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Original Article

The SBAHC Early Intervention Model: A Multidisciplinary Framework for Infants and Toddlers with Disabilities

Bader M. Bader,[1] Amal Alrayes,[2,*] Wahid Ali,[2] Azza Al Borih,[1] Manal Al Sonbul,[1] Lamia Al Faleh,[1] Zakria Al Muhawwis,[1] Majdaldeen M. I. Ashqar,[1] Yousef Alshraah,[1] Sara Aldeghather,[1] Hafsa Ibrahim,[1] Saud A. Alabdullah,[1] Rachid El Khoury,[1] Areej Al Muharib,[2] Khalid hundallah,[2] Kamel Alenazi.[2] Megdi Eltayeb,[3] Mohammad F. Safi,[4] Fiona Abou Abdou,[3] Banan Khairi Suwan[3]

1. Rehabilitation Department, Sultan Bin Abdulaziz Humanitarian City, Riyadh Saudi Arabia.
2. Medical Affairs Department, Sultan Bin Abdulaziz Humanitarian City, Riyadh Saudi Arabia.
3. Qatar Foundation, Doha, Qatar.
4. Department of Rehabilitation Sciences, Qatar University, Doha, Qatar.

*Corresponding Author: aalriyess@gmail.com

Abstract

Background: Early intervention plays a crucial role in maximizing the developmental outcomes of infants and toddlers with disabilities. Nevertheless, there is a lack of coordination between medical, surgical, rehabilitation, and social care systems with early intervention services in Saudi Arabia being fragmented. **Objective:** To describe and introduce the Early Intervention Model designed at Sultan Bin Abdulaziz Humanitarian City (SBAHC) as an interdisciplinary model of working with infants and toddlers with disabilities. **Methods:** This paper is a descriptive white paper describing the structure, components, and operational workflow of the SBAHC Early Intervention Model. This model coordinates medical, surgical, and rehabilitation care by integrating these services around a centralized early intervention program, allowing a quicker multidisciplinary evaluation and plan of care coordination in a single system. **Results:** The SBAHC model also offers an opportunity to access various clinical specialties in one sitting, facilitating early detection, comprehensive assessment, and individualized intervention pathways. These pathways lead to discharge children into normal developmental boundaries, multidisciplinary intervention in an intensive inpatient facility of complex cases and referring to home-based care programs to provide continuous monitoring and family-centered support. **Conclusion:** The SBAHC Early Intervention Model is a structured and possibly scalable model that can enhance the coordination of care and access to many services for infants and toddlers with disabilities. Nevertheless, being a conceptual and working model, it needs more empirical analysis to evaluate its efficiency, cost-effectiveness, and long-term outcomes.

Keywords: Early Intervention Model, Multidisciplinary Framework, Infants Disabilities, Cerebral Palsy, Early intervention, Malnutrition

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Introduction

Childhood, especially during the first three years of life, is a critical period of physical, cognitive, and psychosocial growth of a child. At this age, infants and toddlers experience a high rate of physical development, brain development and functional development, which establish the basis of a healthy and well life throughout their lives (Purdy, 2019). The early childhood development should be monitored and supported to achieve the best development results.

The Center of Disease Control and Prevention (CDC) divides children into developmental groups: newborns (birth to two months), infants (two months to one year), and toddlers (one to three years), and then preschool-aged children (three to five years) (National Center on Birth Defects and Developmental Disabilities, 2021). The rapid neurological growth of this early developmental stage is marked by the brain being approximately 75% of its adult weight at the age of two, with cognitive, motor, and language growth being highly active (PARIS et al., n.d.; Lenneberg, 1967; Webb, 2017).

Early childhood disability is a major worldwide health issue with millions of children being affected and it presents challenges to an individual, family and health care system. It is characterized as a state of body structure or functioning deficits that can cause activity limitations and restrictions on participation (Nations, 2023). There are about 240 million children with disabilities worldwide, and a significant part of them have moderate-severe functional disadvantages (unicef, 2023; Olusanya BO, 2022). The national level of the issue is characterized by the number of people with disabilities constituting about 7.1% of the population in the Kingdom of Saudi Arabia (information, 2023).

Figure 1. Disability in Saudi Arabia

Infants and toddlers with a disability or developmental delay are highly susceptible to poor health and development. They can be caused by genetic disorders, obstetrics or perinatal complications, and infections, or they can be environmental (UNICEF, 2023). Such conditions may result in long-term impairments related to physical, cognitive, and social development, and more risks of morbidity and mortality without prompt detection and treatment (Organization, 2012; Organization, 2023).

Children with disability are at greater risk of being malnourished, which can be represented as wasting, stunting, and poor growth (UNICEF Disability Team, 2022). Some 25% to 40% of infants and toddlers are reported by their caregivers to have feeding problems, mainly colic, vomiting, slow feeding, and refusal to eat (Anne-Claude Bernard-Bonnin, 2006). There is a strong interrelationship between malnutrition and disability since there are many physical difficulties that might affect them, Other than that, they need to rely on other people to feed them or they have feeding or swallowing difficulties, which can lead to recurrent chest infections that need multiple hospitalizations for curing and also that might require special food consistency or special feeding equipment. In addition, they might have gastrointestinal problems

such as gastric esophagus reflux diseases, constipation, or malabsorption/maldigestion, which can affect their nutritional status and growth (Kerzner B. M., 2015) (Kerzner B. , 2009). Malnutrition is considered one of the most crucial challenges and problems that face children with disability as it might have secondary consequences, including poor health outcomes, Poor growth, and development, and affect their psychological, cognitive, motor abilities and, leading to long-term problems and, in extreme circumstances, death. Children who suffer from chronic malnutrition show signs such as mental retardation and changes in behavior (Caresma Chuwa, 2020). Even after treatment, nutritional deficiencies can have long-term effects, such as mental disability and digestive disorders, that can last a lifetime (Bhutta, 2008). Malnutrition is a missing aspect that healthcare facilities and society can disregard and might consider normal and non-treatable for children with disability as it is seen as part of their condition. Malnutrition can be a significant barrier for children with disability and hinder them from improving their physical and cognitive abilities, also acute malnutrition can lead to morbidity, mortality, and disability, as well as impaired cognitive and physical development with an increased risk of recurrent infections (Wali N, 2019). It might be used to discriminate against them from society and accessibility to essential facilities, either in education or healthcare facilities; they also could be excluded from any medical or rehab institutions due to their malnutrition.

Therefore, one of the most important principles and main systems for the care of infants and toddlers, is early intervention or early childhood intervention, which means easy access for children with disabilities, to all health, educational, and social services, that provide them with diagnosis and comprehensive intervention, to counteract the obstacles that prevent them from developing and growing normally (UNICEF D. M., 2021).

