

User's Guide for the Breast Cancer Surveillance Consortium Advanced Cancer Risk Calculator mobile & web app

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Preface

The Breast Cancer Surveillance Consortium (BCSC) previously developed a 5-year risk calculator for invasive breast cancer, which is available on the web and on the App Store. This risk calculator has been used more than 300,000 times. Most recently, our client developed a risk prediction model to estimate the risk of being diagnosed with **advanced breast cancer** despite routine screening with mammography. The app's purpose is to be used by physicians for patient risk calculations to identify women at risk of a mammography screening failure. Meaning that women whose risks are calculated to be higher would be at higher risk of mammogram screening not detecting signs of cancer. Thus, the results from the app would be used at the physician's discretion in recommendations to the patient for more intense screens for early cancer diagnosis.

Overview of the Product

Our Application is called BCSC Advanced Breast Cancer Calculator which allows users to access the prediction model of advanced breast cancer to get their advanced breast cancer risk in women undergoing annual or biennial mammography that could identify women who may benefit from less or more intensive screening, and our target users are mainly medical faculties and women concerned about their breast health. This application supports three platforms, IOS, Google Play, and Web App on the BCSC website, and both web app and mobile app are implemented with distinct intuitive UI&UX that most people are familiar with. The application provides the analogous medical diagnosis of the possibility of users' advanced breast cancer risk when users input their medical history and physical conditions that the prediction model needs. For more advanced usage, the application provides visualization for users to observe their risks and similar groups relatively or their severity of risk in the overall risk distribution of the population. To consider users' different knowledge levels on medication, the applications let users check the definition of the terminologies pertinent to the model.

Mobile

The mobile app contains all functionalities and provides user authentication exclusively, including sign in, sign out, and sign up using emails, but the app still remains the same functionalities without login by going “guest mode.” With user recognition, there are more possibilities to provide a better user experience in the future.

Web

The web application contains all the mobile application's functionalities except for the user login. Since the web application contains more usable space as compared to the mobile screen, the introduction of the calculator now contains more visualization to break down the calculator description. Instead of a text page, the web version provides a more appealing list with icons for users to see.

Besides the visualization change of the introduction, the web application has now merged the home page with the calculator page onto a single calculator page. With this, the user now can be introduced before actually using it as they have to scroll to the very bottom for the calculator. Another change we decided on for the web application is the information page. The information page now contains tabs design for easier navigation. Upon selecting the 3 tabs user manual, risk factor, and definition, they now show the information on the same page instead of navigating to another page. This allows users to have an easier time switching between pages as they all behave like a state switch. This change also has been done on the statistic page when switching between graphs.

Installation or Distribution

IOS

1. Go to <[The link to the app store](#)> or search “BCSC Breast Cancer Calculator” in App Store
2. Login with an Apple Account
3. Click on the “Get” button and follow the on-screen instructions to complete the installation

Android

1. Go to <[The link to the app store](#)> or search “BCSC Breast Cancer Calculator” in Google Play Store.
2. Login with a Google Account
3. Click on “Install” and follow the on-screen instructions to complete the installation

Web APP

1. The web application of the BCSC Risk Calculator can be found on the main BCSC website under the ***BCSC Tools*** category.

Functionalities

As for functionalities within the application, the clients require the following:

- The app should be easily navigated and understandable.
- Terminology should be defined and resources linked.
- A calculator page that produces cancer risk rates based on the user's state inputs.
- A statistics page that functionally shows how the cancer risks change when any variable is varied.

1. Home page:

The Home page contains various information, in order from top to bottom:

- The problem the statistical model behind the calculator is trying to solve.
- The caveat of the model.
- The factors/categories/variables that are the input to the model.
- Model update notice.
- Reference to papers that developed the model.

2. Calculator page:

The Calculator page provides a form composed of selectable fields for each factor/category/variable where a user's specific option can be inputted. After all fields are filled, hitting the “Calculate Risk” button at the bottom of the page will direct the user to the Assessment page.

- On each field, the question mark button reveals information about the corresponding factor.
- On the field of BMI (Body mass index), the calculator button expands the field and allows users to calculate their BMI by weight and height.

3. Assessment page:

(a) Navigation:

- Back button: hitting the back button returns the user to the Calculator form where previously filled fields remain.
- Reload button: hitting the reload button returns the users to a blank Calculator form.

(b) Features: There are 4 modules displayed.

- The first module shows the annual risk and the annual risk for the same age and race, based on information from the submitted Calculator's form.
- The second module shows the biannual risk and the biannual risk for the same age and race, based on information from the submitted Calculator's form.
- The third module shows the inputted options of categories from the submitted Calculator's form, which corresponds to the values displayed in the first two modules.
- The fourth module shows the notice of the results.

4. Statistics page:

The Statistics page provides 4 different graphs that users can consult to gain insights into the breast cancer risk model. The Statistics page will not display until the user completed the form on the Calculator page.

Note: Any user-related information displayed on the graphs in the Statistics page will use the latest user's information submitted on the Calculator page. For instance, after completing the Calculator form for the first time, the Statistics page will display the user's information based on the users characterized by the submitted Calculator form; but after completing the Calculator form for the second time, the Statistics page will display the user's information from this second submitted Calculator form.

(a) Navigation: is wholly located on the top app bar of the Statistics page. On this app bar from left to right are, in order, 2 buttons, the name of the currently selected graph type, and a question mark button.

- The first button allows users to switch between different types of graphs. At this time of writing there are 4 different graph types.
- The second button allows users to switch between different categories/variables (which are the input fields to the statistical model behind the calculator). This second button will only be supported for Line Chart and Bar Chart.
- The question mark button explains the utility and features of the currently selected graph.

