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ASPIRE: Activity Safety Planning and Infection Risk Estimator for COVID-19

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Abstract: The COVID-19 pandemic has prompted multiple researchers to investigate this domain since 2020. One aspect being explored in this topic is the available tools in assisting the public in estimating virus risks. Due to the limited availability of the tools, Jimenez and Peng created the Aerosol Transmission Estimator, which is a peer-reviewed risk estimator that garnered positive reception. The tool is encoded in Google sheets. However, people may find it difficult to use due to the terminologies and information presented in that sheet. To solve this, MyCOVIDRisk, a user-friendly website was built for this estimator, but it is only configured for the United States setting. Accordingly, this study created a website called ASPIRE using Jimenez and Peng's estimator to evaluate the risk and MyCOVIDRisk as reference for the interface design. ASPIRE is configured for the Philippine setting. The usability of ASPIRE was evaluated through surveys and interviews using the System Usability Scale (SUS) and content analysis. The SUS used for measuring usability yielded a grade of A—above average. The overall feedback of the respondents was mostly positive. Issues and suggestions raised by the respondents were addressed. Further research is needed to improve ASPIRE, determine its usability to medical professionals, learn its accessibility and inclusivity to users, and identify its impact on the Philippine community. Overall, this study shows how a COVID-19 risk estimation website was developed and improved based on user evaluation, which can be used as a reference in creating e-health tools.

Keywords: COVID-19; e-health website; estimator; transmission risk; web development

INTRODUCTION

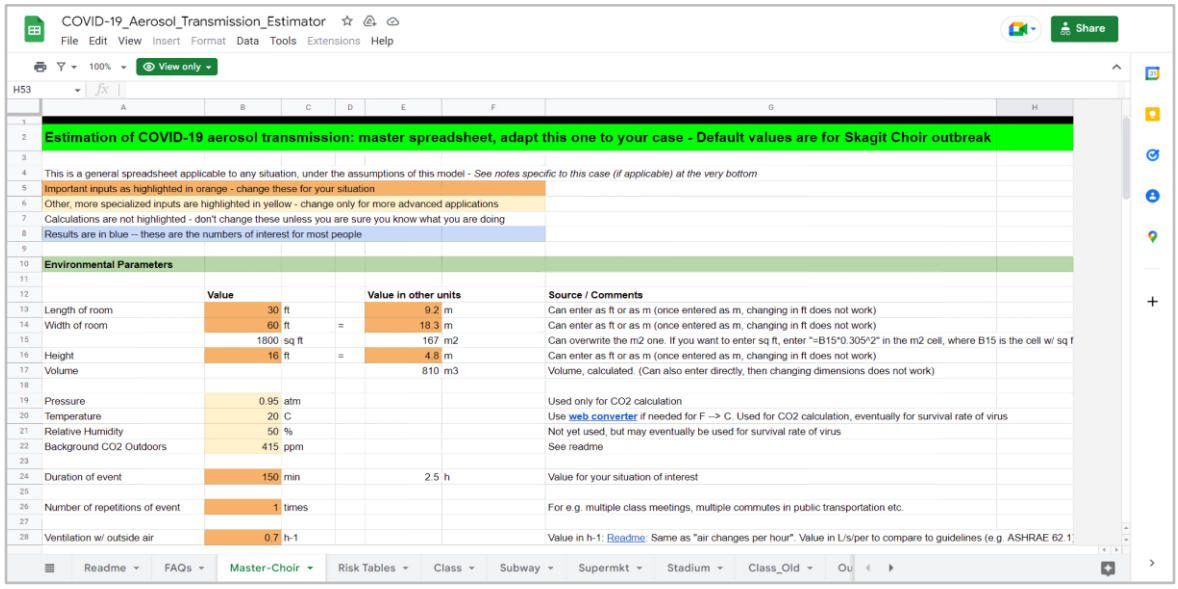
The COVID-19 virus is an infectious disease that has affected the health and livelihood of people across many continents. It has two types of transmission: droplet transmission—which occurs when an infected person expels large amounts of mucus or saliva in contact with another's skin; and aerosol transmission—which occurs when someone inhales floating tiny droplets in the air containing the virus (WHO, 2021). As of January 2022, the global case rate of COVID-19 is still increasing. WHO (2022) reported that the number of cases globally increased by 20%, with the Southeast Asia region having the highest increase in new cases at 145%. The resurgence of COVID-19 is largely driven by five (5) variants of concern (VoC), all of which affected the Philippines—the second country with the highest fatality rate in its region (WHO, 2022). Specifically, the Philippines's COVID-19 epicenter is the National Capital Region, while Davao has the highest number of cases as reported by Mendoza (2021). While Filipinos are knowledgeable of the situation and the two types of transmission (Lau et al., 2020), they still experience symptoms of depression, anxiety, and stress due to the situation (Tee et al., 2020). Due to the limited literature regarding COVID-19, the public was left to estimate their own virus risks (Achenbach, 2020).

To address this public concern, DOH (2021) hosted a case tracker which keeps Filipinos updated with COVID-19 information. However, as of this writing, DOH has yet to attempt creating other COVID-19 e-health applications like risk estimators. One example of a risk estimator is Jimenez and Peng's Aerosol Transmission Estimator which aims to calculate transmission risk based on a given activity. This peer-reviewed tool garnered positive reception in the USA. Despite its recognition, it remains challenging for an ordinary person to use as stated by Jimenez and Peng

themselves. A snapshot of the estimator is shown in Figure 1 below that can be accessed through https://tinyurl.com/covid-estimator.

Figure 1

Screenshot of the Aerosol Transmission Estimator (Jimenez and Peng, 2020)

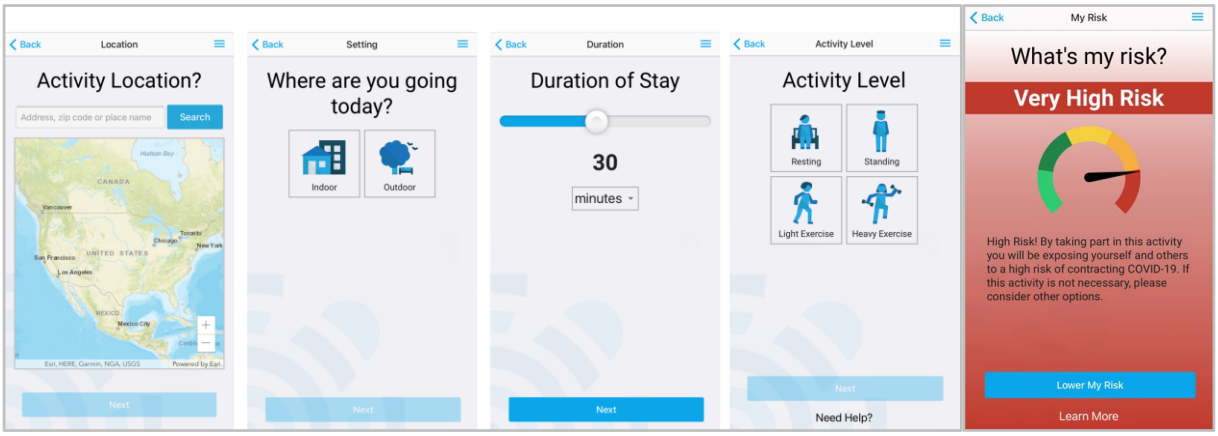


Jimenez and Peng's estimator designed in a Google Sheets document contains the formulae for estimating COVID-19 risk. Users can input values in the orange cells, and view their risk score—which is the probability of being infected—in the blue cells. This procedure creates a problem when users will have to provide data (e.g., room size, breathing rate, or activity level) that they do not usually know or have.

Thus, in 2021, Dr. Goldberg, alongside other researchers, created MyCOVIDRisk—a user-friendly risk estimation website that utilizes Jimenez and Peng's estimator. The website offers a simple and personalized way of estimating transmission risks for the user's guidance in decision-making by reducing jargon and converting it into multiple-choice questions. The website is shown in Figure 2 below and can be accessed through https://mycovidrisk.app.

Figure 2

Screenshots of MyCOVIDRisk (Goldberg et al., 2021)



The website has effectively acquired 410,118 users, where 96.5% of users are from the USA. However, the tool is limited to estimating risks in the United States. Consequently, no similar study has been conducted for the Philippine setting at present. While estimators such as the Job Risk Calculator (UPLB, 2020) and Dy and Rabajante's (2020) COVID-19 Infection Risk Model exist for the use of Filipinos, they are only designed for estimating COVID-19 risk in workplaces and health care facilities respectively, as opposed to Jimenez and Peng's estimator which is designed for the general public's activities such as grocery shopping, eating at a fast-food chain, and more.