The use of early intervention program is a highly known approach to deal with these issues. It includes the early delivery, coordination of multidisciplinary services to children at risk of or experiencing developmental delays, such as medical, rehabilitation, and family support interventions (UNICEF, 2021). It is shown that early intervention programs can greatly enhance the developmental outcomes, increase functional abilities, as well as decrease the requirement of more intensive interventions in the future (Black RE, 2017; Britto, 2017; Daelmans, 2015; Edmond, 2019). Meeting children's needs at an early and critical stage of their development greatly assists in preventing the long-term impact of disability and significantly reduces the financial burdens on the children's parents and governmental and non-governmental institutions concerned with childcare (UNICEF D. M., 2021). The early identification and intervention system reduces the time and effort expended, as it provides all the services mentioned previously in one place and with one multi-disciplinary team (F. Bellour, 2017). Such programs also assist the families as well as enhance the access to resources, guidance and coordinated care (María Auxiliadora Robles-Bello, 2013).

Multidisciplinary and family-centered approaches are organized as early intervention systems on an international basis. The United States and European models of early childhood intervention programs are based on the principles of early detection, coordinated services delivery, and constant monitoring (Act, 2023; Temprana, 2005). In a similar manner, international efforts being promoted by various organizations like UNICEF promote integrated and universal early intervention services that are personalized to the national

situation (UNICEF, 2023).

The cost of early intervention programs is not measured only by the cost paid to run these programs, but rather by the cost-effectiveness that these programs achieve in the long term for children with disabilities. The effectiveness of this impact on education, employment, independent living, health care, and quality of life is studied and calculated, which reduces future spending largely on governmental economic and societal. Also, this makes early intervention programs that focus on early childhood development have an exceptional and significant impact on reducing crime rates and increasing the number of workers and learners. Some studies urge that any future economic development plan must prioritize early childhood development through early intervention programs (Rolnick A, 2003) (Geelhoed, 2020).

In the Kingdom of Saudi Arabia, there has been a lot of effort to assist children with disabilities in terms of healthcare, educational, and social programs. These are early screening programs, rehabilitation services and special educational support systems (KSA national source of government services and information, 2023). Nevertheless, even with the existence of such services, they tend to work independently, thus leading to fragmentation, duplication of efforts, and delays in diagnosis and intervention. This absence of integration restricts access and accessibility of early intervention services.

Although the Kingdom of Saudi Arabia has several existing early childhood and disability-related services, these services remain fragmented, with limited integration of medical, rehabilitation, and social services. As it currently stands, there is no single national model that offers a coordinated multidisciplinary approach to early intervention of infants and toddlers in one system.

Therefore, the aim of this paper is to present, describe and outline the SBAHC Early Intervention Model as a multi-disciplinary, integrated model that is aimed at enhancing early detection, care coordination, and intervention pathways of infants and toddlers with disabilities.

This model is clinically appropriate in the sense that it not only covers missing links in care coordination and service availability but also offers a possible template to institutional and national-level application of early intervention services in Saudi Arabia.

Materials and Methods

Model Description

The SBAHC Early Intervention Model is a model that has been created at the Sultan Bin Abdulaziz Humanitarian City to assist infants and young children aged less than 5 years with developmental issues between the ages of one month to three years of age. This model aims at early diagnosis and early intervention based on a combined approach of medical therapy, surgical therapy, and rehabilitation. All these elements are important to enhance the most beneficial development and enhance long-term outcomes.

The SBAHC Early Intervention Model has been built up using the systematic combination of multidisciplinary clinical expertise, best international practices and institutional service delivery requirements. The process of development was also influenced by the laid-down international early intervention models, such as those of the World Health Organization and the concepts stated in the Individuals with Disabilities Education Act (IDEA) Part C focusing on the need to identify the problem as soon as possible, provide care through the family, and deliver services in a coordinated manner.

Besides international standards, the model was informed by local practice issues that were evident in the local healthcare system, such as the fragmentation of the services, delays in diagnosis and poor inter-specialty coordination. Development was done in an iterative manner with interdisciplinary consultations with pediatricians, neurologists, rehabilitation specialists and other allied health professionals. This participatory methodology made sure that the model is evidence-based as well as contextually adjustable to institutional and national health care contexts.

The resulting model incorporates a medical, surgical and rehabilitative services into a single, patient-driven model. It is meant to facilitate clinical workflows, improve provider to provider communication and minimize delays in diagnosis and intervention which leads to improved developmental outcomes in infants and toddlers.

Conceptual Framework

The SBAHC Early Intervention Model is supported by a formal conceptual framework that coordinates the provision of care into a sequence of stages that are connected to each other. They are early detection and referral, multidisciplinary assessment, individualized intervention planning, implementation of targeted interventions and continuous monitoring and follow-up.

This model is system based where each phase is interdependent and helps in a complete cycle of care. This is made possible through early detection mechanisms that can help in early identification of developmental risks and multidisciplinary assessment that would provide a holistic view of the medical, functional as well as psychosocial needs of the child. Individualized intervention planning converts the results of an assessment to specific therapeutic plans and these plans are, in turn, achieved through a coordinated set of clinical services.

Another aspect of the model is continuous follow-up and reassessment which will enable the dynamic change of care plans according to the progress of the child and his/her changing needs. The active involvement of families in all the stages is also included in the framework as caregivers are identified to be key stakeholders in the process of intervention.

Figure 2 (Conceptual Framework of SBAHC Early Intervention Model) is a visual representation of this framework and shows the nature of the cyclical and integrated nature of the care pathway.

Target Population

The SBAHC Early Intervention Model is intended to be used with infants and toddlers aged between 1 month and 3 years of age who are at risk of developmental delay or have already acquired developmental disabilities. The target population is a wide range of conditions, such as but not limited to neurological ones (e.g., cerebral palsy, epilepsy), genetic syndromes, sensory impairments (hearing and vision) and developmental or motor delay.

The children can be referred to the program in different channels such as primary healthcare providers, neonatal follow up clinics, specialist referrals or parental concerns of developmental milestones. The model focuses on identifying high-risk populations early, e.g. premature babies, low-weight babies or those with perinatal problems.

The model targets to capitalize on neuroplasticity by targeting this critical period of development and ensuring optimal effectiveness of early therapeutic interventions on the long-term functional outcomes and lessening the severity of the disability.

Population and Setting

The model used in the Sultan Bin Abdulaziz City of Humanitarian Services (SBAHC) is SBAHC Early Intervention Model which works at the level of the tertiary level and focuses on the comprehensive care of people with disabilities. The center offers a comprehensive facility with a high level of diagnostic, therapeutic and rehabilitation services that allows the provision of multidisciplinary care in one institution.

Since this is a conceptual and operational model, not an empirical study, a population level data, sample size calculation or statistical analysis is not provided. The model is however intended to be scaled and flexible to be used on a larger scale in other similar healthcare environments.

