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FeverApp for Parents: A Multilingual and Socially Accountable Approach to Paediatric Fever Management in Germany

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ABSTRACT

Policymakers and practitioners are increasingly focused on achieving health equity and meeting the specific health needs of diverse populations, including vulnerable groups such as children. To address these challenges, the Fever App for Parents has emerged as a solution to guide parents through the complexities of managing fever in their children by improving fever management in children through real-time data collection and comprehensive educational support. This systematic approach aims to reduce unnecessary medical interventions and overuse of antibiotics, thereby improving the overall quality of pediatric care and reducing parental anxiety. In Germany, almost every second child aged 0-10 is a child with migration status and/or migration experience. This means that the parents of these children also need to be targeted in fever management and informed about the correct behavior in case of fever. This information will also be monitored anonymously to provide a feedback loop on the parent's experience with the menu navigation and information design. The FeverApp provides parents with a structured, step-by-step guide to accurately track their child's temperature and medication intake to encourage adherence to established fever management protocols. This study examines how the FeverApp embodies the principles of social responsibility through its multilingualism and digital development stages that incorporate user feedback. It shows why this app can be a resource to promote health equity through social responsibility in medical education and practice for parents, but also what barriers need to be considered at different stages of app development for parents from different cultural backgrounds to enable informal medical learning through apps.

Introduction

In paediatric care, acute febrile infections, viral or bacterial, are among the most common problems that bring parents to the paediatric outpatient clinic. Fever is also one of the most common reasons for off-hours calls [1,2]. Parents are anxious and concerned because there is a wide variety of opinions and approaches in society regarding the treatment of fever based on cultural background [3,4]. Jewish Parents in Western society exhibited a lower degree of fever phobia than Bedouin parents [5] and African American parents less likely believe that fever can cause death or brain damage in children [6]. This diversity of opinion may contribute to confusion, unwarranted concern, and overuse of antibiotics and antipyretics. This practice contradicts current scientific guidelines and extensive medical experience [7]. The global concern that often leads parents to take their children to the emergency room for tests and medications, that are not always necessary, needs to be understood in treating fever in children. This phenomenon is particularly prevalent in regions and countries where fever is a significant problem due to a lack of healthcare knowledge due to language barriers.

Exploring Informal Adult Learning Through Knowledge-Sharing Apps: Implications for Adult Education and Healthcare

Information-sharing apps, such as foreign language learning or memory improvement apps, typically collect data or input from users, prepare them for a (learning) topic, and provide prompts. This use of apps can be classified as informal or self-directed learning in adult education. Rohs [8] refers to "informal mobile learning" as "situation-based, intrinsic

motivation, self-determined … and location-independent learning with digital media.' With the emergence of the internet, informal learning has become increasingly important in adult education. This development is not only due to individualisation trends and technological developments but also to the increasing acceptance of constructivist learning theories and educational policy efforts for lifelong learning [9]. In addition, the concepts of intrinsic motivation and self-directed learning, as expounded in the fields of adult education and information-sharing applications, are highly relevant in the healthcare sector, where patients' propensity to acquire knowledge about their medical conditions is a critical factor in their ability to self-manage and adhere to treatment. Motivation has significantly impacted patients' self-efficacy, leading to greater self-awareness and belief in healing their illness [10]. Individualised motivation and complex health education, including explaining the pathophysiology and symptoms of the disease, elucidating treatment goals and benefits, and highlighting the risks of premature termination of therapy, have been shown to enhance treatment adherence and improve clinical outcomes and, therefore, needs knowledgeable health professionals with advanced communication skills and pedagogical competences [11]. In addition, this convergence of intrinsic motivation and self-directed learning principles resonates in the complex landscape of technology and software development, where multidisciplinary teams engage in knowledge transfer and raise relevant questions about the role of diverse knowledge bases in shaping the meaning, practices, and results of such efforts. Although experts may implement and change knowledge through organisation and mediation, it is unique in developing technology and software that employees from different fields, such as computer scientists, physicians, and designers with different bodies of knowledge, are involved in software development. As we explore the complex world of informal adult learning through knowledge-sharing apps, it becomes clear that this learning approach is particularly relevant within the constructivist framework of adult education, especially parent education, as learning involves engaging users in activities that require them to think critically, analyse information, and apply their new gained knowledge [12]. Therefore, informal learning processes of migrants in civil society highlight the transnational perspective and the role of informal learning in integrating migrants into new social environments [13].

