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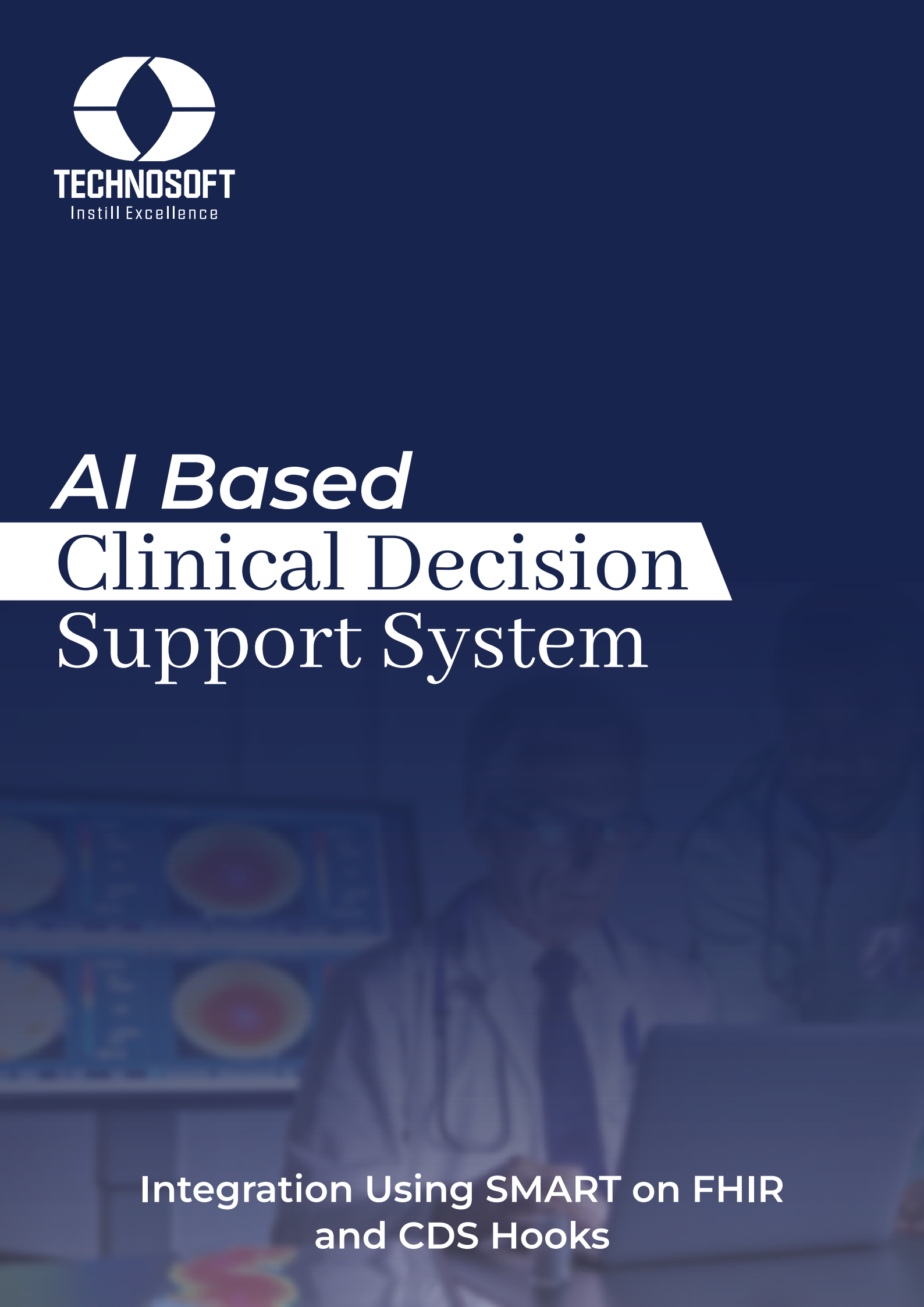
AI Based Clinical Decision Support System

