



eHealth as an Aid for Facilitating and Supporting Self-Management in Families with Long-Term Childhood Illness; Development, Evaluation, and Implementation in Clinical Practice – A Research Programme

Inger Kristensson Hallström¹, Charlotte Castor¹, Helena Hansson², Robert Holmberg³, Degu Jerene⁴, Björn A Johnsson⁵, Gudrun Kristjánsdóttir⁶, Ólof Kristjánsdóttir⁶, Boris Magnusson⁵, Magnus Persson*¹, Annika Sjöström-Strand¹, Anna Welander Tärnberg⁷, Pernilla Stenström⁸, and Åsa B Tornberg¹

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About the AUTHORS

1 Department of Health Sciences, Faculty of Medicine, Lund University, Sweden

2 Department of Paediatrics and Adolescent Medicine/Women's and Children's Health, Copenhagen University Hospital/University of Copenhagen, Denmark

3 Department of Psychology, Faculty of Social Science, Lund University, Sweden

4 KNCV Tuberculosis Foundation, Netherlands

5 Department of Computer Science, Faculty of Technology, Lund University, Sweden

6 University of Iceland, Iceland

7 Centre of Economic Demography and Department of Economics, Lund University, Sweden

8 Department of Clinical Science, Faculty of Medicine, Lund University, Sweden/Skane University Hospital, Sweden

Contact:

Magnus Persson

magnus_c.persson@med.lu.se

Abstract

Introduction eHealth, defined by WHO as: “the transfer of health resources and health-care by electronic means” are expected to increase communication between healthcare providers and patients and increase accessibility and patient participation in healthcare. The aim of this research programme is to: 1) develop a sustainable multidisciplinary environment for advancing, evaluating, and implementing models of eHealth to promote self-management for children and their families, and 2) increase the present knowledge of clinical and economic cost-effectiveness of eHealth as an aid for supporting self-management in families with long-term childhood illness.

Method The research is performed in Sweden, Denmark, and Ethiopia and organized in three research domains: eHealth to enable and promote self-management in advanced paediatric care, eHealth for early diagnosis and treatment in paediatric care, and Co-Creation of multidisciplinary knowledge for the translation of eHealth in practice. The research follows a framework for developing and evaluating complex interventions in healthcare. Through participatory design family members and care providers participate throughout the research process. Quantitative and qualitative data as well as health economics are collected in six clinical areas. Five general areas are run transversal.

Results and conclusion Evidence-based best practices in developing and evaluating eHealth in paediatric healthcare will be suggested. As implementation is part of the programme, cost-effective eHealth directly benefiting families and healthcare services will be guaranteed.

Trial registration NCT04150120



Research and Best Practice

Introduction

Paediatric healthcare is rapidly evolving towards outpatient and community care and from public to parental responsibility (1). For infants, older children, and adolescents with long-term illness (LTI; i.e., illness lasting for three months or longer (2)), international policy and practice aim to minimize care at hospital to reduce the distress of hospital admissions and to keep up normal family life (1). To promote this, eHealth could be one solution, but there is limited research on the effects of digital interactive care on parents and children (3) and evaluation and implementation strategies are lacking (4). eHealth is a broad concept, as indicated by the WHO definition: “eHealth is the use of information and communication technologies (ICT) for health. It is recognised as one of the most rapidly growing areas in health today” (5). Great expectations are associated with the realization of the term. It may: 1) increase communication between healthcare professionals and patients, 2) increase accessibility and patient participation in healthcare (6), and 3) support information and data sharing between patients, family, and healthcare professionals (7)). Here, our focus regarding eHealth is on the potential for facilitating and supporting self-treatment of children at risk of LTI within the framework of child-centred care (CCC), defined as care planned around the child’s perspective and needs and in the context of family and community (8).

Two features of healthcare systems today are easily detected: 1) a trend towards more reliance on the individual and family to take active part in the healthcare process – with self-management being a key term, and 2) great expectations regarding the potential benefits of using modern information technology in the domain of health and healthcare (7). The complex and costly need for care of an increasing number of children with LTI is among the most critical challenges for healthcare systems all over the world (8). In addition to poorer health, people with LTI generally have lower educational achievements, fewer economic opportunities, and higher rates of poverty. Ensuring healthy growth and development in children is a principal concern of all societies (8). In this context, eHealth could be of special interest as an aid for facilitating and supporting self-management for children with and at risk of LTI.

