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Toward an Integrated Digital Monitoring System for Children with Down Syndrome: Therapists' Perspectives

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Abstract

Children with Down syndrome (DS) require continuous multidisciplinary rehabilitation to address delays in cognitive, motor, language, and adaptive development. However, conventional monitoring methods remain fragmented, limiting communication among therapists, parents, and teachers and reducing the continuity of care. This study explored therapists' perspectives on the development of an integrated digital monitoring system for children with DS.A descriptive qualitative study was conducted between May and June 2026 in Pontianak City and Kubu Raya Regency, West Kalimantan, Indonesia. Nine therapists representing speech therapy, occupational therapy, physiotherapy, and behavioral therapy were purposively recruited. Data were collected through semi structured in depth interviews and analyzed using Braun and Clarke's thematic analysis.Six major themes emerged: (1) developmental challenges faced by children with DS, (2) barriers to home based therapy, (3) the need for an integrated digital monitoring system, (4) essential system features, (5) collaboration among therapists, parents, and teachers, and (6) limitations of current monitoring practices. Therapists emphasized that an integrated digital platform should support real time developmental tracking, home therapy monitoring, video based documentation, automated progress reports, and secure communication among stakeholders. Such a system was perceived as essential for strengthening multidisciplinary collaboration, improving continuity of rehabilitation, and supporting individualized interventions.Therapists recognized the urgent need for an integrated digital monitoring system to overcome the limitations of conventional monitoring. The proposed system has the potential to enhance family centered rehabilitation, facilitate evidence based clinical decision making, and improve developmental outcomes for children with DS.

Keywords: Children Down syndrome, Digital Health, Digital Monitoring System, Family Centered Care, Therapists' Perspectives

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1. Introduction

Children with Down Syndrome (DS) face unique challenges in cognitive, motor, and social development due to chromosomal abnormalities (Enea-Drapeau & Tsao, 2021; Prameswari et al., 2026). These challenges often necessitate specialized therapeutic interventions and monitoring systems to support their development and improve their quality of life (Prameswari et al., 2026). Speech therapy, occupational therapy, physiotherapy, and behavioral interventions are widely recognized as essential components of comprehensive care for children with DS. However, the effectiveness of these interventions depends not only on the quality of therapy sessions but also on the consistency of therapeutic activities across home, school, and clinical settings. Maintaining continuity of care remains a significant challenge, particularly when multiple stakeholders are involved in supporting the child's development.

Despite the availability of rehabilitation services, therapists frequently encounter difficulties in monitoring children's progress outside clinical sessions. Parents often struggle to implement therapeutic exercises consistently because of limited time, insufficient understanding of therapy techniques, and competing caregiving responsibilities. Communication between therapists, parents, and teachers is also commonly fragmented, relying on paper based records, verbal reports, or instant messaging applications that are not designed for structured documentation or collaborative decision making. Consequently, developmental information is often incomplete, progress is difficult to evaluate objectively, and therapy programs cannot be adjusted promptly according to children's changing needs.

Recent advances in digital health technologies have created opportunities to improve rehabilitation services for children with developmental disabilities. Various digital applications have been developed to facilitate developmental assessment, therapy scheduling, caregiver education, and remote monitoring. GPS based technologies have also been introduced to improve the safety and independence of children with DS by allowing caregivers to monitor their location in real time (Satria Winekas et al., 2025). Likewise, mobile and web based applications have demonstrated potential to enhance therapy management, improve caregiver engagement, and support communication among healthcare providers and families (Pozderac et al., 2023; Shahid et al., 2022). These innovations suggest that digital technologies can contribute substantially to improving the continuity and quality of care.

However, existing digital solutions remain largely fragmented. Most applications focus on a single function, such as developmental exercises, educational activities, GPS tracking, or caregiver reminders, and are generally designed for individual users rather than supporting collaboration among therapists, parents, and teachers (Miarka et al., 2018; Shahid et al., 2022). Few studies have explored the requirements for an integrated digital monitoring system capable of documenting therapy outcomes, monitoring home based activities, facilitating structured communication, and supporting collaborative decision making across different care settings. Furthermore, the perspectives of therapists who are responsible for designing intervention programs, monitoring developmental progress, and evaluating therapeutic outcomes have received limited attention in the development of digital health solutions for children with DS.