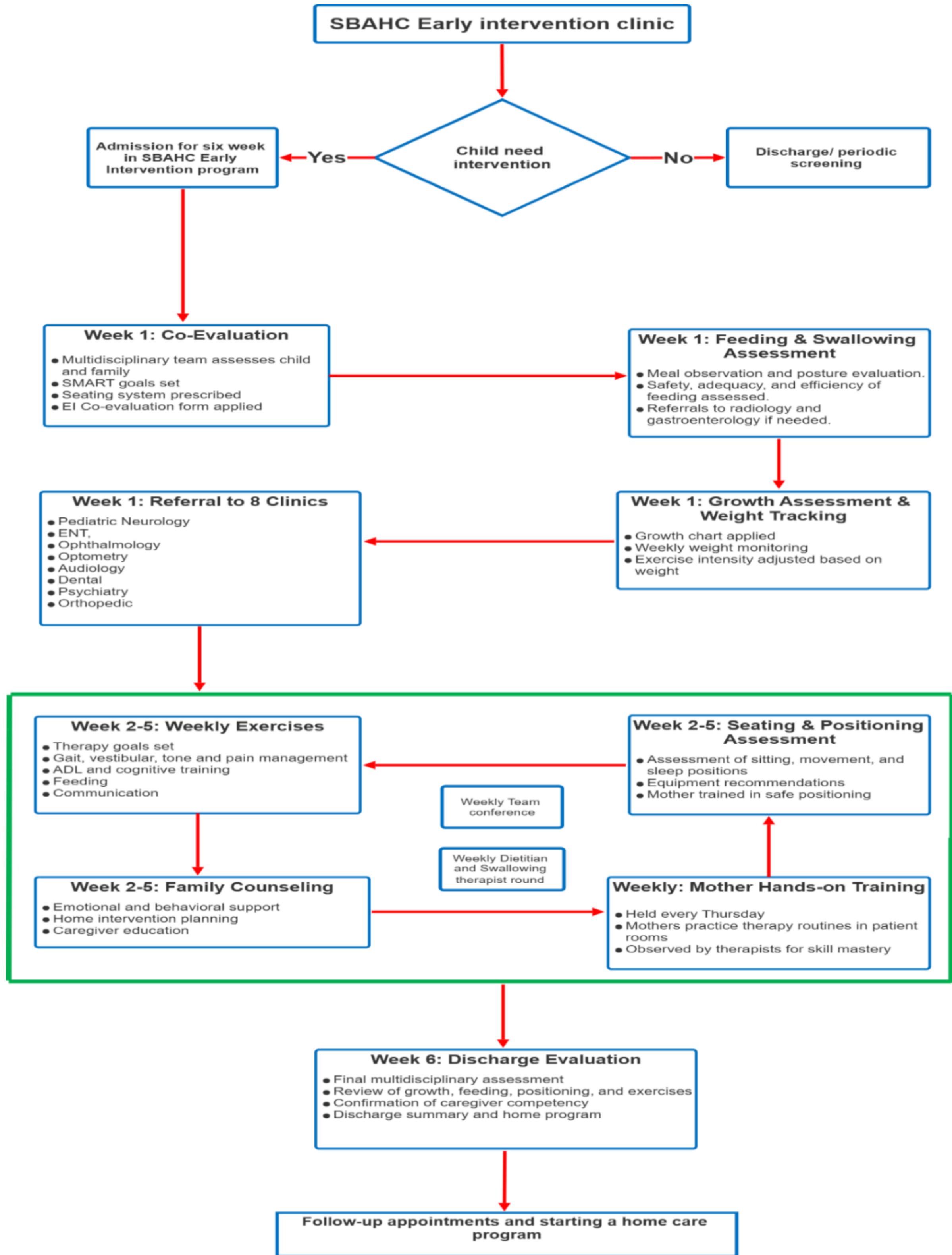

Figure 2. Pathway of Early Intervention Program

Intervention Components

The SBAHC Early Intervention Model is based on three fundamentals of intervention: medical management, surgical intervention (where appropriate) and rehabilitation services. These domains act in a synergistic manner in a

multidisciplinary system to deal with the complex and multifaceted needs of the children with developmental challenges.

Medical management entails diagnostics analysis, medication and follow-up on the underlying diseases. This involves the treatment of neurological conditions, nutrition deficiency and comorbid medical conditions which can influence development.

When necessary, surgical intervention is done to cope with structural or functional deficits that are not dealt with conservatively. This can be orthopedic surgeries, ENT surgeries or any other corrective surgeries to enhance functional outcomes and enable inclusion in rehabilitation programs.

The main element of the model is rehabilitation services which involve physical therapy, occupational therapy and speech and language therapy. These services revolve around the development of motor skills, communication, integrating sensory and functional independence. Interventions are personalized, which is based on detailed assessment and presented in goal-oriented therapy plans.

A combination of these elements constitutes a comprehensive intervention system which responds to both the medical and developmental aspects of early childhood disability.

Medical Intervention

Children who take part in the program are subjected to frequent medical evaluations and have personalized care depending on their needs. This involves checking vital signs, administration of medications, and ensuring adequate nutritional status. In the management of chronic conditions, prevention of complications and healthy growth and development, continuous medical follow-up is paramount.

Surgical Intervention

Surgical intervention might be necessary when medical management proves to be inadequate. Surgical operations may be simple corrective measures to more complex operations that may seek to correct structural abnormalities. The early surgical treatment assists in increasing mobility, decreasing pain, and functional independence, thus leading to improved quality of life.

Rehabilitation Intervention

Rehabilitation is an essential part of the SBAHC Early Intervention Model with a variety of therapeutic services depending on the developmental needs of each child as follows: Physical therapy is aimed at the enhancement of gross motor skills (sitting, crawling and walking), Occupational therapy improves fine motor functions and aids in everyday functioning and Speech and language therapy deals with communication issues and promotes socialization.

The combination of medical care, surgery and rehabilitation helps every infant or toddler develop well and achieve a good start in life.

General principles of the Model

The SBAHC Early Intervention Model would help to decrease or remove developmental and medical impediments to the development of a child. Major areas of concern are:

Growth Monitoring

Health checkups and medical support are given regularly to monitor developmental milestones and early detection of delays. Constant observation will enable the intervention in time and promote

consistent developmental growth.

Feeding and Nutrition

Nutrition plays a key role in a child's growth and development, so the program offers special feeding strategies for each child. Such advice includes tips on breastfeeding, how to feed with bottles and introducing solids to each child so they get the required nutrients for healthy growth. Attention to nutrition ensures that people eat healthy and avoid deficiencies in their diet.

Seating and Positioning

Children with physical disabilities need to be properly positioned. The program offers adaptive devices and instructions to enhance the sitting position, comfort, and active involvement with the surrounding world.

Therapeutic Exercises

Physical and occupational therapy exercises are included in the daily routine to improve strength, flexibility, coordination and independence in everyday activities.

Parental Education

One of the important aspects of the model is family involvement. Parents receive training to apply therapeutic interventions in the home environment, complementing clinical interventions, and enhancing continuum of care.

Integration Mechanism

Another unique characteristic of the SBAHC Early Intervention Model is that the model is integrated in service delivery and this is operationalized via a centralized Early Intervention Clinic. This clinic is a one-stop solution whereby children are evaluated in a multidisciplinary manner in a single visit, which greatly minimizes delays that may be witnessed in the multiple care system.

The clinic visit is a collaboration between specialists in the various fields, who jointly assess the child, present the findings in real time and jointly work on creating a single care plan. This model will do away with the need to have several appointments in various departments and improve communication between healthcare providers.