Exploring the Potential of Real-Time Data and Smartphone Applications in Managing Paediatric Fever

Understanding parents' intentions and actions during their child's febrile episodes is a complex and difficult challenge in paediatric healthcare. Traditional interviews are often not feasible on a large scale and may not provide direct insight into parents' decisions and emotions. This is particularly true for vulnerable populations who are difficult to reach due to financial, social, or language barriers. In addition, while helpful, health insurance and medical records do not provide essential details about fever progression, specific medications administered, alternative antipyretic measures, and the mental state of the parent and child during the fever episode [14].

Real-time data is urgently needed to fill knowledge gaps and improve the effectiveness of existing fever management recommendations [15]. On the other hand, parents need to be informed in a low-threshold way about the appropriate actions according to the guidelines [16]. However, traditional research methods interfere with parents' behaviour and autonomy. Timely data collection is crucial, as people tend not to remember the details of their actions, motivations, and feelings over time [17].

Fortunately, smartphones, which are widely used by parents of all demographic groups, especially those under the age of 39, offer a solution. Smartphones have been found to have a positive impact on patient care and medical education, despite concerns about potential distractions and privacy issues [18]. Using smartphones in a survey allows immediate and direct data collection in a real-world, real-time environment, reducing the impact of recall errors and providing direct and accessible support to parents [16]. Parents have shown great interest in using smartphone applications to collect fever-related data, as evidenced by the widespread appeal of existing "fever" apps [19,20]. However, there is a notable lack of a complementary app developed by healthcare professionals and researchers that enables temperature data collection and medication categorisation and provides evidence-based fever management guidance for all parents.

The FeverApp offers parents systematic help through step-by-step instructions, enabling them to record their child's condition methodically. The primary objective of the FeverApp Registry Study is to

establish a connection between scientific research and the practical management of fevers at home. This will be accomplished by establishing direct contact between medical researchers and parents, streamlining the process of gathering data on adherence to inform the improvement of guidelines and expediting the application of research findings in clinical settings. The outcome will entail enhanced quality of relationships between parents, children, physicians, and nurses, as well as implementing more efficient ways to manage fevers.

The Impact of the FeverApp Registry on Medical Education and Parental Empowerment

The primary objective is to create a significant and enduring impact on healthcare and research while prioritising the concerns of parents and caregivers. By utilising the gathered data, the objective is to enhance scientific understanding and formulate a comprehensive guideline for managing fevers that are both safe and culturally and educationally suitable. The guideline is available via a user-friendly smartphone application in 12 languages, enabling parents to handle fever situations in their children effectively and confidently. Consequently, parents will encounter diminished unease and heightened assurance in handling fevers, resulting in a decreased need for unnecessary antibiotics and antipyretics. Ultimately, this strategy will significantly enhance their offspring's physical and mental state.

The FeverApp registry is also advantageous for healthcare practitioners, furnishing them with enhanced and universally acknowledged protocols, reducing superfluous consultations, and increasing efficient contact with parents. This efficient method will result in more discerning and focused prescription practices, enhancing their professional responsibilities' general contentment and significance. In addition to the advantages for individuals, the register tackles broader public health issues. It plays a pivotal role in combating antimicrobial resistance by advocating for the logical and regulated utilisation of antibiotics. This strategy not only decreases the utilisation of antibiotics but also enhances their efficacy by avoiding unnecessary reduction of fever. The FeverApp registry offers real-time data for national and international public health and health services. This information benefits all stakeholders, including the media, as it offers timely insights that can impact health policy and practice.

Ultimately, the inventive utilisation of mobile applications for gathering registry data signifies a noteworthy progression in parental medical education. By effectively implementing this approach, we are establishing a foundation for future study in various domains of medical care. The FeverApp registry establishes a precedent for enhancing social responsibility in medical education, beginning with prevalent paediatric ailments like fever, and has the potential for additional advancements in healthcare. Recognising that social determinants significantly impact health outcomes, especially among immigrant communities in Germany, the FeverApp for parents goes beyond conventional medical approaches. It empowers parents by providing them with knowledge and resources to handle fever-related concerns within their social, cultural, and economic contexts.

The app's educational sections aim to educate parents about the importance of fever, its risks, and how it can benefit children. By providing this information in languages, including those spoken by migrants in Germany, the app directly addresses language barriers. It improves access to crucial healthcare information based on the German national (AWMF) guidelines.

Launch Strategy and Recruitment

The launch of the FieberApp registry aimed to capture a broader demographic spectrum and align with national dissemination and marketing strategies. The recognition and support of the project in the paediatric community are mainly due to the proactive engagement of the members of the German paediatric associations. Through email correspondence and distribution of informational brochures and posters, 2020 paediatricians have been reached directly. These physicians are encouraged to refer to the FeverApp registry during well-child visits, check-ups, regular paediatric visits, and vaccination appointments.