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This gap is particularly relevant in Pontianak City and Kubu Raya Regency, West Kalimantan, Indonesia, where therapy services are provided by multiple healthcare facilities and educational institutions. Although children with DS receive multidisciplinary interventions, monitoring practices remain predominantly manual, relying on notebooks, paper forms, or unstructured communication through messaging applications. These approaches frequently result in incomplete documentation, inconsistent follow up, and limited coordination among therapists, parents, and teachers, thereby reducing the effectiveness of long term intervention.

Therefore, this study aims to explore therapists' perspectives on the development of an integrated digital monitoring system for children with syndrome in Pontianak City and Kubu Raya Regency. Specifically, the study investigates current challenges in therapy monitoring, identifies the essential features required in a digital monitoring platform, and explores therapists' expectations regarding collaboration with parents and teachers. The findings are expected to provide empirical evidence for designing a user centered digital monitoring system that strengthens continuity of care, enhances multidisciplinary collaboration, and supports more effective developmental monitoring for children with DS.

2. Research Method

This study employed a qualitative descriptive design to explore therapists' perspectives on the development of an integrated digital monitoring system for children with DS. A qualitative approach was considered appropriate because it enables an in depth understanding of participants' experiences, perceptions, and expectations regarding current therapy monitoring practices and the potential implementation of digital technologies.

The study was conducted between May and June 2026 in Pontianak City and Kubu Raya Regency, West Kalimantan, Indonesia. Participants were recruited using purposive sampling, in which individuals with relevant knowledge and direct experience in providing therapy for children with DS were intentionally selected. The inclusion criteria were therapists who had at least one year of professional experience in managing children with DS and were actively practicing in healthcare facilities or therapy centers during the study period.

A total of nine therapists participated in the study, representing various rehabilitation disciplines, including speech therapy, occupational therapy, behavioral therapy, and physiotherapy. These therapists were employed at several healthcare facilities, including Dr. Soedarso Regional Hospital, Dandelion Clinic, Tesla Clinic, and Griya Anak Gang Sehat Clinic.

Data were collected through semi structured, in depth interviews using an interview guide developed from a review of the literature on digital health, rehabilitation, and developmental monitoring for children with DS. The interview questions explored current therapy monitoring practices, barriers to home based therapy, communication with parents and teachers, perceived needs for digital monitoring, desired system features, and expectations for an integrated monitoring platform. Each interview lasted approximately 30–60 minutes and was conducted face to face after obtaining written informed consent from all participants.

The interview recordings were transcribed verbatim and analyzed using thematic analysis following the six step approach proposed by Braun and Clarke. The analysis involved familiarization with the data, generation of initial codes, identification of themes, review and refinement of themes, definition and naming of themes, and preparation of the final report. To

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enhance the trustworthiness of the findings, member checking and peer debriefing were conducted during the analysis process.

Ethical approval for this study was obtained from the Health Research Ethics Committee of ITEKES Muhammadiyah West Kalimantan (Approval No.: 79/II.I.AU/KET.ETIK/VI/2026). All participants voluntarily agreed to participate and signed informed consent forms before the interviews. Confidentiality and anonymity were maintained throughout the study by removing personal identifiers from all transcripts and reports.

3. Results And Discussions

a. Result

1) Characteristics of Participants

Nine therapists participated in this study. All participants were female and represented four rehabilitation disciplines: speech therapy (n = 3), occupational therapy (n = 2), behavioral therapy (n = 2), and physiotherapy (n = 2). Most participants were between 25 and 45 years of age and had more than two years of experience providing therapy for children with DS. The therapists were employed at several healthcare facilities in Pontianak City and Kubu Raya Regency, including Dr. Soedarso Regional Hospital, Dandelion Clinic, Tesla Clinic, and Griya Anak Gang Sehat Clinic.

2) Theme 1. Developmental Challenges Faced by Children with DS

Therapists consistently reported that children with DS experience a wide range of developmental difficulties that require continuous and multidisciplinary intervention. The most frequently reported challenges included speech and language delays, delayed gross and fine motor development, cognitive impairment, sensory integration problems, and limitations in adaptive behavior.