Ethnic minorities and individuals with low socioeconomic status having lower eHealth literacy (the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem), may have poorer access to and use of the internet, compared to others (6). It is important to understand the sociocultural

barriers not only within a country but also between countries that may hamper the successful use of eHealth solutions in vulnerable population groups (6). To date, scarce literature around culture and eHealth exists, particularly around children and young people with LTI and their families (9).

In view of the above, a research programme including different clinical research areas was planned to develop and strengthen safe and satisfactory CCC supported by different devices and software of eHealth technology. The aims of this research programme are to:

- develop a sustainable multidisciplinary environment for advancing, evaluating, and implementing models of eHealth to promote self-management for children and their families,
- increase the present knowledge of clinical and economic cost-effectiveness of eHealth as an aid for facilitating and supporting self-management in families with long-term childhood illness.

Specific outcomes in the different areas and phases are described in Table 1.

Method

Study design

The research programme builds on interventions and implementation in three research domains: 1) eHealth to enable and promote self-management in advanced paediatric care, 2) eHealth for early diagnosis and treatment in paediatric care, and 3) Co-Creation of multidisciplinary knowledge for the translation of eHealth in practice. It is registered in Clinical Trials with registration number NCT04150120. The framework for trials of complex interventions (MRC), including the phases of development, feasibility, evaluation, and implementation are the methodological basis for the research and are used throughout the research programme, which includes economic, technical, cultural, and organizational analyses of the clinical data (Figure 1) (10). The implementation phase (including reporting, long-term outcomes, and dissemination) is an integral part of the research process. Core concepts as context, programme theory, stakeholders, uncertainties, refining the intervention, and economics are discussed throughout the different phases (11). Interactive and interdisciplinary methods with a participatory design are used to involve stakeholders such as patients and families and healthcare professionals (12).

The research programme started in 2019 and will continue until 2025. The different research projects are at different stages according to the MRC framework (Table 1) and proceed in parallel.



Research and Best Practice

Table 1. Specific outcomes in the different areas.

	Development	Feasibility	Evaluation	Implementation
Areas I–IV	To develop a tablet or a digital solution using participatory design.	Usability and technical development.	Acceptability and end-users' experiences, digital feasibility, using patterns. Medical safety. Psychological effects.	Effectiveness of dissemination to professionals at the department, to patient organizations and the hospital management.
Area V	Coherence between GMA assessed by CIMA and clinician for early risk assessment of CP.	Usability and parents' experiences	The association between clinical GMA, the CIMA and developmental delay at two years.	Effectiveness of dissemination to professionals at the departments, and the hospital management.
Area VI	Systematic review; Adolescent-friendly SMS messages co-developed with the adolescents and preferred ways of messaging adopted.	Adequacy of eHealth instructions tested; procedures for participant enrolment verified; and sample size fine-tuned.	Intervention effectiveness determined and economic analysis performed.	Effectiveness of dissemination to professionals at the department and the hospital management.
Area VII	Distribution of family time use, family income and income type, family expenditures, use of savings or loans, use of hospital and other healthcare resources, healthcare expenditures and resource, loss of production, utility scores, and cost-utility ratios.	Distribution of family time use, family income and income type, family expenditures, use of savings or loans, use of hospital and other healthcare resources, healthcare expenditures and resource, loss of production, utility scores, and cost-utility ratios.	Distribution of family time use, family income and income type, use of hospital and other healthcare resources, healthcare expenditures and resource.	Distribution of family time use, family income and income type, use of hospital and other healthcare resources, healthcare expenditures and resource.
Area VIII	Prototype tablet applications for the different clinical settings. Improvements to the underlying technical framework. Software modules based on specific user requirements for eHealth systems.	Performance evaluation of technologies in the context of eHealth, based on real-world usage. Improvements to prototypes.	Technical usage data from wide-spread usage of advanced prototypes.	Technologies for large-scale distribution and maintenance of distributed eHealth systems.
Area IX	Cultural background and values, eHealth, and health literacy.	Cultural background and values, eHealth and health literacy.	Cultural background and values, eHealth and health literacy.	Cultural background. eHealth literacy.
Area X	Synthesizing findings relevant for implementation from the clinical research areas and drawing out lessons learned and possible generalizations through structured activities.	Synthesizing findings relevant for implementation from the clinical research areas and drawing out lessons learned and possible generalizations through structured activities.	Synthesizing findings relevant for implementation from the clinical research areas and drawing out lessons learned and possible generalizations through structured activities.	Supporting and documenting implementation. Team-based approach that involves stakeholders in each clinical research area. Support and facilitation for planning, engaging, executing, and evaluation.

