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To cite this article: Charlotte Wells, Jane L. Cross & Sejal Saglani (29 Aug 2026): Acceptability and feasibility of co-designed hybrid tele-physiotherapy for children with difficult asthma: a mixed-methods study, Journal of Asthma, DOI: [10.1080/02770903.2026.2721167](https://doi.org/10.1080/02770903.2026.2721167)

To link to this article: <https://doi.org/10.1080/02770903.2026.2721167>



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Published online: 29 Aug 2026.



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Acceptability and feasibility of co-designed hybrid tele-physiotherapy for children with difficult asthma: a mixed-methods study

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ABSTRACT

Objective: Respiratory physiotherapists address causes of poor asthma control, including breathing pattern disorders (BrPDs) affecting symptoms and quality-of-life. Co-designed hybrid physiotherapy services and digital resources have been created for children and young people (CYP) with asthma and BrPD. The aim of the study was to assess acceptability and feasibility of co-designed online resources, a digital platform, and hybrid physiotherapy services for CYP with asthma and BrPD.

Methods: Prospective mixed-methods study recruited CYP and carers from a severe asthma clinic. Participants accessed hybrid physiotherapy clinics (Attend Anywhere), online resources (hospital website, Beam Asthma Kids platform), and live group classes over 12 weeks. Acceptability was assessed using questionnaires, feedback, and physiotherapist diaries; feasibility through attendance and website analytics.

Results: Twenty-five CYP aged 7–16 years participated; all completed the program with no intervention-related adverse events. Eighteen (72%) created Beam Asthma Kids profiles to access live classes, videos, or programs. Hospital website videos received 296 views from 68 viewers over six-months. Feedback demonstrated high acceptability of the co-designed digital resources. Participants valued usability, accessibility, and flexibility of the Beam Asthma Kids and hybrid services, while identifying hospital webpage navigation, technical issues, and digital inclusion as implementation considerations. Across 32 clinics, 94 consultations occurred (27 in-hospital, 67 virtual); non-attendance was higher for virtual sessions (42% vs. 20%).

Conclusions: Co-designed physiotherapy resources and hybrid services were acceptable and positively received by CYP with asthma and BrPD. Hybrid physiotherapy may complement care by improving flexibility and access, but technical challenges and virtual non-attendance require attention to optimize implementation.

ARTICLE HISTORY

Received 9 March 2026

Revised 29 July 2026

Accepted 17 August 2026

KEYWORDS

Pediatric; asthma; physiotherapy; dysfunctional breathing; breathing pattern disorder; tele-health services

Background

Asthma is the most common long-term condition affecting children and young people (CYP), with an estimated prevalence of one in 11 children in the UK (1). The primary aim of childhood asthma management is to enable CYP to lead normal, active lives with minimal symptoms while maintained on appropriate therapy (2). Optimal asthma care requires a combination of pharmacological and non-pharmacological interventions, delivered within a personalized and holistic framework that reflects each child's needs (3).

Physiotherapy interventions complement pharmacological management and can improve asthma

control while minimizing medication burden (4). Within specialist multidisciplinary asthma services, physiotherapists play a key role in identifying and managing contributory or modifiable alternative causes of persistent respiratory symptoms despite optimized medication. These include breathing pattern disorders (BrPD), poor physical fitness, exercise-induced laryngeal obstruction, and comorbid conditions such as chronic cough and impaired airway clearance (5). Physiotherapy interventions may include breathing pattern retraining, exercise prescription, manual therapy, relaxation techniques, inspiratory muscle training, and support for self-management and adherence to maintenance therapies (6).

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 Supplemental data for this article can be accessed online at www.tandfonline.com/ijas.

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National and international guidelines, including the British Thoracic Society and Scottish Intercollegiate Guideline Network (7) and Global Initiative for Asthma (2), recommend physiotherapy for children with asthma, particularly where BrPDs are identified. Specialist physiotherapy input has been associated with improvements in asthma symptom scores in CYP (8). However, access to specialist pediatric respiratory physiotherapists remains limited nationally, due to a small skilled workforce and increasing service demand (4). Prolonged waiting lists further restrict access to face-to-face clinics.

Digital health technologies and telemedicine offer potential solutions by improving access, reducing travel burden, and minimizing time away from school or work for CYP and their families. Hybrid clinics combining in-person and virtual appointments can increase flexibility and convenience, with platforms such as Attend Anywhere widely adopted in pediatric services during the COVID-19 pandemic (9,10). Co-designed digital resources, including Beam Feel Good (<https://beamfeelgood.com>), have been successfully piloted in other populations, providing physiotherapy and exercise-guided sessions in an engaging, user-friendly format (11,12), in comparison to hospital webpages, which are often underused.

Using experience-based co-design (EBCD), CYP with asthma and BrPDs, their parents/carers, and key stakeholders across the service, including multidisciplinary clinicians, service managers, and digital platform partners, collaboratively developed a novel hybrid physiotherapy service model and suite of digital support resources (13). This work identified shared experiential and operational barriers to engagement with traditional physiotherapy services and informed the co-creation of flexible, age-appropriate, de-medicalized interventions, and delivery models. Key outputs included redesigned hospital webpages tailored to developmental stage, a hybrid tele-physiotherapy clinic model, and integration of an interactive digital platform (Beam Asthma Kids) offering live and on-demand group classes, educational videos, downloadable resources, and peer-supported content.

Building from the co-design phase, this study evaluates the acceptability and feasibility of implementing these innovations within a tertiary pediatric asthma service from both service user and service provider perspectives. Specifically, it examines a hybrid physiotherapy service model (face-to-face and Attend Anywhere clinics), alongside patterns of use, user experience, and operational feasibility of three digital platforms: the co-designed hospital webpages, Attend

Anywhere virtual clinics, and the Beam Asthma Kids platform, for CYP with asthma and BrPD.

