# **VacciMate**

## **Mobile app for tracking of individual’s vaccination records: Argue for and present the design for your application**

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**Abstract**

So called, paper-based, “vaccination card” is still being used in the Czech Republic as the main tracker of an individual’s tracker of vaccination. Moreover, no central database exists – vaccination records are only kept in the vaccination card and as the entry in a local EHR system used by a clinic of your practical doctor. Thus, making population statistics in the Czech Republic is difficult and time demanding task and individual’s tracking and usage of vaccination card could be inconvenient and confusing. Health systems in most countries are implementing computer-based systems in order to achieve better health care, easy to use mobile app for vaccination could help individual with his vaccination tracking and also to speed up global processes for tracking diseases and immunization rate – for example in this outgoing COVID-19 pandemic. This paper focuses on such application, argue for its need, provides app’s goals, structure, format and functionality.

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1. **Introduction**
   1. **Motivation**

Vaccination is important and powerful medical procedure which helps us to beat diseases, slow down their spreading and much more. Current systems in place in the Czech Republic are using paper-based vaccination records hand in hand with the duplicate records kept by your practical doctor in a local EHR system. However, no central database exists, thus population statistics are difficult to make. Furthermore, paper-based records could be inconvenient to use and orientate in. Information kept there and manually written by a physician which, together with small amount of available space, could result in illegible records. As a result, it could be hard to keep track of your vaccination records and very difficult to provide real time statistics. Mobile application could ease tracking of individual’s vaccination program and also provide real time provocation statistics. App should not be localized only for one country but should be able to be configured based on user’s input.

* 1. **Objective and Methodology**

The main objective of this paper is to argue for need of such application which consists of investigating recent literature and searching for alternative apps which already exist and analyze them. Other objective is to propose possible application structure which should be able to track individual’s vaccination records, propose possible vaccinations personalized for the user and also provide immunization statistics of a population for tracked diseases in a real time.

Articles for literature survey were gained on PubMed, primarily articles which are dealing with mobile applications for vaccination with any purpose. Articles matching exactly the topic only contained apps localized for Canadian citizens. Several articles focused on vaccination in Middle East. Finally, we conducted our own search of Android app store for similar vaccination apps for the Czech Republic.

1. **Background**
   1. **Immunization and technology among newcomers: A needs assessment survey for a vaccine-tracking app**
   2. **Smartphone app uses loyalty point incentives and push notifications to encourage influenza vaccine uptake**
   3. **Operability, Acceptability, and Usefulness of a Mobile App to Track Routine Immunization Performance in Rural Pakistan: Interview Study Among Vaccinators and Key Informants**
   4. **Apps for immunization: Leveraging mobile devices to place the individual at the center of care**
   5. **Search of Google Play Store for vaccination app localized for the Czech Republic**
   6. **Summary of findings from background articles**
2. **Application description**
   1. **Technologies**

Our mobile application will be written in Java since it is default programming language for mobile development of Android apps. We used Android Studio as an IDE for development and GitHub for versioning our work. UI was designed via the built-in designer in Android Studio which supports XML description.

We used Room for persistent saving of data in the local storage. Room is a library which provides abstraction layer over SQLite. This makes usage of databases in the Java code easy and convenient.

* 1. **Collection of anonymized data**

Centralized collection of user data presents potential security risks which can result in information leak. Therefore, central server must be well protected but also data has to be stored in a way, that even if the data are leaked, attackers won’t be able to tie data to their original users. To achieve this, data collected from users will be anonymized – so we can identify duplicates but yet we will achieve the previous point. Hash functions are tools which will help us achieve this. By calculating hash from user’s national ID, date of the vaccination and the vaccination substance, we will obtain unique ID which we can use to identify the event without tying it to the user.

* 1. **Proposed application scheme**

Mobile application running on user’s phone will store individual’s tracking data in an encrypted form. Therefore, user will have to register firstly using his national ID (for example no. of ID card) and setup pin for accessing the app.

After registration and verification of the pin, user will be able to add new vaccination record (date, vaccination substance, category, note). Category is used to distinguish several groups of diseases – against flus, pneumococcus, meningococcus, etc.

After a new vaccination record is added, this record will be anonymized and send to a central server in order to log it. Anonymization process will generate unique ID for that vaccination record – hash of user’s national ID, date, category and vaccination substance. This ID will be then used by server to detect duplicate records and store each vaccination event only once. This is important in order to keep the statistics of immunization rates as much clean as possible.

The central server will store all vaccination records in anonymized state in multiple tables – based on categories. Statistics of immunization rates will be automatically generated and updated each day via a script managed by the cron service. These statistics will be then available to the mobile app clients, so graphs can be shown to the end users.

* 1. **Localization**

To make usage of application to end users as convenient as possible, it needs to be in native language of each user. Moreover, vaccination programs could differ across countries. Thus, application has to take into consideration the country of each end user. Different languages can be easily implemented via built-in Java for Android features – strings.xml. To add a new language support all we have to do is simply add new strings.xml file with translations for that language.

To add a support for vaccination scheme of a new country, we will implement a mechanism which includes config files. Country’s vaccination program will be described in a config text file which will be loaded after user choose his country. This will provide possible vaccination notification and plans which suits him the most.

1. **Security**
   1. **User data security**
   2. **Central server security**
2. **Discussion**