Settings

The research is performed in clinical settings and in families' homes in three countries: Sweden, Denmark, and Ethiopia and is organized in the following three research domains.

eHealth to enable and promote self-management in advanced paediatric care

Here, five groups of children in need of advanced paediatric care are studied: Children with malformations going through advanced paediatric surgery (Area I); Children born with congenital heart disease (Area II); Children born preterm (Area III); Children with paediatric cancer (Area IVa); and Children with acute or LTI receiving home infusion therapy (Area IVb). The studies are conducted at two university hospitals in Sweden (Areas I–IVa) and Denmark (Area IVb).

eHealth for early diagnosis and treatment in paediatric healthcare

In this research domain two groups of children are studied: new-born children at risk of cerebral palsy (CP) (Area V), and adolescents living with HIV (Area VI). The studies are conducted at a region hospital in Denmark (Area V) and in six hospitals and five care centers that provide care services to adolescents in the Gamo, Gofa, Konso, South Omo, and Wolayita zones of the Southern Nations, Nationalities and People's Region in Ethiopia.

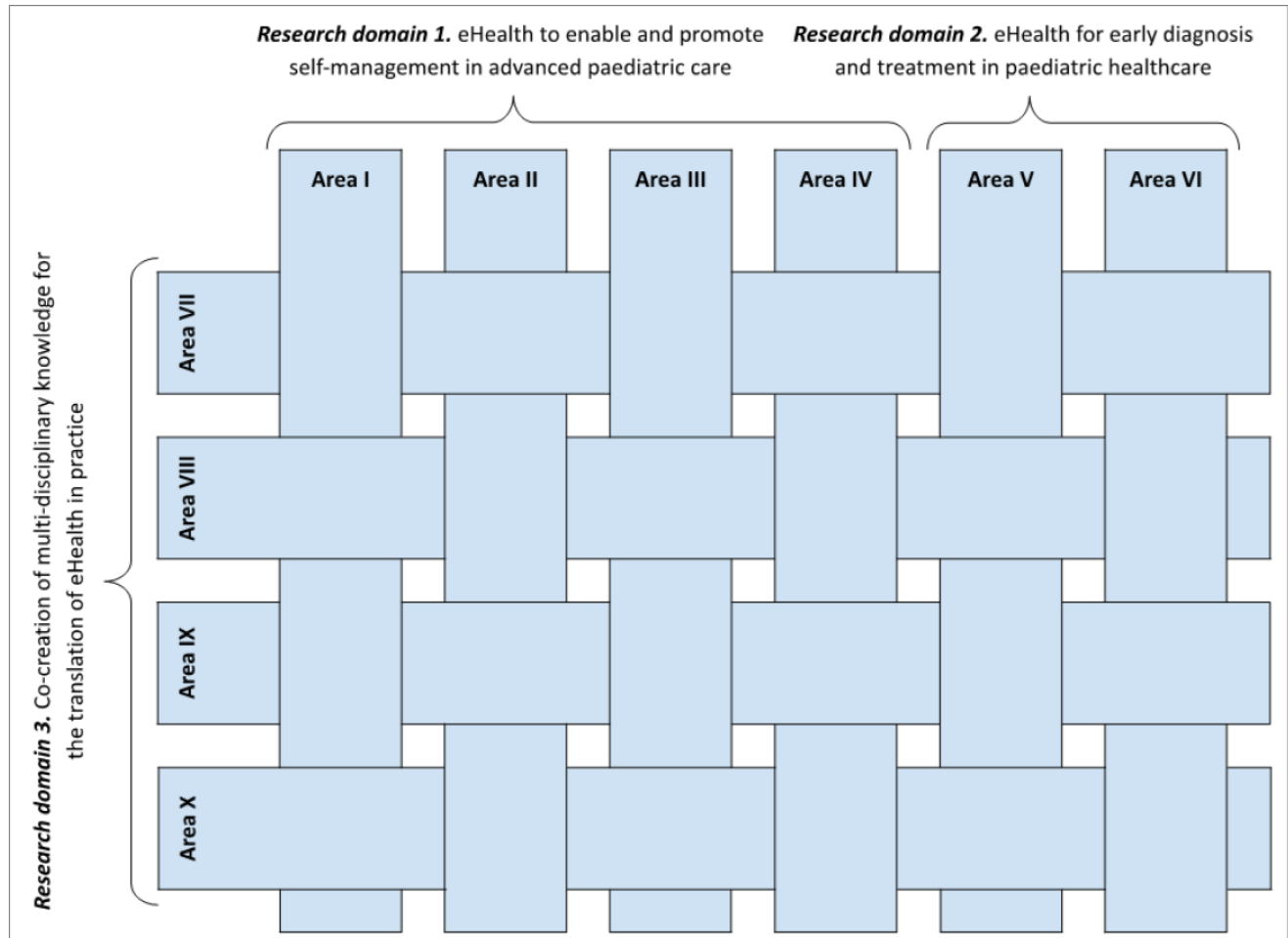
Co-Creation of multi-disciplinary knowledge for the translation of eHealth in practice

