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## Editorial

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# Prevention of Dental Caries (Tooth Decay): Should we be Content with Our Progress?

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Some of us may remember the prevalence of dental caries from the 1950's, 1960's and during my dental career infancy, the 1970's. Caries free individuals, child or adult, may well have qualified as an endangered species. Early television advertising toothpastes portrayed children gleefully boasting only "having two cavities this check-up." The premise that one could conceivably experience a lifetime without decay might have at best been considered fantasy if not merely ludicrous. Neither dentists nor patients readily believed rumblings of a soon to be available vaccine to virtually eliminate caries would materialize. The true skeptics lamented that even if a vaccine was developed and found effective, much of the population probably wouldn't make use of one.

Many parents and children in 2015, not only carry the expectation of no decay, they demand it, and become outraged if not greatly disappointed when their current hygiene efforts fall short of their intended mark. For these fortunate Americans, oral health awareness has reached an all-time high.

The benefits of topical fluorides and varnishes through dental and medical office applications, school rinse programs, systemic fluorides through optimal water fluoridation and appropriate dietary supplementation, the essential nature of parental tooth brushing of infants and small children's teeth and sound oral hygiene practices, reasonable dietary habits to reduce refined carbohydrate exposure, and the effective use of anti-microbial rinses have all played key roles in reducing our nation's decay experience.

Enhanced public relation campaigns between organized dentistry and other health care providers, in collaboration with various local, state, and national societies and governmental agencies have generated effective oral health policies which emphasize early diagnosis and interception of dental disease. Joint efforts of the Center for Disease Control and Prevention (CDC), the National Institute of Health and its dental subsidiary, NIDR, the American Dental Association (ADA) Council on Community Health, the American Academies of Pediatric Dentistry (AAPD) and Pediatrics, and numerous others are aggressively supporting the development of legislation which proclaims that health per se without regard to oral health is incomplete and unacceptable.

Despite these immense successes, should we be content with our progress?

Regrettably, progress toward making optimal care available inclusive of the reduction and eventual elimination of dental decay for all our population is seriously short of universal. Many Americans encounter obstacles through no fault of their own. Access to care remains a nationwide problem for the poor. In the US and most other countries, dental decay is largely untreated in children under age Three.<sup>1</sup> The Center for Disease Control and Prevention (CDC) has reported that Early Childhood Caries continues to occur in all racial and socioeconomic groups; however, it appears far more prevalent in children of low-income families where it oc-

curs in epidemic proportions.<sup>2</sup>

Those children with caries experience have been shown to have high numbers of teeth affected. Consequences of high decay experience include a high risk of new cavities,<sup>3,4</sup> increased treatment costs and time,<sup>5</sup> risk for delayed physical growth and development,<sup>6-8</sup> loss of school days, diminished ability to learn,<sup>9</sup> diminished oral health related quality of life,<sup>10</sup> and hospitalizations and emergency room visits.<sup>11,12</sup>

Many simply cannot afford current costs for care; some do not qualify for either insurance benefits or entitlements because they earn too much to qualify for general assistance but still fall within what would be considered poverty levels. Many states funding for general assistance either becomes exhausted early in the fiscal year, or inadequate to sustain reimbursement for continued dentist and institutional participation. Closings of dental teaching institutions, which served as essential sources of low-cost yet quality care providers has further complicated the plight of dentally-disadvantaged families. Also disconcerting are scientifically unsupported restrictions imposed by third party and managed care programs which limit how often proven prevention measures are covered; for example, coverage limited to only annual fluoride applications; denial of coverage for dental sealants, demands for the lowest percentage of success cost treatment options (extraction vs. pulpal/restorative therapy procedures), and barriers to specialist services are among the most common problems.

Annual conservative estimates report, in the Chicago area alone, thousands of infants and children under three years of age unnecessarily experience Early Childhood Caries (aliases: Bottle Mouth Syndrome, Nursing mouth decay). Despite how much we know about how to stop this preventable phenomenon, it appears efforts to do so have been largely unsuccessful in getting the message out to those who clearly need it the most. For many of these pre-cooperative infants and children, safe management can only occur in a hospital and surgical center environment; some may receive treatment in office settings using sedation or general anesthesia. In either case, both risk and cost remain high for what is otherwise preventable from the outset. Additional complicating factors emerge when dental procedures are not deemed "medically necessary" by medical and dental insurance carriers. This problem is not limited to Illinois.

Why does this occur and what can collectively be done about it?

We need to work harder to get the message out. We need to blitz the public through the media. We need to promote prevention strategies as rigorously as manufacturers promote brighter and whiter smiles. We need to involve those within and outside the field of dentistry what can be done to promote optimal dental health. We need to build bridges with our pediatric medical colleagues. Because pediatricians, pediatric nurses and nurse practitioners and other physician extenders are far more likely to encounter future parents during pregnancy and infants before dentists, it is essential they be made aware of the infectious pathophysiology and associated risk factors of early childhood caries to make effective recommendations and decisions regarding timely and effective intervention. Because of the etiology of dental caries and its course, steps to prevent it should be initiated prenatally to educate pregnant women and be reinforced from the time of the eruption of the first tooth.

Because dental decay can be well advanced by three years of age, urgency exists to bring obstetricians, pediatricians, family practitioners and pediatric nurses to perform caries risk assessment on all children at or prior to one year of age. In the absence of time for such in the medical environment, referral to dental personnel is warranted. It is the responsibility of all health care professionals who have contact with infants and new parents to become involved in efforts to reduce and prevent early dental caries.

As a profession, we need to continue to move from a reactive to proactive role. While great strides have been made toward prevention, our involvement need leave no one behind. We can ill-afford to permit outside interest groups to determine the timing and quality of services to those in need. Opportunity to help children and adults to enjoy good oral and dental health from the outset is within grasp. Dental caries can be made an "endangered species."

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## Research

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# Discretionary Parental Presence in the Dental Operator: A Survey of Pediatric Dentists and Parents

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**ABSTRACT**

**Background:** The decision to include or exclude parent presence in the dental operator during a child's visit has long been a controversial issue in pediatric dentistry. The intent of this paper was to explore the contemporary views of pediatric dentists and parents with respect to the rationale for which including or excluding parents has impact on children's behavior and response to dental treatment.

**Methods:** A printed mailed randomized survey of 1000 nationwide pediatric dentists was distributed. A second survey of parents was requested from offices which both included and excluded parents from the operator to ascertain their opinions of how they anticipated their children would react and whether or not their inclusion in the dental operator would impact favorably or not on their child's acceptance of care.

**Results:** In contrast to previous decades increasing interest and willingness of pediatric dentists to permit parent presence was found significant for children 30 months of age or older. Regardless of whether parents were permitted to be present in various offices, interest to be present among parents was found to be significantly increased for examinations and treatment. Where parent presence was permissible significant differences ( $p < 0.001$ ) were found between parents from pediatric dental practices that routinely allowed parents to be present compared to both dentists and parents from practices in which parents were excluded.

**Conclusions:** For pre-school children, children lacking in cooperative potential, and those with a history of fearful or unpleasant previous experience, arbitrary exclusion of parents from the dental operator appears increasingly perceived as unproductive and unwarranted. Trends appear to emerge in the direction of increasing willingness of pediatric dentists to permit parent presence for examination and treatment visits.

**KEYWORDS:** Parent presence; Behavior guidance; Childhood dental anxiety.

**INTRODUCTION AND BACKGROUND**

Because dental treatment is openly viewed as unpleasant in our society, it is not surprising that for some, dental visits are seen as a threatening event. This can be particularly true for young, timid, and apprehensive children of any age.<sup>1</sup>

Few topics in pediatric dentistry generate more divergence of opinion than whether or not to include parents in the dental operator. For many, mandatory (or arbitrary) exclusion of a parent is considered essential to allow the dental team to establish a rapport with a child, regardless of his/her age. Others contend that arbitrary separation of a young child from his/her parent in the reception room unnecessarily can precipitate a behavior management problem before one either exists or would otherwise occur. While it seems likely that this may long remain a debate among pediatric specialists, interest nevertheless remains to attempt to sort out the basis for the diversity in behavior guidance philosophies. With few exceptions, there is a paucity of (controlled or otherwise) data that has attempted to elucidate the effect of parental presence on children's immediate as well as long-term responses to dental care.

Of the limited prospective data reported, indications have been in directions which support the beneficial nature of parent inclusion. However, there appears to be no disagreement among pediatric clinicians that instances exist in which some parents by virtue of personality, demeanor, attitude, and behavior, consider parent presence as counterproductive to the establishment of a favorable rapport, development of acceptance and coping behaviors of some children. Similarly, there are some children, by virtue of an ability to manipulate adult behavior, perform in the presence of their parents potentially nullifying any benefit of having a parent present.

This project has the global objective to examine the various points of view of clinicians and parents regarding the merit or detriment of parental inclusion in the dental operator. Survey instruments were developed to ascertain relevant variables which cause one to establish either a flexible or inflexible stance on this issue. Survey questions were intentionally not designed to be neutral in nature, but rather to "think out-of-the-box" to probe if not provoke discussion and offer illumination on why we do what we do. The paper examines limited existing data as to whether or not evidence-based support exists for differing practice approaches. This project stipulates that parent presence is not essential for children who possess or demonstrate more sophisticated coping skills and non-anxious behaviors.

This project further stipulates that there exists legitimate rationale by which some children do not respond favorably or reasonably in the presence of their parents; judgment of clinicians who elect to exclude parents in either a mandatory fashion, or selectively request parents to leave the operator based on patient behavioral cues that suggest child behavior and acceptance will be enhanced by their absence serves as a strong and appropriate justification for their protocols. It is not intent of this paper to show bias to policies which either include or exclude parental presence.

