**Chapter Five**

**RESULTS AND DISCUSSION**

This section presents, analyzes, and interprets the results of the study in developing a Blockchain Implementation for Secured Vaccine Certificates. It also presents the result from OWASP ZAP and Slither Solidity Security Scans.

**5.1 Functionality of the Newly Developed System**

**5.1.1 Patient Registration**

Graphical user interface, application

Description automatically generated

This is the catalyst for a patient to be signed-up in the system. It will trigger generation of public and private keys in the backend which is crucial for encryption and uploading to IPFS.

**5.1.2 Patient Login**

Graphical user interface, application

Description automatically generated

The patient will be required to input email (as username) and password to be able to access related vaccine records and details.

**5.1.3 Patient Home Screen**

Qr code

Description automatically generated

Upper part of the home screen is the patient’s profile data: Full name, profile photo, address and patient code. Patient QR code will also be displayed. This code will be used later if patient decides to get vaccinated. It will signify that the patient is currently registered to the system.

Qr code

Description automatically generated

Lower part of the home screen is for vaccination details. If the patient already got vaccinated, this section will be displayed. It will show a summary of vaccine doses and a QR code for these details. This code can be used for validation of third party such as establishments to validated if patient was indeed vaccinated.

The ‘Download Certificate’ button will download the vaccine certificate file as follows:

Qr code

Description automatically generated

**5.1.4 Vaccine Record Creation**

Graphical user interface, application

Description automatically generated

For medical personnel doing the vaccination, this page will be available for them. A valid Patient QR code is required before the system allows encoding of vaccination dose detail. Once details are confirmed, a MetaMask (blockchain plugin) will popup to confirm the transaction. This will log the transaction to the blockchain

**5.1.5 Vaccine Certificate Validation**

Graphical user interface, text, application

Description automatically generated

Graphical user interface, application

Description automatically generated

For third-party validators that would want to authenticate a Vaccine Certificate file, this page will be available. It will require the user to upload the file and will display a prompt that would tell if file is valid or not (within the blockchain logs context)

**5.1.6 Scan Summary QR Code**

Graphical user interface

Description automatically generated

Another way to validate is via summary QR code. For third-party validators that would want quick details of patient’s vaccine records, it will require a summary QR code from a patient and will display related details. QR code will be invalid if app founds out it’s not existing within the blockchain logs.

**5.2 Security Scans**

The researcher employed two scans to audit the application’s functionality. This will ensure that the application complies with existing standard for Solidity and Open Web Applications. Because the application size is fairly small, we will only focus the scans on the blockchain and web application aspects.

**5.2.1 Solidity Slither**

(Still in progress)

Since the researcher employed blockchain to store our transaction logs and Solidity was used to code the smart contracts behind it, we will use Solidity Slither Scans to implement passive scanning of the app’s smart contracts.

**5.2.2 OWASP ZAP**

(Still in progress)

Needs further explanation

A screenshot of a computer

Description automatically generated