In Co-Creating multidisciplinary knowledge within the programme, Health economics (Area VII), Technical development (Area VIII), Cultural analysis (Area IX) and



Research and Best Practice

Figure 1. Relations between the areas in the first two research domains and the areas in the third domain in the research programme, translating eHealth into practice.



Implementation (Area X) are specifically defined as inner and outer settings relevant for research in Areas I–VI.

eHealth interventions

In research domain 1 the eHealth interventions for research areas I–IVa are built on a common technical foundation. Current prototypes have been developed and delivered as an eHealth app (application) for Android-based computer tablets. The central concept is that families of patients are issued a tablet that they bring home when they leave the hospital. The tablets are custom developed for each clinical area and have several features that are based on the needs of the professionals and the families. Common features used by all areas are video calls and text messaging that enabled easily accessible communication between the home and the hospital. Another common feature is photography, where photos taken with the camera of the tablet can be reviewed by professionals at the hospital. An example of an area-specific feature is custom forms that can be filled out on the

tablet to assess and report on the well-being and care of infants that have undergone reconstructive surgery. The tablets operate by communicating wirelessly with a remote, centralized server where all patient data is stored securely. At the other end of the system is the hospital, where the healthcare professionals can monitor the patient in a web browser from their regular computer. The server and the parts of the system used for hospital access of patient data are products of a previous research project – itACiH (13). These as well as the prototypes developed are built on the middleware framework PalCom (14).

In area IVb an eHealth intervention supporting self-management of infusion therapy for children with acute or long-term illness is developed, evaluated, and implemented in two phases. In the developmental phase needs and preferences of children, parents and healthcare professionals related to infusion therapy at home and e-health technologies are identified. After this an eHealth



Research and Best Practice

intervention is developed and included in the patient's digital medical chart, after testing for its feasibility tested for effectiveness in clinical practice.

Research domain 2 includes an eHealth intervention for early diagnosis of cerebral palsy (CP) (Area V) in which a mobile application for smartphone is developed to perform video-recordings to enable computerized general movements assessment (GMA) evaluations with an artificial intelligence device (CIMA) of children with CP (15). GMA is a non-invasive observation used to describe the infant's spontaneous gross motor motility in relation to the maturation of the brain to enable early risk detection of CP. Research domain 2 also includes eHealth for treatment in paediatric healthcare (Area VI), in which interactive mobile phone text messaging interventions are developed, feasibility-tested and evaluated in terms of their ability to improve adherence to antiretroviral therapy and retention in HIV care in adolescents living with HIV in Ethiopia (16).