Unlike pediatric medical practice, where most invasive and uncomfortable procedures are performed under general anesthesia or sedation, the dentist confronts on a daily basis separation

anxiety of young children for whom uncomfortable procedures are often undertaken with little or no pharmacological assistance.<sup>2</sup> Often the decision to include or exclude a parent is not altogether simple, and as such, remains a controversial area within the pediatric dental community. Efforts to establish and define guidelines based on the objective of creating an environment most conducive to gaining a child's attention and compliance are subject to specific limitations. In the development of such guidelines, for all intents and purposes, societies such as the American Academy of Pediatric Dentistry, acknowledge wide variation among practitioner philosophy, training, and experience in addition to a wide range of ever-evolving parental child-rearing practices, preferences, and attitudes. Guthrie<sup>2</sup> accurately points out from a historical perspective organized dentistry has long favored parent exclusion. The expertise of the dental team to best manipulate and manage non-compliant child behaviors was once widely accepted by parents and society.<sup>3-7</sup> Belief among pediatric dentists as a whole in this line of thinking today, however, appears to be waning.<sup>2-4</sup>

Over time, instances have arisen in which the authority and methods employed by clinicians to shape non-compliant child behaviors have become the subject of scrutiny; some "old-time" and aversive communication and management strategies once considered reasonable and appropriate have been discredited and abandoned, or at the very least, discouraged.<sup>3,4</sup> Parental preferences and parent acceptance of the practitioner's need to establish authority and in some cases provide discipline for certain behaviors has lessened. Progress and energies in the direction of demonstrating evidence based support for the methods employed to manage challenging behaviors of children appear to gradually replace old ways. Parents today appear to show increasing interest and involvement to witness the clinician's management style and participate in the decision process as to which techniques are to be instituted.<sup>3</sup> Some parents require explanation at great length; some despite reasonable and adequate discussion remain skeptical, if not mistrusting. Still others, in particular where their presence is excluded, appear to have little or no difficulties in having the dentist determine the appropriateness of their presence. Regardless of whether a clinician chooses to include or deny parental access, his/her obligation to secure patient cooperation with informed consent remains intact.

While those claiming parental presence lessen child separation anxiety, resistance to parent presence is not limited to the dental profession. Many hospitals prohibit family or parent presence in emergency, operating, and recovery room settings. Reasons cited for separation include the relative invasive nature and painfulness of the procedures to be performed, space limitations, acute illness and life threatening situations.<sup>8,9</sup>

Alternatively, trends observed by these authors over the last decade find some pediatric hospitals and surgical centers moving towards giving parents the option of their presence during induction of anesthesia; some claim need for pre-operative medication can be reduced or eliminated and recovery and dis-

charge times are lessened.<sup>10</sup> Professionals who work with children on a daily basis understand and recognize separation anxiety in the context of each child's developmental framework. Vetter<sup>11</sup> in a study of children undergoing anesthesia found children 2-6 yrs of age were likely to exhibit more problematic behavior than older children when separated from their parents.

Separation anxiety is considered a normal component and necessary adaptation in development for 10-24 month children.<sup>2</sup> In the presence of anxiety, however, the interpretation of what constitutes age appropriate behaviors becomes ambiguous and no longer clear. Young children have limited cognitive skills, a restricted range of coping abilities, and limited experience coping with stress; they therefore can be expected to be especially prone to manifest maladaptive responses in anxiety provoking situations. Under these circumstances, there are no age limits at which one might consider separation anxiety from a parent to no longer be problematic.<sup>1</sup>

There has been considerable theoretical and empirical work directed toward the definition and assessment of anxiety. Early simplistic notions have gradually been replaced with the recognition that anxiety is a multidimensional phenomenon involving complex cognitive, emotional, and motivational processes. Major theorists concur that anxiety is a state of undirected arousal induced by the perception of threat.<sup>12-14</sup> This arousal state mobilizes the child's defenses. When anxiety is mild, it promotes a constructive vigilance which can facilitate the child's ability to accurately assess his/her situation and the limit of stress imposed by dental stimuli. When severe, (when cognitive appraisal of threat is exaggerated) it can serve to focus the individual's attention onto a few situational cues and propel the individual into premature and maladaptive action.

Few dental studies have attempted to examine prospectively the merit of parent presence with regard to facilitating the development of coping skills among young children. Frankl et al.<sup>15</sup> reported that separated children (41-49 mos) manifested more negative behavior during treatment than non-separated counterparts, while ages >4 displayed no statistical differences. Venham et al.<sup>16</sup> reported no statistical differences to child behavioral and self-report measures for 4 year old subjects. Given the choice, however, 86% of parents chose to be present during exams; 82% at the first in a sequence of four restorative visits, 66% at the second, 70% at the third, and 56% at the fourth treatment visit. Child behavior, regardless of parent presence was found to improve as experience accrued across sequential visits, lessening the need or perceived benefit of parent presence.<sup>16,17</sup>

Of the remaining reports, most are either anecdotal or subjective surveys. In a survey of the Association of Pedodontic Diplomates,<sup>18</sup> 4% always allowed parents to be present, 81% in select cases, and 15% never allowed parents to be present.

Levy and Domoto<sup>19</sup> surveyed Washington State pediatric dentists and reported 88% permitted parent presence, similar

to the findings of a follow-up Association of Pedodontic Diplomates and non-diplomates<sup>20</sup> who reported 84% and 80% respectively for select cases of 0-3 yr olds. 76 responders always permitted parents, 90 in select cases, and 125 refused to allow parent presence.

In a survey of 60 pediatric dentists in the state of Connecticut, Cipes and Miraglia<sup>21</sup> reported 71% allowed parents during examinations of 3-5 yr olds while 55% would allow the same during treatment visits.

Nathan<sup>22</sup> surveying 616 diplomates and non-diplomates found 60% allowed parents during examinations and 49% agreed somewhat to parent presence during restorative treatment.

Tilliss<sup>23</sup> described a general trend toward increased parental participation during visits, but speculated that the cause for such could not be explained by an increased awareness of developmental separation anxiety, societal pressure, or less use of aversive measures. Kamp<sup>24</sup> surveyed 79 parents; 66% wished to accompany their child. 85% of which said they would feel better and 92% of these felt their child would respond better. Certo et al.<sup>25,26</sup> reported that 75 of 100 parents wanted to be present during all visits, and 90% indicated they would be willing to leave the room if asked. The mean age at which parents felt their presence became unnecessary was 8.2 years.

Marcum et al.<sup>27</sup> reported in survey of 90 practicing Florida pediatric dentists that 90% would allow parent presence during initial examinations of children younger than 4 yrs. 40% would never allow parents for restorative procedures on this age group. Carr et al.<sup>27</sup> found that 84% of respondents in the south-east allowed parents.

From a historical perspective, beginning in the 1950's, predominant thinking among pediatric dentists clearly pointed in the direction of the exclusion of all parents at all times.<sup>5-7</sup> Such prominent and highly respected clinicians were regarded as the authorities to best manage the needs of children and that their training demanded they be the intermediary between parental supervision and the dental operator. Acceptance of the responsibility to navigate the waters between non-coping and coping behavior to best guide and teach children of all ages to accept the dental environment has been taken quite seriously by children's dentists.

Over the past several decades,<sup>3,4,28-31</sup> the climate of parental childrearing and blanket approval for how the dental professional chooses to manage a child has changed. The litigious nature of society has caused, and in some cases justifiably, for many to become skeptical of the health care provider's advice and management choices. Greater parental involvement and interest to take a more active part in the decision process has become the norm rather than the exception.

Many dental training institutions, including the ADA,

were early advocates of child separation decades ago. Subtle and not so-subtle campaigns were promoted to encourage children to enter the operatory alone. Prospective data to examine the appropriateness of such approaches was needed and despite substantial demonstration that this was fundamentally unsound for apprehensive and pre-cooperative children, teaching philosophies were not dramatically altered to encourage and foster parental presence. During this period it was acknowledged that the public in general had little difficulty with the premise that the professional they had selected for their child's care was best-suited to determine how to go about shaping their child's attitude and acceptance of care.

Extrapolating on the works of Frankl (1962)<sup>15</sup> and Venham (1978),<sup>16</sup> Moss (1978),<sup>32</sup> Rayman, (1987),<sup>33</sup> Weinstein and Nathan (1988),<sup>29</sup> discussion of the potential benefit (vs detriment) of parent presence on the facilitation of child acceptance of dental care began to emerge. It is noteworthy that not until 1996 the American Academy of Pediatric Dentistry formally recognized the usefulness of having a parent present as a specific management technique to gain patient's attention and compliance, avert negative or avoidance behaviors, and to enable the dentist to establish authority for treatment.<sup>31</sup>

Focusing on parental attitudes, Peretz and Zadik in 1998 reported over 70% of parents expressed interest to be present,<sup>34</sup> similarly, Fox in 2006 reported over 80% of parents wanting to accompany their children.<sup>35</sup> Looking at both dentist and parent preferences, Crossley and Joshi in 2002 reported similar findings.<sup>36</sup> Casamassimo et al.<sup>37</sup> in 2002 focused on attitudes of pediatric dentistry diplomates toward behavior management techniques while Eaton et al.<sup>38</sup> in 2005, discussed how parents viewed various behavior management techniques reporting concerns over aggressive physical management strategies and preferences for advanced pharmacological techniques.

Adair et al.<sup>3</sup> reported increasing numbers of practitioners allowing parent presence for emergency, restorative, surgical and sedation procedures. For parents of special needs children, this trend toward parent presence was even higher. Also identified by this survey was the need to re-examine the relative appropriateness of previously accepted behavior management techniques. Use of hand-over-mouth (HOM) was subsequently challenged in 2005, and removed from approval status in 2006.<sup>4</sup>

Kotsanos et al.<sup>39,40</sup> in 2005 and 2009 examined prospectively the relative effectiveness of the deliberate use of parent presence/absence as an intervention technique to manage uncooperative children,<sup>39-41</sup> a technique described and advocated by others.<sup>15,16,29,31,33</sup>

Shroff et al.<sup>42</sup> comparing parent responses at a university dental clinic and two private practices, reported that 78% of parents had a preference to be present in the dental operatory regardless of the particular dental treatment procedure being performed. More than one third (38%) did not want the dentist

to unilaterally determine parental involvement in a child's dental appointment. Lastly, they reported that parental desire to be present ranged from 70-78%, and that that frequency had been consistent over the previous twenty years. The study however, did not explore dentist or parent perception of the impact of their presence on child behavioral responses to treatment.

**MATERIALS AND METHODS**

Two surveys were developed for distribution. This project received institutional review board approval from Northwestern University Medical Center, Chicago. One thousand surveys were mailed to pediatric dentists, both diplomats and non-diplomates on a nationwide basis. 665 participants responded, representing 32 states.

A second survey of parent attitudes was distributed through the private practice settings of the authors as well as several offices in which parents were not welcome in the operatory. It was known that each of the authors' settings readily permit and encourage parents to be present during examinations and treatment. Parents were unaware, however, of such bias when asked to respond to the survey. It was also not known if parent presence or the opportunity to be present was a factor in their selecting the particular dental office for care for their child.