Methods

Study design and setting

This single center prospective mixed methods study assessed acceptability and feasibility of a co-designed hybrid physiotherapy service, supportive online materials, and online weekly group classes for CYP (13) (Figure 1). A mixed-methods approach was selected in line with Good Reporting of a Mixed Methods Study (GRAMMS) guidance (14) to capture complementary quantitative and qualitative data: quantitative metrics (e.g. recruitment, retention, attendance, and digital engagement) provided objective measures of feasibility, while qualitative data (e.g. reflective diaries, open-text survey responses) captured stakeholder experiences and acceptability. The service receives regional and national referrals and provides multidisciplinary care focused on confirming diagnosis, identifying modifiable factors, and optimizing personalized treatment for children with difficult-to-control asthma. Specialist pediatric respiratory physiotherapy is embedded within the service to support holistic assessment and management, including identification and treatment of BrPDs. Ethical approval was provided by East Midlands—Leicester Central Research Ethics Committee (IRAS No. 291850).

Participants

Service users and service providers were prospectively recruited from a tertiary pediatric complex asthma service between February and June 2021.

Service users: Children and young people aged 6–16 years were eligible for inclusion if they had difficult-to-treat or severe asthma, along with their parents/carers. All eligible CYP attending the service were invited to participate, regardless of whether they were attending a new or follow-up appointment. Children with additional respiratory diagnoses (e.g. cystic fibrosis, bronchiectasis, and primary ciliary dyskinesia) or comorbidities (e.g. sickle cell anemia, scoliosis) that could influence clinical presentation or treatment were excluded. Non-English-speaking CYP and families were included; interpreters were arranged for face-to-face or virtual appointments to ensure language was not a barrier to participation.

Service providers: All members of the multidisciplinary team (MDT) working within the service during the recruitment period were invited to take part, including part-time and full-time clinicians involved in inpatient

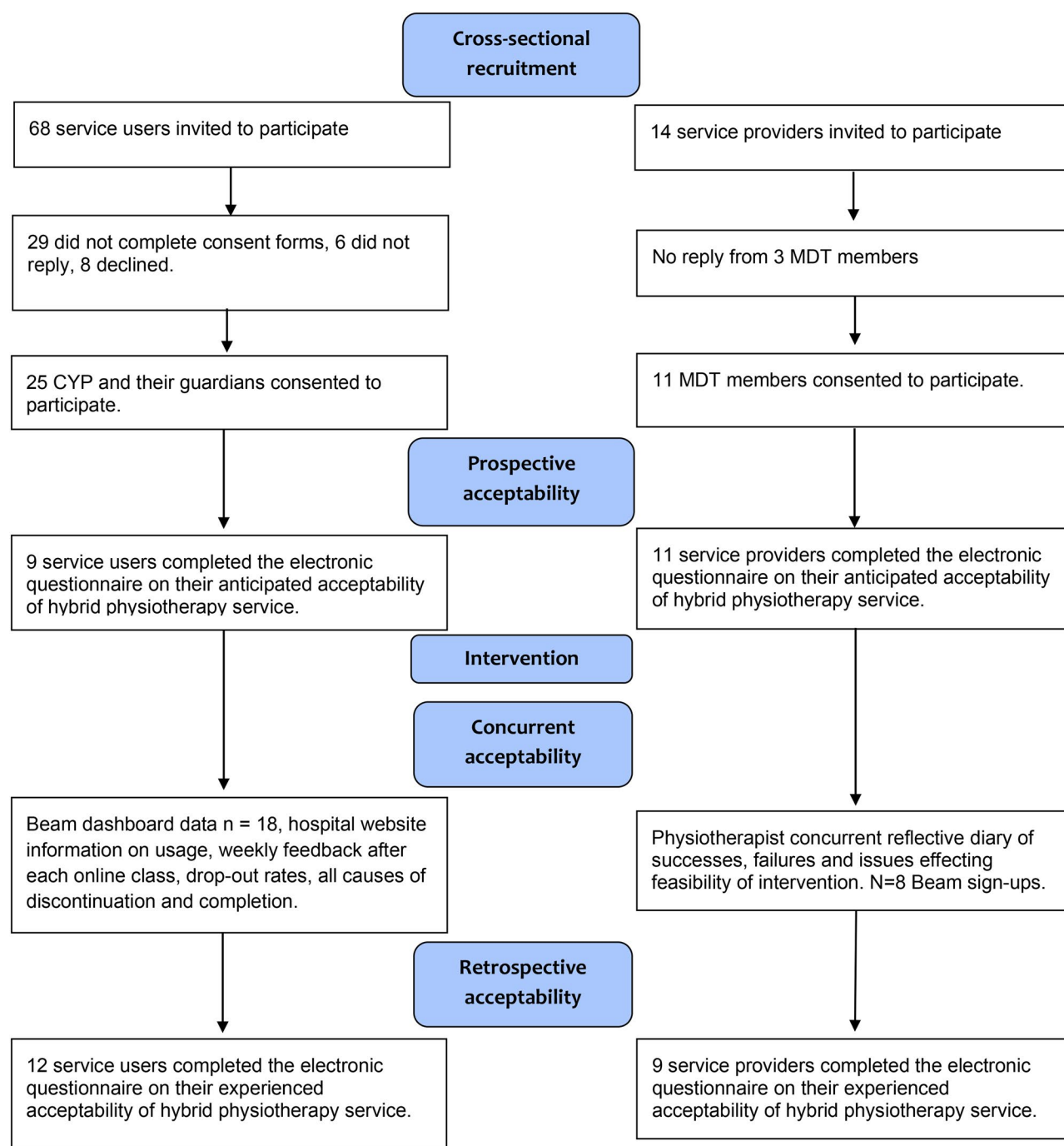


Figure 1. Consort flow diagram of acceptability and feasibility mixed-methods study.

and/or outpatient care of CYP with difficult or severe asthma. All clinical staff had completed nationally recognized pediatric asthma training consistent with tier 4 competencies as defined in the National Capability Framework for the care of CYP with asthma (15).