This study attempts to create a usable and accurate website by utilizing Jimenez and Peng's estimator to generate transmission risk scores and using MyCOVIDRisk as a basis to design the user interface. The website is configured to use values based on the Philippine setting with the addition of a Filipino language option. This way, people residing and staying in the Philippines will be able to use the estimator without nationality, language, or knowledge barriers. They will also experience estimating their risks in any indoor locations in their own country, as opposed to UPLB Job Risk Calculator and COVID-19 infection risk model which are limited to workplaces

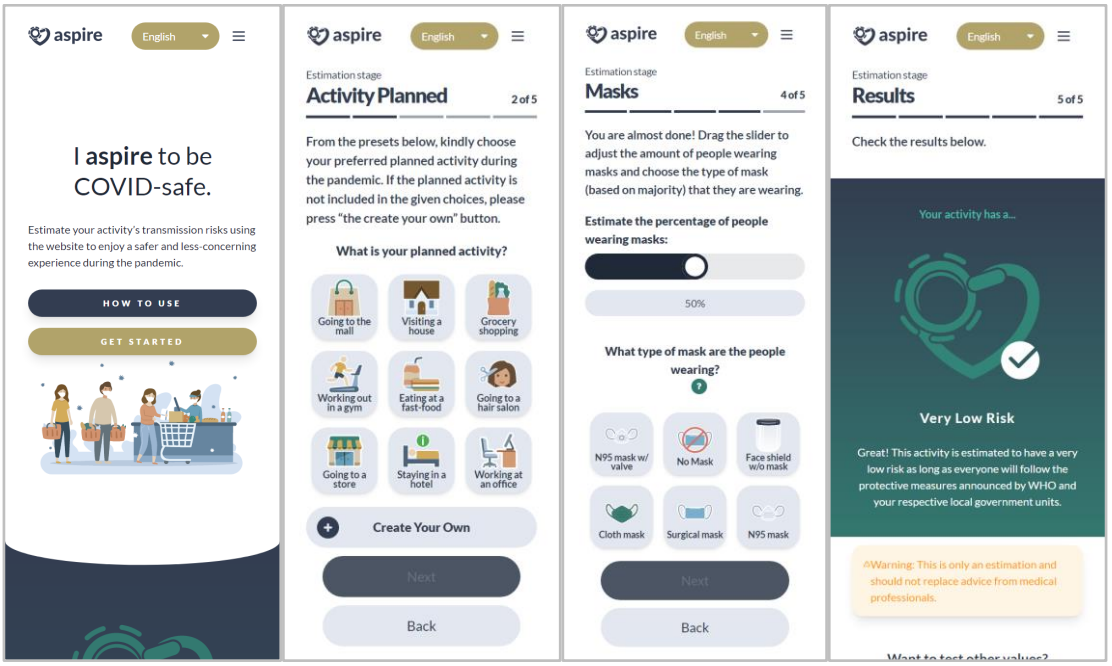
and health care workers, respectively; and MyCOVIDRisk and Jimenez and Peng's estimator which are configured to the US setting only.

This Philippine-based website is thereby named ASPIRE, an acronym for Activity Safety Planning and Infection Risk Estimator, with the tagline, "We all ASPIRE to become COVID-safe."

Presented in Figure 3 are some of the screenshots of the ASPIRE website which will be discussed in the Methodology section. The website can be accessed through https://aspireph.herokuapp.com.

Figure 3

Screenshots of the ASPIRE Website as Viewed Using a Mobile Device



This research may be significant to Filipinos, government officials, and future researchers. First, the website allows Filipinos to estimate their risk of getting the COVID-19 virus during their activities, which may allow them to reschedule or reorganize their activities. Second, government officials could also benefit from this study since the website may serve as a reference for the

possible transmission risks of various facilities in their respective cities. Moreover, ASPIRE could also serve as a catalyst to improve protocols in places that are estimated to be at high risk. Third and lastly, this study contains information on developing a usable e-health website that may be adapted or used for similar future research.

This study is primarily aimed to provide a usable interface for a risk estimator based on the Philippine setting. Although Jimenez and Peng's estimator is peer-reviewed, the estimator is continually being improved based on the latest best available science since studies regarding this domain are still increasing. The significance mentioned will take effect once the estimator is developed enough to properly accommodate real-life situations.

Objectives and Scope

This study aims to accomplish the following objectives:

1. To create ASPIRE—a Philippine-based website for estimating COVID-19 transmission risk using Jimenez and Peng's estimator with a user interface inspired by the MyCOVIDRisk website.
2. To ensure that ASPIRE has properly replicated the formulae in Jimenez and Peng's estimator by using significant figures—the closeness of the risk score generated by ASPIRE to the risk score generated by Jimenez and Peng's estimator with the same exact inputs.
3. To evaluate and compare the usabilities of ASPIRE and Jimenez and Peng's estimator using the System Usability Scale (SUS).

In implementing ASPIRE, certain scope and limitations were applied.

First, an online website through the Heroku cloud platform is the chosen medium for implementing a Philippine-based user interface for Jimenez and Peng's estimator. Users will have to provide the data needed for the estimation process. For their convenience, users are given presets they can select, but fields are still available to set custom values. The values used for the presets in the website are based on the Philippine setting, which was taken from the National Building Code of the Philippines, the Philippine Green Building Code, and the room sizes of various buildings in the country. After the estimation, the user's risk score is presented as either very high, high, medium, low, or very low risk. This scale is based on MyCOVIDRisk.

Second, to determine the accuracy of the risk score generated by ASPIRE, the output values of the website were compared to Jimenez and Peng's estimator to ensure that the values were accurate. Significant figures are utilized to measure how accurate the results are until a specific digit. No experts or evaluators have assisted in determining the accuracy of the website.

Lastly, numerous participants were invited to evaluate the usability of ASPIRE. An evaluation form was created following the System Usability Scale (SUS) of John Brooke to measure usability. Furthermore, one-on-one interviews were conducted to critique various aspects of ASPIRE such as user interface, technical issues, and text content.

Definition of Terms

Accuracy. The degree to which the calculation of the estimator in the ASPIRE website exactly follows Jimenez and Peng's estimator.

Database. A collection of structured data is usually stored electronically in a computer system (Oracle, n.d.).

Estimator. A quantitative measure of evaluating datasets that confirm better-represented effects to support and provide the likelihood of acquiring COVID-19 (Ross, 2014).

Preset. A preexisting value designed as a choice that users can select.

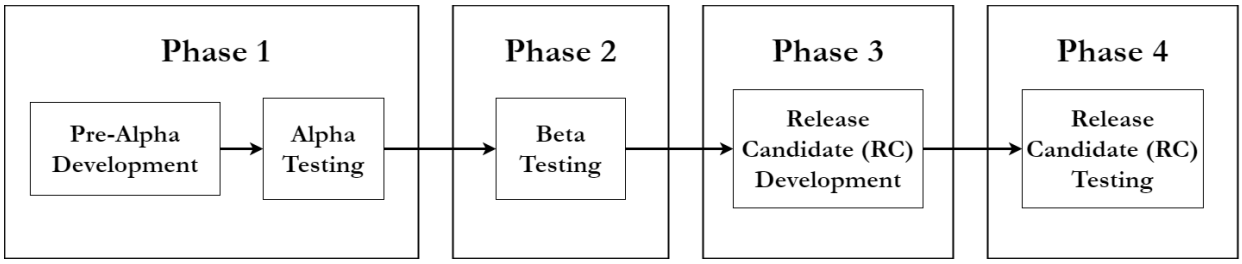
Usability. A measure of the website being efficient, effective, and satisfying to users (WAI, 2016).

METHODOLOGY

The ASPIRE website was designed and developed in four phases, as shown in Figure 4.

Figure 4

Development Process of the ASPIRE Website



Phase 1 comprises two stages: **Pre-alpha development**—data collecting, designing, and programming of the website; and **Alpha testing**—testing done by the research team to gather and fix overlooked issues in the website.

Phase 2 involves **Beta testing** where participants use the website and give feedback through surveys and/or interviews.

Phase 3 includes **Release candidate (RC) development** where accepted feedback is implemented in the website.

Phase 4 covers **Release Candidate (RC) testing** which is similar to Phase 2, wherein old and new participants give feedback regarding the improved website.

Phase 1 (Pre-alpha Development and Alpha Testing)

In Phase 1, the user interface of ASPIRE was designed. Website content and assets were created. The formulae in Jimenez and Peng's (2020) risk estimator were analyzed and translated into code for the website. Preset values were determined. The website underwent alpha testing.

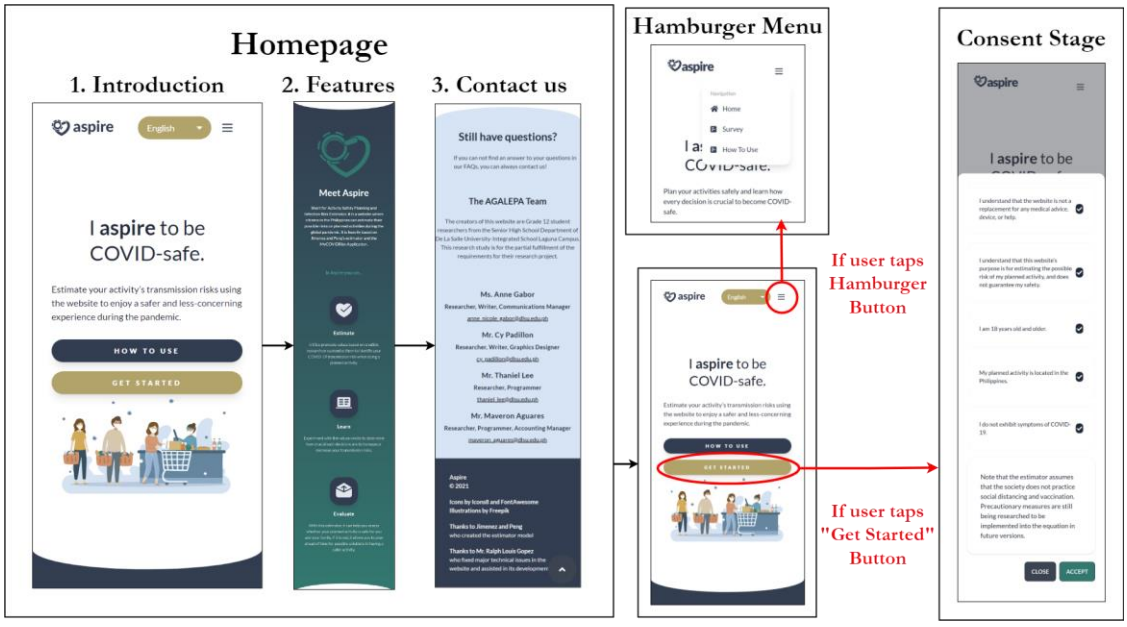
Designing User Interface

Babich (2020) stated that a design language includes a collection of UI elements, style guides, and semantics to make the design consistent. Thus, the ASPIRE design language was created. The ASPIRE design language covers nine areas: philosophy, typography, color, logo, iconography, illustration, interaction, animation, and layout. Please refer to Appendix A for the documentation of the ASPIRE design language.

The website design utilized a responsive approach and a minimalistic layout. Responsive web design allows the website layout to automatically adjust to different screen sizes and devices e.g., laptops, tablets, and phones (Smashing Magazine, 2018); while a minimalistic layout removes unnecessary elements that do not support the website's purpose. Both of these are necessary to not only avoid confusing users with bad design, but also reduce development time and loading time.

