



TCN UX Recommendations Whitepaper

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June 16, 2020

Version 1.0

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Introduction

The TCN Coalition is a global community of technologists united by the mission to support Exposure Notification (EN) apps during the COVID-19 pandemic. The TCN Coalition believes that EN apps should be interoperable, trusted by the public, and privacy-preserving to quickly and safely reduce the need for lockdowns. We do this through providing resources that span across EN apps and use cases, including sharing best practices among our members, providing tools and resources to allow for interoperability, and educating the public about the potential of EN.

Purpose of Document

This whitepaper contains UX recommendations and best practices for EN apps. It takes into account the different requirements and desired features of different applications.

Summary of Recommendations

The following are some user experience best practices that are recommended for EN apps, and are elaborated on in this document:

- Being inclusive with design, catering to a heterogeneous user base
- Communicate consistently across all touchpoints, from within and around the app as well as from health authorities
- Being respectful of the users' privacy
- Conducting thorough user research, ideally pre-release to reduce the need for revisions
- Employing robust onboarding, using progressive disclosure to avoid information overload
- Handling exposure notifications, warnings, and infection reports in a calm and transparent manner
- Expediting the test reporting or symptom check process through design that reduces cognitive load and increases efficiency

Audience

EN applications will reach maximum efficacy when approximately 80% of all smartphone users, or 56% of the population overall, are using an interoperable EN app¹. That being said, even low levels of adoption can help in reducing COVID-19 infection rates². If these higher adoption goals are met, EN apps will have a highly heterogeneous user base. Indeed, the target audience is very broad, ranging widely in age, language, and other demographics. An EN app designer should design for the least tech savvy in this audience and assume low technical literacy.

¹ Hinch, Robert et al. "Effective Configurations of a Digital Contact Tracing App: A report to NHSX", 2020, p. 3.

² O'Neill, Patrick Howell. "No, coronavirus apps don't need 60% adoption to be effective", 5 June 2020, <https://www.technologyreview.com/2020/06/05/1002775/covid-apps-effective-at-less-than-60-percent-download/>

General Design Practices

Since there may be some trepidation in installing an EN app for privacy reasons, extra care should be taken to avoid bad word-of-mouth. Critically, users should have a smooth onboarding experience and not be given reason to doubt the security or accuracy of app data. Some things to watch out for:

- Dark user experience patterns should be avoided³.
- Don't overwhelm your audience with notifications; only send key updates. (see: [Exposure Warning](#))
- EN apps should communicate neither a false sense of security nor exemption from safety guidelines

In conjunction with avoiding negative patterns and other pitfalls, steps should be taken towards positive additions.

- Focus on transparency and clarity will build trust with users.
- Emphasize the security and trustworthiness of information provided to the user.
- Acknowledge, and where appropriate address, existing information and assumptions users may have about COVID-19 and EN apps.

Inclusive Design / Accessibility

It is important that the user interface is highly accessible, particularly since the target demographic is very wide. We recommend the following to ensure the EN app is accessible:

- Contrasts and font sizes should at least follow WCAG 2.1⁴ AA standards.
- Where possible, operating system accessibility features should be used.
- Ensure the app copy is inclusive and accessible. Language should be clear and simple.
- Multilingual support is necessary for inclusivity.
 - For example, an app designed for Canada must be in the official languages English and French, but should also consider other non-official languages, which are spoken by significant fractions of the population.
- Providing comprehensive and clear guidance to the user is critical for EN apps since they require higher levels of trust than a typical app. The purpose, functionality and context of the app should be explained to the user.
- Comprehensive onboarding is critical, as users who cannot understand the app will not remain active. Onboarding information should remain accessible after onboarding.
- For a more holistic user experience, provide multiple means of user support to enable anyone to contact help - at least one voice-based and one text-based support system should be provided.

³ Rieger, Sebastian and Sinders, Caroline. "Dark Patterns: Regulating Digital Design." Stiftung Neue Verantwortung. 13 May 2020,

<https://www.stiftung-nv.de/en/publication/dark-patterns-regulating-digital-design>

⁴ "Web Content Accessibility Guidelines (WCAG) 2.1", W3C. 5 Jun 2018 <https://www.w3.org/TR/WCAG21/>

Design for Privacy

Addressing privacy concerns will go a long way toward increasing the adoption rate of a COVID-19 app. Users desire privacy from three sources: snoopers, authorities, contacts⁵. Another study underscores the importance of privacy: 82% of survey respondents are willing to install an EN app if it is accurate and private. However, if the app leaks data, that number drops to 24% to 26% (depending on the recipient of who gets the leaked data)⁶.