Sample size and recruitment

As this was a mixed-methods feasibility and acceptability study, it was not designed or powered to detect

clinical effectiveness, and formal power calculations were therefore not undertaken. A pragmatic recruitment target of 25–30 CYP and their parents/carers was set to allow estimation of key feasibility parameters, including recruitment, retention, engagement with digital platforms, and service utilization patterns. This sample size is consistent with feasibility study recommendations and was considered sufficient to capture a range of user experiences. Service providers were also recruited to obtain diverse professional

perspectives. Recruitment targets were informed by clinic referral numbers and anticipated uptake during the study period. Sampling decisions for qualitative components followed GRAMMS guidance (14) to ensure adequate information power, capturing a breadth of stakeholder experiences

Intervention

The intervention ran for 12 weeks from 1 July 2021 to 30 September 2021.

Hybrid 1:1 clinics

All physiotherapy interventions delivered within 1:1 clinics are established components of standard UK pediatric respiratory physiotherapy practice. While these interventions are part of routine care, the frequency and duration of physiotherapy provision are not standardized across NHS services (4). These interventions have demonstrated benefit for children with asthma and BrPD (6,8,16). To ensure consistency within a patient-centered approach, interventions were described using the 12-point TIDieR checklist (17) (see [Supplementary Material](#)). Participants attended individual physiotherapy sessions either in person at the hospital or via Attend Anywhere video conferencing. Sessions included assessment and delivery of interventions such as breathing pattern retraining, exercise programs, postural correction, airway clearance, and relaxation techniques (6). This hybrid approach offered flexibility while maintaining personalized care.

Sessions were supported by co-designed hospital webpages providing videos, downloadable PDFs, and information to reinforce self-management (13):

- *Primary school-aged children and parents: Physiotherapy in the management of children with asthma and altered breathing patterns—resources.* Royal Brompton & Harefield hospitals.
- *Teenagers and young adults: Asthma and difficulty breathing: resources for teenagers and young adults.* Royal Brompton & Harefield hospitals.

Co-designed digital platform: Beam Asthma Kids

Participants were offered access to Beam Feel Good Asthma Kids, a pediatric asthma program delivered via the existing Beam Feel Good digital platform, which had previously been used for other long-term health conditions; the asthma-specific content was

developed through an EBCD process (13). The digital platform hosted:

- 12-week live online group classes for CYP ([Table 1](#));
- On-demand videos for those unable to attend live;
- Pre-set physiotherapy programs, downloadable resources, and peer blogs.

Live sessions followed a structured format: welcome (5 min), specialist talk (10 min), discussion (10 min), break, activity/exercise (20 min), cool-down (5 min), and final check-in. Monthly online support sessions were provided for carers. iPads were available for families with limited access, and face-to-face sessions remained available if online engagement was not possible.

Safety and safeguarding

All online sessions required children to keep cameras on, with parents nearby. Dress code guidance ensured appropriateness. Physiotherapists monitored symptoms and adapted interventions as needed. Service providers did not work alone, and clinical nurse specialists were available for support in case of adverse events.

Data collection

Demographic data collected for all service users included age, sex, ethnicity, and postcode to calculate household income deprivation. Intervention acceptability was assessed using the theoretical framework of acceptability (TFA) (18), comprising seven constructs: ethicality, affective attitude, burden, opportunity costs, perceived effectiveness, self-efficacy, and intervention coherence. The TFA framework was selected *a priori* to provide a structured approach for understanding participant and clinician perceptions of acceptability across intervention components.

Electronic surveys were developed using the TFA for CYP, their parents/carers, and hospital staff (18). The initial questions were reviewed by the research team for redundancy, clarity, and relevance. Surveys were then constructed in Microsoft Forms and included both open-ended free-text questions and closed-ended questions (e.g. scales, rating/ranking, and multiple-choice), with question type chosen according to its purpose (19).

Surveys were sent after consent but before the 12-week program, and again after program completion, with reminders at two weeks and one month.

Table 1. Asthma kids virtual summer school timetable.

