Xamarin XPlat Exposure Notification API

Apple and Google are both creating API's for a compatible BLE based Contact Tracing implementation which relies heavily on generating and storing rolling unique identifiers on a device, which are broadcast to nearby devices. Devices which detect nearby identifiers then store these identifiers as they come into range (or contact) with for up to 14 days.

When a person has confirmed a diagnosis, they tell their device which then submits the locally stored, self-generated rolling unique identifiers from the last 14 days to a back end service provided by the app implementing the API.

Devices continually request the keys submitted by diagnosed people from the backend server. The device then compares these keys to the unique identifiers of other devices it has been near in the last 14 days.

Confirming a diagnosis
The native API's and spec mention that in order to submit a self positive diagnosis, you should ensure that the diagnosis is actually verified through the health authority for the app. How this is done is largely left up to the individual app implementation.

The technique in our sample uses a `diagnosisUid` which would be generated on the administrative side of the app and added to the back end server's database. One `diagnosisUid` would be given out to each person with a positive test result which would then be entered into the app when submitting a self diagnosis. If the code submitted by the user exists in the database, the keys will be stored. This mechanism should prevent users from submiting false claims of diagnoses.

> ***IMPORTANT:*** *The `diagnosisUid` should NOT be derived from or be linked back to any personally identifiable information.*

These codes should be thought of as randomly generated consumable items which are entered into the database and given out randomly to confirmed test cases. The code is only meant to prevent abuse of the system by persons wishing to try and submit false positives.

One idea for this is to print post card type materials with a randomly generated QR code value on it. The card could also include instructions for how to scan the QR code into the app and submit a positive self diagnosis.

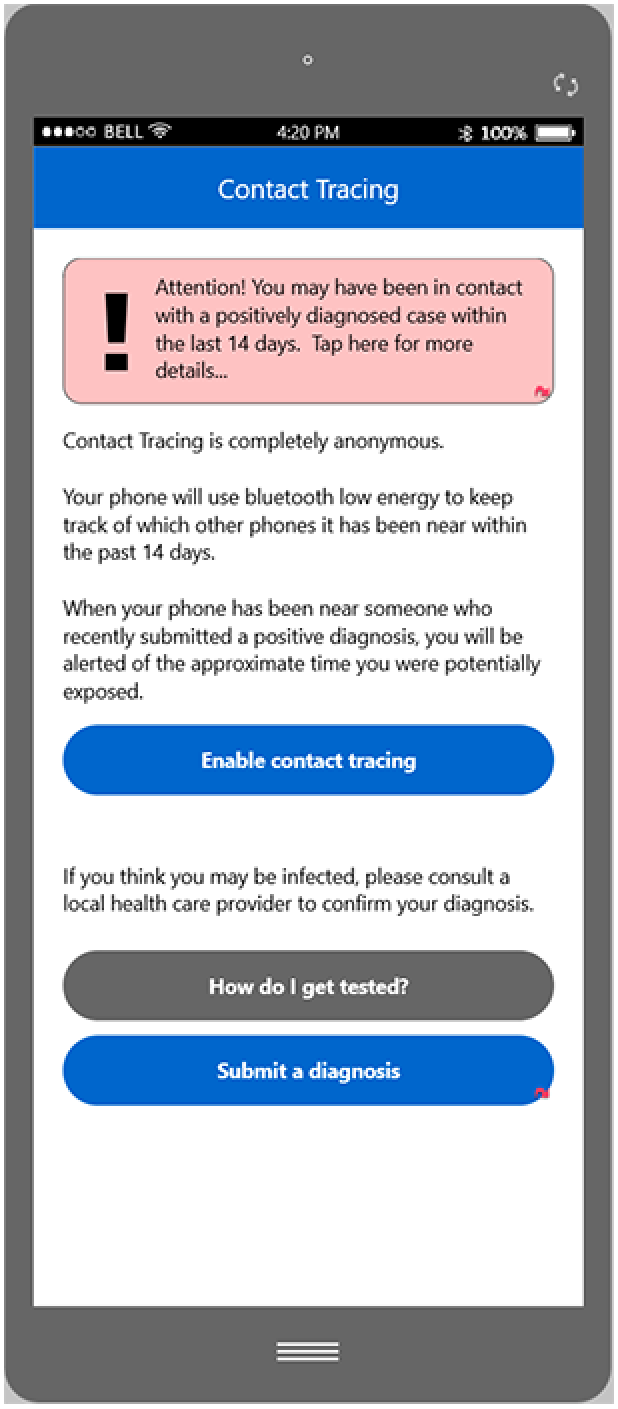
Links

- Apple Specs / Docs
- Google Specs / Docs
- Xamarin.iOS.ExposureNotification iOS Bindings NuGet Package

What We Still Need:

- Final APIs release by Google
- Understand if we have Xamarin coverage of final APIs. (Google Play Services / iOS updates that may be needed)
- Understand the limitations / OS versions required for the opt-in for iOS/Android devices.
    - Android: 5.0+
    - iOS 13.x? beta+
- Document how to opt-in, use the APIs, and have a COVID Tracing API landing page for Xamarin to point users to.

Sample Concept:


●●●○○ BELL 4:20 PM 100%

Contact Tracing

Attention! You may have been in contact with a positively diagnosed case within the last 14 days. Tap here for more details...

Contact Tracing is completely anonymous.

Your phone will use bluetooth low energy to keep track of which other phones it has been near within the past 14 days.

When your phone has been near someone who recently submitted a positive diagnosis, you will be alerted of the approximate time you were potentially exposed.

