norman [48] question whether it is in fact content specificity limiting the generalizability from one problem to the next. Analogous transfer is the recognition that the general principles in one context are useful in a second, conceptually similar domain. Perhaps it is the lack of ability to recognize this applicability that limits the generalization of problem solving skills. Either way, it is important to recognize that

problem solving skills do not readily transfer between problems, as this has profound implications for curriculum planning. This is consistent with the principles of learning from a Developmental Perspective described in the previous section, particularly that the context provides important cues for storing and retrieving of information. Thus the next logical question to address is how knowledge is stored in and retrieved from memory.

Memory and Retrieval of Knowledge

The specifics of how information is stored in memory are not known, but research regarding memory function may be directly applied to curriculum development. It is generally accepted that there are three basic components to memory: encoding, retention and retrieval. There are several models of memory, but the Modal Model of Memory based on the Atkinson-Shiffrin model provides a general representation of different components of memory (Figure 2). There is potential loss or decay of information at several levels of memory, thus it is critical to provide opportunity within a curriculum for repeated exposure to information and for practice of retrieval and rehearsal steps. Increased retrieval from memory is facilitated by increasing the time allotted to the item or task and by increasing the level of processing of the information [43]. In order to enhance acquisition, retention and use of knowledge, the learning of new knowledge should also occur in the context of its future application [49]. This is critically important, as "forgetting" information is likely due to an inability to access or retrieve information, rather than a decay in the information trace in memory [50]. In addition, the effect of practice on memory is highly specific. The more often a particular piece of information

Figure 2. Modal Model of Memory



is retrieved from long term memory, the easier it becomes to retrieve that particular piece of information again [50]. The activation of prior knowledge also facilitates the subsequent processing of new information [49]. These features of memory will be applied throughout the curriculum.

Regardless of the model used to explain the structure of information stored in memory, there are three principles that help to explain the storage of complex information in memory. The first is the Mnemonic Encoding Principle. This principle assumes that a high level of memory performance relies on the use of existing knowledge. In particular, existing knowledge is used to organize the items that need to be remembered and make them more meaningful at encoding [43]. Another concept is that of the Structured Retrieval Principle. This principle states that experts develop abstract and reusable organizational structures in memory that are derived from the mnemonic encoding system. In other words, experts develop ways of organizing the material they need to remember, and these organizational strategies do not depend on the

specific items with which they are working [43]. The findings of Norman et al. [51] are consistent with this principle. In their study, increased expertise was associated with increased clustering of individual data into meaningful relationships and more extensive use of causal explanations. The third concept is the Speed-up Principle. This describes the fact that both encoding and retrieval processes become faster with practice [43]. It is not known whether assisting students with the storage of information in memory will decrease this period of time. There is evidence to indicate that experts' schemes are distinctive and the development of expertise is assisted by early practice of logical approaches [52]. Regehr and Norman [50] state that educational strategies to enhance memory should be directed at three goals – to enhance meaning, to reduce dependence on context and to provide repeated practice in retrieving information. Meaning is enhanced to the extent that relevant prior knowledge can be activated.

The models seeking to explain the organization of medical knowledge in memory have all sought to describe the differences between novices and experts, yet residents represent an intermediate stage of expertise – they are novice in some areas and expert in others. In addition, no information is available on which model is most appropriate to apply to developmental pediatrics, or in fact, to pediatric training in general. Thus, rather than choosing one model to draw upon during the process of curriculum development described in this document, principles have been selected from the above discussion and incorporated throughout. Further research is required to examine memory structure, learning strategies and cognitive models in intermediate trainees such as pediatric residents to provide a more precise understanding of the appropriate application of these models and concepts to residency training.

Summary and Application of Principles

The curriculum plan described in this document has been based upon principles of adult education and theory of cognitive psychology. While some of these concepts may have previously been incorporated into residency training, it is important to make them explicit. These key concepts are summarized in Table 1 and discussed below.

Table 1. Key Concepts of Cognitive Psychology and Principles of Adult Education

Key Concepts	Implications for Curriculum Development
Residents have diverse previous experiences, interests and learning styles	-apply andragogical process design -allow residents to build on previous experiences -provide multiple different learning activities -encourage self-direction to explore personal interests
Adults may require assistance to progress from dependent to independent learners	-adopt Developmental Perspective as dominant philosophy
Retrieval from memory is optimal if the learning context matches the application context	-provide learning activities that mimic future pediatric practice
Active learning is superior to passive learning	-engage the learners in active learning activities -seek input from the learners at all stages of curriculum development
Content specificity may interfere with the transfer of knowledge from one problem solving setting to another	-provide residents with exposure to a wide range of clinical problems
Retrieval of information from memory improves with practice	-provide repetition through related learning activities -provide formative evaluations throughout curriculum

Residents are adult learners and thus have diverse previous experiences, learning styles and interests that will impact on their learning. Employing a philosophy based on the Developmental Perspective allows residents to build upon their previous experiences. In order to maximize recall and transfer of knowledge and skills, it is essential to match the learning activities closely to the context of future application.

Learners must be engaged in the process of curriculum development and active learner input has been incorporated throughout this project, beginning with the needs assessment described in Chapter Four and continuing during the implementation and evaluation processes. Learning activities have been structured to allow residents to build upon previous knowledge drawn from experiences both within and outside of the formal curriculum. The requirement that learning activities closely match the context of future application has been difficult for residency programs in many disciplines. Frequently, there is a significant difference between primarily hospital-based training programs, and primarily community-based clinical practice [53]. However, the learning activities within this curriculum have been designed to minimize this difference within the constraints of the structure of the training program.

As mentioned previously, no one cognitive model is completely satisfactory to apply to the discipline of developmental pediatrics. To a large degree this is due to a paucity of research specific to training and expertise in this field. However, it is clear that the important issue of content specificity related to problem solving must be addressed in any medical training program. In addition to providing the knowledge specific to a wide range of clinical problems, trainees must be assisted in learning to apply the knowledge to the myriad of clinical problems that may be encountered.

Whether the limiting factor is truly content specificity or perhaps analogous transfer, it is clear that training limited in scope is unlikely to meet trainee needs. Thus a comprehensive set of educational experiences must be provided to maximize resident training.

The principles relating to memory are also critical to consider when planning a curriculum. New information is best incorporated into memory when it has meaning relating to previous memories, thus providing opportunities for trainees to build upon their previous experiences is critical. In situations where the trainees have limited relevant previous experiences, it is essential to provide such experiences and to form logical connections between sequential learning activities. Increased opportunities for practice of retrieval from memory do improve subsequent retrieval from memory, thus it is important to incorporate time and opportunity for this activity. In addition, repetition is known to aid memory, as is the provision of multiple related learning activities, thus these have been incorporated throughout the curriculum.

One of the most significant factors limiting the quality of resident education is time. Medical trainees have multiple demands on their time and must acquire vast quantities of information and skills extremely rapidly. As the volume of medical knowledge grows, this problem becomes more significant despite greater recognition of sound educational principles in medicine. It is critical to incorporate time for reflection on past learning and experiences into a curricular plan, yet often this is considered "wasted time". In the context of developmental pediatric training, reflection is particularly important, as often trainees will encounter clinical problems with which they have not had previous experience. Many clinical situations encompass difficult ethical

and attitudinal issues, thus reflection on personal attitudes and values is essential. In the curriculum plan, opportunities for reflection have been included where possible, but the problem of limited time remains an important constraining factor when attempting to incorporate sound principles of education.

CHAPTER THREE. MODEL OF CURRICULUM IMPROVEMENT

The process of curriculum development and implementation requires that a series of planning, implementation and evaluation steps be completed in a logical order. A model of curriculum improvement has been used to guide this project as "a better program usually results when planners use a model of program planning as a guide." [54]. While there is extensive literature discussing curricular development from an educational perspective, there is relatively little available pertaining specifically to medical education. Fisher and Levine [29] describe theoretical and practical considerations for curricular planning in professional schools, but their recommendations are best suited to undergraduate medical curricula.

Similarly, the University of Calgary Undergraduate Curriculum Redesign Team has compiled a framework and process for curriculum redesign for undergraduate programs at the University of Calgary [55]. While the recommendations are better suited to larger, undergraduate programs, several of the principles outlined in the document are directly applicable to this Thesis project. In particular, curriculum change is described as including the creation of opportunities for students to synthesize information across courses and disciplines. In developmental pediatrics, it is essential to consider clinical problems in various settings and over extended periods of time in the residency program. As described in the Canadian Guidelines [1], one of the key components to training in developmental pediatrics is the incorporation of a multidisciplinary approach. Thus curriculum development must provide opportunities for learning that extend beyond the traditional block rotation. In order to enhance student development, several factors are

important in the learning environment including an increased variety of instructional styles and modes, increased student participation, learning oriented evaluations, and an opportunity to develop autonomy and purpose [55]. These qualities have been incorporated throughout the curricular plan described in this Thesis.

One of the recommendations of the University of Calgary Undergraduate Curriculum Redesign Team is for the development of an explicit course syllabus that specifies the purpose, objectives, outcomes, and evaluation of the program [55]. In developing the curriculum described in this Thesis, the inclusion of a course syllabus was felt to be crucial to the success of the improvement process.

Stone and Qualters [56] discuss implementation of outcome assessment in medical education. Two main models of outcome assessment are described, "institution-centered" and "student-centered". The student-centered model is course-based and focuses on the individual student's mastery of the learning objectives. A modification of this model is used for evaluation of the curriculum in this Thesis. This model was chosen because the formative, continuous measurements afforded by the course-based model allows the curriculum to create necessary changes quickly and thus allows faculty to be self-regulating and flexible in meeting the students' needs [56]. Inherent in the principles of this model are three key concepts which have been important in structuring the evaluation plan for the curriculum improvement process described in this Thesis. First, student assessment must measure learning over time and in multiple domains. Second, assessment must attend not only to learning outcomes, but also to the educational experiences designed to achieve the outcomes. Third, assessment is an ongoing process.

In fact, the process of curriculum evaluation is best considered as part of a continuous loop of curriculum improvement.

The steps of curriculum development followed in this Thesis project are described by Kern et al [27]. These are (1) Problem Identification and General Needs Assessment, (2) Needs Assessment of Targeted Learners, (3) Development of Goals and Objectives, (4) Development of Educational Strategies, (5) Implementation, and (6) Evaluation and Feedback. Similarly, Harden [57] proposes a series of questions to ask when planning a curriculum. Table 2 demonstrates the relationship between Kern's steps and Harden's questions.

As Kern's steps may be applied directly to curriculum improvement in residency training, this overall strategy has been utilized in the creation of this Thesis. Step 1 has been discussed in Chapter One, Step 2 is described in Chapter Four, and Steps 3 and 4 are included in Chapter Six. The main focus of this Thesis will be on Steps 5 and 6. These components are discussed in Chapters Eight, Nine and Ten.

Table 2. Steps in Planning a Curriculum

Kern's Steps [27]	Harden's Questions [57]
1. Problem Identification and General Needs Assessment	1. What are the needs in relation to the product of the training program?
2. Needs Assessment of Targeted Learners	
3. Goals and Objectives	2. What are the aims and objectives?
4. Educational Strategies	3. What content should be included?
	4. How should the content be organized?
	5. What educational strategies should be adopted?
	6. What teaching methods should be used?
5. Implementation	8. How should details of the curriculum be communicated?
	9. What educational environment or climate should be fostered?
	10. How should the process be managed?
6. Evaluation and Feedback	7. How should assessment be carried out?

CHAPTER FOUR. NEEDS ASSESSMENT[1]

Purpose

The key stakeholders in this project of curriculum improvement are the pediatric residents and the pediatricians. As the needs of the targeted learners (pediatric residents) and teachers (pediatricians) may be different from the needs of learners and medical institutions in general, it was essential to seek input from these groups [27]. A survey of residents and pediatricians in Calgary was therefore conducted. This needs assessment had three main objectives:

1. To elicit feedback regarding the teaching of developmental pediatrics at the University of Calgary prior to the initiation of curriculum revision
2. To compare the perceived importance of developmental pediatrics between residents and practicing pediatricians
3. To identify areas in need of curriculum development

Methodology

Questionnaire Development

A written questionnaire was developed with items designed to address the perceived importance of training in developmental pediatrics, the perceived quality of

[1] Data in this chapter has been published in the Annals of the Royal College [58].

training, the degree of physicians' confidence in developmental pediatrics, and the perspectives of the residents and the pediatricians on the value of various educational experiences. The format included open-ended items, forced-choice items, and five-point rating scales. Two versions of the questionnaire were prepared: one for residents and one for pediatricians. Specific questions relevant to each group were included to gather information from the trainee pediatrician's and the practicing pediatrician's perspectives. Parallel questions relevant to both groups were included in both versions. These items were used to draw comparisons between the groups. Items were included in the resident questionnaire regarding the formal clinical rotation and other training in developmental pediatrics. Copies of the questionnaires are included in Appendix 1.

The questionnaires were reviewed by two members of the Division of Developmental Pediatrics at the University of Calgary and by two administrative staff members. Five physicians participated in a pilot test to ensure that the questions were clear. These physicians were not part of the target population for the survey.

The proposal was reviewed by the Child Health Research Committee and the Conjoint Health Research Ethics Board, The University of Calgary.

Questionnaire Administration

Questionnaires were sent to all 29 pediatric residents and 74 pediatricians at the University of Calgary in the fall of 1998. Respondents were assured of confidentiality. Reminders were sent at one, three and seven weeks after initial mailing following the methods described by Dillman [59].

Data Analysis

Respondents were divided into three groups, pediatric residents, general pediatricians, and subspecialist pediatricians for the statistical analysis. The comparison was performed using a multiple analysis of variance (MANOVA) for the items with numerical results on five-point rating scales. A p-value of less than 0.05 was considered statistically significant. Multiple comparison analysis was completed using Scheffe's method. As a few questionnaires were incomplete, the analysis was done in two ways: including the incomplete questionnaires but replacing the missing data with group means for the questions, and removing the incomplete questionnaires from the analysis. The items relating to the formal clinical rotation in developmental pediatrics were analyzed only for those residents who had completed the rotation at the time of the survey. All other items were analyzed for the whole group.

Results

Surveys were returned by 19 residents (66 percent) and 55 pediatricians (74 percent). As the responses of the general pediatricians and the subspecialist pediatricians did not differ significantly, they are discussed as a single group (the pediatricians). Half of the pediatricians who responded to the survey had completed their residency training at the University of Calgary, and one third had completed training within the last five years. No difference in their responses was detected when they were stratified by location or timing of residency training.

On the five-point scale, the pediatricians assigned a mean rating of 2.5 for an overall assessment of their education in developmental pediatrics during residency training. The pediatric residents assigned a mean rating of 2.2 for an overall assessment of their education in developmental pediatrics to date. Among the pediatricians, 20 (36 percent) reported that most or all of their knowledge in developmental pediatrics was acquired after residency training. All of the general pediatricians indicated that they spent at least some clinical time assessing or managing patients with developmental disorders. Of the general pediatricians, 30 percent reported that they spent at least 25 percent of their time dealing with these problems.

Nine parallel items were presented with five-point rating scales and could be compared using the MANOVA technique (Table 3). The pediatrician and resident groups were found to differ on four of the nine items. The results were the same using the two methods selected to deal with missing data.

Both the pediatricians and the residents believe that developmental pediatrics is an important area, but the residents assigned a lower priority for education in this area than did the pediatricians. However, the residents' priority for education in this area increases with increased level of training. Both residents and pediatricians indicated a need for improved residency training in developmental pediatrics. The residents' self-rating of their assessment, diagnosis and treatment abilities was generally poor. Residents, however, have high expectations for their abilities at the end of their training. The pediatricians' recollection of their assessment, diagnosis and treatment abilities at the end of residency is significantly lower than the residents' expectations.

Table 3. Mean Scores by Group on Parallel Items

Question	General Pediatricians' Responses*	Sub-specialist Pediatricians' Responses*	Pediatric Residents' Responses*	p-value
What is your assessment of the importance of DP** for Pediatric Residents?	4.7	4.3	4.3	NS
What is your assessment of the importance of DP for General Pediatricians?	4.8	4.6	4.6	NS
How would you prioritize education in the area of DP compared with other areas of Pediatrics?	4.0	3.8	2.8	<0.0001
At the end of your residency, how competent do you expect to be/do you feel you were at assessing a child for normal development?	4.3	4.4	4.8	NS
At the end of your residency, how competent do you expect to be/do you feel you were at assessing a child for abnormal development?	3.6	3.6	4.4	<0.001
At the end of your residency, how competent do you expect to be/do you feel you were at treating a child with abnormal development?	2.8	2.4	3.6	<0.0001
How would you rate your ability/the pediatric residents' ability to assess a child for normal development?	3.4	3.5	3.3	NS
How would you rate your ability/the pediatric residents' ability to assess a child for abnormal development?	2.9	2.8	2.8	NS
How would you rate your ability/the pediatric residents' ability to treat a child with abnormal development?	2.6	2.4	1.9	<0.01

* All responses on 5-point rating scale (1=lowest, 5=highest)

** DP = Developmental Pediatrics

Of the eight residents who had completed their four-week block rotation in developmental pediatrics and psychiatry at the time of the survey, only one felt that the rotation had provided adequate clinical exposure. Residents who had completed the rotation, however, gave it a mean overall rating of 3.5. Table 4 lists the ten most frequent responses to the open-ended question, "What do you think are the most important areas in developmental pediatrics that should be focused on during residency training?" The pediatricians indicated that the most important problems that are encountered in practice are (in decreasing order of frequency) attention deficit hyperactivity disorder, global developmental delay, behavioral problems, learning disorders, and school difficulties. The pediatricians indicated a wide variety of clinical problems that they had encountered in practice and did not have adequate knowledge or skills to manage. The most frequent clinical problems are (in decreasing order of frequency) autism/pervasive developmental disorder, learning disabilities, severe and complex behavioral problems, attention deficit hyperactivity disorder, and sleep problems.

Among the pediatricians, 38 (69 percent) thought that a pediatrician should receive most of his or her education in developmental pediatrics throughout the residency instead of in one specific year of training. A similar response was obtained from 12 (63 percent) of the residents. Most respondents indicated that they felt a variety of educational experiences would be valuable. These could include a formal clinical rotation in developmental pediatrics, other subspecialty and general pediatric rotations, formal rounds, self-directed learning, and community experiences. Also, most respondents indicated that a variety of professionals should be involved in teaching

residents. These could include general and subspecialty pediatricians, multidisciplinary professionals, residents or fellows in pediatrics, parents, and patients.

Table 4. Important Areas to Focus upon During Residency Training

Pediatrician Responses	Resident Responses
1. Assessment of Child Development	1. Normal Development
2. Normal Development	2. Community Resources & Services
3. Attention Deficit Hyperactivity Disorder	3. Diagnosis of Developmental Delay
4. Community Resources & Services	4. Management of Developmental Disorders
5. Diagnosis of Developmental Delay	5. Assessment of Child Development
6. Learning Disabilities	6. Attention Deficit Hyperactivity Disorder
7. Management of Developmental Disorders	7. Indications for Referral
8. Management of Behavioral Problems	8. Mental Illness
9. Indications for Referral	9. Common Developmental Disorders
10. Autistic Spectrum Disorders	10. Other

Both groups identified several ways to improve the quality of residency training in developmental pediatrics. The most common issues were the need to increase the time allotted to training and the need to improve the organization of the formal rotation. Suggestions regarding the structure of residency training focused on the addition of

opportunities to follow patients over extended periods and the use of other rotations to develop learning opportunities for relevant problems.

Interpretation

Both residents and pediatricians in Calgary indicated a need for improved residency training in developmental pediatrics. Their perceptions of residency training were consistent with those indicated in surveys done in Chicago, Illinois [21], Cincinnati, Ohio [10], and Australia [9].

The need for improvement is emphasized by the finding that pediatric residents' end-of-training competency expectations in developmental pediatrics have not been met by most practicing pediatricians. No significant differences were detected between the responses of pediatricians trained in Calgary and those trained elsewhere. This indicates that the experience of residents training at the University of Calgary is typical, although perhaps not ideal. No significant differences were detected between the responses of recent graduates and those who had graduated more than five years previously. In view of the increasing recognition of developmental pediatrics as an important subspecialty, recent graduates would be expected to have had more opportunity for training in this area, and thus a greater perceived competency at the end of their residencies.

The finding of little difference in pediatricians' assessment of their residency training suggests that the problems at the University of Calgary are common to many programs. It also indicates that although the discipline is developing as a subspecialty, the training programs may be lagging behind.

Feedback regarding the block rotation in developmental pediatrics indicates that while the residents rate their rotation in developmental pediatrics highly, they also indicate that the clinical skills acquired during their rotation are inadequate. This is supported by most respondents, who suggest that increasing the time allotted to residency training in developmental pediatrics is important.

Both pediatricians and residents believe developmental pediatrics is important, but the residents assigned a lower priority to training in this area. The differences in priority and the finding that the residents' expectations were not met by most of the pediatricians may speak to the larger issue of residency training structure and the ability of programs to adequately prepare residents for clinical practice. Recently, programs have become increasingly aware of the difference between mainly hospital-based residency programs and primarily community-based pediatric practice [53]. The residents may have an inaccurate perception of what their future clinical practice will be like and thus develop unrealistic expectations.

The respondents identified the full scope of developmental pediatric problems that are important for training and clinical practice. The diverse suggestions for content to be included in residency training indicate a need for general training in this area. No specific areas of deficiency were identified. Most suggestions for content involved a general category of problems such as "school failure" or "developmental delay". This suggests that efforts for curriculum change should concentrate on developing residents' skills and experience in managing common clinical problems to establish a base of skill from which to explore unusual diagnoses.

Limitations

The information obtained in this survey is limited by the nature of the questionnaire. Surveys depend on self-reporting, which is subject to recall bias and memory effect. Also, several items were presented with global rating scales. Such scales may have inadequate sensitivity to detect small differences between groups, and thus the finding of no difference between pediatrician groups stratified by location and year of training may be partly explained by the format.

The survey also asked respondents to rate their competence in developmental pediatrics. However, the validity of self-assessment of physician performance is known to be limited [60, 61]. Therefore, confirmation of the residents' self-report will be important during the evaluation component of the curricular improvement process.

The response rate in this survey was 72 percent overall, but the residents' response rate was lower than that of the pediatricians. More than 50 percent of the residents in each year, however, returned the survey, thus responses were obtained at each level of training. This represents the majority of pediatricians and residents in the target group, however, any sampling of less than 100 percent limits the generalizability of survey results.

CHAPTER FIVE. DEVELOPMENTAL PEDIATRIC TRAINING AT OTHER CANADIAN UNIVERSITIES

Purpose

This project describes the process of curriculum development at a single university, yet it is anticipated that the results could be generalized to other Canadian programs. Based on the information obtained in the needs assessment survey described in Chapter Four, pediatricians recall similar problems in their residency training in developmental pediatrics regardless of their training site. The Canadian Guidelines [1] mentioned in the introduction are intended to apply to all pediatric residency training programs in Canada, thus it is anticipated that other sites would require similar updates of their curricula. During the preparation for the Royal College Accreditation of the sub-specialty of Developmental Pediatrics, the Section of Developmental Pediatrics of the Canadian Pediatric Society reviewed the existing structure of developmental pediatrics within Canadian training centers in 1996 [1]. As the accreditation process had been placed on hold until recently, the previous review requires update.

The objective of the survey of other residency programs in Canada was to compare the structure of developmental pediatric training in other programs to that at the University of Calgary prior to the implementation of curricular changes.

Methodology

A written questionnaire was developed with items addressing the structure of resident training and evaluation in developmental pediatrics. The respondents were also asked if their program followed the Canadian Guidelines [1], and whether there were learning objectives for developmental pediatrics. A copy of the questionnaire is included in Appendix 2.

The questionnaire was sent by mail in the summer of 1999 to the chief residents at each of the 15 other Canadian universities with pediatric residency training programs and by email to the Canadian Pediatric Society resident representatives. This group of people were chosen as they are likely to be aware of the Canadian Guidelines [1] and will also be most familiar with the structure of their training programs and the educational opportunities available in each year of residency training. Reminders were sent at one, three and seven weeks after initial mailing following the methods described by Dillman [59].

Results

Surveys were returned by representatives from 11/15 (73 percent) of the Canadian pediatric residency training programs. A summary of the structure of training in developmental pediatrics at each program is provided in Table 5. Five of the respondents reported that their programs follow the Residency Training Guidelines for Developmental Pediatrics and the remainder were unsure. However, one program (F) indicated that they

Table 5. Survey of Developmental Pediatric Training in Canadian Pediatric Residency Training Programs

University	Curriculum Guidelines followed by Program	Mandatory Block Rotation	Formal Teaching Sessions	Longitudinal Educational Opportunities	Method of Resident Evaluation
A	yes	2 months in R1 year	6 hrs/yr	no	Preceptor evaluation*
B	unsure	2 months in R2 year	12 hrs/yr	no	Preceptor evaluation
C	unsure	1 month in R3 year	8 hrs/yr	no	Preceptor evaluation
D	unsure	1 month in R2 year	3-5 hrs/yr	Follow-up clinic q3wks	
E	unsure	2 months in R2/R3 years	10-15 hrs/yr	Special infant clinic	Preceptor evaluation
F	yes	none	1-2 hrs/yr	Ambulatory block (2-4 months)	**
G	unsure	1 month in R1, 1 month in R3/4 years	6 hrs/yr	no	Preceptor evaluation
H	yes	1 month in R2 year	6-10 hrs/yr	In R4 year only	Preceptor evaluation
I	yes	2 months in R2 year	4-6 hrs/yr	no	Preceptor and written evaluations
J	unsure	1-2 months in R3 year	none	no	Preceptor evaluation
K	yes	3-4 months in R1-R3 years	10 hrs/yr	no	Preceptor evaluation

* Also included in general biyearly OSCE examination
** Also included in general annual OSCE examination

follow the Guidelines, yet there is no mandatory rotation in developmental pediatrics and only 1-2 hours per year of formal teaching in the area at that center. Ten of the programs have mandatory block rotations in developmental pediatrics ranging in duration from 1 month to 3-4 months. Depending on the site, the rotations are completed in the R1, R2 or R3 years of residency. Nine of the programs with mandatory rotations require the residents to "cross cover" night call for different clinical areas. The clinical activities performed during the rotation vary widely, but most respondents indicated that the majority of resident time was spent in tertiary level clinics in developmental pediatrics.

Ten of the programs have formal teaching sessions in developmental pediatrics ranging from 3 to 15 hours per year. Four programs have opportunity for longitudinal follow-up of children typically in the setting of a general pediatric clinic.

Preceptor evaluation is used by 9 of the 11 programs. Two programs use regular OSCE type examinations, however, these examinations assess multiple areas of pediatrics, not specifically developmental pediatrics.

Interpretation

Prior to the initiation of curricular improvement at the University of Calgary, the structure of pediatric resident training in developmental pediatrics was similar to that in other training programs. However, the time allotted to the block rotation in Calgary (two weeks) is short compared with the other Canadian programs.

Evaluation of residents is generally done by preceptor evaluations, and only one program uses a written examination specific to developmental pediatrics. This is

consistent with the traditional method of resident evaluation used at the University of Calgary.

Few programs provide opportunity for longitudinal follow-up of patients. There is an existing longitudinal clinic at the University of Calgary, but similar to the four sites that provide this learning opportunity, it is in the structure of a general pediatric follow-up clinic.

In summary, the structure of residency training in developmental pediatrics at the University of Calgary is similar to that of other programs in Canada. This is consistent with the finding in the needs assessment survey described in Chapter Four that the pediatricians surveyed did not differ in their responses according to location of training. While resident training in developmental pediatrics at the University of Calgary prior to July 1999 may not have been ideal based on the needs assessment survey, it likely was typical of pediatric training in this discipline.

As the basic structure of other Canadian training programs is similar to that at the University of Calgary, the process of curriculum improvement described in this Thesis should be applicable to other programs seeking to better meet physician needs and to follow the recommendations for resident training.