Sampling and study participants

Since children are non-autonomous, the common point of departure for our research is the family. In the clinical studies, consecutive series of families and children are recruited in each clinical area I-V based on relevant inclusion criteria to each specific area and where the parents speak and understand Swedish, Danish or English (see Table 2). Exclusion criteria are complications and multi-illness as defined by the responsible medical doctor for each child and adolescent. In clinical area VI based on a power analyses 308 adolescents are included in a parallel group, individual randomized controlled trial. The diversity of our study population is explored through the perspective of gender and ethnicity.

Evaluation is performed in controlled clinical trials where family caregivers within each research area are included in intervention groups for one year and use the eHealth interventions in their homes. In research areas IV, V, and VI children and adolescents are also included. A matched number of caregivers constitute control groups receiving care as usual. During the implementation phase families using the eHealth interventions are followed for three months up to one year within each research area. Additionally, healthcare professionals are included in all phases (Table 2).

Methods and measurements

Homogeneous and consistent data are gathered among the different research areas describing resources and services. The general areas VII–X run throughout the entire programme period and are fed by data and findings of areas I–VI. The clinical areas (areas I–VI) and areas IX–X include both quantitative and qualitative analyses, in addition to health economic analysis (VII). Statistical power is approximatively calculated per area and phase for estimating sample size, using relevant end-points but are also based on the available number of patients during one year since several of the research areas include children with rare disorders (17). Since cost is an essential variable, which generally varies substantially across modalities of care, economic evaluations normally require large sample sizes to achieve adequate power. The available number of patients may be less than would be strictly desired for the economic analysis. Even if certain conclusions cannot be drawn due to limited power, data collection may yet be worthwhile, especially when combined with future studies with similar designs. Gender differences in the economic

Table 2. Participants in different phases and areas of the research programme.

	Development	Feasibility	Evaluation	Implementation
Area I	5–10 family caregivers, 3 healthcare professionals.	7 family caregivers, 2 healthcare professionals.	30 family caregivers (15 inter- vention and 15 control); 2 healthcare professionals.	30 family caregivers; 10 healthcare professionals.
Area II	5–10 family caregivers, 3 healthcare professionals.	7 family caregivers, 2 healthcare professionals.	30 family caregivers (15 inter- vention and 15 control); 2 healthcare professionals.	33 family caregivers; 10 healthcare professionals.
Area III	5–10 family caregivers, 3 healthcare professionals.	7 family caregivers, 2 healthcare professionals.	30 family caregivers (15 inter- vention and 15 control); 2 healthcare professionals.	33 family caregivers; 10 healthcare professionals.
Area IVa	5 children and their parents; 5–10 healthcare professionals.	10 children and their parents, 7 healthcare professionals.	30 children and their parents.	80 children and their parents; 12–20 healthcare professionals.
Area IVb	10–15 children and their caregivers; 12–20 healthcare professionals.	4 caregivers of 4 children.	30 children and their caregivers	12–20 healthcare professionals.
Area V	100 children at risk of developing CP.	86 family caregivers	300 children at risk of developing CP.	300 children at risk of developing CP.
Area VI	15–20 adolescents, family caregivers, and healthcare professionals.	30–50 adolescents living with HIV.	306 adolescents living with HIV.	30–50 adolescents living with HIV.



Research and Best Practice

consequences of child's illness are considered in terms of changes in time use for father and mother and changes in personal and family incomes attributed to the division of labour between father and mother.

Qualitative outcome variables and data collection

Semi-structured individual interviews and focus group interviews are conducted in areas I-VI, including a strategic sample of caregivers, adolescents, and healthcare professionals, to explore and describe their experiences of eHealth, the relationship between family members and between family members and professionals. In area X data is collected through interviews and focus groups with healthcare professionals, managers, researchers, and technical staff in the hospital.