Three hundred thirty five parent surveys were returned from offices which excluded their presence and 150 surveys from parents from offices in which their presence was welcomed.

**RESULTS**

**Response Rate**

1000 were sent to pediatric dentists across the United States and 500 surveys were given to parents from both practices in which parents were permitted as well as excluded from the operatory. 665 surveys were returned from dentists (66.5% response rate). Thirty two states were represented in this survey, separated into three regions with data analysis presented in Table 1.

Region 1	Region 2	Region 3
NY, CT, PA, MA, NJ, DC, MD, KY, NC, FL, TN, SC, MS, VA, GA, AL	MO, MI, IN, IA, IL, OH, MN, LA, OK, AR, TX	CA, CO, WA, AZ, OR

Region 1 = Eastern                      Region 2 = Middle                      Region 3 = West  
**Table 1:** Regional distribution of states surveyed.

Three hundred and thirty five surveys were returned from parents that attended offices that did not allow them back and 150 surveys were returned from parents in which their presence was permitted.

**Parental Presence and the Age of the Child**

The majority of dentists surveyed stated that they would

allow parents back for children < 18 months (85%), and 18-25 months (79%) and 24-30 months (63%). For children between 30-60 months, no significant differences were found in regard to preference for having the parent in the operatory. 53% of the dentists did feel that parents were helpful in the operatory when treating difficult 5-9 year old children and 40% felt that having parents present was a hindrance for the dentist (Table 2).

AGE (MOS)	HELPFUL N(%)	NEUTRAL N(%)	HINDRANCE N(%)	NR N(%)
<18	546(85)*	53(8)	34(5)	12(2)
18-24	509(79)*	76(12)	47(7)	13(2)
24-30**	408(63)*	124(19)	100(16)	13(2)
30-36**	301(47)	172(27)	158(24)	14(2)
36-48**	187(29)	191(31)	248(38)	19(3)
48-60**	149(23)	183(28)	291(45)	22(3)
5-9 YRS**	345(53)	119(18)	142(22)	39(6)
IN GENERAL	152(24)	146(23)	258(40)	89(14)

\*\*=Statistical significance at p<0.001 using ANOVA on ranks when comparisons were made among age groups

\*=Statistical significance at p<0.001 using ANOVA on ranks when comparisons were made for individual age groups

Table 2: Dentists' attitudes towards parental presence and age of the child.

Regional analysis showed that dentists in region 2 (Midwest and Central U.S.) felt that parents were either neutral in helping with the child or were a hindrance when compared to dentists from regions 1 and 3 that generally felt parent presence was helpful (p<0.05). When parents were asked how their child would respond to the dental visit, 62% of those from offices that allowed them back said their child would react favorably. 23% said their child would be reluctant, 7% thought they would be timid, and 7% thought they would be uncooperative. In contrast, only 23% of the parents from offices in which they were excluded felt their child would respond favorably. Nineteen percent said their child would be reluctant, 21% timid, and 37% uncooperative (p<0.001, Table 3). These differences, however, are most likely due to the fact that the median age of those patients attending offices which allowed parents presence was 79 months in comparison to offices which exclude parents of only 33.5 months (p<0.05).

**Parental Presence and Procedure**

Both dentists and parents were asked questions regarding their preference for parental presence during various dental procedures (Table 4). In general, dentists responded favorably to allowing parents during initial exam, recall, restorative, and extractions (76%, 66%, 51%, and 50%, respectively (p<0.05). However, no statistically different differences were found for procedures using nitrous oxide or other sedative agents. In general it was found that 44% of the dentists allowed parents and 29% did not routinely allow parents to be present (Table 4). Regional comparisons were made regarding dentists' preferences for having parents present for certain procedures. These data showed that for all situations, dentists from region 2 were much less inclined to have parents present compared to regions 1 and 3 (p< 0.05). The same questions were asked of parents from offices that either allowed or refused their presence. Table 5 presents the results of this analysis. Eighty six percent of the parents from offices that allowed parents responded they would like to be present during the initial exam. Similarly, 79% said this for the recall, 84% for restorations, 87% for extractions, and 87% for sedation. Alternatively, only 44% of the parents from offices that do not permit parents stated they would like to be present for recall exams. For restorative, extractions, and sedation, 54%, 51%, and 54% respectively said they would like to be present (p<0.001). Table 6 shows a composite of the results from both dentists and parents in regard to their preference for being present. As might be expected, parents from dental offices where parents are allowed responded yes significantly more than either dentists or parents from practices that do not allow them (p< 0.001).

**Parental Presence and Communication between Dentist, Child and Parent**

Overall, (Table 7) 52% of the dentists agreed that parents generally expect to be present, 70% felt parent presence helps with parent rapport, 62% said it helped facilitate treatment acceptance, and 57% felt it was appreciated by the child. Nevertheless, only 34% stated they thought parent presence helped with the rapport of the child. When regional comparisons were made, overall those dentists from region 2 felt that under no circumstances was parental presence a positive experience. In contrast, 85% of those parents surveyed from offices that allowed

Parental Presence	N	Age* (mos)			Response to Dental Visit			
		Med	25%	75%	Favorably N(%)	Reluctant N(%)	Timid N(%)	Uncoop N(%)
Allowed	335	79**	49	109	208(62)**	77(23)	22(7)	25(7)
Not Allowed	150	33.5	26	41	35(23)	29(19)	31(21)**	55(37)**

\*\*=Statistical significance at p<0.001 using Mann-Whitney Rank Sum Test

\*=Age is represented in months (mos) with the median age (Med), 25 percentile and 75 percentile

Table 3: Parents' perception on how their children will react to their dental visit.

	YES N(%)	NO N(%)	SOMETIMES N(%)	NR N(%)
INITIAL EXAM	489(76)*	31(5)	122(19)	3(0.5)
RECALL	424(66)*	64(10)	153*24)	4(0.6)
INJECT/** FILLING	330(51)*	129(20)	182(28)	4(0.6)
EXTRACT**	324(50)*	149(23)	166(26)	7(1)
NITROUS**	292(45)	144(22)	156(24)	53(8)
OTHER SEDATION**	180(28)	244(38)	119(18)	102(16)
IN GENERAL**	284(44)	185(29)	118(18)	58(9)

\*\*=Significant differences were found at p<0.05 using ANOVA on Ranks when procedure types were compared  
 \*=Significant difference were found at p<0.05 using ANOVA on Ranks when responses for individual procedures were compared

Table 4: Dentists' responses on allowing parental presence in the dental operator during various procedures.

	PARENTAL PRESENCE									
	Initial Exam		Recall		Injection/Filling		Extractions		Sedation	
	Allow N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)
Yes	290(86)*	112(75)*	263(79)*	66(44)	289(84)*	81(54)	292(87)*	76(51)	293(87)	81(54)
No	13(4)	35(23)	26(8)	74(49)	22(7)	59(39)	16(5)	64(43)	15(5)	59(39)
Neutral	29(9)	3(2)	42(13)	10(7)	22(7)	10(7)	26(8)	10(7)	25(7)	10(7)
NR	2(0.6)	0	4(1)	0	1(0.3)	0	1(0.3)	0	2(0.6)	0

\*\*=Using Mann-Whitney rank sum test, statistical differences were found at p<0.001 between perceptions of parents survey in dental offices that allow them back vs. those parents from dental offices that do not allow them back.  
 \*=using ANOVA on ranks, statistical differences were found at p<0.01 in individual parental groups regarding preference for being present during certain procedures  
 NR=Non responders

Table 5: Parents' perceptions on presence in the dental operator during various procedures.

Group	New Exam			Recall			Restorative			Extraction			Sedation		
	Med	25%	75%	Med	25%	75%	Med	25%	75%	Med	25%	75%	Med	25%	75%
Dentist	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Some	Yes	Yes	Some	Yes	Yes	No
Parents Not Allowed Back	Yes	Yes	No	No*	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Parents Allowed Back	Yes	Yes	Yes	Yes	Yes	Yes	Yes*	Yes	Yes	Yes*	Yes	Yes	Yes*	Yes	Yes

Some= sometimes; \*=Kruskal Wallis ANOVA on Ranks, p<0.001

Table 6: Perceived expectations of parental presence during different dental procedures as viewed by dentists and parents that are allowed in the dental operator and those that are not.

their presence, stated they thought the child preferred having them back and 62% believed their child did not behave better when they were excluded (Table 8). Similarly, only 51% agreed that the dentist should decide if they should be present or not (Table 8). Alternatively, only 64% of the parents from offices that exclude all parents thought that their child preferred them there and 34%stated their child behaved better with them in the

operator. Along with this, 71% said that the dentist should decide whether or not they should be present.

**Parent Presence and the Quality of Care, Productivity, and Behavior Management**

Dentists were asked regarding their views on paren-

	SA/A N(%)	N N(%)	SD/D N(%)	NR N(%)
Parents Generally expect to be present	338(52)**	91(14)	210(32)	6(1)
Parental presence helps rapport with child	219(34)	144(22)	278(43)	4(1)
Parental presence helps rapport with parent	453(70)**	94(15)	96(15)	2(0.3)
Parental presence facilitates treatment acceptance	401(62)**	116(18)	125(19)	3(0.5)
Parental presence appreciated by parents	506(78)**	85(13)	42(6)	12(2)
Parental presence appreciated by child	367(57)**	178(28)	84(9)	16(2)

SA/A=Strongly agree/agree; N=Neutral; SD/D=Strongly disagree/disagree  
 \*\*=Statistical significance at p<0.001; ANOVA on rank was used as the data points were ranked using a Likert type scale

Table 7: Dentists perceptions on parental presence associated with communication between dentist, child and parent.