Standardized assessment protocols, common documentation systems, and coordinated scheduling processes are other mechanisms that facilitate the integration mechanism. Based on the results of the initial assessment, the individualized care plan is developed and includes the suggested interventions, schedules, and the follow-up plans.

This collaborative and centralized model is efficient in clinical practice as well as it enhances the experience of caregivers by giving them clear directions, lightening their logistical load, and continuity of care throughout the intervention pathway.

Early Intervention Program Pathway

The SBAHC Early Intervention Model is implemented using a structured and sequential care pathway that guarantees the timely assessment, coordinated intervention and continuity of care of infants and toddlers with developmental delays. It is a multidisciplinary service pathway that incorporates multidisciplinary services to create a unified framework and reduce fragmentation and maximize clinical outcomes. The program is made up of interrelated steps, starting with the first entry, and continuing with discharge and home based follow up as shown in Figure 2 (Pathway of Early Intervention Program).

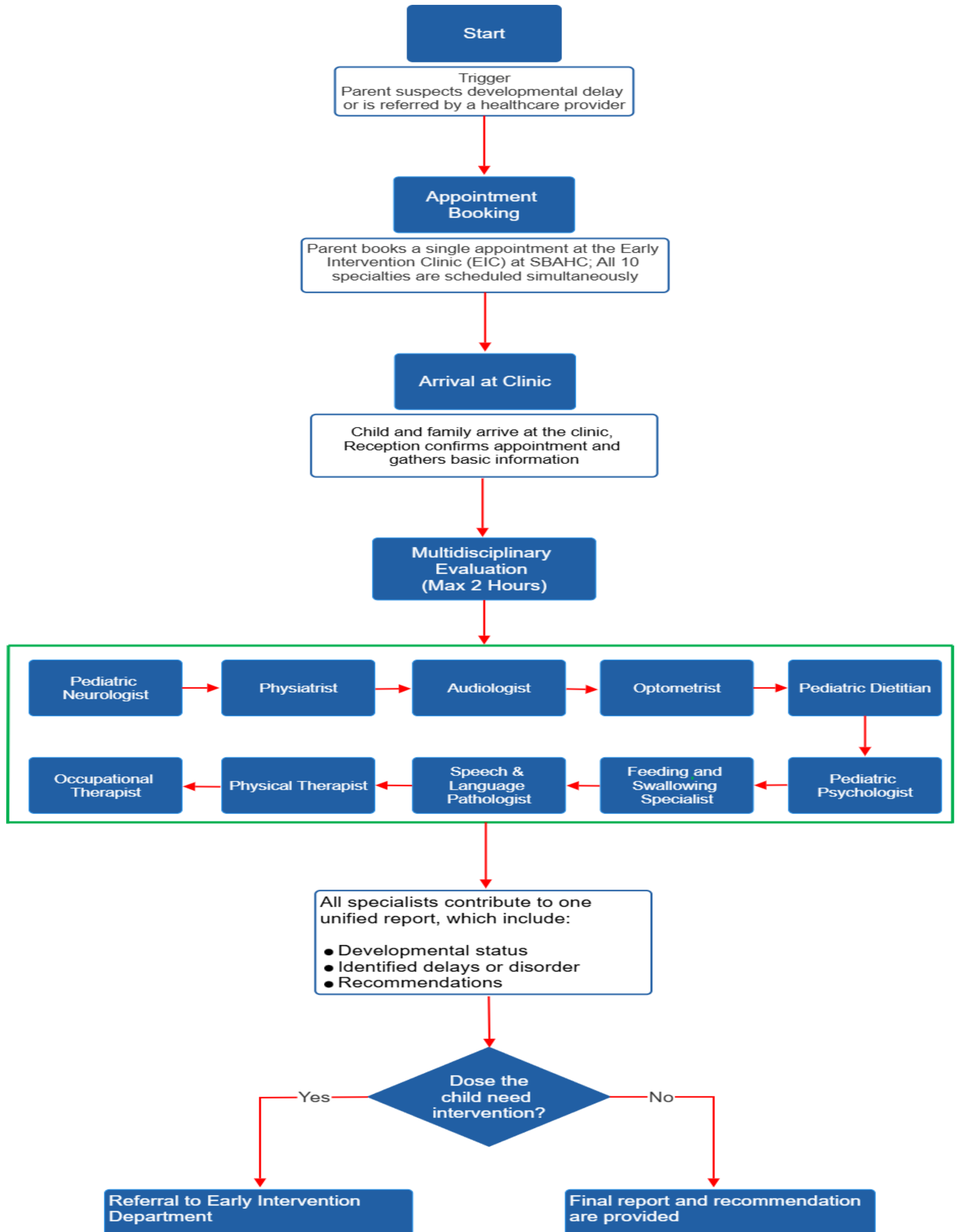

Figure 3. Pathway of Early Intervention Clinic

Stage 1: Early Intervention Clinic (Entry Point)

The Early Intervention Clinic is a main entry point to the program and is one of the innovations of the SBAHC model. This clinic offers a complex multidisciplinary evaluation with one visit as opposed to the traditional referral system where one has to make numerous visits to multiple specialties in order to get a complex evaluation that is usually done in two hours.

At this age, a group of experts are involved in assessing the child and this might consist of pediatric neurology, physiatry, audiology, optometry, dietetics, psychology and rehabilitation therapists. All specialists carry out domain-specific tests but add to a common knowledge of the condition of the child.

This combined method allows a quick detection of developmental issues, minimizes the time lost in diagnosis and allows prompt clinical decision making. Finally, at the end of the visit the multidisciplinary team generalizes the findings and identifies the most suitable care pathway, this can be in terms of admission to the program, referral to other services or discharge with guidance.

Stage 2: Admission and Nursing Assessment

Those children who need to be subjected to structured intervention are placed under a specific early intervention program which is normally a six-week program.

Infant / Pediatric Initial Admission Assessment

After the patient is admitted, a full Infant/Pediatric Initial Admission Assessment is done by the nursing team. The first step of the assessment is to note down the child's date of birth, age, gender, nationality and which caregiver the child is with and their relationship. The nursing team makes sure the child is using any aids, for example, vision aids, hearing aids, walking aids or splints.

Nursing teams should always update the alert system as a key part of their admission process, such as resident falling, chances of pressure injuries, measures for isolation, hearing or vision conditions, seizure risks and aspiration risk. To guarantee safety and correct identification, the child is given an identification band. Nurses gather further critical information regarding allergies, infectious and communicable diseases, immunization records, past medical history, medications taken prior to admission, and relevant socioeconomic and cultural considerations.

A variety of screenings and assessments are then applied, including developmental milestones, psychosocial, fall and safety risk, neurological, musculoskeletal, functional, cardiovascular, pulmonary, gastrointestinal, genitourinary, nutritional, integumentary, pain, and skin assessments. In addition, the child's weight, height, head circumference, and BMI are measured to establish a baseline for monitoring growth and development. Finally, the multi-disciplinary team is informed of the child's arrival and provided with the initial assessment details to ensure coordinated and effective care planning across all relevant specialties.