Figure 5

Walkthrough of the ASPIRE Website as Viewed Using a Mobile Device

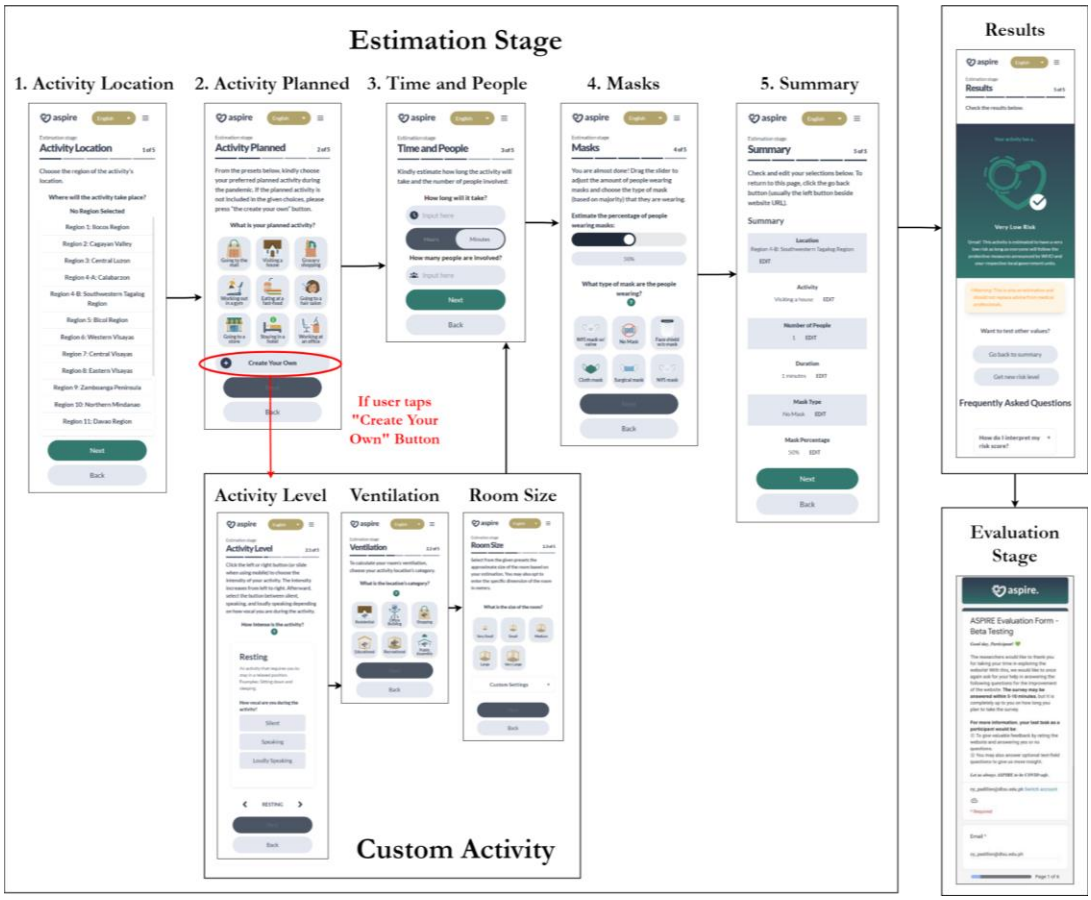


Web navigation is split into **four stages:** homepage, consent, estimation, and evaluation.

The user enters the website through the **homepage** which contains a brief introduction, description of features, frequently asked questions, and contacts. The hamburger menu allows the user to visit other pages like "**How To Use**" and "**How It Works**." To start the estimation, the user will simply click the "**GET STARTED"** button. A pop-up checklist of prerequisites will appear and this is called the **consent stage**. Once filled, the user enters the **estimation stage**.

Figure 6

Walkthrough of the ASPIRE Website - Continuation



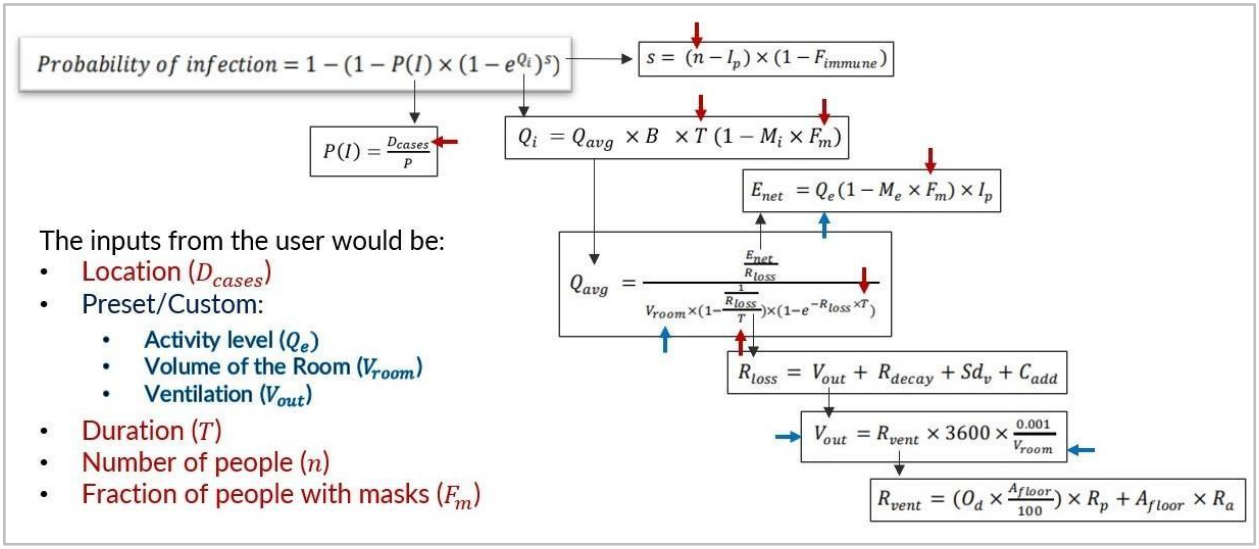
The **estimation stage** consists of five steps: Activity Location, Activity Planned, Time and People, Masks, and Summary. Once the user has filled up all necessary data, the risk score is presented on the Results page. Afterward, the user is directed to the **evaluation stage**, which is a Google Forms survey to evaluate the usability of ASPIRE.

Formulae Analysis

Among Jimenez and Peng's (2020) risk estimator formulae, *conditional result for a given person and one event* was used for general risk estimation. These formulae were analyzed and used for ASPIRE, and were broken down into a flowchart shown in Figure 7.

Figure 7

Formulae Used in ASPIRE



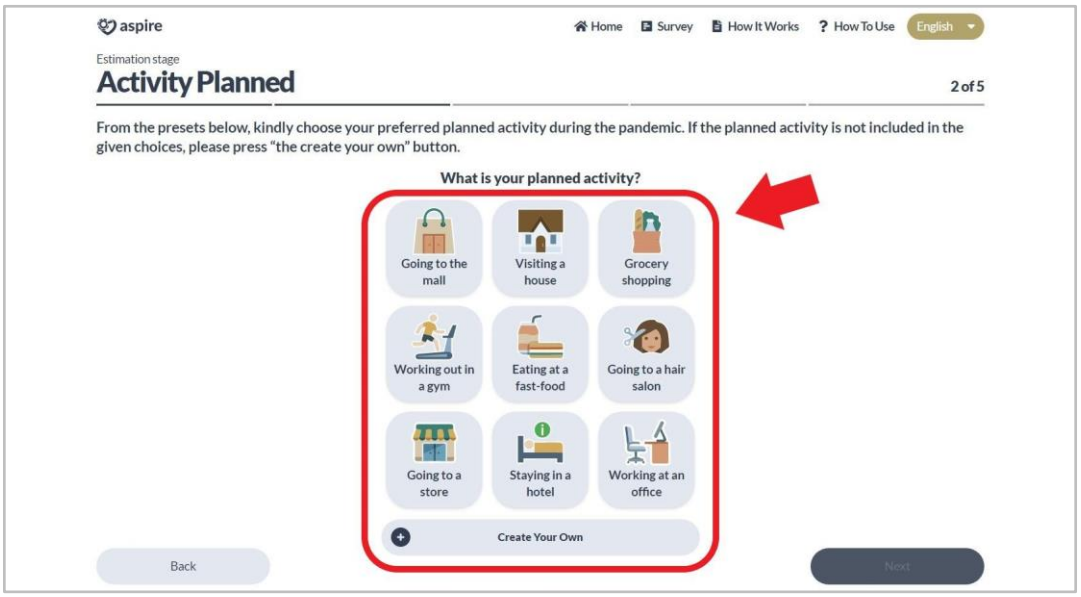
Note. Inputs labeled in red are required from the user, while inputs in blue are optional because these are needed only when the user creates a custom activity.

Preset Data Collection

There are three sets of presets provided for users: **activity presets**, **ventilation presets,** and **room size presets**. First, activity presets include nine choices the user can pick during the second step of the estimation stage, as shown in Figure 8.

Figure 8

Activity Presets in the Activity Planned Page



Each activity preset contains three values: activity level, ventilation, and room size, which are shown in Table 1. The room size is a volume calculated by multiplying the floor area with the room height.

Table 1

Standard Values in Each Activity Preset

Code	Presets	Activity Level	Floor Area (m^2)	Room Height (m)	Ventilation with outside air		
					R_p	R_a	O_d
GM	Going to the mall	5.60	498,000.00	15.00	3.54	0.30	39
GS	Grocery Shopping	5.60	4,468.00	8.00	3.54	0.91	8
WG	Working out on gym	13.50	222.97	2.40	10.00	0.90	7

VH	Visiting a friend's house	2.00	20.00	2.40	3.54	0.30	30
EF	Eating at a fast-food restaurant	2.00	1150.00	6.00	3.54	0.91	97
GH	Going to a hair salon in the mall	2.00	150.00	3.55	3.54	0.30	25
GSM	Going to a shop in the mall	5.60	150.00	3.55	3.54	0.30	39
SH	Staying in the Hotel	2.00	20.00	2.40	2.36	0.30	10
WO	Working at an Office Space	2.30	60.00	2.40	2.36	0.30	5

Note. Rp means People Outdoor Air Rate, Ra means Area Outdoor Air Rate, and Od means Occupant Density.