	Parental Presence							
	DDS Decides		Child Prefers		Child Behaves Better With Us Not There		Other DDS Have Not Allowed Us	
	Allow N(%)	Not Allow** N(%)	Allow** N(%)	Not Allow N(%)	Allow N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)
Yes	172(51)*	106(71)*	284(85)*	96(64)*	51(15)	48(32)	83(25)	4(3)
No	98(29)	20(13)	23(7)	19(13)	298(62)*	51(34)	113(34)	14(9)
Neutral	54(16)	24(16)	25(7)	35(23)	70(21)	51(34)	41(12)	132(88)*
NR	11(3)	0	3(1)	0	5(1)	0	98(29)	0

\*\*=Statistically significant difference at p<0.05 using Mann-Whitney Rank Sum Test between perceptions of parents surveyed in dental offices that allow them back vs. those parents from dental offices that do not allow them back

\*=using ANOVA on Ranks, statistical differences were found at p<0.05 in individual groups regarding parental presence and child behavior, presence and dentists' decision making

Table 8: Parents' perceptions on child behavior, preference and dentists' decision making regarding their presence.

tal presence and the quality of care, productivity, appointment length, recognition of behavior management skills, parental observation of different treatments, and general enjoyment when parents were present (Table 9). Sixty nine percent agreed that their behavior management skills were more appreciated (p<0.05) and 55% felt that parents should not observe all interactions between the child and dentist (p<0.05). In general dentists thought that neither their quality of care, productivity or visit length were affected by a parent being present.

**Importance of Parental Presence in regard to Past Medical and Dental Experience**

When asked if it was important for the dentist to allow them back, 87% of the parents surveyed from offices that allow

parent presence responded yes in contrast to only 23% of those parents from offices that do not allow their presence (p<0.001, Table 10). Similarly, 69% of the parents where they are permitted, selected the office because of this ability, compared to 1% of the parents from those offices where their presence is prohibited (p<0.001). An interesting finding was that 49% of the parents that took their children to offices, in which they were allowed back, had had a negative dental experience. This compared to 87% of the parents from offices that did not allow parents back who had not had a bad dental experience (p<0.05).

**DISCUSSION**

When confronting young, timid, and apprehensive children during their initial dental experiences adoption of a proto-

	SA/A N(%)	N N(%)	SD/D N(%)	NR N(%)
Quality of care increases	233(36)	130(20)	272(42)	10(2)
Productivity inhibited	281(44)	145(22)	214(33)	5(1)
Visit prolonged	304(47)	147(23)	190(30)	4(1)
Behavior management skills appreciated more	445(69)**	113(17)	82(12)	5(1)
I enjoy parental presence	218(34)	172(27)	250(39)	5(1)
Parents shouldn't observe all interactions	497(55)**	142(22)	143(22)	5(1)

SA/A= strongly agree/agree; N=neutral, SD/D=strongly disagree/disagree  
 \*\*=ANOVA on Ranks; statistical significance at p<0.05. Data points were ranked using a Likert type scale  
**Table 9:** Dentists' perceptions on parental presence and quality of care, productivity and behavior management.

	PARENTAL PRESENCE									
	Important for DDS to Allow Us		We Selected this Office Because Allow us Back		Child Had Prev Bad Experience		Child Had Prev Bad Medical Experience		Parent Had Prev Bad Experience	
	Allow** N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)	Allow N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)	Allow** N(%)	Not Allow N(%)
<b>Yes</b>	291(87)*	35(23)	232(69)*	1(1)	58(17)	36(24)	64(19)	13(9)	163(49)	19(13)
<b>No</b>	9(3)	44(29)	33(10)	138(92)	263(79)*	112(75)*	254(76)*	136(90)*	158(47)	131(87)*
<b>Neutral</b>	32(10)	71(47)	55(16)	11(7)	3(1)	2(1)	3(1)	1(1)	8(2)	0
<b>NR</b>	3(1)	0	15(4)	0	11(3)	0	14(4)	0	6(2)	0

\*\*Statistical significance at p<0.05 using Mann-Whitney Rank Sum Test were found between parents surveyed in dental offices that allow them back vs. those parents from dental offices that do not allow them back.  
 \*Using ANOVA on Ranks, statistical differences were found at p<0.001 in individual parental groups regarding importance of presence in operatory and past medical/dental experiences  
 NR=Non responders

**Table 10:** Parents' perceptions on importance of presence in operatory and past medical/dental experiences.

col which mandates separation of parent from child before sufficient coping behaviors have developed may questionably be expected to facilitate patient communication and acceptance of care. However, given variation in experience, training, and disposition of clinicians, it is not surprising that disparity among pediatric dentists perceptions regarding the merit or detriment to parent presence continues to exist, although to a lesser extent than in previous decades.

Parent presence or absence, is not an issue when dealing with cooperative, non-apprehensive children. Children whose cooperative potential readily permits exposure to novel situations, even potentially noxious stimuli, and/or strangers are not the subject of this debate.

Age alone may not be a factor or criterion upon which

to base decisions whether or not a parent should be included. Where an assessment is made that the child possesses a disposition (regardless of age) that readily permits entrance into the dental situation without fear or trepidation seems among the most pertinent of variables upon which to set office policy regarding parent presence.<sup>1,29</sup> While many children readily encounter their first and subsequent dental experiences with minimal or no anxiety, such responses and the capacity to cope with dental treatment is by no means universal. Regardless of age, there are those young or older who lack an ability to accurately appraise the limit of threat imposed by dental stimuli either during their initial exposures, or secondary to a previous unpleasant experience. Apprehension and a lack of successful coping experience contribute to a child's maladaptive response when confronting novel situations and result in a distortion of their perceptual and cognitive interpretations. Anxious children require lengthier pe-

riods in which to develop coping skills.

Alternatively, there is virtually no disagreement among pediatric dentists that there indeed exists reasons and appropriate indications to exclude some parents from the operator. Parents generally have the best intentions when visiting the dental office with their child. No one has motive to derail a positive experience for their child. There are some parents, however, whose entry characteristics, biases, personal experiences and anxieties preclude them from responding favorably to advice and counseling as to how they may most benefit their child. Unfavorable body language, facial expressions, verbal inquiries and conjecture of pain and discomfort compromise one's best efforts to establish rapport with the child. These parents can be particularly challenging despite even the most subtle (or not so subtle), sympathetic and conciliatory gestures to identify how their presence can be optimized. Alternatively, assessment of children who behave in one manner which contradicts cooperation and would otherwise not occur if a parent was excluded is at best judgmental and difficult to either predict or explain. Nevertheless, this intuitive assumption and integral component of clinician judgment plays a significant role for those who mandate or request parent exclusion. This is elaborated below.

#### **Justifiable Parent Exclusion - Dentist Considerations**

In addition to parental factors which impact on whether or not to include parents in the operator, the style of the dentist no doubt plays a role. There are some who, simply put, are uncomfortable with a parent present. Their training, experience, personal disposition, preference and comfort level make inclusion of parents a distraction and source of irritation.

Alternately, to deny there are instances in which some children simply will misbehave or manifest non-coping behaviors as a show for their parent, which might not otherwise manifest, supports the contention of practitioners who choose either an arbitrary manner to exclude parents, or, based on specific cues they receive from the child, have legitimate reasons to exclude or ask a parent to leave the operator.

In some offices, space designs do not readily permit additional chairside presence of a parent. For such individuals, referral of the parent insisting to be present is a viable option. These factors appear as reasonable justification for identifying an office policy of exclusion.

#### **Unjustifiable Basis for Exclusion**

For others, however, the rationale for arbitrary parent exclusion may not be credible or valid. Some indicate they believe child rapport cannot be established with a parent present. Some contend parent presence inhibits their productivity and slows the dental team from achieving their treatment objectives in timely fashion. The data obtained in this study do not support this contention.

More contemporary arguments to the contrary appear to prevail. For the introduction of children below the age of reason, children whose cooperative potential can at best be described as volatile, and those who report unpleasant prior medical or dental experiences, parent presence, in almost every instance, may be believed to facilitate establishment of a rapport as well as productivity.

First, parent child-separation for those lacking in cooperative potential can more often than not be expected to initiate a negative child response simply on entry. From a practice management perspective there can be little benefit derived when a behavior management problem is precipitated before a problem need occur. Having a known and friendly person present to assure the child of the safety of a new environment might be sufficient to allow the child to adapt over the next several minutes, more effortlessly and less traumatically to the dental operator. Allowing the parent to maintain physical contact with their child allows time, before the examination is initiated, to establish a dialogue with both parent and child. Such opportunity offers dentist, parent, and patient opportunity to become acquainted, explore relevant concerns, such as medical history, child developmental and behavioral issues, and specific parental concerns and queries. Opportunity for observation of the physical attachment of parent and child, the child's relative responsiveness to his/her new environment, can only facilitate the clinician's judgment as to how to best determine the modality to pursue. Opportunity to elicit valuable insight from the parent, inclusive of securing informed consent at this early moment, may be lost when a parent is not included in the operator. The impact of such is magnified when circumstances deteriorate in which the parent is excluded at the outset and behavioral resistance is encountered by separation, only later to require the dentist explain what took place, and why the child is or became upset, and the measures taken to address the situation. In addition to avoiding such occurrences by having the parent present might also enhance rather than inhibit productivity.

Secondly, it might be hypothesized that for some who arbitrarily exclude all parents, there is in reality, an underlying reluctance to have parents witness how a child, ("out of control" or responding negatively at the outset) is spoken to or physically managed by the dentist or the dental team. In every instance conceivable, it would be the hope and expectation that such is not representative of what occurs in the dental office. Literature, media, and alleged anecdotal reports of misbehavior have been reported. Inappropriate application of obsolete and discouraged aversive techniques of behavior management have appeared. It suffices to say that nothing is said or done to a child, regardless of the severity or potentially harmful nature of the child behavior, should occur without the parent's presence and consent. Reports of the application of physical restraints without parent presence or consent raise serious and legitimate public concerns. Parent presence without exception, offers opportunity to ensure that consent is (or is not) granted on an ongoing basis.

Thirdly, this report explored the relative frequency with which parents are permitted to be present during treatment, inclusive of when sedation techniques are employed. During such visits, the dentist is obligated to follow specific and expected guidelines to assure patient safety. As per the survey, 75% prefer to exclude parents from such visits, in large part due to the complexity of care and the extent to which interruptions are less likely to facilitate efficient and safe care.

#### Effect of Arbitrary Parent Exclusion

With or without parent presence, it is not uncommon that some young children may be refractory to any and all conventional communication strategies during initial contacts. Under these circumstances, the dentist faces a dilemma. If the origin of the child's non-compliance is initiated or exacerbated by parent exclusion and the dentist is determined to proceed without the benefit of the parent, what options and techniques become available to elicit cooperation? How does one establish communication lines when behaviors are so resistant? The extremely skillful communicator may eventually succeed in taming such behaviors and successfully manipulate a disruptive child's responses. Those less skilled, some out of frustration, may give way to aversive methods and deploy physical methods to redirect non-compliant behaviors. Without parental consent, this has potential to create additional problems, practical or legal, if the parent and dentist are not in agreement with how to address the misbehavior.

