

# Early Intervention For Sleep Related Breathing Disorders:

*“The Nexus of Airway 3.0, Dentistry 3.0, and Medicine 3.0”*

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Early in life I was involved in politics and quickly learned how difficult it can be to influence the spinning world, especially when most people don't even know where we currently are. Every journey should begin with the following three questions - ALWAYS.

- 1- What is your view of the current situation?
- 2- What are your goals?
- 3- What is the most effective strategy to achieve your goals?

The three seminal questions can be summarized as follows. “Current Situation” is about interpreting the scientific evidence we have now as well as understanding the drivers of our healthcare system. “Goals” identify what we are aiming for and reveal our deeper purpose. “Strategy” is the battle plan to navigate towards our goals. It encompasses a commitment to multidisciplinary collaboration to screen, evaluate, and intervene when necessary. Let's check our egos at the door and figure out what is best for our children as we recognize they are all “snowflakes” and require unique approaches.

In what I call Airway 2.0 we learned many ways to treat a patient's AHI. We found many treatment interventions fell short as they lacked recognition of an individual's unique causal problem(s). Our focus then evolved to treating causes. Data collection has been elevated to war game status and we have begun doing our best to address the actual cause of a patient's airway condition. Roadmaps of possible treatments, based on stages of development, have been proposed but again, these sign posts are incapable of providing templated solutions for all. Perhaps artificial intelligence “AI” will eventually be able to inform treatment algorithms to help us untangle the complexities of airway problems, but is that enough? As earlier intervention approaches the status of prevention asymptotically, the recent target shift towards prevention ushers us into a new era of airway science, Airway 3.0. As we cannot prevent or intervene in what we

cannot detect, Airway 3.0 will recognize the earliest possible screening as its north star.

## **PART 1: "Current Situation"**

Many children suffer from medical conditions that have been correlated with airway problems. Obstructive sleep apnea "OSA" in the pediatric population "POSA" has been shown to lead to cognitive and social impairment, behavioral and mood disturbances, impaired growth and obesity.<sup>1</sup> Various levels of evidence support that a healthy airway translates into a healthier growing kid and probably a healthier adult. Conversely, evidence supports that an unhealthy airway leads to problems in young children as well as adults. Early childhood malocclusion "ECM" is frequently associated with symptoms of sleep disordered breathing/obstructive sleep apnea (SDB/OSA)<sup>2</sup>. In fact, skeletal deficiencies including; maxillary transverse deficiency (with or without a visual crossbite), long-face syndrome, mandibular retrusion, excessive vertical facial growth, or insufficient vertical development are usually a consequence of sleep related breathing disorders and do not self-correct.<sup>3</sup>

Every study ends with a call for future research to be a little more rigorous in some way. The authors have some doubt about the significance of their conclusions and are blowing the whistle on the lack of "strong" evidence. In addition to the deficiency in our available scientific evidence, which usually falls short of informing our treatment decisions, the healthcare delivery system itself is fraught with imperfect responses. Some academic organizations have become "set" in their ways (politics) and see no compelling need to recalibrate their response to the ever growing epidemic. The fear camps are divided into fear of over treatment versus fear of under treatment. Finally, corporate profitability adds to the deterioration of patient management for optimal health. Sometimes it seems like there's a lack of consensus that we even have a problem. Perhaps history can help us.

Malocclusions and airway deficiencies have been discussed by orthodontists and otolaryngologists for over 100 years.<sup>4</sup> At present, it is generally accepted that growth and development of the cranio-cervico-mandibular

system "CCMS" is determined by both genetics and the environment.<sup>5</sup> (please replace CCMS with the term cranio-facial-respiratory complex "CFRC".) Physical anthropologists recognize that high levels of activity and correct function must be maintained to stimulate the largest amount of growth and development in a child to prevent malocclusion. Treatment aimed at correcting a malocclusion at any age, including deciduous dentition, should focus on rehabilitating the entire CFRC as a whole, treating all of the dysfunctions and problems which may exist in each of the components of the CFRC. All dysfunctions should be corrected as early as possible when a lack of growth and development is diagnosed in either the primary, mixed or permanent dentition. Orthodontists, oral surgeons, general dentists, myofunctional therapists, speech and language pathologists, and breathing coaches need to work together more than they do today. Young infants need more guidance to masticate hard/semi-hard and fibrous diet, to breathe through their nasal airways, to perform physiologic swallowing, to use correct tongue function when talking, and to maintain a proper lip seal as part of the treatment. Airway problems are infrequently eradicated with a "monotherapy" approach which is all too common today. Parents and primary care physicians (especially pediatricians) and dentists from all specialties do not work sufficiently as a team when signs and symptoms become apparent.