Furthermore, additional materials such as desk cards and posters have been provided for display in physicians' offices, which can be accessed through the German Paediatric Association or the study's website. The goal of the joint effort was to reach as many parents of the 11 million children under 14 as possible.

Data Analysis

The descriptive data analyses provide information using absolute and relative frequencies. The main objective of the primary analysis was to calculate the extent of guideline adherence, measured as relative frequency with a binomial confidence interval. The

analysis was also divided into sociodemographic categories by sex, age, region, and nationality to account for treatment-related aspects and to better understand the impact on temperature trends. The sociodemographic data were broken down by country to examine the progression of app use by nationality over the course of the study project. The study has received a positive vote from the Witten/Herdecke University ethics committee on pseudonymised data collection (#139/2018).

Results Regarding Multicultural Background

Results of the feasibility and interactions within the app, content analysis of user perspectives, and sociodemographic characteristics and interests of FeverApp Users have already been published [1]. After the first testing and iteration in October 2020, the study results show that a small percentage of parents, 6.6% of the 1592 registered mobile application users who used the information library and fever registry, had low education levels. In this context, low education refers to completing only lower secondary school or having no formal qualifications. In addition, almost 11% of the parents in the sample were classified as having a migrant background, according to the definition of the Federal Statistical Office. Hamideh's first evaluation did not filter the analysis by nationality to Germany.

The FeverApp is organised as a family tool, where multiple users (e.g. mother or father) or installations on different devices can monitor multiple children. Between September 2019 and August 2023, 24,925 families installed the FeverApp. Of these 21,754 (87.3%) families are from Germany, and about 10.3% did not provide a country of origin. Another 1.7% are from Austria and Switzerland, so only 0.7%

of the families have installed the FeverApp. In 19,803 (91.0%) of the families using it in Germany, there is only one installation; in 7.9%, there are two installations; and in 1.1%, there is more than one installation per family. These 21,754 families correspond to 23,731 installations in Germany (Table 1). Multiple installations do not necessarily mean multiple users, but multiple devices could be used. On average, 81.0% of the installations are used by mothers, 18.2% by fathers, 0.2% by grandparents, and 0.6% by other persons.

About 2.0% ($N = 427$) of the 23,731 installations did not answer the nationality question, so the nationality of 23,259 installations, of which 9.9% were non-German, could be answered. Of the 9.9% of users in Germany with another nationality, the majority are Turkish (1.2%), followed by Poland (0.9%), Romania (0.6%), Russia (0.5%), Ukraine (0.4%), India (0.4%), Italy (0.4%), Kazakhstan (0.3%), Syria (0.3%), Spain (0.3%), Albania (0.3%) and Austria (0.3%). Of the 4.3% of foreign language users in Germany, the majority (2.8%) use FeverApp in English, followed by Russian (0.4%), Arabic (0.3%), Polish (0.3%) and Turkish (0.2%).

Discussion

When launching an app designed to help parents manage their children's fever, it is crucial to review the original goals of the app and recognise the changing notion of social responsibility. The app's primary goal was to provide comprehensive support to all parents faced with managing their children's fever. However, the data presented shows that the app's users' demographics have changed unexpectedly, providing insights into the complex notion of social responsibility in healthcare applications.

Table 1. Four-year FeverApp registry information related to migration from the user in Germany.

	2019 (last tertial)	2020	2021	2022	2023 (first two tertials)	Total 1.9.2019 – 31.8.2023
Families in Germany	226 (1.0%)	1924 (8.8%)	5897 (27.1%)	7589 (34.9%)	6618 (28.1%)	23 528 (100%)
Users in Germany	208 (0.9%)	2133 (9.0%)	6456 (27.2%)	8268 (34.8%)	6666 (28.1%)	23 731 (100%)
German Nationality (User in Germany)	177 (86.3%)	1878 (89.6%)	5794 (91.3%)	7289 (90.1%)	5818 (89.2%))	20956 (90.1%)
Non-German Nationality (User)	28 (13.7%)	218 (10.4%)	550 (8.7%)	799 (9.9%)	708 (10.8%)	2303 (9.9%)
German Language (Users in Germany)	207 (99.5%)	2078 (97.4%)	6268 (97.1%)	7885 (95.4%)	6269 (94%)	22 707 (95.7%)
Non-German Language (Users in Germany)	1 (0.5%)	55 (2.6%)	188 (2.9%)	383 (4.6%)	397 (6.0%)	1024 (4.3%)
Number of languages	2 German, English	3 German, English, Russian	Seven languages	Ten languages	Ten languages	Currently 12 languages