#### Use of Parent Presence as a Positive Reinforcement Tool

Alternately, where parent presence is permitted, opportunity exists for parent and dentist to witness the behavioral management challenge ahead, engage in a productive dialogue to optimally establish a mutually accepted plan how to proceed. After having exhausted all reasonable verbal attempts to secure the child's attention and elicit desirable behavior, the dentist may consider a technique which makes use of the parent's presence as a reward and positive reinforcement. This technique<sup>31,32,36</sup> first involves explanation to the parent on how he/she wishes to use the parent's presence to shape their child's behavior. Failing to acknowledge the parent as an expert on their child's disposition and capabilities may serve to compromise development of a favorable rapport at the outset.

While this may be time-consuming, energies to describe the technique has the potential to rapidly re-direct a child's lack of cooperative ability to one of compliance and acceptance. At the very least, a reticent parent may be inclined to become a strong advocate and referral source for the dentist's expertise and compassionate management skills. Comments frequently expressed afterwards by parents indicate an appreciation for the tact, calm demeanor, and patience of the dentist who shows no alarm to initial displays of their child's negative behavior, and for their systematic and soft-spoken approach.

In some instances, mention of Mommy being asked to leave the treatment area is sufficient to induce acceptable child behavior; other times, the sight of the parent getting up to leave will induce a change in behavior for the better. Sometimes, the parent may have to leave the area, return, leave and return several times before the child realizes he/she will have to mind the dentist if he/she wants the parent to stay. In almost all instances, behavior can be expected to improve after two to three trials of having the parent enter or leave. If this continues 2-3 times to no avail, the dentist and parent may wish to reassess the situation. Recalcitrant children may require a non-mainstream modality if urgent treatment needs are identified. Regardless, all efforts are expended to give the child a choice and that their feelings are being considered meaningful. In this manner, the child has some control, but similarly, the options given remain acceptable to the dentist. At this juncture, opportunity for parent and dentist to collectively review future exploits can remain healthy and intact.

#### CONCLUSIONS

1. There appears to be general agreement among pediatric dentists that there are legitimate reasons to include and exclude parents from the dental operatory.
2. Regardless of whether parents are permitted by office policies of pediatric dentists, there is a tendency of parents to prefer to be present for examinations and in many cases for various forms of treatment, particularly for children who are below the age of reason, manifest non-coping and apprehensive behaviors, or have a history of unpleasant previous medical or dental experiences.
3. General belief appears among dentists that parent presence is not a hindrance to establishment of a favorable child rapport, improved patient cooperation, and office productivity.
4. Arbitrary parent exclusion denies an opportunity for the dentist to make use of the parent's presence as a positive reinforcement tool to re-direct initial or uncooperative child behaviors. Those who mandate parent exclusion from the outset for all children may wish to re-assess their office policies when encountering initial negative and non-coping behaviors.

#### SUMMARY

While not universal, pediatric dentists report more parents expressing a desire to be present and that parents believe their presence will be helpful to their children. The majority of pediatric dentist's today report that neither quality of care, productivity, nor visit length was adversely affected by a parent's presence. The opportunity for a parent to be present to witness their child's behavior brings numerous possible advantages. If parent presence is indeed important to the child, their selective presence can be used as positive reinforcement to replace disruptive behaviors with desirable ones. Mandatory parent exclusion serves to remove this potentially useful and effective technique from a clinician's conventional behavior shaping arsenal.

Lastly, additional potential benefits to parent presence,

when mutually agreed upon, include opportunity for the dentist to be assured of ongoing parental consent. This enables the dentist to remain alert for changes in parental expression, verbal or body language to indicate a disapproval of the direction approaches is being taken. From a practice management vantage, permitting parents in the dental operatory has potential to allow parents opportunity to not miss what the dentist is able to accomplish with their child.

**CONFLICTS OF INTEREST:** None.

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## Review

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# Pathogenesis and Management of Retinopathy of Prematurity in Premature Infants

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**ABSTRACT**

Retinopathy of Prematurity (ROP) continues to be a major cause of preventable blindness in considerable parts of the world, including developing countries. The incidence of ROP varies with the level of neonatal care; adequate screening and follow-up of these infants is essential for intervention to occur at the appropriate time. Even though the pathophysiology is not certain, oxygen and its interaction with angiogenic factors plays a central role in the development of the disease. Despite the role of oxygen in the pathogenesis of ROP, optimal oxygen saturation in the first few weeks of life in the premature infant remains unclear. Current treatment strategies include ablation of the peripheral avascular retina, management of abnormal vasoproliferation in late stages of disease and visual rehabilitation. A team effort involving neonatologists, ophthalmologists and excellent nursing care will go a long way in not only decreasing the incidence of ROP but also in building a strong screening and follow-up program, which is critical in the management of these patients.

**KEYWORDS:** ROP; Prematurity; VEGF; O<sub>2</sub> Saturation; Neonate.

**ABBREVIATIONS:** ROP: Retinopathy of Prematurity; NeOProm: Neonatal Oxygenation Prospective Meta-analysis Study; BOOST: Benefits of Oxygen Saturation Targeting; STOP-ROP: Supplemental Therapeutic Oxygen for Prethreshold Retinopathy of Prematurity; VEGF-A: Vascular Endothelial Growth Factor A; BEAT-ROP: Bevacizumab Eliminates the Angiogenic Threat of Retinopathy of Prematurity; PROP-ROP Propranolol in Newborns with Retinopathy of Prematurity; PUFAs: Poly Unsaturated Fatty Acids; EPA: Eicosapentaenoic acid; DHA: Docosahexaenoic acid; AA: Arachidonic acid; VEGF: Vascular Endothelial Growth Factor; IGF-1: Insulin Growth Factor-1; SUPPORT: Surfactant, Positive Airway Pressure, Pulse Oximetry Randomized Trial; COT: Canadian Oxygen Trial; ET-ROP: Early Treatment for Retinopathy of Prematurity.

**INTRODUCTION**

Retinopathy of prematurity (ROP) is a leading cause of preventable blindness worldwide, associated with abnormal retinal vascular development that occurs only in premature infants. Low birth weight and prematurity are strongly associated with an increased disease risk. The incidence of ROP in the United States is 68% in premature infants weighing <1251 grams; among the affected, severe ROP developed in almost 37% of the infants.<sup>1</sup> The incidence of premature births is increasing throughout the world, and with it, ROP is now appearing in countries with the technology to save premature infants. Consequently ROP has become a leading cause of childhood blindness worldwide.<sup>2</sup> The management of ROP include screening of at-risk preterm infants by frequent retinal examinations followed by treatment interventions if necessary, such as laser treatment of the peripheral avascular retina in eyes with severe ROP and visual rehabilitation.<sup>3</sup>

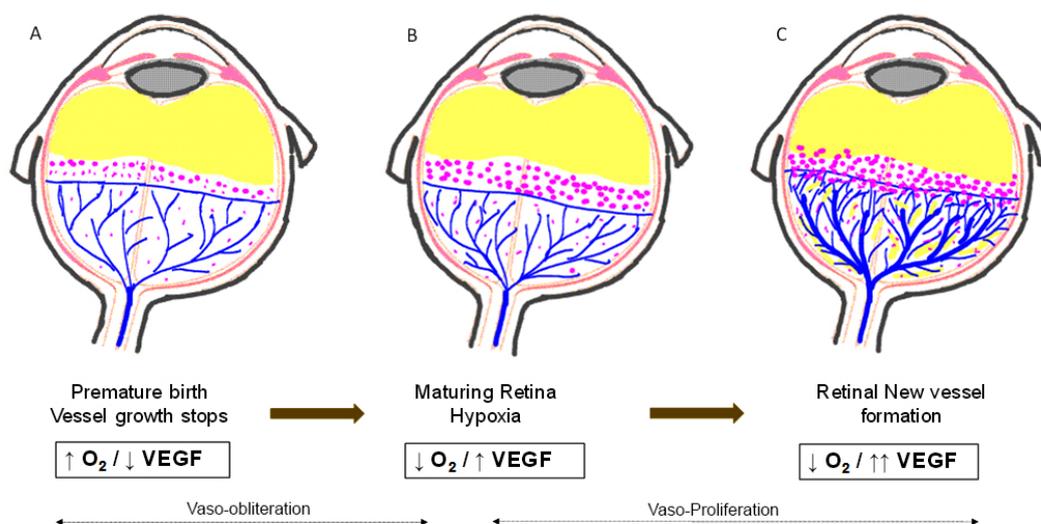
**PATHOGENESIS**

The pathogenesis of ROP is related to disruption of normal retinal neuronal and vascular development. The inner parts of the eye including the retina are supported metabolically by the hyaloid vasculature in the first trimester and retina remains avascular during this period.<sup>4</sup> However, the switch from hyaloid to retinal vasculature begins at around 16 weeks of gestation with the development of the vascular plexus beginning at the optic nerve head and spreading centrifugally. Retinal vessels growing out of the optic nerve head reach the ora serrata nasally at approximately 32 week gestation and temporally by 2 months of postnatal age.<sup>5</sup> As glial cells such as the astrocytes cover much of the retina during development, they may act as a template for endothelial cell migration to occur promoting vasculogenesis. This is facilitated by the release of growth factors such as Vascular Endothelial Growth Factor (VEGF) from the astrocytes and retinal ganglion cells in the presence of hypoxic *in utero* environment. Tissue hypoxic gradients generated in the retina facilitate the formation of endothelial tubes and blood vessels centrifugally from the optic nerve under the influence of VEGF and other factors such as Insulin Growth Factor-1 (IGF-1).<sup>3,4</sup> After premature birth, disruption of normal angiogenesis and vascularization of the retina occur secondary to reduced VEGF and IGF-1 in the retinal tissue due to relative hyperoxia resulting in vaso-obliteration (Figure 1). This is followed by relative ischemia and tissue hypoxia secondary to growth and high metabolic rates of the underlying neurons such as astrocytes and the retinal ganglion cells. Retinal tissue hypoxia will eventually produce high levels of VEGF and other growth factors ultimately leading to the vasoproliferative phase of ROP characterized by pathologic vascularization beginning at 32-34 weeks gestational age.<sup>3,4</sup> Pathologic vascularization is dysregulated as aberrant vessels grow into the vitreous; they are excessive and of minimal

function to the avascularized retina. Normal retinal development driven by hypoxic tissue gradients is at first disrupted resulting in dysregulated angiogenesis and this is followed by abnormal vascular development culminating in ROP. Of the many risk factors for ROP, low birth weight and lower gestational age are the most important risk factors. Other factors include extremely low birth weight, duration of ventilation,<sup>6</sup> high volume of blood transfusion<sup>7</sup> and candida sepsis.<sup>8</sup>