Although the majority of our literature suffers from inclusion bias as well as lack of RCTs, perhaps the bigger problem is that even if we did have adequate RCTs for each individual therapy it would be useless because rarely is one treatment modality (monotherapy) the sole treatment required anyway. If RME or adenotonsillectomy do not yield a statistically significant outcome by themselves, that does not mean they weren't necessary. If you're traveling cross country in your car you'll need your tires filled with air.... but without checking your oil and your gas you won't get very far. The problem of interpreting the data/evidence is problematic when evaluating "monotherapy". Studies evaluating monotherapy are used by some as evidence that we should employ watchful waiting. We need evaluation of combination therapy studies which of course increases the complexity. Additionally, more work is needed on how a particular combination of therapies is decided on for each individual.

This conundrum with our healthcare system is explored more deeply in Peter Attia's just released bestselling book, *Outlive*. He manages to distill the myriad of issues into the framework of what he refers to as Medicine "2.0" versus "3.0". Our current medical system "2.0" and current dental system "2.0" are excellent at fixing what's broken, germ theory is an example. If your blood pressure is uncontrolled or your cholesterol or triglycerides are too high or maybe you've worn your teeth down due to your overactive sympathetic nervous system..... take a pill or let us cover your teeth or build them up.... we will react to your bleeding and bandage you up and you'll be fine in the "2.0" version of medicine and dentistry. Or will you? Alternatively, Medicine "3.0" is oriented more towards prevention as well as treating the underlying cause of the problem. Let me offer an example of how these approaches differ. If you see your physician and have a HbA1C of over 5.7% you will be told you are "pre-diabetic". You may be told to come back for more testing next year and when you get to 6.5%, the cutpoint for T2DM, you will be treated ala Medicine "2.0". Why would anyone with evidence of a metabolic dysregulation want to push off some type of intervention (which could be as simple as exercise) until they are sicker. Is it ethical to watch a crack in a molar cusp grow, possibly into the pulp or maybe to infringe on the holy biologic width, before offering to restore the tooth? Why would we want to wait for kids to be 7 years old to treat? Keep in mind that orthodontics is only one of many possible "intervention offerings" with the ability to address a contributing factor(s) to a sleep related breathing disorder. Hard and soft tissue surgery, non-surgical expansion, allergy treatments, release of tethered tissues, behavioral sleep medicine, and myofunctional therapy are alternate or collaborative solutions. It depends on the phenotype and data collection for that individual patient. Of course, if we are thinking orthodontics, there are specific treatment "decision trees" for primary, mixed and permanent dentitions.

Watchful waiting may work sometimes but when does it not work? How can we be sure no damage is being done to the brain while we fail to act? Loss of gray matter has been well documented by Gozal et al.<sup>6</sup> Behavioral problems, requiring very early intervention have been well documented by Bonuck<sup>19</sup>. We simply do not know when watchful waiting may have zero consequence and who wants to take a chance? The ethical issue of responsibility needs to be addressed. In the determination of whether a

young patient should be treated, does the burden of proof regarding any negative consequences fall on those advocating intervention or non-action?