One therapist stated: "Children commonly experience speech delay, weak oral motor function, and difficulty maintaining attention." Another participant explained: "Most children present with global developmental delays involving motor, language, sensory, and social development."

3) Theme 2. Barriers to Home Based Therapy

All participants acknowledged that maintaining therapy at home remains one of the greatest challenges. Several barriers were identified, including parents' limited understanding of therapeutic techniques, inconsistent implementation of home exercise programs, time constraints, children's lack of cooperation, and inadequate therapy equipment at home.

One therapist commented: "Many parents are unable to continue the therapy program consistently because they are busy with work or other family responsibilities." Another therapist added: "Parents often want to help but are uncertain whether they are performing the exercises correctly."

4) Theme 3. The Need for an Integrated Digital Monitoring System

Almost all therapists agreed that an integrated digital monitoring system would substantially improve therapy management for children with DS. Participants emphasized that such a system should facilitate continuous monitoring of developmental progress, record therapy attendance, document home based activities, and provide objective information for evaluating therapeutic outcomes.

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One therapist explained: "A digital monitoring system is no longer an option but a necessity because it enables therapists to monitor children's progress even when they are not attending therapy sessions." Another participant highlighted the importance of systematic documentation: "Digital records would help us evaluate progress more accurately and modify intervention programs when necessary."

5) Theme 4. Essential Features of the Digital Monitoring System

Participants identified several essential features that should be incorporated into an integrated digital monitoring system. The most frequently recommended features included:

a) Digital Developmental Records;
b) Therapy Progress Reports;
c) Home Exercise Monitoring;
d) Video Uploads Of Therapy Activities Performed At Home;
e) Therapist Feedback;
f) Developmental Milestone Tracking;
g) Reminders For Therapy Schedules; And
h) Communication Platforms Connecting Therapists, Parents, And Teachers.

One therapist stated: "Parents should be able to upload videos of home therapy sessions so therapists can provide corrections and recommendations." Another participant suggested: "The application should generate progress reports automatically to make evaluation easier."

6) Theme 5. Collaboration Among Therapists, Parents, and Teachers

All therapists emphasized that collaboration among therapists, parents, and teachers is essential for achieving optimal developmental outcomes. Participants explained that children with DS require consistent therapeutic approaches across healthcare facilities, schools, and home environments. One therapist stated: "Children learn more effectively when therapists, teachers, and parents use the same therapeutic strategies." Another participant commented: "Communication should be continuous so everyone understands the child's current developmental goals." Therapists recommended that the digital monitoring system include shared progress reports, discussion forums, educational materials, and regular communication features to strengthen multidisciplinary collaboration.

7) Theme 6. Limitations of Current Monitoring Practices

Participants reported that therapy monitoring is currently conducted using paper based records, communication notebooks, and messaging applications such as WhatsApp. Although these methods are familiar and easy to use, they often result in fragmented information, incomplete documentation, and difficulties in tracking children's long term developmental progress. One therapist explained: "Paper records are frequently misplaced or forgotten, making it difficult to compare children's progress over time." Another participant added: "Communication through messaging applications is helpful, but important information can easily be lost among daily conversations.

b. Discussion

1) Developmental Challenges Faced by Children with DS

The present study demonstrates that therapists consistently encounter children with DS who experience multidimensional developmental challenges involving speech and language, gross and fine motor function, cognition, sensory processing, and adaptive behavior. These findings are consistent with recent evidence indicating that developmental

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outcomes in children with DS depend on comprehensive interventions addressing multiple functional domains simultaneously rather than focusing on a single area of development (de Groot et al., 2024).

Therapists participating in this study emphasized that speech and language delay remains one of the most prominent developmental concerns. These findings are supported by a recent scoping review demonstrating that communication disorders remain among the most persistent developmental challenges in individuals with DS and require evidence based interventions that are individualized according to children's communication profiles. Early identification and continuous monitoring of communication development are therefore essential to optimize therapy outcomes (de Groot et al., 2024).

In addition to communication difficulties, therapists described significant delays in gross and fine motor development that influence children's independence during daily activities. These findings correspond with recent rehabilitation studies demonstrating that motor development in children with DS can be substantially improved through continuous rehabilitation supported by innovative technologies such as virtual reality and digital rehabilitation platforms. However, these interventions require systematic monitoring to evaluate progress over time and adjust therapeutic goals according to each child's developmental trajectory (Piñar-Lara et al., 2024).