Quantitative outcome variables and data collection

The quantitative data is collected using REDCap (Research Electronic Data Capture), a secure web-based application designed to support data collection for research, provided by Lund University. The data is either collected through automatic emailing of electronic questionnaires to the participants (Area I-IVa) or through data collectors in the case of Ethiopia (Area VI). In Areas I-IVa the primary outcome variables, measured after participation ends, concern adolescent/parental satisfaction with care (The PedsQL Healthcare Satisfaction Generic Module™) including information, family inclusion, communication, technical skills, emotional needs, and overall satisfaction. Secondary outcome variables include the child's general and specific health status, family impact (The PedsQL Family Impact Module™) (18), parents' health-related quality of life (EQ-5D) (19), parental security and satisfaction (20), adverse events, postoperative complications (21), length of hospital stay, number of routine and acute visits, nutritional status, anxiety, and avoidant behaviour (22), and stress measurement in parents (23).

The primary outcome in area VI is the proportion of patients retained in care and levels of adherence to medications 3- and 6-months post-intervention. Secondary outcomes are incidence of opportunistic infections and tuberculosis, CD4 recovery rates at 3 and 6 months, and proportion virally suppressed 6-months post-intervention. Outcomes are collected using standardized case records including socio-demographic characteristics, mode of HIV infection, time of HIV diagnosis, disclosure status, disease stage, opportunistic infections, CD4 count, body weight, haemoglobin, viral load, and treatment regimens.

The health economic outcome variables used include distribution of family time use, family income and family

income by income type, family expenditures, use of savings or loans, use of hospital resources, use of other healthcare resources, healthcare expenditures by type of resource, loss of production, utility scores, and cost-utility ratios (24).

One outcome variable in technical development is professional and parental acceptance of the developed prototypes, i.e., how interested and how able they are to interact with the developed eHealth solutions. The main idea of using participatory design and involving the user in the design and development process is to produce a product that they can understand and find useful. Another outcome variable is how technical aspects of the developed prototypes performed during the test periods of the studies. This can be evaluated by referring to technical issues that were reported by the users. Additionally, technical logs on both servers and the eHealth solutions can provide useful data.

The concept of culture is approached multidimensionally by assessing adolescent/parent: 1) cultural value orientation (INDCOL-Short version (25) including horizontal/vertical individualism and horizontal/vertical collectivism; 2) eHealth literacy (eHLQ (26)) including the variables: using technology to process health information, understanding of health concepts and language, ability to actively engage with digital services, feel safe and in control, motivated to engage with digital services, access to digital services that work, digital services that suit individual needs; and 3) cultural background, including primary language spoken, nationality, citizenship, ethnicity, and rural vs. urban living (27). The same measurement tools are used in all countries, but the eHealth modes, population, and contexts vary between the countries. Thus, the intention is not to compare the outcomes between countries, but rather within each country.

The area of implementation serves to guide facilitation and support by combining a structured framework, the Consolidated Framework for Implementation Research (CFIR) (28) for analysis, planning and interventions and a process-oriented team approach emphasizing reflection and learning. CFIR defines five key domains of factors that influence implementation success: 1) Intervention characteristics, 2) outer setting, 3) inner setting, 4) characteristics of individuals and 5) process. The approach has three phases: 1) Introducing the CFIR and other complementary frameworks to identify suitable facilitation strategies. 2) Applying implementation frameworks in work-shops with stakeholders in the clinical research areas. This process involves the steps of planning, engaging, executing, and evaluation/reflection.



Research and Best Practice

3) Synthesizing findings from the clinical research areas and drawing out lessons learned and possible generalizations through structured activities (learning stories, dialogue forums, and stake-holder conferences). There is overlap between the phases and in some cases a need for iterations.