Today we do not have a rational workflow to address our younger patients. There are no widely adopted screening protocols by pediatricians or pedodontists or orthodontists before the age of 7. Today for a child to seek treatment he/she really needs to already have florid signs or symptoms. Although we do catch some problem kids with medicine/dentistry 2.0, like cancer screening and treatment has taught us, earlier intervention leads to superior outcomes always. The American Association of Orthodontists position is that there is little substantiated evidence to suggest that expansion and growth modification will mitigate health risks of OSA in adulthood and question the benefit in recommending that parents bring their children in for treatment as early as 2-3 years of age.<sup>7</sup> Some even accuse dentists of unethically being interested in the money they make doing procedures. One argument against early expansion is that more robust RCTs need to be done which will take time and be expensive and why would we want to subject children to these treatments that may not even make a long-term difference in their lives anyway. Another argument against early intervention is acrylic poisoning. Yet another argument is if a child is gasping for air in bed at night that no orthodontic intervention is going to help or cure their OSA signs and symptoms and that they should seek medical attention only. This statement is followed by the question "would it not be better, and more in line with the AAO White Paper's guidelines, for such treatments to be carried out when these children are much older"<sup>7</sup> Some orthodontists do suggest it is just too complicated because of the anatomic and non-anatomic features involved. Others may feel unprepared to treat young children.<sup>3</sup> The AAO supports the position that orthodontists should screen for any obvious OSA signs and symptoms, albeit at age 7. If the orthodontist detects a problem, then referral to the appropriate medical professional is indicated even though it is general knowledge that very few medical professionals have an appreciation of the benefits of orthodontic treatment such as dento-facial orthopedic development. Finally, it is openly stated by some orthodontists that the practitioners who are intervening are doing so based on "biased" research. This represents the "current situation" regarding the position of the AAO on early intervention.

Unfortunately, robust screening, a prerequisite for early intervention, is currently non-existent for our younger population. This fact represents a major obstacle. No screening translates into lack of intervention. This puts us back to Airway 2.0 with treatment offered only when florid signs and symptoms present.

Reviewing the current literature reveals the following conclusions:

-Behavioral problems, sleepiness, secondary symptoms, blood pressure, and quality of life improved more with adenotonsillectomy than with watchful waiting although executive function and attention were equivalent.<sup>8</sup>

-Orthodontic widening should be performed before the suture becomes highly interdigitated to avoid fracture and fusion which could compromise future expansion if needed.<sup>9</sup>

-Transverse maxillary deficiency is moderately associated with greater degree of septal deviation among a sample of OSA patients.<sup>10</sup>

-Skeletal restriction in the transverse dimension and hyoid descent are associated with elevations in pharyngeal collapsibility during sleep, suggesting a role of transverse deficiency in the pathogenesis of airway obstruction.<sup>11</sup>

-Bimaxillary expansion can be a treatment option for improving respiratory parameters in children (3-14 years old) with sleep-disordered breathing.<sup>12</sup>

-AHI was enhanced after rapid maxillary expansion among children with OSA. It is recommended to diagnose the disorder at an early stage for reducing the adverse health outcomes.<sup>13</sup>

-Evidence indicated that MAA (alone or combined with RME) and RME + AT were associated with benefits for pediatric patients with OSA.<sup>14</sup>

-Otolaryngologists should be aware of the indications and benefits of MRE treatment, considering its possible multiple beneficial effects.<sup>15</sup>

-Naso-respiratory obstruction with mouth breathing during critical growth periods in children has a higher tendency for clockwise rotation of the growing mandible with disproportionate increase in the anterior lower vertical face height and decreased posterior facial height. Mouth breathers had increased overjet, increase in mandibular plane angle, a higher palatal plane, and narrowing of both upper and lower arches at the level of canines and first molars compared to the nasal breathers.<sup>16</sup>

-OSAS preschool children with retrognathic jaws could benefit from RME.<sup>16</sup>

-The study provides robust evidence of multiple neurocognitive impairments in children with SDB with no evidence of sparing in children with even primary snoring.<sup>17</sup>

-Pediatric OSA subjects show extensive regionally demarcated grey matter volume reductions in areas that control cognition and mood functions, even if such losses are apparently independent of cognitive deficits. This may be a result of delayed neuronal development, neuronal damaging processes, or a combination.<sup>6</sup>

-SDB has been associated with serious and long-term neurocognitive consequences in children. There is striking cumulative evidence of the existence of this association and a multitude of studies conducted worldwide support this finding. There is a need to identify vulnerable phenotypes of SDB and confirm that timely treatment may diminish or prevent SDB associated long-lasting damage to the central nervous system in children.<sup>18</sup>

-In this large, population-based, longitudinal study, early-life SDB symptoms had strong, persistent statistical effects on subsequent behavior in childhood. Findings suggest that SDB symptoms may require attention as early as the first year of life.<sup>19</sup>