Another important finding is that therapists considered developmental progress to be highly dependent on continuity of intervention beyond clinical settings. This observation highlights the importance of continuity of care, in which therapy is viewed as an ongoing process rather than a series of isolated clinical sessions. Contemporary rehabilitation literature increasingly emphasizes that sustainable developmental improvement requires coordinated intervention across healthcare, educational, and family environments supported by effective communication among all stakeholders (Arntz et al., 2023).

The findings also demonstrate the importance of adopting a family centered approach in the management of children with DS. Therapists consistently reported that parents play a decisive role in reinforcing therapeutic activities, encouraging children's participation, and maintaining developmental stimulation during everyday routines. Recent evidence suggests that families of children with DS show greater resilience and achieve better developmental outcomes when they receive adequate care coordination, access to information, and collaborative support from multidisciplinary professionals (Van Riper et al., 2023).

Interestingly, therapists in this study highlighted that developmental monitoring remains largely dependent on subjective observations and fragmented documentation. Similar concerns have been reported in recent digital rehabilitation research, which emphasizes that integrated monitoring systems improve the availability of longitudinal developmental data, facilitate evidence based clinical decision making, and enhance coordination among rehabilitation professionals (Arntz et al., 2023).

Therapists require access to comprehensive information regarding children's daily performance across multiple environments to evaluate intervention effectiveness accurately. Digital technologies provide considerable opportunities to support this process by enabling continuous documentation, remote monitoring, and collaborative communication among therapists, parents, and teachers. Such an approach is expected to improve individualized intervention planning while strengthening continuity of care throughout children's developmental journey (Arntz et al., 2023).

2) Barriers to Home Based Therapy

Home based therapy emerged as one of the most significant challenges identified by therapists in this study. Participants reported that parents frequently experience difficulties

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maintaining therapy routines because of work commitments, household responsibilities, limited knowledge of therapeutic techniques, and children's fluctuating motivation. Consequently, developmental progress achieved during therapy sessions may not be adequately reinforced within the home environment, reducing the overall effectiveness of rehabilitation.

One of the most frequently reported barriers was parents' limited confidence in performing therapeutic activities independently. Similar findings have been reported in studies examining parent supported interventions, which indicate that caregivers benefit from structured guidance, practical demonstrations, and continuous professional feedback to improve confidence and adherence to home programs (Romski et al., 2023).

Another major obstacle identified by therapists was inconsistency in family routines. Many parents balance employment, household responsibilities, and caregiving simultaneously, making it difficult to allocate sufficient time for structured therapy activities. Recent family based research has similarly demonstrated that caregiving burden, time constraints, and competing family priorities substantially influence therapy adherence among children with developmental disabilities (Van Riper et al., 2023).

Therapists also highlighted children's behavioral characteristics as barriers to home based intervention. Children with DS may demonstrate reduced attention span, limited motivation, or resistance toward repetitive therapeutic exercises outside clinical settings. Digital technologies incorporating multimedia content, gamification, and visual feedback may increase children's motivation while simultaneously supporting parental participation. Recent studies have shown that technology assisted rehabilitation can improve children's engagement and facilitate motor and cognitive learning when integrated appropriately into home environments (Piñar-Lara et al., 2024).

Communication barriers between therapists and families represented another important finding. Participants reported that communication is currently maintained through notebooks or instant messaging applications such as WhatsApp. Recent digital health research similarly identifies fragmented communication as one of the principal barriers limiting continuity of rehabilitation services and recommends integrated digital platforms capable of centralizing documentation, communication, and progress monitoring (Shaigetz et al., 2021).

Another challenge identified in this study was the absence of objective mechanisms to monitor home therapy implementation. Therapists generally rely on parents' verbal descriptions to determine whether therapeutic activities have been completed. Emerging digital rehabilitation technologies incorporating video documentation, wearable sensors, and remote monitoring have demonstrated considerable potential for improving therapists' ability to evaluate home based intervention objectively while maintaining continuous communication with families (Arntz et al., 2023).