Data analysis

Qualitative analysis

Data from interviews are analysed with inductive content analysis, which refers to a process of condensing, abstracting, coding, and categorizing meaning units of stakeholders' experiences. The researchers discuss and revise the categorization and subcategorization until a coherent pattern of similarities and differences emerges. In a final stage, the latent meaning of the data will be soaked and formulated in themes (29). We utilize the CFIR (28) and the Nonadoption, Abandonment, Scale-up, Spread, and Sustainability (NASSS) framework (30) to analyse, intervene, and evaluate the data within each clinical research area. In addition to these established frameworks, we see a need for addressing soft aspects concerning meaning, values, and norms (i.e., culture) that can be seen as underlying constructs for how problems and solutions are framed and addressed in relation to what we here refer to as problems of implementation. The six clinical areas differ from each other in aspects that allow for potentially interesting comparisons. They are therefore suitable case studies and together they provide a matrix of potential challenges and strategies that can be generalized to other contexts as well. A thorough analysis using a culture lens is therefore part of a meta-perspective that supports analysis and learning within the programme, thus providing a stronger framework for understanding.

Quantitative analysis

Quantitative data, descriptive and analytical, are analysed, using appropriate statistical methods for data types and variables. Parents' education, income, and family situation, and child, parent and family outcomes are analysed, using descriptive statistics and multivariate generalized linear models. During the evaluation phase, intention-to-treat analysis is used to compare primary outcomes between intervention and control groups. Multi-level generalized linear regression models are used to provide statistical estimates after controlling for cluster and matched stratum effects. Kaplan-Meier survival analysis is used to estimate time from enrolment to occurrence of primary and secondary outcomes, and Cox proportional regression method for adjusted analyses. Intracultural group comparisons are made within the seven clinical areas. These analyses are grounded in cross-cultural theory and methodology by Berry et. al.

(31). As for health economics, in addition to the parametric statistical tests above, non-parametric bootstrapping (32) is used to test for significant differences among treatment alternatives. Using the perspectives of family, health sector, and society, results of the economic evaluations are reported either as dominance (in which one of the studied treatment alternatives increases quality of life and healthcare satisfaction and reduces costs) or as ratio – incremental cost per unit of quality of life.

Discussion

In this research programme we aim to develop, through participatory design, different kinds of eHealth interventions to facilitate and support self-management of families with children who have or are at risk of developing long-term illness. This is in line with the UN Child Convention (33) that became law in Sweden in 2020, and with the updated Swedish Patient Act of 2014 (2014:821) (34), which emphasize the need to stimulate the participation of children and their parents in care and care decisions. The remote contact between patient and hospital is often limited to consultations by phone, and physical visits at home are rare. New technology involves the use of video or tele-medicine, which is becoming much more accessible, in addition to photos, online monitoring, and messaging for increasing participation in care. In two systematic reviews on eHealth interventions to improve self-management among two different groups of children with LTI, the interventions were found feasible and acceptable (35;36) but the studies included in the reviews were assessed to be of low quality and future studies with well-defined methods and theoretical frameworks were warranted.

We hypothesize that eHealth can bridge the transition between hospital and home to facilitate safety and quality of care for the children, their families and healthcare professionals, and maintain continuity of care between hospital and home, increase the accessibility for the family despite fewer physical meetings, and contribute to improved health outcomes through enhanced communication (37). However, it is important to emphasize that eHealth should not replace all physical meetings between patients, family, and professionals (38).

Increased knowledge of how to increase the child's and the family's participation in healthcare through eHealth can lead to improved self-efficacy and patient safety, and better allocation of family, healthcare, and societal resources. Investments in improving child health generate significant gains for the individual in terms of longer life expectancy, improved quality of life, improved educational results, and improved performance in the labour market (less unemployment, less part-time work, and



Research and Best Practice

higher wage rates). In addition, for the public sector, improved child health means both reduced future health and social care expenditures and stronger tax base, the latter depending on the individual's improved performance in the labour market (39).

Although the technologies involved are widely used in other contexts in society, they need careful integration in medical settings from an information security point of view. These technologies also need to be integrated in such a way that they are manageable for the professionals and contribute to effective work processes rather than introducing even more work for the staff (13). Our research is also relevant and important for families in low- and middle-income countries as it builds simple eHealth interventions, for example text messages, which have been suggested earlier to be appropriate for infrastructures in these countries for health monitoring and surveillance (40). The current Covid-19 pandemic has brought healthcare services faster into an era of electronic communications and resources and helped us appreciate the possibilities of distant collaboration and communication (41-42).