Date	Theme	Specialists	Education/topic	Activity	Attendance live	On demand viewing numbers
Week 1	Introducing physiotherapy, basic anatomy, and physiology of breathing	Physiotherapist	What do physios do and how do we breathe?	<i>Physiotherapist:</i> Posture—stretch and tone session and exploration of breath.	2	21 education and 6 activity
Week 2	Fitness/healthy living	Sports person/British triathlon athlete.	Overcoming adversity. Achieving your dreams even with asthma, BrPD and EILO.	<i>Physiotherapist:</i> HIIT session easy/moderate intensity.	5	7 education and 5 activity
Week 3	Exercise and breathing	BrPD in Athletes and Inspiratory Muscle Training (IMT) session Prof from School of Sports Science	Breathing assessments for athletes and introducing IMT	<i>Physiotherapist:</i> Strength training (legs) with IMT breath technique	6	6 education and 3 activity
Week 4	Breathing pattern retraining—ask the UK experts	Two clinical specialist physiotherapists from across the UK.	Short talk from specialist on breathing retraining (15 min) questions and answers (15 min)	<i>Physiotherapist:</i> Basic breathing retraining and common mistakes.	4	6 education and 17 activity
Week 5	Nose breathing	Two clinical specialist physiotherapists from across the UK.	Role of the nose—why is it important. Practice sinus rinsing—live demonstration	<i>Physiotherapist:</i> Nose breathing exercises and live sinus rinse demonstration.	4	8 education and 6 activity
Week 6	Anxiety, asthma, and breathing.	Clinical psychologist	How to identify emotions. How do our emotions impact our breathing symptoms?	<i>Physiotherapist:</i> Guided body scan relaxation activity.	3	8 education and 6 activity
Week 7	Fitness/healthy living	Specialist pediatric dietitian	Healthy eating and balancing our diet.	<i>Physiotherapist:</i> Strength training—core and arms.	3	4 education and 10 activity
Week 8	Fitness/healthy living	Two specialist pediatric physiologists	What is exercise testing and why do we do it?	<i>Physiotherapist:</i> Football fitness.	5	4 education and 7 activity
Week 9	Fitness/healthy living	Specialist pediatric physiotherapist.	Breathing pattern retraining next level and exercise and symptoms.	<i>Physiotherapist:</i> Next level breathing retraining during exercise.	4	21 education and 5 activity
Week 10	Vocal health and EILO	Pediatric speech and language therapist.	Vocal cords, how they work and how they can cause symptoms of breathlessness.	<i>Pediatric speech and language therapist:</i> Vocal warm up and voice exercises.	3	10 education and 8 activity
Week 11	Back to school—managing symptoms at school	Specialist pediatric clinical nurse specialist.	Importance of asthma action plan and going from primary to secondary school	<i>Physiotherapist:</i> P.E. at home (40-minute exercise) HIIT session.	4	4 education and 2 activity
Week 12	Back to school	Specialist pediatric asthma nurse	<i>Practical tips:</i> Ways to remember your inhalers.	<i>Physiotherapist:</i> Dance	4	5 education and 3 activity

Note. Once a week 16:30 to 17:30.

Concurrent feedback included reflective diaries from physiotherapists and participation data from online group classes (attendance, satisfaction ratings, and post-session feedback).

Data analysis

Quantitative data, including demographics, session attendance, participation rates, and survey responses, were summarized descriptively using frequencies, percentages, and simple measures of central tendency.

Survey responses were analyzed by construct. Closed-ended items (e.g. Likert scales and rankings) were summarized descriptively. Open-ended free-text responses were analyzed using deductive directed content analysis. One researcher (CW) manually coded the data in Microsoft Excel, with codes organized according to the relevant TFA domains. Within each domain, intervention-specific patterns and themes were identified to explore differences in acceptability across the digital intervention components. The coding framework and interpretation of the findings were

reviewed and discussed with the supervisory team to enhance the credibility and trustworthiness of the analysis. As coding was undertaken by a single researcher, formal inter-coder reliability assessment was not performed. Illustrative quotations were selected to represent key findings.

Concurrent feedback from reflective diaries and session-specific data (attendance, satisfaction, and technical issues) were summarized descriptively to assess feasibility and fidelity. Quantitative and qualitative data were analyzed concurrently and integrated in accordance with GRAMMS guidance (14) to identify patterns in feasibility, fidelity, and acceptability across intervention components.

Results

Participation

Service users

Of the 68 CYP invited to participate, 25 provided consent, a participation rate of 35%. Twenty-nine did not return consent forms within the timeframe thus were unable to participate, six did not respond, and eight declined. Reasons for declining participation included being too busy ($n = 3$), feeling overwhelmed by treatments ($n = 1$), lack of motivation ($n = 1$), dislike of online group classes ($n = 1$), and no response ($n = 2$). No withdrawals, dropouts, or intervention-related clinical adverse events occurred during the study.

Among the 25 CYP participants, 15 were male, with a mean age of 12 years (range 7–16). Half of the participants were White British ($n = 12$), with the remainder representing other ethnic backgrounds. Participants came from all deciles of the Income Deprivation Affecting Children Index (IDACI 1–10).

Service providers

Eleven of 14 MDT staff consented to participate, including four medical consultants, two clinical nurse specialists, one physiotherapist, two physiologists, one pharmacist, and one research nurse.

Anticipated acceptability and feasibility

Nine of 25 (36%) service users and 11 (100%) service providers completed the pre-intervention questionnaire. Responses indicated openness to hybrid physiotherapy and online resources, with families reporting prior experience using online information sources such as Google or Asthma and Lung UK (<https://www.asthmaandlung.org.uk/>), reflecting familiarity

with self-directed information seeking. While face-to-face appointments were often preferred, respondents highlighted the convenience, flexibility, and reduced travel associated with online sessions, particularly for families living a distance from the hospital. Participants were cautiously optimistic about the effectiveness of video consultations and online resources, noting that these could be revisited at home and supplemented face-to-face care. Key barriers included internet connectivity, difficulties maintaining child engagement during virtual sessions, and challenges for younger or neurodiverse children.

Service providers ($n = 11$) similarly anticipated that online physiotherapy could deliver a high-quality service for many patients, particularly when used as a complement to face-to-face appointments. Providers noted potential equity concerns, as some families may lack reliable internet or appropriate devices, and highlighted the need for adapted approaches for children with learning disabilities. They also recognized the reduced burden of virtual clinics for some families and the potential to improve patient self-efficacy through supportive online resources, provided sessions were tailored and monitored.

Overall, the qualitative findings from both groups align with quantitative survey data: face-to-face appointments were generally preferred but required more effort than virtual sessions. These insights are summarized in Table 2, which illustrates key themes across service users and providers.