**OXYGEN SUPPLEMENTATION & RETINOPATHY OF PREMATURITY**

Supplemental oxygen exposure, an important risk for the development of ROP in premature infants has been extensively studied. Historical role of oxygen in the pathogenesis of ROP has been confirmed by clinical trials, demonstrating definitively the relationship between elevated oxygen and ROP and further that, by restricting supplemental oxygen use, could lead to increased mortality.<sup>9-11</sup> Pulse oximetry monitors oxygenation in infants non-invasively and continuously in infants, allowing titration of inspired oxygen to maintain desired oxygen saturations (SpO<sub>2</sub>). In one of the earlier studies, higher SpO<sub>2</sub> (88-98%) in the first 8 weeks of life in infants born between 24 to 28 weeks gestational age, had four times higher rates of surgery for ROP compared to lower SpO<sub>2</sub> (70-90%) group.<sup>12</sup> In a meta-analysis of five studies by Chen, et al. the relative risk for ROP was significantly lower in the lower saturation (70-96%) group.<sup>13</sup> However, the conclusion was confounded by the studies not being randomized and being mostly retrospective. The Surfactant, Positive Airway Pressure, Pulse Oximetry Randomized Trial (SUPPORT), assigned infants born between 24 weeks and 28 weeks gestation to low O<sub>2</sub> saturations (85-89%) or high O<sub>2</sub> saturations (91-95%) within one hour of birth. Severe ROP occurred less frequently in the lower O<sub>2</sub> saturations group;



**Figure 1:** Pathogenesis of Retinopathy of Prematurity (ROP). The figure illustrates the interactions of oxygen and angiogenic factors, particularly vascular endothelial growth factor (VEGF) in the development of ROP. Vessel growth stops following birth due to relative hyperoxia in premature neonates resulting in decreased VEGF (A); this is followed by pathological hypoxia inducible factor (HIF) signaling and increasing VEGF over time from hypoxia (B) resulting in retinal new vessel formation and stage III ROP by 36 weeks gestation (C). Multiple other factors are involved in the development of retinal vasculature including Insulin growth factor (IGF-1) and other cell signaling molecules.

however death occurred more frequently in the lower saturation group (RR-1.27; CI: 1.01-1.60), raising concerns for practical implications.<sup>14</sup> Two other trials have also published the data as part of the NeOProm (Neonatal Oxygenation Prospective Meta-analysis Study) collaboration initiative. The Benefits of Oxygen Saturation Targeting (BOOST) II assessed 1224 infants with similar study design. The incidence of ROP were lower in the pooled data for the lower O<sub>2</sub> saturation group (RR-0.79; CI: 0.63-1.00) with the higher incidence of death in the same saturation group (Revised algorithm – RR-1.45; CI: 1.15-1.84).<sup>15</sup> The Canadian Oxygen Trial (COT) with similar study design did not demonstrate significant difference in death or disability at 18 months or in secondary outcome measures such as ROP or brain injury.<sup>16</sup> These studies suggest that targeting SpO<sub>2</sub> of 91-95% is reasonable in the first few weeks of life, and that would decrease death, however it might increase the risk for ROP and high saturations in the first few weeks do not worsen neuro-developmental outcome. It was hypothesized from animal studies that oxygen supplementation during the disease process would reduce the severity of ROP by reducing the hypoxia induced release of angiogenic factors believed to be responsible for the vasoproliferation seen in severe ROP.<sup>17,18</sup> This hypothesis was tested in the Supplemental Therapeutic Oxygen for Prethreshold Retinopathy of Prematurity (STOP-ROP) study, wherein infants supplemented with oxygen to maintain higher saturations (96-98%) were compared to 89-94% SpO<sub>2</sub> group and assessed for progression to threshold ROP.<sup>19</sup> These infants had a mean gestational age of 35.4 weeks and had pre-threshold ROP at enrollment. Supplemental oxygen did not decrease significantly the number of infants with pre-threshold ROP progressing to threshold ROP requiring treatment. However, in the subset of infants without plus disease, fewer infants progressed to threshold in the oxygen supplemented group. Also higher rate of pulmonary complications were noted in the oxygen supplemented group.

**CLASSIFICATION OF ROP**

The severity of acute ROP is determined by the zone, presence or absence of plus disease, the stage and the clock-hour extent of the worst stage of the disease (Figure 2).<sup>20</sup>

**Zones**

**Zone I:** This represents the least amount of retinal vascular development and includes retinal vascularization limited to a circular area centered on the optic nerve. The radius is equivalent to two times the distance from the optic nerve to the fovea. *Zone I ROP is a strong predictor for severe ROP* and can be estimated visually with indirect ophthalmoscopy.

**Zone II:** Vascularization limited to the circular area outside zone I with the optic nerve as the center. Its radius is equivalent to the distance from the optic nerve to the nasal horizontal oraserrata.

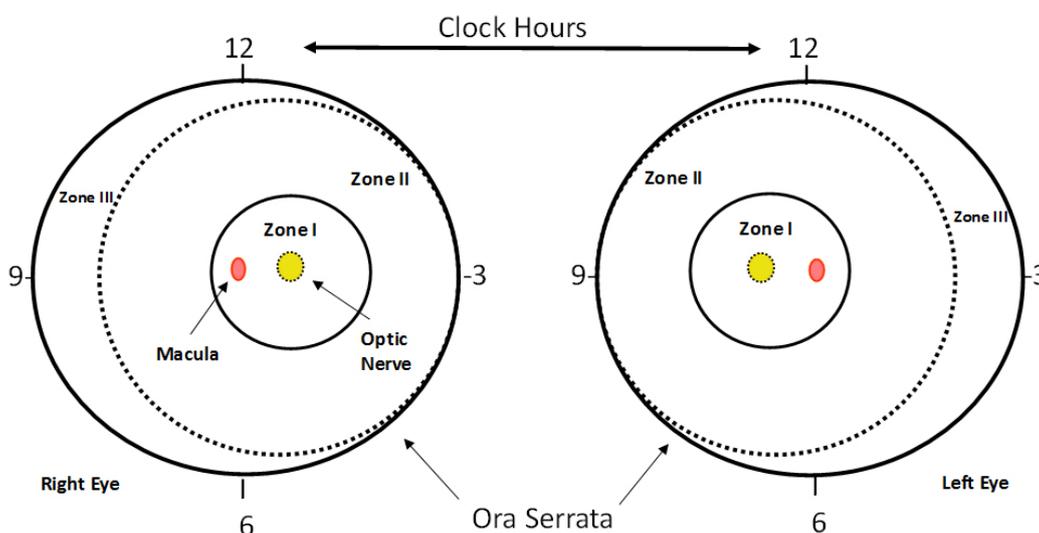
**Zone III:** Vascularization within the remaining temporal, crescent-shaped area. Once vascularization extends to the nasal oraserrata and into zone III, there is little risk of a poor visual outcome from ROP.

**Plus Disease**

Defined as two quadrants of dilated and tortuous vessels and is a strong predictor of severe ROP.

**Stages of ROP**

**Stage 1:** A demarcation line between vascularized and avascular retina.



**Figure 2:** Scheme of retina of the right and left eyes demonstrating zone borders and clock hours used to describe the location and extent of ROP. Diagrammatic representation of the potential total area of the premature retina, with zone 1 (most posterior) symmetrically surrounding the optic nerve-head (the earliest to develop). A larger retinal area is present temporally (laterally) rather than nasally (medially) (zone II). Only zones I and II are present nasally.

**Stage 2:** A ridge with volume in the region of the demarcation line.

**Stage 3:** Neovascularization growing into the vitreous at the ridge. Stage 3 is a strong predictor of severe ROP and a poor outcome.

**Stage 4:** A partial retinal detachment. Treatment of progressive stage 4 ROP can preserve and improve visual outcomes by preventing stage 5 ROP.

Stage 4 is further classified by whether the macula is involved (4A without macular involvement and 4B with macular involvement) and by whether it is predominantly exudative or tractional. Exudative ROP that occurs after treatment with laser or cryotherapy may resolve spontaneously.

**Stage 5:** Total retinal detachment.

**Prethreshold and Threshold Disease**

- **Prethreshold ROP, Type 1:** Zone I, any stage with plus disease; zone I, stage 3 without plus disease; zone II, stage 2 or 3 with plus disease.
- **Prethreshold ROP, Type 2:** Zone I, stage 1 or 2 without plus disease; zone II, stage 3 without plus disease.
- **Threshold ROP:** Zone I or II, stage 3 (five contiguous or eight total clock hours with plus disease).

**SCREENING FOR ROP**

The progressive nature of the ROP demands that timely treatment is essential in reducing the risk of visual loss. Effective care now requires that at-risk infants receive carefully timed retinal examinations by an ophthalmologist who is experienced in the examination of preterm infants for ROP on a scheduled basis according to their gestational age at birth and their subsequent disease severity and that all pediatricians who care for these at-risk preterm infants be aware of this schedule.<sup>21</sup> Because unchecked ROP can lead to permanent blindness, it is important that all infants be screened in a timely fashion, recognizing that not all infants require treatment. It is important to recognize that screening parameters vary in countries across the globe.

1. Infants with a birth weight of  $\leq 1500$  grams or  $GA \leq 30$  weeks and selected infants with a birth weight between 1500-2000 grams or  $GA > 30$  weeks with an unstable clinical course, including those requiring cardiorespiratory support are at high risk for ROP and should have retinal screenings performed.
2. The initiation of acute-phase ROP screening should be based on the infant's postmenstrual age. The onset of seri-

ous ROP correlates better with postmenstrual age (gestational age at birth plus chronologic age) rather than with postnatal age. That is, the more premature the infant at birth, the longer it takes to develop serious ROP. Table 1 shows the timing of first eye exam based on gestational age at birth.