-OSA has been linked to the development of allergies such as allergic rhinitis, asthma, and eczema, as well as the severity of allergic rhinitis. Evidence demonstrates a correlation between the severity of allergic rhinitis and the severity of OSA. Persistent and moderate/severe allergic rhinitis may increase the risk of developing OSA. Habitual snoring has been associated with heightened asthma symptoms in children, poorer asthma control, and increased healthcare utilization.<sup>20</sup>

- Nasal obstruction mainly caused by adenoid hypertrophy in children affects the craniofacial growth and development process, and the craniofacial deviations reported in the children are very similar to those in the adults with OSAS.<sup>21</sup>

-This epidemiological survey reveals a high prevalence of dental malocclusions and functional disorders. Oral respiration and the low position of the tongue at rest are the most important factors in the prediction of malocclusion.<sup>22</sup>

-A survey was sent to 85 orthodontists of full experience and their answers show that most orthodontist's patients are mouth-breathers when first examined. (1912)<sup>4</sup>

- Upper airway resistance during sleep with 2.5 times higher with oral breathing versus nasal breathing.<sup>23</sup>
- The relationship between sleep problems and craniofacial features is controversial with most studies suggesting that breathing patterns affect the function and morphology of craniofacial muscles and negatively affect the efficiency and how quickly the upper airway collapses in sleep.<sup>24</sup>
- Results indicate that tooth position can be changed by muscle therapy, even in non-growing subjects. This implies that muscle training can be a highly supportive therapy of orthodontic treatment.<sup>25</sup>
- The "Roadmap of craniofacial growth modification for children with sleep disordered breathing: a multidisciplinary proposal" by Yoon has created a significant amount of emotional reaction from all sides of the discussion.<sup>26</sup>
- It should be appreciated that the "Roadmap" article was conceived and presented as a perspective piece, not a clinical practice standard. It is through discussions around such perspectives that everyone can grow.<sup>27</sup>
- Upper airway resistance during sleep and the propensity to obstructive sleep apnoea are significantly lower while breathing nasally rather than orally.<sup>16</sup>
- Expansion of the maxilla led to a significant increase in airway volume in the treated patients, estimated at 5,183 mm<sup>3</sup> (+41.5%).<sup>28</sup>
- The present study showed that RME treatment determines a significant sagittal space increase in the upper airways space and a counterclockwise mandibular growth in children with OSA compared to a control group. These results suggest that a widening of the nasal cavities induced by RPE may support a return to physiological nasal breathing and promote a counterclockwise mandibular growth in children. This evidence confirms the crucial role of the orthodontist in the management of OSA in pediatric patients.<sup>29</sup>
- Changes in the voice due to RME were noted confirming that the tongue moves higher in the oral cavity, closer to the palate. RME also decreased recurrent naso-respiratory infections. RME led to reduction of adenotonsillar volume and a stiffening of the collapsible pharyngeal segment of the airway. Otolaryngologists should be aware of all the indications, benefits, and implications of RME treatment including middle ear function, OSA, enuresis and the voice.<sup>30</sup>



- Our study demonstrated the potential benefit of RME in treating children with persistent snoring and transverse maxillary deficiency (TMD). RME can improve snoring and the QOL of children with refractory SDB after AT.<sup>31</sup>
- Overreliance on AHI as the sole metric for defining OSA has led to the pursuit of oversimplified diagnostic tools. As a result, we miss the opportunity to fully characterize OSA and to better understand disease traits that may affect cardiovascular or other risks, and importantly, that may better inform treatment strategies and outcomes.<sup>32</sup>
- Splitting of maxillary bones occurs in a triangular way and the principal enlargement is observed at the incisor level, just beneath the nasal cavity valves. This process results in a wider anterior than posteriorly, which provides more favorable conditions for the nasal cavity and also the breathing pattern The present umbrella review concludes that significant and stable increases in the nasal and oropharyngeal space volumes and a decrease in airway resistance of growing children and adolescents, occur immediately after RME and at 3, 6- and 12-months follow-up.<sup>33</sup>
- Pediatric obstructive sleep apnea (OSA) has been shown to not only affect the quality of sleep, but also overall health in general. As the complex effects of pediatric OSA are discovered, they must be identified early so that healthcare providers can be better equipped to treat and even prevent them. Ultimately, adequate management of OSA improves overall quality of life.<sup>34</sup>
- In a noncontrolled study of children 5-12 years old with a history of adenotonsillectomy more than 2 years prior, RME achieved positive outcomes. Authors concluded the need for treatment for SDB should consider the association of symptoms and behavioral disturbances with the child's obstructive apnea-hypopnea index. RME might prove to be an alternative treatment for children with SDB refractory to adenotonsillectomy, improving quality of life and behavioral aspects.<sup>35</sup>
- Study designed to evaluate the effects of rapid maxillary expansion (RME) on nasal patency in mouth breathing (MB) children with maxillary atresia due to or not due to allergic rhinitis (AR) associated with asthma. In MB patients with AR, asthma, and maxillary atresia, RME increased nasal cavity volume and improved respiratory symptoms. However, it should not be used as the only treatment for managing patients with respiratory allergies.<sup>36</sup>