Infant / Pediatric daily monitoring

As part of the SBAHC Early Intervention Program, daily monitoring of infants and pediatric patients is a critical nursing responsibility to ensure ongoing assessment and timely response to any changes in the child's condition daily, that include, any new behavioral change, physical change and nutritional intake. As a result of this daily monitoring, the healthcare team understands the child's health and progress very well during the program. Weight

will be measured every Saturday by the nursing team.

Stage 3: Multidisciplinary Co-Evaluation

After the admission, co-evaluation is carried out by the multidisciplinary team. This multidisciplinary evaluation is a combination of the results of multiple disciplines with the aim of creating a comprehensive picture of the developmental profile of the child.

Co-evaluation process is based on interdisciplinary dialogue and joint decision-making. Clinical findings are also discussed in a group and it is possible to identify interrelated factors which influence the development of the child. Notably, it is a stage where caregivers actively participate, having information on the behavior of the child, the surrounding and how it functions daily.

This step will result in the development of a personalized intervention plan that will address clinical priorities and family needs and expectations.

Stage 4: Comprehensive Clinical Assessments

A set of standardized and specific tests are carried out to test the child on several developmental areas. Such tests act as a guarantee of objective assessment of functioning capabilities, as well as guide specific intervention programs.

The main areas of assessment comprise of as follows:

Feeding and Swallowing: Assessment of oral-motor skills, swallowing safety and feeding efficiency with validated instruments and through clinical observation.

Nutritional Status: Evaluation of diet, growth, and nutritional deficiencies to direct customized plans in nutrition.

Motor Function: Gross and fine motor skills, posture and mobility are assessed using standardized functional scales.

Communication and Language: A test of receptive and expressive language skills, and other communication requirements.

Cognitive and Behavioral Functioning: assessment of developmental milestones, adaptive functioning and psychosocial aspects.

Sensory and Visuals: Evaluation of sensory processing, visual perception and oculomotor control.

These in-depth analyses give a multidimensional portrait of the child on which evidence-based interventions are based on goal-oriented interventions.

Stage 5: Seating and Positioning

Early intervention should include a proper sitting and positioning specially to motor impaired children. During this phase, the assessment of the optimal postural positioning, support and functional positioning is done using specialized assessment tools.

Personalized seating arrangements can be made to ensure comfort, avoid secondary complications (including contractures or deformities) and ease of engagement in therapeutic activities. The proper positioning techniques are taught to the caregivers so that the same is done in both the clinical and home settings.

Stage 6: Family Counseling and Engagement

One of the key pillars of SBAHC Early Intervention Model is family involvement. Organized counseling

is also held to help the caregivers emotionally, inform them on the condition of the child and ensure they are also able to actively engage in the intervention process.

Individualized counseling, group education and development of home-based intervention plans are part of this stage. Caregivers receive realistic approaches to assist their child in developing in everyday activities to achieve continuity of care outside the clinical environment.

Stage 7: Mandatory Multidisciplinary Referrals

The children are taken to special clinics based on their initial evaluation so that they can be further evaluated and attended to accordingly. These referrals have got broad coverage of all areas of concern in the medical and developmental field.

Specialty clinics can be pediatric neurology, otolaryngology (ENT), ophthalmology, audiology, and orthopedics, dental and visual rehabilitation. Every referral will help to achieve the perfect diagnosis and intervention plan. Such well-organized system of referral can guarantee that there is no single area of the child condition that is ignored and care is well coordinated across the specialties.

Stage 8: Team Conference

Multidisciplinary team meetings that are conducted every week and led by a physiatrist and include a Pediatrician, Clinical Dietitian, Occupational therapist, Speech therapist, Physical therapist, Social worker, Case manager, and Nurses. The purpose of the team conference is to discuss the new, discharged, and current patients to share information, discuss treatment plans and goals, and review patient progress, then the plan will be fully explained to the family. During this conference, each team member provides their goals, perspectives, or any barriers that affect their treatment plan, which contribute to a comprehensive understanding of the patient's condition and needs. Team conference

Stage 9: Daily Therapeutic Interventions

The fundamental elements of the program include daily, in-depth and person-centered therapeutic interventions. These interventions are individualized according to the needs of the child, and are based on the objectives set in the course of multidisciplinary assessment. Physical therapy to enhance mobility and strength, occupational to enhance functional skills and sensory integration and speech and language to support communication and feeding abilities may be included in the therapy sessions. Interventions are provided in an organized but appealing way that can be continued to be adjusted depending on progress made by the child.

Stage 10: Caregiver Training (Mother Training Day)

The structured caregiver training aspect that is a unique aspect of the program is the so called Mother Training Day. This program is aimed at providing the knowledge and skills that caregivers should have in order to be able to continue with the therapeutic activities at home.

Training is practical and interactive, which involves elements like positioning, feeding methods, communication skills and stimulation of development. The strategy facilitates confidence among caregivers, increases the compliance with intervention strategies and reinforces the home-based care setting.

Stage 11: Discharge Evaluation

A detailed discharge assessment by the multidisciplinary team is done at the end of the

program. This reassessment will gauge advancements in all developmental areas and also assess whether the intervention has been attained.

The discharge process involves the formulation of a comprehensive follow-up plan, prescribed therapies, monitoring plans and community based resources. Transitional competency and readiness of caregivers is also evaluated so that they can easily transition to home care.

Stage 12: Home Care Program and Follow-Up

The SBAHC model incorporates the post-discharge care as a continuity of intervention and support in the long-term. The home care program will be based on the structured follow-up which may be outpatient visits or telehealth visits or home-based monitoring which may be required depending on the needs of the child. Caregivers maintain therapeutic measures learnt in the course of the program, and are guided by clinical team continually. This phase helps to confirm the sustainability of the results of the interventions and promote the further development of the child in the home and community setting.

SBAHC Early Intervention Model Team Structure and Role

The SBAHC Early Intervention Model is provided by an interdisciplinary group of professionals, providing comprehensive and coordinated care as summarized in Table 1.

Table 1. Members of the Early Intervention Team

Member	Role	Outcome	Suggested Interventions
1. Pediatric Neurologist	Diagnoses and treats neurological disorders such as epilepsy, cerebral palsy, and autism spectrum disorders; assesses development	Coordinates with families and medical staff to create personalized treatment plans and ensure referral to appropriate services	Medication management, developmental assessments, referral to therapy services
2. Pediatrician	Conducts health and developmental screening to find any possible health or development issues in the early years; refers to multi-label medical specialists; collaborates with rehabilitation professionals	Monitors child progress, adjusts treatments, and supports families emotionally and medically	Health monitoring, vaccinations, referrals to other medical specialists
3. Physiatrist	Assesses physical abilities and rehabilitation planning; collaborates with therapists and families	Creates personalized therapy plans and ensures coordinated care across disciplines	Rehabilitation planning, physical therapy coordination, assistive device prescription
4. Early Intervention Specialist	Evaluates patient needs, develops care plans, trains staff, and ensures program quality	Improves care delivery and maintains high standards through training and mentorship	Program coordination, staff training, care plan development
5. Clinical Dietitian	Assesses growth and	Improv overall nutritional	Individualized Nutrition