In Dr. Ann Cavoukian's research, which has since been incorporated into the General Data Protection Regulation, states that privacy should be built into the design as a default, that any personal data collected should be minimal, secured, and destroyed once it is no longer needed. Furthermore, the usage and necessity of the data collection should be transparently communicated⁷. We recommend adherence to these privacy recommendations.

The following are design considerations to impart a strong sense of privacy to the user:

- Adopt a clear privacy policy, following the guidelines of www.exposurenotification.org⁸.
- Ensure that there is clear communication around any data that is collected, where it will be used, and what the retention policy is.
- Delete all data once it is no longer epidemiologically useful⁹.
- Allow the user to view all of their personal data at any time.

Marketing and User Value Propositions

The intent of EN apps is not to directly protect users from infection, but rather to assist with earlier interruption of infection chains, thereby reducing the infection risk for the social circle surrounding the user. Any app should be designed with a clear communication and branding strategy in mind. Public Service Announcements and other advertisements from the app provider (usually the government and health authorities) will accompany the app. All channels should deliver a similar message.

Marketing should be comprehensive and optimized for massive acceleration using different channels. Ideally there should be material for a variety of outlets prepared for a single launch and aim to achieve the highest possible penetration rates within one to two weeks of availability. We recommend monitoring the number of new users daily. If the adoption trajectory is not satisfactory after several days, additional resources can soon be deployed.

⁵ Cho, Hyunghoon et al. "Contact Tracing Mobile Apps for COVID-19: Privacy Considerations and Related Trade-offs". arXiv.org. 30 Mar 2020.

⁶ Redmiles, Elissa. "How good is good enough for COVID19 apps?" pp. 4-8. arXiv.org. 20 May 2020.

⁷ Wiesemborksi, Martin. "How to Design with Privacy in Mind." UX Collective. 19 May 2019, <https://uxdesign.cc/how-to-design-with-privacy-in-mind-24c96cfc2611>

⁸ Itani, Julia. "Why should we care about privacy in UX?". Prototype.io. 16 May 2018, <https://blog.prototypr.io/why-should-we-care-about-privacy-in-ux-f8e83eb2a6a7>

⁹ Friedman, Vitale. "Privacy UX: Privacy-Aware Design Framework". Smashing Magazine. 25 April 2019. <https://www.smashingmagazine.com/2019/04/privacy-ux-aware-design-framework/>

It is important that the application is aligned with public authorities' messaging surrounding the COVID-19 crisis. EN apps should communicate neither a false sense of security nor exemption from safety guidelines.

We recommend incorporating the following user benefits into the messaging strategy:

- Protect yourself - using EN apps helps prevent the spread of COVID-19, thus lowering the infection risk for the user themselves.
- Protect your friends and family - since the app can alert the user of exposure to a COVID-19 case, the user can take the necessary precautions to protect their social circle from the virus.
- Protect society - By using an EN app, the user is contributing to society's fight against COVID-19. This could lead to safer easing of lockdown measures, allowing users more personal freedom.

Communication and messaging around the app should consider its narrative, which in turn should be aligned with the UX. There are different forms an app might take, a few examples are listed here:

- Diary - this focuses on the aspect that the app creates "notes" for encounters with other people automatically and can "remember" them without any user action.
- Risk evaluation / warning - focuses on notification functionality
- COVID-19 Assistant - focuses on relevant healthcare information and assistance

These different focus points should be differently implemented in the UX, but also pertain to the messaging strategy around a single application.

Go to Market

For a successful launch, it is important to make time for a multi-phase release. E.g. perform alpha testing with a very small group of stakeholders and make time to iterate based on feedback, perform a beta test with a larger test audience and make time to iterate again¹⁰. Create mutually agreed acceptance criteria for each step ahead of time to help drive the decision on community-wide release.

UX Research

EN app design teams should follow the best user experience practice of doing thorough user research, and any assumptions should be challenged with evidence. There is extraordinarily high interest in EN app solutions and their fast delivery, so be aware that common A/B testing and other create-inspect-adapt techniques with a live audience may not be suitable.

¹⁰ Schaenzle, Jordan. "How to Ensure a Successful Mobile App Release" Atomic Object. 13 June 2019, <https://spin.atomicobject.com/2019/06/13/successful-mobile-app-release/#:~:text=Start%20with%20a%20Phased%20Rollout,the%20app%20to%20the%20public.&text=It%20just%20means%20that%20your.a%20set%20period%20of%20time.>

The risk of misinformation, misguidance or user frustration is very high. If some users opt-out after the install it is unlikely that these users will come back. We recommend focusing on pre-release user feedback and testing to ensure that the publicly released app is optimised and does not require major revisions. To this end, we recommend making time for a multi-phase release (see [Go to Market](#)).