Concurrent intervention acceptability and feasibility

Over the 12-week intervention period, 34 hybrid physiotherapy clinics were conducted with a total of 150 appointments. Data were available for 32 clinics, with two datasets missing due to staff leave. Across this period, 34 in-person appointments (34/150, 23%) and 116 virtual appointments (116/150, 77%) were made available. Attendance was higher for in-person sessions (27/34, 80%) than virtual sessions (67/116, 58%). Technical difficulties affected 53% (17/32) of hybrid clinics, including poor internet connectivity, platform login issues, and reliance on mobile devices, which limited visual assessment. Qualitative data from physiotherapy diaries highlighted children with neurodiversity often benefited more from in-person sessions, young people could find video consultations challenging to engage with, and physiotherapists valued face-to-face contact for hands-on assessment and clinical reasoning. Overall, physiotherapist satisfaction with hybrid clinics was moderate, averaging 3.41 (range 1–5).

Table 2. Anticipated acceptability of proposed intervention.

Key theme/TFA construct	Service user illustrative quotes	Service provider illustrative quotes
Use of online resources/ intervention coherence	"I have looked at Asthma UK on a couple of occasions."	"The quality of the service provided is not dependent on the medium but on the provider...with the right patients the service would work well."
Preferred mode of physiotherapy/ affective attitude	"I think it's a good idea, particularly when mixed with face-to-face care."	"Yes, provided they do not replace face-to-face, but are complementary...a hybrid version would work."
Convenience, flexibility, and effort/burden and opportunity costs	"So much easier for us living in Wales!...it saves a lot of time and expense."	"Some families may not put the same level of engagement into a video call...with the right patients, online clinics can be as effective as face-to-face."
Child engagement/ burden	"My child struggles with Zoom interactions."	"Sometimes children with learning disabilities may need different approaches...hands-on guidance is required for some patients."
Technical barriers/ ethicality and feasibility	"Just attention span of my daughter. Internet speeds affecting quality."	"Several of our patients do not have access to good Wi-Fi or devices...equity is a concern, particularly for disadvantaged families."
Cautious optimism/ perceived effectiveness and self-efficacy	"Although we haven't done this before, I'm happy to trial it out, it could be beneficial."	"Yes, we can improve patient self-efficacy with online resources, provided sessions are tailored and supported."

On the Beam Asthma Kids platform, 18 service users (72%) and eight service providers (73%) created profiles and were active on the platform. Weekly live classes were attended by a median of 4 CYP [range 2–6], and on-demand education videos were viewed by 7 viewers [4–21 range] and activity videos six views [2–17 range] (Table 1). No intervention-related clinical adverse events were reported during any sessions.

During the 12-week program, among registered platform users, the co-designed library of seven videos hosted on the Beam Asthma Kids platform was viewed 150 times (mean 21 views per video; range 8–45) (see Table 3). During the evaluation period, access to Beam Asthma Kids was restricted to registered study users and was not a publicly accessible resource. Platform analytics were therefore limited to study users and did not allow further breakdown by unique individual viewers.

In addition, following wider dissemination of the same seven videos via the hospital website, these resources generated 296 views from 51 unique users between 20 September 2021 and 25 March 2022. These analytics represent service-level webpage activity and were not restricted to study participants; therefore, they cannot be directly compared with Beam Asthma Kids usage data.

Table 3. Descriptive viewing analytics of the co-designed resource library hosted on Beam Asthma Kids and the hospital website.

	Beam Asthma Kids (unique views)	Hospital website (unique views)	Hospital website total views
Basic video library			
Am I breathing right? A quick breathing pattern checklist	31	10	42
Rescue breathing	45	13	62
What is causing my symptoms? What is 'normal' breathlessness?	22	7	39
How to master your breathing during exercise	8	12	63
How to support your child with asthma	10	7	26
How we breathe	19	8	27
There is more than one way to breathe: educational series for teenagers	15	11	37
Totals	150	68	296
Average	21	10	42
Min	8	7	26
Max	45	13	63

Note. Beam Asthma Kids analytics represent usage by enrolled study participants during the intervention period. Hospital website analytics represent broader webpage activity and were not restricted to study participants; therefore, the figures are not directly comparable.

Experienced acceptability and feasibility

Twelve service users (48%) and nine service providers (82%) completed the post-intervention questionnaire. Qualitative findings indicated that retrospective acceptability varied across intervention components and was influenced by participants' experiences of usability, accessibility, perceived usefulness, flexibility, and digital inclusion (Figure 2).

Both service users and providers reported positive experiences of the new Beam Asthma Kids webpages, with almost all participants registering for the platform (users 12/12, providers 8/9). Participants described the webpage as user-friendly, visually appealing, child-focused design, with clear navigation and accessible, informative content. Users valued the on-demand videos and live sessions, appreciating the ability to pause, rewind, and access information at their own pace. Providers similarly viewed the platform as engaging and easy to use, recognizing its value in extending education and support beyond clinical appointments.