Collectively, these findings indicate that barriers to home based therapy extend beyond parental motivation alone. Instead, rehabilitation services should incorporate integrated digital monitoring systems that facilitate real time communication, provide structured home exercise guidance, document developmental progress longitudinally, and enable therapists to deliver timely feedback. Such systems have the potential to strengthen family engagement, improve adherence to home based therapy, and enhance continuity of multidisciplinary care for children with DS (Arntz et al., 2023).

3) Need for an Integrated Digital Monitoring System

One of the most significant findings of this study is the strong consensus among therapists regarding the urgent need for an integrated digital monitoring system to support the rehabilitation of children with DS. Participants consistently reported that current monitoring practices rely primarily on paper based records, communication notebooks,

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and instant messaging applications, which are insufficient for documenting children's developmental progress comprehensively.

Therapists explained that effective rehabilitation requires continuous monitoring rather than periodic assessment during scheduled therapy sessions. Developmental changes in children with DS occur gradually and are influenced by interventions implemented across multiple environments, including healthcare facilities, schools, and homes. Consequently, therapists require access to longitudinal developmental information to evaluate intervention effectiveness, identify emerging developmental concerns, and adjust therapy programs accordingly.

These findings align with the growing body of literature emphasizing the role of digital health technologies in pediatric rehabilitation. Recent studies have demonstrated that digital monitoring platforms facilitate continuous documentation of developmental outcomes, improve communication between healthcare professionals and caregivers, and enable timely intervention adjustments through remote monitoring. Unlike traditional documentation systems, digital platforms allow therapists to access children's developmental records in real time, thereby supporting individualized and data driven clinical decision making (Asrifan et al., 2025)

Another important issue identified by therapists was the lack of standardized documentation across therapy settings. Similar challenges have been reported in pediatric rehabilitation services worldwide, where fragmented health information systems contribute to duplication of assessments, inconsistent intervention planning, and reduced continuity of care (WHO, 2024)

Participants also highlighted that an integrated digital monitoring system should function not merely as a documentation tool but as a collaborative platform connecting therapists, parents, and teachers. Such a system would enable all stakeholders to share developmental observations, monitor homebased therapy implementation, and communicate regarding children's progress using standardized documentation. This finding supports the principles of integrated care, which emphasize coordinated service delivery, shared decision making, and patient centered rehabilitation to improve health outcomes (WHO, 2024).

Furthermore, therapists emphasized that digital monitoring has the potential to reduce administrative workload while improving service quality. Recent evidence suggests that digital documentation systems improve clinical efficiency, reduce documentation errors, and increase healthcare professionals' satisfaction by minimizing repetitive administrative tasks (Zoller et al., 2024)

Overall, the present findings indicate that an integrated digital monitoring system represents a strategic innovation capable of strengthening continuity of rehabilitation services for children with DS. By facilitating comprehensive documentation, real time monitoring, and multidisciplinary communication, such systems may contribute to more effective, coordinated, and family centered rehabilitation services.

4) Essential Features of an Integrated Digital Monitoring System

Beyond recognizing the need for digital monitoring, therapists in this study identified several functional features considered essential for ensuring the effectiveness and usability of an integrated monitoring system. Rather than focusing solely on technological sophistication, participants emphasized features that directly support routine clinical practice, facilitate communication, and improve continuity of care.

One of the most frequently recommended features was comprehensive developmental progress tracking. Continuous visualization of developmental progress would enable therapists to evaluate intervention outcomes objectively while facilitating early identification of developmental stagnation or regression. Participants also considered

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video based home monitoring an indispensable feature. Similar approaches have been increasingly adopted in pediatric telerehabilitation, where asynchronous video review has been shown to improve treatment adherence, parental confidence, and intervention quality (Camden & Silva, 2023).

Another important recommendation involved automated therapy progress reports. Digital dashboards have recently become important components of pediatric rehabilitation systems because they enhance interpretation of longitudinal developmental data and facilitate evidence based decision making (Zoller et al., 2024). Participants further recommended incorporating personalized home exercise programs into the monitoring system. Previous studies have shown that digital coaching and personalized educational resources improve caregiver adherence to rehabilitation programs while reducing uncertainty regarding home based intervention techniques (Kairy et al., 2024).

Therapists also emphasized the importance of integrated communication features. This recommendation aligns with current digital health frameworks promoting interoperable communication systems to improve continuity and coordination of healthcare services (WHO, 2024).