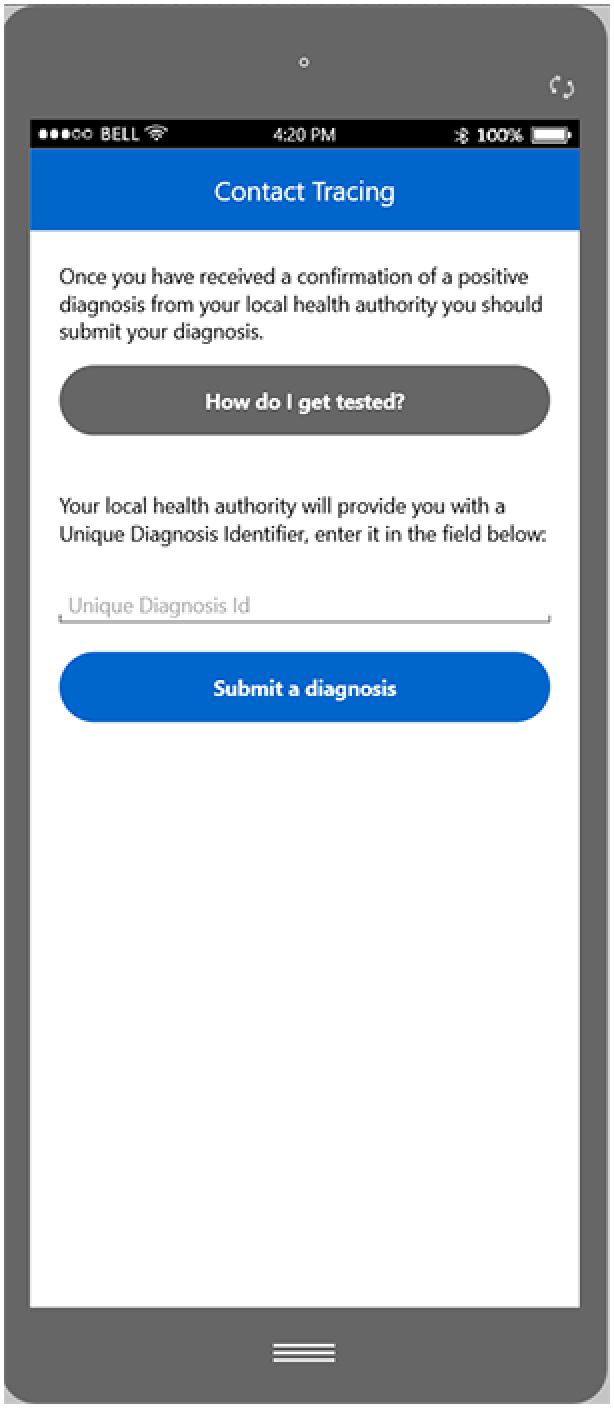
Enable contact tracing

If you think you may be infected, please consult a local health care provider to confirm your diagnosis.

How do I get tested?

Submit a diagnosis

User can enable contact tracing/exposure notification.

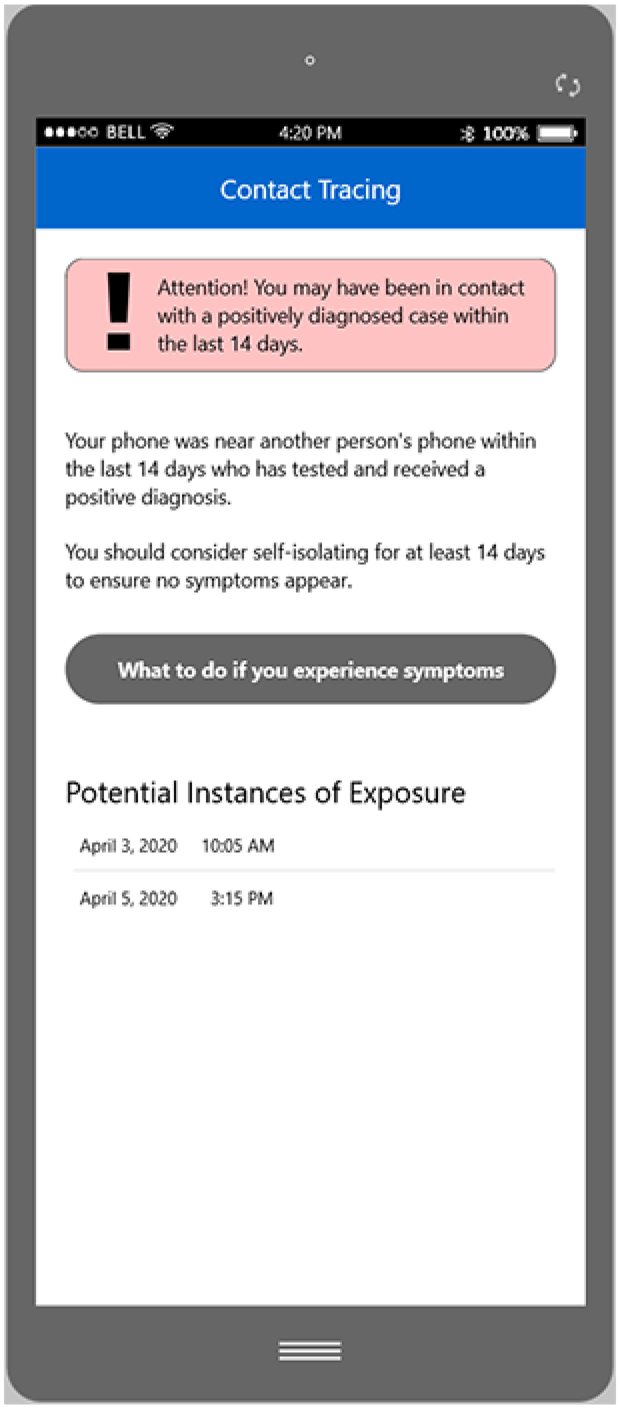


Contact Tracing

Once you have received a confirmation of a positive diagnosis from your local health authority you should submit your diagnosis.

Your local health authority will provide you with a Unique Diagnosis Identifier, enter it in the field below:

User can submit a diagnosis via a unique diagnosis identifier.



Attention! You may have been in contact with a positively diagnosed case within the last 14 days.

