SmartCHANGE: From Risk Prediction to Daily Habits Through AI and Gamified Lifestyle changes

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Abstract — **Lifestyle-related chronic conditions are increasingly emerging during childhood and adolescence, highlighting the need for effective early prevention strategies beyond traditional care settings. Although digital health technologies enable continuous monitoring and personalized support, many fail to sustain engagement or deliver actionable insights to Health-Care Professionals (HCPs). This paper presents SmartCHANGE, an integrated digital ecosystem that combines AI-based risk prediction with lifestyle change support. The system includes *HappyPlant*, a gamified mobile app for children and families, and a web-based application for clinicians. While the app promotes healthy behaviors through goal-setting and personalization, the HCPs web app supports data interpretation and tailored feedback. Preliminary findings indicate strong user acceptance and improved clinical efficiency, suggesting potential for scalable preventive care.**

Keywords: non-communicable diseases; digital tools; lifestyle change; preventive healthcare.

I. INTRODUCTION

Non-communicable Chronic Diseases (NCDs), including diabetes and cardiovascular conditions, are increasingly diagnosed during childhood and adolescence and are strongly associated with poor nutrition, physical inactivity, and other modifiable lifestyle factors. These behaviors often develop early in life and persist into adulthood, increasing long-term health risks and healthcare burden [1]. Effective early prevention is therefore essential; however, conventional healthcare models provide limited insight into young patients' daily behaviors between consultations, constraining timely intervention. Digital health technologies offer opportunities for continuous monitoring and personalized support outside clinical environments. Despite this potential, many existing solutions struggle to maintain engagement among young users and rarely provide HCPs with clinically actionable insights [2] [3]. Adolescents respond more positively to supportive, personalized, and playful experiences than to risk-based messaging, while clinicians require interpretable analytics that integrate efficiently into clinical workflows.

To address these challenges, this paper introduces SmartCHANGE, an integrated digital ecosystem that combines AI-based risk prediction with lifestyle change support across two interconnected platforms: *HappyPlant*, a mobile application for children and families, and a web-based application for HCPs. In Section II, the methodology adopted is presented, while in Section III we describe the system design and architecture, and report initial findings from early deployment and formative evaluation. A discussion about the current findings is reported in Section IV along preliminary conclusion drawn in Section V.

II. METHODOLOGY

SmartCHANGE was developed through an iterative co-design process involving children, families, and HCPs across Europe to identify user needs, engagement barriers, and expectations for preventive technologies. Children and families preferred systems that emphasize positive reinforcement, offer clear and achievable goals, and enable playful, personalized interaction. Clinicians highlighted challenges such, as limited consultation time, limited insight into patients' daily behaviors, difficulties translating data into actionable guidance, and maintaining continuity of care beyond clinical visits. These inputs directly informed the system's design and functional requirements, ensuring alignment with real-world workflows and developmental needs.

The SmartCHANGE solution (see Figure 1) adopts a modular, microservices-based architecture to enable scalable and secure deployment. It includes the *HappyPlant* mobile app, a web application for HCPs, and a backend for data processing, AI services, and security. Data from wearables and questionnaires are securely transmitted to the backend, where predictive models update risk estimates. The platform complies with GDPR, using encryption, pseudonymization, and audit logging, while OpenID Connect supports secure, role-based access.
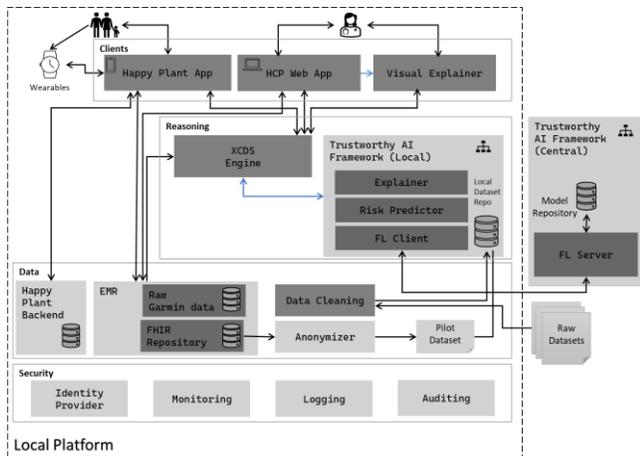
Figure 1: SmartCHANGE overall solution architecture

Machine-learning models trained via federated learning estimate health risk from longitudinal data. The models are neural networks that take primarily behavioural risk factors as input (physical activity, diet, fitness, sleep, smoking, alcohol consumption and body mass index) and output the risk of cardiometabolic disease until the age of 65 years. The models were trained on seven datasets that track health variables of thousands of people over more than 40 years. Clinicians receive interpretable outputs, and users receive age-appropriate, goal-oriented feedback to encourage lifestyle change.

