

SwissFever – Cloud-based Platform Enabling Real-time Fever Alerts for Children Undergoing Chemotherapy

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Early fever detection in children undergoing therapy for cancer is an important factor in reducing the risk of complications and thus improving the patients' outcome. The SwissFever study aims to continuously monitor the body temperature of children undergoing cancer therapy, and to issue temperature alerts when the body temperature reaches a given threshold. CSEM collaborated with the Inselspital in Bern to develop a platform to support this clinical study conducted by a team from the pediatric oncology department. Using, adapting and further developing the proprietary cloud-based X-Data platform, CSEM shows to be a prime partner for data acquisition, data visualization and data management in clinical trials.

In children and adolescents undergoing chemotherapy for cancer, fever in neutropenia (abnormally low concentration of certain white blood cells) is the most frequent potentially lethal complication. Emergency hospitalization and empirical treatment with broad-spectrum antibiotics have reduced lethality from >50% in certain high-risk situations to <1%. Continuous monitoring of body temperature leads to earlier fever detection compared to the usual discrete body temperature measurements performed only intermittently for clinical reasons. Earlier detection of fever leads to earlier assessment and treatment and thus can reduce the risk of complications. The present study primarily aims to assess the efficacy of automated fever alerts resulting from continuous fever monitoring using wearable devices. A secondary goal is to run an offline exploratory data analysis to assess the possibilities to predict fever or infection events even earlier using physiological data measured by wearable devices.

CSEM contributed to the project with their existing X-Data platform to cover the secure data management needs and tailored it to fulfill all the study's requirements. X-Data is a cloud-based platform to securely collect, store and manage data collected by wearables: either CSEM's proprietary or commercial off-the-shelf devices. To connect the wearable devices to X-Data, a gateway, either in form of dedicated hardware or a smartphone, is used. Once development and testing are finished, X-Data will allow to securely manage and visualize the measured data from the study participants, while offering the real time alerting system needed to send the fever alerts to the patients' caregivers.

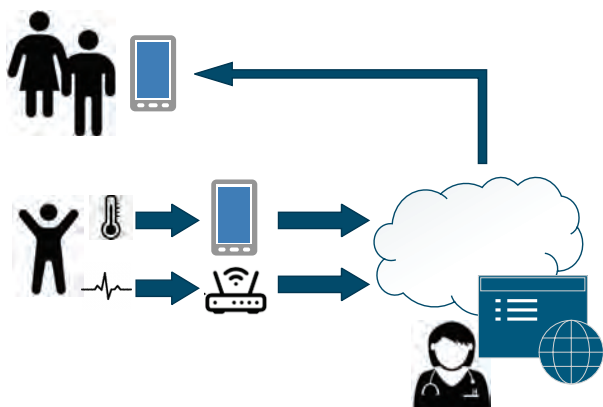


Figure 1: System overview of wearable devices interacting with CSEM's cloud-based X-Data platform.

Figure 1 shows the overview of the system, consisting of the wearable devices, the gateway smartphone application and the X-Data cloud platform.

Two different wearables are used, the commercially available Greenteg Core to measure the core body temperature and the Actigraph LEAP (developed in collaboration with CSEM) to measure various other, mainly PPG based vital signs. The latter are to be used in the offline exploratory analysis for the prediction of fever events. The Core is connected via BLE to a smartphone, allowing to send real-time body temperature data to the cloud. The LEAP will once a day be connected via an USB-cable to a dedicated gateway to charge its battery and at the same time transmit the recorded data to the cloud.

On the smartphone, connected to the Core, a gateway Android application is running, which transmits the temperature data to the cloud in real time. The application also shows the current body temperature, together with the battery and connection status of the Core in a simple graphical user interface. The app further allows to securely onboard wearable devices and assign them to the patients, a necessary one-time set-up before the patient receives the wearables and the smartphone.

Already existing features of the platform, such as gateway and user authentication, secure data transfer, secure data storage and secure data access, were used to fulfill the requirements of the study. Additional features were developed, which at the same time extend X-Data's general capabilities to be used in other clinical studies. Those features are easy and secure onboarding of patients or devices, management and monitoring of patients and wearable devices through a web interface and the real-time SMS alerting system. Additionally, the device data visualization and the graphical representation was added to the dashboard. For this study, the system is used to send body temperature SMS alerts to caregivers, however it is extendable to other parameters from the same or other wearables.

The X-Data platform continues growing and it is already requested to be used in other clinical trials. The study describe in this article is planned to start in January 2025 with ~10 patients at Inselspital Bern. Upon success, the study will be extended to other cancer centers throughout Switzerland, aiming to include ~250 patients over the next 2-3 years.

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