Key stakeholders might not be familiar with the technology. Involve them early in the design process and consider creating a cross-functional, cross-organizational task force that collaborates on the overall service design. Setting time aside for a periodic, interdisciplinary design meeting can be used to facilitate brainstorming, wireframing and design reviews.

User Journey

Awareness

The COVID-19 pandemic can be mitigated with 80% of all smartphone users using the app, or 56% of the population overall¹¹. Because of this finding, promotion of an EN app should be comprehensive. Awareness of COVID-19 is high across countries and regions, which will help attain a critical mass of users for EN apps.

Install

An EN app can gain more traction if it comes from a trustworthy publisher. For example, more Americans are willing to install a coronavirus tracking app provided by a public health agency like the CDC or by their health insurance provider than one distributed by the federal government or their local government in general without specification as to the distributor agency¹². Most users will install EN apps from either the Google Play or Apple App store. Standard app store optimization techniques should be used to emphasize trust and transparency. Good screenshots and a clear description of the app's purpose are basic requirements. The description of the app should address perceived issues of privacy, technical implications (eg. battery usage), and ease of use.

¹¹ Hinch, Robert et al. "Effective Configurations of a Digital Contact Tracing App: A report to NHSX", 2020, p. 3.

¹² Hargittai, Eszter and Redmiles, Elissa. "Will Americans Be Willing to Install COVID-19 Tracking Apps?", 28 Apr 2020, <https://blogs.scientificamerican.com/observations/will-americans-be-willing-to-install-covid-19-tracking-apps/>

Onboarding

Onboarding is important for user retention¹³, and is an extension of the communication strategy, connecting the brand and marketing to the UI of apps. Onboarding should address anticipated user questions such as:

- What is COVID-19?
- How does this EN app work?
- What happens when there is a potential exposure?
- How is user privacy protected?
- Which data is collected and where is it stored?

We recommend several best practices for onboarding. For instance, functionality and purpose of the app needs to be clear during onboarding. This includes the scope of the app's capabilities and limits. You can use progressive disclosure to ease the onboarding process. Progressive disclosure refers to disclosing features, navigation, and options as the user advances through the onboarding process¹⁴, rather than providing all the information at once. App designers can ask what is necessary to have during onboarding, and which information can be given later.

Permissions

With growing concerns about consumer privacy, people are becoming more selective in sharing their data and granting permissions. Users sense a higher level of risk when the requested permissions exceed the functions provided¹⁵. Thus, an EN app should only ask for the minimum permissions necessary for its functionality. The Google and Apple documentation mentions that an additional permission will be required for the EN protocol to work.¹⁶

Before prompting the user with a permission sheet from the OS, the app should introduce the user to the coming OS dialog and explain why this is shown. This so-called permission priming helps the user to trust the app and prevents accidental and uneducated user actions.¹⁷ To support this, permissions should never be requested immediately upon opening the app.

If there are several correct actions within the permission sheet, also explain which option to choose and why. Another aspect of priming is the right time and point for permission granting

¹³ Chapin, Bree. "First Impressions – A Guide to Onboarding UX"

<https://www.toptal.com/designers/product-design/guide-to-onboarding-ux>

¹⁴ Cutler, John. "Onboarding, Progressive Disclosure, Memory and Your Brain", Pendo, 7 April 2017,

<https://www.pendo.io/pendo-blog/onboarding-progressive-disclosure/>

¹⁵ Lai, Hsiangchu, et al. "The Impacts of Requested Permission on Mobile App Adoption: The Insights Based on an Experiment in Taiwan" Proceedings of the 51st Hawaii International Conference on System Sciences, 2018, p. 8.

¹⁶ Apple and Google. "Privacy-Preserving Contact Tracing". Apple,

<https://www.apple.com/covid19/contacttracing>

¹⁷ Kim, Jonathan. "Asking nicely: 3 strategies for successful mobile permission priming", Appcues.

<https://www.appcues.com/blog/mobile-permission-priming>

within the app. If users get asked for permission directly at exploring a feature, it makes more sense instead of just giving permissions to the app without seeing any benefit.

Don't lock the user into dead ends when you ask for OS permissions. If the user declines a permission, move on and ask the user again at a later step, once the user has had a chance to take a look around the app. If the next action is dependent on an OS permission explain that beforehand and also think about giving more information if the user declines the first time.