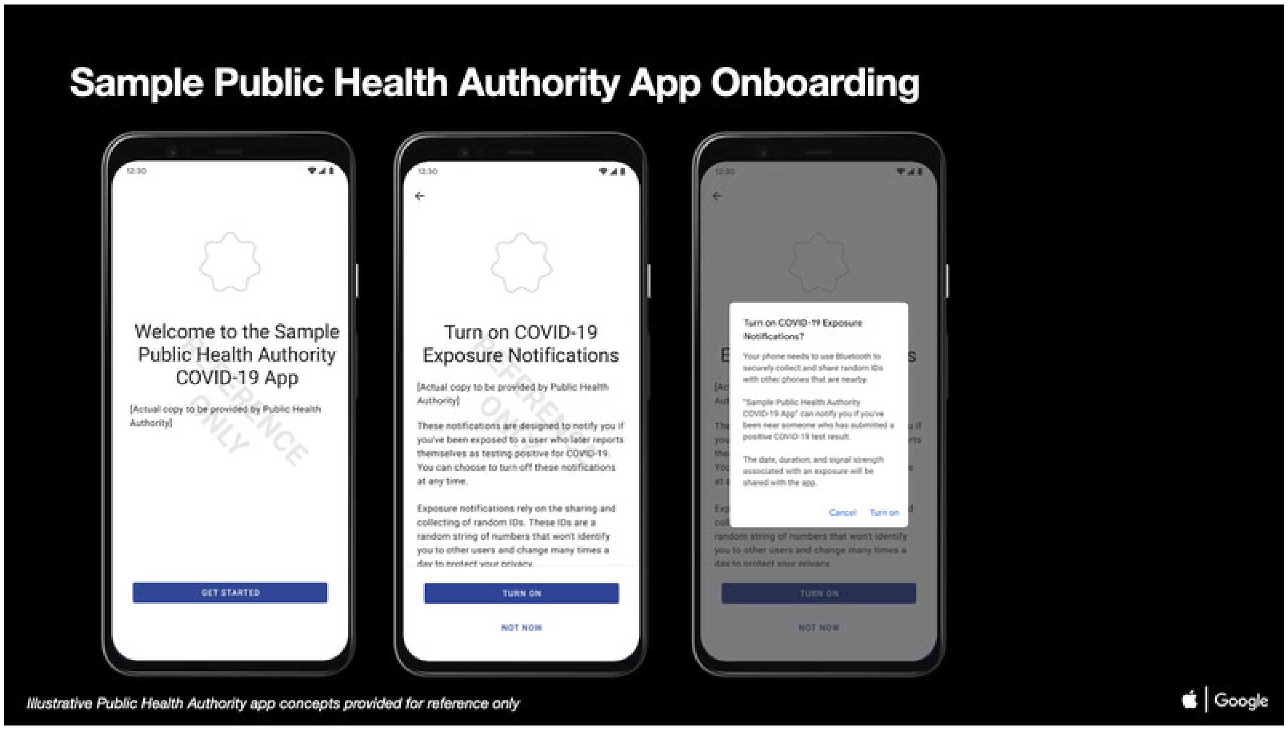
Your phone was near another person's phone within the last 14 days who has tested and received a positive diagnosis.

You should consider self-isolating for at least 14 days to ensure no symptoms appear.

Potential Instances of Exposure

April 3, 2020	10:05 AM
April 5, 2020	3:15 PM

User can see instances of exposure.



Sample Public Health Authority App Onboarding

12:30

Welcome to the Sample Public Health Authority COVID-19 App

[Actual copy to be provided by Public Health Authority]

REFERENCE ONLY

GET STARTED

12:30

Turn on COVID-19 Exposure Notifications

[Actual copy to be provided by Public Health Authority]

These notifications are designed to notify you if you've been exposed to a user who later reports themselves as testing positive for COVID-19. You can choose to turn off these notifications at any time.

Exposure notifications rely on the sharing and collecting of random IDs. These IDs are a random string of numbers that won't identify you to other users and change many times a day to protect your privacy.

TURN ON

NOT NOW

12:30

Turn on COVID-19 Exposure Notifications?

Your phone needs to use Bluetooth to securely collect and share random IDs with other phones that are nearby.

"Sample Public Health Authority COVID-19 App" can notify you if you've been near someone who has submitted a positive COVID-19 test result.

The date, duration, and signal strength associated with an exposure will be shared with the app.

Cancel Turn on

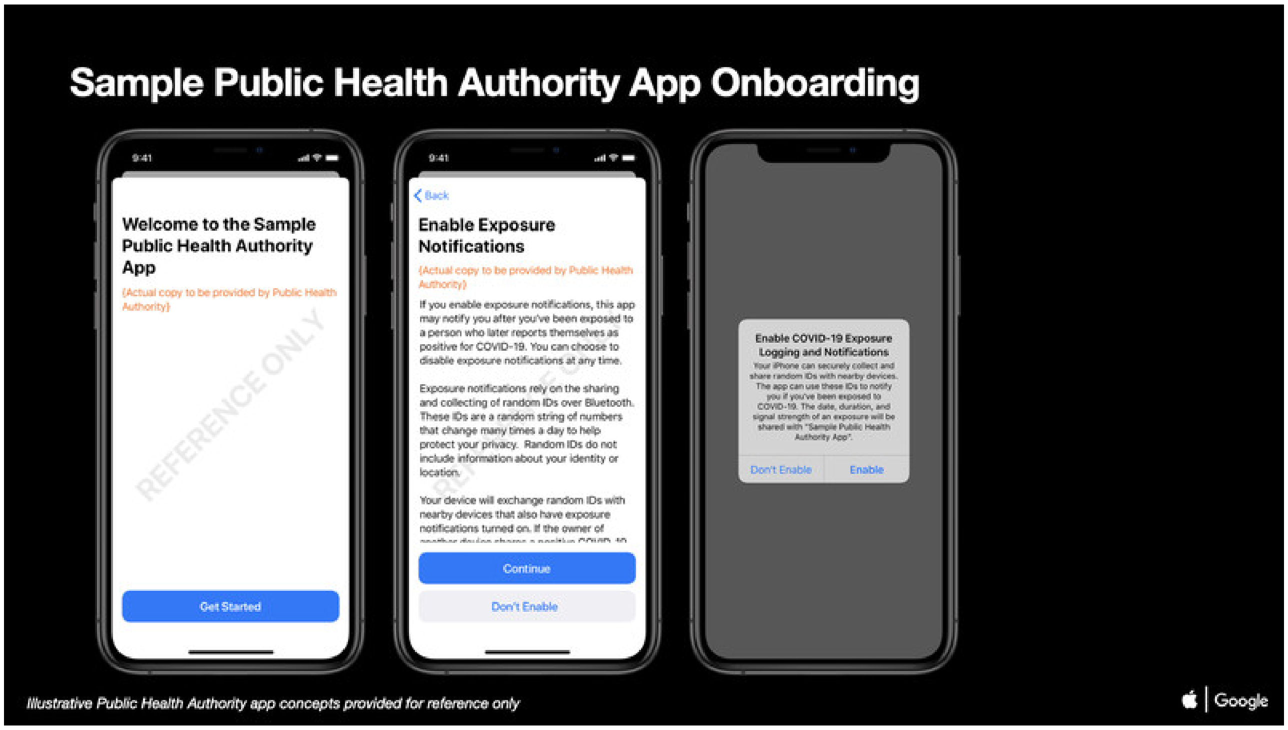
TURN ON

NOT NOW

Illustrative Public Health Authority app concepts provided for reference only

 | Google

Android - Onboarding Flow



Sample Public Health Authority App Onboarding

9:41

Welcome to the Sample Public Health Authority App

(Actual copy to be provided by Public Health Authority)

REFERENCE ONLY

Get Started

9:41

Back

Enable Exposure Notifications

(Actual copy to be provided by Public Health Authority)

If you enable exposure notifications, this app may notify you after you've been exposed to a person who later reports themselves as positive for COVID-19. You can choose to disable exposure notifications at any time.