Live online physiotherapy group sessions were generally well received, although experiences reflected both benefits and challenges. Participants valued the interactive nature of the sessions and opportunities to engage with clinicians and other young people, while some described fatigue associated with attending live sessions. Ten service users recognized the

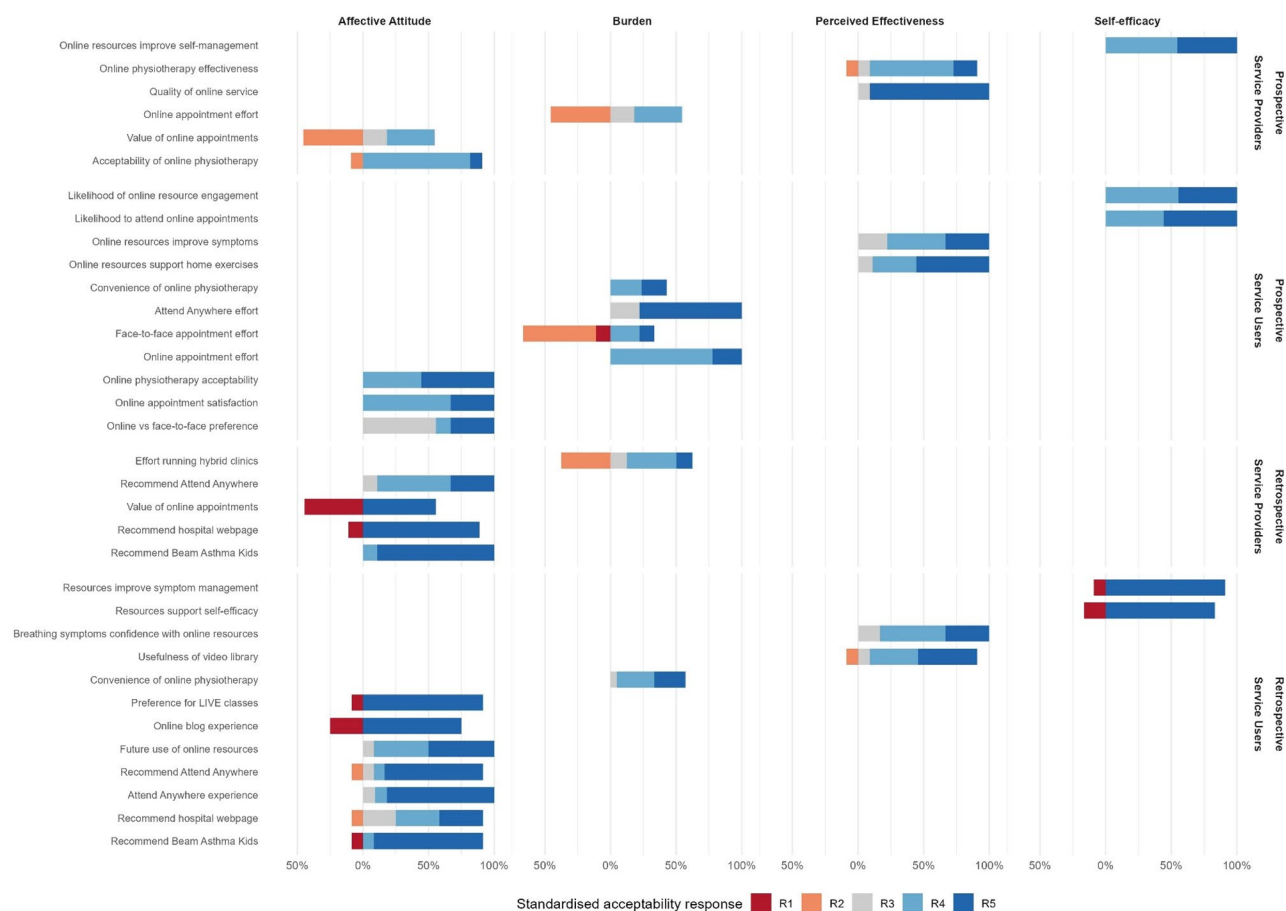


Figure 2. Standardized acceptability responses (R1–R5) to quantitative questionnaire items mapped to the theoretical framework of acceptability (TFA) domains. Responses were standardized across different five-point response scales to represent the direction of acceptability (R1 = least acceptable response; R5 = most acceptable response), enabling comparison across questionnaire items. Bars show the percentage of respondents selecting each response category for prospective and retrospective service users and service providers.

convenience of virtual delivery and reduced travel requirements. Providers also reported positive experiences delivering live sessions, highlighting interactive format and availability of catch-up recordings as important features that support flexibility for families. Online videos, blogs, and downloadable leaflets were valued by 10 service users and nine service providers for supporting home physiotherapy and symptom management, with users reporting increased understanding of breathing techniques and asthma control. Reading blogs written by peers and specialists were considered helpful, some participants expressed a preference for video-base resources.

Experiences of the Hospital physiotherapy webpages received mixed feedback. Participants appreciated availability of downloadable resources and clear clinical information but described difficulties locating the webpages within the wider hospital website. Many felt that content was buried within multiple menu layers, reducing accessibility and ease of navigation. Providers

echoed these concerns, suggesting clearer labeling, improved signposting, and enhanced search functionality to improve usability.

Most service users (10/12) and service providers (7/9) had used physiotherapy appointments via the Attend Anywhere platform. Participants generally viewed virtual consultations positively, highlighting convenience, flexibility, and reduced travel as key advantages. Nine service users rated their experience as “very good”, while providers valued the platform for maintaining clinical contact with families. However, several providers reported technical challenges, including poor internet connectivity affecting video and sound quality, which occasionally limited the quality of consultations.

Looking ahead to future care, both service users and providers expressed a preference for a hybrid model combining face-to-face and virtual appointments, recognizing benefits such as flexibility, reduced travel, and ongoing support between appointments.

Participants identified digital inclusion as an important consideration for future implementation. Providers highlighted barriers including limited internet access, device availability, language differences, and digital literacy, emphasizing the need for technology support, multilingual resources, and community-based

assistance to ensure equitable access. Participants suggested that engagement could be enhanced through better communication about appointments, greater use of apps and social media, and flexible appointment scheduling to better meet the needs of the CYP and their families (Table 4).