If a user revokes permissions from the app, there should be an easy way for them to grant them again. Different functionalities of the app with different permissions should be opt-in. Data transfer to third-parties should be avoided unless necessary to the core functionality of the EN app.

Exposure Notification Active

For the EN app to function correctly users will always need to carry their phones, turned on and with Bluetooth enabled. The current status of app activity should always be clearly communicated. For instance, if the app is disabled because of technical problems or specific user actions (e.g. Bluetooth disabled) the app should address this by clearly informing the user about the consequences for the app's current status. Crucially, it should give guidance on how to enable the exposure notification system again.

If the app shows any exposure indices or levels etc. ensure that this data is accurate and easy to understand. We do not recommend integrating data visualisations derived from data not provided by the underlying API. The inaccurate visualization of any exposures in the surrounding area can give an impression of false security. Nevertheless if the app provides reasonable visualization of exposures the user could get a better picture of how accurate the exposure collection is and thus enhance transparency and trust.

According to user experience analytics company Appsee, "battery-heavy mobile apps are the ultimate user experience killers"¹⁸. Thus, EN apps should be implemented so that they minimize drain on phone battery.

EN apps should provide the ability to easily pause and resume tracing for whatever reason. We recommend providing the user an option to pause for a limited period of time, so it automatically re-enables itself after the time period. If the option to limit the time is not provided, users may pause the tracing and forget to turn it back on, thereby reducing the app's effectiveness.

Exposure Warning & Status, Notification Overview

Notifying a user that they might have been infected with COVID-19 is a delicate situation. Thus, the notification content should be vetted so that it does not alarm the user while still being honest and

¹⁸ Appsee. "Solving the Issue of Mobile App Battery Drain", Android Pub. 24 Nov 2016, <https://android.jlelse.eu/solving-the-issue-of-mobile-app-battery-drain-7551d3df0f74>

accurate. There should also be clear, subsequent action items for the user to perform. Also, recommendations should be localized as much as possible.

Notification messages should be written by a public health authority in conjunction with a UX copywriter. The messages should be phrased in terms of “potential exposure” rather than “confirmed exposure” and should take into account the risk scoring that triggered the notification itself. For example, someone who had a low-risk encounter should see a different type of notification than someone who had a high-risk encounter. Low-risk encounters might involve a reminder of the importance of masks, handwashing, and to avoid high-risk populations. For the high-risk encounter it might include a request to self-isolate.

Another piece to keep in mind is the concept of “alarm fatigue”.¹⁹ If notifications are too frequent or not specific enough, it will lead to users ignoring or turning off their alerts. Public health agencies and app designers should collaborate together to figure out how to balance the frequency of notifications with the epidemiological needs, and user engagement with regards to notification frequency should be measured and analyzed within the app to determine how to optimize this.

Keep in mind that exposure warning states in the app are private information. To mitigate misuse of an exposure notification, we recommend providing the user with the option to hide or dismiss the exposure status within the app. In addition, any push notifications should be vague and invite the user into the app for more information so the lock screen does not accidentally disclose their status.

Symptom Check

For applications that include a symptom checking component for users, the symptom check portion should be frequently checked by copy editors and designers in cooperation with health authorities to make sure they reflect the latest scientific findings. The questions on a symptom check form should be clear and concise. To increase reporting rates, the form should be as brief as possible while still effectively assessing a possible COVID-19 case. We recommend using inline validation to display errors and warnings where appropriate. Inline validation results in increased completion rate, along with reduced error rate and completion times²⁰. This in turn increases user satisfaction, which can drive positive word-of-mouth that was mentioned earlier in this paper as vital to EN app effectiveness. Also, where possible consider keeping page length short (ideally fit to the screen). It is best to use more pages with progress indication, such as the Dutch EN WIP app²¹. This is good user experience practice, especially with smartphones.

¹⁹ “Alarm Fatigue”, Wikipedia, 7 June 2020.
https://en.wikipedia.org/wiki/Alarm_fatigue

²⁰ Wroblewski, Luke, et al. “Inline Validation in Web Forms.” *A List Apart*, 1 Sept. 2009,
<http://alistapart.com/article/inline-validation-in-web-forms/>.

²¹ <https://www.figma.com/file/EJ4aJwKnemkxysCZ6aAzFv/Covid-19-notificatie-app-Read-only?node-id%3D23302%253A23>

The result of the symptom check should provide clear next actions for the user. For example if the user is possibly infected with COVID-19, present health authority points of contact for next steps. Do this in accordance with the app's local health ecosystem in mind.