Exposure notifications rely on the sharing and collecting of random IDs over Bluetooth. These IDs are a random string of numbers that change many times a day to help protect your privacy. Random IDs do not include information about your identity or location.

Your device will exchange random IDs with nearby devices that also have exposure notifications turned on. If the owner of

Continue

Don't Enable

Enable COVID-19 Exposure Logging and Notifications

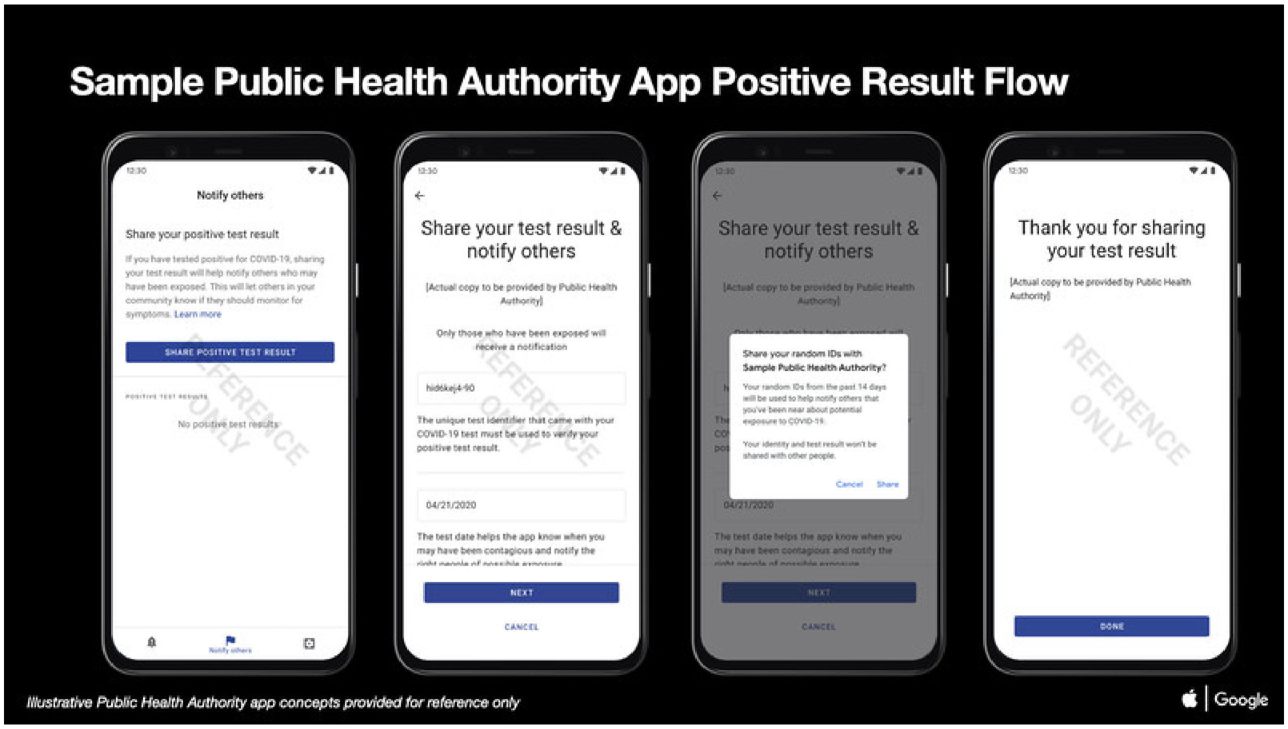
Your iPhone can securely collect and share random IDs with nearby devices. The app can use these IDs to notify you if you've been exposed to COVID-19. The date, duration, and signal strength of an exposure will be shared with "Sample Public Health Authority App".

Don't Enable Enable

Illustrative Public Health Authority app concepts provided for reference only

 | Google

iOS - Onboarding Flow



Sample Public Health Authority App Positive Result Flow

12:30

Notify others

Share your positive test result

If you have tested positive for COVID-19, sharing your test result will help notify others who may have been exposed. This will let others in your community know if they should monitor for symptoms. Learn more

SHARE POSITIVE TEST RESULT

POSITIVE TEST RESULTS

No positive test results

Notify others

12:30

Share your test result & notify others

[Actual copy to be provided by Public Health Authority]

Only those who have been exposed will receive a notification

hid6kej4-90

The unique test identifier that came with your COVID-19 test must be used to verify your positive test result.

04/21/2020

The test date helps the app know when you may have been contagious and notify the right people of possible exposure.

NEXT

CANCEL

12:30

Share your test result & notify others

[Actual copy to be provided by Public Health Authority]

Share your random IDs with Sample Public Health Authority?

Your random IDs from the past 14 days will be used to help notify others that you've been near about potential exposure to COVID-19.

Your identity and test result won't be shared with other people.

Cancel Share

04/21/2020

The test date helps the app know when you may have been contagious and notify the right people of possible exposure.