Initial Objectives Vs. Emerging Realities

The app's initial goal of reaching all parents with a child with a fever demonstrates a laudable commitment to improving accessible healthcare. However, the data show that the user base includes various families with non-German citizenship and different language preferences. The expected diversity of users challenges initial assumptions about the app's user base and underscores the need for a broader approach to social responsibility, because only 6% were non-German language users and only 10% of the users were from a different nationality than Germany, though the app was available in 12 different languages.

Beyond Translation

The study into informal adult education through a knowledge-sharing app reveals important implications for adult education in health care. The results of our study reveal a nuanced reality that goes beyond conventional approaches to the social responsibility of health apps. One of the most striking observations concerns the demographics of the health app users designed to help parents manage fever in their children. Although the app is available in 12 languages and distributed through a network of paediatricians, the data shows that only one in ten users is of a nationality other than that of the host country. This discrepancy challenges traditional models of social accountability in health technology, particularly those focusing on linguistic accessibility. Social accountability in health technology involves more than just translating the language. Although linguistic accessibility is essential, proper social accountability in health applications goes beyond linguistic factors. This recognition is consistent with the broader context of health technology implementation, which cultural values indirectly influence [21]. The interplay between sociodemographic variables and technology acceptance is a common phenomenon well-documented in the literature [22]. In the context of our study, the app's user base reflects the influence of factors such as education level, income, and social network breadth. This convergence of sociodemographic variables and user diversity underscores the need for an inclusive approach that meets the diverse needs of adult learners. The cultural differences of users must be considered in developing health technologies[23]. This consideration extends to the application's content and design, particularly regarding cultural sensitivity.

To effectively promote social responsibility, the application must manage the complexity of cultural nuances. This includes avoiding culturally sensitive content that could lead to misunderstandings, especially in the application's images, symbols, or animations. In addition, the app should provide information on fever and childcare tailored to the cultural differences and needs of the country of origin. This may result in different advice or treatment options and respect for cultural preferences. Based on the results, the project group is going to involve a social accountability expert in the further development of the app (Figure 1) and actively invite parents through meetings and digitally via the app or the website to participate in the development of the app by reporting bugs and ideas. Through regular parents' evenings with the app developers and via the paediatricians' network, an attempt is made to achieve social embedding to promote trust in the app. The revised launch strategy will also include social workers from the migration offices in the future.