As dark and troubling as much of the current status appears, there is a glimmer of hope as Dentistry 3.0 is gaining momentum. Craniofacial modification by orthodontic/orthopedic techniques is increasingly incorporated into multidisciplinary management of sleep disordered breathing in children and adolescence.<sup>26</sup> From “sperm to worm” the dentition and craniofacial complex change with growth patterns that can be intercepted at critical time points. The referenced Yoon article<sup>26</sup> proposes a clinical guideline for application of multidisciplinary care with emphasis on dentofacial interventions that target variable growth stages. The key word here is emphasis. This article is brilliant as it recognizes the advantages of multidisciplinary early intervention for prevention. It provides a roadmap for the best choices of appliances for each developmental stage which leads us towards our goals and strategies moving forward. Airway 3.0 represents a potentially new era of earliest intervention and prevention. Airway 3.0 has seen major recent advancements with treating the causes which include: release of tethered oral tissues, myofunctional therapy to functionally improve muscles and increase coordination, sleep hygiene, cognitive behavioral therapy, surgery to reduce nasal obstruction, oral appliances and mouth tape and breathing exercises and so many more options.

Dentistry itself is joining the movement and on the verge of crossing the Rubicon. Dentistry 2.0 has leveraged modern science and technology to repair and replace body parts in a biomimetic way. No other institution providing higher dental education in the world has equaled the Kois Center in its unrelenting pursuit of excellence. With Dr. John Kois at the helm, an evidenced based approach to constantly improving dentistry is always on the menu. The cutting-edge educational mecca is now offering courses to educate dentists on how to approach restorative dentistry for airway compromised patients. Here comes Dentistry 3.0. (Spoiler alert: airway issues are the root cause of most dental problems) This educational opportunity is the first in the world to recognize that excellence in restorative dentistry is not possible while viewing airway problems as an unwelcomed stepchild. No longer is simply restoring the teeth to proper form and function sufficient for long term stability or even the patient’s optimal health. Appreciating the role airway has played in the mechanism(s) of breakdown is now being recognized as a crucial determinant in deciding how to restore a patient. Home sleep studies are

now recommended pretreatment and during treatment to reveal the impact on the patient's airway.

By now the reader will hopefully have an idea about what our shared goals might look like. As the component goals of optimal health are collectively acknowledged, the strategy to get there will unfold.

## **PART 2: "Goals"**

*There comes a point where we need to stop just pulling people out of the river. We need to go upstream and find out why they're falling in.*

Bishop Desmond Tutu

*The power of imagination can transform medicine from treating diseases to preventing them.*

Christian Guilleminault

*The aim of medicine is to prevent disease and prolong life; the ideal of medicine is to eliminate the need of a physician.*

Willam J. Mayo

Our goals should be to prevent people from falling in upstream. The ultimate challenge is to approach our profession in the context of airway 3.0 and dentistry 3.0.

Our goals could be as simple as screening for sleep related breathing disorders in all children to support optimal health for all from cradle to grave. This doesn't deny possible contributions from genetics or poor lifestyle choices. No doubt our culture, with our pseudo food and stress and sedentary lifestyle, is inflammatory and killing us slowly. Can we all agree on the importance of a properly functioning cranio-facial-respiratory-complex? Do we value having a larger proportion of adults who don't

suffer from hypoxia and sleep fragmentation as well? We already understand the impact of chronic inflammation on our bodies. I'm sure we can all agree on the desire to reduce; Heart disease, Cancer, Strokes, Chronic respiratory diseases, Alzheimer's disease, Diabetes, Liver disease and kidney disease to name a few.