NEXT

CANCEL

12:30

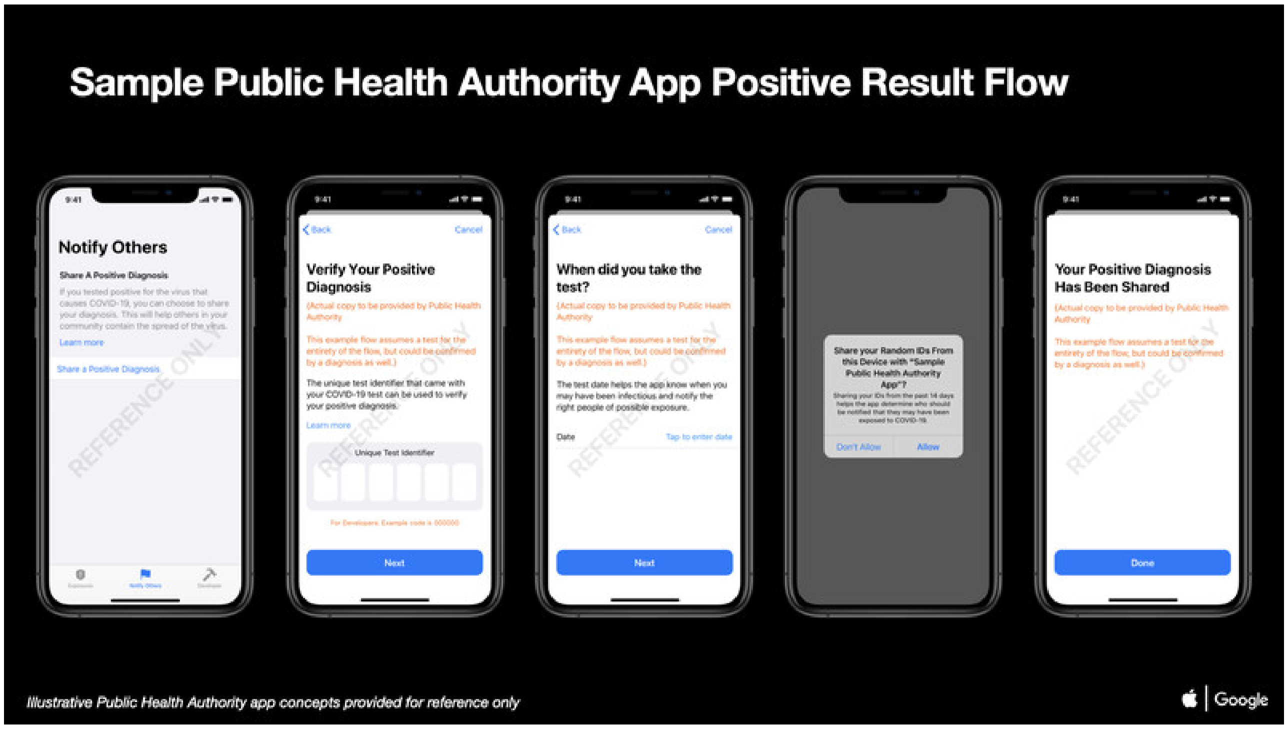
Thank you for sharing your test result

[Actual copy to be provided by Public Health Authority]

DONE

Illustrative Public Health Authority app concepts provided for reference only

Android - Sample Public Health Authority Flow



Sample Public Health Authority App Positive Result Flow

9:41

Notify Others

Share A Positive Diagnosis

If you tested positive for the virus that causes COVID-19, you can choose to share your diagnosis. This will help others in your community contain the spread of the virus.

Learn more

Share a Positive Diagnosis

Exposures Notify Others Developer

9:41

Back Cancel

Verify Your Positive Diagnosis

(Actual copy to be provided by Public Health Authority

This example flow assumes a test for the entirety of the flow, but could be confirmed by a diagnosis as well.)

The unique test identifier that came with your COVID-19 test can be used to verify your positive diagnosis.

Learn more

Unique Test Identifier

For Developers: Example code is 000000

Next

9:41

Back Cancel

When did you take the test?

(Actual copy to be provided by Public Health Authority

This example flow assumes a test for the entirety of the flow, but could be confirmed by a diagnosis as well.)

The test date helps the app know when you may have been infectious and notify the right people of possible exposure.

Date Tap to enter date

Next

Share your Random IDs From this Device with "Sample Public Health Authority App"?

Sharing your IDs from the past 14 days helps the app determine who should be notified that they may have been exposed to COVID-19.

Don't Allow Allow

9:41

Your Positive Diagnosis Has Been Shared

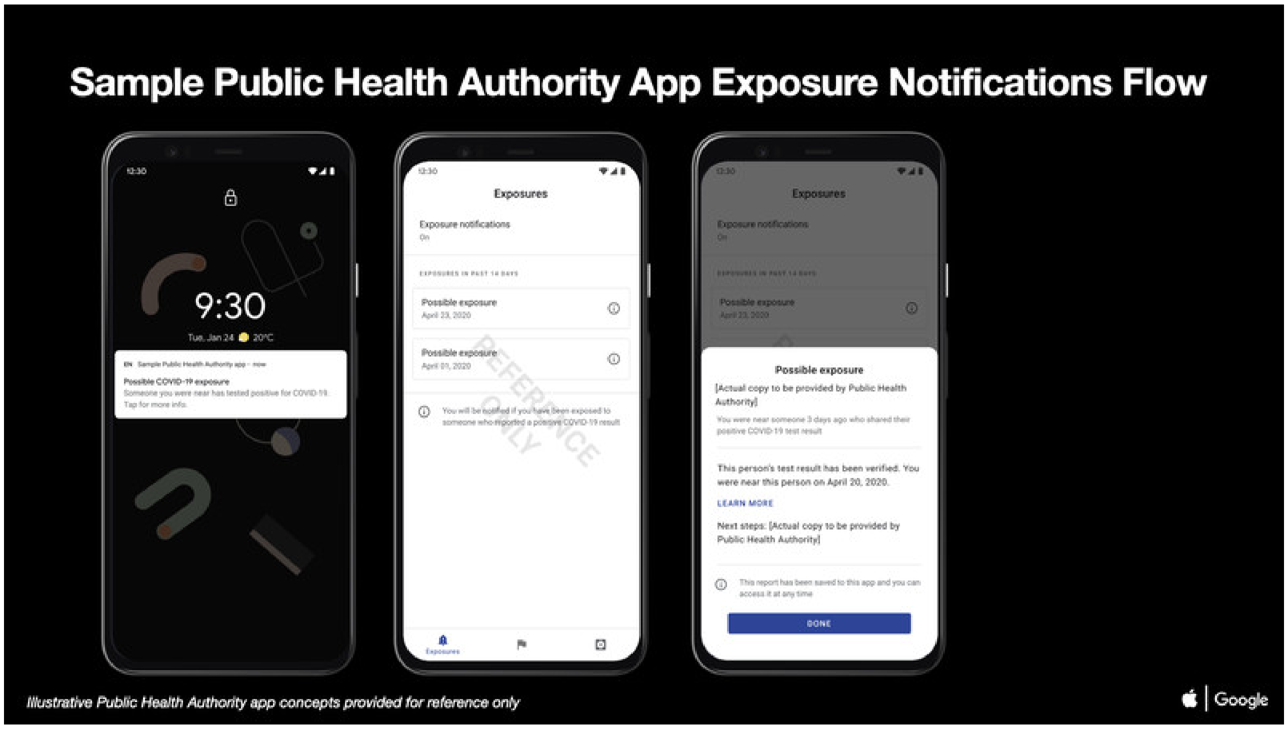
(Actual copy to be provided by Public Health Authority

This example flow assumes a test for the entirety of the flow, but could be confirmed by a diagnosis as well.)