Table 4. Retrospective experiences of acceptability of digital intervention components: findings from deductive directed content analysis mapped to the theoretical framework of acceptability.

Intervention component	TFA domain(s)	Service user perspectives	Service provider perspectives	Illustrative quotes
Beam Asthma Kids webpage	Affective attitude; perceived effectiveness; self-efficacy	Participants described the webpage positively, highlighting its visual appeal, accessibility, and ease of navigation. The resource was perceived as informative and supportive, helping families understand symptom management strategies.	Providers viewed the webpage as an engaging and accessible resource that extended support beyond clinical encounters and provided families with information outside appointments.	User: "It looks great, colourful and visually appealing." Provider: "Very informative and easy to understand; website is really colourful and user friendly."
Hospital Physiotherapy webpage	Affective attitude; burden; perceived effectiveness	Participants valued the availability of physiotherapy information and downloadable resources; however, difficulty locating the webpage reduced accessibility and affected engagement with the resource.	Providers noted difficulty locating the page due to poor labeling and search issues and identified the need for clearer navigation, improved signposting, and better search functionality.	User: "I can't find it! It is quite embedded under rehab and therapies." Provider: "I couldn't find the hospital physiotherapy webpage."
Attend Anywhere virtual clinics	Affective attitude; burden; perceived effectiveness	Participants valued virtual appointments for convenience, flexibility, and reduced travel demands. Technical difficulties related to connectivity and audio/video quality were identified as barriers to a positive experience.	Providers recognized the benefits of virtual consultations while highlighting the importance of reliable technology and infrastructure to support effective delivery.	User: "Good for avoiding travel, convenient." Provider: "Internet speeds affecting quality of the video call and poor sound quality."
Live online group sessions and on-demand videos	Affective attitude; burden; perceived effectiveness; self-efficacy	Participants valued the interactive nature of live sessions and opportunities to engage with clinicians, although some experienced fatigue associated with attending online sessions. The availability of catch-up recordings supported flexibility and enabled access when live attendance was not possible. Videos were valued for supporting independent practice at home.	Providers described live sessions as engaging and interactive, supporting communication with families. Catch-up options were considered important to accommodate different family circumstances and reduce barriers to participation.	User: "I really enjoyed the session and felt it was interactive." User: "The option to watch the session on catch-up is a great idea!" Provider: "Sessions were well facilitated, very interactive with lots of questions."
Support materials (blogs, leaflets, and video library)	Perceived effectiveness; self-efficacy; affective attitude	Participants valued resources that could be accessed outside appointments, particularly videos and leaflets that supported understanding, practicing techniques and managing symptoms at home.	Providers considered digital resources valuable for reinforcing education, supporting self-management, and extending care beyond scheduled appointments.	User: "Very helpful to have downloadable leaflets and videos." Provider: "Invaluable resource for children and young people with dysfunctional breathing."
Digital inclusion and equity	Opportunity costs; burden; ethicality	Participants recognized that digital approaches may not be accessible to all families, particularly where there were challenges relating to devices, connectivity, digital skills, or confidence. Maintaining alternative routes of support and development of multilingual resources was considered important to ensure equitable access.	Providers highlighted the need to address digital inequalities, including access to devices, internet connectivity, digital literacy, and language support. Suggestions included practical support and partnership approaches to enable inclusion.	User: "Some families don't have good internet or devices; need help to include everyone." Provider: "Need to ensure access for all, provide devices if needed, and offer education on technology use."
Hybrid model of care (virtual and face-to-face)	Ethicality; affective attitude; perceived effectiveness	Participants valued having choice in how care was delivered. Face-to-face appointments remained important, while virtual options were viewed as beneficial for convenience and flexibility.	Providers supported hybrid models as a sustainable approach, allowing care to be tailored according to family preferences, clinical needs, and circumstances.	User: "Face to face is best but hybrid with video appointments is good for convenience." Provider: "Hybrid model is here to stay; combining F2F and virtual consultations."
Future considerations for sustaining engagement	Burden; opportunity costs; self-efficacy; ethicality	Participants suggested that future engagement could be supported through improved awareness of available resources, more education around appointment expectations and approaches such as apps or social media.	Providers emphasized the importance of flexible appointment options (after school and evenings), accessible communication, and adapting delivery around family circumstances.	User: "Apps and social media could engage young people better." Provider: "Listening to families and offering flexible appointment times helps engagement."

Note. Qualitative findings were generated through content analysis and subsequently mapped onto relevant TFA domains to aid interpretation.

Discussion

This study demonstrates that a co-designed hybrid model of pediatric respiratory physiotherapy, including face-to-face care, virtual clinics, live group sessions, and digital resources, was feasible and perceived as acceptable for children with asthma and BrPD, as well as clinicians. These findings support the potential role of digitally enabled physiotherapy within routine pediatric respiratory services, while highlighting the importance of considering implementation barriers alongside perceived benefits.

Hybrid and group-based digital models in pediatric respiratory physiotherapy

The acceptability of live group sessions and digital resources aligns with evidence from pediatric pulmonary rehabilitation and structured asthma education, where supervised exercise, breathing retraining, and peer interaction enhance engagement (20,21). While adult pulmonary rehabilitation is well established, pediatric applications remain limited (22). Digitally delivered group sessions may therefore provide a scalable means to adapt rehabilitation principles for children when embedded within a hybrid service, rather than as stand-alone interventions. Qualitative feedback emphasized flexibility, peer support, and revisiting recorded content, suggesting that digital interventions can extend service reach, particularly in contexts of workforce constraint (23). However, acceptability alone does not indicate effectiveness; future studies should assess clinical outcomes such as symptom control, exercise tolerance, and healthcare utilization.