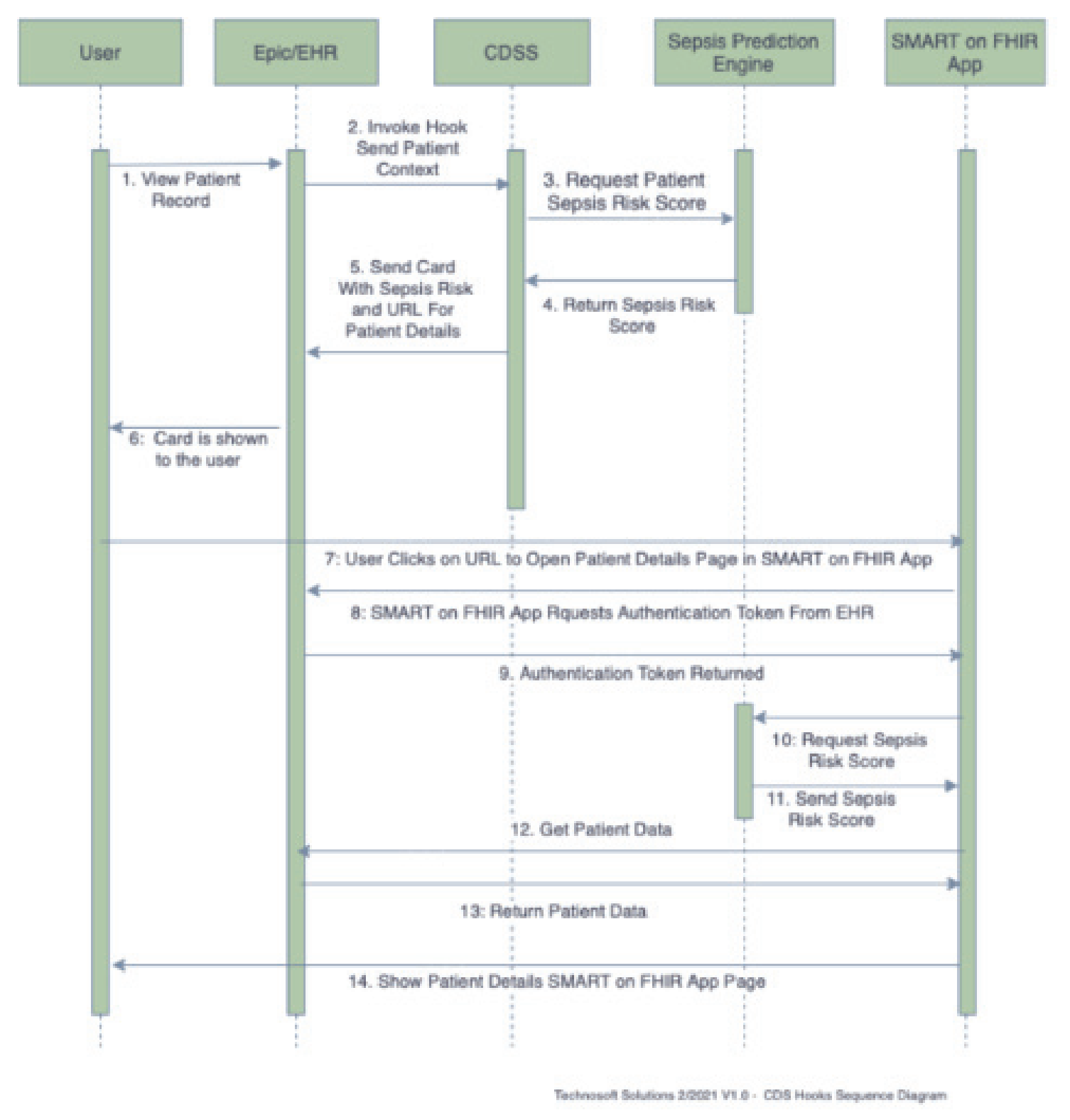


Integration Using SMART on FHIR and CDS Hooks

Techno-soft developed an AI-based CDS system with CDS Hooks and SMART on FHIR technologies. Below, we will discuss in detail how we implemented a Sepsis CDSS for a client.