FeverApp and Health Equity in Pediatric Care

The FeverApp is a tool for parents and a valuable resource for medical education in Germany, a country with a diverse population. In schools and institutions, diverse students are taught the importance of social responsibility in health care with cultural and linguistic diversity. Communicating with parents from different linguistic backgrounds with FeverApp guides managing fever while considering the cultural aspects of a child's life. In addition, this app can play a role in evaluating the effectiveness of social responsibility education within childcare and nursing programmes. By analysing its use and evaluating the outcomes of linguistically diverse parents who have used it, medical educators can gauge the impact of incorporating social determinants of health, such as language accessibility, into their curricula. The FeverApp has been integrated into PädCompenda, a tool for training future paediatricians in Germany. It also promotes accountability, inclusivity, and accessibility among medical students by offering opportunities to collaborate with app developers to expand language options and create educational materials in different languages. This engagement fosters a sense of responsibility and prepares future health professionals to meet paediatric patients and their families' diverse linguistic and cultural needs. In this scenario, the FeverApp aligns to establish policies and benchmarks that promote social accountability in health care, specifically for immigrant populations. Medical institutions and national bodies in Germany can consider endorsing this app as a practice for managing paediatric fever, emphasising its ability to support
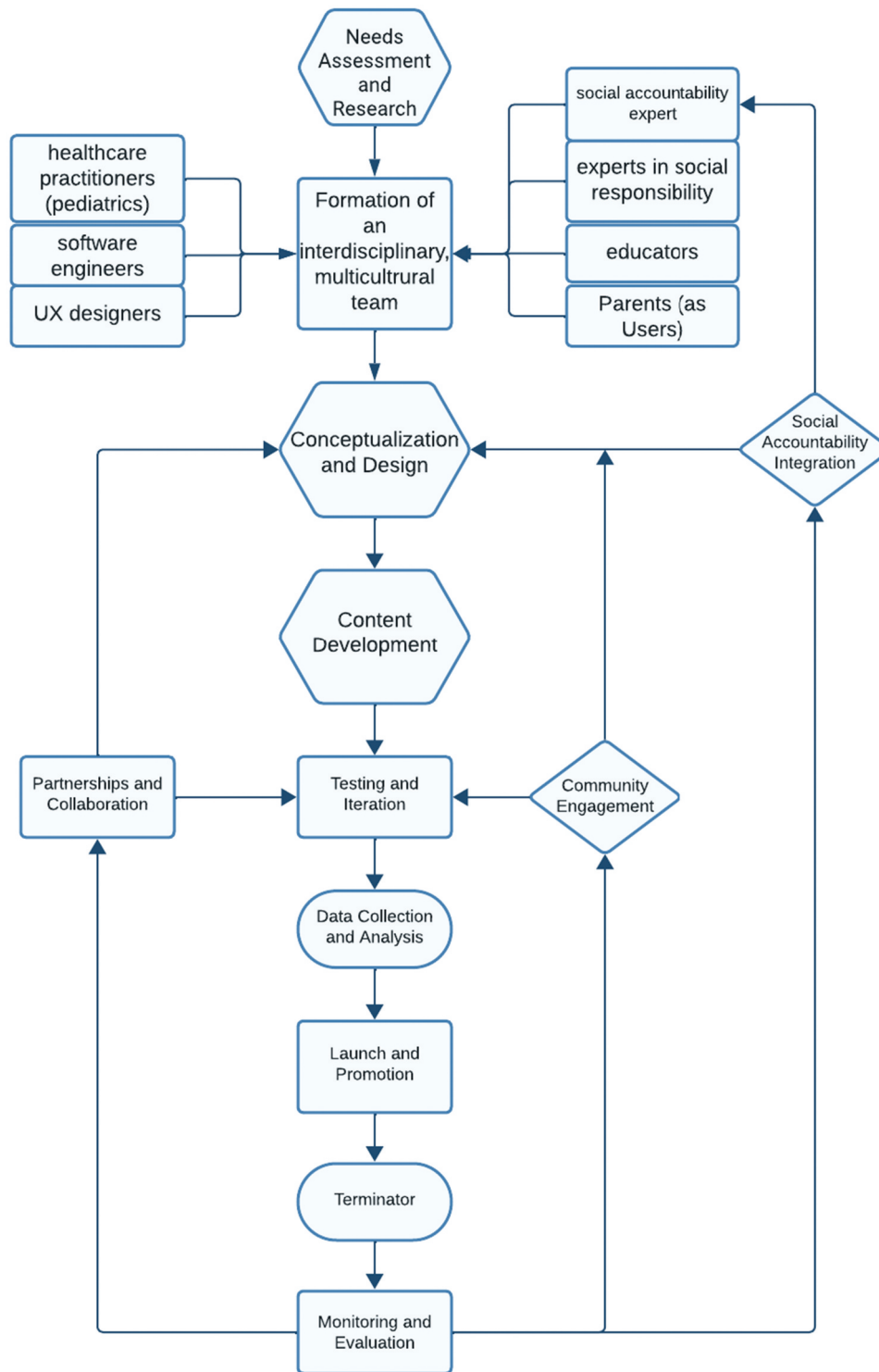
Figure 1. Revised the development process of the FeverApp with the support of a social accountability expert and community engagement.

multiple languages. Doing so will significantly improve access to primary care services while promoting health equity among paediatric populations, including migrant communities.

Conclusion

The FeverApp for Parents stands out as an approach towards socially accountable management of paediatric fevers, primarily focusing on multilingual accessibility. It

addresses factors influencing health outcomes, enhances medical education, engages medical students actively, and presents potential policy solutions to promote health equity across migrant populations in Germany.

This app plays a role in the pursuit of fair healthcare. It is an inclusive and linguistically accessible tool that adds value to the ongoing conversation about "Health Equity Through Social Accountability in Medical Education and Practice". By embracing versatile tools supporting multiple languages, we move closer to a future where all children and families, regardless of their language or economic status, receive the care they rightfully deserve according to national guidelines.

Improving understanding of fever and fever management in migrant populations can significantly contribute to reducing antibiotic use to the medically necessary level, thereby reducing antimicrobial resistance. According to modern immunological research, fever is understood as a resource. Most populations still use antipyretics with the sole aim of suppressing fever.

Further, the often traumatic visits to emergency services can be reduced to when necessary while ensuring that warning signs that should lead patients to emergency services are not overlooked or ignored.

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