Finally, participants highlighted usability as a critical determinant of successful implementation. Technology acceptance studies consistently demonstrate that usability significantly influences healthcare professionals' and caregivers' willingness to adopt digital health innovations. Therefore, successful implementation depends not only on system functionality but also on user centered design principles that accommodate the needs and digital literacy of all stakeholders (Camden & Silva, 2023). Collectively, these findings demonstrate that therapists prioritize practical, accessible, and collaborative features rather than technologically complex solutions.

5) Collaboration Among Therapists, Parents, and Teachers

A central finding of this study is that therapists perceive collaboration among healthcare professionals, parents, and teachers as fundamental to achieving optimal developmental outcomes for children with DS. Therapists explained that parents are children's primary caregivers and therefore play the most important role in maintaining daily therapeutic activities. These findings reinforce the principles of family centered care, which recognize families as equal partners in rehabilitation planning and implementation rather than passive recipients of healthcare services (Camden & Silva, 2021)

Participants also highlighted the important contribution of teachers in supporting developmental continuity. Previous research similarly indicates that interdisciplinary collaboration between educators and rehabilitation professionals improves functional outcomes, school participation, and children's overall quality of life (WHO, 2024). Despite recognizing the importance of collaboration, therapists reported that communication among stakeholders remains fragmented. Recent systematic reviews have identified fragmented communication as a major barrier to integrated pediatric rehabilitation services and recommend digital platforms that centralize information sharing among multidisciplinary teams (Esmaeilzadeh, 2020; Kern et al., 2024)

Participants believed that an integrated digital monitoring system could substantially strengthen collaborative practice by enabling therapists, parents, and teachers to access shared developmental records, communicate regularly, monitor therapy implementation, and participate in coordinated care planning. The findings also suggest that collaborative monitoring contributes to greater accountability among stakeholders. Overall, this study demonstrates that the successful implementation of an integrated digital monitoring system depends not only on technological innovation but also on strengthening collaboration among therapists, parents, and teachers.

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6) Clinical and Practical Implications

The findings of this study have important implications for clinical practice, rehabilitation services, and digital health innovation for children with DS. Therapists consistently emphasized that rehabilitation should not be confined to clinical settings but should extend into children's daily environments through continuous monitoring and collaborative intervention. This finding highlights the need to transform conventional therapy models into integrated care systems that facilitate communication among therapists, parents, and teachers while supporting continuous developmental monitoring.

The proposed integrated digital monitoring system has the potential to improve the quality and continuity of rehabilitation by providing centralized documentation of children's developmental progress. Unlike conventional paper based records, digital platforms enable therapists to access longitudinal developmental data, evaluate intervention outcomes objectively, and modify individualized treatment plans based on real time information. Previous studies have demonstrated that digital rehabilitation technologies improve clinical efficiency, facilitate evidence based decision making, and enhance care coordination for children with developmental disabilities (Ogourtsova, 2023; Ogourtsova et al., 2023)

From a practical perspective, the proposed system could strengthen family centered rehabilitation by increasing parents' participation in therapeutic activities. Features such as home exercise reminders, video based monitoring, therapist feedback, and automated developmental reports may improve caregivers' confidence and adherence to home based therapy programs. Similar findings have been reported in pediatric telerehabilitation studies, which indicate that continuous communication between healthcare professionals and caregivers enhances treatment adherence and children's functional outcomes (Camden & Silva, 2021)

The study also demonstrates the importance of integrating educational settings into rehabilitation services. Teachers play an essential role in reinforcing developmental goals during daily learning activities. Therefore, incorporating teachers into the digital monitoring platform may facilitate coordinated intervention planning, improve consistency between therapeutic and educational strategies, and ultimately promote children's participation and independence. This multidisciplinary collaboration aligns with the principles of integrated, person centered rehabilitation promoted by the World Health Organization (Organization, 2024)

Furthermore, the implementation of integrated digital monitoring systems may contribute to healthcare system strengthening, particularly in low and middle income countries where access to specialized rehabilitation services remains limited. Digital platforms can reduce geographical barriers, facilitate remote consultation, improve documentation quality, and support equitable access to rehabilitation services. Consequently, the findings of this study provide practical evidence supporting the integration of digital health technologies into pediatric rehabilitation programs in Indonesia and other resource limited settings.