Limitations

The data presented in this section has several limitations. The survey was originally intended to be included as part of a larger survey to update the records of the Committee on Education of the Developmental Pediatrics Section, Canadian Pediatric Society. The Committee Chair sent this survey to "key contacts" in developmental pediatrics at the various Canadian universities. The "key contacts" were typically program directors and/or division heads. The methodology used in the "key contact" survey was chosen and administered by the Committee Chair. Although responses were obtained from approximately two-thirds of those contacted, the data was not forwarded to the author of this Thesis. Thus, the second attempt made to collect the information has been described in this chapter. The chief residents and Canadian Pediatric Society resident representatives were chosen as they had not previously been asked the survey questions and they would likely be knowledgeable about the structure of resident training. However, this group may have been less familiar with the Canadian Guidelines than the "key contacts" since six of the eleven respondents indicated they were uncertain if their program followed the Guidelines.

As with any survey, the data is also affected by sampling. Responses were obtained from 73 percent of the programs, thus it is likely that a reasonable representation of various program structures was obtained. While recall bias and self-reporting often adversely affect quality of data obtained from surveys, in this case the questions were quite specific to the structure of the program and the responses would be unlikely to vary with different responders who were familiar with the rotations and the teaching sessions.

CHAPTER SIX. CURRICULUM DEVELOPMENT

Introduction

This chapter contains a formal description of the revised curriculum. The curriculum was developed based primarily upon the Canadian Guidelines [1] and the data collected during the needs assessment survey described in Chapter Four. Principles of adult learning and cognitive psychology described in the literature review (Chapter Two) are incorporated throughout.

Chapter Eight describes the plan to incorporate the curriculum into the residency program, and Chapter Nine describes the results of the implementation process.

Goals

The overall goal of pediatric residency training is to develop competent physicians who will be able to meet the needs of their patients and the community. Specific to developmental pediatrics, the physician graduating from a pediatric residency program will be able to:

1. Assess and manage developmental problems in pediatrics
2. Act as a consultant to family physicians and other agencies with regard to developmental and behavioral problems of childhood and adolescence
3. Promote factors that optimize the health and development of children
4. Support the family of a child with a developmental or behavioral disorder

Philosophy

Prior to addressing problems in child development, it is first necessary to appreciate the normal spectrum of development from infancy to adulthood including physical changes, and the development of language and communication, social interaction, cognition, attention, memory, emotion, personality and sexuality. It is recognized that much of this appreciation is derived from personal and professional experience in both clinical and non-clinical settings that provide exposure to children of all ages.

The pediatrician has a responsibility to promote child advocacy and health care for all children including disadvantaged children and those with special needs. The curriculum must incorporate throughout the principle of providing sensitive, empathic care to all children in a way that is sensitive to their individual needs, background, strengths and vulnerabilities.

Problems of development will usually have many implications for a child's functioning. Thus a multidisciplinary approach often provides the best form of care for a child. When proceeding through a training program in the area of developmental pediatrics, emphasis must then be placed upon the role of the physician as a member of a multidisciplinary team.

Context

This curriculum will be integrated into a comprehensive pediatric residency training program. It is understood that content areas may overlap with subjects relevant to other pediatric disciplines.

As understanding of health and illness continues to expand, increased demands are made upon the training programs to include a greater breadth and depth of training. Thus, training in the area of developmental pediatrics must be incorporated into an overall plan of education that includes prioritization of all disciplines relevant to the practice of pediatrics.

The priorities of the learners must also be considered. The optimal time for the introduction of aspects of developmental pediatrics is determined by many factors including the interest of the students, the set of knowledge, skills and attitudes required to function successfully at a given level of residency training, the constraints of other clinical and educational demands, and the availability of educational opportunities at a given time. In general, residents assign greater priority to problems in this area as they become more senior in the training program. Therefore, the timing of educational experiences has been planned to reflect changes in resident priorities and requirements for learning.

Target Learners

This curriculum is designed for pediatric residents at the University of Calgary. Residents at all levels of training (R1-R4) are included. It is anticipated that as the residents progress through their training that they will expand their knowledge, skills and clinical experience in this area. Thus the curriculum reflects the differing requirements and priorities for each level of training.

Perceived Resources and Constraints.

A four-week block of time is allotted for training in developmental pediatrics and psychiatry at the University of Calgary. Each year, approximately 10-12 hours are allotted to developmental pediatrics in the residents' academic half-day. This amount of time is inadequate given the depth and breadth of developmental pediatrics and is shorter than that allotted at other Canadian Universities. Thus, prioritization of learning experiences is essential in order to ensure that key concepts and clinical problems are covered. It is hoped that in the near future, additional time in the residency training program will be allotted to clinical rotations in developmental pediatrics and that this will allow further expansion of the curriculum. At present, however, it will be important to incorporate learning opportunities in various aspects of the residency training program to ensure adequate exposure to problems in developmental pediatrics.

Children's development is most accurately observed and understood in natural settings, but these settings will be utilized only occasionally during this curriculum. This

is due both to time restrictions and to the structure of the training program. It is anticipated that in the future, additional educational settings may be utilized more formally, possibly including schools, day cares, group homes and/or private homes (with community outreach programs).

The faculty resources in the Division of Developmental Pediatrics at the University of Calgary are limited. As this is a small division, the utilization of other sources of expertise such as community pediatricians and multidisciplinary professionals will be essential to the success of the curriculum. Over recent years, there has been reorganization of Developmental Services at the Alberta Children's Hospital spanning the time of curriculum implementation. This limits some of the educational opportunities and necessitates modification to the curriculum due to logistics external to the education program.

Prerequisites

The pediatric residents have satisfactorily completed their undergraduate medical training in pediatrics. It is assumed that the residents therefore have the prerequisite knowledge of basic sciences such as anatomy, physiology, biochemistry, etc. relevant to pediatric medicine that was acquired in their undergraduate medical education. These areas will not be formally evaluated prior to the initiation of the curriculum in developmental pediatrics, as the undergraduate evaluation process must document success in these areas. In addition, all residents complete annual written examinations that include these areas.

It is also expected that the pediatric residents will be proficient at basic clinical skills such as history taking and physical examination skills for general pediatric assessments of children ages 0 to 18. These skills are expected to vary with each resident's level of training. In the course of the pediatric residency training program, biannual examinations are completed in order to review clinical skills. Rotation preceptor evaluations are also used to assess clinical skills. Therefore, evaluation of the basic clinical skills of the residents will not be duplicated prior to the initiation of this curriculum.

Attitudes of patience, sensitivity and empathy are expected of the pediatric residents at all levels of training. An ethical approach to children and their families and to the practice of medicine is also expected at all levels of training. The attitudes and ethical behavior of the residents are also included as part of the rotation preceptor evaluations. The pediatric residency training program presently incorporates a theme in ethics throughout the program.

Objectives

The *Educational Objectives for Curriculum in Development and Behavior in Pediatric Residency Training* described in the Canadian Guidelines [1] were used as a starting point for the development of learning objectives for this project. These objectives were written in the form of broad, non-specific statements, thus it was necessary to create a set of specific learning objectives to guide the process of curriculum

revision. The results of the needs assessment described in Chapter Four were also used to guide the development of the learning objectives.

There are different types and levels of objectives that may be included in a curriculum plan. These include objectives related to the achievements of learners, to the educational process, and to health care and other outcomes of the curriculum [27]. In this chapter, the learning objectives described are related to the achievements of the learners. The other levels of objectives are implicit in the design of the curriculum. In order to address the learners' needs, it is necessary to provide an appropriate educational process and this will lead to suitable outcomes in terms of training physicians to provide appropriate health care.

Learning objectives reflect different approaches to learning as described in Chapter Two. For example, Behaviorist theory dictates that objectives be written in precise, measurable and observable terms. However, Cognitive theory requires that objectives be written to describe the desired behavior and the context in which the behavior applies. Others, who see learning as a process of inquiry, reject the idea of learning objectives entirely [36].

The objectives are written in the form of behavioral objectives. Each objective contains a specific verb that describes the desired behavior of the learner. This was chosen because the format is familiar to the residents and to the preceptors who will be involved in implementing the curriculum. Also, the use of behavioral objectives facilitates evaluation of defined expected outcomes, thus assisting in Step 6 (evaluation and feedback) of the process of curriculum implementation.

At the University of Calgary, there has been a recent trend to writing objectives in a CUBE (CUrriculum dataBase for Medical Education) format [62]. However, when the objectives were translated into the CUBE format, the length of the printed objectives was increased by four times. This length of objectives is unlikely to be utilized either by the students or the preceptors. The CUBE format is best suited for use with the computer-based system used in the Bacs Center at the University of Calgary medical school. Unfortunately, the technology required to optimally use this objective technique is not readily available to the pediatric residency program as it is located at a different site (Alberta Children's Hospital).

A copy of the learning objectives is located in Appendix 3. The terminal objectives indicate expectations at the completion of the pediatric residency. The enabling objectives define the course content and specify the depth and breadth of knowledge, skills and attitudes expected of the pediatric residents. In addition, the objectives regarding "Normal Development" and "Clinical Assessment and Communication" are enabling objectives to those regarding "Abnormal Development" and "Management".

It is clearly quite difficult to describe the full scope of the curriculum content by way of concise, measurable learning objectives. This is particularly true when attempting to write objectives for clinical skills and attitudes that are more difficult to measure than are knowledge objectives. One of the important features of behavioral learning objectives is that they specify a measurable behavior in the learner. Often, it is difficult to specify the behavior in a manner that does not require a subjective judgement as to

whether appropriate technique or interpersonal skill was used. The following objective illustrates this problem.

"The pediatric resident will assess a child's development using history taking and physical examination technique appropriate for the child's age."

In order to specify the particular assessment techniques, objectives would be required for each age and presenting problem. Obviously, this would be exceedingly cumbersome and even an extensive list of detailed objectives would be unlikely to cover all clinical presentations. Therefore, this limitation is unavoidable due to the nature of medical practice. This issue is addressed further in Chapter Seven (Development of Resident Evaluation Tools).

Two content experts (developmental pediatricians) have reviewed the objectives listed in this document in order to ensure the objectives had appropriate content and scope for pediatric residents.

Course Units and Themes

The content outlined in the objectives has been organized into course units. These are:

1. Normal Development
2. Assessment of Infant and Child Development
3. Developmental Disorders associated with Dysmorphic Features
4. Global Developmental Delay
5. Speech Delay

6. School Failure
7. Behavioral Problems
8. Tic Disorders
9. Child Abuse

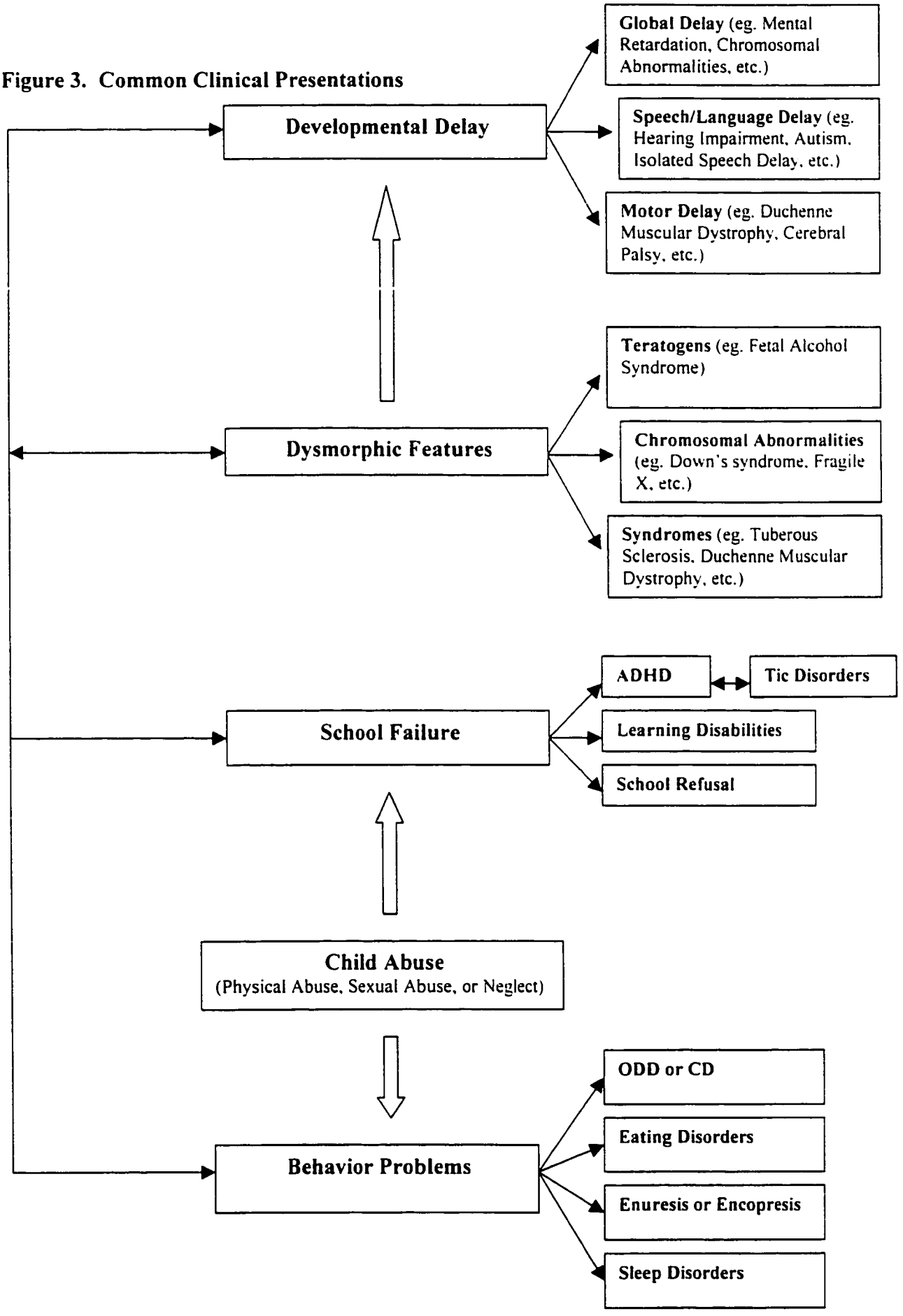
The first two units are prerequisite for the remainder of the units. Knowledge and understanding of normal child development must precede learning activities focussing on abnormal development. "The Assessment of Infant and Child Development" is a unit incorporating clinical skills required for all of the other units.

Units 3-9 have been organized to reflect the clinical presentation of infants and children with developmental and behavioral disorders. Most of the clinical problems in this area present in one of these seven patterns. Although there is overlap between the groups, this organization allows the content to be structured in a logical manner that tends to reflect clinical practice. This is presented schematically in Figure 3. The group sessions and clinical learning experiences (see below) are organized to reflect this structure.

Throughout each unit, important themes are incorporated including:

1. Communication
2. Anticipatory Guidance
3. Prevention Strategies
4. Management
5. Child Advocacy

Figure 3. Common Clinical Presentations



These units and themes have been organized into a course blueprint (Table 6). In addition to the units mentioned above, two group sessions have been specifically designed to cover management issues. These sessions are included because this area was most consistently identified in the needs assessment survey as a weak area for both residents and pediatricians. The domains, learning experiences and evaluation methods in bold print are primary ones for each content area.

Table 6. Course Blueprint

Content	Domain*	Learning Experiences**	Number of Group Sessions	Evaluation Method
Normal Development and Health Promotion	**K** A	Group Session 1 **Clinical (Amb)** **Clinical (Res)**	1 Session	**Written Examination**
Assessment of Infant and Child Development	**S** A	Group Session 2,3 **Clinical (Res)** **Clinical (Dev)** Clinical (all other rotations)	2 Sessions	Written Examination **Preceptor Checklist**
Developmental Disorders with Dysmorphic Features	**K** S A	Group Session 4 **Clinical (Gen)** Clinical (Dev)	1 Session	**Written Examination** Preceptor Checklist
Developmental Delay	**K** S A	**Clinical (Dev)** **Clinical (Neuro)** Clinical (Amb) Clinical (Res)	2 Sessions	**Written Examination** Preceptor Checklist
a. Global Delay		Group Session 5		
b. Specific Patterns		Group Session 6		
School Failure	**K** S A	Group Session 7 **Clinical (Dev)** **Clinical (Amb)**	1 Session	**Written Examination** Preceptor Checklist
Behavioral Problems	**K** S A	Group Session 8 **Clinical (Amb)** Clinical (Dev)	1 Session	**Written Examination** Preceptor Checklist
Tic Disorders	**K** S A	Group Session 9 **Clinical (Dev)** **Clinical (Neuro)**	1 Session	**Written Examination** Preceptor Checklist
Child Abuse	**K** S A	Group Session 10 Clinical (Dev)	1 Session	**Written Examination** Preceptor Checklist
Management	**K**	All clinical rotations	2 Sessions	**Written Examination** Preceptor Checklist
a. Pharmacology		Group Session 11		
b. Resources		Group Session 12		

*K Knowledge
S Skills
A Attitudes

**Amb Ambulatory Pediatric Rotation
Res Pediatric Resident Clinic
Dev Developmental Pediatric Rotation
Gen Genetics Rotation
Neuro Pediatric Neurology Rotation

Learning Experiences

As discussed in Chapter Two, a working definition of learning is "a change in behavior". If this simplified definition is accepted, then teaching may be defined as the process of inspiring, encouraging and facilitating that change. A teacher plans learning, stimulates learning, directs learning, monitors learning and evaluates learning, but the learning process itself is a student activity [29]. Thus, the intent is to plan resident activities that promote the learning process, rather than simply delineate the curriculum content. Instructional activities also must provide for repetition of learning, increasing complexity and correlation of learning [29]. The students must experience repeatedly the knowledge, skills and attitudes specified by the objectives, apply them in increasingly complex situations and experience related learning activities that reinforce one another.

As outlined in the course blueprint (Table 6), the learning experiences are distributed throughout the pediatric residency training program. This is consistent with the American Guidelines recommendation of "an integrated experience that incorporates behavioral developmental issues into ambulatory and inpatient experiences throughout the [training program]" [19]. The learning experiences include group sessions during the residents' academic half-day, the block rotation in developmental pediatrics, the pediatric resident clinic, other subspecialty pediatric rotations (neurology, genetics and ambulatory pediatrics) and independent learning activities (Table 7). While it may be argued that all of the residents' clinical activities have some relevance to developmental pediatrics, the efforts for curriculum change in developmental pediatrics will be restricted to these five areas.

Table 7. Learning Experiences Relevant to Developmental Pediatrics

	Learning Experience	Details	Time Allotted	R level
1	Group sessions	-academic half day -12 sessions (6/year) -repeat every 2 years	2 hours/session	All
2	Developmental pediatric rotation	-clinic based -multiple preceptors -combined with Psychiatry	4 weeks	R3
3	Clinical Rotations			
	a. Ambulatory	-single preceptor -community based -outpatients only	4 weeks/rotation, 1 rotation/year	R1-R3
	b. Pediatric resident clinic	-longitudinal clinic -hospital based -outpatients only	1 half-day/month	R2-R4
	c. Genetics	-hospital based -inpatients/outpatients	4 weeks	R3
	d. Neurology	-hospital based -inpatients/outpatient	4 weeks	R2
4	Independent learning activities			

Focus areas for levels of training:

R1 Normal Development
R2 Assessment Skills
R3 Abnormal Development
R4 Management and Consultation

In order to meet the learning objectives, there must be congruence between the objectives and the learning activities. As individuals have different learning styles, it is preferable to employ various teaching methods when planning a curriculum [27]. This curriculum encompasses a wide range of learning objectives from all domains (knowledge, skills and attitudes) and thus must employ various learning opportunities to

meet these objectives. By incorporating the activities throughout the training program, specific learning activities may be tailored to be congruent with the learning objectives.

Several consistent principles are included in each of the settings described below. Adult learning theory described in Chapter Two is incorporated throughout, particularly in terms of maximizing active resident participation in clinical activities and providing timely feedback to the residents. In addition, the residents have had direct input into the curriculum development both in the planning stages and through ongoing feedback during the implementation process. Evidence-based medical care is an essential part of current practice of medicine and is included throughout as part of the presentation of content. Where available, clinical practice guidelines are utilized in resident teaching [63].

Key concepts of cognitive psychology and principles of adult education were presented in Table 1 on page 26. These have been applied during the development of the learning experiences as summarized in Table 8.

The description of the learning activities in this chapter has been restricted to the organization of the activities within the residency program. Faculty development and description of specific teaching methods is included in Chapter Eight.

Table 8. Key Concepts of Cognitive Psychology and Principles of Adult Education Applied to the Development of Learning Activities

Key Concepts	Implications for Curriculum Development	Application to Development of Learning Activities
Residents have diverse previous experiences, interests and learning styles	-apply andragogical process design -allow residents to build on previous experiences -provide multiple different learning activities -encourage self-direction to explore personal interests	-needs assessment used to guide content and structure of learning activities -multiple different learning activities planned throughout training program -organization of learning activities in hierarchy to reflect experiences and priorities of residents at different levels
Adults may require assistance to progress from dependent to independent learners	-adopt Developmental Perspective as dominant philosophy	-graduated responsibility for learning (and patient care) as residents progress from R1 to R4 level -learning activities reflect resident priorities and experiences at different levels
Retrieval from memory is optimal if the learning context matches the application context	-provide learning activities that mimic future pediatric practice	-group sessions designed to be problem-based with discussion around live, video or paper cases -clinical activities in setting of actual pediatric practice -resident clinic structure mimics "group community practice"
Active learning is superior to passive learning	-engage the learners in active learning activities -seek input from the learners at all stages of curriculum development	-all learning activities require active resident participation -input sought during needs assessment prior to curriculum revision -feedback sought throughout planning and implementation

Table 8 (continued)

Key Concepts	Implications for Curriculum Development	Application to Development of Learning Activities
Content specificity may interfere with the transfer of knowledge from one problem solving setting to another	-provide residents with exposure to a wide range of clinical problems	-content clearly specified in learning activities -multiple settings utilized as learning activities -residents provided exposure to a wide range of clinical problems
Retrieval of information from memory improves with practice	-provide repetition through related learning activities -provide formative evaluations throughout curriculum	-repetition provided through hierarchical learning activities throughout residency program -formative evaluation provided in pediatric resident clinic (clinical assessment skills) and in block rotation in developmental pediatrics

Group Sessions

All residents regardless of level of training attend the group sessions. Although it may be preferable to separate the residents by level of training so that the learning activity could be tailored to meet resident needs at each individual level of training, this is not practical due to the structure of the training program and the academic half days. The group session topics will thus be repeated every two years, allowing each resident to participate in each session as a junior resident and as a senior resident. Outlines of the group sessions are included in Appendix 4. The outlines will be provided to the residents and the presenters prior to the group sessions and include the purpose and objectives of

the session, suggested references, and a brief description of the planned learning activities. The objectives in the outlines are the relevant terminal objectives described above. This provides the presenters with the final goal for the presentation without overly restricting the content to be included.

Block Rotation in Developmental Pediatrics

The block rotation in developmental pediatrics was modified significantly. No changes were made to the psychiatry component of the four-week rotation. The two main criticisms of the block rotation prior to curriculum revision had been that the rotation was poorly organized and there was only infrequent opportunity for residents to work with individual preceptors on more than one or two occasions. Thus there was a clear need to improve the logistics of the rotation, to allow further opportunities for residents to work with preceptors over a longer period of time, and to improve the feedback given to the residents. In order to accommodate these improvements, the structure was changed to a preceptor-based format. Each resident is assigned two primary preceptors with whom they will spend a minimum of one clinic day per week over the course of the rotation. Within the limitation of the four-week rotation, this allows the residents to interact with specific preceptors on at least four occasions, thus facilitating planning of the learning activities, discussion of clinical problems, and provision of feedback to the residents. In addition, past residents have indicated that they frequently observed, rather than participated in clinical assessments, and this structure

will allow increased inclusion of the resident into clinical activities as they progress through the rotation.

Primary preceptors for each resident will include one community-based pediatrician and one hospital-based pediatrician. This will provide the residents with clinical activities both in the community and in the tertiary care setting.

One day per week, residents will participate in scheduled teaching cases. These are specifically selected patient cases representing key presentations in developmental pediatrics. The resident will perform complete clinical assessments with direct observation by his/her preceptor. Immediate feedback will be provided regarding the resident's performance using the Formative Evaluation Checklists shown in Appendix 5.

The Formative Evaluation Checklists are specific checklists for key problems used to collect information regarding particular clinical skills important at different patient ages or in different clinical problems. As these are used during scheduled teaching cases, it is possible to tailor these checklists to include specific detail regarding important factors on history or techniques on physical examination. In addition, they contain more specific items regarding interpretation of the clinical information and investigation and management of the clinical problem. These checklists are formative and are used for the purposes of resident feedback only. The summative evaluation is described in Chapter Seven.

Despite the lack of suggestions received during pilot testing, midway through the first year of curricular implementation, the specific checklists required modification to allow a rating scale rather than a yes/no response. The preceptors indicated that the forced choice of "yes" or "no" limited their ability to provide feedback, as often a

resident would attempt to perform a component of the assessment but his/her performance was suboptimal. Change to a 5-point rating scale solved this problem. In addition, it allowed residents to review their clinical skills and compare their relative strengths and weaknesses more readily. Direct feedback enhances learning [64] and one of the key weaknesses found in the needs assessment survey was little provision of feedback to residents during their developmental pediatric rotations. As this was an important factor in determining the structure of the rotation, the evaluation was modified to provide maximal useful feedback to the residents.

Residents will participate in additional clinical activities when they are not scheduled with their primary preceptors. This time will be spent participating in multidisciplinary team assessments including psychology, speech/language pathology, occupational therapy, physiotherapy, social work and audiology. In general, this is organized so that the residents may follow an individual child through each of these assessments and then participate in the team conference as well.

The block rotation does not provide the opportunity for residents to follow children with developmental problems over time, yet it has been retained in the curriculum plan for other reasons. First, it provides the residents with unique clinical learning opportunities that are not available elsewhere in the program. Second, the provision of a block rotation in this area helps to increase the profile of the discipline within the training program. Despite clear recognition that this is an important area for pediatricians, training programs in general seem to be lagging behind clinical practice. Third, there are constant competing demands for residents' time. A dedicated block rotation allows each resident to focus on the discipline without conflicting

responsibilities. Finally, several educational strategies that are to be introduced during the curriculum revision may be piloted within the Division of Developmental Pediatrics prior to their introduction to other disciplines.

Pediatric Resident Clinic

This setting provides a unique opportunity for the residents to participate in longitudinal patient care. The pediatric resident clinic operates as a general pediatric clinic. However, over past years, the success of the clinic has been limited by low patient numbers and by conflicting resident responsibilities.

Prior to utilizing the resident clinic as a learning activity for this curriculum, several administrative difficulties within the clinic had to be solved. In the academic year 1999-2000, several steps have been taken to improve the clinic. A pediatrician is now located "on-site" to supervise the clinic, resident scheduling has been improved to avoid conflicts with other clinical responsibilities, advertisement of the clinic to family physicians and emergency departments has increased, and resident evaluation is included.

Residents in years 2, 3, and 4 participate in the resident clinic on average once per month. A variety of clinical problems including developmental pediatric problems are seen and followed in the clinic. However, for the purposes of this curriculum, the emphasis in the resident clinic is on the objectives relevant to clinical assessment and communication. The residents are identified as the primary physicians in the clinic and are expected to complete full assessments independently. Residents will thus have the opportunity to gain experience regarding the developmental assessment of all children

attending the clinic regardless of the nature of the presenting complaint. As patients return for follow-up, the residents have the opportunity to re-examine them over a period of up to three years. This is not possible on block rotations lasting typically four weeks as most patients do not return for follow-up in that time. Residents will be directly observed performing clinical assessments and thus will obtain feedback on their skills on a daily basis.

In the second year of curriculum implementation, it is anticipated that the role of the pediatric resident clinic will increase, with a greater emphasis placed specifically on developmental pediatric problems. In addition, as patient numbers increase, it is hoped that the first year residents may also be included in the clinic.

One of the limitations of longitudinal ambulatory experiences tends to be related to the assignment of patients. In most ambulatory settings, patient assignment is not based on the training needs of the residents [65]. Thus, once the administrative problems are solved, the next step is to assign patients to residents according to the curriculum goals and objectives. The structure of the clinic visit could also be planned to maximize resident learning [66, 67].

