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# Assessment of HL7 FHIR Interoperability Between EHR Systems and the Survivorship Passport v2.0 Platform to Generate Treatment Summaries for Childhood Cancer Survivors in Six Clinics: Preliminary Testing Results

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**Abstract.** The Survivorship Passport (SurPass) for childhood cancer survivors provides a personalized treatment summary together with a care plan for long-term screening of possible late effects. HL7 FHIR connectivity of Electronic Health Record (EHR) systems with the SurPass has been proposed to reduce the burden of collecting and organizing the relevant information. We present the results of testing and validation efforts conducted across six clinics in Austria, Belgium, Germany,

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Italy, Lithuania, and Spain. We also discuss ways in which this experience can be used to reduce efforts for the SurPass integration in other clinics across Europe.

**Keywords.** Testing, Validation, HL7 FHIR IG, EHR systems, Cancer Survivorship

## 1. Introduction

The Survivorship Passport (SurPass) for childhood cancer survivors (CCS) has been developed as a digital tool containing the personalized treatment summary of each CCS together with a personalized survivorship care plan (SCP) for long-term follow-up and screening for possible late complications [1].

The evolution of SurPass platform has been shaped since 2011 through iterative development across various European projects [2,3,4,5].

To facilitate the use of the tool in clinical practice and to reduce the time spent to generate the treatment summary, which might cover more than two years of medical history, the EU-funded PanCareSurPass project has implemented interoperability between Electronic Health Record (EHR) systems, through the HL7 FHIR (Fast Healthcare Interoperability Resources) R4 (Release) standard, and the SurPass platform across six clinics in Europe with diverse healthcare scenarios, leading to the release of SurPass v2.0 [6,7].

We present the steps to achieve interoperability, assess the preliminary results of the testing and validation process in six participating clinics using the SurPass platform, and discuss the potential of using this experience to streamline efforts associated with SurPass integration in additional clinics and countries across Europe.

## 2. Methods

The implementation of HL7 FHIR standard in SurPass involved several key steps: 1) the creation of a comprehensive HL7 FHIR Implementation Guide [8]; 2) the equipment of the SurPass platform with HAPI FHIR [9], an open-source server, alongside with the development of a module capable of reading and writing HL7 FHIR data directly within SurPass's Oracle-based database, organized in a tabular format; 3) the efforts of each clinic by developing solutions to extract and transfer data from Electronic Health Record (EHR) systems, by producing HL7 FHIR resources and transferring them to the SurPass.

SurPass platform, hosted in Italy at Cineca supercomputing centre, underwent examination of data privacy to ensure compliance and enhance security measures.

We started the testing and validation phase between 2022 and 2023, thanks to several testing sessions conducted at the participating clinics. The participation in the X-eHealth online hackathon in October 2022 facilitated the initial interoperability experiments [10].Test cases covered various interoperability aspects, documented with explicit pass/fail criteria, and executed in a controlled testing environment using synthetic data.

The platform was then rolled out across live environments with deployments occurring at varying times for each clinic, ranging from November 2023 to February 2024, thereby initiating the pilot phase involving real-world data.

To enhance user engagement in promptly addressing potential issues, a ticketing system was implemented at the beginning of the testing phase, to report issues

encountered during platform interactions (Fault), request clarifications on certain aspects (Help), or suggest changes to improve the overall use of SurPass (Change).

## 3. Results

The effectiveness of the usage of HL7 FHIR standard in generating treatment summaries was evaluated by analysing the variety of data automatically sent to the platform.

Table 1 provides an overview of automation, detailing the following for each clinic: 1) "Data transmission capability", which examines the variations in types of data that can be automatically transmitted, analysing 113 distinct variables out of a total of 168 [1]; 2) "Data transfer in live environment", indicates the volume of automatically transmitted data (number of variables and number of forms); 3) "Data volume in live environment", shows the number of the first passports generated using HL7 FHIR data.

**Table 1.** Automatically transmitted HL7 FHIR data (as of March 8th, 2024).

| Clinic | Data transmission capability<br>% | Data transfer in live environment<br>n. of variables / n. forms | Data volume in live environment<br>passports issued |
|---|---|---|---|
| CCRI, Austria | 69,8% | Not available* | * |
| UZ Leuven, Belgium | 60,4% | 69 in 106 forms | 19 |
| UzL, Germany | 30,2% | Pending** | ** |
| IGG, Italy | 37,7% | 70 in 292 forms | 31 |
| VULSK, Lithuania | 64,2% | 19 in 6 forms | 1 |
| IIS La Fe, Spain | 52,8% | 56 in 53 forms | 10 |

* CCRI uses the National eHealth Infrastructure (ELGA) to store and maintain data changes.
** The data import is currently on hold due to bureaucratic hurdles.