7) Strengths and Limitations of the Study

This study has several important strengths. First, it provides one of the few qualitative investigations exploring therapists' perspectives on the development of an integrated digital monitoring system specifically designed for children DS in Indonesia. While previous studies have primarily focused on evaluating digital rehabilitation interventions, this research explores user needs before technology development, thereby contributing valuable evidence for user centered system design.

Second, participants represented multiple rehabilitation disciplines, including speech therapy, occupational therapy, physiotherapy, and behavioral therapy. This

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multidisciplinary representation enabled the identification of comprehensive functional requirements for the proposed monitoring system, reflecting diverse professional experiences and rehabilitation practices.

Third, the use of in depth semi structured interviews allowed participants to describe their experiences, expectations, and perceived challenges in detail. The qualitative approach provided rich contextual information that may not have been captured through quantitative methods alone, thereby enhancing the understanding of rehabilitation needs within the local healthcare context.

Despite these strengths, several limitations should be acknowledged. The study involved therapists from healthcare facilities located only in Pontianak City and Kubu Raya Regency, limiting the transferability of the findings to other geographical settings. Rehabilitation practices, resource availability, and digital infrastructure may differ across regions of Indonesia and internationally.

In addition, the study explored only therapists' perspectives. Parents, teachers, pediatricians, psychologists, and other healthcare professionals were not included, although they play essential roles in children's rehabilitation. Their perspectives may provide additional insights into system requirements, implementation challenges, and user acceptance.

Another limitation relates to the absence of prototype testing. Since this study focused on identifying user needs rather than evaluating an existing application, the usability, feasibility, and effectiveness of the proposed digital monitoring system could not be assessed. Future implementation studies are therefore necessary to determine whether the identified features improve rehabilitation outcomes and stakeholder satisfaction.

Finally, qualitative findings are inherently context specific and are not intended for statistical generalization. Nevertheless, the themes identified in this study provide valuable conceptual guidance for the development of integrated digital health interventions targeting children DS.

8) Future Research Directions

The present study provides a foundation for the future development and evaluation of integrated digital monitoring systems for children DS. Future research should focus on translating the identified user requirements into a functional prototype using a human centered design approach involving therapists, parents, teachers, healthcare administrators, and software developers throughout the development process.

Following prototype development, usability testing should be conducted to evaluate system acceptability, ease of use, functionality, and user satisfaction among therapists and families.

Subsequent research should also evaluate the effectiveness of the digital monitoring system through longitudinal or experimental study designs. Outcomes of interest may include therapy adherence, parental engagement, developmental progress, quality of communication among stakeholders, service efficiency, and children's functional independence.

In addition, future studies should include broader stakeholder groups, including parents, teachers, pediatricians, psychologists, special education professionals, and healthcare policymakers.

Considering the rapid advancement of digital health technologies, future systems may also integrate artificial intelligence, predictive analytics, wearable sensors, and Internet of Things (IoT) devices to support real time developmental monitoring and personalized intervention planning.

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Finally, multicenter studies involving diverse healthcare settings across Indonesia and other countries are recommended to evaluate the scalability, adaptability, and sustainability of integrated digital monitoring systems.

4. Conclusion

Therapists identified significant challenges in monitoring the rehabilitation of children with DS using conventional methods. An integrated digital monitoring system was considered essential to facilitate developmental tracking, improve communication among therapists, parents, and teachers, and support continuity of care. The proposed system has the potential to enhance multidisciplinary collaboration, strengthen family involvement, and promote more effective and evidence based rehabilitation services for children with DS.

5. Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. All authors contributed to the study, participated in the preparation of the manuscript, approved the final version, and agree to be accountable for all aspects of the work. The research was conducted independently without any financial, personal, or institutional relationships that could have influenced the study's design, data collection, analysis, interpretation, or reporting.

Statement of informed consent

Written informed consent was obtained from all participants prior to their participation in this study. Participants were informed about the study objectives, research procedures, potential risks and benefits, confidentiality of the collected data, and their right to withdraw from the study at any time without any consequences. All participants voluntarily agreed to participate and provided written informed consent before the interviews were conducted.

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