In Table 1, the activity levels were taken from Jimenez and Peng's risk estimator values. The parameter values of each of the activity levels were generated based on the available data for the Philippine setting.

Ventilation with outside air data was obtained from the 2010 Philippine Society of Ventilating, Air Conditioning and Refrigerating Engineers (PSVARE) Standards in the Philippine Green Building Code.

Room heights were approximated using the National Building Code of the Philippines. According to the National Building Code, the minimum room height is 2.4 meters. Some activities require buildings with multiple stories. If such were the case, the height is approximated with the following guideline stated in the Code: the minimum room height of the first floor should be at least 2.7 meters, and the succeeding floors should have a height of at least 2.4 meters. The floor areas were obtained from various Philippine-based buildings (BusinessMirror, 2015; Meinhardt Philippines, n.d.; SNAP Fitness, n.d.; Teoalida, 2006;

Jollibee, 2017; Ramanpreet Kaur, 2015; Department of Tourism, n.d.; PSA, 2016). The selection process for these buildings is as follows:

1. Check if there is data for the building's floor area.
2. Check if it is located in the Philippines.
3. Check if the source is reliable.

The user, on the other hand, can select the **"Create Your Own"** button in Figure 8, if none of the choices fit the planned activity. This will allow the user to create a customized activity by entering the values needed for activity level, ventilation, and room size.

Second, ventilation presets are choices in the Ventilation Page of custom activity as shown in Figure 9 below. Table 2 shows the standard values used for every ventilation preset.

Figure 9

Ventilation Presets in the Ventilation Page

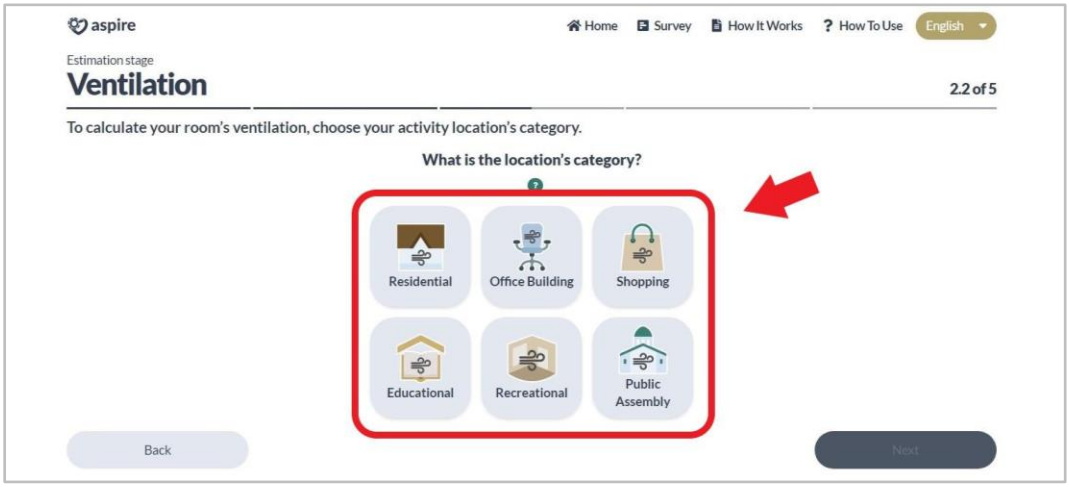


Table 2

Standard Values in Each Ventilation Preset

Code	Presets	Ventilation with outside air		
		R_p	R_a	O_d
R	Residential	2.60	0.41	36
O	Office Buildings	2.36	0.30	22
S	Shopping	3.72	0.61	33
E	Educational	4.38	0.82	51
R	Recreational	5.19	0.88	49
P	Public Assembly Spaces	2.65	0.38	77

Note. Rp means People Outdoor Air Rate, Ra means Area Outdoor Air Rate, and Od means Occupant Density.

Ventilation with outside air values in Table 2 were also obtained from the 2010 PSVARE Standards in the Philippine Green Building Code. After selecting a ventilation preset, the user will pick the room size for the custom activity.

Last, room size presets are choices presented in the Room Size Page of custom activity as illustrated in Figure 10 below. Table 3 shows the floor area values used for every room size preset. Note that the user can still change the room size values if they have it on hand.

Figure 10

Room Size Presets in the Room Size Page

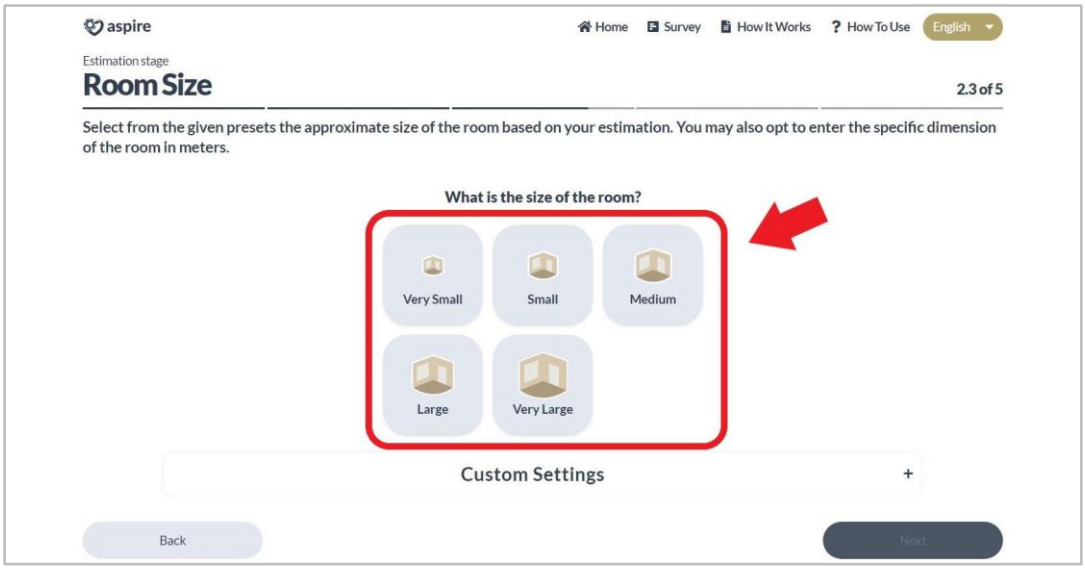


Table 3

Standard Room Size Values in Each Room Size Preset

Presets	Floor Area (m^2)	Room Height (m)
Very Small	20	8
Small	120	10
Medium	350	15
Large	1150	30
Very Large	28,584	40

Floor areas in Table 3 were also obtained from various Philippine-based buildings (Leviste, 2008; Pinoyentre, 2009; Jollibee, 2017; Yorukoglu et al., 2008). Room heights were approximated using the National Building Code of the Philippines.

Asset and Content Creation

Asset creation. Assets are any visual element in the website such as icons and illustrations. Free royalty assets were grabbed from Icons8 and Freepik, while fonts were obtained from FontAwesome. Sources were credited at the footer of the homepage. Assets were adjusted to fit the ASPIRE design language.

Content creation. Instructions, contact details, and simplified objectives and purpose of this research are also included. The contents were written in English first and later on translated to include the Filipino version of the content.

Pre-alpha Development

The ASPIRE website was developed using the Visual Studio Code IDE. To hasten development and reduce the load of the website, the TailwindCSS design framework was utilized in designing and styling the website. Additionally, pre-made components made by DaisyUI were also used. The website was hosted through the Heroku cloud platform.

A MongoDB cloud database was used to store data: user inputs, results, and the device used to access the website. DbSchema was used to manage the structure, columns, and schema of the database. HeidiSQL was used to manage the data and preset information inside the database. Heroku's database management system, Heroku Data, was used to store the data collected by the website.

Alpha Testing

Every aspect of the website was manually checked to ensure that every function works properly. The risk scores generated by ASPIRE were compared with the risk scores generated from Jimenez and Peng's estimator. This is important because ASPIRE used the formulae from Jimenez

and Peng's estimator to generate its risk scores. Having the risk scores match would imply that the formulae was replicated properly.

There is a limitation in the Google Sheets where Jimenez and Peng's estimator is located—it only allows up to 3 decimal places to be computed. Thus, only up to 3 decimal places were compared to the actual result. Nonetheless, it would still show if the ASPIRE website is accurate or not compared to Jimenez and Peng's estimator. Two test cases were made per activity preset, one in the high range and one in the low range as shown in Table 4. The inputs used for the presets were randomly chosen to achieve the perspective ranges.

Table 4

Precision Accuracy Test Log High Cases

Test Cases	High Range		Low Range	
	J&P's Estimator Risk Score	ASPIRE Risk Score	J&P's Estimator Risk Score	ASPIRE Risk Score
Eating at a Fast Food	1.317%	1.3166235%	0.001%	0.0008844%
Going to a Hair Salon	19.498%	19.4982788%	0.002%	0.0019918%
Going to a Store	43.188%	43.1883367%	0.006%	0.0064995%
Going to the Mall	0.185%	0.1854574%	0.007%	0.0073352%
Grocery Shopping	61.009%	61.0093691%	0.000%	0.0002647%
Staying in a Hotel	44.709%	44.7091279%	0.008%	0.0075925%
Visiting a House	35.530%	35.5298892%	0.004%	0.0040678%
Working at an Office	42.873%	42.8731201%	0.002%	0.0016210%
Working out in a Gym	44.787%	44.7874027%	0.006%	0.0065519%

Note. J&P means Jimenez and Peng. Per test case, both websites were given the same inputs.

High range inputs mean that the inputs have a higher value than low range inputs have.