Other Clinical Rotations

Modifications to the other clinical rotations such as ambulatory pediatrics, genetics, and pediatric neurology are planned in the second year of curriculum implementation. They are mentioned here briefly for completeness. These rotations have been chosen specifically because several of the clinical presentations outlined in Figure 3

(page 60) are directly applicable to these areas. During the ambulatory pediatric rotation, residents spend time with preceptors in community pediatric offices and thus may experience any of the clinical presentations in that setting. In particular, children frequently present to community pediatricians with developmental delay, behavior problems and/or school failure. Similarly, patients frequently present to pediatric neurologists with developmental delay and tic disorders and to clinical geneticists with dysmorphic features. Eventually, all of these opportunities will be utilized to maximize the residents' learning in developmental pediatrics. In fact, this is essential in view of the brief time allocated specifically to developmental pediatrics.

Independent Learning Activities

While the formal learning activities endeavor to provide appropriate opportunities for the residents to attain the learning objectives of the curriculum, there is a clear expectation that residents will also participate in independent learning activities. This is consistent with the concept of physicians as "life-long learners". It is well known that physicians continue in their education following the completion of their residencies. In the needs assessment survey described in Chapter Four, 36% of the pediatricians surveyed indicated that most or all of their knowledge in developmental pediatrics was acquired after residency training.

Examples of independent learning activities include readings, literature review, case presentations at rounds, journal club presentations, etc. These activities are facilitated within the training program by providing the residents with recommended

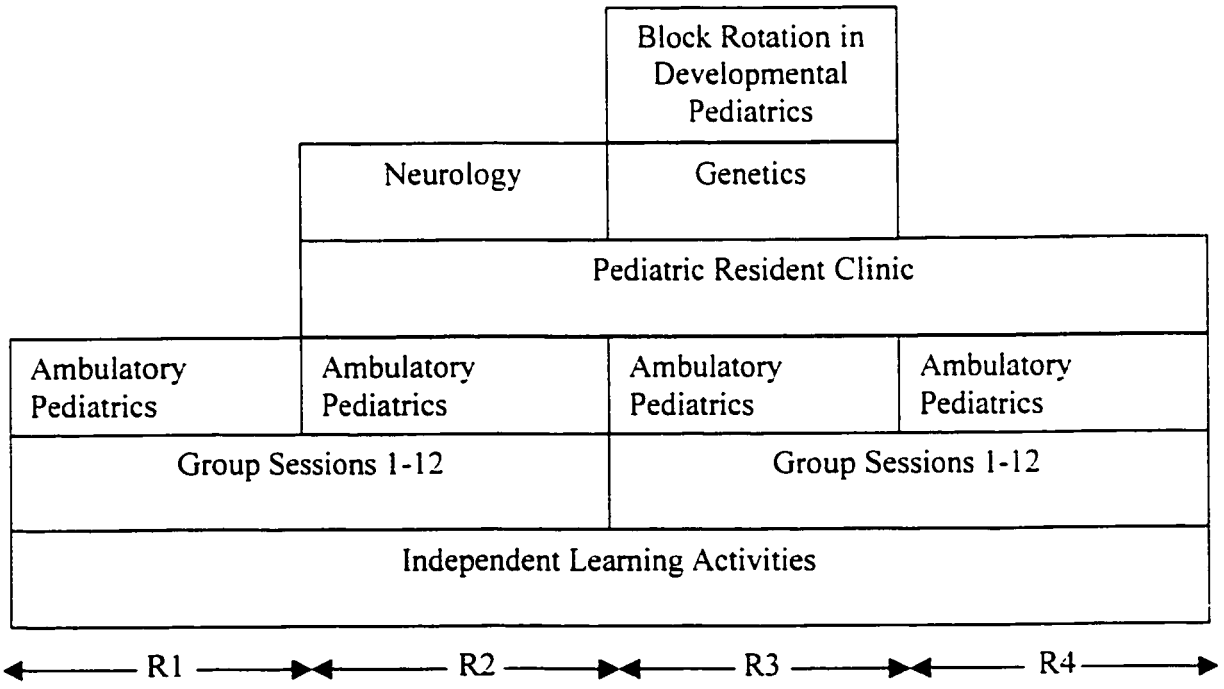
reading lists, preceptor and resident discussion regarding clinical issues or cases, and providing opportunity for the residents to present at rounds and journal clubs.

No attempt has been made to limit the scope of these activities, but rather to support and encourage development of residents' independent learning skills.

Summary of Learning Activities

Over the four years of pediatric residency training, the pediatric residents will participate in a variety of learning activities in the curriculum. This is presented schematically in Figure 4. The content specified in the learning objectives will thus be covered in various settings as the resident progresses through his/her training. This was summarized in Table 6 on page 62.

Figure 4. Learning Activities over the Four Year Pediatric Residency Training Program



CHAPTER SEVEN. DEVELOPMENT OF RESIDENT EVALUATION TOOLS

Background

Previous efforts to demonstrate improvement of physician education following curriculum improvements in developmental pediatrics have been frustrating. In the United States in the 1980's, developmental pediatric curricula were developed in response to the recommendations of the American Academy of Pediatrics Task Force on Pediatric Education [11]. It has been difficult to document improvement in physician competence as a result of these efforts. Weinberger and Oski [3] surveyed pediatric residency training programs in the United States five years after the Task Force report. There had been changes in the structure and content of residency training during that period of time, but no attempt was made to measure the educational outcome of the curricular changes. Guralnick et al. [8] describe using four clinically oriented evaluation and case study questions to assess resident knowledge and clinical decision-making skills. However, this technique offers limited sampling of the spectrum of learning objectives in a clinical rotation. These authors also used self-report of residents' perceived competence and their estimation of the proportion of their knowledge that could be attributed to the clinical rotation. Unfortunately, self-report of competence is known to be relatively unreliable [60, 61, 68], and there is no way to objectively confirm the proportion of knowledge attributable to the rotation. Phillips, Friedman and Zebal [14] used an attitudes and knowledge inventory that included self-reporting of

competence and a 60 item multiple-choice examination, however, they did not comment on the validity or reliability of their examination.

In general, medical schools, medical licensing authorities and specialty certification bodies have used a combination of written, oral and observation-based examination formats with the assumption that these techniques are valid and reflect examinee competence [69]. Regardless of the evaluation method chosen, it is extremely important to define the clinical task to be evaluated and establish validity of the examination.

Purpose

To document the effect of curriculum improvement on resident knowledge, skills and attitudes in developmental pediatrics, a feasible, objective evaluation tool is essential. Such evaluation must have demonstrated reliability and validity. The purpose of the evaluation is to provide feedback to the students and preceptors during the process of curriculum improvement and to document whether the learning objectives were met. The written examination aims primarily to evaluate the residents' knowledge, while the preceptor evaluations aim primarily to evaluate the residents' clinical skills and attitudes.

Written Examination

Examination Development

A question bank consisting of items (60) congruent with the learning objectives was created. Extended matching, short answer and multiple choice questions were used. The question types were chosen to best match the cognitive level of the objectives and the clinical task described in the objectives. Examples of the question types are included in Appendix 6. Negatively worded questions and "Type K" questions were avoided as they have been shown to be inferior when compared to other question types [70, 71].

A Minimum Performance Level (MPL) was assigned for each question based upon residents' expected abilities at the completion of a block rotation in developmental pediatrics. For the multiple choice and extended matching questions, a judgment was made as to which options the residents must know to be correct or incorrect and which options the residents may know to be correct or incorrect. The "must know" items received a score twice that of the "may know" items and the MPL is the sum of the "must know correct" and the "may know incorrect" options. This is illustrated in the following example of a multiple-choice question.

A newborn infant has been diagnosed with Down's syndrome. The parents have done research on the Internet about this condition. They come to you with several questions. Which of the following statements(s) is (are) true about children with Down's syndrome? Chose one or more options.

a. They should not participate in physical activities because of the risk of cervical dislocation.
b. Cosmetic surgery is recommended to reduce tongue size.
c. They have an increased risk of developing leukemia compared to the general population
d. They are expected to have adult short stature.
e. They commonly have hearing and/or vision impairments

Options d and e were judged to be "must know correct" options and were assigned a value of 0.4 each. Option c was judged to be a "may know correct" option and was assigned a value of 0.2. The correct options sum to a total of 1.0, which is the maximum possible score for the question. Option b was a "must know incorrect" option with a value of –0.4 and option a was "may know incorrect" with a value of –0.2. The MPL for this item is thus (0.4) +(0.4) + (-0.2) = 0.6. The MPL assignment for the extended matching questions followed a similar strategy.

Assignment of the MPL for the short answer questions followed similar reasoning. All possible correct responses to an item were listed and a judgment was made about which of these a resident "must know" or "may know". The MPL was then assigned as the value of the "must know" option. The following question illustrates this process.

A 13-year-old boy is referred for difficulty in school. He has always had a short attention span and been quite active. A diagnosis of Attention Deficit Hyperactivity Disorder was suggested in the past. Over the past year he has developed facial grimacing that increases when he is anxious. He frequently blinks his eyes and clears his throat. What is the most likely diagnosis for this child?

Correct Answer 1: Tourette's Disorder
Correct Answer 2: Tic Disorder

Answer 1 was assigned a value of 1.0 and Answer 2 was assigned a value of 0.5. Both are correct and the students "must know" that this clinical vignette is a description of a child with a tic disorder. They "may know" that it meets the criteria for Tourette's Disorder. The MPL for this question is thus 0.5.

Two developmental pediatricians reviewed the questions. For each question, they were asked to determine if the question was congruent with the relevant objective(s), was appropriately worded and clear, was relevant to the clinical practice of developmental pediatrics, and had an appropriate scoring key. They were also asked if the instructions were clear and if the questions were written at a level appropriate for pediatric residents. Revisions to the questions were made based upon the feedback received. As the reviewers were unfamiliar with the process of MPL assignment, they did not provide input regarding the MPL.

Thirty questions were drawn from the question bank to construct the test. Question selection was based upon an examination blueprint, developed to ensure appropriate sampling of the objective content. The blueprint was constructed using a grid as shown in Table 9. The vertical columns represent the clinical task required in the questions. The horizontal columns represent the content of the questions as outlined in the learning objectives. The relative weighting reflects the approximate teaching time allotted to each area in the curriculum.

The four questions on normal developmental milestones are in the form of extended matching questions. The questions regarding risk factors, treatment and anticipatory guidance (13) are in the form of multiple choice questions. The remaining 13 questions assessing the diagnosis of abnormal development are in the form of short

answer questions. The MPL values of each question were summed to yield a MPL for the examination of 18/30 or 60%. The complete examination is shown in Appendix 7.

Table 9. Examination Blueprint

	History Taking	Diagnosis	Treatment	Prognosis/ Anticipatory Guidance	Number of Questions	Percent of exam
Normal					6	20
Milestones	4					13
Risk Factors	2					7
Abnormal					13	43
Dysmorphic Features		2				7
Development Delays		4				13
School Failure		2				7
Behavioral Problems		2				7
Tic Disorders		2				7
Child Abuse		1				2
Management			6		6	20
Health Promotion				5	5	17
Examination Total	6	13	6	5	30	100

Pilot Test

Three examinees participated in the pilot test. These examinees were final year residents (R4) in the academic year 1998/99. This group of people was at the same level of training as the expected future examinees. Feedback regarding the scope, format and difficulty level of the examination was collected. The examinees were also asked to comment regarding any specific question found to be ambiguous or inappropriate. The examination was repaired following the feedback received.

The mean score on the pilot test was 22.4/30 (75%). All three examinees surpassed the MPL. Feedback from the examinees led to replacement of one question and clarification of the wording of three other questions.

Reliability and Validity Assessment

The repaired test was administered to the cohort of trainees in pediatrics at the University of Calgary in July 1999 (1999 cohort). Thirty-five people completed the test including eight final year medical students (R0), six first year residents (R1), eight second year residents (R2), eight third year residents (R3), and five fourth year residents (R4). Reliability scores were calculated using Cronbach's alpha calculation of internal consistency. Analysis of variance was performed to compare the mean scores for each level of training. The Spearman rank correlation coefficient was calculated to examine the relationship between level of training and examination score.

The scores of the 1999 cohort are summarized in Table 10. Following review of examinee comments, two questions were omitted because of ambiguity that was not identified during the process of expert review or pilot testing. Thus the results of the remaining 28 questions are shown.

The MPL was met or exceeded by 12.5% of the medical students, 50% of the first year residents, 62.5% of the second year residents, 75% of the third year residents, and 100% of the fourth year residents.

The exam scores are positively correlated with level of training (Spearman rank correlation coefficient +0.56, $p<0.001$). An analysis of variance (ANOVA) revealed a significant overall effect of level of training on mean score ($F(4,30)=3.77$, $p=0.01$). Further analysis revealed that the medical students' (R0) scores differed significantly from the R3 and R4 scores and that the R1 and R2 scores differed significantly from the R4 scores ($p<0.05$). The examination thus was able to discriminate between trainees with greater or equal to two years difference in training levels but was not able to discriminate between trainees separated by one year in their level of training. Cronbach's coefficient alpha was calculated to be 0.78.

Table 10. Results of 1999 Cohort of Pediatric Trainees

Level of Training (R)	Raw Scores (max=28)	Proportion of Examinees Surpassing MPL (16.5/28)	Mean Scores (max=28)
0	7.3	1/8 (12.5%)	14.3
	12.8		
	13.7		
	14.5		
	14.9		
	15.2		
	15.5		
	20.4		
1	15.1	3/6 (50%)	17.6
	15.9		
	16.2		
	18.5		
	19.2		
	21.0		
2	5.4	5/8 (62.5%)	15.3
	9.4		
	11.8		
	18.3		
	18.4		
	19.1		
	19.8		
	20.3		
3	14.7	6/8 (75%)	19.2
	15.3		
	17.5		
	18.8		
	20.5		
	21.9		
	22.3		
	22.8		
4	18.0	5/5 (100%)	21.5
	18.5		
	22.8		
	24.1		
	24.3		

Interpretation of Validity and Reliability Assessment

Reliability is the consistency of measurement of a particular assessment tool and must be present for the assessment tool to be valid [72]. This examination demonstrated good reliability as measured by Cronbach's alpha of 0.78. It is generally accepted that a coefficient of 0.80 indicates good reliability of an examination [73].

Validity is a measure of how well an assessment carries out its intended function [72]. The written examination described above demonstrates several types of validity including content, face, criterion and construct.

Content validity determines whether the assessment procedure provides a representative sample of the competencies expected of the examinees. This is a crucial attribute for an examination as content validity must be present for other attributes such as face validity and reliability to be relevant [69]. Content validity was addressed during the process of expert review and by the use of an examination blueprint that ensured appropriate sampling of content. The questions were determined to be congruent with their respective learning objectives. The emphasis of topics in the examination reflected the time and importance given to these topics in the curriculum.

Face validity refers to the superficial impression of experts and examinees of whether the assessment tool appears to measure the intended content or trait [74]. Face validity was demonstrated during the process of expert review and pilot testing and was confirmed by comments from the pediatric trainees who completed the test. Overall, the expert reviewers and the examinees found the test to be appropriate, relevant and fair.

Criterion validity is determined by the correlation of test scores with another empirical criterion [74]. Unfortunately, no other empirical criterion was available for comparison, as the residents' past performance on preceptor evaluations is confidential.

Construct validity is the degree to which the evaluation measures an abstract trait or ability. In this case, the construct of interest is clinical competence. If one accepts that the clinical competence of medical trainees increases with level of training then the construct validity was demonstrated, albeit indirectly, by the positive correlation of scores on the examination with increased level of training. Further work would be required to determine if the examination was able to predict future performance in pediatric practice.

The examination was able to discriminate between junior trainees (R0, R1, and R2) and senior trainees (R3 and R4). It is possible that by increasing the number of questions that the examination may be even more discriminating, but the time required for the examination would increase. As the reliability of the current examination was good, the examination was not lengthened.

The question bank used to derive this examination was relatively small. Ideally, a question bank should consist of several times the number of questions required to construct the examination. This allows random selection of items while maintaining the sampling of the examination. The question bank will be expanded over time, however, the use of the examination blueprint to select questions for the examination ensured adequate sampling despite the limitation of the size of the question bank.

In a criterion-referenced examination, it is important to ensure that the standard of performance chosen (MPL) is appropriate. Inevitably, the initial assignment of a MPL is

an arbitrary choice and thus confirmation during subsequent examination use is essential. In this case, the standard was chosen based upon residents' expected abilities at the end of their block rotation in developmental pediatrics. At the University of Calgary, the residents complete this rotation during their third year. Seventy-five percent of the R3 residents and all of the R4 residents met the MPL on the examination, thus confirming that the standard was set at an appropriate level.

It is important to note that the MPL was set based upon the expected abilities of residents prior to the implementation of curriculum improvement. Following the curriculum changes, it is anticipated that the resident scores would increase but this may or may not result in a greater proportion surpassing the MPL.

Resident Performance Evaluation

Background

In order to assess clinical skills and resident attitudes, the written examination must be supplemented with other evaluation techniques. Options include resident self-assessment by surveys, preceptor evaluation by checklists and global rating scales, observation such as by critical incident review, and Objective Structured Clinical Examinations (OSCE). Preceptor evaluation was chosen for this project for several reasons. First, physician self-assessment is known to have limited validity [60, 61]. Second, critical incident review is only helpful in specific situations (typically emergencies or poor outcomes), and does not apply well to developmental pediatrics.

Recently, there has been increased interest in the use of the OSCE to evaluate clinical skills, and it has even been referred to as the "Gold Standard" for evaluation of postgraduate clinical performance [75]. However, this examination format is not practical for developmental pediatrics at the University of Calgary at present. There are between five and six residents completing their rotation per year and a relatively small number of suitable preceptors. The cost and time required to develop and run an OSCE is prohibitive. There have been a few reports of successful OSCE examinations in pediatrics at the undergraduate level of training [76-79], but previous descriptions of OSCE format examinations for pediatric residents have been relatively discouraging. Joorabchi [80] describes an OSCE in Pediatrics with good reliability and validity and wide sampling of content. However, 42 stations and extensive financial and personnel resources were required to provide this examination. Although this author describes relatively low cost per examinee ($57), his calculation of cost does not include faculty or staff time and is based upon giving the examination to a total of 35 examinees. Hilliard and Tallett [81] describe a smaller scale Pediatric OSCE with only five stations that is relatively feasible but had limited reliability and validity primarily due to the small number of stations and subsequent limited sampling. In addition, their examination did not assess physical examination skills, but simulated history-taking situations only. These authors also describe potential technical and ethical limitations of using children as standardized patients. However, Lane, Ziv and Boulet [82] describe the successful use of children as standardized patients in a clinical skills evaluation without apparent technical difficulty or adverse effects on the children. Although the OSCE is not feasible for use in

the subspecialty of developmental pediatrics at present, it may have an important role in the assessment of pediatric residents' clinical skills in general.

Within developmental pediatrics, the method chosen to evaluate resident clinical skills and attitudes is preceptor evaluation. This is an inexpensive and feasible technique that is immediately available for implementation. It is also familiar to the faculty at the University of Calgary as all clinical rotations are currently evaluated in this manner. In addition, the use of preceptor evaluation facilitates the accomplishment of a primary goal of the curriculum that is to provide timely feedback to the residents about their performance. The daily preceptor evaluation forms provide a framework for the resident evaluations by specifying areas of importance to evaluate. The evaluation also necessitates that some time be formally allotted to the process of feedback and thus helps to increase the perceived importance of the process. Daily evaluation allows the residents to review their progress and difficulties over time rather than simply being informed of past performance at the end of the rotation. Daily evaluations require sampling of resident performance on multiple occasions by multiple observers and thus should help to increase reliability and minimize observer bias in the preceptor evaluations.

Checklist Development

Preceptor checklists were developed for use during the block rotation in developmental pediatrics. A general daily evaluation form using global rating scales was developed for use during most clinical encounters. An example of the preceptor evaluation form is presented in Appendix 8.

The general daily evaluation form includes a resident component to provide information regarding the type of educational interaction upon which the preceptor assessment is based. Items on this form are in the form of 5-point rating scales. A general question regarding overall competence is incorporated at the end of the form. Room for comments is included. Sources of variability in the daily evaluations include variation in resident performance, variation in preceptor scoring, and the specific setting or clinical problem (content). In order to minimize the limitations in global rating scales including the "halo effect", "central tendency" and variation in the leniency between raters [74], preceptors were educated about these potential problems. They were also given copies of the learning objectives on which the evaluation was based in order to clarify expectations. The checklists completed during the last week of the rotation serve as summative evaluations to determine if the learning objectives have been met.

The variation in patient ages is an important issue to consider when developing checklist forms for clinical skills. The specific skill to be demonstrated may be quite variable depending on the age and cooperation of the child, and this problem is magnified in the area of developmental pediatrics when the majority of the children have either developmental delays or behavioral problems. To avoid the need of multiple checklists for each age and situation, this anticipated difficulty has been accounted for by the use of the term "appropriate" on the preceptor forms. This does require the preceptors to make a judgment about the clinical skill observed and this may introduce a further source of variability, however, it would be impractical to create checklists for all of the possible patient encounters.

The checklist forms were pilot tested during the academic year immediately preceding the implementation of curricular changes (1998-1999). No modifications were made to the forms as they were reported to be clear and easy to use. In fact, the preceptors indicated a preference for use of these checklists over the standard ones provided by the residency training program, as they were much more relevant to the discipline of developmental pediatrics.

Limitations

It is recognized that there may be elements of useful "learning" that are difficult to measure and are not specified in the learning objectives. This has been referred to as the "hidden curriculum" of medicine [33, 34] and includes attitudes, beliefs, values and related behaviors deemed important in medicine. It describes the socialization process that occurs during medical training as the trainees develop as physicians. Thus the "hidden curriculum" may have both positive and negative effects on resident learning related to the defined learning objectives. This concept may be taken further to describe the obvious fact that not all possible learning outcomes will be located within documented learning objectives. Often there are assumed steps or implied consequences that are not explicit in the objectives. These may be as important or relevant as the written objectives. The "hidden curriculum" is thus a feature of residency training that limits both the ability to define the intended curriculum and to evaluate its implementation.

All examination techniques have limitations and may not accurately reflect future success and competence in clinical practice. However, the purpose of the resident evaluation is to determine if the residents meet the learning objectives. As it is difficult to measure all domains of learning with a single tool, several techniques were utilized in order to maximize sampling over each domain.

Due to the inherent difficulties in preceptor evaluation, it is unlikely that small differences between residents' level of competence will be identified by the preceptor evaluation. However, residents with weak clinical skills should be identified in this way, thus a poor preceptor evaluation would serve the purpose of identifying those residents who need to improve their clinical skills in developmental pediatrics. In part, this is due to the inclusion of global rating scales in the evaluation checklists. However, it was considered important to minimize the number of different forms required in order to maximize the utilization of the evaluations. Thus a compromise was developed using the global ratings for most clinical encounters (summative evaluation), and using the specific checklists for "scheduled teaching cases" to improve the quality of the feedback received by the residents regarding specific clinical skills (formative evaluation).

In addition, another issue is that pediatric residents are a relatively homogeneous group, thus it may be difficult to demonstrate differences in performance as a result of different training experiences [14].

A final caution in the evaluation is that the curriculum improvement process likely will increase the general awareness of developmental pediatrics as well as its perceived importance in residency training. This may cause both residents and pediatricians to focus more upon these areas in their clinical activities that are not part of

the formal curriculum. While this is a desired outcome of the improvement process, some of the success attributed to the curriculum may be a result of this increased awareness. Therefore, any changes documented in resident performance may be directly or indirectly related to the curriculum revisions.

CHAPTER EIGHT. CURRICULUM IMPLEMENTATION

This chapter describes the methodology for implementation of the curriculum outlined in Chapter Six. The timeline of the implementation, communication and faculty development plans, and outcome measures are discussed.

Timeline

The implementation process is planned to occur over two years beginning in July 1999. Phasing-in a complex curriculum, one part at a time permits a focusing of initial efforts and can lessen resistance and increase acceptance of the curricular changes [27]. An overview of the implementation plan is presented in Table 11, but the focus of this document is on the first year (July 1999-June 2000). The results of the first year of implementation are presented in Chapter Nine.

All of the pediatric residents at the University of Calgary will be included in the planned curricular changes. During the academic year 1999-2000, all residents will participate in the group sessions, and all R2, R3 and R4 residents will participate in the pediatric resident clinic. The number of residents completing the block rotation in developmental pediatrics is determined by the master rotation schedule for the training program. In the academic year 1999-2000, five residents will complete this rotation.

Table 11. Overview of Implementation Plan

Year	Goals of Implementation	Learning Activities to be Implemented	Faculty Development Activities
1 (1999-2000)	1. Increase resident participation in clinical activities 2. Improve resident feedback/evaluation process 3. Correct deficiencies in developmental pediatric rotation 4. Correct administrative difficulties in pediatric resident clinic	Group sessions 1-6	Individual discussion, written material, and presentations at division rounds
		Block rotation in developmental pediatrics	
		Pediatric resident clinic	
2 (2000-2001)	1. Expand to include areas external to Division of Developmental Pediatrics 2. Increase role of pediatric resident clinic 3. Formal faculty development	Group sessions 7-12	Workshops on teaching skills (applicable to both group sessions and clinical rotations)
		Clinical rotations in genetics, neurology and ambulatory pediatrics	
		Pediatric resident clinic	

Communication

In planning implementation, consideration of communication with several different groups is important. Specific to this project, communication with administrative staff, faculty and residents is crucial.

There must be appropriate administrative support to facilitate curriculum change [27]. Prior to the start of implementation in July 1999, support was obtained from the Pediatric Department Head, the Director of the Residency Training Program, and the Division Head of Developmental Pediatrics.

Communication with the residents and the faculty participating in the curriculum implementation is essential for several reasons. In order to maximize the success of a curriculum plan, input from the key participants must be actively sought throughout both the preparation and the implementation phases [27]. It is necessary to ensure that the goals and rationale of the planned changes are clear and that the participants are working in a manner complementary to one another. The feedback from the participants during the implementation is also extremely important. Such feedback allows early identification and correction of unanticipated problems, recognition of areas within the curriculum plan that may not be feasible to implement, and modification to the plan based upon resident or supervisor needs.

During the first year of implementation, communication with the preceptors occurred via four main routes. (1) Presentations regarding the needs assessment survey, the planned curriculum revisions, the implementation plan and the preliminary results were provided during division rounds throughout the first year of implementation.

Discussion and feedback followed these presentations in a group setting. (2) The faculty members were provided with written information summarizing the learning objectives and the evaluation process. (3) Informal discussions on an individual basis were used to clarify any additional questions and to ensure that the goals to increase resident participation in clinical activities and to improve the resident feedback/evaluation process were clear. (4) A confidential questionnaire was used to collect additional feedback from the preceptors, particularly those who do not regularly attend division rounds (described below).

Similarly, communication with the residents used several methods. (1) Presentations were made to the residents at their academic half-day regarding the needs assessment survey, the planned curricular changes to the block rotation in developmental pediatrics and the pediatric resident clinic, and the evaluation process. (2) During the block rotation in developmental pediatrics, the residents were provided with an introductory package that included the learning objectives, evaluation forms, schedule of learning activities and suggested references. (3) At the end of the rotation, the residents completed a formal evaluation of the rotation and their preceptors, and they also provided feedback regarding the structure of the rotation. (4) Informal discussion also ensured that the learning activities were progressing well and permitted clarification of resident expectations.

Feedback was collected specifically from the participants using the methods described later in this chapter. Each time information was sought, additional space was allotted for general comments to allow participants to provide feedback in an anonymous fashion regarding any of the educational interventions.