If only we could evaluate which constellation of signs and symptoms a child would present with that would inform our choice between treatment versus watchful waiting. Because we don't have adequate outcome information now, we have a decision to make. Is it wiser to error on the side of rare but possible negative outcomes associated with treatment or to do nothing until a more obvious acute condition stares us down.

The choice we have is the story of Dentistry 2.0 versus 3.0. Do we want to wait for a significant problem to develop before acting, throwing caution to the wind regarding potentially negative health consequences because of the limbo period, or shall we intervene. If we decide to intervene, we should appreciate that monotherapy may be the first step but a lack of a full response does not comport with unnecessary treatment. Rather it should push us to investigate all the treatment options including combining some.

There is no doubt that living in our contemporary culture has created great health challenges. The good news is that Dentistry 3.0 is sprouting, and although there are "suggestions" for age-appropriate treatment protocols, this doesn't espouse a black and white approach for all patients. It signals us to react to structural, functional, and behavioral problems that arise whatever the level of development. Waiting to see an orthodontist until age 7 for a young child with even seemingly minor symptoms is akin to sending away a prediabetic or prehypertensive patient and telling them to come back when their condition has advanced to T2DM or full-on hypertension.

Do we have universal protocols for screening or treatment? Of course not! Should we remain vigilant of all of our children's signs and symptoms of an airway issue? Of course we should! Parents, primary care doctors including pediatricians, and all healthcare providers need to work together. As our modern culture shows no signs of decreasing the negative

epigenetic influences on us, the incidence of airway problems is growing at a mind-blowing rate. Dentistry 3.0 is one way to stem the tide on the increasing prevalence of potentially preventable medical conditions. We have an opportunity to help our patients have a healthier life rather than becoming reliant on the pharmaceutical industry to counter their metabolic issues. Perhaps we can even expect their healthspan to approximate their lifespan more closely.

Goals for screening need to be clarified. What types of screening are appropriate. Should screening be based on signs and symptoms, or should all children be screened. There also needs to be an evidence-based rationale for interpreting the results of screening and sleep studies as well. Data collection can impressively fill our charts, but we need to learn how exactly it can help us in determining the best treatment choice(s). Finally, what does the workflow look like from data collection to sleep studies to multidisciplinary treatment. The workflow should be simple and repeatable while the followup protocols should provide the necessary guard rails for the rest of their lives.

### **PART 3: "Strategies"**

Sleep related breathing disorders are a preventable lifelong condition. Having open discussions on the preceding two parts will guide our strategies. There is a need to implement programs to screen for and treat young children.

The concepts of Medicine 3.0, Dentistry 3.0, and Airway 3.0 have been introduced and represent an opportunity to increase not only one's lifespan, but most importantly the length of one's healthspan. No one wants to live a long miserable unhealthy life.

There are no stand-alone gate keepers of airway health. Orthodontists may be highly trained to manage skeletal growth and development, but they are not likely the first providers on the crime scene. The first witnesses will be the nurses and physicians in the delivery room. The

second level of sentinels will include the pediatricians and parents. As signs and symptoms are revealed the list will likely expand with the schools playing a “backstop” roll. Finally, all physicians of every specialty should be educated about whether the array of symptoms they treat could be a result of an airway problem. Medical school curriculums need to do some catching up.

As more physicians and dentists openly share common goals we are stepping into an exciting new era in health care, one where Medicine 3.0 and Dentistry 3.0 are becoming game changers for children’s health. As wonderful as it is that more energy is being focused on the causes of medical and dental conditions, we now have an opportunity to raise the bar even higher by closing the gap between the earliest intervention and prevention. There’s lots of work ahead but the juice is worth the squeeze.

While identifying the current situation, the goals, and the strategies to achieve them is critical, perhaps the most important overarching question is...why you have chosen this healthcare journey. Why do you do what you do?

Moving forward, the tactics we use for Dentistry 3.0 will become as much a part of our lives as eating, breathing, and sleeping. Excelsior!

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*People don’t buy what you do; they buy why you do it and what you do simply proves what you believe. In fact, people will do the things that prove what they believe.”*

Simon Sinek

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