Feasibilty of SmartCHANGE tools has been planned through a 3-months observational study across five sites (Portugal, Slovenia, Finland, the Netherlands and Taiwan) and will engage around 100 children aged 6-10 years and their families, plus about 150 adolescents aged 11-14 years. Real-world settings will be used, which means that each of the sites will involve type of HCPs depending on the standard of care in a particular setting (i.e., school nurses, family physicians or pediatricians).

III. RESULTS

A. HappyPlant

The *HappyPlant* mobile app was developed as a lifestyle change companion for adolescents and families, translating complex lifestyle guidance into an engaging, game-based experience. *HappyPlant* designs were evaluated during several co-design sessions with end-users and subsequently tested during an initial internal deployment phase in which more than 30 testers used the app over approximately three months. In the final end-user evaluation, usage data and user feedback will be collected to assess feasibility, engagement, and usability.

Users adopt a digital plant that grows as they earn "Growth Water" through positive behaviors, such as being physically active and completing healthy lifestyle challenges. To support behavior change, the app provides personalized daily and weekly goals related to movement,

sleep, nutrition, and mindfulness. These goals are framed positively, emphasizing achievability and autonomy. Progress toward goals is visualized through Growth Water, which users collect and use to nurture their plant. Gamified elements, including accessories, streaks, reward gardens, and playful notifications are designed to sustain long-term engagement.

To monitor lifestyle behaviors, the application collects data on physical activity and sleep through a consumer wearable device, while dietary habits and body mass index are assessed using questionnaires. Importantly, although goals and challenges are ultimately tailored based on a calculated risk prediction (with a human HCP in the loop), the app avoids communicating medical risk scores directly and instead focuses on positive reinforcement and actionable steps.

B. Web-based application

Co-design activities informed development priorities and shaped the functionalities of the SmartCHANGE web app, which was piloted across the target user groups (primarily HCPs, teachers and administrators) across 3 clinical sites. HCPs used the dashboard to review behavioral data trends, track personalized goal progress, and AI-assisted risk estimates. The application collects the information on fitness, smoking and alcohol consumption, as well as non-behavioural traditional cardiovscular risk factors such as blood pressure and lipid when available. This additional information helps to improve the quality of risk prediction. Preliminary evaluation was conducted using structured feedback forms and semi-structured interviews.

By testing the web app, HCPs reported improved visibility into patients' daily behaviors between visits and greater confidence in identifying lifestyle-related risk patterns. Structured data presentation and visualization of longitudinal trends support more focused clinical discussions and helps reducing time spent interpreting raw data. Preliminary pilot feedback indicates that consultations are more efficient and goal-oriented when supported by the web app, facilitating shared decision-making with patients and families. The most valued features included trend analysis, early risk flagging, and support for tailored feedback. Although long-term clinical outcomes were not assessed in this phase, early findings suggest that the system improves workflow efficiency and enhances the clinical relevance of lifestyle data.

IV. DISCUSSION

SmartCHANGE addresses core limitations of current preventive health technologies by combining predictive modelling with user-centered design and clinician integration [2]. Unlike many digital interventions that motivate users or analyze risk in isolation, SmartCHANGE integrates these functions within a single interoperable system, enabling personalized intervention informed by

continuous lifestyle data. Early feedback indicated that explainable outputs and structured data visualization supported clinicians' interpretation of risk patterns and contributed to trust in the system's predictions. At the user level, the focus on positive reinforcement and achievable goals aimed to promote sustained engagement without increasing anxiety associated with medical risk communication. According to preliminary findings, after 5 weeks of the study in Slovenia and Finland more than 90% of participants are still engaged with the *HappyPlant* app. Moreover, initial feedback from school nurses in Finland is very positive, emphasizing the utility of the SmartCHANGE web app features for their daily clinical practice.

V. CONCLUSIONS AND FUTURE WORK

This paper highlights the potential of AI-driven digital ecosystems to advance preventive healthcare for young populations by enabling early intervention, continuous support, and data-informed care. Ongoing studies are assessing feasibility, engagement and lifestyle change impact, while future work will focus on electronic health record integration, model refinement, and broader usability evaluation.

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