(b) Graph types: At this time of writing there are 4 different graph types

- *Bar Chart*: draws on the selected category/variable. There are multiple options for the selected category/variable; this chart displays the risks for all options of the selected category/variable, assuming the inputted options for other categories/variables remain the same (as entered on the latest submitted Calculator form). This graph serves to see how the risk would be different if this selected category/variable of the user has been different, allowing a useful way to compare. The red bar is the inputted option of the selected category/variable of the user. As the name implies, the Bar Chart displays the risk in the form of bars.
- *Line Chart*: has similar functionality and features as Bar Chart, except the Line Chart displays the risk in the form of points connected by line.
- *Box Chart*: does not depend on the selected category/variable, since the graph displays information about all categories at once. There is one box plot for each category. For each box plot, the values used are the prevalence-weighted risk values of each option of the category, calculated using this formula:

$$\frac{\sum_x p(x)r(x)}{\sum_x p(x)}$$

where x is the input (a chosen option for each category) of the model.

$p(x)$ is the prevalence of input x .

$r(x)$ is the risk (annual or biannual) of input x .

Caveat: Due to the lack of free library providing Box Plot functionality, a chart called “CandleStickChart” is used instead, so some feature like tooltip is not available and the graph may not be optimally visualized.

- *Histogram chart*: does not depend on the selected category/variable. This chart shows the distribution of risk values, as measured by its prevalence. The graph will range from risk value 0% to 1% or to {user’s risk percentage + 0.2} %. The color on the chart shows green if risk values there are relatively ‘safer’, yellow if

they are relatively 'less safe', deep orange if they are relatively 'least safe'. The red vertical line shows where the user's risk falls on the distribution.

(c) Graph layouts: For each graph page, the first graph is about annual risk, the second graph is about biannual risk, the third box shows user's input (as entered in the latest submitted Calculator form)

5. Terminology page:

Under the information page; you will be able to find out the four different sections which are as follows:

(a) User Manual:

This tab simply guides the users on how to use the BCSC calculator step by step. There are roughly four steps that are well explained so that any users with no experience in using the app can easily navigate, access, and get the results using the BCSC calculator.

(b) Risk Factors:

This tab explains all of the possible variables that the users will manipulate according to their needs while using the BCSC calculator. That's why all of those variables are named as risk factors where different variables have different significance/effects while calculating the risks of Breast Cancer.

(c) Definitions:

While using the BCSC calculator, users may find different highly technical terminologies used while questioning the users. We cannot assume that all of our users will have knowledge of all of the medical/technical terminologies that we have used while developing the calculator. Taking that into consideration; we have defined all possible highly technical terminologies under the definitions tab.

(d) Resources:

Under the information page, we have a tab called resources which will direct the users to navigate to the home page of the BCSC web application.

6. User Login Page (exclusive for mobile app):

This page appears when the app is launched and allows users to log in, signup, password reacquire, and password reset.

(a) Login:

Users entering the correct registered email address with the corresponding password will be redirected to the home page of the application when clicking “Login.” False information will show an error message indicating the reason for the mistake, including empty field and incorrect email or password.

(b) SignUp:

Users clicking “Register” will be redirected to the registration page. Users can input the desired email and passwords, needed to be at least eight letters, to sign up by clicking “Sign Up” on the registration page or return to the login page by clicking “Already have an account?.” After clicking “Sign Up” with the correct information, the system will send a 6-digits verification code to the intended email address, and the users will need to type the same verification code to complete sign up. False information will show an error message indicating the reason for the mistake, including empty field, incorrect format of email or password, mismatched password, and incorrect verification code.

(c) Reset Password:

Users could reset their password by entering their email address; then, they will receive a 6-digits verification code in the entered email address. They will be asked to enter a new password along with the verification code, and if the information is correct and follow the format, the reset is complete. False information will show an error message indicating the reason for the mistake, including empty field, incorrect format of password, non-exist email, mismatched password, and incorrect verification code.

Troubleshooting

- Most pages will show error messages for invalid interactions.
- Relaunch the app if it gets stuck.

Frequently Asked Questions

- What is the BCSC?
 - The Breast Cancer Surveillance Consortium (BCSC) is a collaborative network of six active breast imaging registries and two historic registries focused on research to assess and improve the delivery and quality of breast cancer screening and related outcomes in the United States.
- What is the purpose of the BCSC Risk Calculator?
 - The BCSC Risk Calculator is a validated interactive tool designed by the scientists of the BCSC to estimate a woman's five-year risk of developing invasive breast cancer.
- What platform is the application available on?
 - The BCSC Risk Calculator is available on the BCSC main website, iOS App Store, and Google Play App Store.
- Does the user authentication store my personal information?
 - The signup process only requires the email address and the password, and the managers of the user base are only allowed to see users' email address.
- Where can I find more information?
 - The BCSC Risk Calculator can be found here:
<https://www.bsc-research.org/tools>

Contact Information

- To contact someone with questions or suggestions regarding the Breast Cancer Surveillance Consortium, please email us at KPWA.scc@kp.org.
- Regarding the BCSC Breast Cancer Calculator project affair, reach out to Diana L. Miglioretti, PhD, dmiglioretti@ucdavis.edu
- To report the technical and functional issues of the application, reach out to the development team Elite:
 - Abraham Emmanuel Hernandez, abrhernandez@ucdavis.edu
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Glossary

- Tab Bar: Horizontal Navigation Bar at the bottom of the screen to switch between different pages
- UI: User interface
- UX: User interaction

Appendix

BREAST CANCER SURVEILLANCE CONSORTIUM, <https://www.bsc-research.org/>