Overall, ASPIRE accurately computed the same output as Jimenez and Peng's estimator up to 3 decimal places in all test cases. This shows that ASPIRE has successfully copied the formulae and delivers results accurate to Jimenez and Peng's estimator.

Phase 2 (Beta Testing)

In Phase 2, the gathering of feedback on the beta version of ASPIRE was performed. A total of thirty-two (32) participants beta-tested the website, six (6) of which were invited for a one-on-one interview to gather more detailed feedback on the website and its functionality. Google forms and Zoom meetings were utilized as mediums for survey and interview, respectively. Afterward, the data collected were analyzed using the System Usability Scale (SUS) and content analysis. More details regarding the methods performed during Beta Testing are discussed in Research Design.

Phase 3 (Release Candidate Development)

The goal of Phase 3 is to identify suggestions and issues that were found in Phase 2 by the users that can be implemented to improve ASPIRE.

There are five major changes to ASPIRE during Phase 3:

- During the beta testing, some users mentioned that the page takes too long to load, which sometimes leads to an Operational Error. To address this issue on speed, the website was recreated completely using the Express.js framework. It is now also considered a Single Page Application (SPA).

- During the data collection, users suggested ways to improve the experience of using the website. Several UI changes were made in light of the comments and suggestions made by the users. Most of these changes were made with the goal of improving quality and clarity.
- A “Filipino language” mode was added to improve accessibility for Filipino users.
- A “How It Works” page was added to provide a basic understanding of how the website works and where the formulas were taken from.
- To make it easier to learn how to use ASPIRE, a video tutorial was also added to the “How to Use” page. Instructions can now be viewed by swiping or clicking the left and right buttons.

Phase 4 (Release Candidate Testing)

The goal of Phase 4 is for users to test the changes applied in Phase 3 to determine if its usability has improved compared to the previous version. Since this version is the final version of the ASPIRE website, its usability is also compared with the usability of Jimenez and Peng’s estimator. A total of 20 participants (7 are new and 13 are from Phase 2) were gathered. Ten of them were interviewed. Details regarding the methods performed during the Release Candidate (RC) testing are discussed in Research Design.

Research Design

In testing the ASPIRE website, the mixed-method approach was utilized—qualitative and quantitative. A Google form survey questionnaire was created following the System Usability Scale (SUS) to determine the usability of the website. Additionally, one-hour one-on-one interviews were conducted for acquiring feedback about the website’s user interface, technical

aspects, and text content. Twenty-three questions were self-constructed by the researchers, with general, technical, features, estimation stage and results page as the centers of inquiry.

Respondents of the Study

There are no set criteria for users of ASPIRE as long as they are interested in measuring the risk of their activities in the Philippines and are of 18 years of age or older. For this study, Grade 12 students of various Philippine schools were invited to participate in testing the website. The ideal number of users needed to identify usability problems are at least 15 (Nielsen, 2000). For Phase 2 - Beta testing, there were 32 participants, and 6 of them were interviewed. For Phase 4 - Release Candidate Testing, there were 20 participants (7 are new), and 10 of them were interviewed.

Research Instrument

Google forms and Zoom meetings were utilized as mediums to conduct the surveys and interviews respectively. The survey contains two sections: informed consent form and the System Usability test of John Brooke. For Phase 2, only the usability of ASPIRE was tested. For Phase 4, the usability of Jimenez and Peng's estimator was tested together with ASPIRE to compare their usabilities. On the other hand, the self-constructed interview questions are divided into seven sections: general, technical, features, homepage, consent pop-up, estimation, and results, making up a total of 23 questions.

Administration of the Instrument

Participants were chosen via convenience sampling, which is a typical practice in usability research (Sauro, 2010; UX Stack Exchange, 2018). Although convenience samples have been

shown to raise the likelihood of bias in favor of the intervention, the bias was mitigated by intentionally reaching out to users from different schools, resulting in a diverse sample as seen in Tables 5 and 6.

Table 5

Number of Participants per School for Phase 2

School	No. of testers
De La Salle University Integrated School - Laguna	15
Pampanga High School	7
University of Baguio	3
University of the Philippines	2
STI College Carmona	1
Saint Louis University	1
Baguio City National Science High School	1
Graduates	2
	Total: 32

Three college students and two graduates were included in Phase 2. While they are not considered Grade 12 students, they were asked for feedback for the sole purpose of gathering more diverse criticisms to improve the website for Phase 3. The number was kept at 5 to avoid major diversions from the intended Grade 12 samples.

Table 6

Number of Participants per School for Phase 4

School	No. of testers
De La Salle University Integrated School - Laguna	9
Pampanga High School	6
University of Baguio	4
STI College Carmona	1
	Total: 20

Due to participants coming from different schools, issues about the website identified may be more diverse. Some of the major changes made on the website during Phase 3 came from constructive criticisms from a sample of informed students, two experienced student programmers, and two graduates.

The survey questionnaire and scheduling of interviews were distributed through GMail on January 12, 2022 and May 3, 2022, respectively. Interviews for Phase 2 and Phase 4 were scheduled between January 12-21, 2022, and May 4-13, 2022, respectively.

Data Collection and Analysis

The data gathered from the survey and interviews were analyzed using the following:

System Usability Scale (SUS)

The System Usability Scale (SUS) is a quantitative 10-item questionnaire where the user will give a rating of 1 (strongly disagree) to 5 (strongly agree) on each item (Brooke, 1995). This was used to measure the usability of ASPIRE on Phase 2, and the usabilites of both ASPIRE and Jimenez and Peng's estimator during Phase 4. Please refer to Appendix A for the document containing the 10 item questions in the SUS and their brief description. The method for analyzing the SUS survey results is shown below in Listing 1.

Listing 1

Algorithm for SUS Analysis

1. Group the responses according to questions.
2. Read each response and look for a code.
3. List new codes that are found for each question.
4. Count the occurrence of a code in the responses per question.

Lewis and Sauro (2018) conducted a study to determine the average SUS rating score. From an average of 500 studies, they acquired a final average of 68. A final average SUS rating of above 68 would mean that the website's usability is above average. Anything below 68 would consider the website as below average.

Insight Feedback

Interviews are utilized to gather qualitative feedback that may not have been seen on a quantitative evaluation form. To observe user behavior, the interviewees were asked to share their screens while using ASPIRE.

The interview data was analyzed using content analysis and the results are presented in frequency tables. Content analysis is a qualitative research tool used to determine the presence of specific words or concepts in recorded communication (Busch et al., 2022). Interviewees were asked 23 questions which are aimed towards understanding the users experience with the website. The questions were grouped into 7 categories: general, technical, features, homepage, consent pop-up, estimation stage, and results stage. Please refer to Appendix A for the document containing the 23 questions that were asked to the interviewees.

RESULTS AND DISCUSSION

Usability of the Website

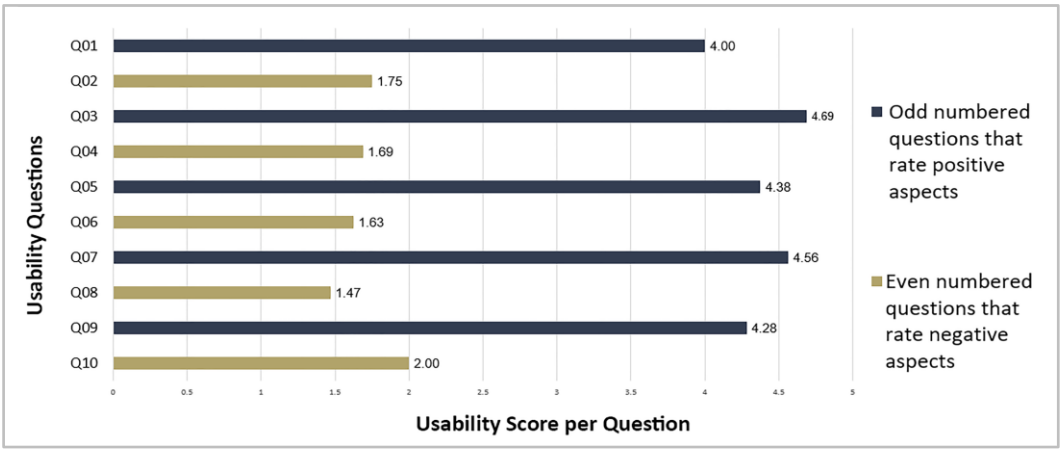
This section discusses the results and findings gathered in Phase 2 and Phase 4, specifically the SUS scores gathered from the survey answers of the 32 beta testers and 20 release candidate testers.

Phase 2 Usability Results

Figure 11 shows the survey results collected from 32 participants. The chart below shows the average scores for each question under the SUS section.

Figure 11

Average Usability Score per Question in ASPIRE (Phase 2)



Odd-numbered items are questions that focus on positive aspects about the website in terms of usability, while the even-numbered items are those that focus on negative aspects. The results of the positive-feedback questions (blue bars) are high, with a mean of 4.38 and a standard deviation of 0.27, while negative-feedback questions (gold bars) are relatively low, with a mean

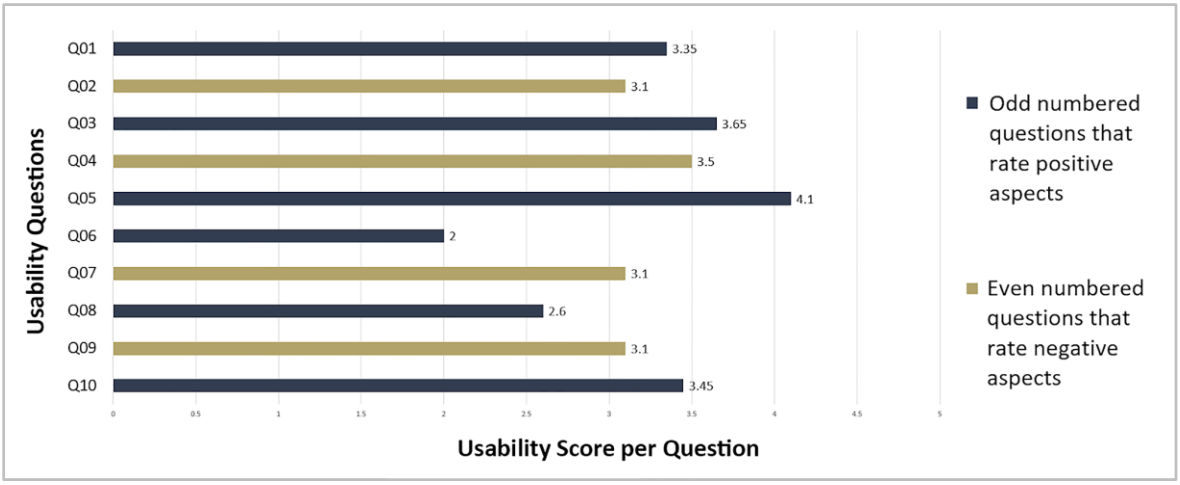
of 1.71 and a standard deviation of 0.19. The results mean that the usability is mostly positive. With these, the website achieved an average **system usability score of 83.44** with a standard deviation of the scores at 12.50. This score is equivalent to a **grade of A,** which is higher than average (68).