The following diagram shows how CDS Hooks is used in our case:

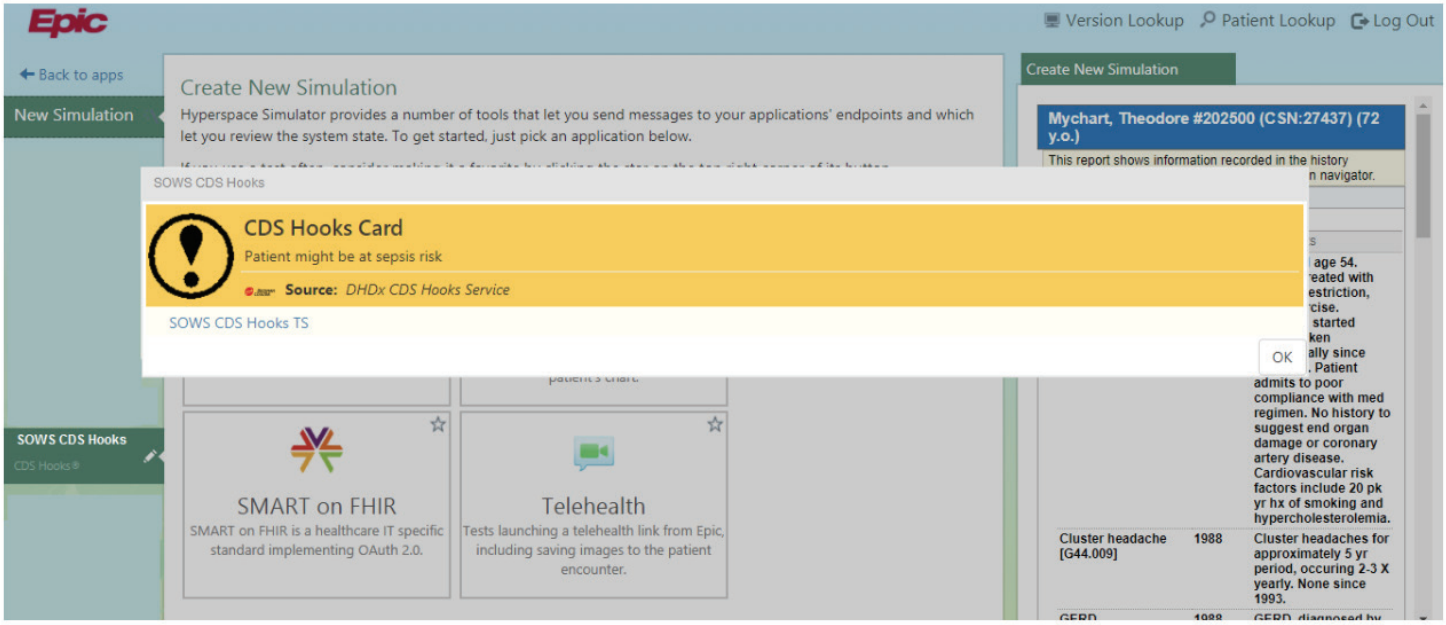
Sepsis CDS Hooks Sequence Diagram:

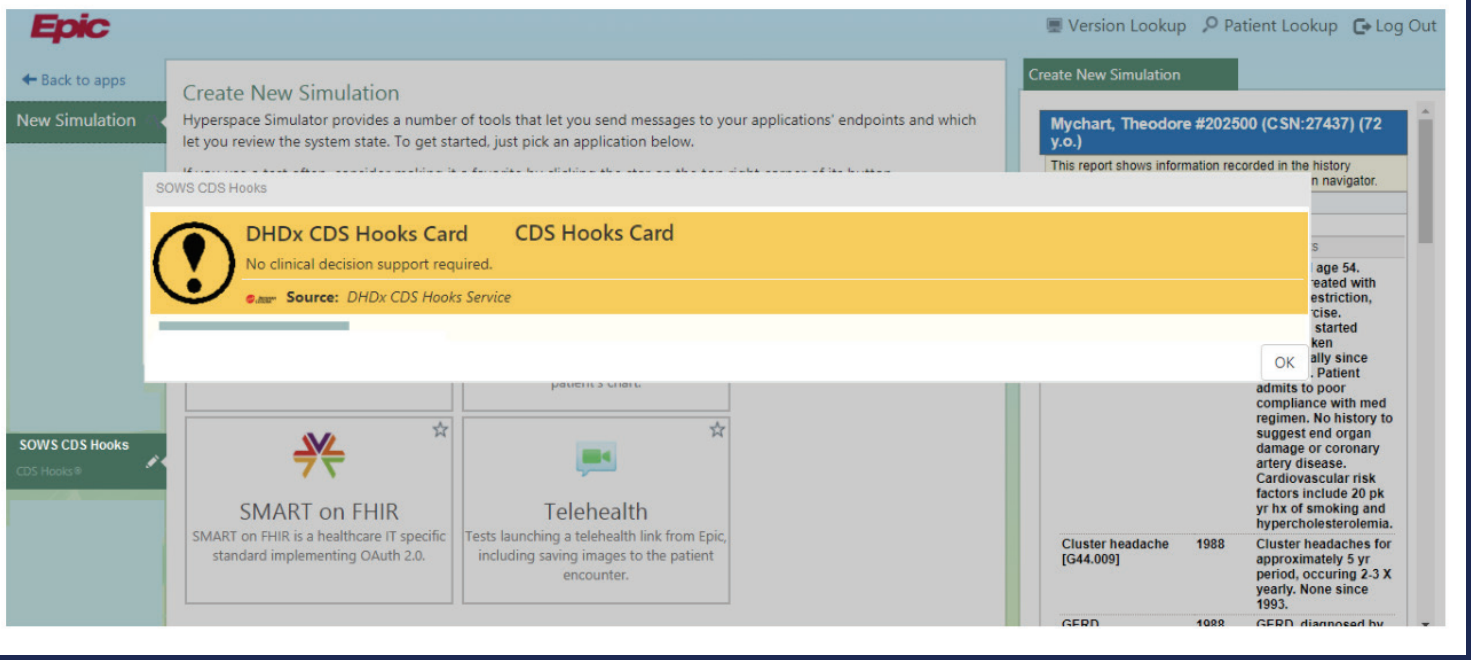


SMART on FHIR Implementation Details:

We have focused predominantly on the SMART on FHIR solution, along with CDS Hooks. The following diagram shows how a SMART on the FHIR app was used for our use case.

In this scenario, we linked the Hook to the opening of the patient record in Epic. At this time, the hook can send the patient context to our clinical decision support system and in turn if the patient is at high risk of developing sepsis, a card is returned to the EHR with High Sepsis Risk mentioned and a link URL to the patient details page with further information.





The Sepsis CDSS App is integrated with EHR at two levels:

A: Integrate part of the CDSS Web UI into the Epic Hyperspace, and Cerner's Simulator software as a SMART on the FHIR app.

B: SSO-based user authentication and provisioning are handled through an authentication framework used by Epic/Cerner (i.e. OAuth 2.0). OAuth 2 allows Danaher to use the Sepsis CDSS solution as a stand-alone product and a fully EHR-integrated solution, offsetting all the authentication handling tasks to the EHR.

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SEPSIS CDSS

Main Dashboard

5 Total | 2 Treating | 3 Open

Search | Location: All | Disposition: All

Patient Name	Age	Gender	Location	Alert Time	Treatment Started	Status
SMART Fredrick	74Y	male	5E	Alert time 12:34 pm	OPEN	SEPSIS RISK
SMART Wilma	73Y	male	2E	Alert time 08:09 am	OPEN	SEPSIS RISK
SMART Valerie	36Y	male	ICU	Last check 11:11 am	OPEN	SEPSIS RISK
SMART Timmy	08Y	male	ED	Last check 05:09 pm	TREATING	SEPSIS RISK
SMART BabyBoy	10m	female	2E	Last check 07:45 am	TREATING	SEPSIS RISK