Importantly, acceptability should be interpreted as a balance between perceived benefits and the burden associated with participation. Although the co-designed Beam Asthma Kids resources were viewed positively overall, technical challenges were experienced by 53% of participants attending virtual 1:1 clinics delivered via Attend Anywhere, representing an additional burden within the TFA domains of burden and opportunity costs. These challenges highlight that successful implementation of hybrid models requires not only acceptable content and delivery formats, but also reliable digital infrastructure and appropriate technical support. At the time of implementation in 2021, virtual consultation platforms were being rapidly embedded within NHS services, and both families and clinicians were adapting to new models of healthcare delivery.

Choice, flexibility, and the continuing role of face-to-face care

Both service users and providers emphasized the importance of choice. Face-to-face appointments were highly valued for assessment, complex symptom evaluation, hands on examination and relationship building, while virtual modalities were appropriate for follow-up exercise progression, education, and reinforcement of breathing strategies. These findings support broader telehealth literature advocating hybrid models that align delivery mode with clinical purpose (24). Determining which encounters must remain in person is a key priority for service optimization.

Although virtual delivery increased flexibility and was valued by many participants, attendance patterns suggested higher non-attendance for virtual compared with face-to-face sessions (42% versus 20%). These findings should be interpreted cautiously given the feasibility design and small sample size; however, they highlight the importance of understanding factors influencing engagement with different delivery formats. One potential area for exploration is whether families perceive different modes of care as having equivalent importance or value, which may influence attendance and engagement. While this feasibility study was not designed to explore these perceptions, future qualitative work should investigate how children, young people, and families understand and prioritize different modes of healthcare delivery, and whether this influences engagement with virtual models.

Digital innovation, sustainability, and NHS infrastructure

Despite strong acceptability, this study highlights persistent challenges in sustaining digital innovation within NHS services. The co-designed Beam Asthma Kids platform received consistently positive feedback from families and clinicians, particularly for its usability, child-centered design, and integration of live and on-demand content. However, the platform was unable to continue beyond a limited number of disease areas due to funding constraints. This reflects a broader tension between research-led digital innovation and the slower pace of NHS commissioning, governance, and technological adoption, which frequently lags behind the private sector (25). For pediatric respiratory care, where long-term education, self-management, and family engagement are central, this risks the loss of effective and well-received digital interventions.

Clearer pathways to embed and sustain validated digital tools within routine NHS services are needed to ensure that promising innovations translate into lasting clinical impact. Although the NHS digital landscape has continued to evolve since this study was conducted in 2021, the broader challenges relating to implementation and sustainability of digital innovations remain pertinent.

Hospital websites and child-centered digital design

Evaluation of the Hospital physiotherapy website highlights limitations in NHS digital infrastructure. Analytics were limited by the site's late launch and lack of participant-specific data, restricting interpretability. Qualitative feedback indicated that webpages were less engaging, harder to navigate, and text-heavy compared with the dedicated digital platform, particularly for children and adolescents. These findings reflect broader concerns that NHS digital resources are often designed for adults (26,27). Enhancing child-centered digital design is a key priority for pediatric respiratory services.

Limitations

This tertiary single-center feasibility study has several limitations. Participation was voluntary and may have introduced selection bias, as families who chose to participate and complete post-intervention questionnaires (12/25 CYP and families) may have differed from those who did not. Respondents may have represented those more willing to engage with a hybrid model of care or who had more positive experiences; therefore, acceptability findings should be interpreted cautiously. Recruitment took place during the summer of 2021, immediately following the easing of COVID-19 restrictions in the UK, when families were resuming in-person education, work, and recreational activities. This unique context may have influenced willingness to participate in a digitally delivered intervention and should be considered when interpreting transferability of findings. Service users potentially traveling longer distances for specialist care may also have influenced acceptability of hybrid services.

The lead researcher occupied a dual clinical-research role. This could introduce social desirability bias, however, qualitative feedback was collected through anonymous questionnaires to mitigate this. The researcher did not conduct the clinical appointments, but the insider position supported recruitment and participant trust.

Website analytics should be interpreted cautiously: the hospital site launched at the end of the intervention, data cover the following six months. Unlike Beam Asthma Kids usage data, hospital webpage analytics represented unrefined, publicly accessible webpage activity and could not be linked to study participants or distinguish unique users. Website views may have included patients, families, health-care professionals, and wider national or international visitors following dissemination through clinical communications and professional networks; therefore, these data should not be interpreted as directly comparable measures of engagement between platforms.

Conclusions

This mixed-methods feasibility and acceptability study was designed to evaluate the implementation of a co-designed hybrid tele-physiotherapy model for CYP with difficult asthma, rather than to assess effectiveness. Integrated quantitative and qualitative findings demonstrate that recruitment, delivery, and retention were achievable, and that the intervention components were acceptable to both service users and providers. No safety concerns were identified. However, higher non-attendance rates and technical challenges for virtual appointments highlight important implementation issues requiring refinement prior to wider adoption. Collectively, these results provide the necessary feasibility data to inform the design of a future adequately powered randomized controlled trial, including selection of primary outcomes, optimization of the hybrid model, and identification of appointments best delivered face-to-face versus virtually.

Acknowledgments

Thank you to the team at Beam Feel Good for the support and facilitation of developing a new platform for CYP with Asthma. Great thanks given to the Association of Physiotherapists in Respiratory Care (ACPRC) for supporting the writing of this manuscript through a writing retreat and mentorship.

Author contributions

CRedit: **Charlotte Wells:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing; **Sejal Saglani** and **Jane L. Cross:** Supervision, Writing – review & editing.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

Funding

This work is supported by the Royal Brompton Hospital Charity.

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