Phase 4 Usability Results

Figure 12 illustrates the survey results of Jimenez and Peng's estimator. The chart below shows the average scores for each question under the SUS section.

Figure 12

Average Usability Score per Question in J&P



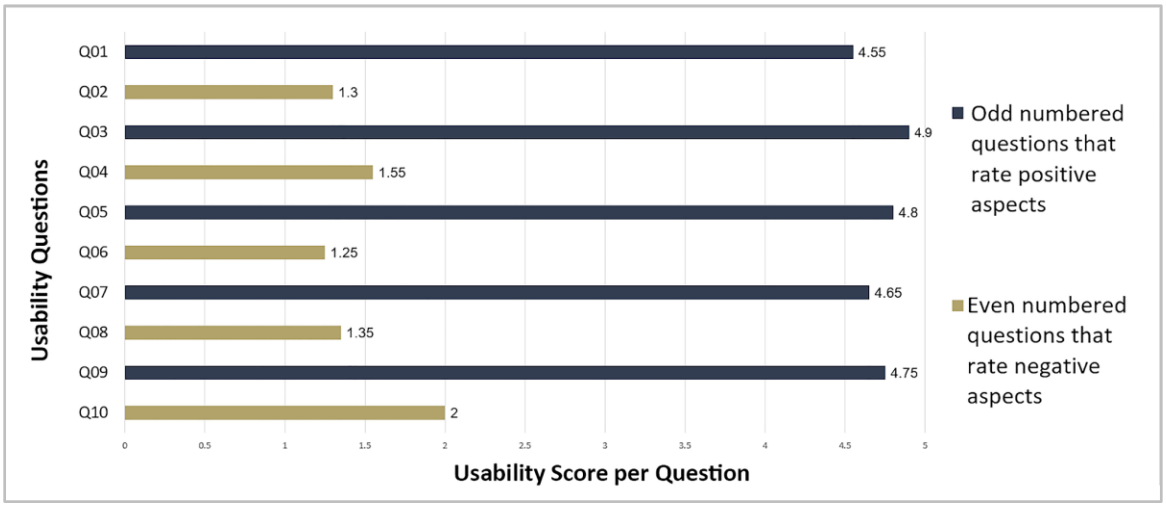
It can be seen that results are mixed in terms of usability where positive-feedback questions (blue bars) had a mean of 3.46 with a standard deviation of 0.42, while negative-feedback questions (gold bars) had a mean of 2.93 with a standard deviation of 0.63. With this, Jimenez and Peng's estimator achieved an average **system usability score of 56.625** with a standard deviation of 26.17. This score is equivalent to a **grade of D,** which is lower than the average (68).

Moreover, Figure 13 below shows the new usability survey results of the ASPIRE website.

The chart below shows the average scores for each question under the SUS section.

Figure 13

Average Usability Score per Question in ASPIRE (Phase 4)



The results show the usability score of the updated ASPIRE website has increased. Positive-feedback questions (blue bars) had a mean of 4.73 with a standard deviation of 0.13, while negative-feedback questions (gold bars) had a mean of 1.49 with a standard deviation of 0.31. With this, the website achieved an average **system usability score of 90.50** with a standard deviation of 10.84. This grade is equivalent to a **grade of A,** which is higher than average (68).

Comparison of Results

Based on the Phase 2 and Phase 4 average usability test scores of ASPIRE, Phase 2 ASPIRE got **83.44**, while Phase 4 ASPIRE acquired **90.50** after implementing the changes suggested by the participants of Phase 2. Comparing both values, release candidate-ASPIRE is **7.06 points higher** than beta-ASPIRE. Additionally, the release candidate-ASPIRE reached a mean of 4.73 for positive-feedback questions while having very low negative-feedback scores, with a mean of 1.49. In contrast, the scores for positive-feedback questions of beta-ASPIRE were lower, the mean for

positive feedback questions of beta-ASPIRE was lower, with a mean of 4.38, and the mean of the negative-feedback question was higher at 1.71. The results prove that the usability of the website improved.

Based on the Phase 4 results, the ASPIRE website achieved an average score of **90.50**, while Jimenez and Peng's estimator achieved an average score **of 56.625.** Comparing both values, the score of the updated ASPIRE website is **33.875 higher** than Jimenez and Peng's estimator**.** Furthermore, the scores of the positive-feedback questions of Jimenez and Peng's had a relatively lower mean of 3.46. while having a higher mean for the negative-feedback questions at 2.93. Release candidate-ASPIRE shows scores that maximize the positive-feedback questions while having low negative-feedback scores. Thus, the ASPIRE website is more usable compared to Jimenez and Peng's estimator.

Insight Feedback

This section discusses the results gathered during Phase 2 and Phase 4, specifically the insight feedback gathered from the 6 beta testers and 10 release candidate testers during the interviews. These insights are compared to identify any improvement in the website.

Phase 2 User Feedback

Table 7 below shows the frequency of the coded responses from Phase 2. The interviewees of Phase 2 stated that they experienced issues when loading the website. Furthermore, users also pointed out visual design issues such as inconsistent button sizing or issues with interactibility i.e. buttons that do not trigger next event or action. Some users also recommended additional quality-of-life features such as text-speech, video tutorials and others.

Table 7

Frequency Table for Phase 2 Interview Responses

Category	Question	Code	Frequency
General Questions	How did you first learn about our website?	**Discovered by interviewees**	**3**
		Friend recommendation	2
	What first came to your mind when you saw the website's logo and icon?	Good and meaningful	2
		Innovative	2
		Useful	1
		COVID-19 information site	1
	Would you use this more than other existing similar websites?	**Yes—interviewee is not knowledgeable of other sites**	**3**
		Yes—if they knew more details	1
		Yes—it is convenient/useful	1
		No—interviewee does not use these types of website	1
	Is this website welcoming for Filipinos?	Yes—it is welcoming for filipinos	3
		Non-english speakers may find it difficult to use	3
Technical Questions	Did you run into any speed, visual, or loading problems during your experience with the website?	**Slow loading speeds**	**5**
		Better button indicators	1
	Were there any issues that could make it difficult for people with	**None**	**3**
		Lack of color blind modifier or	1

Category	Question	Code	Frequency
	disabilities to use?	high-contrast UI	
		Add video or audio options	1
Features Questions	What do you like the most about the website?	**Visuals/design/style**	**3**
		Custom activity feature	2
		Everything	1
	Which feature is the most important for you?	Estimation stage	1
		User-friendliness	1
		Results page	1
		Speed of the website	1
	Is there a lacking feature? If so, what do you suggest adding/improving?	**Mask step updates**	**3**
		Safety tips/DOH guidelines in results page	1
		Vaccinations step	1
		None	1
Homepage Questions	Does the homepage provide a clear introduction of the website? Is it overwhelming or just right?	**Yes**	**6**
	Does the "How to Use" page describe clearly and concisely the process you went through when using the website?	Yes	2
		Improve screenshot clarity	2
		Clarify instructions for editing values and summary	1
		Improve readability by	1

Category	Question	Code	Frequency
		changing format	
Consent Stage Questions	Is the consent stage overwhelming to read?	**No**	**4**
		Words can be shortened	1
		Font is small	1
	Does it clearly explain how the study works to make a proper informed consent decision?	**Yes**	**3**
		Adjust checkboxes	1
Estimation Stage Questions	Were you always able to identify what to put in each section? If not, please elaborate.	**Yes**	**3**
		Confusion in ventilation stage	2
		Using the website requires focus	1
	Do the icons and illustrations feel inclusive among races, gender, and age as a Filipino?	**Yes**	**4**
		Icons and illustrations are inclusive but not particularly Filipino	2
	Is there a visual inconsistency among different steps in the estimation stage? What is it?	**No visual inconsistencies**	**4**
		Icons and Illustrations are inclusive	1
		How to use page	1
	Is there anything that can be improved in the estimation stage?	Changes to Activity Location	2
		Changes to Activity Planned	1
		Changes to Activity Level	2
		Changes to Ventilation	1

Category	Question	Code	Frequency
		Changes to Room Size	**4**
		Changes to Time and People Page	2
		Changes to Mask Stage	1
		General Changes	3
		Add options for vaccinations	1
		No changes	1
	What comments and opinions do you have about the summary page?	**Changes to summary table**	**3**
		Did not notice access to summary page	2
		No changes to summary table	1
Results Page Questions	Were you able to comprehend clearly the results given?	**Yes**	**5**
		Button not working	1
	Did you feel like you did not understand the real world equivalent of your results? Why or why not?	**Yes**	**5**
		No—due to lack of safety tips and DOH guidelines	1
	Does it make you curious to try again and test other values?	**Yes**	**5**
		No—due to the website being slow	1

Category	Question	Code	Frequency

Phase 4 User Feedback

Based on the results gathered during the data collection for Phase 4, the users provided mostly positive feedback. Many commended the ease of use of the website as well as the minimalistic design. Table 8 below shows the coded responses. Based on the content analysis of the transcript of the interviews, it shows that the speed and performance issues that affected version 1 of ASPIRE were fixed. In the updated ASPIRE website, 9 out of the 10 participants did not encounter technical issues. However, a participant experienced lagging when loading the custom settings for room dimension. Users were also able to go through the estimation stage smoothly. Some have stated that the information displayed in the estimation stage helped in selecting inputs. Lastly, the information on the homepage, "How To Use" page, "How It Works" page, and the results page are adequate in explaining the background of ASPIRE, its functionality and how to use it.