Infection Report Flow

Diagnosis

Receiving a positive diagnosis and deciding what action to take next is a stressful moment for the user. Thus, we recommend that an EN app provides content that is reassuring to the user.

There are several methods that an app can choose to use in order to report an infection:

- Symptom-based self-reporting
- Symptom-based healthcare provider diagnosis
- Confirmed test provided by a healthcare provider
- Self-administered test

Each public health authority has to choose both which types of infection reports to permit being published as well as which infection reports they are willing to receive from other jurisdictions. They will benefit from considering the availability of testing in their jurisdiction, the likelihood of bad actors over-reporting, and the logistics around reporting an infection.

Limiting Bad Actors

Once a user has reported themselves as infected, if the app continues to register encounters greater than what they might encounter at home the app should consider ways to warn the user that they are putting others in danger and continue to encourage self-isolation.

The design should provide affordances around the technical limitations put in place to limit malicious behavior. Many apps will have reporting rate-limited to help prevent malicious actors from overwhelming the system. Reports should be signed by the device so that the server can de-duplicate reports. The UX should accommodate this by disabling the ability to report an infection after an infection has been recorded for a period of time.

Reporting the Infection

It will be critical to the success of an EN ecosystem to have users report their infection. There is a reasonable risk that the user will either forget to report the infection in their app or will not feel comfortable sharing this information with the app. However the purpose of EN becomes moot if the infection is not reported. Therefore designers should focus heavily on the actual reporting experience to make sure that it is top of mind for a user, that it is easy, and that the user feels comfortable and informed around the entire reporting process.

The actual reporting of the infection should be done by the user and not on behalf of the user. They should be able to understand where their data is going and not have the chance of being “outed” by someone else. The moment of infection reporting is also a critical moment in time to explain where their data is headed, as this is the first moment in the EN flow where an individual’s data is sent to a server.

For the remainder of this section we will explore situations where a healthcare provider authorizes an infection report, as we expect this to be the most common choice for infection reports. Whether this is symptom- or test-based should not make a difference.

There is an inherent UX challenge that will be present in the majority of infection reports because the user and the healthcare provider will most likely not be co-located. Thus the healthcare provider will need to provide some kind of key to the user to sign the report. This key will allow the server to verify that the infection was actually confirmed by a healthcare provider.

The user will need to include this key with their infection report. There are several basic mechanisms that teams have been exploring in order to do this:

- Scan a QR code
- Enter an alphanumeric code (TAN – transaction authentication number)
- Text or email a link

When choosing a method, it is important to keep in mind the usability of your method or combination of methods:

- How likely are typos to cause problems?
- Can any personally identifiable information be connected to the infected person?
- Is the method accessible for all types of users?
- Does the method need a physical item (like a printed code to scan)?
- Can the method be accessed exclusively via a mobile device?
- What is the chance of fraud?
- How easy is it to use?

The local healthcare system will have its own requirements that need to be taken into account when choosing a method.

After Infection Report

An effective EN app should provide clear action items to the user after submitting an infection report. The action items to recommend should be considered in the context of the report format: if the user has self-reported, action items should include seeking advice from or contact to the relevant public health authority, whereas if the user has submitted a positive test result, this contact will have already occurred. It is also important to communicate clearly what the next user-application interactions are. Keep the user informed what use the app now has. If certain aspects of the app are no longer functioning correctly (eg. future encounters with people can’t be

reported anymore) deactivate these aspects and inform the user about what has been deactivated and why it can no longer be used.

Delete Data

To establish a high level of trust and privacy, it is important to give EN app users the ability to partially or totally delete their data where possible. A reminder of the impact of deleting data to the self and the community of users should be given. After deletion of data a confirmation should be displayed telling the user what has been deleted.

Conclusion

EN apps have the potential to help mitigate the COVID-19 pandemic if used by enough individuals. Following user experience best practices will go a long way towards achieving a critical mass. We have provided and discussed recommendations for such practices. In particular, inclusivity, respect for privacy, efficiency and transparency are important for the success of EN apps. Furthermore, pre-release user research and testing are critical to validating design hypotheses.

Appendix

References

- [Wikipedia Article containing list of EN apps](#)
- [EN App Landscape by LFPH](#)
- [Valsplat initial User Research for EN apps](#)
- [This Is What a Contact Tracing App Could Look Like \(Medium Article\)](#)
- [Documentation of Design Process at Dutch EN App \(in Dutch\)](#)