CONFIDENTIAL

SEPSIS CDSS

Snapshot | Trends

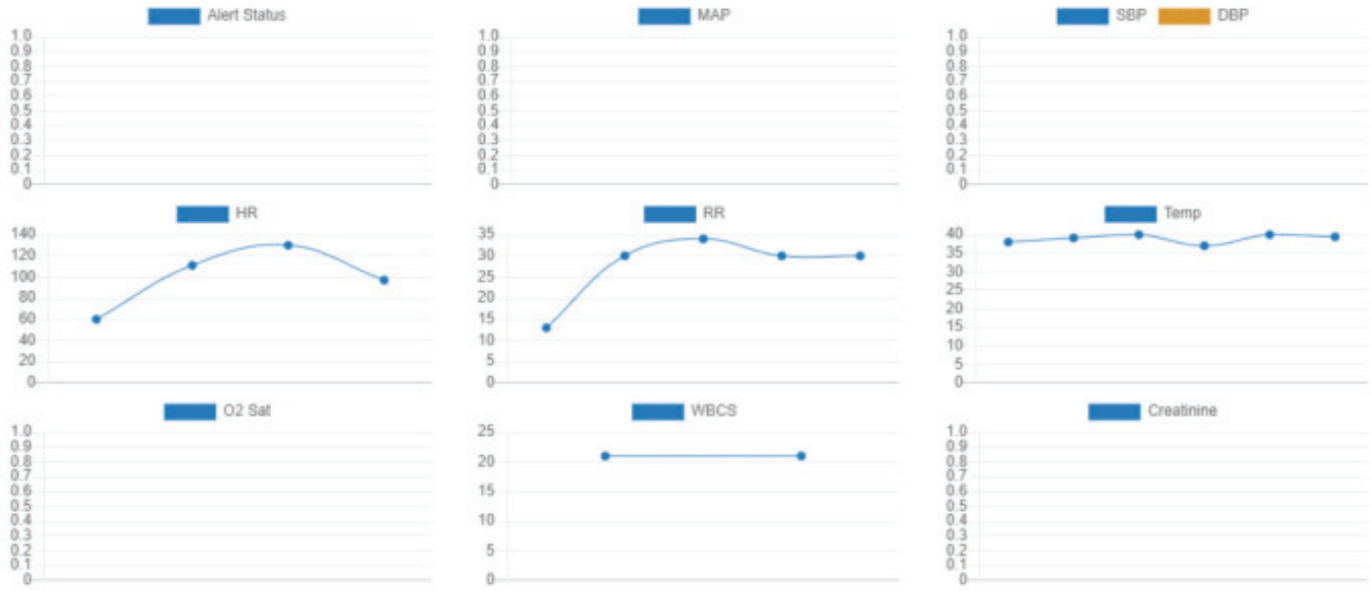
FREDRICK SMART SEPSIS RISK

Age 74Y **Gender** Male **Location** 5E

MRN 6934 **Alert time** 12:34 pm

DISPOSITION

Open



The workflow of the app is as following:

There are three main UX flow scenarios.

- **EHR Launch**

  Shows Multiple Patients Dashboard View

- **Stand Alone Launch**

  Shows Multiple Patients Dashboard View

- **Mobile SMS Link Launch**

  Shows Single Patients View

- The user gets authenticated against the EHR's OAuth 2 Authentication in all these UX Flows.
- Once authenticated, the app obtains the list of currently monitored patients and their sepsis status from the Sepsis CDSS Prediction Engine.
- The app then pulls additional basic patient data (e.g., names, demographics, locations) from the
- The EHR FHIR server will populate the patient list view elements.
- When the user selects a patient from the list, the app pulls the patient's clinical data (e.g., vitals and labs) from the EHR FHIR server to populate the elements of the patient detail view.

Details of the three UX Flows:

EHR Launch

A user can launch the app using Epic's Hyperspace software. The app is opened from the EHR's UI into a separate browser window. The first view is a simple dashboard containing a list of patients the system monitors. Each entry has basic patient information (name, gender, date of birth, admission date/time, and sepsis alert status). To see more information about a particular patient, the user clicks that patient's entry in the dashboard to open a patient detail view showing more information about that patient, such as the time the alert was issued, last vitals, and lab values completed at the time the alert was issued, and other information.

Stand Alone Launch

The user accesses the app from a separate login page in a web browser, same as user flow A above, except the user accesses the dashboard through the standalone app's login page outside the EHR's environment. The user can authenticate using the EHR's SSO without the need to enter an additional password.