Limited understanding exists on the role of culture in the adoption and use of eHealth, especially for parents of vulnerable children at home (43). Culture is a shared social construction and a dynamic process that is co-created between groups of people, however large or small. In this light, cultural aspects, for example differences in value of personal time, can be analysed at an individual (44) (e.g., parents, health professionals), organizational (e.g., healthcare units), regional, national, or international level.

In this research programme we work with situations where patients and/or parents are supported in self-management in cooperation with professionals. Our agile development method implies that we build increasingly more functional technical solutions in cooperation with families and staff and use continuous evaluation to make it work well for them. We interact with prospective stakeholders; healthcare professionals as well as parents, in several sessions to understand how self-management in the home can be supported (32) as the importance of involving stakeholders in the development is acknowledged (45). We propose and demonstrate technical solutions and use the feedback to make improvements. After several iterations we will reach a technical solution mature enough to evaluate with actual patients in their home. We thus work in close contact with end-users and use their participation and feedback from use of technical prototypes, to improve and expand the applications in accordance with the participatory

design. This approach is likely to have positive effects on the implementation of eHealth interventions.

Conclusion

Bridging the hospital care and safe care at home for children with LTI with the aid of eHealth is a vital clinical area, as is the scientific area as eHealth change the communication between children, parents, and health professionals. This is a new research area that needs to be explored. To develop, evaluate and implement eHealth devices in clinical care, an inter- and multidisciplinary approach is needed. Thereby, it is possible to address the important study of encounters with technology and various methods of communications and how eHealth aid can capture complex exchange of wellbeing and health, and feelings and perceptions of for example anxiety, stress levels, safety, many of which are culturally related. Also, values and contexts are sensitive to communication methods. The multi-method design including both qualitative and quantitative methods will enhance the understanding to advance and evaluate routines and practices for better physiological and psychological outcomes in children with LTI and their families. The clinical projects will also contribute to a deeper understanding on identifying risk factors for complications and how to prevent adverse events in care performed at home. The encounter with the child and the family system, the values, and norms relevant to participation in care and treatment in different organisational and socio-economic contexts are rarely studied but are crucial when describing communication and implementation of technical advancements in care practice. Importantly, our studies within different clinical contexts and considering cost-effectiveness, technical development, cultural and implementation aspects contribute to the knowledge and understanding about how eHealth can reduce the information asymmetry between providers, developers, and consumers for further implementation into clinical practices, policies, and procedures. This programme also provides a significant contribution to a grounded and evidence-based understanding of both possibilities and limitations of eHealth applications in this area not only in terms of their efficacy but also in terms of the possible ethical conflicts involved in the introduction of new technology.

Contributors:

Conception and design of the study: Conceptualization: All authors; Methodology: All authors; Software: BAJ, BM; Validation: All authors; Formal Analysis: IKH, CC, HH, RH, DJ, BAJ, GK, ÓK, BM, ASS, PS, AWT, ÅBT; Investigation: IKH, CC, HH, RH, DJ, BAJ, GK, ÓK, BM, ASS, PS, AWT, ÅBT; Writing – Original Draft Preparation ÅBT, IKH; Writing – Review & Editing: All authors; Visualiza-



Research and Best Practice

tion: BAJ; Supervision: IKH, ÅBT, CC, HH, RH, DJ, BAJ, GK, ÓK, BM, ASS, PS, AWT.

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Ethics approval: The study is conducted according to the guidelines of the Declaration of Helsinki, approved by the Swedish Ethical Review Authority (no. 2019-0341), and registered at ClinicalTrials NCT04150120. The project in Ethiopia (Area IV) was approved by the Swedish Ethics Review Board (no. 2019-03433) and the national ethics review board of Ethiopia (no. MoSHE/RD/14y/8869/2). Area IVb was approved by the Danish Data Protection Agency with Journal number P-2019-392. Area V was approved by the Danish Committee System on Health Research Ethics, reg.no. 170117778 and by the Danish Data Protection Agency. NOH-2017-025, I-Suite no. 05988.

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Research and Best Practice

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