Table 8

Frequency Table for Phase 4 Interview Responses

Category	Questions	Code	Frequency
General Questions	What first came to your mind when you saw the website's logo and icon?	**Healthcare/health-related**	**4**
		Fits the theme	1
		Futuristic aesthetic	1

Category	Questions	Code	Frequency
	Is this website welcoming for Filipinos?	Yes	9
Technical Questions	Did you run into any speed, visual, or loading problems during your experience with the website?	**No technical issues**	**9**
		Lag in custom room size	1
	Were there any issues that could make it difficult for people with disabilities to use? If not, please explain why.	**None**	**6**
		Issues may arise for persons with visual impairment (blindness)	3
		Issues may arise for persons with physical impairments (eg. amputees)	1
		People with disabilities will have difficulties (non-specific)	1
		Individual with disabilities may have people assisting them	1
Features Questions	What do you like the least and most about the website?	Most liked: Ease of Use/ Simplicity	3
		Most liked: Information	2
		Most liked: Design/Interface	2
		Most liked: Language function	1
		Most liked: Customizability	3

Category	Questions	Code	Frequency
		Most liked: The website itself	2
		Least liked: No least liked feature	**6**
		Least liked: small text	1
		Least liked: limited options	2
		Least liked: guessing/estimation of numbers in estimation stage	2
	Which feature is the most important for you?	**Results of the estimation/Estimation stage**	**5**
		How to Use page	1
		How it Works page	1
		The website itself	1
		Ease of use	1
	Is there a lacking feature? If so, what do you suggest adding/improving?	**No lacking features**	**6**
		Accessibility features	1
		Additional feature to estimation	2
Homepage Questions	Does the homepage provide a clear introduction of the website? Is it overwhelming or just right?	**Yes**	**10**

Category	Questions	Code	Frequency
	Does the "How to Use" page describe clearly and concisely the process you went through when using the website?	**Yes**	**9**
		Had suggestions	2
	Do you have a basic understanding of how the website works and where the formulas are taken from? If not, what can we do to improve it?	**Yes**	**10**
		Had suggestions	1
Consent Stage Questions	Is the consent stage overwhelming to read?	**Not overwhelming**	**10**
		Text is small	1
	Does it clearly explain how the study works to make a proper informed consent decision?	**Yes**	**10**
		Difficulty with signed consent form	1
Estimation Stage Questions	Were you always able to identify what to put in each section? If not, please elaborate.	**Yes**	**8**
		Difficulties in mask step	1
		Difficulties in time and people step	1
		Text is small	1
	Do the icons and illustrations feel inclusive among races, gender, and age as a Filipino?	**Yes—inclusive to all groups**	**6**
		Yes—inclusive to Filipinos	3
		No comment	1
	Is there a visual inconsistency	**None**	**9**

Category	Questions	Code	Frequency
	among different steps in the estimation stage? What is it?	Infographics in the results page	2
	Is there anything that can be improved in the estimation stage?	**None**	**5**
		UI suggestions	2
		Add more activity presets	1
		Adjust time and people step	1
		Increase text size	1
	What comments and opinions do you have about the summary page?	**Useful**	**6**
		Good design	3
		Text is small	1
		Suggested improvements	1
		Easy to understand	1
		No comment	2
Results Page Questions	Were you able to comprehend clearly the results given?	**Yes**	**10**
	Did you feel like you did not understand the real-world equivalent of your results? Why or why not?	**Yes**	**8**
		User does not understand but can plan accordingly.	1
		User expected a different result to their scenario	1

Category	Questions	Code	Frequency
		User did not understand.	1
	Does it make you curious to try again and test other values?	**Yes**	**9**

Comparison of Results

The results gathered in Phase 4 showed that there was an improvement in several key aspects. First, technical issues such as lags and bugs were fixed in ASPIRE since the majority stated that there were no technical issues found in Phase 4. Second, users were able to navigate through the estimation stage with greater ease because of the information that was added for each page in the estimation stage. Lastly, the interviewees suggested minimal additional features or changes for Phase 4. This suggests that the version used in Phase 4 is more refined.

CONCLUSIONS

The COVID-19 pandemic has caused multiple researchers to investigate this domain since 2020. One aspect being explored in this topic is the availability of tools in assisting the public in estimating their virus risks. Although DOH has created a case tracker for the Filipinos, studies in identifying these risks are yet to be explored in the Philippines. One example of a transmission risk estimator is Jimenez and Peng's Aerosol Transmission Estimator, which is a peer-reviewed risk estimator that garnered positive reception. The estimator is a Google sheet which people may find difficult to use due to all the jargon and information present in the sheet. To solve this, a user-friendly website called MyCOVIDRisk was built for this estimator. However, it is only configured for the United States setting. As such, this study aims to create a website called ASPIRE that uses Jimenez and Peng's estimator and is based on the MyCOVIDRisk user interface. The study also aims to achieve two more objectives: to produce an accurate website to Jimenez and Peng's estimator, and to evaluate its usability to the source estimator. The study could be beneficial to government officials, future researchers, and Filipinos.

To achieve this endeavor, the creation of the website underwent 4 phases: pre-alpha development and alpha testing, beta testing, release candidate development, and release candidate testing. The usability of ASPIRE was evaluated through SUS surveys, and insight feedback was obtained through interviews which were conducted and analyzed through content analysis. The respondents for the different phases consist of grade 12 students, college students, and graduates of different Philippine schools. The respondents are chosen through convenience sampling. To limit bias, a wide range of students from different schools were gathered which resulted in a more diverse sample set.

Based on the results of the surveys and interviews, the SUS score of ASPIRE yielded a grade of A—which means that the website is highly usable or above average. Moreover, users found that the website is more usable than Jimenez and Peng's estimator. The overall feedback of the respondents showed that the website met the usability criteria. All issues and suggestions raised by the respondents were addressed.

All throughout the process, ASPIRE was able to achieve its objectives in creating a usable website based on Jimenez and Peng's estimator and MyCOVIDRisk's user interface by configuring it to fit the Philippine setting. Overall, this study shows how a COVID-19 risk estimation website was developed and improved based on user evaluation. This may be used as a reference in creating e-health tools.

Although ASPIRE attained a high usability grade, there are still points for improvement. While people can know their risk of infection through the website, it would be helpful to have a recommendation system for reducing risks because the current version of ASPIRE only considers the region, activity, time, people, and type of masks in the transmission risk result which is based on the risk estimator of Jimenez and Peng. Recently, different COVID-19 variants have emerged with different levels of severity; a model that can take into consideration the severity of other COVID-19 variants can be used in place of Jimenez and Peng's estimator. Precautionary measures such as social distancing and vaccination could be taken into account within the formulae to further determine the transmission risk result. Currently, ASPIRE only takes indoor activities into consideration; as such, including outdoor activities in the estimation can increase the options available to users. The presets used in the website are only estimates and were gathered from unofficial sources; replacing the current preset values with values taken from a database will further improve ASPIRE's accuracy. The current evaluation of ASPIRE is currently done by

students and non-medical professionals; as such, it is also recommended that ASPIRE be tested by graduates from the medical field and other health professionals to gather insight on how to further improve the website. Further testing is needed to collect information on ASPIRE's accessibility and inclusivity, since usability, accessibility, and inclusivity are three essential aspects in creating, designing, and developing a website (WAI, 2016). Considering the region, especially the epicenter National Capital Region, evaluating ASPIRE may also be beneficial for a better-represented analysis of the website to the residents of the Philippines. Moreover, the impact of ASPIRE on the Filipino community is yet to be determined.

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Appendix A

Supplementary Information

The following file links provide additional important information to support the study.

Additional file 1. ASPIRE Design Language.

Additional file 2. System Usability Scale.

Additional file 3. Interview Questions.

Additional file 4. Example of a Signed Research Informed Consent Form.

Additional file 5. Invitation Email for Survey and Interview Participants.

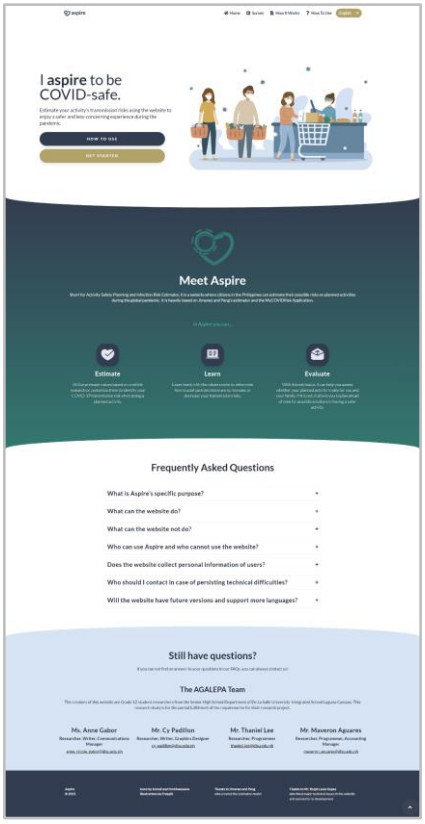
For demonstration purposes, the ASPIRE website can be accessed through https://aspireph.herokuapp.com. Similarly, a video tour of the ASPIRE website can be watched through https://youtu.be/o19_LzVYIQE.