Faculty Development

During year 1, the emphasis was placed on incorporating curricular modifications into the existing structure of the residency training program. The main faculty development component will occur during the second year of implementation. General teaching skills workshops are made available to all University of Calgary faculty on an ongoing basis, but none of the preceptors involved in the implementation process chose to participate in these workshops in 1999-2000. Thus, during this year, only passive faculty development techniques were utilized such as provision of feedback to the faculty and use of checklist forms for clinical encounters to clarify expectations. Two goals were emphasized in all communication with the faculty: (1) to increase feedback given to the residents regarding their clinical performance and (2) to increase active resident participation in clinical activities. These were felt to be the most important weaknesses in the existing developmental pediatric rotation prior to the curriculum revision and they must be addressed prior to further faculty development that may concentrate on more specific teaching methods based on principles of adult learning. As pointed out by Coury et al. [19], it is commonly believed to be difficult to provide opportunities for residents to be active learners in the area of developmental pediatrics since the residents have limited responsibility for patient care. This is such a critical stumbling block that it is essential to change the prevailing mind-set to one that permits the resident to become actively involved in clinical activities before progressing with other curriculum modifications.

Outcome Measures

During the implementation, several measures will be used to assess the outcome of the intervention. These will be used for the purpose of collecting feedback from participants in the curriculum.

Resident Evaluation

As described in Chapter Seven, the residents will be evaluated by a written examination and by preceptor evaluations to determine if they have met the learning objectives. The written examination will be administered at the end of the block rotation in developmental pediatrics. Thus five residents will complete this examination during the academic year 1999-2000. As these residents are part of the group that participated in the pilot test of the examination in July 1999, it is possible to compare their scores before and after curriculum implementation with a paired t-test. However, a varying amount of time will have passed (between 0.5 and 8.5 months) between the writing of the examinations, thus the results must be interpreted with caution (see Chapter Ten for discussion of the interpretation). Preceptor evaluation will be used in the block rotation in developmental pediatrics as described in Chapter Seven. Preceptor evaluation will also be used in the pediatric resident clinic, but the feedback form used in this clinic is based upon the *Assessment of Clinical Skills – General Exam* developed by the Royal College of Physicians and Surgeons Task Force on Examination Development in Pediatrics. The evaluation of residents' clinical activities in the pediatric resident clinic is

not included as an outcome measure for this project as it is used as part of the residents' formal evaluation by the pediatric residency training program.

Process Evaluation

Evaluation of Group Sessions

The quality of these sessions will be evaluated in two ways. The participants in the sessions will be asked to provide feedback at the completion of each session. In addition, the author of this Thesis will observe all sessions and a checklist of elements deemed important for inclusion in the sessions will be completed. Forms used for this evaluation are located in Appendix 9.

Evaluation of Block Rotation in Developmental Pediatrics

At the completion of the block rotation in developmental pediatrics, the residents will complete a rotation evaluation. The items on this evaluation parallel the items asked in the needs assessment survey specific to the block rotation. This facilitates comparison between resident satisfaction and perceived competence before and after implementation of curricular revision. Unpaired t-tests will be used to compare responses of the group of residents who had completed their rotation prior to the implementation of the revised curriculum with the responses of residents who completed their rotation during the implementation phase.

The residents have been asked to complete a log of the cases that they have seen during the clinical rotations. These logs also track data regarding whether the residents are actively participating in the patient assessments during the block rotation in developmental pediatrics or if they are simply observing. A checklist of clinical problems relevant to the area of developmental pediatrics that are identified in the learning objectives was also provided to the residents to allow identification of content deficiency within the curriculum and to assist in future curriculum improvement and selection of appropriate teaching cases.

The resident logs will be evaluated in two ways. First, the most frequent patient cases seen by the residents will be compared with the content specified in the learning objectives to ensure they correspond. Second, any clinical problems specified in the learning objectives that have not been encountered by the residents will be identified so these can be incorporated into the future development of the curriculum or selected as specific teaching cases during the block rotation in developmental pediatrics.

Evaluation of Preceptors

The residents will complete an evaluation of each of their primary preceptors at the end of the block rotation. The form used for this evaluation is included in Appendix 10. The questions on this evaluation form primarily reflect the goals for the first year of the implementation process of increasing active resident participation in clinical activities and increasing feedback provided to the residents.

Feedback from Preceptors

Following the group sessions, the presenters have been asked to provide feedback using questions similar to the participant feedback questions described above. A copy of the questions is located in Appendix 11.

All of the preceptors who have participated in the implementation process will be asked to provide feedback regarding the process in March 2000. This information will be collected by way of a confidential questionnaire (Appendix 12) and through group discussion at division rounds following a presentation of the results of the implementation process.

Ethical Considerations

Ideally, in order to assess outcomes objectively, an intervention group of participants should be compared with a control group. However, the curriculum described in this document will update and replace the existing training in developmental pediatrics that is considered mandatory for all residents. Ethically, one could not withhold teaching from one group of residents, as this subject area is important and necessary for their functioning as both residents and future pediatricians. Also, as the number of residents and faculty is small, division of residents into two groups, one with the new program and one with the old program is not feasible. Thus all residents in the pediatric residency program at the University of Calgary will be required to participate in the learning activities outlined. These activities will be incorporated into or will replace

existing mandatory elements of the residency training program. In order to ensure that these changes are appropriate to initiate, the program director of the pediatric residency training program has approved these learning activities.

During the implementation, the outcome measures will be used only for the purpose of collecting feedback from curriculum participants. Respondents must be assured of confidentiality when providing such feedback and therefore responses will be collected and tabulated devoid of identifying information. However, due to the relatively small number of residents and preceptors, it is possible that the investigator may be able to identify individual respondents. If this situation were to arise, the identity of the individual(s) would not be released.

Resident evaluations will be completed for all residents participating in the block rotation in developmental pediatrics during the implementation of curricular change. However, the existing formal evaluation forms used by the pediatric residency training program will be completed as well, thus separating the data collection for curriculum improvement (research) purposes from the residents' formal evaluations until the implementation and pilot testing process is completed. Residents will have the opportunity to review the feedback obtained by both methods.

The proposal for this Thesis project was reviewed by the Chair of the Conjoint Health Research Ethics Board at the University of Calgary who indicated the protocol had appropriate safeguards for confidentiality.

Anticipated Constraints

The main limitations of this project are due to time constraints. The curriculum described is intended to be incorporated throughout the residency training program with learning activities provided at all levels of residency training. Therefore, evaluation of the curriculum and the implementation would ideally occur over a minimum of four years to allow a cohort of residents to complete the entire curriculum. However, such a long-term evaluation is beyond the scope of this Thesis. The data presented in this document represents an interim evaluation of the first year of implementation, but the curriculum improvement and evaluation will continue over the next three years. As well, the ultimate outcome of improved physician competence in the discipline of developmental pediatrics is extremely difficult to measure, and appropriate measurement tools have yet to be developed.

The current structure of the pediatric residency training program also introduces several limitations. A four-week block of time is too short to include the broad scope of clinical problems in developmental pediatrics. However, as the block rotation is combined with psychiatry, the time allotted is actually only two weeks. Obviously, this requires that learning opportunities be incorporated into other aspects of the residency program in order to achieve the scope and depth of training required. However, problems in developmental pediatrics are not the primary focus of other clinical rotations that are also limited to four-week blocks of time. The organization of these rotations is dependent upon the individual subspecialties and thus there may be variable interest in including topics in developmental pediatrics in other areas.

In this project, the psychiatry rotation has not been changed, except for some scheduling changes to coincide with modifications to the developmental pediatrics component. The psychiatry rotation is thus a confounding variable. The psychiatry component of the block rotation may have significant impact on the rotation's success as cases seen in psychiatry may or may not be directly relevant to the developmental pediatric component of the rotation. Thus residents may interpret the psychiatry component as contributing to or deriving from their experience in developmental pediatrics. In addition, the residents' evaluation of the rotation is likely to include their overall perceptions of the rotation including the psychiatry component.

Historically, the tertiary level developmental pediatric clinic at the Alberta Children's Hospital has evolved without a significant teaching component. Resident training is not considered to be a primary role of the multidisciplinary team. The presence of residents has often been perceived as an imposition on non-physician staff, and thus the inclusion of residents in this setting requires careful planning, identification of the role of the resident, and opportunity for feedback. Due to this historical problem, the curriculum outlined in this document focuses primarily on the resident/preceptor relationship implying that the physician preceptor is the teacher and the resident is the learner. In developmental pediatrics, the multidisciplinary team approach is critically important, and ideally, a new curriculum would include a significant amount of learning activities involving the team [1]. While this has not been specifically addressed in the planning of the block rotation in developmental pediatrics, it is anticipated that the resident will participate with his/her preceptor in multidisciplinary activities. Over time,

as the curriculum evolves, perhaps the expertise of the non-physician professionals could be better utilized to improve resident training.

The involvement of multiple preceptors with different practice patterns, personalities, teaching styles, and expertise introduces significant uncontrolled variability into the implementation process. In order to minimize the impact this has on the success of the curricular changes, expectations of the preceptors' teaching role have been made explicit and multiple opportunities for communication with the preceptors have been incorporated throughout the implementation plan.

Despite these limitations it is anticipated that the curricular implementation plan will be successful. In general, one of the greatest problems that may be encountered during curriculum revision is a resistance to change of the key participants. Amongst both the residents and the faculty, there is a clear recognition of a need to improve the training in this discipline. Both groups have expressed frustration with the existing structure and a willingness to participate in the process of update and revision. Thus, with ongoing communication throughout the implementation, the process of change is expected to be relatively smooth.

CHAPTER NINE. RESULTS OF FIRST YEAR OF IMPLEMENTATION

In general, the first year of implementation of the curriculum improvement plan proceeded well. The goals of the first year of implementation outlined in Table 11 on page 94 were met. Residents were actively involved in clinical activities and received better feedback regarding their performance. The deficiencies within both the block rotation in developmental pediatrics and the pediatric resident clinic were improved. Throughout the year, informal feedback indicated a general interest and enthusiasm for the improvement process and multiple suggestions for future changes were received.

This chapter outlines the results of the implementation documented by the outcome measures described in Chapter Eight. A discussion of the implications of these results follows in Chapter Ten.

Participants

Between July 1999 and April 2000, four residents completed the block rotation in developmental pediatrics. This number was determined by the master rotation schedule for the residency training program. Additionally, one elective resident (R1) and one medical student participated in the rotation during this time, but will not be included in the data analysis as their rotations were significantly different from the other four residents.

Six group sessions were conducted and the number of participants varied between 10 and 25 (mean 14) per session. These sessions were held during the residents'

academic half-day. While resident attendance is expected at these sessions, 100% resident attendance does not typically occur due to other competing demands such as call duties and ward responsibilities.

All R2, R3 and R4 residents participated in the pediatric resident clinic during the implementation period.

Resident Evaluation

The purpose of the resident evaluation was to determine if the learning objectives were met. The resident evaluation was completed at the end of the residents' block rotations in developmental pediatrics. A variable time (0.5-8.5 months) had passed between the start of curriculum improvement and the evaluation of each resident.

Written Examination

All four residents who completed the written examination surpassed the MPL. Their examination results are shown in Table 12. As these residents were also part of the 1999 cohort who participated in the reliability and validity assessment of the written examination, their scores prior to curriculum improvement are also shown in the table. With the exception of resident A, each resident had improvement over his or her pretest score. However, comparison of the "pre" and "post" scores by a paired t-test does not reveal statistical significance likely related to the small sample size.

Table 12. Results of Written Examination

Resident	Score on Exam before Implementation of Curricular Changes ("pre")	Score on Exam after completion of Block Rotation in Developmental Pediatrics ("post")	Time Interval between "pre" and "post" scores
A	79.5 %	78.4 %	2 weeks
B	56.7 %	74.6 %	3 months
C	78.3 %	90.7 %	8.5 months
D	54.5 %	84.5 %	7.5 months

The mean score of the eight R3 residents in the 1999 cohort had been 75%. The mean score of the four residents described above was 82.1%. This difference approaches statistical significance when compared by a two-sample t-test ($p=0.06$). The R3 residents in the 1999 cohort were at similar level of training to the study group, yet the 1999 cohort had not participated in the curricular revisions

Resident Performance Evaluation

Few daily evaluation forms were returned. In general, each preceptor returned only one completed form for each resident despite both written and verbal instructions given to the residents and the preceptors at the beginning of each rotation and written and verbal reminders given to the residents and the preceptors at the end of the rotations. The forms returned generally represented a summary assessment of all the clinical activities in which the resident had participated during the rotation. Thus the data collected in this manner was limited. The average rating of each resident is shown in Table 13. There is

not much difference between the residents, but scores for resident communication skills and attitude were generally higher than scores for history taking, general physical examination and neurodevelopmental assessment. No resident was found to be unacceptable or below average in any of the areas.

Table 13. Results of Resident Performance Evaluation

Category of Assessment	Resident A*	Resident B*	Resident C*	Resident D*
History Taking	3.5	3.5	3.3	3
General Physical Examination	4	4	3.7	3
Neurodevelopmental Assessment	3.5	3.5	3.5	3
Communication Skills	4.5	3.5	4.1	4
Attitude	4.5	4	4.1	4
Overall Assessment	Above Average	Average to Above Average	Average to Above Average	No data

*All responses on 5-point rating scale (1=unacceptable, 2=below average, 3=average, 4=above average, 5=exceptional)

Process Evaluation

Group Sessions

The planned schedule of the group sessions outlined in Chapter Six was modified slightly due to scheduling logistics and resident feedback. A session regarding normal

development of the older child and adolescent was added to the original list of presentations because resident feedback at the first session indicated a significant need to cover the normal development of this age group in more detail. Thus the group sessions presented during the 1999-2000 academic year were:

1. Normal Development
2. Assessment of Infant and Child Development 1
3. Assessment of Infant and Child Development 2
4. Normal Development of Older Children and Adolescents
5. Developmental Delay 1
6. Developmental Disorders associated with Dysmorphic Features

Participant Feedback

Overall, the participant feedback regarding the group sessions was extremely positive. The evaluation forms were returned by 20 of the 21 participants in Session 1, 15 of the 18 participants in Session 3, all 14 of the participants in Session 4, 11 of the 13 participants in Session 5, and 9 of the 10 of the participants in Session 6. The preceptor for Session 2 was ill, therefore a videotape presentation on the same topic was substituted and no evaluation was conducted for this session.

The participant feedback for each session is summarized in Table 14. The participants gave each session an overall rating between "good" and "excellent". Similarly, the preceptors were felt to be well prepared, the format was rated between

"good" and "excellent", and the residents indicated the sessions were highly relevant to them.

Table 14. Participant Feedback of Group Sessions

Category of Assessment	Session 1 mean* (range) n=20	Session 3 mean* (range) n=15	Session 4 mean* (range) n=14	Session 5 mean* (range) n=11	Session 6 mean* (range) n=9
My overall rating of today's session is:	4.3 (3-5)	4.3 (4-5)	4.3 (4-5)	4.7 (4-5)	4.6 (4-5)
The preceptor's preparation for today's session was:	4.9 (4-5)	4.7 (3-5)	4.5 (3-5)	4.8 (4-5)	5.0 (5-5)
The format of today's session was:	4.2 (3-5)	4.2 (4-5)	4.6 (3-5)	4.5 (4-5)	4.8 (4-5)
The relevance of today's topic to me as a resident was:	4.6 (4-5)	4.4 (3-5)	4.3 (3-5)	5.0 (4-5)	4.7 (3.5-5)

*All responses on 5-point rating scale (1=unacceptable, 2=fair, 3=average, 4=good, 5=excellent)

Review of the resident comments regarding the group sessions revealed some consistent themes. This is compared with the observer feedback discussed below and summarized in Table 15. The residents consistently commented on their appreciation for an interactive presentation style. The opportunity to apply concepts and skills to clinical situations was valued and suggestions for improvement often related to providing more opportunity to practice this application. These themes are related, and with only one exception, the interactive style was evident primarily during opportunity for application of the concepts and skills to clinical situations but not during other parts of the

presentation. The exception to this was in Session 6, where the preceptor skillfully utilized an interactive style to determine the residents' starting level of knowledge and to present the content of the session. Sessions 3 and 4 primarily involved active resident participation and application of clinical skills and this was described as a strength of the session, yet the residents indicated that they would have appreciated smaller groups with more children to interview/examine so that each resident could maximally participate in the interaction and application of clinical skills.

Table 15. Themes Evident in Resident Feedback

Theme – Desired Qualities in Sessions	Proportion of Session Estimated by the Observer to Follow Desired Qualities	Suggested as Area for Improvement in Resident Feedback	Identified as Area of Strength in Presentation in Resident Feedback
Interactive Style			
Session 1	50%	yes	yes
Session 3	90%	yes	yes
Session 4	90%	yes	yes
Session 5	10%	yes	no
Session 6	90%	no	yes
Opportunity to Apply Concepts and Skills			
Session 1	50%	yes	yes
Session 3	90%	yes	yes
Session 4	90%	yes	yes
Session 5	<5%	yes	no
Session 6	75%	no	yes

In addition to the two main themes mentioned previously, several other comments were provided generally concentrating on session format or content. The conclusion of

the needs assessment survey discussed in Chapter Four that developmental pediatrics is an area in need of improvement in pediatric residency training is reflected in the resident feedback. The topics presented during the group sessions had not previously been taught to a large proportion of the residents. Of the residents who completed feedback forms for group sessions 1, 3, 4, 5, and 6, 30%, 27%, 58%, 55%, and 22% respectively indicated that they had not previously received any teaching on the session topic.

Observer Feedback

The purpose of the observation of the group sessions was to determine whether the content and format of the sessions was consistent with the planned curriculum. This observation also allows the resident feedback to be interpreted in the context of the actual sessions that may have differed somewhat from the planned session outlines.

All sessions were judged to be of excellent quality. Each of the sessions was identified as a part of a series of teaching sessions in developmental pediatrics and reviewed or alluded to material covered in the previous sessions. Suggested references were provided for each session. The learning objectives for the sessions were made explicit on three of the five occasions. The scope of content generally covered that specified in the learning objectives except in Session 6 which covered greater breadth than required. Residents actively participated to some degree in all the sessions. Four of the five sessions followed the suggested format, but one session was primarily a didactic session with little active resident participation. Sessions 3 and 4 had the most interaction

as they included children for the residents to interview or examine. Sessions 1 and 6 involved active resident participation around videotape or photograph cases. Session 5 had the least resident interaction due to the style of the presentation, although the preceptor frequently paused for questions and discussion. All sessions were very well prepared with good audio-visual aides. Four of the five preceptors provided the students with a handout.

Each session was allotted 2 hours and this was appropriate for Sessions 1, 3, and 4. However, Session 5 only required 1.5 hours and Session 6 required 2.5 hours.

Feedback from Presenters

Feedback was received from four of the five presenters. In general, the presenters' feedback was quite consistent with the participant feedback listed above.

The primary purpose of seeking presenter feedback was to identify any unanticipated difficulties encountered by the presenters and to identify areas in need of faculty development or support for them. A secondary purpose was to determine if the participants and the presenters perceived the quality of the sessions similarly.

All four presenters indicated that they used the learning objectives to prepare for the sessions and found the objectives to be appropriate in scope. One presenter indicated a need for a relevant videotape that was not available. However, this did not adversely impact the presentation as the format of the session was modified to allow the residents to interview adolescents rather than observe them on videotape.

A summary of the presenter feedback is in Table 16. The presenters agreed with the resident and observer feedback that the quality of the sessions was "good" to "excellent". They felt the sessions were strongly relevant to the residents and that the residents' participation in the sessions was "good" to "excellent". The only exception to the agreement is that the participants in Session 6 felt the sessions were more relevant to them than did the presenter for the session. When asked to describe the best part of the presentation, each presenter indicated the component of his/her presentation that was the most interactive, again consistent with the resident feedback.

Table 16. Presenter Feedback of Group Sessions

Category of Assessment	Session 1*	Session 3*	Session 4*	Session 6*
My overall rating of today's session is:	4	4	4.5	4
The residents' participation in today's session was:	5	4	5	4
The residents' preparation for today's session was:	4	3	4	3
The relevance of today's topic to residents is:	4.5	4	5	3

*All responses on 5-point rating scale (1=unacceptable, 2=fair, 3=average, 4=good, 5=excellent)

Rotation Evaluations

The four residents who completed their block rotation in developmental pediatrics had very positive experiences. They were asked to rate their rotation overall on a scale of 1 to 5 (1=poor, 5=excellent). They assigned a mean rating of 4.3 (range 3.5-5). The eight residents who had completed their block rotation in developmental pediatrics prior to July 1999 assigned a mean score of 3.3 (range 2-4) when asked to rate their rotation overall during the needs assessment survey. This difference approaches statistical significance when compared using a 2-sample t-test ($p=0.09$), but the statistical analysis is limited by the small numbers in the two groups.

The residents were also asked to rate their abilities to assess, diagnose and treat children with normal and abnormal development using a similar 5-point scale. Their responses compared with the responses collected during the needs assessment survey are shown in Table 17. The four residents who completed their block rotation in developmental pediatrics after the onset of curriculum improvement rated their competence higher than the group of residents responding to the needs assessment survey in July 1999. This difference reaches statistical significance at the 95% confidence level only for the question regarding diagnosis of children with abnormal development. The other differences approach statistical significance. However, when the same four residents' responses are compared to the eight residents who had completed a block rotation prior to July 1999, the self-ratings are similar.

Table 17. Results of Resident Self-Assessment Questions

Question	Residents in Study Group* (n=4)	Residents completing Block Rotation in Developmental Pediatrics before July 1999* (n=8)	All respondents in Needs Assessment Survey* (n=19)	P values for comparison between Study Group and Needs Assessment Survey*
How would you rate your ability to assess a child for normal development?	3.9 (range 3.5-4)	3.8 (range 3-4)	3.3 (range 2-4)	p=0.10
How would you rate your ability to diagnose a child with abnormal development?	3.9 (range 3.5-4)	3.5 (range 3-4)	2.8 (range 1-4)	p=0.03
How would you rate your ability to treat a child with abnormal development?	2.9 (range 2-3.5)	2.8 (range 2-4)	1.9 (range 1-4)	p=0.09

*All responses expressed as mean scores on 5-point rating scales (1=not competent, 5=fully competent)

Residents' comments were also elicited. The "best part of the rotation" described by each resident varied, but each resident tended to describe an aspect of the rotation that either involved his/her direct participation or that exposed the resident to patient pathology or physician approaches that were new to that resident. The "weakest part of the rotation" again varied between residents, but typically reflected a problem with the logistics of the rotation that had been previously identified such as a short time allotment to the rotation, scheduling difficulties or observation of clinical assessments. In general,

these weaknesses were minor compared with the degree of concern raised by the pediatric residents prior to the curriculum modification.

Two of the four residents raised a very interesting point in their feedback. This was that they had never seen or performed "a developmental assessment" during their rotation. The residents indicated that they expected to learn how to do this almost as a procedural task and did not seem to appreciate that the clinical activities they had been participating in had all included assessment of development. This will be discussed in further detail in Chapter Ten.

Resident Log

The resident log was intended to determine what types of patients the residents were exposed to during their rotation, to identify any areas of deficiency in the clinical experiences and to determine if the residents were actively participating in the patient assessments. The log was part of the daily performance evaluation forms, thus due to the low rate of return of these forms, this data was unavailable. Therefore, retrospective data collection was substituted. Residents were asked to estimate the number of patients with the clinical problems specified in the learning objectives that the residents had encountered during their block rotations in developmental pediatrics and during their residency programs to date.

The residents reported encountering a variety of patient problems during the course of their rotations. These are summarized in Table 18 in decreasing order of frequency. The estimated number of patients seen is indicated for each resident. There is

clearly great variation between the numbers of each type of patient problem reported by the residents. In part, this reflects that the residents generally estimated the numbers of patients they had seen, rather than record them prospectively. However, it also reflects the clinical practices of the residents' primary preceptors.

Table 18. Summary of Clinical Problems during Block Rotation

Clinical Problem	Resident A	Resident B	Resident C	Resident D	Totals
ADHD	11	20	10-15	>10	>50
Learning Disabilities	4	3	5	>10	>23
Tic Disorders	5	1	11	1	18
Autism / PDD	5	2	6	4	17
Anxiety Disorders	5	2	6	3	16
Depression / Suicide		3	4	>5	>12
Speech Delay	2	2	7	1	12
Global Developmental Delay	5	2	5		12
Mental Retardation	1	1	3	>5	>10
Child Abuse			3	>5	>8
Cerebral Palsy	2			3	8
Fetal Alcohol Syndrome			5	1	6
Down Syndrome	5		1		6
Oppositional Defiant Disorder		1	2	1	4
Substance Abuse		1	2		3
Conduct Disorder		2	1		3
Encopresis / Enuresis				1	1
Spina Bifida	1				1

The clinical problems relevant to developmental pediatrics that at least one of the residents indicated he/she had not encountered at any point in his/her residency training are shown in Table 19. Most of these are relatively rare presentations and/or problems that are typically addressed by subspecialists (eg. Duchenne Muscular Dystrophy), or are

managed primarily in outpatient settings. One resident reported that he/she had not seen a patient with global developmental delay. This is quite surprising, as global developmental delay is one of the primary clinical presentations to the developmental clinic. This will be discussed further in Chapter Ten.

Table 19. Clinical Problems Not Encountered To Date by at Least One of the Pediatric Residents

Child with Dysmorphic Features	Fragile X Syndrome
	Turner's Syndrome
	Klinefelter's Syndrome
Child with Developmental Delay	Sensory Impairment
	Duchenne Muscular Dystrophy
	Global Developmental Delay
Child with Behavioral Problems	Conduct Disorder
	Sleep Disorders
	Eating Disorders
Psychiatric Disorders	Substance Abuse

Unfortunately, it was not possible to determine if the residents were actively participating in the clinical sessions. The daily evaluation forms were returned for a minority of the clinical activities and these forms were also intended to document the amount of resident participation. All of the forms that were returned indicated that the residents had actively participated but it is likely that this was not the case in all clinical activities based on the residents' report in the evaluation of their preceptors (see below).

Evaluations of Preceptors

The residents' evaluations of their preceptors were generally very positive. Seven physicians acted as primary preceptors for the four residents during the residents' block rotations in developmental pediatrics. All of the residents returned preceptor evaluations. All respondents indicated that their preceptors welcomed the residents to participate in the clinical activities, were prepared for the resident to join him/her in the clinical activities and demonstrated enthusiasm for the clinical problems. Five of the seven preceptors provided residents with feedback on a daily basis and all residents felt the feedback they received was appropriate. Opportunity was provided for the residents to provide feedback to six of the seven preceptors.

A summary of the estimated time spent observing versus actively participating in clinical activities is provided in Table 20. Preceptors 1, 2 and 6 acted as primary preceptors for two residents each, thus they were each evaluated twice. Five of the preceptors were reported to spend time with the residents in teaching activities that were not patient-based such as case discussions, literature review, etc.

Three of the residents indicated that they had encountered minor scheduling problems such as patient cancellations or another trainee present in the clinic.

Table 20. Estimated Breakdown of Residents' Clinical Activities

Preceptor	Percentage of the time spent actively participating in clinical activities	Percentage of the time spent observing preceptor's clinical activities	Percentage of time involved with evaluation or feedback of resident knowledge or skills
1	80-100	40-60	60-80
1	80-100	0-20	20-40
2	80-100	0-20	0-20
2	40-60	40-60	40-60
3	20-40	60-80	20-40
4	60-80	20-40	60-80
5	60-80	20-40	0-20
6	0-20	80-100	0-20
6	0-20	80-100	0-20
7	80-100	20-40	40-60

Preceptor Feedback

Feedback was sought from the primary preceptors who participated in the curricular improvement implementation. Written feedback was received from three of the seven preceptors, although informal discussions were held with each preceptor.

The three preceptors who completed the written feedback indicated that the change to a preceptor-based rotation had been somewhat successful in increasing active resident participation in clinical activities and in increasing feedback given to residents regarding their clinical performance. One felt that the change had been successful in minimizing scheduling problems but two did not. All felt that communication with the preceptors regarding the curriculum changes had been adequate, but only one indicated that he/she had used the rotation objectives in clinical activities with the residents. All

had returned daily rotation evaluation forms but did not complete one for each encounter with the resident. None felt that the amount of feedback given to preceptors was adequate. Two of the preceptors indicated strong interest in attending faculty development activities regarding "teaching skills" and "giving feedback" in the future.