	nutritional status, Physical Examination, muscle, and fat wasting, feeding skills, feeding problems, Gastrointestinal symptoms. Nutritional related Laboratory result, and dietary intake; develops individualized nutrition plans	status and optimizes growth and collaborates with other specialists to ensure adequate nutrition and hydration.	Plans, supplement recommendations, and alternative feeding methods if needed. Collaboration with the Multidisciplinary Team to make sure that the infant and toddler receive adequate nutrition and make sure that there are no barriers that might affect their development
6. Staff Nurse	Monitors weight change and development, provides emotional support, and detects early complications	Detects early issues, promotes mobility, and ensures continuity of care	Daily monitoring, developmental support, family education
7. Psychologist	Conducts psychological assessments and provides behavioral and developmental support	Supports emotional well-being and refers for further evaluation when needed	Behavioral therapy, psychological assessments, family counseling
8. Family Counselor	Provides guidance and psychological support to families; promotes positive parenting strategies	Improves family coping mechanisms and engagement in the child's care	Parent training, emotional support, behavioral management guidance
9. Speech & Language Pathologist	Assesses and treats communication, feeding, and swallowing impairments	Enhances speech, language, and feeding skills	Speech therapy, feeding and swallowing interventions
10. Physiotherapist	Improve motor and sensory skills through therapy and exercise	Prevents worsening of motor disabilities and enhances functional independence	Motor skill development, physical therapy exercises
11. Occupational Therapist	Restores sensory, motor, and daily living skills; promotes independence	Enhance participation in daily activities and social environments	Sensory integration, fine motor skill training, adaptive equipment uses
12. Seating & Positioning Specialist	Assesses and provides customized seating and positioning solutions	Improves alignment, comfort, and functionality through equipment and education	Custom seating solutions, posture correction
13. Visual Rehabilitation Specialist	Evaluates visual abilities and provides rehabilitation to enhance visual-motor skills	Supports visual development and refers to ophthalmology when needed	Vision therapy, visual-motor skill enhancement

Pediatric Neurologist

Pediatric neurologists identify and treat neurological diseases, including epilepsy, cerebral

palsy, autism spectrum disorders and developmental delays. They create personalized treatment strategies in collaboration with families and the larger clinical team and make proper referrals to rehabilitation services.

Pediatrician

Is responsible for assessing the patient within the first 24 hours of admission through:

Assessment

Physical examination is connected to the gastrointestinal and respiratory systems.

Reviewing the patient’s past treatments, diet, feeding status, achievement of developmental points, what medicines he or she uses, vaccination history and family matters.

The risk of aspiration or fractures that might affect any rehabilitation intervention.

Orders for diagnostic imaging, needed medication, and lab tests.

Diagnoses

The pediatrician makes a set of diagnoses based on the patient’s medical history, examination and test findings.

Treatment and referral

The treatment plan is created and began, and patients are referred to other healthcare specialists when needed.

Family education and support

The responsible pediatrician communicates with the patient and their family about the plan and assessments, explains information, and discusses various choices so that the patient and family can participate in choosing the best care.

Daily monitor and discharge Plan

Monitoring the patient daily through the nurse's documentation or referral.

Team rounds to ensure that all the patient’s requirements are addressed.

Upon discharge, the Pediatrician arranges follow-up appointments in the clinic.

Physiatrist

Physiatrist's main role

Assessment

The responsible physiatrist evaluates functional capabilities and determines if the patient is fit for rehabilitation.

Treatment and referral

Create personalized rehabilitation programs. The physiatrist placed an order for diagnostic imaging and arranged interdisciplinary care.. Requests any necessary consultations to support the patient’s care. Actively participate in interdisciplinary team conferences.

Family education and support

Throughout the entire care process, the physiatrist is the main responsible person to communicate directly with the patient and their family, discussing assessments, plans of care, and offering various options to empower decision-making based on patient preferences. They also keep the patient and family informed about outcomes, including any unexpected developments during treatment.

Discharge plan

Upon discharge, physiatrists ensure follow-up in the clinic, readmission when it is safe, or arrange referrals to other rehabilitation programs or the patient's main doctor to maintain proper care. The patient and the family are provided with thorough discharge instructions and education to make sure they recover well and keep the illness under control.

Early Intervention Program Specialist

Assure that the patient received the required services at the time. Evaluate the overall patient's needs during admission and develop a personalized plan of care. Helping specialists to design treatment plans that suit the needs of each patient. Train the other health care providers and give competency training and resources to the team. Assist clinical supervisors in creating new abilities for early intervention programs. Determine the most important measures for checking the progress of the program and review the qualifications of the staff. Cooperation makes sure that educational initiatives are well-planned to suit both staff and patient requirements.

Clinical Dietitian

Assesses all admitted infants and toddlers, which include Anthropometric measurements, history of food introduction and food allergies, dietary intake, feeding problems, gastrointestinal symptoms, Laboratory results, and medication. Physical Examination, muscle, and fat wasting. Monitor patient dietary intake if needed for patients who are failing to thrive, experiencing poor growth, or have poor oral intake. Develop Individualized Nutrition Plans tailored to the specific needs of the child. Nutritional supplements are prescribed based on the nutritional status. Tube feeding might be recommended for infants and toddlers who need it. Monitors patient improvement and tolerance to the plan, and modifies it as needed. Collaborates with other healthcare specialists to make sure that there are no barriers that might affect their development.

Staff Nurse

Nurses are responsible for assessing the patient upon admission, monitoring the progress of patients, help to detect complications in time and educating the family. They are crucial in care coordination and assisting the child and family during the intervention process.

Psychologist

Standardized tools are how psychologists evaluate cognitive, behavioural and social development. They develop interventions to deal with developmental problems and track progress along the way.

Family Counselor

Family counselors assist and support caregivers psychologically, facilitate good parenting techniques, and assist the family to adjust to the condition of the child.

Speech and language pathologist

They evaluate and treat communication, feeding and swallowing disorders, facilitate language and social interaction development.

Physiotherapist

Examine and assess the movement of the child to find out about their motor abilities and other physical limitations. Develop personalized treatment programs that improve the physical and sensory skills of children and assure recovering from musculoskeletal problems. Teaching children how to make good use of the skills they have. Educating the family about the needed exercises

that should be done at home. d

Occupational Therapist

Evaluate and restore the skills of children with disabilities. Create personal intervention plans to develop a child's skills for regular tasks at home and social situations in the community. Helping the child improve sensory, motor and play-related abilities and adapting to their surroundings. Enhancing the child's position and seating and boosting cognitive skills.

Prescribe aid devices

Positioning and Seating Specialist

Evaluating the child's physical state, their ability to move, balance, and muscle tone, and how they function in general. Provide ideal seating and positioning based on each child's special needs. Develop and present design ideas for individual seating, which might include wheelchairs, adaptation to seating, safe sleep supports, cushions and many other devices. Educate families about using and looking after equipment, as well as the correct ways to position their child at home and in many other places.