Done

Illustrative Public Health Authority app concepts provided for reference only

iOS - Sample Public Health Authority Flow



Sample Public Health Authority App Exposure Notifications Flow

12:30

9:30

Tue, Jan 24 20°C

EN Sample Public Health Authority app · now

Possible COVID-19 exposure

Someone you were near has tested positive for COVID-19. Tap for more info.

12:30

Exposures

Exposure notifications

On

EXPOSURES IN PAST 14 DAYS

Possible exposure
April 23, 2020

Possible exposure
April 01, 2020

You will be notified if you have been exposed to someone who reported a positive COVID-19 result

REFERENCE ONLY

Exposures

12:30

Exposures

Exposure notifications

On

EXPOSURES IN PAST 14 DAYS

Possible exposure
April 23, 2020

Possible exposure

[Actual copy to be provided by Public Health Authority]

You were near someone 3 days ago who shared their positive COVID-19 test result

This person's test result has been verified. You were near this person on April 20, 2020.

LEARN MORE

Next steps: [Actual copy to be provided by Public Health Authority]

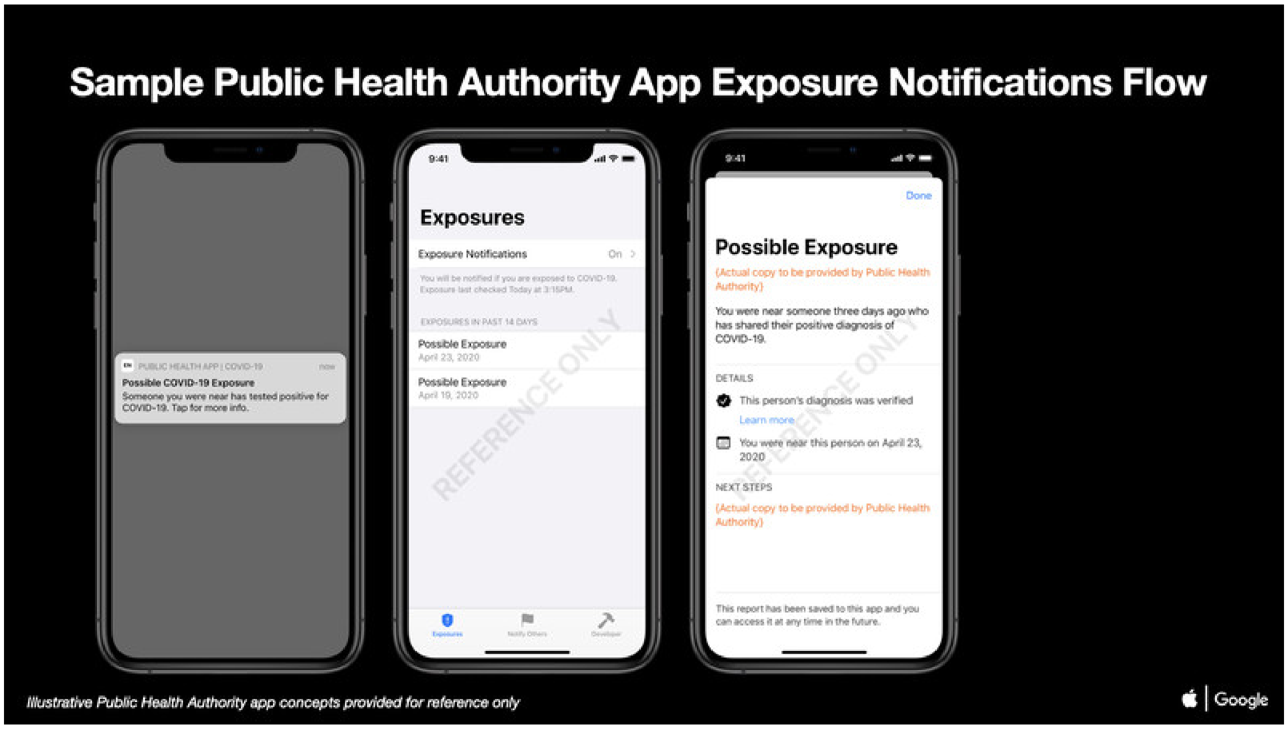
This report has been saved to this app and you can access it at any time

DONE

Illustrative Public Health Authority app concepts provided for reference only

Google

Android - Exposure Notifications Flow



Sample Public Health Authority App Exposure Notifications Flow

EN PUBLIC HEALTH APP | COVID-19 now

Possible COVID-19 Exposure

Someone you were near has tested positive for COVID-19. Tap for more info.

9:41

Exposures

Exposure Notifications On

You will be notified if you are exposed to COVID-19. Exposure last checked Today at 3:15PM.

EXPOSURES IN PAST 14 DAYS

Possible Exposure
April 23, 2020

Possible Exposure
April 19, 2020

REFERENCE ONLY

Exposures Notify Others Developer

9:41

Done

Possible Exposure

(Actual copy to be provided by Public Health Authority)

You were near someone three days ago who has shared their positive diagnosis of COVID-19.

DETAILS

This person's diagnosis was verified
Learn more

You were near this person on April 23, 2020

NEXT STEPS

(Actual copy to be provided by Public Health Authority)