The informal feedback received from the other preceptors concentrated primarily on the daily resident evaluation forms. Most preceptors were quite reluctant to complete the forms on a daily basis and many preferred not to review their comments with the residents directly. Other comments both from preceptors and secretarial staff indicated that, in fact, there had been a decrease in scheduling difficulties during the rotations, and that the difficulties that were encountered had been easier to solve than in the past.

Pediatric Resident Clinic

As mentioned in Chapter Six, the pediatric resident clinic has had difficulty with administrative and organizational problems until recently. During the first year of curriculum implementation, the main goal for this clinic was to solve these problems to create a viable, longitudinal clinic that would allow innovative teaching and evaluation activities to be planned during the second year of implementation.

The pediatric resident clinic was re-established in October 1999 with some modifications to the structure of the clinic. A general pediatrician is now on-site during all of the clinics and resident attendance at the clinic is mandatory. The residents are organized into "practice groups" similar to the organization of community pediatricians so that they may provide coverage for each other's patients during vacations and

intensive care rotations. The Denver Developmental Screening Test II is used with all children less than six years of age following the techniques presented to the residents during Group Sessions 2 and 3. A checklist evaluation form is used by the clinic preceptor to provide feedback to the residents regarding their clinical performance with this screening test (formative evaluation).

Prior to October 1999, there had been no formal evaluation of resident clinical skills in the pediatric resident clinic. The residents are now directly observed during the initial assessment of newly referred patients and feedback is provided immediately to the residents. Summative evaluation of resident performance is carried out by the *Assessment of Clinical Skills – General Exam* developed by the Royal College of Physicians and Surgeons Task Force on Examination Development in Pediatrics.

Unanticipated Constraints

In Chapter Eight, several anticipated constraints to the implementation of the planned curriculum were listed. These included inadequate time, variable interest of other disciplines to incorporate topics in developmental pediatrics into their clinical rotations, the combination of the block rotation in developmental pediatrics with psychiatry, the historical attitude and context of the multidisciplinary team, and variations in preceptors' teaching and practice styles. However, other constraints were encountered over the first year of implementation that may have limited the success of the process. (1) Two preceptors who were anticipated to have prominent roles as primary preceptors were unavailable for several months. Thus other preceptors were required to substitute

for these individuals. (2) Revision to the administrative component of clinical service administration within the Division of Developmental Pediatrics has continued on an ongoing basis throughout the implementation. Thus it has been necessary to continually adapt the curriculum due to external factors. (3) Communication with the preceptors has been more difficult than anticipated, particularly with those who are community-based and thus do not have frequent opportunities to attend division rounds or participate in informal discussions. However, the communication with the resident participants has proceeded extremely well throughout the implementation. (4) Prior to the implementation, the preceptors indicated that they were willing and interested in using the daily evaluation forms to assess resident performance. In fact, they were directly consulted during the development and pilot testing of the evaluation procedure. However, it has been extremely difficult to collect these forms from the preceptors. In addition, several preceptors have indicated that they did not complete them on the day of the clinical assessment, but used them at the end of the rotation in a summary manner. Clearly, this does not serve the intended purpose of providing residents with timely feedback and of increasing the sampling of resident performance to provide greater reliability and validity to the preceptor evaluations. It is likely that at least some of the preceptors were providing residents with feedback daily without completing the paperwork as the residents reported that five of the seven preceptors provided them with at least some feedback on a daily basis. This difficulty with the collection of the evaluations also interfered with the collection of the resident log on a prospective basis as this data was included at the top of each form (see Appendix 8). Similarly, the preceptors had only a fair response rate when asked to complete questionnaires regarding the

success of the curriculum implementation. (5) Compliance of the preceptors with the plan for the block rotation in developmental pediatrics requires more intensive ongoing communication with the preceptors than was anticipated. This is best illustrated in Table 20 on page 122. Between the first and second time the preceptors were evaluated as primary preceptors, both preceptors 1 and 2 had decreased the amount of time allotted to the two main goals of increasing active resident participation in clinical activities and of increasing feedback provided to the residents.

The implications of these unanticipated difficulties will be discussed in the next chapter.

CHAPTER TEN. DISCUSSION

This project has focussed upon a process of curriculum improvement following the steps of curriculum development described by Kern et al. [27]. These steps have provided a framework to achieve the main purpose of the project which is to develop, implement and evaluate a curriculum in developmental pediatrics that is incorporated throughout the pediatric residency training program. At the completion of the first year of curriculum implementation, it is important to review the original purpose of the project and the goals of the implementation in order to determine if the process has been successful.

Overall, the project has been successful. The curriculum was developed based upon principles of adult learning and cognitive psychology to meet the needs identified during the needs assessment survey and the specifications of the Canadian Guidelines [1]. The implementation has proceeded well over the first year with few unanticipated difficulties. The evaluation has indicated that the objectives of the curriculum were met and that the changes have been well received by the participants in the process. In this chapter, discussion of the results provides further interpretation and explanation of the outcome of the curriculum improvement.

Evidence that Curriculum Improvement was Necessary

The first two steps described by Kern et al. [27] are (1) Problem Identification and General Needs Assessment and (2) Needs Assessment of Targeted Learners. As

reviewed in Chapter One, a general problem affecting pediatric residency training programs is that training of pediatric residents in developmental pediatrics has not adequately met the needs of pediatricians. This general state described in the literature is critically important as problems in this discipline become increasingly prominent in clinical pediatric practice.

The first purpose of this Thesis project was to review the existing residency training in developmental pediatrics at the University of Calgary prior to the curriculum revision. It was hypothesized that similar to other centers, training in this area was not meeting the needs of pediatric residents and pediatricians. As discussed in detail in Chapter Four, this hypothesis was confirmed during the needs assessment survey of residents and pediatricians in Calgary.

In addition to confirming that the curricular improvement was necessary, this survey provided several important results that have had direct impact on the process of curricular revision. First, the priority assigned for training in this area increases as trainees progress from junior to senior residents, but remains lower throughout residency compared with the priority assigned by practicing pediatricians. This has two important implications for curriculum development. It implies that there is likely optimal timing to maximize resident learning in this area as learning is significantly affected by learner motivation. Also, it suggests that residents may not be aware of the significance of this clinical area in the context of clinical pediatric practice. Thus the curriculum was designed to match the priorities of the residents with increased emphasis on developmental pediatrics in the later years of training. It was also designed to better mimic the residents' future clinical practice.

The second important result of the needs assessment survey was that there were no specific areas of deficiency in the existing training program, but rather that a wide variety of clinical problems in this area were identified as important and in need of inclusion in a revised curriculum. Therefore, rather than concentrating on one or two specifically targeted key areas in training, the entire discipline of developmental pediatrics was considered and the curriculum planned to improve the training in general.

The third important result of the needs assessment survey was that most respondents felt that there was inadequate time allotted to training in the area of developmental pediatrics. To date, this problem remains and it is unlikely that more time will be allotted to the discipline in the immediate future. Thus it was important to creatively incorporate learning activities into existing clinical settings throughout the training program.

In summary, the needs assessment confirmed that the curriculum was in need of improvement and that the experience at the University of Calgary was similar to that described in the literature. Multiple suggestions were received that have helped to guide the curriculum improvement.

Curriculum Development

The curriculum was developed to address the needs identified in the needs assessment survey and to follow the Canadian Guidelines [1]. Principles of adult learning and cognitive psychology were used to guide this development as outlined in Chapter Six. The curricular development corresponds to Kern's steps 3 and 4, which are

(3) Development of Goals and Objectives and (4) Development of Educational Strategies. Specific educational objectives were developed based upon the Canadian and the American Guidelines [1, 19]. Learning activities and teaching methods to achieve these objectives were developed.

The greatest challenge in the design of the curriculum was to provide appropriate learning experiences with adequate depth and breadth within the limitations of time and available resources. This had impact on the curriculum in several ways. First, learning activities were often chosen primarily due to logistical factors and secondarily due to whether the learning activity was most suitable for the learning objective(s). This limitation is most evident when one considers that it is essential to consider child development over time. Thus it would be optimal to provide primary learning activities in this area over several months or years. However, the block rotation in developmental pediatrics is limited to one calendar month and there is currently no possibility to change this structure, for example, to one day per week over several months. The block rotation was retained in the curriculum for other reasons specified in Chapter Six, and, within the rotation, learning activities and teaching methods were utilized to maximize resident education in that setting.

Another example of limitations in learning activities due to logistics occurred in the group sessions. As residents are at different levels of training, it would be ideal to provide learning activities that were tailored to individual needs, motivation, prior knowledge, etc. at each level of training. However, this was not feasible, as there are a small number of suitable faculty members available to provide these sessions. Thus, the group sessions were conducted with all trainees participating. While the use of active

participation of the learners helped to improve the quality of the sessions for all learners, it may have been more helpful to specifically address the individual needs at different levels of training. However, many of the residents at all levels indicated that they had not previously received any education in the topics discussed and the sessions were rated very highly by all participants, thus the problem of including trainees at different levels may not have been as significant as anticipated. Perhaps most participants were at a similar level regarding clinical problems in developmental pediatrics.

The preceptors who participated in the curriculum improvement were extremely supportive of the process. However, they were also a limiting factor in the development and implementation of the curriculum. Clinical learning activities must be acceptable to the preceptors whose primary responsibility remains patient care. The preceptors must also have appropriate support, training and feedback to successfully participate in resident education. Physicians are not generally trained in education and many are not familiar with the principles of adult education that they are expected to incorporate into the learning activities. At the same time, they are experts in the clinical areas and many have been involved in resident education to some degree for many years. Often the preceptors have expectations of the role of the residents in their clinic, or of how to best train the residents. The residents must be perceived as important (and essential) contributors to the clinical team, yet this has not historically been the case in developmental pediatrics. This problem has been intensified as there is only a resident assigned to developmental pediatrics approximately 50% of the time, and there is little requirement for coverage of inpatients by the residents. Thus all of the activities

performed by the residents during their block rotation in developmental pediatrics become responsibilities of other team members during months when no resident is assigned to developmental pediatrics. To address this difficulty in the block rotation in developmental pediatrics, two primary goals for the first year of implementation were focussed upon including (1) to increase active resident participation in clinical activities and (2) to improve resident feedback and evaluation. These were considered priorities as they are essentially prerequisite factors that must be in place in order to incorporate other principles of adult education and to make more specific modifications to clinical learning activities. No formal faculty development activities were completed during the first year of implementation, however, this will clearly be required in the future in order to ensure that the teaching methods used by the various preceptors during clinical teaching do follow sound principles of adult education. During the first year of implementation, it was accepted that there may be a range of teaching activities and expectations of the different preceptors, but the intent was to provide a foundation to improve this variability over the remainder of the implementation process.

Implementation

The fifth step in curriculum development described by Kern et al. is Implementation [27]. The implementation of the curricular plan is the primary focus of this project. Examining the implementation allows the research question proposed in Chapter One, "Can a formal curriculum in developmental pediatrics ... be successfully

implemented into the pediatric residency program at the University of Calgary?" to be answered.

To date, the implementation of the curriculum has been successful overall. This section provides a discussion of the measures of this success and of the difficulties encountered during implementation.

Process Evaluation

The implementation process was formally evaluated in two contexts, the group sessions and the block rotation in developmental pediatrics.

Group Sessions

The topics for the group sessions were chosen to reflect key knowledge and skills required by the pediatric residents in developmental pediatrics. The topics reflect common patient presentations in this discipline with added emphasis on areas identified in the needs assessment as specific weaknesses in the training program. The choice of topics was confirmed to be appropriate based upon resident feedback. At the completion of each session, the residents were asked what topics they would like included in future sessions. With only one exception, all topics mentioned were already planned over the two years. The exception was "Normal Development of Older Children and Adolescents" which was incorporated into the schedule as Session 4.

The quality of the group sessions was excellent as indicated both by the participants and the observer. Several factors in the planning of these sessions likely contributed to this excellence. These factors are not generally present in the planning of other presentations at the academic half-day, nor were they present in the planning of teaching sessions relevant to developmental pediatrics prior to July 1999.

The first factor is that the sessions were part of a planned curriculum. While this may seem obvious, it is in fact critical to the success of the sessions. The group sessions built upon other learning experiences within the curriculum and thus were able to reinforce and enhance learning in other settings. The topics were planned in sequence with specific learning objectives and content specified for each session. Thus the expectations for the sessions were clear and the presenters did not feel obligated to cover an excessive amount of material. The second factor is that the residents and the presenters had direct input into the organization of the sessions and the topic selection during the needs assessment and the curriculum development processes. The topics chosen were directly relevant to the participants. The third factor is that the sessions incorporated principles of adult learning throughout. This was most evident in the degree of active resident participation in the sessions. It was remarkably successful in view of the lack of formal faculty development for the presenters. They were simply provided with clear expectations for the sessions that included a suggestion to actively involve the residents as much as possible through discussions, patient demonstrations, etc. The fourth factor is that the sessions were formally evaluated. The presenters were given a copy of the evaluation form prior to the sessions so that they were aware of the factors being evaluated by the residents. Also, they were aware that the sessions would be

observed. This evaluation may have had several effects on the quality of the presentation as the presenters would likely want to be evaluated positively, and the expectations were explicit. Although the presenters may strive to obtain a positive evaluation, this is the desired result, and any observation bias generated would be in the desired direction. However, in general, the presenters were pleased to receive feedback and did not appear to be artificially responding to items on the evaluation. The presenters' assessments of the group session also mirrored that of the participants and the observer.

As the ratings provided by the participants for each of the sessions were quite similar, it is important to examine the rating scale to ensure it was appropriate. The scale chosen was a 5-point scale with number values assigned to subjective descriptors (1-unacceptable, 2-fair, 3-average, 4-good, 5-excellent). These categories were arbitrarily chosen and it was assumed that the residents would rate the sessions in comparison to others provided during their academic half-day. It is possible that an expanded scale would have improved the ability to detect differences between the sessions, however, the purpose was not to compare between the sessions, but to evaluate the quality of each individual session. The possibility of a systemic bias in these results is discussed in a later section.

The observer data was consistent with the participant feedback, and in fact the observer's expectations of the sessions were exceeded. Compliance with the planned curriculum was appropriate, and excellent teaching skills were demonstrated by each of the presenters. A substantial effort was directed to providing high quality sessions and the success of this effort is reflected in the evaluations.

The two main themes that were evident in the participant feedback were consistent with the principles of adult learning described in Chapter Two. The participants appreciated interactive teaching methods that allowed them to actively participate in the sessions. They also found the opportunity to apply the concepts and skills to clinical situations or patient problems to be extremely helpful.

Block Rotation in Developmental Pediatrics

The implementation of the block rotation in developmental pediatrics was also successful, however there were some constraints and unanticipated difficulties that limited both the implementation and evaluation of the curricular revisions in this area.

The residents rated their rotation higher overall than did the members of the 1999 cohort who had completed a rotation in developmental pediatrics prior to the curriculum improvement. The study group also reported greater self-perceived competence than did the residents responding to the needs assessment survey. The limitations of physician self-assessment have been discussed earlier in this document, and thus the main assessment of resident performance was done using other techniques. The small number of trainees limited the evaluation of whether the curricular changes had been successful. The difference between resident ratings of their block rotation in developmental pediatrics before and after curriculum revision approaches statistical significance. Certainly, the comments received on the rotation evaluation indicate that many of the problems previously encountered during the block rotation in developmental pediatrics have been solved.

The small number of participating residents also limited implementation of the revised block rotation in developmental pediatrics. There were frequently blocks of time during which there was no resident and individual preceptors only participated in resident education for one or two months during the first year of implementation. Thus, there was a need to re-educate the preceptors (and the residents) regarding expectations, evaluation methods, etc. each time there was a new resident. The preceptors did not have the opportunity to become familiar with the revised structure of the rotation and evaluation processes and to continue to use them for greater than one month. It is likely that there was also decay in preceptor compliance with the curriculum plan after the initial months of implementation. This is reflected in the resident preceptor evaluation forms and in their informal feedback. The greatest enthusiasm and compliance with the changes was observed in the first few months of implementation, and during this time there was a resident present for almost three consecutive months.

The resident log was intended to prospectively collect information regarding the types of patients the residents encountered and whether they were actively participating in the clinical activities. This log was incorporated into the residents' daily evaluation forms. However, one of the unanticipated difficulties was that the preceptors only returned a small proportion of the evaluation forms, thus the prospective data for the resident log was not available. Instead, the residents completed a log checklist at the end of the rotation. This information is thus retrospective and is subject to memory effect and recall bias, and it cannot be confirmed. The purpose of the resident log was to determine if the learning activities were reflective of the learning objectives. Based upon the retrospective data, it appears that the residents participated in a wide variety of clinical

activities and were exposed to a wide range of clinical problems in developmental pediatrics. Thus the focus was placed on those clinical problems that were not encountered by one of the residents during his/her training.

The clinical problems identified in the learning objectives that were not encountered by at least one of the residents during their residency program were listed in Table 19 on page 120. In general, these represent unusual diagnoses or clinical problems usually cared for by subspecialist pediatricians. An important exception was noted, however, and warrants further discussion. One resident identified that she had not encountered any patients with global developmental delay. This is highly unlikely as a large proportion of the patients presenting to developmental pediatricians have this problem. However, it is not a specific diagnosis, but a symptom that often reflects a specific etiology or underlying condition. It is suspected that the resident that reported this omission mistook "global developmental delay" for a diagnosis and implied that she had not seen a child diagnosed with this "disease". Review of clinic lists during this resident's rotation reveal that there were several patients with this presenting complaint, thus confirming the above assumption. An alternate explanation is that the delay of these children was not evident to this resident. This would be much more disturbing in view of the purpose of the developmental pediatric curriculum, and if true would imply a greater need to improve the teaching methods used in the clinical setting. The other clinical problems not encountered to date by at least one of the pediatric residents likely reflects which rotations and group sessions they had completed at the time, as all are covered in at least one of these settings.

Another interesting point raised in the resident feedback was that two residents stated that they had not learned "how to do a developmental assessment". They were disappointed that their expectation that they would learn this "procedural skill" was not met. However, both of these residents were assessed by their preceptors to have average or above average clinical skills in this area. It is likely that this discrepancy is a result of different definitions and expectations regarding the nature of developmental assessment. When questioned about this statement, the residents indicated they expected to observe and perform "developmental testing" in a formal way using a standard method such as the Denver Developmental Screening Test or cognitive testing done by psychologists. However, the practice of most of the preceptors is to combine history and physical examination with observation of the child's skills to develop a clinical impression. In fact, it is seldom appropriate to use a screening tool with a clinical population that already has identified developmental problems. It will be important to address this discrepancy as the implementation continues and to include specific definitions and indications for "developmental testing" in various clinical settings. It clearly is important that residents learn to perform screening assessments to detect developmental problems that may present to a general pediatrician, and this is incorporated into the pediatric resident clinic.

In general, the preceptors were motivated and supported the modifications to the curriculum. They indicated that they agreed with the need to improve resident education and recognized that one of the major constraints was that of inadequate time. They were extremely positive in their presentation of the leaning activities to the residents and welcomed and involved them in each of the clinical settings. Again, as no formal faculty development was undertaken during the first year of implementation, the two main goals

for the preceptors were to actively involve the residents in the clinical activities and to increase the amount and quality of feedback provided to the residents. Similar to the residents, the preceptors found the curriculum implementation to be successful. However, this statement is based upon informal discussion with the preceptors, and formal feedback from only three of the seven primary preceptors. The preceptors indicated that the communication with the preceptors had been adequate and the changes made to the curriculum had been appropriate, but they also indicated that they would appreciate more feedback and that faculty development activities would be useful.

The preceptors indicated that they would like more feedback regarding their teaching during the block rotation in developmental pediatrics. However, the residents were assured when they provided their comments that their identities would not be revealed to the preceptors. As the number of residents participating in the block rotation is small, it has not been possible to provide specific feedback to the preceptors in a way that protects the residents' confidentiality. Thus, only general feedback has been provided to date. At the end of this academic year, the preceptors will be given a summary of resident feedback that includes comments from all of the residents. It is anticipated that as more residents participate in the block rotation in developmental pediatrics that it will be possible to increase the specific feedback for individual preceptors.

The amount of time residents spent actively participating in clinical activities varied between preceptors and could only be assessed indirectly based upon retrospective resident reports. However, review of the prospectively collected data comprising only about 30 percent of the residents' clinical activities reveals that the residents were

participating actively on nearly 100% of those occasions. Thus the residents' retrospective reports may underestimate the amount of participation in the clinical activities. However, it may also be that no forms were returned on days that the residents did not actively participate and were simply observing clinical interactions.

The second goal of improving resident feedback and evaluation was definitely met during the implementation. Despite the difficulty mentioned previously of collecting daily resident evaluation forms, the residents felt that the amount and quality of feedback received was excellent and surpassed most of their other rotations. Thus, although the performance evaluation fell somewhat short of the goal of the implementation, it still represented a significant improvement. In part this was due to the other feedback and evaluation techniques used, including the formative evaluations and the written examination that provided information to the residents regarding the evaluation of their knowledge, skills and attitudes.

Two other factors were felt to be limiting during the implementation of the block rotation of developmental pediatrics. The first was that two of the preceptors became unavailable during the implementation. Both of these preceptors were anticipated to have significant roles as primary preceptors. However, other preceptors were recruited to replace them and appear to have been quite successful in implementing the curricular recommendations. The second factor relates to the administrative structure of the developmental pediatric clinic. This structure was in constant change throughout the implementation, and thus a large amount of uncertainty was prevalent. Despite this, the preceptors worked extremely hard to provide appropriate clinical learning opportunities to the pediatric residents.

In summary, the implementation of the curricular revisions was evaluated for two segments of the curriculum, the group sessions and the block rotation in developmental pediatrics. The implementation was extremely successful for the group sessions, and was moderately successful for the block rotations. While there were several limiting factors, none of these were serious nor prevented the successful implementation of the curriculum. The only significant difficulty encountered in the implementation was the introduction of daily resident performance evaluation. This will be discussed further in the next section.

Resident Evaluation

The second part of the original research question for this project is whether implementing the curriculum would improve the quality of residency training in the discipline of developmental pediatrics. This corresponds to the sixth step described by Kern et al. [27] which is Evaluation and Feedback. Unfortunately, there were no preexisting valid and reliable evaluation tools to assess resident performance in this field, so one of the purposes of the project was to develop a reliable and valid evaluation for pediatric residents in the area of developmental pediatrics.

The written examination developed for this project and described in Chapter Seven was found to be valid, reliable and feasible. No difficulties were encountered in the implementation of this examination. The residents readily accepted the examination, and they appreciated the feedback it provided and the opportunity to review the improvement in their scores over time.

All residents surpassed the MPL on the examination, thus implying that they had met the learning objectives tested in the written examination. Their scores improved from before the implementation, but this result must be interpreted with caution. It is hoped that this improvement is the result of the curriculum improvement efforts, however there are uncontrolled variables that may also have impact on the examination results. For example, between 0.5 and 8.5 months had elapsed between the "pre" and the "post" examinations. During this time, the residents would have participated in a variety of clinical learning activities that may or may not have been relevant to the discipline of developmental pediatrics.

A more important result, however, is that the residents who participated in the implementation process scored better than did a cohort of residents at similar level of training before the implementation. This provides more direct evidence that an improvement in the resident knowledge has resulted from the implementation of the revised curriculum. Obviously, other changes are constantly being made to the training program in general, but the only intervention to the area of developmental pediatrics during this time period was this project.

While the implementation of the written examination was quite successful, the implementation of the resident performance evaluations was much more difficult. In fact, because of the poor rate of return of these evaluations, it is difficult to draw conclusions from the limited data. The performance evaluation was intended to evaluate learning objectives related to clinical skills and attitudes, as these are difficult to assess via a written examination. All residents were assessed to be at, or above, an average level, based upon the forms received, so the conclusion might be that they had met the learning

objectives. However, this is a small sample and the evaluation tool used global rating scales rather than specific items. While there were no significant deficits identified, the performance evaluation will require improvement in order to enhance its utility to determine if the learning objectives are being met. The formative evaluations and the written examinations appear to have met the goal of increasing the feedback to the residents regarding their performance.

In summary, the implementation of curricular changes appears to have been successful in improving residency training in developmental pediatrics. The residents met the learning objectives as measured by the evaluation tools described above. There were some limitations to this assessment as the sample size was small, thus statistical significance was not reached, and there were unanticipated difficulties with the resident performance evaluation. However, it is important to note that only approximately half of the planned implementation has occurred to date, thus it is extremely encouraging that the process has been successful when evaluated at this interim point.

Discussion of Potential Bias in Results

It is important to consider potential sources of bias in the collection and interpretation of the results. While some of the outcome measures used in the evaluation of implementation were objective, many were subjective and the interpretation of the outcome measures could be affected. In this section, potential sources of bias are described including the likely direction of effect. However, it is unlikely that the results

have been significantly affected by systemic bias as many of the potential sources balance one another in opposite directions.

The most important potential source of bias relates to the investigator of this Thesis project. There was one primary person responsible for the needs assessment, curriculum development, implementation and evaluation that comprised the project. Clearly, this investigator has invested significant time and effort into this project and was hopeful that the curriculum improvement would be successful. Thus she may tend to interpret the results favorably. In view of the small sample size of participants in the implementation, it is difficult to confirm her conclusions with statistically significant results. In order to allow other investigators to draw their own conclusions, all data has been presented along with the statistical analysis and the investigator's interpretations.

In addition, the investigator is well known to the participants in the implementation and evaluation. The pediatric residency training program is relatively small, and the number of preceptors is also limited. All of the participants have been aware of the investigator's interest in this area, and likely also were cognizant of the time and effort she has invested. This may have served to artificially inflate the ratings of the interventions, as participants may not have wished to disappoint her or to show her effort to have been futile. However, this potential problem would be unlikely to affect all outcome measures, but only those that involved participant rating to determine the success of the implementation process. The resident evaluation would not likely be affected by such bias.

The investigator has attempted to analyze data without identifying the participants. This was done by entering all numeric results and written comments into a

computer database without identifying features. However, some of the feedback was collected informally through conversations with the investigator. Although she endeavored to remain objective and to record both positive and negative comments, it is difficult to confirm this.

One of the interesting factors that may have affected the success of the implementation is the position of the investigator as a Clinical Fellow in the area of developmental pediatrics. Although she was directing the process of curriculum improvement, she had a subordinate role to the preceptors who were involved. This may have had a significant adverse effect on the implementation of the curriculum. Despite clear support from administrative personnel, the preceptors may have minimized or disregarded some of her attempts to improve the curriculum. Her position also made it difficult at times to address specific issues within the implementation such as the failure of preceptors to comply with the planned curriculum or to return the evaluation forms. It is likely that the implementation would have been more successful if the primary investigator had been a person with equal status to the preceptors or perhaps even in a position of authority.

However, this unique position of trainee and investigator likely also improved the feedback that was received during the implementation process. It is likely that the residents were more willing to discuss negative aspects of their training experiences with the investigator because she was not an attending physician, and so was less threatening. Also, the preceptors may have been more willing to criticize the process, again because the investigator was not in a position of authority. Thus it is likely that the feedback

received during the implementation process was in fact more balanced than it would have been with an investigator in a different position.

In summary, there are several potential sources of bias that would be expected to affect the data in different directions. It is likely that the influences of these factors have balanced out, but this can not be confirmed in this experimental design. The best way to examine for potential bias would be to compare the study group to a control group, but this was not possible for reasons outlined in Chapter Eight. In order to minimize any potential bias that has been introduced either in data collection or interpretation, emphasis has been placed upon the more objective outcome measures such as the written examination and on those that can be compared to previous measures such as the needs assessment survey and the parallel questions asked on the rotation evaluation. It is believed that by placing the emphasis on these objective measures to determine if the implementation has been successful that the conclusions will be minimally affected by any possible bias.

Generalization to Other Canadian Training Programs

In developing this curriculum implementation project, it was hoped that the methodology would be applicable to other residency programs that also seek to improve residency training in developmental pediatrics. As this project has demonstrated success in implementing curricular revision and improving resident training, it could serve as a framework for other programs attempting to implement the Canadian Guidelines [1]. While training programs may differ somewhat in terms of their administrative structure

and available resources, most Canadian programs face the same issues as the University of Calgary.