Visual Rehabilitation Specialist

They assess visual functioning and offer interventions to enhance visual-motor coordination and general developmental participation.

Bias and Limitations of Model

Despite its strengths, the SBAHC model may be subject to several limitations. As an institution-based framework, its applicability may be influenced by resource availability and infrastructure capacity. Additionally, the model has not yet undergone formal empirical validation, and its effectiveness may vary across different healthcare settings.

Ethical Considerations

The implementation of the SBAHC Early Intervention Model adheres to ethical principles of patient-centered care, confidentiality, and informed family involvement. All services are delivered with respect to patient rights and cultural considerations

Evidence and Validation

At present, this paper presents a conceptual and operational model. Formal evaluation studies are required to assess clinical outcomes, cost-effectiveness, and long-term impact.

Early intervention model implantation process

Initial Multidisciplinary Assessment

When a child is admitted, he/she is given a multidisciplinary co-evaluation, which is usually conducted in a relatively short period of time, to enable quick clinical decision-making. In this assessment, there is interaction between the pediatricians, physiatrists, therapists and allied health professionals.

Assessment tools, as shown in appendix 1, used to measure include standardized and discipline specific assessment tools that measure motor function and physical development, Cognitive and communication abilities, Nutritional Status and Growth, Feeding and swallowing function, Sensory processing and visual skills, Psychosocial and family dynamics

The results of these tests are recorded in a single clinical report, on which the individual intervention planning is based. Table 2 gives the specific details of the assessment domains, tools, outcomes measures and recommendations in each of the

specialties.

Table 2. Comprehensive Assessment and Evaluation Table

Specialization	Classification	Details	Outcome	Recommendations
Speech & Language Pathologist	Evaluation	Parent interview, play observation, REEL test	Communication profile created	Referral to dentistry, gastroenterology, sensory integration assessment
Speech & Language Pathologist	Bedside Assessment	Observing eating behavior, utensil use, mouth movements	Feeding issues identified	Feeding therapy and caregiver education
Speech & Language Pathologist	Instrumental	Modified barium swallow study	Swallowing safety evaluated	Adjust feeding methods and refer as needed
Speech & Language Pathologist	Assessment Tools	FOIS, EDACS, Penetration Aspiration Scale	Feeding & swallowing ability categorized	Therapy plan tailored to classification
Clinical Dietitian	Evaluation	Anthropometric measurements, dietary intake, feeding skills, GI symptoms, lab results	Nutritional status assessed	Nutrition plan and individualized intervention
Clinical Dietitian	Outcome Measures	Growth chart tracking, weekly weight checks	Growth monitored	Adjust nutrition plan as needed
Clinical Dietitian	Recommendations	Tube feeding if oral intake <60% RDA	Improved nutrition and growth	Referral to a gastroenterologist if needed
Physical Therapist	Evaluation	WeeFIM, GMFCS-E&R, GMFM-88/66, ROM, balance, vestibular tests, Ashworth scale	Motor abilities assessed	Personalized therapy plan
Physical Therapist	Outcome Measures	Weekly progress reports	Progress tracked	Adjust therapy based on outcomes
Occupational Therapist	Evaluation	WeeFIM, Mini-MACS, SPM, CARS, visual-motor skills, Ashworth scale	Developmental skills assessed	Intervention plan created
Occupational Therapist	Outcome Measures	Safety and ADL assessment, carryover skills	Functional independence supported	Assistive devices recommended

Psychologist	Evaluation	Observation, clinical interviews, Vineland	Behavioral and developmental needs identified	Counseling and family support
Psychologist	Outcome Measures	Behavioral analysis, family condition review	Psychological profile developed	Referral to psychiatry or family counseling
Visual Rehabilitation Specialist	Evaluation	Eye efficiency, visual perception, oculomotor function, visual fields	Visual abilities assessed	Referral to ophthalmology and visual rehab plan
Visual Rehabilitation Specialist	Outcome Measures	McDowell assessment, VMI test, MVPT	Vision development tracked	Home program and family education
Seating & Positioning Specialist	Evaluation	Physical state, movement, balance, muscle tone	Seating needs identified	Custom seating and caregiver training
Seating & Positioning Specialist	Outcome Measures	Comfort and alignment assessment	Improved posture and function	Follow-up and equipment adjustment

Specialized Multidomain Assessments

After the first assessment, children are subjected to specific tests in the major areas of development, in order to have a comprehensive picture of their needs. The following are the list of assessment performed:

Visual Skills Assessment:

The visual rehabilitation screening clinic is visited during the first week of admission for all children.

A visual rehabilitation specialist is engaged in a systematic assessment of the eye efficiency, visual perception, oculomotor, and visual fields.

Personal visual rehabilitation plans are made with referrals to optometry or ophthalmology.

Family Education to help the home-based visual stimulation programs.

Seating and Positioning Assessment:

Seating and positioning specialists assess the posture, muscle tone, movement patterns, comfort and functional sitting ability. Working with occupational therapists and speech-language pathologists will provide the best positioning of the feeding, communicating, and safe sleeping.

Nutrition status and Feeding/Swallowing Assessment:

All admitted patients will be discussed one-week post admission in the Dietitian and swallowing therapist round, that include:

Identifying the barriers that hinder the child from growing and developing.

Develop a mutual plan during admission that is suitable for each child. The plan will be explained

and discussed with the family.

Recommended referral might be done for the needed patients.

The high-risk patient will be discussed in the round before discharge to identify the long-term plan to ensure continued improvement.

Mandatory Multidisciplinary Referrals

All the patients in the SBAHC Early Intervention Model are referred to a group of core specialty clinics to be evaluated and managed further to ensure comprehensive and holistic care. Each specialty has elaborate evaluations with the help of relevant diagnostic procedures and is involved in the overall care plan with specific medical, surgical or rehabilitative interventions. This form of referral system will make sure that every consideration of the condition of the child is properly assessed and taken care of. Table 3 summarizes the assessment procedures, recommendations and interventions offered in these mandatory referral clinics.

Family-Centered Interventions

The SBAHC Early Intervention Model has family engagement as one of its key pillars and organized programs that aim to empower the caregivers and increase their ability in helping the

- based on the findings, consisting of two to five organized lessons.

- A special weekly Mother Hands-on Training Day, in this session, therapists instruct mothers on the exercises to perform, methods of handling techniques, feeding methods and positioning skills in a real-world setting, usually the room in which the patient is. This will guarantee that the caregivers are competent, enhance learning by practice and transition to home-based care is smooth and effective.

Discharge Planning and Transition

The initiation of discharge planning starts the pathway of patient care early in the patient care process and is based on a multidisciplinary assessment process, similar to the assessment process used during the initial admission. It involves as follows:

Re-evaluation of the development status of the child to assess his or her progress and outstanding needs.

The competence of the carers is thoroughly checked especially in the key aspects of feeding, positioning, and handling, and prescribed exercises to be ready to go home.

An organized home care plan is created including continuous interventions, objectives and follow-up needs.

Follow-up appointments are made in the various medical, surgical and rehabilitation specialties to ensure continuity of care.