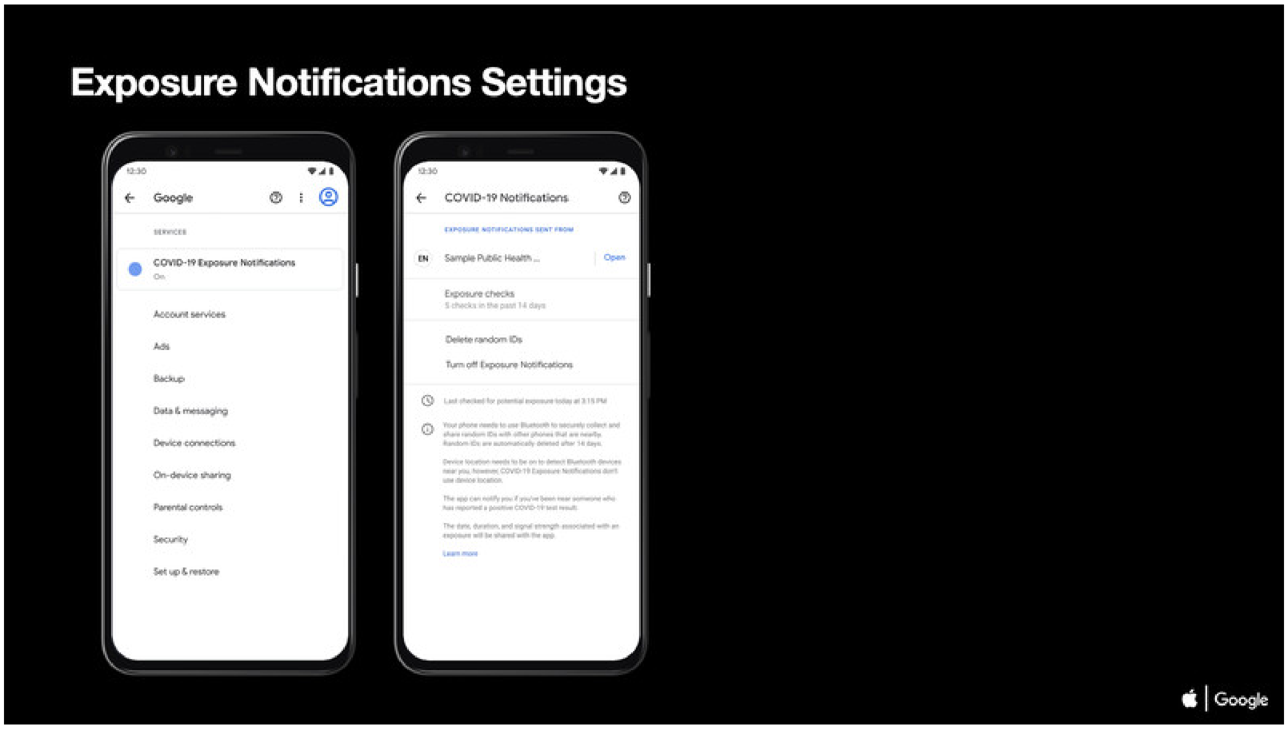
REFERENCE ONLY

This report has been saved to this app and you can access it at any time in the future.

Illustrative Public Health Authority app concepts provided for reference only

Google

iOS - Exposure Notifications Flow



Exposure Notifications Settings

12:30

Google

SERVICES

COVID-19 Exposure Notifications
On

Account services

Ads

Backup

Data & messaging

Device connections

On-device sharing

Parental controls

Security

Set up & restore

12:30

COVID-19 Notifications

EXPOSURE NOTIFICATIONS SENT FROM

EN Sample Public Health ... Open

Exposure checks
5 checks in the past 14 days

Delete random IDs

Turn off Exposure Notifications

Last checked for potential exposure today at 3:15 PM

Your phone needs to use Bluetooth to securely collect and share random IDs with other phones that are nearby. Random IDs are automatically deleted after 14 days.

Device location needs to be on to detect Bluetooth devices near you, however, COVID-19 Exposure Notifications don't use device location.

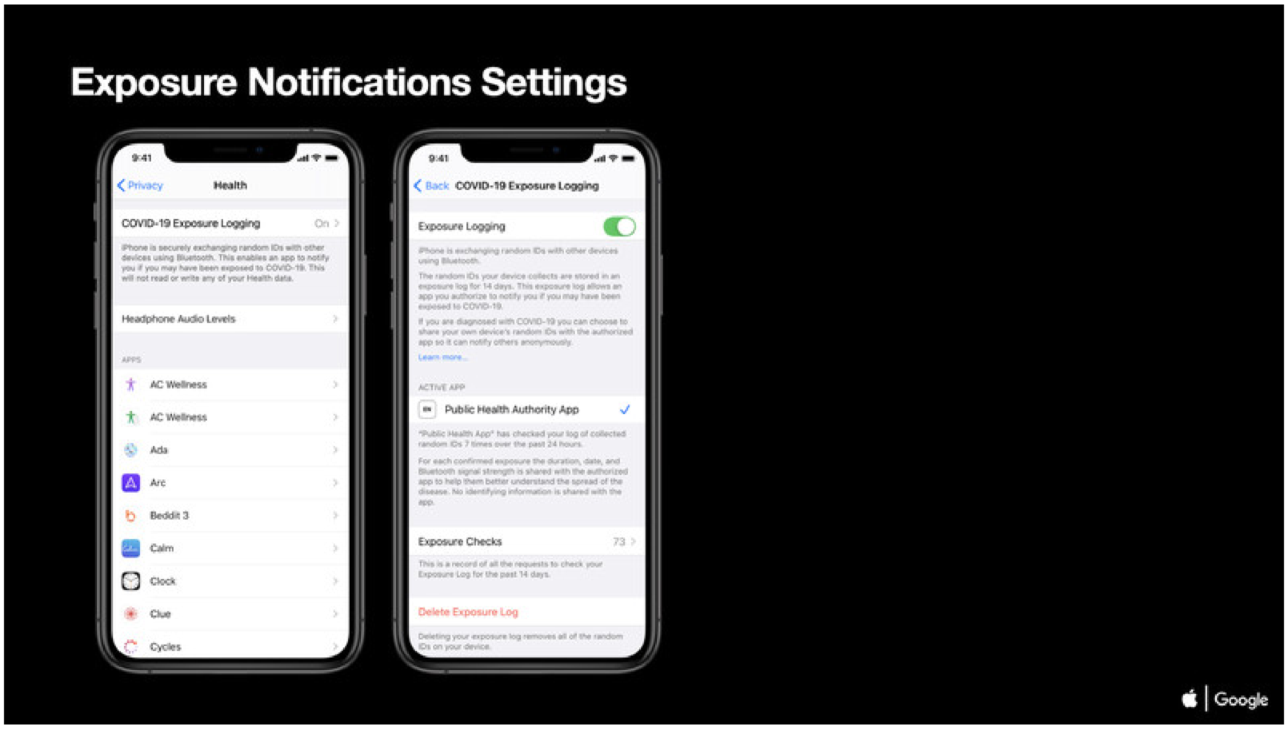
The app can notify you if you've been near someone who has reported a positive COVID-19 test result.

The date, duration, and signal strength associated with an exposure will be shared with the app.