3. Infants born before 25 weeks GA should be considered for earlier screening on the basis of severity of co-morbidities (6 weeks chronological age), to enable earlier identification and treatment of aggressive posterior ROP that is more likely to occur in this population.
4. Follow up exams are recommended on the basis of retinal findings as per the international classification and the schedule is outlined by the AAP.<sup>21</sup>
5. Plus disease is defined as abnormal dilation and tortuosity of the posterior retinal blood vessels in 2 or more quadrants of the retina in zones I or II. Presence of plus disease suggests that peripheral ablation, rather than observation, is the most appropriate therapy.
6. ROP treatment should be initiated for the following retinal findings – Zone I ROP of any stage with plus disease; Zone I ROP: stage 3 – no plus disease; Zone II: stage 2 or 3 ROP with plus disease.

Gestational Age at Birth (Wks)	Age at Initial Exam (Weeks)	
	Postmenstrual Age	Chronological Age
22 <sup>a</sup>	31	9
23 <sup>a</sup>	31	8
24	31	7
25	31	6
26	31	5
27	31	4
28	32	4
29	33	4
30	34	4
Older GA; high risk factors <sup>b</sup>		4

<sup>a</sup>This guideline should be considered tentative rather than evidence based for infants with a gestational age of 22 to 23 wk because of the small number of infants of survivors in these post menstrual age categories.

<sup>b</sup>Consider the timing on severity of comorbidities

**Table 1:** Timing of first eye examination based on Gestational age at birth.<sup>21</sup>

**MANAGEMENT OF ROP**

The practicality of performing screening exams and rigorous follow-up is difficult in the best of circumstances and the hurdles to effective screening in developing countries can only increase, as they are difficult to perform and the *treatment 'window' for intervention is brief – within 2 to 3 days of decision to treat*. Management includes screening with a dilated fundus examination, treatment of acute severe ROP with ablation of the

peripheral avascular retina, surgery for tractional retinal detachment resulting from progressive stage 4 or stage 5 ROP and visual rehabilitation.

#### CRYO-THERAPY & PHOTOCOAGULATION (LASER)

Trans-scleral cryotherapy to the avascular peripheral retina of premature infants with ROP has been used clinically since 1970's. For the first time in 1988, the preliminary results of the Multicenter Trial of Cryotherapy for Retinopathy of Prematurity (CRYO-ROP) demonstrated that cryotherapy is effective in reducing ROP-induced blindness.<sup>22</sup> The follow-up of the CRYO-ROP study cohort has shown that the beneficial effect of cryotherapy is maintained long-term; however 10 years after treatment 45.4% of the treated eyes had a visual acuity of 20/200 or worse.<sup>23</sup> Since then, laser photo-coagulation has gained widespread acceptance and has largely replaced cryotherapy and is currently the standard of care for the treatment of ROP. In a randomized trial, at 5.8 years of follow-up, the odds that an eye treated with laser had a good clinical outcome were 6.91 times greater than for eyes treated with cryotherapy. Additionally, the laser-treated eyes were less myopic with a mean SE of -3.05 diopters compared to a mean SE of -5.08 diopters for the cryotherapy-treated eyes. The study concluded that laser photocoagulation for threshold ROP was more likely to result in a good clinical outcome with better final visual acuity and less myopia compared to cryotherapy treatment.<sup>24</sup>

The indication for treatment in CRYO-ROP was threshold ROP, when the risk for blindness was 50%. *Threshold was defined as 5 or more continuous or 8 cumulative clock hours of stage 3 ROP in zone I or zone II in the presence of plus disease (dilation and tortuosity of posterior pole retinal vessels in at least two quadrants).* This remained unchanged for 15 years until the Early Treatment for Retinopathy of Prematurity (ET-ROP) study in 2003, which concluded that early treatment of high-risk pre-threshold ROP significantly reduced unfavourable outcomes to a clinically important degree.<sup>25</sup> The preliminary report of the ETROP identifies characteristics that predict which eyes are most likely to benefit from early peripheral retinal ablation. As per the clinical algorithm, peripheral retinal ablation should be considered for any eye with *type 1 ROP* – Zone I, any stage of ROP with plus disease; Zone I, stage 3 ROP, with/without plus disease; Zone II, stage 2 or 3 ROP with plus disease. Plus disease requires at least 2 quadrants (6 or more clock hours) of dilation and tortuosity of the posterior retinal vessels and the presence of significant disease. The algorithm also indicates that *continued serial exams are indicated as opposed to treatment for any of the type 2 ROP* – Zone 1, stage 1 or 2 ROP without plus disease; Zone II, stage 3 ROP without plus disease. *The presence of plus disease (retinal arteriolar tortuosity and venous congestion) is one of the key differences between type 1 and type 2 pre-threshold ROP as defined by ETROP that requires treatment.* Treatment should be considered for an eye with type 2 ROP when progression to type 1 status or threshold ROP occurs.<sup>25</sup>

#### ANTI VEGF TREATMENT

Bevacizumab (Avastin, Genentech/Roche, San Francisco, CA) is a 150-kD, recombinant humanized monoclonal immunoglobulin G1 antibody that binds to all isoforms of Vascular Endothelial Growth Factor A (VEGF-A). The advantage of bevacizumab is its inability to cross the blood retina barrier due to the relatively large size of the molecule and hence may decrease systemic complications. Case reports have demonstrated its benefits in the regression of stage 3/zone I ROP with no adverse events.

The largest study examining the use of anti-VEGF therapy to date is the Bevacizumab Eliminates the Angiogenic Threat of Retinopathy of Prematurity (BEAT-ROP) Trial.<sup>26</sup> This study enrolled 150 infants with Zone I or Zone II posterior stage 3 ROP and randomly assigned each to receive bilateral intravitreal bevacizumab (0.625 mg) or laser photocoagulation with a primary outcome measure being need for retreatment before 54 weeks GA. The rate of recurrence in Zone I disease was significantly higher with laser therapy (42% recurrence rate) than with intravitreal bevacizumab (6% recurrence rate). In contrast, a difference in the recurrence rate noted between Zone II disease treated with laser therapy (12% recurrence) versus intravitreal bevacizumab (5%) did not reach statistical significance suggesting that it may be used in the treatment of zone I disease.

Bevacizumab has to be used with caution in selected patients as the study does not address some of the concerns of the medication including safety issues. Complications of bevacizumab related to intravitreal injection include endophthalmitis, retinal hemorrhage, cataracts and retinal detachment. The drug has to be given at the right time, as, if given too late may lead to retinal detachment. Knowledge of the anatomy of the eye in a premature infant is essential to give an injection safely. Although the potential systemic effects of intravitreal bevacizumab use in preterm infants are of greatest concern and they are hardest to determine.

#### INSULIN GROWTH FACTOR-1 (IGF-1)

IGF-1 and VEGF interactions have been proposed to mediate endothelial cell survival and proliferation and by extension control blood vessel development in infants. Specifically, IGF-1 is likely necessary for VEGF signaling, most likely through the stimulation of the mitogen-activated protein kinase pathway.<sup>27</sup> A current clinical trial investigating the administration of IGF-1 to preterm infants is under way to determine if restoring *in utero* levels of the protein can prevent ROP through normalizing vascular growth in phase I (vaso-obliteration) and thus circumvent the pathologic neovascularization of phase II (vaso-proliferation).<sup>28</sup>

## PROPRANOLOL

Propranolol, a non-selective  $\beta$ -adrenergic blocker has been used in the treatment of infantile hemangiomas for its ability to reduce VEGF and hence vascularization. As hypoxia induced neovascularization may be mediated through the  $\beta$ -adrenergic receptor, propranolol is now being evaluated in the treatment of ROP. In mouse models of ROP, propranolol reduced VEGF production only in the hypoxic retina of mice without affecting VEGF levels in normoxic retina of control mice, suggesting distinct mechanisms of VEGF regulation in normoxic and hypoxic conditions.<sup>29</sup> In a pilot study, oral propranolol (0.25 mg/kg q6 or 0.5 mg/kg q6) added to standard treatment in infants with stage 2/zone 2 ROP was effective in reducing the progression of ROP compared to standard treatment alone, however safety was a concern.<sup>30</sup> The Propranolol in Newborns with Retinopathy of Prematurity (PROP-ROP) clinical trial is currently underway to evaluate the effectiveness of propranolol in infants with stage 2 ROP in zone II/III without plus disease.<sup>31</sup> The primary goal of this study is to evaluate the safety of the drug including side effects such as bradycardia, hypoglycemia, hypotension and dyslipidemia.

## POLYUNSATURATED FATTY ACIDS

The retina requires  $\omega$ -3 long chain Poly Unsaturated Fatty Acids (PUFAs) for normal structure and function and has the highest concentration of these fatty acids of all bodily tissues. The major PUFA found in the retina are Eicosapentaenoic acid (EPA) the precursor to Docosahexaenoic acid (DHA) and Arachidonic acid (AA) found primarily in neural and vascular cell membranephospholipids.<sup>32</sup> Emerging knowledge of lipid mediators and epidemiologic data linking PUFA and neovascular age-related macular degeneration indicate that EPA, DHA and AA may function *in vivo* to regulate retinal vaso-obliteration and neovascularization.<sup>32,33</sup> Premature infants lack the essential transfer of  $\omega$ -3-PUFA from the mother to the infant that normally occurs in the third trimester of pregnancy and total parental nutrition fail to compensate for the losses that occur from *in utero* transfer. In a recent study in mice, increasing  $\omega$ -3-PUFA tissue levels decreased the avascular area of the retina by increasing vessel regrowth after injury, thereby reducing the hypoxic stimulus for neovascularization.<sup>34</sup> The bioactive  $\omega$ -3-PUFA-derived mediators' neuroprotectinD1, resolvinD1 and resolvinE1 protected against neovascularization and the protective effect of  $\omega$ -3-PUFAs and their mediators was mediated in part, through suppression of tumor necrosis factor- $\alpha$ .<sup>34</sup> Supplementing  $\omega$ -3-PUFA may be of benefit in preventing retinopathy and clinical trials to examine the effect of supplementing neonatal diet with  $\omega$ -3-PUFA are being investigated.