The needs assessment survey discussed in Chapter Four did not find any difference between the responses of pediatricians who had completed their training at the University of Calgary and those who had completed their training at other universities. Again, this confirms the general need to improve training in developmental pediatrics in most training programs and indicates that curriculum revision would be appropriate.

The survey of other programs described in Chapter Five addressed issues of time, organization and structure of developmental pediatric training. It revealed that prior to initiation of curricular improvement at the University of Calgary, the structure of pediatric residency training in developmental pediatrics was similar to that of other training programs. Only some programs were currently following the Canadian Guidelines [1], and most were limited by time constraints.

A similar process of curriculum revision would thus be applicable to other Canadian residency training programs. There may be specific constraints or limitations on such a process at certain sites, but the curriculum could be individualized to accommodate specific needs. However, the six-step process is directly applicable to any program, and most of the specific methodology used in this project would be appropriate, including the surveys, evaluation forms, and written examination.

For example, a Canadian residency training program may have determined that modifications are necessary to meet the needs of its trainees and to comply with the Canadian Guidelines [1]. The program director may wish to undertake a formal needs assessment survey to identify specific needs relevant to that site, or he/she could assume

that the needs would be similar to those at the University of Calgary. This assumption would be based upon the existing literature and upon the findings in the needs assessment survey at the University of Calgary that there was no difference between pediatrician responses regarding their residency training when stratified by the location of that training. The next step would be to review the learning objectives produced in this project and to modify them to address any specific needs relevant to that site. The objectives should require relatively few modifications because they are based upon the Canadian Guidelines [1] which are applicable to all programs. Learning activities could then be designed according to the resources and constraints specific to the training program. It is likely that at least some of the learning activities described in this project would be feasible to implement as most training programs in Canada have similar structure. Subsequently, evaluation of the curriculum implementation could proceed in a similar manner to that described in this document, with the exception that the resident performance evaluation for clinical skills and attitudes (daily performance evaluations) requires improvement. Similar consideration would be required throughout to incorporate principles of adult learning, to communicate with participants in the implementation, to develop faculty skills, and to commit the time and resources required for successful implementation.

Future Plans

This document has described the development of a revised curriculum, the first year of curricular implementation and an interim evaluation of the implementation process. The second year of implementation will begin in July 2000 and the evaluation will continue. During the second year, the focus will be upon development of an increased role of the pediatric resident clinic, expansion of the learning activities to include areas external to the Division of Developmental Pediatrics, and formal faculty development activities.

The administrative difficulties of the pediatric resident clinic have been addressed during the first year of implementation. In the second year, it is anticipated that the pediatric resident clinic will become a primary site for teaching and evaluation of clinical skills. Gaps identified in training in developmental pediatrics during the first year of implementation will be addressed in this clinical location by selection of specific patient cases for the residents. The structure of the clinic visits will also be planned to maximize resident learning using techniques similar to those described by Kurth, Irigoyen and Schmidt [66] and by Heidenreich et al. [67].

It is clearly apparent that in order to meet the learning objectives and the needs of the physicians in the discipline of developmental pediatrics that use of other clinical rotations such as pediatric neurology, genetics, ambulatory pediatrics, etc. will be essential. Specific educational objectives and learning activities relevant to these rotations will be developed in conjunction with the specialists in these areas.

Faculty development will be introduced formally during the second year of implementation. During the first year, it was important to incorporate the learning activities into the existing practices of the pediatrician supervisors. It has been important to modify the prevailing opinion that it is difficult to involve trainees in active participation in clinical activities. While this attitude has improved over the past year, it is clear that faculty development is now required to provide the staff with teaching skills to accommodate this expectation. Preceptors have also indicated interest in faculty development activities concentrating on providing feedback to trainees, and again, this is critically important to the learning process.

In addition to the items listed above which were planned at the outset for inclusion in the second year of implementation, two other issues have arisen during the first year. The first is the need to improve the resident performance evaluation (daily preceptor evaluations). The evaluations have been completed only sporadically and often were done as summary evaluations several weeks after the residents' rotations. The preceptors have indicated that the forms were easy to use and preferred them to the generic forms used by the training program, but do not wish to use them on a daily basis. Over the second year, this evaluation process will be reviewed. The daily evaluation forms were felt to represent the best balance between the quality of evaluation of clinical skills and the feasibility of the evaluation, however, a different format of evaluation may need to be added or substituted. Thus the plan for the second year of implementation will be to preserve the formative evaluations for purposes of providing residents with feedback on their clinical skills. The summative evaluation will consist of the written examination and global preceptor evaluation done by the primary preceptors at the end of

the block rotation in developmental pediatrics. More specific assessment of clinical skills and attitudes will be moved to the pediatric resident clinic, and it will be necessary to develop another evaluation tool for this setting. It is anticipated that evaluation in this setting will consist of a more reliable technique than global preceptor assessment such as videotape review and/or OSCE style examination, however these have not been developed or implemented to date.

The second issue is that of communication with the community preceptors. Despite significant effort to communicate regularly with all preceptors both in written and verbal format, this has been challenging to maintain over the year. In the second year of implementation, additional efforts will be made to accommodate the needs of those preceptors who do not regularly attend division rounds. It is clear that in order to sustain the curriculum improvements and continue with the implementation, a significant commitment of both time and resources is required to ensure appropriate communication with the participants in the curriculum.

The first year of implementation has been very encouraging. In general, the curriculum has been well received, and despite the small number of residents, the modifications appear to be improving the training in developmental pediatrics. The efforts over the upcoming year will focus upon increasing the learning opportunities in this area in a way that is coherently coordinated throughout the residency training program.

CHAPTER ELEVEN. CONCLUSIONS

In conclusion, it is clear that a formal curriculum in developmental pediatrics that is integrated over the four-year residency program and provides learning opportunities over a longitudinal period of time can be successfully implemented into the existing pediatric residency program at the University of Calgary. At the end of the first year of implementation, this curriculum has improved the quality of residency training in the discipline of developmental pediatrics. This improvement was demonstrated by increased participant satisfaction, improved resident performance on the outcome measures, resident report of increased self-confidence in their clinical skills, improvement in the process of resident evaluation, and a decrease in the number of logistical difficulties throughout.

Prior to the implementation of the curriculum, resident education in developmental pediatrics at the University of Calgary lacked structure and organization and there were no specific learning objectives relevant to the discipline. The residents received a variable quality and quantity of learning experiences and the evaluation of resident performance was limited. Now, following curriculum improvement, resident education in developmental pediatrics has a clear structure and an explicit curricular guide (syllabus). The curriculum is based upon identified needs of residents and pediatricians and upon principles of cognitive psychology and adult education. There are specific learning objectives for the discipline, and residents are now actively participating in specific learning activities designed to meet these objectives. The process of resident evaluation, both formative and summative has been significantly improved.

Further implementation will continue over the next year to fully integrate the curriculum into the pediatric residency program. To date, the implementation process has proceeded with few unanticipated difficulties and the changes made have been well accepted by both the residents and the preceptors involved.

Bibliography

1. *The Sub-specialty of Developmental Pediatrics: A Proposal for Accreditation without Certification.* 1996. Accreditation Sub-Committee, Section of Developmental Paediatrics, Canadian Paediatric Society.

2. Haggerty, R.J., K.J. Roghmann, and I.B. Pless, *Child Health and the Community.* 1975, New York: John Wiley & Sons Inc. 388.

3. Weinberger, H.L. and F.A. Oski, *A Survey of Pediatric Resident Training Programs 5 Years after the Task Force Report.* Pediatrics, 1984. **74**(4): p. 523-526.

4. Glasscock, S.G., *et al.*, *Residency Training in Behavioral Pediatrics.* Developmental and Behavioral Pediatrics, 1989. **10**(5): p. 262-263.

5. Camp, B.W., *et al.*, *Evaluation of Developmental/Behavioral Training in Primary Care.* Developmental and Behavioral Pediatrics, 1991. **12**(4): p. 243-247.

6. Chee, K.Y., J.M. Simpson, and P. Hutchins, *Survey on Developmental-Behavioral Training Experiences of Australian Paediatric Advanced Trainees.* Journal of Pediatric and Child Health, 1994. **30**: p. 478-482.

7. Dworkin, P.H., *et al.*, *Training in Developmental Pediatrics: How Practitioners Perceive the Gap.* American Journal of Diseases of Children, 1979. **133**: p. 709-712.

8. Guralnick, M.J., *et al.*, *Training Residents in Developmental Pediatrics: Results from a National Replication.* Developmental and Behavioral Pediatrics, 1987. **8**(5): p. 260-265.

9. Oberklaid, F., *Mismatch between Paediatric Training and Paediatric Practice.* Lancet, 1991. **337**: p. 920.

10. Liebelt, E.L., *et al.*, *Evaluation of Pediatric Training by the Alumni of a Residency Program.* Pediatrics, 1993. **91**(2): p. 360-364.

11. *Task Force on Pediatric Education: The Future of Pediatric Education.* 1978, American Academy of Pediatrics: Evanston, IL.

12. Trent, P.J., R.A. Hock, and W.S. Yancy, *Evaluation of Behavior and Development Training for Pediatric Residents.* Journal of Medical Education, 1982. **57**: p. 113-118.

13. Bennett, F.C., *et al.*, *Teaching Developmental Pediatrics to Pediatric Residents: Effectiveness of a Structured Curriculum.* Pediatrics, 1984. **74**(4): p. 514-522.

14. Phillips, S., S.B. Friedman, and B.H. Zebal, *The Impact of Training in Behavioral Pediatrics: A Study of 24 Residency Programs.* Developmental and Behavioral Pediatrics, 1984. **6**(1): p. 15-21.

15. Richardson, H.B., Jr., *Pediatric Residents and Young Handicapped Children: Curriculum Evaluation.* Journal of Medical Education, 1978. **53**: p. 487-492.

16. Guralnick, M.J., H.B. Richardson, Jr., and K.E. Heiser, *A Curriculum in Handicapping Conditions for Pediatric Residents.* Exceptional Children, 1982. **48**(4): p. 338-346.

17. Desguin, B.W., *Chronic Illness in Children: An Educational Program for a Primary-Care Pediatric Residency.* American Journal of Diseases of Children, 1986. **140**: p. 1246-1249.

18. Yancy, W.S., *et al.*, *A Curriculum Guide for Developmental - Behavioral Pediatrics.* Developmental and Behavioral Pediatrics, 1988. **9**(6): p. S1-8.

19. Coury, D.L., *et al.*, *Curricular Guidelines for Residency Training in Developmental-Behavioral Pediatrics.* Journal of Developmental and Behavioral Pediatrics, 1999. **20**(2S): p. S1-S38.

20. Taras, H.L. and P.R. Nader, *Ten Years of Graduates Evaluate a Pediatric Residency Program.* American Journal of Diseases of Children, 1990. **144**(10): p. 1102-1105.

21. Breunlin, D.C., *et al.*, *Pediatricians' Perceptions of Their Behavioral and Developmental Training.* Developmental and Behavioral Pediatrics, 1990. **11**(4): p. 165-169.

22. Kwasman, A., B.J. Tinsley, and H.S. Lepper, *Pediatricians' Knowledge and Attitudes Concerning Diagnosis and Treatment of Attention Deficit and Hyperactivity Disorders.* Archives of Pediatric and Adolescent Medicine, 1995. **149**: p. 1211-1216.

23. Friedman, S.B., S. Phillips, and J.M. Parrish, *Current Status of Behavioral Pediatric Training for General Pediatric Residents: A Study of 11 Funded Programs.* Pediatrics, 1983. **71**(6): p. 904-908.

24. Agnes, M., ed. *Webster's New World College Dictionary.* 4 ed. 1999, New York: Macmillan. 1716.

25. MacKeracher, D., *Making Sense of Adult Learning.* 1996, Toronto: Culture Concepts Inc. 288.

26. Merriam, S.B., ed. *An Update on Adult Learning Theory*. New Directions for Adult and Continuing Education, ed. R.G. Brockett and A.B. Knox. Vol. 57. 1993, San Francisco: Jossey-Bass Publishers. 116.

27. Kern, D.E., *et al.*, *Curriculum Development for Medical Education: A Six-Step Approach*. 1998, Baltimore, Maryland: The Johns Hopkins University Press. 178.

28. Tobin, K., ed. *The Practice of Constructivism in Science Education*. 1993, Hillsdale: Lawrence Erlbaum Associates. 344.

29. Fisher, L.A. and C. Levene, *Planning a Professional Curriculum: A Guide to Understanding Program Design*. 1989, Calgary: The University of Calgary Press. 217.

30. Carey, W.B., *Presidential Address: The Question of Subspecialty Certification in Developmental-Behavioral Pediatrics*. Developmental and Behavioral Pediatrics, 1992. **13**(1): p. 1-3.

31. Guze, P.A., *Cultivating Curricular Reform*. Academic Medicine, 1995. **70**(11): p. 971-973.

32. Kramlinger, T. and T. Huberty, *Behaviorism versus Humanism*, in *Training and Development*. 1990, The American Society for Training and Development.

33. Hafferty, F.W. and R. Franks, *The Hidden Curriculum, Ethics Teaching, and the Structure of Medical Education*. Academic Medicine, 1994. **69**(11): p. 861-871.

34. Wear, D., *Professional Development of Medical Students: Problems and Promises*. Academic Medicine, 1997. **72**(12): p. 1056-1062.

35. Baxter Magolda, M.B., *Creating Contexts for Learning and Self-Authorship*. 1999, Nashville: Vanderbilt University Press. 344.

36. Knowles, M., *The Adult Learner: A Neglected Species*. 4 ed. 1990, Houston: Gulf Publishing. 293.

37. David, T.J. and L. Patel, *Adult Learning Theory, Problem Based Learning, and Paediatrics*. Archives of Disease in Childhood, 1995. **73**: p. 357-363.

38. Pratt, D.D., *Andragogy after Twenty-five Years*. New Directions for Adult and Continuing Education, 1993. **57**: p. 15-23.

39. Shatzer, J.H., *Instructional Methods*. Academic Medicine, 1998. **73**(9 S): p. S38-S45.

40. Spencer, J.A. and R.K. Jordan, *Learner Centred Approaches in Medical Education*. British Medical Journal, 1999. **318**: p. 1280-1283.

41. Pratt, D.D., *Five Perspectives on Teaching in Adult and Higher Education*. 1998, Malabar: Krieger Publishing Company. 289.

42. Arseneau, R. and D. Rodenburg, *The Developmental Perspective: Cultivating Ways of Thinking*, in *Five Perspectives on Teaching in Adult and Higher Education*, D.D. Pratt, Editor. 1998, Malabar: Krieger Publishing Company. p. 105-149.

43. Payne, D.G. and M.J. Wenger, *Cognitive Psychology*. 1998, Boston: Houghton Mifflin Company. 483.

44. Schmidt, H.G., G.R. Norman, and H.P.A. Boshuizen, *A Cognitive Perspective on Medical Expertise: Theory and Implications*. Academic Medicine, 1990. **65**: p. 611-621.

45. Custers, E.J.F.M., G. Regehr, and G.R. Norman, *Mental Representations of Medical Diagnostic Knowledge: A Review.* Academic Medicine, 1996. **71**(10S): p. S55-S61.

46. Bordage, G. and M. Lemieux, *Semantic Structures and Diagnostic Thinking of Experts and Novices.* Academic Medicine, 1991. **66**(9S): p. S70-S72.

47. Bordage, G. and R. Zacks, *The Structure of Medical Knowledge in the Memories of Medical Students and General Practitioners: Categories and Prototypes.* Medical Education, 1984. **18**: p. 406-416.

48. Eva, K.W., A.J. Neville, and G.R. Norman, *Exploring the Etiology of Content Specificity: Factors Influencing Analogic Transfer and Problem Solving.* Academic Medicine, 1998. **73**(10S): p. S1-S5.

49. Norman, G.R. and H.G. Schmidt, *The Psychological Basis of Problem-based Learning: A Review of the Evidence.* Academic Medicine, 1992. **67**(9): p. 557-565.

50. Regehr, G. and G.R. Norman, *Issues in Cognitive Psychology: Implications for Professional Education.* Academic Medicine, 1996. **71**(9): p. 988-1001.

51. Norman, G., R. *et al.*, *Cognitive Differences in Clinical Reasoning Related to Postgraduate Training.* Teaching and Learning in Medicine, 1994. **6**(2): p. 114-120.

52. Mandin, H., *et al.*, *Helping Students Learn to Think Like Experts When Solving Clinical Problems.* Academic Medicine, 1997. **72**(3): p. 173-179.

53. Shope, T.R., B.J. Bradley, and H.L. Taras, *A Block Rotation in Community Pediatrics.* Pediatrics, 1999. **104**(1): p. 143-147.

54. Caffarella, R.S., *Planning Programs for Adult Learners: A Practical Guide for Educators, Trainers and Staff Developers*. 1994, San Francisco: Jossey-Bass Publishers. 248.

55. *University of Calgary Undergraduate Curriculum: A Framework and Process for Redesign*. 1998, University of Calgary: Calgary.

56. Stone, S.L. and D.M. Qualters, *Course-based Assessment: Implementing Outcome Assessment in Medical Education*. Academic Medicine, 1998. **73**(4): p. 397-401.

57. Harden, R.M., *Ten Questions to Ask when Planning a Course or Curriculum*. Medical Education, 1986. **20**: p. 356-365.

58. Veale, P.M., J.-G. DesCôteaux, and M.E. Clarke, *Residency Training in Developmental Pediatrics: A Survey of Residents and Pediatricians*. Annals of the Royal College of Physicians and Surgeons of Canada, 1999. **32**(8): p. 432-436.

59. Dillman, D.A., *Mail and Telephone Surveys: The Total Design Method*. 1978, New York: John Wiley and Sons.

60. Gordon, M.J., *A Review of the Validity and Accuracy of Self-assessments in Health Professions Training*. Academic Medicine, 1991. **66**(12): p. 762-769.

61. Tracey, J.M., *et al.*, *The Validity of General Practitioners' Self-assessment of Knowledge: Cross Sectional Study*. British Medical Journal, 1997. **315**: p. 1426-1428.

62. Mandin, H., *et al.*, *Developing a "Clinical Presentation" Curriculum at the University of Calgary*. Academic Medicine, 1995. **70**(3): p. 186-193.

63. Bachman, K.H. and D.J. Mazur, *Using Practice Guidelines to Teach Residents*. Academic Medicine, 1998. **73**(2): p. 118-119.

64. Quattlebaum, T.G., *Techniques for Evaluating Residents and Residency Programs.* Pediatrics, 1996. **98**(6): p. 1277-1283.

65. Brush, A.D. and G.T. Moore, *Assigning Patients According to Curriculum: A Strategy for Improving Ambulatory Care Residency Training.* Academic Medicine, 1994. **69**(9): p. 717-719.

66. Kurth, R.J., M. Irigoyen, and H.J. Schmidt, *A Model to Structure Student Learning in Ambulatory Care Settings.* Academic Medicine, 1997. **72**(7): p. 601-606.

67. Heidenreich, C., *et al.*, *The Search for Effective and Efficient Ambulatory Teaching Methods Through the Literature.* Pediatrics, 2000. **105**(1): p. 231-237.

68. Regehr, G., *et al.*, *Measuring Self-assessment Skills: An Innovative Relative Ranking Model.* Academic Medicine, 1996. **71**(10S): p. S52-S54.

69. Newble, D., *et al.*, *Guidelines for Assessing Clinical Competence.* Teaching and Learning in Medicine, 1994. **6**(3): p. 213-220.

70. Harasym, P.H., D.A. Norris, and F.L. Lorscheider, *Evaluating Student Multiple-Choice Responses: Effects of Coded and Free Formats.* Evaluation and the Health Professions, 1980. **3**(1): p. 63-84.

71. Harasym, P.H., *et al.*, *Negation in Stems of Single-Response Multiple-Choice Items.* Evaluation and the Health Professions, 1993. **16**(3): p. 342-357.

72. Violato, C., A. Marini, and D. McDougall, *Assessment of Classroom Learning.* 1998, Calgary: Detselig Enterprises Ltd. 181.

73. Swartz, M.H., *et al.*, *Validating the Standardized-patient Assessment Administered to Medical Students in the New York City Consortium.* Academic Medicine, 1997. **72**(7): p. 619-626.

74. Hopkins, K.D., *Educational and Psychological Measurement and Evaluation.* 8 ed. 1998: Allyn and Bacon. 486.

75. Sloan, D.A., *et al.*, *The Objective Structured Clinical Examination. The New Gold Standard for Evaluating Postgraduate Clinical Performance.* Annals of Surgery, 1995. **222**(6): p. 735-742.

76. Waterston, T., J.I. Cater, and R.G. Mitchell, *An Objective Undergraduate Clinical Examination in Child Health.* Archives of Disease in Childhood, 1980. **55**: p. 917-922.

77. Watson, A.R., I.B. Houston, and G.C. Close, *Evaluation of an Objective Structured Clinical Examination.* Archives of Disease in Childhood, 1982. **57**: p. 390-398.

78. Smith, L.J., D.A. Price, and I.B. Houston, *Objective Structured Clinical Examination Compared with Other Forms of Student Assessment.* Archives of Disease in Childhood, 1984. **59**: p. 1173-1176.

79. Matsell, D.G., N.M. Wolfish, and E. Hsu, *Reliability and Validity of the Objective Structured Clinical Examination in Pediatrics.* Medical Education, 1991. **25**: p. 293-299.

80. Joorabchi, B., *Objective Structured Clinical Examination in a Pediatric Residency Program.* American Journal of Diseases of Children, 1991. **145**: p. 757-762.

81. Hilliard, R.I. and S.E. Tallett, *The Use of an Objective Structured Clinical Examination with Postgraduate Residents in Pediatrics.* Archives of Pediatrics and Adolescent Medicine, 1998. **152**: p. 74-78.

82. Lane, J.L., A. Ziv, and J.R. Boulet, *A Pediatric Clinical Skills Assessment Using Children as Standardized Patients* Archives of Pediatric and Adolescent Medicine, 1999. **153**: p. 637-644.

Appendix 1. Needs Assessment Questionnaires

SURVEY OF ACH PEDIATRICIANS

Developmental Pediatrics in Residency Education

1. What year did you complete your Pediatric Residency?_____

Where? _____

Was there a rotation in Developmental Pediatrics included in your program? _____

Do you practice ___General Pediatrics
___Subspecialty Pediatrics (which subspecialty?_____)

2. How much of your clinical time is spent with assessment or management of patients with developmental disorders?

___none ___0-25% ___25-50% ___50-75% ___75-100%

3. What is your overall assessment of your education in Developmental Pediatrics during your residency training?

poor 1 2 3 4 5 excellent

4. How much of your knowledge in the area of Developmental Pediatrics did you learn **after** you completed your residency

___ Minimal - my residency training covered the majority of the area of Developmental Pediatrics.
___ Some - I have expanded certain areas of clinical knowledge since starting practice.
___ Most - my residency training did not cover the areas I consider important in Developmental Pediatrics.
___ All - I did not receive training in this area during my residency program.

Please comment on how you have increased your knowledge in this area since starting practice.
(e.g. Journal Articles, Books, Courses/Seminars, etc.)

_____
_____

What are the three most important problems in Developmental Pediatrics that you encounter in your practice?

#1 _____
#2 _____
#3 _____

5. What is your assessment of the importance of Developmental Pediatrics for Pediatric Residents?

not important 1 2 3 4 5 very important

6. What is your assessment of the importance of Developmental Pediatrics for General Pediatricians?

not important 1 2 3 4 5 very important

7. How would you prioritize education of Pediatric Residents in the area of Developmental Pediatrics compared with the importance of other areas of Pediatrics?

low priority for Develop. Peds 1 2 3 4 5 high priority for Develop. Peds.

8. **At the end of your residency,**

Do you feel you were competent in assessing a child for normal development?

not competent 1 2 3 4 5 fully competent

Do you feel you were competent in assessing a child for abnormal development?

not competent 1 2 3 4 5 fully competent

Do you feel you were competent in treating a child with abnormal development?

not competent 1 2 3 4 5 fully competent

9. **At the present time,**

Do you feel you are competent in assessing a child for normal development?

not competent 1 2 3 4 5 fully competent

Do you feel you are competent in assessing a child for abnormal development?

not competent 1 2 3 4 5 fully competent

Do you feel you are competent in treating a child with abnormal development?

not competent 1 2 3 4 5 fully competent

10. When do you think a Pediatrician should receive the majority of his/her education in Developmental Pediatrics?

___ Medical School/Clerkship
___ R1
___ R2
___ R3
___ R4
___ throughout pediatric residency (R1-R4)
___ Fellowship
___ during clinical practice as a Pediatrician

11. Have you given any sessions on topics in Developmental Pediatrics during Thursday afternoon resident teaching ? _____

12. Have you given any teaching on topics related to Developmental Pediatrics to residents in other settings (e.g. Preceptor Rounds, Ambulatory Rotations, etc.?_____
Describe: _____

13. What do you think are the most important areas in Developmental Pediatrics that should be focussed upon during Pediatric Residency Training?

#1 _____
#2 _____
#3 _____

14. Please reflect on your involvement with Pediatric Residents in Calgary over the last three years.

In your opinion, how is the knowledge of Pediatric Residents in the area of Developmental Pediatrics overall?

inadequate 1 2 3 4 5 appropriate

How well do you think Pediatric Residents are able to assess patients with normal development?

not competent 1 2 3 4 5 fully competent

How well do you think Pediatric Residents are able to assess patients with abnormal development?

not competent 1 2 3 4 5 fully competent

How well do you think Pediatric Residents are able to treat patients with developmental disorders?

not competent 1 2 3 4 5 fully competent

15. Which of the following educational opportunities do you think should be utilized for education of residents in Developmental Pediatrics? (check all that apply)

___ Formal Rotation in Developmental Pediatrics (1 month rotation)
___ Ambulatory Pediatric Rotations
___ Pediatric Resident Clinic
___ Specialty Clinics (e.g. Down's, Cleft Palate, Perinatal Follow-up, etc.)
___ School Based Clinics
___ Other Community Programs (e.g. Learning Center)
___ Outreach Clinics in Developmental Pediatrics
___ Cluster Rotations (e.g. Preceptor Rounds, Case Presentations, etc.)
___ Thursday Afternoon Teaching Sessions
___ Grand Rounds
___ Other Rounds (e.g. noon rounds)
___ Self-directed learning (e.g. reading list, written case examples, etc)
___ Videotaped patient examples
___ Other (list: _____)
___ Other (list: _____)

16. Who do you feel should be involved in teaching residents in the area of Developmental Pediatrics? (check all that apply)

___ Subspecialty Pediatricians
___ General Pediatricians
___ Multidisciplinary Professionals (e.g. Psychologists, Speech Therapists, Physiotherapists, etc.)
___ Parents of Children with Developmental Disorders
___ Other (list: _____)

17. In your opinion, how could the current training of Pediatric Residents in the area of Developmental Pediatrics be improved?

_____
_____
_____
_____

18. Please list three clinical problems in Developmental Pediatrics that you have encountered in your practice and have not had adequate knowledge or skills to manage.

#1 _____
#2 _____
#3 _____

19. Thank you for your cooperation with this questionnaire. Please use the remainder of this page for any comments.

RESIDENT SURVEY

Developmental Pediatrics in Residency Education

1. What is your R level? R1 R2 R3 R4

2. What is your overall assessment of your education in Developmental Pediatrics to date?

poor 1 2 3 4 5 excellent

3. What is your assessment of the importance of Developmental Pediatrics for Pediatric Residents?

not important 1 2 3 4 5 very important

4. What is your assessment of the importance of Developmental Pediatrics for General Pediatricians?

not important 1 2 3 4 5 very important

5. At this point in your residency, how would you prioritize education in the area of Developmental Pediatrics compared with other areas of Pediatrics?

low priority for Develop. Peds 1 2 3 4 5 high priority for Develop. Peds.