This all-encompassing discharge procedure would make sure that the child and family are well prepared to sustain the progress and further growth outside the inpatient environment.

Table 3. Mandatory Referral Clinics - Assessments, Recommendations, and Interventions

Clinic	Assessment Tools/Methods	Recommendations	Interventions

Pediatric Neurology Clinic	Blood tests, MRI, CT scans, EEG, lumbar punctures, genetic tests	Diagnosis and follow-up for neurological conditions	Medical treatment and rehabilitation referrals
ENT Clinic	History review, physical exam, tympanometry, endoscopy, CT/MRI scans	Identify ENT-related issues and recommend treatment	Medication, tympanostomy tubes, adenoidectomy, tonsillectomy
Ophthalmology/ Optometry Clinic	Preferential Looking test, Teller Acuity Cards, Lea Symbols, cover/uncover tests, slit-lamp exam	Assess vision and prescribe corrective measures	Eyeglasses, patch therapy, surgical procedures
Audiology Clinic	Otoacoustic emissions, visual reinforcement audiometry, tympanometry, ABR, ASSR	Diagnose hearing loss and recommend aids	Hearing aid fitting, cochlear implant referral
Dental Clinic	Oral health evaluation, history of dental issues	Prevent and treat dental problems	Oral hygiene education, treatment for caries, cleft palate care
Orthopedic Clinic	Joint alignment, muscle strength, posture, mobility assessment	Identify musculoskeletal issues	Orthotics, Botox, bracing, physical therapy, surgery
Visual Rehabilitation Clinic	Eye efficiency, visual perception, oculomotor function, visual fields	Enhance visual development	Visual aids, therapy, referral to ophthalmology
Seating & Positioning Clinic	Posture, movement, muscle tone, comfort evaluation	Optimize seating and positioning	Custom seating devices, caregiver training

Post-discharge Home Care Program

The post-discharge home care early program is used as a continuum of care that can be expanded to the clinical environment of the SBAHC model to the natural environment of the child. All the multidisciplinary team conducts continuous follow-ups by scheduling home visits or conducting virtual visits. The main objectives of the home care program include improvement of developmental outcomes, hospital remissions, healthcare (long term) costs, and independence and school preparation; this will finally see the child achieve his or her full potential in his or her community. This program is also aimed at ensuring the following:

The development of the child and his/her medical condition through continuous therapy interventions at home.

The caregivers are trained on exercises, assistive devices and daily care strategies that will help the child to develop in terms of his or her functional activities.

Further assistance is also given to develop feeding, communication, and daily living skills.

Results

Since this manuscript is a descriptive white paper there are no quantitative outcome data at this point. The main task is to describe the form of SBAHC Early Intervention Model, its processes and clinical pathways in a detailed fashion. Although the model lacks empirical findings, the model integrates a great variety of standardized assessment instruments and outcome measures in a number of different disciplines, as presented in Table 2 and Table 3. These instruments can offer a systematic and quantifiable system that can be used to assess patient progress reliably and to support future research endeavors. A series of studies to be conducted in the future will be aimed at determining developmental results with the use of standardized scales, as well as functional improvement in various areas of therapy. Other domains to be assessed will be feeding skills, communication skills, motor development and family engagement and compliance with the recommended home programs. All these evaluations will allow objective evaluation of the effectiveness of the model, its efficiency in operation, and its impact on patient outcomes and healthcare use in the long term.

Limitations

There are quite a number of limitations which are very important in interpreting the proposed model in this study. First, the manuscript does not have the data of the empirical outcomes because it introduces a conceptual and descriptive framework without any empirical data, which restricts the possibility of quantitatively assessing its effectiveness. Second, the model has been constructed and tested in one specialized center and this might limit its applicability to other healthcare environments having different resources, infrastructures and organizational structures. Moreover, the model might not be scalable nationally, as it can be restricted by the logistical, financial and human resources, especially in those areas, where multidisciplinary teams or specialized rehabilitation services are not widely available. Moreover, the model has not been contrasted with other early intervention models and thus it is not yet easy to establish the relative benefits of the model in various settings. Further studies are needed to overcome these limitations by implementing multi-centre validation, determining scalability to a wide range of healthcare settings and considering ways to incorporate into national health policies and systems.

Discussion

The SBAHC Early Intervention Model shows a good compatibility to internationally accepted models such as the World Health Organization early intervention model and the principles of the Individuals with Disabilities Education Act (IDEA) Part C. The focus on the early detection and family-centered care, as well as multidisciplinary teamwork, is especially noticeable in the model. Meanwhile, the model generates a very specific structural novelty by means of the introduction of a centralized, multidisciplinary one-stop clinic. This would help to quickly evaluate and come up with unified care plans during a visit, and thus overcome the inefficiency normally linked with the fragmented way of service delivery. Contrastingly, most of the early intervention systems in Europe and North America are based on decentralized systems where services are spread over a number of providers and locations which in most cases results in delayed diagnosis and intervention.

The SBAHC model has a number of benefits. It realizes a high degree of coordination by combining medical, surgical and rehabilitation services into a

single coordinated system thereby minimizing the level of fragmentation of care. The capability of performing same-day multidisciplinary testing improves effectiveness by speeding up the process of making diagnoses and interventions. Additionally, joint planning of common care plans enhances the specialty coordination making sure that there is consistency in objectives and approaches to treatment. The model also tends to emphasize extensively on the family empowerment by the use of structured education, counselling and training programs with hands-on training programs which are needed to maintain the progress even after the clinical setting. Considering these features, the SBAHC model can be especially relevant to the healthcare systems that have limited resources or develop at a rather fast pace (e.g., the Saudi Arabian one), and the enhancement of coordination, minimization of the number of services delivered, and rational resource use are the priorities.

Conclusion

The SBAHC Early Intervention Model is an integrated, multidisciplinary model that aims to support better developmental outcomes, improve the early detection and streamline the delivery of care to infants and toddlers with disabilities. The model has helped to solve the major challenges in the early intervention systems such as service fragmentation, late diagnosis and lack of involvement of the family because of centralization of services and focus on team-based care. The systematic combination of medical, surgical, and rehabilitation care with the effective family-centered care makes the model a potentially effective approach to enhancing clinical and efficiency rates in the system. Nonetheless, although the model shows great potential, it still needs additional empirical testing to determine the effectiveness of this model, its cost-effectiveness, and scalability to a larger scale. Further studies are needed in terms of rigorous outcome based assessment, thorough cost effectiveness studies, extended developmental follow up, and strategies to implement the same on a national level. These initiatives will be critical in identifying the role of the model in supporting the development of the early intervention services and guiding the health care policy and practice.

Author Contributions

All authors contributed to the study conception and design, material preparation, data collection and analysis.

Ethical Approval and Patient Consent

The Institutional Ethical Committee approved this study. A written, informed consent was obtained from all patients, the research carried on human data in compliance with Helsinki.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Conflicts of Interest

The authors declare no potential conflicts of interest in this study.

Declaration of generative AI and AI-assisted technologies

The author utilized AI tools to enhance the language quality and address any grammatical issues while

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