Appendix B

ASPIRE Website Screenshots

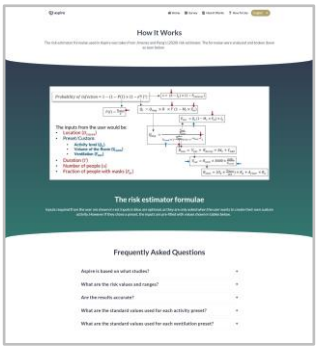
Figure B1

Homepage Screenshots



Homepage

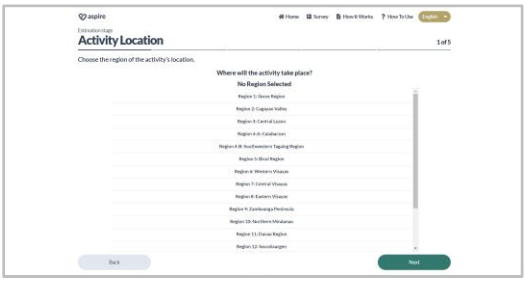
How To Use



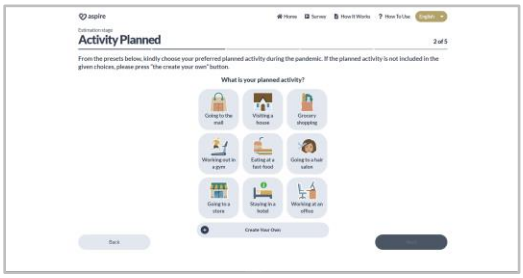
How It Works

Figure B2

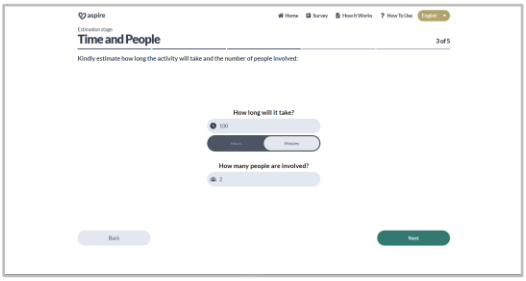
Estimation Stage Screenshots



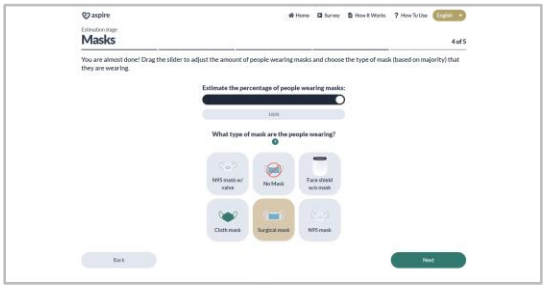
Step 1 - Activity Location Page



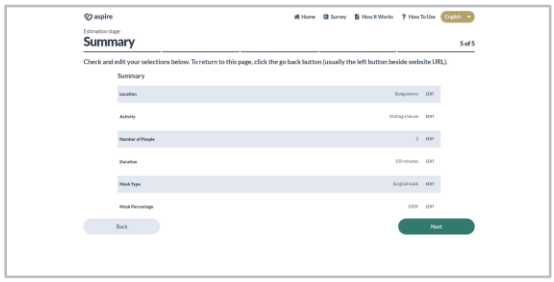
Step 2 - Activity Planned Page



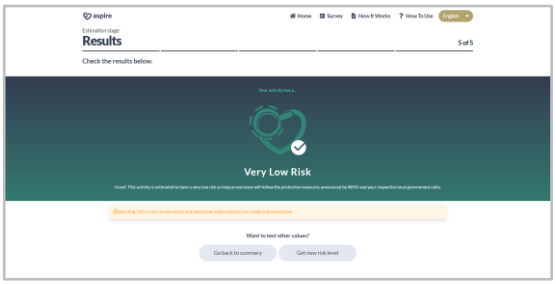
Step 3 - Time and People Page



Step 4 - Masks Page



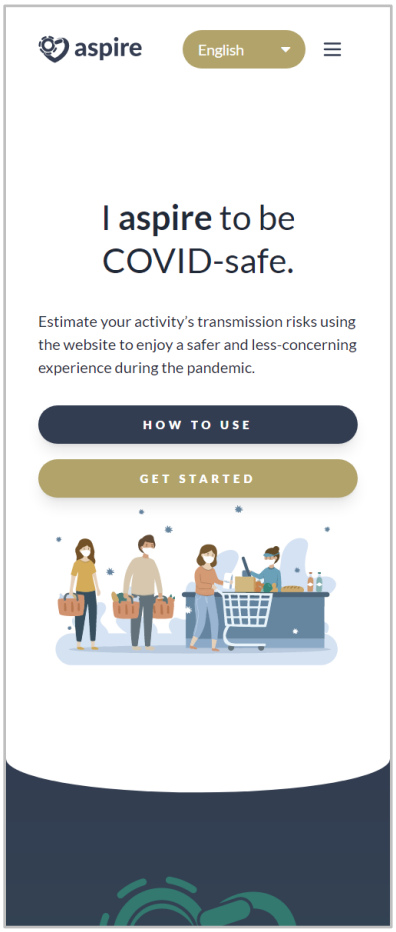
Step 5 - Summary Page



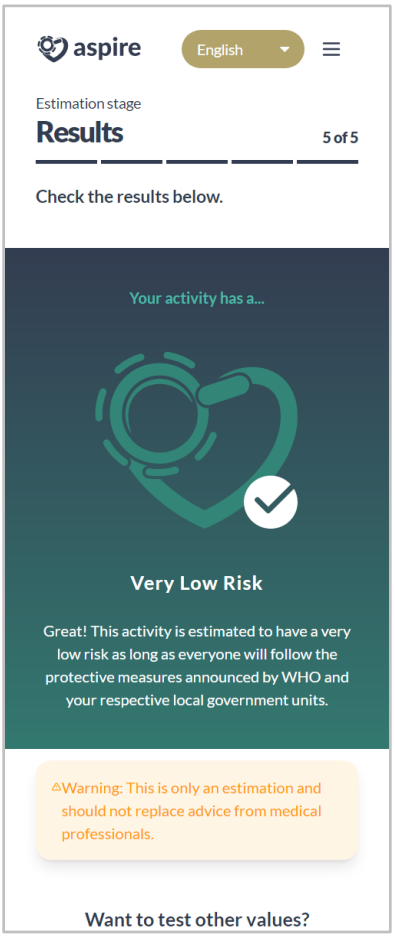
Results Page

Figure B3

Screenshots on Mobile



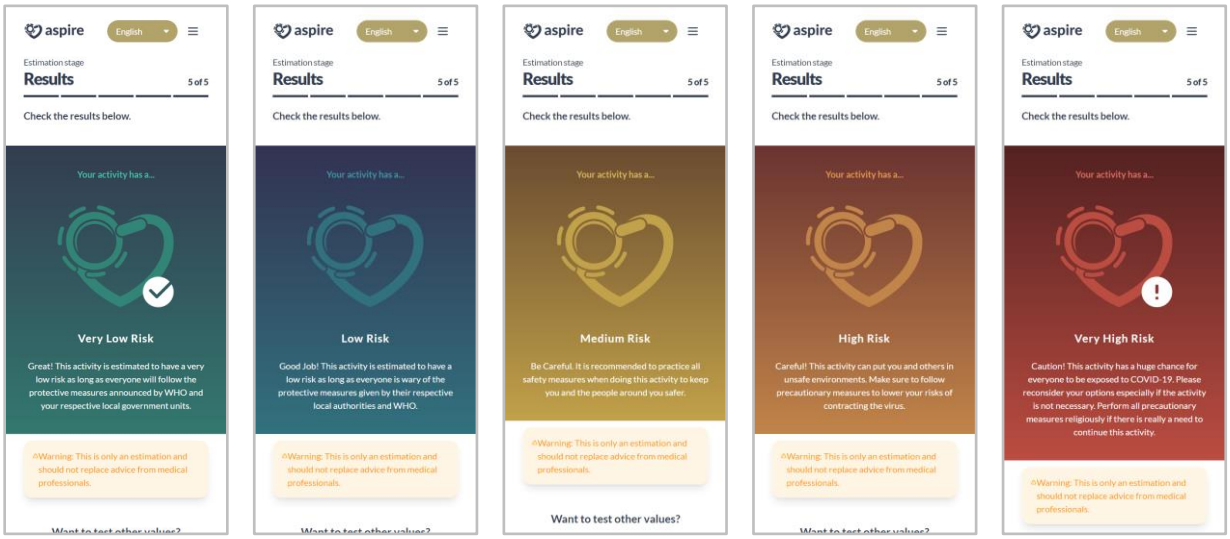
Homepage as Viewed through Mobile



Results Page as Viewed through Mobile

Figure B4

Risk Score Scale (As Shown in the Results Page)



Very Low *Low* *Medium* *High* *Very High*

Note. The risk score ranges were adapted from Brown-Lifespan Center for Digital Health's MyCOVIDRisk App. The risk ranges are as follows: Very Low Risk = 0.00001%; Low Risk = 0.01 - 0.00001%; Medium Risk = 0.01 - 0.1%; High Risk = 0.1 - 5%; and Very High Risk = 5%.

ABOUT THE AUTHORS

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Maveron studied in the University of Baguio Science High School where he completed his junior high school education. He is currently enrolled in De La Salle University Integrated School as a STEM student and will graduate from said institution. He joined the Commision on Student Elections Technical Team.

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Anne is a graduating Senior High School student from De La Salle University Integrated School under Science, Technology, Engineering, and Mathematics. She completed her junior high school in the same institution. She held numerous leadership positions in school, including being a Chairperson of the Commission on Student Elections of Laguna.

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Thaniel finished junior high school at Emmanuel Christian School and is soon graduating from De La Salle University Integrated School under Science, Technology, Engineering and Mathematics Strand. He is an aspiring computer science student and software developer. He has joined the Commission on Student Elections of Laguna as a Technicals Team member.

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Cy completed junior high education at Pampanga High School and will be graduating from De La Salle University Integrated School as a Science, Technology, Engineering, and Mathematics student. He excels in artistry, and has joined the Commission on Student Elections of Laguna as a Graphic Artist under Public Relations.

Shirley B. Chu

Ms. Shirley Chu is a faculty member of the College of Computer Studies of DLSU. She obtained both undergraduate and graduate degrees from DLSU. She teaches introductory programming courses, discrete structures and algorithms. Her research areas are neural networks, genetic algorithms and natural language processing.