6. Please list 5 clinical problems that are part of the area of Developmental Pediatrics.

#1 _____
#2 _____
#3 _____
#4 _____
#5 _____

7. **At this point in your education,**

How would you rate your ability to assess a child for normal development?

not competent 1 2 3 4 5 fully competent

How would you rate your ability to diagnose a child with abnormal development?

not competent 1 2 3 4 5 fully competent

How would you rate your ability to treat a child with abnormal development?

not competent 1 2 3 4 5 fully competent

8. **At the end of your residency,**

How competent do you expect to be at assessing a child for normal development?

not competent 1 2 3 4 5 fully competent

How competent do you expect to be at assessing a child for abnormal development?

not competent 1 2 3 4 5 fully competent

How competent do you expect to be at treating a child with abnormal development?

not competent 1 2 3 4 5 fully competent

9. When do you think a Pediatrician should receive the majority of his/her education in Developmental Pediatrics?

___ Medical School/Clerkship
___ R1
___ R2
___ R3
___ R4
___ throughout pediatric residency (R1-R4)
___ Fellowship
___ During clinical practice as a General Pediatrician

10. Have you completed your rotation in Developmental Pediatrics?_____
If no, please go on to question 11.

If yes, how would you rate your rotation overall?

poor 1 2 3 4 5 excellent

What was the best part of the rotation ? _____

What was the weakest part of the rotation? _____

Did you feel you received adequate clinical experience during your month? _____
Explain. _____

Did you receive any reading material during your rotation? _____

Please indicate which of the following you participated in during your rotation.

___ Developmental Clinic-preschool age
___ Perinatal Follow-up Clinic
___ Audiology Clinic
___ Neuromotor or Neuromuscular Clinic
___ School-based Assessment
___ Multidisciplinary assessments
___ Outreach clinics (e.g. High River)
___ Other (list: _____)

___ Developmental Clinic-school age
___ Cleft Palate Clinic
___ Vision Clinic
___ Down's Clinic
___ Other Community Programs
___ Multidisciplinary conference
___ Inpatient consultations
___ Other (list: _____)

Of the clinical experiences above, which ones do you feel were the most useful to you?

#1 _____
#2 _____
#3 _____

Which were the least useful to you?

#1 _____
#2 _____
#3 _____

11. Have you attended any sessions on topics in Developmental Pediatrics during Thursday afternoon teaching ? _____

What is your assessment of the quality of these sessions?

poor 1 2 3 4 5 excellent

12. Have you had any teaching on topics related to Developmental Pediatrics on Cluster Rotations such as Preceptor Rounds, Patient Presentation/Discussion, etc.? _____
Describe: _____

13. Have you had any teaching on topics related to Developmental Pediatrics on Ambulatory rotations? _____
Describe: _____

14. Have you had any teaching on topics related to Developmental Pediatrics in any other setting such as subspecialty rotations, emergency rotations, etc? _____
Describe: _____

15. What do you think are the most important areas in Developmental Pediatrics that should be focussed upon during Pediatric Residency Training?

#1 _____
#2 _____
#3 _____

16. Which of the following educational opportunities do you think should be utilized for education of residents in Developmental Pediatrics? (check all that apply)

___ Formal Rotation in Developmental Pediatrics (1 month rotation)
___ Ambulatory Pediatric Rotations
___ Pediatric Resident Clinic
___ Specialty Clinics (e.g. Down's, Cleft Palate, Perinatal Follow-up, etc.)
___ School Based Clinics
___ Other Community Programs (e.g. Learning Center)
___ Outreach Clinics in Developmental Pediatrics
___ Cluster Rotations (e.g. Preceptor Rounds, Case Presentations, etc.)
___ Thursday Afternoon Teaching Sessions
___ Grand Rounds
___ Other Rounds (e.g. noon rounds)
___ Self-directed learning (e.g. reading list, written case examples, etc)
___ Videotaped patient examples
___ Other (list: _____)
___ Other (list: _____)

17. Who do you feel should be involved in teaching residents in the area of Developmental Pediatrics? (check all that apply)

___ Subspecialty Pediatricians
___ General Pediatricians
___ Multidisciplinary Professionals (e.g. Psychologists, Speech Therapists, Physiotherapists, etc.)
___ Parents of Children with Developmental Disorders
___ Other (list: _____)
___ Other (list: _____)

18. In your opinion, how could the current training of Pediatric Residents in the area of Developmental Pediatrics be improved?

_____
_____
_____
_____

19. Thank you for your cooperation with this questionnaire. Please use the space below for any comments.

Appendix 2. Canada-wide Survey Questionnaire

Residency Training in Developmental Pediatrics

University _____

1. Are you aware of the Royal College Sub-Specialty Accreditation document? ☐ yes ☐ no

If yes, does your program follow the Curriculum Guidelines? ☐ yes ☐ no ☐ unsure

2. Does your program have a mandatory rotation in Developmental Pediatrics? ☐ yes ☐ no

If no, go on to question 3.

2a. How long is the rotation in Developmental Pediatrics? _____
How many times do the residents rotate through this rotation? _____

2b. Are there learning objectives for this rotation? ☐ yes (please attach copy if possible) ☐ no

2c. In what year(s) of the residency program do the residents do this rotation? ☐ R1 ☐ R2 ☐ R3 ☐ R4

2d. During the rotation, what responsibilities do the residents have?

☐ call for Developmental Pediatrics
☐ call for other areas (i.e. cross-coverage on wards, etc)
☐ combined clinical responsibilities in other areas (specify: _____)
☐ other (specify: _____)

2e. What are the clinical activities during this rotation? Please indicate approximate percentage of time spent in each of these areas.

☐ Inpatient consultations
☐ Tertiary level clinics in Developmental Pediatrics (i.e. Hospital Based)
☐ Community clinics (i.e. School Based clinics, Outreach clinics, etc.)
☐ General Pediatric office visits
☐ Multidisciplinary team activities (i.e. Psychiatry, Physiotherapy, etc)
☐ Other (specify: _____)
☐ Other (specify: _____)

3. Do you have formal teaching sessions in Developmental Pediatrics? ☐ yes ☐ no

If no, go on to question 4.

3a. Approximately how many hours per year are designated to formal teaching sessions in Developmental Pediatrics? _____

3b. Who gives these session?

- ☐ Developmental Pediatricians
- ☐ Other Subspecialist Pediatricians (e.g. Neurologists, Psychiatrists, etc.)
- ☐ General Pediatricians
- ☐ Pediatric Residents
- ☐ Multidisciplinary Professionals (e.g. Psychologists, Speech Therapists, etc.)
- ☐ Other (specify: _____)

3c. Please describe briefly the format of these sessions including content, format, size of group, etc.

_____
_____
_____
_____
_____
_____

4. Do you have educational opportunities in your center in Developmental Pediatrics other than those described in questions 2 and 3? (e.g. Ambulatory Clinics) ☐ yes ☐ no

If yes, describe: _____
_____
_____

5. Do you have a longitudinal clinic that provides residents with exposure to children with problems of Development and Behavior over time? ☐ yes ☐ no

If yes, describe: _____
_____
_____

6. How are your residents' skills and knowledge in Developmental Pediatrics evaluated?

- ☐ Preceptor evaluation
- ☐ Written examination
- ☐ Oral examination
- ☐ Other (specify: _____)
- ☐ Royal College examination

Thank you for your time! Please indicate if you would like to receive a summary of the data collected. ☐ yes, send a summary ☐ no, do not send a summary

Appendix 3. Learning Objectives

Terminal Objectives – Normal Development

1. The pediatric resident will describe the continuum of normal human development from birth to adolescence.

2. Given a description or demonstration of an infant's abilities in the domains of language, motor and social development, the pediatric resident will estimate the developmental age of the infant within 2 months.

3. Given a description or demonstration of the abilities of a child between 1 and 6 years of age, the pediatric resident will estimate the developmental age of the child within 6 months.

4. Given a description or demonstration of the abilities of a child between 7 and 18 years of age, the pediatric resident will estimate the developmental age of the child within 2 years.

5. Given a description or demonstration of a child, the pediatric resident will identify potential risk factors for developmental disorders.

Enabling Objectives

The pediatric resident will:

1. Recall the milestones of normal child development from birth to adolescence, including:
    - Neuromuscular skills
    - Language and communication skills
    - Social skills
    - Cognition, attention and memory skills
    - Emotional development
    - Personality development
    - Sexual development

2. Describe how the different areas of child development listed in objective #1 interact with one another throughout child development

3. Describe the individual variation in sequence, tempo and quality of human development

4. Define temperament

5. Describe how the variation of temperament and personality in children may impact on child development

6. Identify features extrinsic to the child that may impact his/her development including:

- Parenting styles
- Parental discord
- Family structure
- Alcohol or drug abuse in the family
- Poverty
- Socioeconomic factors
- Environmental factors
- Toxins
- Peer groups
- Cultural influences
- Societal influences

7. Identify risk factors for developmental disorders including:

- Genetic factors
- Antenatal/perinatal events
- Disease states
- Nurturing/parenting insufficiency
- Child abuse
- Injury
- The physical environment of the child

8. Identify factors that may increase the resilience or vulnerability of a child to adverse influences on his/her development

9. Describe the role of the family in healthy child development

Terminal Objectives – Abnormal Development

1. Given a description or demonstration of an infant or child's abilities, the pediatric resident will identify abnormal patterns of development.

2. Given a description or demonstration of an infant or child with abnormal development, the pediatric resident will diagnose common developmental disorders.

3. The pediatric resident will classify developmental disorders according to common patient presentations outlined in Figure 3.

Enabling Objectives

1. Given a description or demonstration of a child presenting with *Developmental Delay*, the pediatric resident will:

   a. Determine if the child has global developmental delay or delay limited to individual domains of development

b. Describe the impact of acute and chronic illness on child development

c. List risk factors for hearing loss including

Prematurity or low birth weight	Family history of hearing loss
Ototoxic drugs	Craniofacial anomalies
Congenital infection	Meningitis
Severe hyperbilirubinemia	Neonatal asphyxia
Persistent fetal circulation	Head trauma
Recurrent otitis media	Mastoiditis

d. Describe the impact of sensory impairment of child development

e. List the relative frequency of the modes of inheritance of hearing loss

f. Identify clinical features of common genetic syndromes including

Tuberous Sclerosis	Neurofibromatosis
Duchenne Muscular Dystrophy	Rett's Syndrome

g. Describe the mode of inheritance and the recurrence risk for the disorders listed in objective 1f

h. Identify clinical features of Pervasive Developmental Disorders including Autism and Asperger's Syndrome

i. Identify clinical features of
- Learning Disabilities
- Mental Retardation
- Cerebral Palsy

j. Identify patterns of brain injury leading to cerebral palsy including
- Periventricular injury
- Watershed infarcts
- Diffuse brain injury

k. List the differential diagnosis, natural history, prognosis and recurrence risk for the disorders listed in objective 1h and 1i

h. Identify complications including neurologic, cardiovascular, respiratory, musculoskeletal, nutritional, metabolic and endocrinologic problems that may arise due to the disorders listed in objectives 1f and 1h

2. Given a description or demonstration of a child presenting with *Dysmorphic Features*, the pediatric resident will:

a. Identify clinical features of children exposed to common teratogens in utero including

Alcohol	Cocaine
Valproic Acid	Phenytoin
Coumarin	Isotretinoin

b. Identify clinical features of common genetic syndromes including

Down's Syndrome	Turner's Syndrome
Fragile X Syndrome	Prader-Willi Syndrome
Angelman Syndrome	Klinefelter's Syndrome

c. List the differential diagnosis, natural history, prognosis and recurrence risk for the disorders listed in objectives 2a and 2b

d. Identify complications including neurologic, cardiovascular, respiratory, musculoskeletal, nutritional, metabolic and endocrinologic problems that may arise due to the disorders listed in objectives 2a and 2b

3. Given a description or demonstration of a child presenting with *School Failure*, the pediatric resident will:

a. Identify clinical features of

Attention Deficit Hyperactivity Disorder
Tic Disorders including Tourette's Syndrome

b. List common comorbid conditions that may be present in a child with Attention Deficit Hyperactivity Disorder including

Learning Disabilities	Oppositional Defiant Disorder
Conduct Disorder	Anxiety Disorder
Mood Disorder	Language and Communication Disorder
Tic Disorder	Developmental Coordination Disorder

c. List the differential diagnosis, natural history, prognosis and recurrence risk for the disorders listed in objectives 3a and 3b

4. Given a description or demonstration of a child presenting with *Behavioral Problems*, the pediatric resident will:

a. Identify clinical features of:
Conduct Disorder
Oppositional Defiant Disorder
Eating Disorders including Anorexia Nervosa and Bulimia
Sleep Disorders
Enuresis
Encopresis

b. List the differential diagnosis, natural history, prognosis and recurrence risk for the disorders listed in objective 3a

c. Recall the mortality rate for patients with Anorexia Nervosa

d. Recall that the cause of death in patients with Anorexia Nervosa is usually severe electrolyte disturbance, cardiac arrhythmia or congestive heart failure in the recovery phase

5. Given a description or demonstration of a child with a developmental disorder or an abnormal pattern of development, the pediatric resident will:

a. Identify risk factors for abnormal child development

b. Identify clinical features of child abuse including
Physical Abuse
Emotional Abuse
Sexual Abuse
Child Neglect

c. Identify the interaction between clinical presentations and diagnoses in Developmental Pediatrics as outlined in Figure 3

d. Describe the impact of a child's disability on his/her functioning in terms of developmental progress, learning and behavior

Terminal Objectives – Clinical Assessment and Communication

1. Given a patient between 0 and 18 years of age, the pediatric resident will assess a child's development using history and physical examination technique and assessment tools appropriate for the child's age.

2. Given a child with a suspected developmental or behavioral disorder, the pediatric resident will perform an appropriate medical assessment to determine or confirm the diagnosis.

3. The pediatric resident will demonstrate sensitivity and empathy in the assessment and management of children with developmental and behavioral disorders.

4. Given a child with a developmental or behavioral disorder, the pediatric resident will communicate the diagnosis, prognosis, recurrence risk, and management plan to the child's family.

Enabling Objectives

The pediatric resident will:

1. Assess a child's development using history taking and physical examination technique appropriate for the child's age

2. Describe the purpose of and the indications for investigations including:
   - EEG
   - Brain CT scan or MRI scan
   - Blood lead level
   - Blood hemoglobin level
   - Metabolic screening
   - Chromosome analysis
   - Fragile X assay
   - ECG
   - Thyroid function tests
   - Electrolyte panel
   - Urinalysis/urine culture

3. Interpret the results of the investigations listed above

4. Use and interpret questionnaire information data including:
   - Conner's questionnaires for parents and teachers
   - ANSER questionnaires

5. Administer and interpret the Denver Developmental Screening Test II

6. Describe the indication for use of other cognitive assessment tools including:
   - The Goodenough Draw-a-man Test
   - The Gesell Figures
   - The Bayley Infant Development Scales-II
   - The Wechsler Tests (WPPSI-R and WISC-III)
   - The Stanford-Binet

7. Determine the indication for formal assessment by other health care professionals including:

Psychology
Speech and Language Pathology
Occupational Therapy
Physiotherapy
Social Work
Audiology
Ophthalmology
Nursing

8. Describe the methodology and limitations of hearing assessment in different age groups including

Pure tone audiology
Speech recognition
Play audiometry
Visual reinforcement audiometry
Behavioral observation audiometry
Tympanometry
Auditory brainstem response

9. Cooperate with other health care and education professionals in a multidisciplinary setting

10. Identify family, cultural and social influences on a child that may impact his/her development

11. Make a diagnosis of common developmental and behavioral disorders

12. Communicate diagnoses to families including the natural history, the treatment plan and the prognosis of the disorder

13. Describe methods of antenatal diagnosis of teratogenic, chromosomal or genetic disorders

14. Counsel a family regarding recurrence risk of Down syndrome based upon maternal age

15. Based upon the known modes of inheritance, estimate the recurrence risk for the sibling of a child with

Hearing loss
Down's Syndrome
Turner's Syndrome
Fragile X Syndrome
Prader-Willi Syndrome
Angelman Syndrome
Klinefelter's Syndrome
Tuberous Sclerosis
Neurofibromatosis
Duchenne Muscular Dystrophy
Mental Retardation
Autism

16. Demonstrate a supportive attitude towards children with developmental disorders and their families

17. Report suspected cases of child abuse to the appropriate authorities

18. Appropriately document suspected child abuse cases as outlined in the AMA Document on Child Abuse

Terminal Objective – Management

1. The pediatric resident will create a management plan for an infant or child with a disorder of development or behavior.

Enabling Objectives

The Pediatric resident will:

1. Describe the use of psychostimulant medication (methylphenidate, dextroamphetamine, pemoline) in the treatment of attention deficit hyperactivity disorder including:

Formulations available
Indications and contraindications for use
Adverse effects
Dosage and schedule of administration

2. List the indications and contraindications for use of other medications including:
    - Clonidine
    - Carbamazepine
    - Tricyclic antidepressants
    - SSRI antidepressants
    - Antipsychotic medications
    - DDAVP

3. List the adverse effects for the medications listed in objective 2

4. Recommend the appropriate monitoring for patients taking medications listed in objectives 1 and 2

5. List the indications for modes of therapy utilized for developmental and behavioral problems including:
    - Medical Care
    - Pharmacotherapy
    - Individual or family counseling
    - Behavioral modification
    - Speech therapy
    - Occupational therapy
    - Physiotherapy
    - Play therapy
    - Educational intervention
    - Respite Care
    - Child Placement

6. Create and discuss appropriate management plans for children with developmental and behavioral problems including:
    - Motor disabilities and delays
    - Global developmental delay
    - Mental retardation
    - Sensory impairment
    - Communication and language disorders
    - Learning disorders
    - Attention deficit disorders
    - Tic disorders
    - Eating disorders
    - Enuresis
    - Encopresis
    - Sleep disorders

Discussion of the management plans should include:

- Indications for modes of therapy including medical and multidisciplinary interventions based upon the child's diagnosis and problem list
- Recommended follow-up and monitoring of interventions
- Natural history of the disorder including potential future problems and intervention opportunities to limit further disabilities (anticipatory guidance)
- Community resources and emotional/financial support for families

7. State that an appropriate rate of weight gain for a severely malnourished patient with Anorexia Nervosa is 0.2 to 0.4 kg per day

8. Recommend appropriate community resources to families of children with developmental or behavioral problems

9. Describe the need for supportive funding for education and therapy for children with developmental or behavioral disorders

Terminal Objectives – Health Promotion

1. The pediatric resident will describe the promotion of child health and the prevention of developmental disorders.

2. The pediatric resident will create a plan for anticipatory guidance for a child between 0 and 18 years of age based upon the child's developmental stage.

Enabling Objectives

The Pediatric resident will:

1. List potential risk factors for developmental disorders including:
   Genetic factors
   Antenatal/Perinatal events
   Disease states
   Nurturing/Parenting insufficiency
   Child Abuse
   Injury
   The Physical Environment of the Child

2. Identify areas for potential intervention to prevent developmental abnormalities

3. Give anticipatory guidance to families regarding the development of their child

4. Adopt the role of the pediatrician in promoting child advocacy and health care for all children including disadvantaged children and those with special needs

Appendix 4. Outlines of Group Sessions

Group Session 1
Normal Development

Purpose

This session will provide a review of normal developmental milestones.

References

Nelson's Textbook of Pediatrics (15th ed.)

Normal Speech and Language Development: An Overview. Pediatrics in Review 16(3). 1995

Infant Growth and Development. Pediatrics in Review 18(7). 1997
Toddler Development. Pediatrics in Review 18(8). 1997
Preschool Development I. Pediatrics in Review 18(9). 1997
Preschool Development II. Pediatrics in Review 18 (10). 1997

Developmental and Behavioral Issues in Childhood Injury Prevention. Developmental and Behavioral Pediatrics 16(5): 362-370. 1995.

Denver Developmental Screening Test II

Objectives

Terminal Objectives:

Normal Development Objectives 1, 2, 3

Health Promotion Objective 2

Learning Activities

This will be an interactive session. The residents will be presented with descriptions or videotape demonstrations of infants and children of varying ages and asked to estimate their developmental age based upon achievement of milestones. Subsequently, for each case, discussion will ensue regarding anticipatory guidance for a child at the specific developmental stage.

Group Sessions 2 & 3
Assessment of Infant and Child Development

Purpose

These sessions (2) will review the assessment of infant and child development using the Denver Developmental Screening Test II as an example of a commonly used tool to assess infant and child development.

References

The Denver Developmental Screening Test II Administration Guide

Developmental Testing. Pediatrics in Review 16(9), 1995

Objectives

Terminal Objectives:

Clinical Assessment and Communication Objectives 1 and 3

Prerequisites

The residents are expected to be familiar with the content of the Denver Developmental Screening Test II. The residents are also expected to be familiar with normal developmental milestones as covered in Session 1.

Learning Activities

Children of varying ages (3 per session) will be brought by their parents to the session. Each child will be assessed by one of the residents using the Denver Developmental Screening Test II. The other residents will observe this assessment and will provide feedback regarding the assessment technique. The residents will also be asked to comment on whether the child's development is appropriate for age and performed in a sensitive manner.

If time permits, discussion regarding the limitations of the Denver Developmental Screening Test II could be included. Such discussion might also cover alternate assessment techniques available.

Group Session 4
Developmental Disorders with Dysmorphic Features

Purpose

This session will review common developmental disorders that are associated with dysmorphic features.

References

Smith's Recognizable Patterns of Human Malformation

Handouts

Objectives

Terminal Objectives

Abnormal Development Objectives 1 and 3

Clinical Assessment and Communication Objectives 2 and 4

Enabling Objectives

Abnormal Development Objectives 2a-d

Learning Activities

Clinical descriptions and photographs of common developmental disorders that are associated with abnormal development will be presented. Discussion regarding etiology, prevention, recurrence risk, appropriate investigation, prognosis and management plan will be included for key diagnoses including both genetic and teratogenic syndromes.

Key diagnoses to be covered in detail are Fetal Alcohol Syndrome, Down's Syndrome and Fragile X Syndrome. Other cases with specific phenotypes will also be presented if time permits.

Group Sessions 5&6
Developmental Delay

Purpose

These sessions will review common clinical situations of infants and children presenting with developmental delay. The emphasis in these sessions will be placed upon recognizing the pattern of developmental delay rather than the individual diagnoses.

References

Autism and the Pervasive Developmental Disorders. Part I. Pediatrics in Review 16(4). 1995
Autism and the Pervasive Developmental Disorders. Part II. Pediatrics in Review 16(5). 1995

Evaluation of Mental Retardation: Recommendations of a Consensus Conference American Journal of Medical Genetics 72:468-477. 1997

Caring for the Developmentally Disabled Child. Pediatrics in Review 17(6). 1996

Objectives

Terminal Objectives

Normal Development Objective 5

Abnormal Development Objective 1, 2 and 3

Clinical Assessment and Communication Objective 2, 3 and 4

Management Objective 1

Enabling Objectives

Abnormal Development Objectives 1a-h

Learning Activities

Clinical descriptions and/or videotape examples of children with developmental delay will be presented. The emphasis will be placed upon description of the pattern of developmental delay and the relevant differential diagnosis for each pattern. Discussion regarding etiology, prevention, recurrence risk, appropriate investigation, prognosis and management plan will be included for key clinical problems including global developmental delay, isolated delay in single domain of development, and combined delays in language and social development.

Group Session 7
School Failure

Purpose

This session will review common causes of school failure with an emphasis on the differential diagnosis and the assessment tools relevant to the pediatric assessment of a child with school failure.

References

Handouts

Attention Deficit/Hyperactivity Disorders. Pediatrics in Review 19(11), 1998

Diagnosis and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. JAMA 279(14): 1100-1107,1998

Objectives

Terminal Objectives

Normal Development Objective 5

Abnormal Development Objectives 1, 2 and 3

Clinical Assessment Objectives 1, 3 and 4

Enabling Objectives

Abnormal Development Objectives 3a-c

Learning Activities

Clinical descriptions of children with school problems will be presented. The emphasis will be placed upon the differential diagnosis for each case. Assessment tools will be introduced including ANSER questionnaires and Conner's questionnaires for parents and teachers. Should time permit, description of other cognitive assessment tools may be included. The indications for medical investigation and/or multidisciplinary assessments will be discussed.

Group Session 8
Behavioral Problems

Purpose

This session will review common behavioral problems in childhood.

References

Handouts (DSM IV Criteria)

Objectives

Terminal Objectives

Clinical Assessment and Communication Objectives 2, 3 and 4

Management Objective 1

Specific Enabling Objectives

Abnormal Development 4a-d

Learning Activities

Clinical descriptions of children with behavioral problems will be presented. The emphasis will be placed upon the differential diagnosis for each case. The indications for medical or psychiatric investigation and/or multidisciplinary assessments will be discussed. The residents will be asked to create a plan of management for these problems. The risk factors, comorbidities, and prognosis of the behavioral problems will be discussed.

Group Session 9
Tic Disorders

Purpose

This session will review the tic disorders in the pediatric population including their etiology, presentation, differential diagnosis, comorbidities, prognosis and treatment.

Reference

Movement Disorders. Pediatrics in Review 17(11), 1996

Objectives

Terminal Objectives

Normal Development Objective 5

Abnormal Development Objectives 1, 2 and 3

Clinical Assessment and Communication Objectives 2, 3 and 4

Management Objective 1

Learning Activities

Examples of clinical cases of patients with tic disorders will be presented by videotape. Residents will be asked to describe the movement disorders and to discuss the differential diagnosis. Discussion regarding the etiology, genetics, prognosis and treatment will be discussed. Specific emphasis will be placed upon the presentation of Tourette's syndrome and comorbid ADHD symptomatology and upon the relationship of psychostimulant medication to tic disorders.

Group Session 10
Child Abuse

Purpose

This session will review common presentations of child abuse including physical abuse, sexual abuse, emotional abuse and neglect. The emphasis will be placed upon recognition of child abuse and the appropriate management of suspected cases.

References

AMA Document on Child Abuse

Handouts

Objectives

Terminal Objectives

Management Objective 1

Enabling Objectives

Abnormal Development Objective 5b

Clinical Assessment and Communication Objective 17 and 18

Learning Activities

Case descriptions and photographs of suspected child abuse cases will be presented. The role of the pediatrician in both emergency and chronic cases will be discussed including medical investigation and treatment. Appropriate reporting of suspected cases and correct documentation technique will be emphasized. Resources available to the pediatrician will be described.

Group Sessions 11 and 12
Management

Purpose

These two sessions will review management of common problems in Developmental Pediatrics. The first session will concentrate on pharmacology and the second will concentrate on community resources.

References

Handouts

Objectives

Terminal Objectives

Management Objective 1

Learning Activities

Using case presentations as a basis for discussion, common pharmacological agents used in the treatment of developmental and behavioral disorders will be discussed. Emphasis will be placed upon indications, contraindications, dosage, and adverse effects of the medications. Appropriate monitoring of the child taking these medications will be reviewed. Medications to be discussed in detail are the psychostimulants, the antidepressants and clonidine. Carbamazepine, antipsychotic medications and new agents (e.g. Wellbutrin) will be discussed briefly.

Community and hospital based resources available for children with developmental and behavioral disorders will be discussed. Indications for multidisciplinary involvement, placement in special programs, etc. will be reviewed. Discussion will include funding issues and public versus private resources.