Between September 2022 and February 2024, a total of 111 requests were submitted, with 50 of them (45%) originated in the initial four months of the pilot phase in live environments.

Encountered errors were categorized, described, and analysed, pinpointing areas for intervention. As shown in table 3, some entries (Fault: 60 tickets, 54%) highlighted technical issues, suggesting actions for platform optimization. Others (Help: 38 tickets, 34%) for clarification, indicating a need for improved user guidance. The rest (Change: 13 tickets, 12%) included suggestions for new features or enhancements.

**Table 2.** N. of tickets by type of intervention and differences between test and live environments.

| Category | Type of intervention | Test environments | Live environments | Total |
|---|---|---|---|---|
| **Fault** | | **41** | **19** | **60** |
| | Bug fixes | 33 | 9 | 42 |
| | Translation errors | 3 | 6 | 9 |
| | System down | 3 | 3 | 6 |
| | SSL certificate | 2 | 1 | 3 |
| **Help** | | **15** | **23** | **38** |
| | User support | 13 | 9 | 22 |
| | Data management | 2 | 14 | 16 |
| **Change** | | **5** | **8** | **13** |
| | New feature request | 4 | 7 | 11 |

| Configuration | 1 | 1 | 2 |
|---|---|---|---|
| | **61** | **50** | **111** |

Table 3 summarizes the key areas of improvement, categorized by intervention type across different platform sections. The primary focus was on refining the Care Plan, addressing bug fixes, translation errors, user support, and implementing new features.

This was followed by improvements to the User Interface and resolving errors in the Radiotherapy and Relapse forms, along with addressing system downtime issues.

Additionally, efforts were made to assist users with daily platform usage, including data management and assistance with the login process.

**Table 3.** N. of tickets by type of intervention in a real-world scenario (data from live environments).

| **Fault** | **19** |
|---|---|
| **Bug fixes** | **9** |
| Care Plan | 3 |
| Radiotherapy | 2 |
| Relapse | 2 |
| Survivor Access | 1 |
| User login | 1 |
| **Translation errors** | **6** |
| Care Plan | 6 |
| **Infrastructure** | **4** |
| System Down | 3 |
| SSL Certificate | 1 |

| **Help** | **23** |
|---|---|
| **Data management** | **14** |
| Surgery | 8 |
| Chemotherapy | 3 |
| Demographics | 2 |
| Diagnosis | 1 |
| **User support** | **9** |
| Care Plan | 4 |
| User login | 3 |
| Chemotherapy | 1 |
| Demographics | 1 |

| **Change** | **8** |
|---|---|
| **New feature request** | **7** |
| User Interface | 4 |
| Care Plan | 1 |
| Radiotherapy | 1 |
| Search | 1 |
| **Configuration** | **1** |
| User login | 1 |

## 4. Discussion

The analysis confirmed that HL7 FHIR interoperability reduces manual entry for distinct variables by a range of 30% to 69%.

Although some training has been necessary for clinics, the HL7 FHIR Implementation Guide [8] reduced the need for extensive IT training sessions. The ticketing system has been instrumental to build trust in clinics and improve on-boarding of IT and clinical stuff.

### *4.1. Lessons learned*

While dedicated test environments with synthetic data provided a safe learning space for users, first-hand experience with real-world data proved invaluable, revealing some platform shortcomings that remained undetected during the initial testing phase.

Extensive testing and error correction have improved the platform and additional clinics will benefit directly from the error resolution efforts, enabling them to leverage a more robust and refined platform from the very beginning.

### *4.2. Future directions*

Future efforts will leverage experiences from participating clinics, integrating a broader array of scenarios that more closely reflect real-world complexities, potentially improving the effectiveness of the tests.

## 5. Conclusions

The HL7 FHIR interoperability of EHR systems with the SurPass was implemented in participating clinics. Preliminary test results indicate that thanks to the integration the platform has effectively reduced the amount of input data required, streamlining the process for physicians of collecting patient relevant information.

Testing and validation efforts optimized the platform's performance in processing and managing HL7 FHIR data. However, the use of synthetic data masked some errors.

Real-world experience identified platform improvements, paving the way for a more robust and efficient deployment in additional clinics which will benefit from these enhancements.

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