Learn more

Google

Android - Exposure Notification Settings



Exposure Notifications Settings

9:41

Privacy Health

COVID-19 Exposure Logging On

iPhone is securely exchanging random IDs with other devices using Bluetooth. This enables an app to notify you if you may have been exposed to COVID-19. This will not read or write any of your Health data.

Headphone Audio Levels

APPS

AC Wellness

AC Wellness

Ada

Arc

Beddit 3

Calm

Clock

Clue

Cycles

9:41

Back COVID-19 Exposure Logging

Exposure Logging

iPhone is exchanging random IDs with other devices using Bluetooth.

The random IDs your device collects are stored in an exposure log for 14 days. This exposure log allows an app you authorize to notify you if you may have been exposed to COVID-19.

If you are diagnosed with COVID-19 you can choose to share your own device's random IDs with the authorized app so it can notify others anonymously.

Learn more...

ACTIVE APP

Public Health Authority App ✓

"Public Health App" has checked your log of collected random IDs 7 times over the past 24 hours.

For each confirmed exposure the duration, date, and Bluetooth signal strength is shared with the authorized app to help them better understand the spread of the disease. No identifying information is shared with the app.

Exposure Checks 73

This is a record of all the requests to check your Exposure Log for the past 14 days.

Delete Exposure Log

Deleting your exposure log removes all of the random IDs on your device.

Google

iOS - Exposure Notification Settings

Key Areas To Demonstrate

- Bluetooth Permission (i.e. "App would like to use Bluetooth")

- Notifications Enabled (i.e. “App would like to send you notifications”)
- General Instructions
  - Keep phone on you when you leave the house.
  - Keep the application running.
  - Keep Bluetooth enabled.
- Sample App / API FAQ
  - Specifically limitations of the APIs / Bluetooth / Notifications
- Fun extras
  - Lottie animation or other animation for home screen? (probably overkill)
  - Share link (Concept to share this sample app with friends/family)
  - Download link to official Coronavirus app
  - Latest CDC / government news (Probably world to avoid country differences)

Xamarin Cross Platform API

```
public static class ExposureNotification
{
  // Check if the exposure notifications are active
  public static Task<bool> IsEnabledAsync();

  // Start advertising and watching for exposure keys
  public static Task StartAsync();

  // Stop
  public static Task StopAsync();

  // User has a positive diagnosis and is self reporting
  // This will cause the INotificationHandler.UploadSelfExposu
reKeysToServer
  // to be invoked with the user's self exposure keys to be se
nt to the server
  // It is important to ensure a confirmed diagnosis before ca
lling this
```

```
  public static Task SubmitSelfDiagnosisAsync();

  // Beging fetching new positive diagnosis keys from the server to check
  // against locally stored observed keys the user has been near
  public static Task UpdateKeysFromServerAsync();
}

public interface IExposureNotificationHandler
{
  // Provide the risk score configurations
  Configuration Configuration { get; }

  // Download new exposure keys from the server to check against local database
  // of keys the user has observed
  // These keys should be securely transmitted from the server
  Task<IEnumerable<TemporaryExposureKey> FetchExposureKeysFromServer();

  // Called when the native API's have detected exposure risk
  Task ExposureDetected(ExposureDetectionSummary summary,
    // This can be called to provide more details about the exposure
    Func<Task<IEnumerable<ExposureInformation>> getDetailsFunc);

  // Called when the passed in keys should be sent to the server for a verified
  // self diagnosis.
  // These keys should be securely transmitted to the server.
  Task UploadSelfExposureKeysToServer(IEnumerable<TemporaryExp
osureKey> selfKeys);
}

public class TemporaryExposureKey
{
  // Unique rolling key data
  public byte[] KeyData { get; set; }

  // key start (seconds since epoch) / (60 * 10)
  public DateTimeOffset RollingStart { get; set; }

  // Amount of time exposed (usually 5-10 min increments)
  public TimeSpan RollingDuration { get; set; }

  // How much risk is assessed for this exposure key
  public RiskLevel TransmissionRiskLevel { get; set; }
}
```

Web Server REST API

Get Diagnosed Keys

The app should cache the returned `latestTimestamp` value to use in subsequent calls to only retrieve keys it hasn't previously received.

```
GET /keys?since=[timestampInSecondsSinceEpoch]
HTTP 200 OK:
{
  "latestTimestamp": 123456, // Time in seconds since epoch
  "keys" : [
    {
      "keyData" : "base64encodedBytes",
      "rollingStart" : 123446, //
      "rollingDuration": 10, // minutes, in 5 or 10 min increm
ents
      "transmissionRiskLevel": 5 // 1-8
    },
    // ...
  ]
}
```

Submit Diagnosis
This step requires a `diagnosisCode` which should be determined and provided by the health authority owner of the app. The typical flow would be for someone to receive a test from them and to be informed of a positive diagnosis and then be given a code to enter into the app to complete the diagnosis confirmation in the app.

```
POST /selfdiagnosis
{
  // This is a code which the health authority which owns the 
app
  // has given the diagnosed individual to use in the app to v
erify their
  // diagnosis when submitting it
  // This will be the key used to verify this diagnosis key su
bmission is authentic
  "diagnosisUid" : "...",

  // All the keys from the last 14 days
  // Additionally, new keys for 14 days after diagnosis will b
e submitted the same
  "keys" : [
    {
      "keyData" : "base64encodedBytes",
      "rollingStart" : 123446, //
      "rollingDuration": 10, // minutes, in 5 or 10 min increm
ents
      "transmissionRiskLevel": 5 // 1-8
    },
    // ...
  ]
}

HTTP 200 OK
```

Backend Systems API
These API's are intended to provide an easy way to manage valid `diagnosisUid` values in the database. Ideally case management systems for the health authority would integrate with these API's to add codes for users to submit from their app when confirming a diagnosis from the app.

These would require authentication with `Authorization: Bearer abc123def456` where the bearer token value can be some pre-determined API key in the web app config.

```
PUT /diagnosisuids
Authorization: Bearer abc123def456
{
  // Diagnosis UID's to add
  [
    "someDiagnosisId",
    "anotherDiagnosisUid",
    //
  ]
}
```

```
HTTP 200 OK
```

```
DELETE /diagnosisuids
Authorization: Bearer abc123def456
{
  // Diagnosis UID's to delete
  [
    "someDiagnosisId",
    "anotherDiagnosisUid",
    //
  ]
}

HTTP 200 OK
```