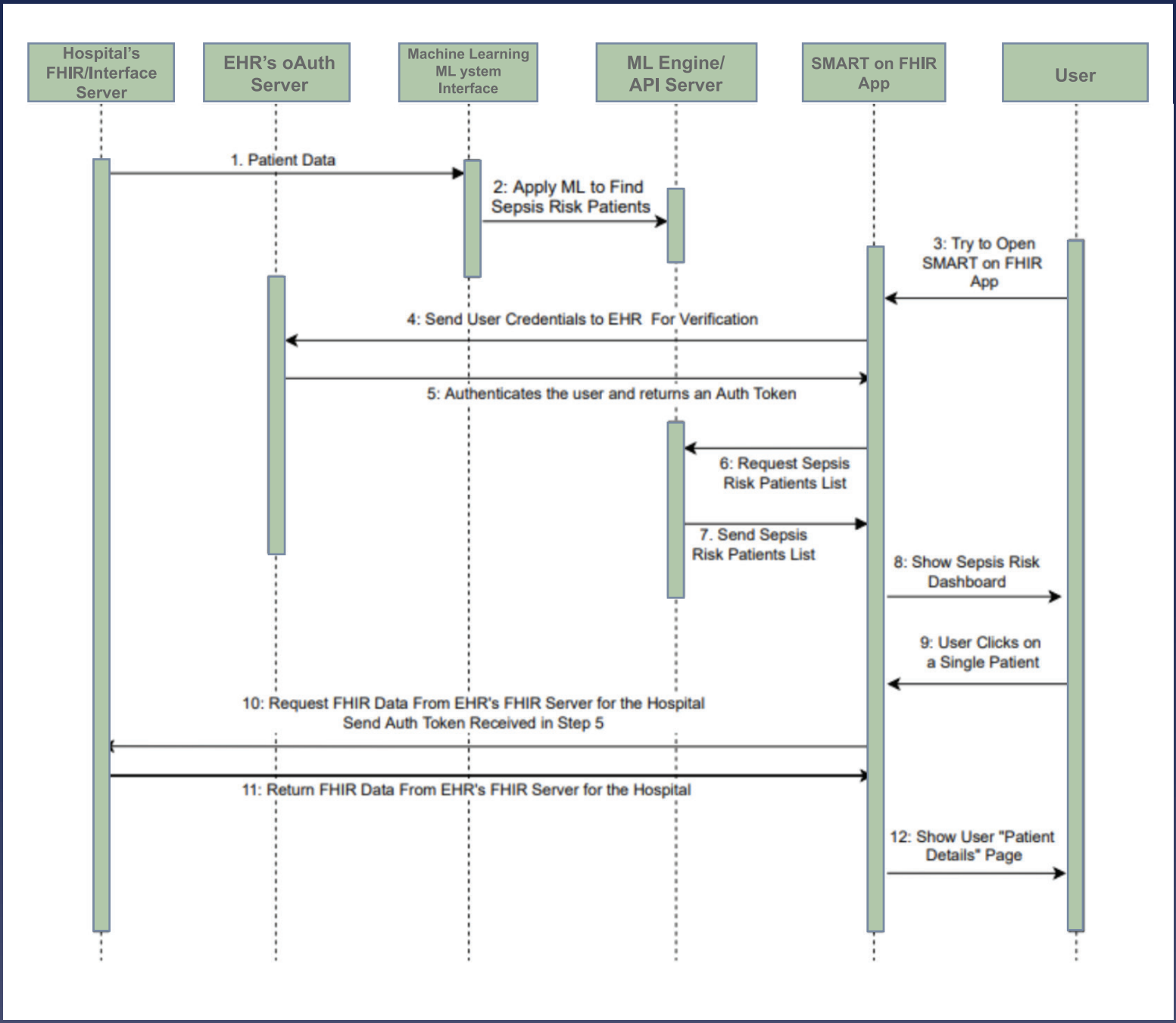
SMS Launch

The user receives an SMS sepsis alert containing a custom link to the web app. The Alert links contain a specific anonymized patient identifier that automatically directs the user to that patient's alert detail page when the user taps the link, the user first logs in to the system using their Epic or Cerner Login credentials

User Interface

Please see below images of the SMART on the FHIR app from the Demo implementation:

Clinical Decision Support System Sequence Diagram with SMART on FHIR



Benefits and Challenges:

Benefits:

- **Improved Patient Outcomes:**
  Personalized and timely recommendations enhance patient care.
- **Interoperability:**
  Standards-based approach ensures seamless integration with EHRs.
- **Efficiency:**
  Streamlined clinical workflows reduce clinician workload.

Challenges:

- **Data Privacy:**
  Ensuring patient data security and compliance with regulations.
- **Integration Complexity:**
  Streamlined clinical workflows reduce clinician workload.

The integration of AI-based Clinical Decision Support Systems with SMART on FHIR and CDS Hooks represents a significant advancement in healthcare technology. It offers the potential to transform clinical decision-making, improve patient outcomes, and streamline healthcare delivery.

For more information on implementing AI-based CDSS using SMART on FHIR and CDS Hooks

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