Appendix 5. Formative Evaluation Forms

Patient with Developmental Delay – Clinical Checklist (Original)

Resident Name _____ **Preceptor Name** _____ **Date** _____

Demonstrated by Resident	Clinical Activity
	History Taking – Did the resident inquire appropriately about
yes ☐ no ☐ not applicable ☐	Presenting Concerns (Parents, Teachers, Physicians, etc.)
yes ☐ no ☐ not applicable ☐	Pregnancy, Delivery and Neonatal History
yes ☐ no ☐ not applicable ☐	Family / Social History
yes ☐ no ☐ not applicable ☐	Sensory Function (Hearing / Vision)
yes ☐ no ☐ not applicable ☐	Developmental Milestones / Current Functioning / School Readiness
yes ☐ no ☐ not applicable ☐	Previous Investigations and Therapeutic Interventions
yes ☐ no ☐ not applicable ☐	Behavioral Concerns
yes ☐ no ☐ not applicable ☐	History of Trauma or Abuse
yes ☐ no ☐ not applicable ☐	Past Medical History
yes ☐ no ☐ not applicable ☐	Parental Understanding of Diagnosis and Etiology
	Physical Examination – Did the resident appropriately demonstrate ...
yes ☐ no ☐ not applicable ☐	Measurement of Vital Signs
yes ☐ no ☐ not applicable ☐	Measurement and Plotting of Growth Parameters
yes ☐ no ☐ not applicable ☐	Recognition and Description of Dysmorphic Features
yes ☐ no ☐ not applicable ☐	General Physical Examination
yes ☐ no ☐ not applicable ☐	Appropriate Assessment of Gross Motor Skills
yes ☐ no ☐ not applicable ☐	Appropriate Assessment of Fine Motor Skills
yes ☐ no ☐ not applicable ☐	Appropriate Assessment of Speech and Language Skills
yes ☐ no ☐ not applicable ☐	Appropriate Assessment of Social Skills
yes ☐ no ☐ not applicable ☐	Appropriate Assessment of Cognitive Skills
	Investigations – Did the resident appropriately request ...
yes ☐ no ☐ not applicable ☐	Interpretation of formal cognitive assessment tools (WISC-III or other)
yes ☐ no ☐ not applicable ☐	Appropriate recommendation for multidisciplinary assessments
yes ☐ no ☐ not applicable ☐	Appropriate indications for laboratory investigations
yes ☐ no ☐ not applicable ☐	Appropriate indications for diagnostic imaging investigations
yes ☐ no ☐ not applicable ☐	Appropriate indications for vision and/or hearing assessment
	Differential Diagnosis and Management - Did the resident demonstrate ...
yes ☐ no ☐ not applicable ☐	The formulation of a differential diagnosis for developmental delay
yes ☐ no ☐ not applicable ☐	Modification of the differential diagnosis based upon this specific case
yes ☐ no ☐ not applicable ☐	Formulation of an appropriate management plan for this child
	Communication – Did the resident demonstrate ...
yes ☐ no ☐ not applicable ☐	Sensitivity and empathy toward the patient and his/her family
yes ☐ no ☐ not applicable ☐	The ability to communicate effectively with the patient and family
yes ☐ no ☐ not applicable ☐	Cooperation with other professionals in a multidisciplinary setting
yes ☐ no ☐ not applicable ☐	A supportive attitude towards the patient and family
yes ☐ no ☐ not applicable ☐	Willingness to address the family's concerns and agenda

Patient with Developmental Delay – Clinical Checklist (Revised)

Resident Name _____ **Preceptor Name** _____ **Date** _____

Please use the following scale to rate the resident's performance on each of the following items.

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Demonstrated by Resident	Clinical Activity
	History Taking – Did the resident inquire appropriately about ...
1 2 3 4 5	Presenting Concerns (Parents, Teachers, Physicians, etc.)
1 2 3 4 5	Pregnancy, Delivery and Neonatal History
1 2 3 4 5	Family / Social History
1 2 3 4 5	Sensory Function (Hearing / Vision)
1 2 3 4 5	Developmental Milestones / Current Functioning / School Readiness
1 2 3 4 5	Previous Investigations and Therapeutic Interventions
1 2 3 4 5	Behavioral Concerns
1 2 3 4 5	History of Trauma or Abuse
1 2 3 4 5	Past Medical History
1 2 3 4 5	Parental Understanding of Diagnosis and Etiology
	Physical Examination – Did the resident appropriately demonstrate ...
1 2 3 4 5	Measurement of Vital Signs
1 2 3 4 5	Measurement and Plotting of Growth Parameters
1 2 3 4 5	Recognition and Description of Dysmorphic Features
1 2 3 4 5	General Physical Examination
1 2 3 4 5	Appropriate Assessment of Gross Motor Skills
1 2 3 4 5	Appropriate Assessment of Fine Motor Skills
1 2 3 4 5	Appropriate Assessment of Speech and Language Skills
1 2 3 4 5	Appropriate Assessment of Social Skills
1 2 3 4 5	Appropriate Assessment of Cognitive Skills
	Interpretation of Developmental Assessment – Did the resident demonstrate ...
1 2 3 4 5	Identification of areas of Developmental Delay
1 2 3 4 5	Estimation of age equivalence for Gross Motor Skills
1 2 3 4 5	Estimation of age equivalence for Fine Motor Skills
1 2 3 4 5	Estimation of age equivalence for Speech and Language Skills
1 2 3 4 5	Identification of abnormal patterns of development
	Investigations – Did the resident appropriately request ...
1 2 3 4 5	Interpretation of formal cognitive assessment tools (WISC-III or other)
1 2 3 4 5	Appropriate recommendation for multidisciplinary assessments
1 2 3 4 5	Appropriate indications for laboratory investigations
1 2 3 4 5	Appropriate indications for diagnostic imaging investigations
1 2 3 4 5	Appropriate indications for vision and/or hearing assessment

	Differential Diagnosis and Management - Did the resident demonstrate ...
1 2 3 4 5	The formulation of a differential diagnosis for developmental delay
1 2 3 4 5	Modification of the differential diagnosis based upon this specific case
1 2 3 4 5	Formulation of an appropriate management plan for this child

	Communication – Did the resident demonstrate ...
1 2 3 4 5	Sensitivity and empathy toward the patient and his/her family
1 2 3 4 5	Effective communication with the patient and family
1 2 3 4 5	Cooperation with other professionals in a multidisciplinary setting
1 2 3 4 5	A supportive attitude towards the patient and family
1 2 3 4 5	Willingness to address the family's concerns and agenda
1 2 3 4 5	Appropriate discussion of diagnosis with family
1 2 3 4 5	Appropriate discussion of investigation results with family
1 2 3 4 5	Appropriate discussion of management plan with family

Please use the remainder of this page for comments.

Appendix 6. Examples of Question Types

Multiple Choice Question

A three year old child has recently been diagnosed with autism. Appropriate management strategies include (choose one or more):

a. institutional placement for chronic care

b. multidisciplinary treatment program

c. facilitated communication program

d. institution of Risperdal to manage behavioral symptoms

e. respite care for the family

Learning objective: The pediatric resident will create a management plan for an infant or child with a disorder of development or behavior.

Cognitive task: Problem Solving (Cognition and Attitudes)

Extended Matching Question

An infant who has a fine pincer grasp, will pull to stand, and uses "dada" or "mama" non-specifically is closest to a developmental age of:

A. Newborn
B. 2 months
C. 4 months
D. 6 months
E. 8 months
F. 10 months
G. 12 months (1 year)
H. 15 months
I. 18 months
J. 24 months (2 years)
L. 36 months (3 years)
M. 4 years
N. 5 years
O. 6 years
P. 8 years
Q. 10 years
R. 12 years
S. 14 years
T. 16 years

Learning objective: Given a description or demonstration of an infant's abilities in the domains of language, motor and social development, the pediatric resident will estimate the developmental age of the infant within 2 months.

Cognitive task: Application of Knowledge (Cognition)

Short Answer Question

A 5 year old child is referred for assessment of possible learning disorder at the suggestion of his ECS teacher. He is able to count to 10 but can not recite the alphabet. Review of his developmental history reveals that he learned to walk at 19 months of age and did not speak in two word sentences until 3 years of age. He is clumsy compared to other children his age. Examination reveals that his head circumference is at the 95%ile while his height and weight are at the 25%ile. He has several café-au-lait spots and freckling in the inguinal area, but his physical examination is otherwise unremarkable. What is the most likely diagnosis for this child?

Learning objective: Given a description or demonstration of an infant or child with abnormal development, the pediatric resident will diagnose common developmental disorders.

Cognitive task: Problem Solving (Cognition)

Appendix 7. Written Examination

Name _____ **R Level** _____ **Date** _____

For questions 1 to 4, choose the BEST answer from the following list.

A. Newborn
B. 2 months
C. 4 months
D. 6 months
E. 8 months
F. 10 months
G. 12 months (1 year)
H. 15 months
I. 18 months
J. 24 months (2 years)
L. 36 months (3 years)
M. 4 years
N. 5 years
O. 6 years
P. 8 years
Q. 10 years
R. 12 years
S. 14 years
T. 16 years

1. An infant who reaches for objects, sits with support, has no head lag but has not yet rolled over is closest to a developmental age of

_____

2. An infant who has a fine pincer grasp, will pull to stand, and uses "dada" or "mama" non-specifically is closest to a developmental age of

_____

3. A child who is able to ride a tricycle, copy a circle, count to three, discriminate colors, and remove her clothing is closest to a developmental age of

_____

4. A child who is able to perform tandem walking, prints neatly, repeats 5 digits correctly, but can not yet draw a cube is closest to a developmental age of

_____

Questions 5 and 6 summarize case histories of children with developmental delay. From the choices below each question, please indicate which factor(s) on history is (are) risk factor(s) for developmental delay. Choose ONE OR MORE responses for each item.

5. The history obtained for a 3 year old child referred for assessment of developmental delay revealed the following information. The child was born at 36 weeks gestation following a pregnancy complicated by maternal hypertension. The child's mother smoked during pregnancy but did not use alcohol. The mother was given antibiotics in labor for Group B Streptococcus colonization. Delivery was forceps-assisted and the infant required positive pressure ventilation for approximately 30 seconds at birth. Apgar scores were $2^{1}4^{5}6^{10}$. The cord pH was 7.05. The infant was observed for 24 hours in the NICU and then discharged. At age 9 months, the child presented to emergency with a febrile seizure lasting <10 minutes at the time of an acute otitis media infection. The child has had a history of recurrent otitis media and is now awaiting tympanostomy tube placement. Which of the factor(s) on history is(are) risk factor(s) for developmental delay in this child?

a. preterm delivery at 36 weeks
b. Group B Streptococcus colonization of the mother
c. fetal distress at time of delivery
d. febrile seizure
e. recurrent otitis media

6. The history of a 7 year old child referred for assessment of school failure revealed the following information. The child had a history of recurrent otitis media in the first year of life requiring tympanostomy tube placement. Hearing test done at age 2 was normal. The child was placed in foster care at age 2 following investigation of a closed head injury and femur fracture. The child at age 2 had no words, did not walk, but could "cruise" around furniture. A rapid improvement in the child's development was observed between age 2 and 3 and at school entry, he was able to say the alphabet and write his name. He continues to be "clumsy". The biologic father is known to have had difficulty in school and obtained a grade 10 education. The biologic mother has been treated for depression and alcohol abuse in the past but denies alcohol or drug use during pregnancy. Which of the factor(s) on history is(are) risk factor(s) for learning disorders in this child?

a. recurrent otitis media
b. suspected child abuse and neglect
c. developmental delay in first 2 years of life
d. father's history of difficulty in school
e. mother's history of depression

For questions 7 to 19, please indicate the most likely diagnosis. Please respond with a single word or phrase. Multiple responses will not be scored.

7. A three year old girl is referred for evaluation of her speech delay. She spoke her first word at age 11 months but is now only using 5 words. She screams and grunts frequently. Her parents do not believe she understands much language. She does not spontaneously point out interesting objects nor does she come to parents to be comforted when she is upset. By parental history, she seems to have normal motor milestones, but in the office you can not engage her in gross motor or fine motor tasks as she is preoccupied with a small toy that she passes from hand to hand. What is the most likely diagnosis for this child?

_____

8. A seven year old boy is referred for evaluation of his behavior. He walked at age 13 months, spoke his first word at 14 months, and was using phrases by age 3 years. This boy is having difficulty with peer relationships at school and has no friends. He has minimal interest in the activities of his family members. He is preoccupied with insects and will talk incessantly about insects to anyone present. When excited or upset, he exhibits hand flapping behavior. What is the most likely diagnosis for this child?

_____

9. An eight year old boy in grade 3 is referred to you at the request of his teacher. He is doing poorly in reading and math and is performing at a mid grade 2 level in both areas. He has been noted over the last 2 years to have difficulty sustaining attention in the classroom setting and does not follow through with instructions. He is frequently active in the classroom and must be reminded to sit still. His parents report that he has been active from infancy. He often forgets instructions and safety rules. IQ testing done through the school demonstrates average scores in both verbal and performance areas. What is the most likely diagnosis for this child?

_____

10. An eight year old boy in grade 3 is referred to you at the request of his teacher. He is doing poorly in reading and is performing at a mid grade 1 level. He seems to have less difficulty in other areas including math. His teacher reports that he is inattentive in class and is easily frustrated. No behavior problems have been evident at home, but he has been involved in some fights on the playground. Review of his past medical history reveals that he has a history of asthma controlled with inhaled steroids and has had a tonsillectomy. His developmental milestones have been appropriate but he did require speech therapy during the preschool period. What is the most likely diagnosis for this child?

_____

11. A three year old girl is referred for speech delay. In infancy, she was reported to "coo" and "babble" appropriately. At present, however, she has no understandable words. She does scream and cry when upset. Her parents do not believe that she understands much language. She does not respond to her name and does not imitate speech sounds. She communicates her wants and needs with gestures and pointing. She has normal motor milestones and is toilet trained. Her past medical history is unremarkable. What is the most likely diagnosis for this child?

---

12. A nine year old boy is referred for assessment of his behavior at the recommendation of his teacher. He is disruptive in the classroom and frequently requires discipline. He follows directions poorly and is often argumentative. He frequently appears angry and often blames other children for his mistakes. He was not cooperative with the psychological testing attempted and simply refused to respond to the questions. His mother states that he does not follow directions well at home and frequently uses obscene language. What is the most likely diagnosis for this child?

---

13. A two year old child is referred to you for general pediatric care. He was born at 28 weeks gestation at 700g and is known to have had a grade II intraventricular hemorrhage and sepsis in the neonatal period. He is now physically healthy but has had some difficulty with weight gain. At present, he is using approximately 25 words, will scribble with a crayon, and will walk holding on to furniture. His examination reveals growth parameters at the 5^{th} percentiles. He has increased tone in his legs bilaterally and a left hand preference. He can identify several body parts and pictures. What is the most likely diagnosis for this child?

---

14. A six year old boy is brought for assessment of his development. He has always been "slow" to obtain developmental milestones in all areas. He can count to 3 but does not know the alphabet. His mother is concerned that he is not yet ready for school. His mother smoked during pregnancy but denies alcohol or drug use. His past medical history is unremarkable and his physical examination is normal. He has no dysmorphic features other than prominent ears. He has two maternal uncles with mental handicaps and a paternal cousin with attention deficit hyperactivity disorder. What is the most likely diagnosis for this child?

---

15. A ten year old boy has been referred for assessment of his behavior. He has been suspended from school for fighting for the second time in 6 months. His mother reports that he has run away from home on two occasions in the past year and has attempted to set the family home on fire. His classroom teacher reports that he is often inattentive in class, but describes him as a bright child when he is interested in the subject at hand. His past medical history is remarkable for recurrent otitis media as a young child requiring tympanostomy tube placement. His mother denies any recent family changes and can not recall a specific time of onset of his difficult behavior. What is the most likely diagnosis for this child?

---

16. A 13 year old boy is referred for difficulty in school. He has always had a short attention span and been quite active. A diagnosis of Attention Deficit Hyperactivity Disorder was suggested in the past. Over the past year he has developed facial grimacing that increases when he is anxious. He frequently blinks his eyes and clears his throat. What is the most likely diagnosis for this child?

---

17. A 7 year old child is referred for behavioral difficulties at the request of his teacher. Over the past six months, the child has had frequent temper tantrums in class. The teacher has observed him exposing his genitals to other children in the playground. His parents have no concerns regarding his behavior at home, but report new onset of nocturnal enuresis and constipation. What is the most likely diagnosis for this child?

---

18. A 9 year old boy has been recently placed on a methylphenidate trial for treatment of Attention Deficit Hyperactivity Disorder. He has had a good response to the methylphenidate with improvement in his attention and behavior. He has no significant appetite suppression but has been noted to have twitching of his face over the past two weeks. What is the most likely diagnosis for this child?

---

19. A 5 year old child is referred for assessment of possible learning disorder at the suggestion of his ECS teacher. He is able to count to 10 but can not recite the alphabet. Review of his developmental history reveals that he learned to walk at 19 months of age and did not speak in two word sentences until 3 years of age. He is clumsy compared to other children his age. Examination reveals that his head circumference is at the 95th%ile while his height and weight are at the 25th %ile. He has several café-au-lait spots and freckling in the inguinal area, but his physical examination is otherwise unremarkable. What is the most likely diagnosis for this child?

For questions 20 to 30, choose ONE OR MORE OPTIONS for each item.

20. A seven year old child with attention deficit hyperactivity disorder has been noted to develop facial tics during a trial of methylphenidate treatment. Appropriate management of this problem includes which of the following options?

a. discontinuation of the methylphenidate
b. change to a different psychostimulant medication
c. continue the methylphenidate and add clonidine
d. change to an antipsychotic medication to treat Tourette's syndrome
e. request a cranial MRI scan

21. A 5 year old child is suspected to have fetal alcohol syndrome based on maternal history, dysmorphic features and poor growth. The child has been adopted and has not yet started school. Which of the following is (are) potential management options for this child.

a. treatment with methylphenidate for attention deficit disorder
b. ophthalmologic evaluation annually
c. plastic surgery to repair dysmorphic features
d. placement in a special education classroom
e. nocturnal tube feedings to increase weight gain

22. A newborn infant has been diagnosed with Down's syndrome. The parents have done research on the Internet about this condition. They come to you with several questions. Which of the following statement(s) is(are) true about children with Down's syndrome?

a. they should not participate in physical activities because of the risk of cervical dislocation
b. cosmetic surgery is recommended to reduce tongue size
c. they have an increased risk of developing leukemia compared to the general population
d. they are expected to have adult short stature
e. they commonly have hearing and/or vision impairments

23. A child with attention deficit hyperactivity disorder is treated with dextroamphetamine and clonidine. He has difficulty falling asleep and has a poor appetite. He complains of dizziness when standing up quickly from a supine position. He has an irritable mood and cries easily when frustrate. Which of his symptoms is(are) likely side effects(s) of dextroamphetamine?

a. difficulty falling asleep
b. poor appetite
c. dizziness on rising from supine position
d. irritable mood
e. tearfulness

24. Which of the following is(are) statements regarding appropriate monitoring of patients taking psychostimulant medications methylphenidate or dextroamphetamine?

a. electrocardiogram should be performed to monitor QT interval during initiation of the medication
b. liver function testing to monitor for evidence of liver toxicity should be done every 3 months
c. monitoring of blood pressure and growth should be done every 3-6 months
d. serum levels should be checked prior to dose increase to avoid toxicity
e. CBC should be done monthly to monitor for evidence of bone marrow suppression

25. A 3 year old child has recently been diagnosed with autism. Appropriate management strategies include:

a. institutional placement for chronic care
b. multidisciplinary treatment program
c. facilitated communication program
d. institution of Risperdal to manage behavioral symptoms
e. respite care for the family

26. At the 9 month medical checkup, what is(are) important factor(s) to address for prevention of injury and disability?

a. prevention of falls
b. type of shoes to choose for child learning to walk
c. day care placement versus at home child care
d. use of Syrup of Ipecac
e. car restraint use

27. At the 3 year medical checkup, which of the following is(are) important issue(s) to address regarding anticipatory guidance?

a. car safety
b. water safety
c. tricycle safety
d. Syrup of Ipecac
e. choking on small objects

28. A child is able to sit unsupported but does not yet pull to stand. Anticipatory guidance for this child would be important in which of the following area(s)?

a. avoidance of dangling cords
b. use of infant walkers
c. choking prevention
d. stair gates
e. use of car seats

29. A child is able to cruise on furniture but does not yet walk independently. Anticipatory guidance for this child would be important in which of the following area(s)?

a. use of infant walkers
b. stair gates
c. location of poisons in the home
d. use of car seats
e. bathtub safety

30. A child can walk without assistance and has a 5 word vocabulary. Anticipatory guidance for this child would be important in which of the following area(s)?

a. use of car seats
b. bathtub safety
c. avoidance of strangers
d. management of accidental poisoning
e. bicycle safety

Please use the back of this page for any comments regarding this examination.

Appendix 8. Resident Log and Daily Preceptor Evaluation Form

Part 1: To be completed by resident

Name _____ R Level _____

Please list clinical activities completed today including the ages and diagnoses of patients seen.

Did you ☐ actively participate in the assessment of the above patient(s)?
☐ observe only?

Part 2: To be completed by preceptor

Preceptor _____ Clinic _____

Please indicate your rating of the resident based upon your observation of him/her today.

History Taking

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Comments: _____
_____

General Physical Examination

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Comments: _____
_____

Neurodevelopmental Assessment

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Comments: _____
_____

...2

Communication Skills

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Comments: _____

_____

Attitude

1	2	3	4	5
Unacceptable for Level of Training	Below Average for Level of Training	Average for Level of Training	Above Average for Level of Training	Exceptional for Level of Training

Comments: _____

_____

During your observation of the resident today, was he/she able to demonstrate appropriate choice of assessment techniques given the child's age and presentation in the following areas?

History Taking	yes ☐	no ☐	N/A ☐
Physical Examination	yes ☐	no ☐	N/A ☐
Assessment Tools	yes ☐	no ☐	N/A ☐

During your observation of the resident today, did he/she demonstrate sensitivity and empathy in the assessment and management of patients? yes ☐ no ☐

Overall, please rate your assessment of the resident based on your interaction today.

☐ Above average for R level (satisfactory)
☐ Average for R level (satisfactory)
☐ Below average for R level (unsatisfactory)
☐ Unable to assess

Please comment on the resident's areas of strength.

_____

_____

_____

Please comment on the resident's areas of weakness.

_____

_____

_____

Signature of Preceptor _____ Date _____

Was this evaluation reviewed with the resident? ☐ yes
☐ no

Appendix 9. Checklists for Group Sessions

Observer Checklist

Session Title: _____
Date: _____
Preceptor: _____
Number of Residents: _____

Topic Introduction

Part of series in Developmental Pediatrics	yes ☐ no ☐
Identified Objectives	yes ☐ no ☐
Suggested References	yes ☐ no ☐
Described Planned Format	yes ☐ no ☐

Comments

_____
_____

Content

Review of previous session(s)	yes ☐ no ☐ N/A ☐
Scope as outlined by objectives	yes ☐ no ☐
Too broad ☐	
Too narrow ☐	
Summarize/Review at end	yes ☐ no ☐ N/A ☐

Comments

_____
_____

Presentation Style

Organized	yes ☐ no ☐ N/A ☐
A/V Aides	yes ☐ no ☐ N/A ☐
Handout	yes ☐ no ☐ N/A ☐
Resident participation	yes ☐ no ☐ N/A ☐

Comments

_____
_____

Time

Time allotted	too much ☐ appropriate ☐ too little ☐
Pacing of presentation	too fast ☐ appropriate ☐ too slow ☐

Group Session Participant Evaluation Forms

Session Title _____

Preceptor _____

Part A: General Questions

1. Were the objectives for this session clear? yes / no

2. Did you use the suggested references for this session? yes / no

3. Please use the following scale to respond to the items below.

1	2	3	4	5
Unacceptable	Fair	Average	Good	Excellent

   a. My overall rating of today's session is: _____

   b. The preceptor's preparation for today's session was: _____

   c. The format of today's session was: _____

   d. The relevance of today's topic to me as a resident was: _____

4. Please describe the best part of today's presentation.

_____

5. Please describe two specific ways to improve today's presentation.

_____

_____

Part B: Specific Questions (based on content of individual session)

Appendix 10. Questions for Preceptor Evaluation of Block Rotation in Developmental Pediatrics

Preceptor Name: _____

Date: _____

Content / Structure

1. Did the preceptor use the learning objectives? yes ☐ no ☐
   If yes, how _____

2. What percentage of the time spent with this preceptor were you actively participating in clinical activities?

   0-20 ☐ 20-40 ☐ 40-60 ☐ 60-80 ☐ 80-100 ☐

3. What percentage of the time spent with this preceptor were you observing his/her clinical activities?

   0-20 ☐ 20-40 ☐ 40-60 ☐ 60-80 ☐ 80-100 ☐

4. What percentage of the time spent with this preceptor was involved with evaluation or feedback of your knowledge or skills?

   0-20 ☐ 20-40 ☐ 40-60 ☐ 60-80 ☐ 80-100 ☐

5. Did you spend any time with this preceptor in teaching activities (not-patient based) such as case discussions, discussion of literature, etc. yes ☐ no ☐
   If yes, describe _____

6. Did you encounter any scheduling difficulties such as clinic cancellations, other students/residents also present, etc. yes ☐ no ☐
   If yes, describe _____

Attitude/Enthusiasm

6. Did you feel that the preceptor welcomed your participation in the clinical activities?
   Explain _____

7. Did the preceptor appear prepared for you to join him/her in the clinical activities?
   Explain _____

8. Did the preceptor demonstrate enthusiasm for the clinical problems?
   Explain _____

Feedback

9. Did the preceptor provide you with feedback on a daily basis? yes ☐ no ☐

10. Was the feedback provided to you appropriately? yes ☐ no ☐
    Explain _____

11. Were you given an opportunity to give feedback to the preceptor? yes ☐ no ☐

Suggestions for Improvement

Please identify two ways that the preceptor could improve his/her teaching.

1. _____
_____

2. _____
_____

Appendix 11. Presenter Evaluation of Group Sessions

Session Title _____

Preceptor Name _____

Date _____

1. Were you given clear objectives regarding the content of today's session? yes / no

   If yes, was the scope of the objectives too narrow / just right / too broad?

   Did you use the objectives to prepare your session? yes / no

2. Did you feel adequately prepared for today's session? yes / no

   If no, explain _____

   _____

3. Is there any resources that you would have liked to use for today's session that were not available to you? (example: videotapes, written materials, etc) yes / no

   If no, specify _____

   _____

4. Was the time allotted to the session too short / just right / too long?

5. What do you think was the best part of today's presentation?

   _____

   _____

6. Please describe two specific ways to improve today's presentation.

_____

_____

_____

_____

7. Please use the following scale to respond to the items below.

1	2	3	4	5
Unacceptable	Fair	Average	Good	Excellent

a. My overall rating of today's session is: _____

b. The residents' participation in today's session was: _____

c. The residents' preparation for today's session was: _____

d. The relevance of today's topic to residents is: _____

8. What questions or topics would you suggest be discussed in upcoming sessions?

_____

_____

_____

_____

9. Please indicate any other comments or suggestions.

_____

_____

_____

_____

Appendix 12. Feedback from Preceptors Regarding Block Rotation in Developmental Pediatrics

Structure of Rotation

1. The rotation was changed to a "preceptor-based" rotation to facilitate two key goals Please use the following scale to rate how successful the change to a preceptor-based rotation has been in meeting the goals listed below.

5	4	3	2	1
extremely successful	somewhat successful	no effect	somewhat unsuccessful	extremely unsuccessful

(a) To increase active resident participation in clinical activities _____

(b) To increase feedback given to residents regarding their clinical performance _____

2. One of the ongoing difficulties with the rotation has been related to scheduling difficulties. Using the scale above, how successful has the switch to a preceptor-based rotation been in minimizing scheduling problems? _____

Communication

3. Do you feel that communication with you regarding the changes to the Developmental Pediatric Rotation has been adequate? _____

Comments/Suggestions regarding communication with preceptors:

_____

_____

_____

4. The residents' evaluation is based upon learning objectives for the rotation. Are you familiar with these objectives? _____
If yes, have you used them in your clinical activities with the residents? _____

Feedback

5. Have you utilized the residents' daily evaluation forms? _____
If yes, have they assisted you in providing residents with feedback on their clinical skills?

_____

Comments/Suggestions regarding resident feedback:

_____

_____

_____

6. Have you received feedback regarding your teaching of residents during the rotation in Developmental Pediatrics? _____

Do you feel the amount of feedback given to preceptors is adequate? _____

Comments/Suggestions regarding preceptor feedback:

_____

_____

_____

Faculty Development

7. Please indicate your interest in the following activities (to be considered in academic year 2000-2001).

Faculty Development Activity	**Definitely interested – would participate**	**Unsure**	**Not interested – would not participate**
Workshop re. Teaching Skills			
Workshop re. Giving Feedback			
Other (specify)			
Other (specify)			

Please provide any additional comments/suggestions regarding the Block Rotation in Developmental Pediatrics:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____