## CONCLUSIONS

New pharmacologic interventions are on the horizon and are only expanding. However, the treatments need to be

studied in rigorous clinical trials so that safety concerns are addressed before put into practice in premature neonates. In the meantime, sick premature infants between 32 weeks and 44 weeks gestational age are to be followed very closely as they at risk for ROP and need immediate treatment if necessary.

## CONFLICTS OF INTEREST

The authors declare that they have nothing to disclose.

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## Commentary

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## Interprofessional Collaboration and Interprofessional Education

**Marcia R. Gardner\****Associate Professor, Associate Dean for Undergraduate Programs and Assessment, College of Nursing Seton Hall University, NJ 07079, USA***COMMENTARY**

The recent re-affirmation of the Affordable Care Act (ACA) by the U.S. Supreme Court reassures many of us that we are moving in the direction of better access to health care in the U.S. Whether there is adequate access to the *highest quality and safest* health care is a different question. What else is needed to grow and solidify quality and safety in health care? The U.S. Institute of Medicine,<sup>1,2</sup> emphasized the need for more, and more effective, interprofessional collaboration to achieve improved healthcare quality and safety standards. According to the Interprofessional Education Collaborative (IPEC) expert panel, representing nursing, medicine, dentistry, pharmacy, and public health education, the IOM reports highlighted the fact that "...*how* care is delivered is as important as *what* care is delivered."<sup>3, p. 4</sup> An effective interprofessional collaborative approach involves a deliberate, planned system for patient care based on trust, collaboration, communication, role clarity, and shared commitment among clinicians from various relevant health disciplines, related closely to the needs of the patient.<sup>3</sup> Health care curricula must also be planned carefully to ensure that students are equipped to practice within an interprofessional collaborative framework in many types of settings. One assumes that the readers of an interprofessional journal such as PNNOJ appreciate the value of collaborative interprofessional teamwork, as well as the contributions of a variety of health care disciplines to the development of interdisciplinary knowledge for improved practice, and acknowledge the importance of collaboration to promote the best outcomes in the care of neonates, infants, and children.

Concerns about the nature and definitions of interprofessional health care approaches and questions about how to facilitate are not new; however, less than optimal progress toward full interprofessionality has been achieved.<sup>3,4</sup> New graduates of health care programs need specific competencies to function effectively in an interprofessional context.<sup>3</sup> These competencies for interprofessional practice include: valuing patient-centeredness, having conflict management, communication and collaborative leadership skills, understanding of the scope of practice in other health care disciplines as well as their own scope of practice, and appreciation of best practice approaches to deliver safe and effective health care, regardless of setting or specialty.<sup>3,5</sup> Educators in a variety of health care preparation programs, including medicine, nursing, and allied health disciplines, continue to explore methods to promote these competencies during their students' educational processes. Specialized interdisciplinary courses, clinical training opportunities in interprofessional environments, creation of interprofessional student teams for patient care, and interprofessional simulation experiences may be methods to promote interprofessional education and facilitate development of interprofessional team competencies. Little is known yet about the outcomes of these as they relate to safety and quality of care after students graduate into professional practice. An interesting corollary (and potentially a future driver) of interprofessional competency initiatives has been the development of classroom, lab, conference, simulation, and meeting spaces designed with the goal of promoting both planned and informal interaction and learning among health professions students.<sup>6</sup> Right now, my own university's nursing and health professions colleges are examining our curricula to determine how to best promote the development of interprofessional competencies in our students, and

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are in process of designing classroom, lab, simulation, and faculty and student meeting spaces which may help to facilitate achievement of this goal.

Infusing these competencies into health professions curricula is a necessary but not a sufficient step toward safer and higher quality patient care processes. Students are strongly influenced by the behaviors and practices of clinicians they observe and work with during their clinical rotations. To learn to be members of well-functioning interprofessional teams, students most likely benefit from observing and participating in well-functioning interprofessional teams. Let's challenge ourselves by asking how well we each are modeling the competencies associated with interprofessional collaboration and teamwork. What else can we do in the clinical setting to support and help students develop essential competencies for interprofessional collaboration and practice? How do we continue to move out of our theory, evidence, and practice 'silo's', and show the students in our health care settings, the clinicians of the near future, that we appreciate the interprofessional collaborative 'whole', beyond the sum of our single-disciplinary 'parts', when it comes to care of our patients and their families?

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## Opinion

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## Infant Formula: Fast Food for Babies

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**ABBREVIATIONS:** WIC: Special Supplemental Nutrition Program for Women, Infants and Children; AAP: American Academy of Pediatrics.

Pediatric obesity is a declared epidemic with enormous consequences.<sup>1,2</sup> There are many risk factors for being overweight, including frequent consumption of fast food. Fast food is cheap, calorie-dense, and easily accessible. Infant formulas closely resemble some of these characteristics and thus may contribute to expansion of pediatric obesity epidemic.

Infant formulas are designed to resemble growth and developmental parameters of breast fed babies. According to the statement by American Academy of Pediatrics (AAP), Work Group on Breastfeeding "The breast-fed infant is the reference or normative model against which all alternative feeding methods must be measured with regard to growth, health, development, and all other short- and long-term outcomes".<sup>3</sup> In spite of their meticulous engineering over the last half century, human milk is far superior form of nutrition for most infants, as it serves a dual function of providing the optimal nutrition for growth and development, as well as disease protection.<sup>4</sup> Furthermore, breast feeding provides numerous benefits to the infant, mother and the society in general. One of these benefits is being the only approved intervention during infancy to decrease the likelihood of developing obesity.<sup>5</sup> It could be argued, however, since breast fed infant is the reference point, breast feeding does not protect against obesity, but rather that formula feeding increases the risk of being overweight. It is from this limited perspective that infant formulas may resemble some of the characteristics of fast food, such as being cheap, calorie-dense and easily accessible and contribute to the development of pediatric obesity.

Infant formulas are relatively cheap, especially when calculated on a per meal basis. An average six-month old that weighs 17 pounds and consumes 90 kcal/kg/day, requires approximately 34 ounces of mixed formula or about five ounces of formula powder per day. An average price for a thirteen ounce can of formula is fifteen dollars. Thus, the total daily formula expense comes to five dollars, or about 1.67 dollars per meal! Many impoverished families, unable to afford ongoing formula expenses, may qualify for state and federal programs, such as Special Supplemental Nutrition Program for Women, Infants and Children (WIC), which provides free formula. In fact, over half of all infant formulas sold in the United States are obtained through WIC.<sup>6</sup> Furthermore, formula companies commonly give a significant amount of formula as free samples to new and expecting mothers, as their advertising campaign,<sup>7,8</sup> thus further decreasing the cost of acquiring infant formula.

Although breast milk and standard infant formulas both contain 20 kilocalories per ounce, formula fed infants tend to consume more calories. Overfeeding is a common issue with bottle fed babies.<sup>9</sup> This likely stems from a lack of self-regulation,<sup>10-12</sup> as the size of a bottle fed infant's meal is somewhat predetermined by caregivers. Breast fed infants, on the other hand, determine their own portion size, as well as maternal milk production by the intensity of their suckling.<sup>13</sup> Breast feeding is also an active process requiring generation of negative intra-oral pressure, while bottle feeding is a relatively passive process. As a result, infants with craniofacial abnormalities who fail breast feeding may do well with bottle feeding.<sup>14</sup> Health-

care providers have long recognized these feeding differences and thus common recommendation for breast fed neonate is to feed on demand, every 2-3 hours, while formula fed infants may feed every 3-4 hours. In addition to overfeeding, another reason for longer time interval between feeds is that formula is more difficult to digest leading to prolonged gastric emptying and thus producing longer satiety.<sup>15</sup> The overfeeding effects of bottle fed infants have been quantified and in one study it resulted in six fold increased odds of obesity at 3 years of age, especially if solid food intake was initiated before 4 months of age.<sup>16</sup>

Infant formulas are easily accessible at all major stores. Moreover, a larger pool of care-providers other than the mother is available to offer feedings. This presents greater convenience and allows for feeding in places where breast feeding might not be socially acceptable. On the other hand, breast feeding initially is a more time consuming process and – like home cooking – in the beginning, it may take more time. However, with experience breast feeding mothers have stated that breast feeding becomes easier, more enjoyable and even restful.<sup>17</sup>

Some well recognized complications of pediatric obesity include a myriad of health problems such as insulin resistance, type 2 diabetes, non-alcoholic fatty liver disease, hyperlipidemia, sleep apnea, pseudotumor cerebri, orthopedic complications,<sup>18</sup> as well as social rejection and scrutiny,<sup>19,20</sup> diminished education potential,<sup>21</sup> and a higher likelihood of living in poverty.<sup>22</sup> The full extent of its negative implications is difficult to appreciate, as obesity impinges on every aspect of a child's life and its consequences are likely to extend far beyond childhood.<sup>23</sup> Some even fear that as a consequence of pediatric obesity this generation of American children might be the first in history to have shorter life expectancy than their parents.<sup>24</sup> Due to the magnitude of this effect, it might be argued that the formula industry will “catch up” and engineer a lower-calorie alternative. This is not likely to occur, however, since both breast milk and infant formulas already contain equivalent quantity of calories per ounce, the amount required for optimal brain development. Calorie reduction as a mode of obesity prevention is not a recommended intervention during infancy, so lower-calorie alternative is not a plausible solution.

Healthcare professionals need to continue encouraging exclusive breast feeding during the first six months and continued breastfeeding for up to two years of age.<sup>20</sup> One often overlooked reason for this recommendation is that it may help decrease the risk of developing obesity. It might be difficult to imagine that the choice others make for us early on might have such a profound effect, however, studies indicate that infancy may be a crucial time when predisposition to obesity develops.<sup>25-27</sup> Pediatrician's voices must therefore be strong and clear to match the advertising campaigns by the formula industry. Pediatricians should advocate for breast feeding as zealously as they do for any other health-protecting and behaviour enhancing practice – for example vaccinations, safe car seats, a smoke-free

environment, and injury prevention – on behalf of society's largest vulnerable population group.

If we accept breast feeding as the norm against which every other foods for infants must be measured, then it should not be considered protective against obesity. Rather, other feeding methods must be recognized to increase the risk of being overweight, if their growth outcomes exceed those of breast fed infants. Health care providers should recognize this difference and provide anticipatory guidance indicating that infant formula feeding increases the risk of developing obesity and use it as a tool in an attempt to increase consumption of the most natural food source for infants, human milk.

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#### COMPETING INTERESTS

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