

# **Comparison of usability of PC based and smartphone symptom checker**

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## **Abstract**

### **Background**

Computerized symptom checkers are becoming increasingly popular, however, although they have been tested for accuracy there is little information around the usability and perceived usefulness of computer-based symptom checkers. Previous work has shown that elderly users prefer to use larger format devices. This study concentrated on the differences between smartphone and PC-based systems.

This research compared four symptom checkers (two PC based: Isabel, Symcat and two smartphones based: Ada, WebMD) using a think-aloud usability evaluation protocol and a questionnaire based on the technology acceptance model (TAM).

### **Method**

10 participants (age range, gender) were asked to test each system in random order using a different set of imaginary symptoms for each system in a single session using a think-aloud protocol followed by a modified TAM. The TAM questionnaire used a 7-point Likert scale with statements related to the usability and potential usefulness of a product.

### **Results**

All users completed all the tasks, but generally only made comments at the end of each test. In terms of overall TAM score, PC-based systems were most popular, Isabel having the highest overall score. The time taken to complete the task varied with participants. Participants who were above the age of 40 took more than 60 minutes however, the group of users 25-40 took less than 25 minutes to complete the four applications. Interestingly, user's views of the systems changed during use, with some users finding Ada easy to use initially, but were less satisfied with the results output and the reverse was true for Isabel.

### **Discussion**

A number of suggestions were made by users. Speech recognition was thought to be important for elderly and disabled people along with multiple-language options. Participants felt that there should have been an option either to save or print the results.

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## **1. Introduction**

### **1.1. Background of the research**

Researchers are now proposing mHealth applications for many health conditions and also to allow people to interpret their own symptoms. Usability is a key factor in the adoption of these applications as they are intended for a mass-market. Symptom checkers are software tools that allow users to submit a set of symptoms and receive advice related to them in the form of a diagnosis list, health information or triage (Semigran, Linder et al. 2015).

Symptom checkers can not only be beneficial tools for doctors and patients but also provide access to health care in low resource settings such as in rural areas or developing countries. Generally, symptom checkers make a diagnosis of a disease based on the answers to questions and data on the prevalence of disease and the diagnostic sensitivity and specificity of symptoms recorded (Morita, Rahman et al. 2017). Symptom checkers have several potential benefits. They can encourage patients with a life-threatening problem such as stroke or heart attack to seek emergency care. For patients with a non-emergency problem that does not require a medical visit, these programs can reassure people. For example, approximately a quarter of visits for acute respiratory illness such as viral upper respiratory tract infection, patients do not receive any intervention beyond over the counter treatment, and over half of patients receive unnecessary antibiotics. Reducing the number of visits saves patients' time and money deters overprescribing of antibiotics and may decrease demand on primary care provider (Gan and Poon 2016).

However, the user interface is often not well tested (Marco-Ruiz, Bønes et al. 2017). In particular, the design of such symptom checkers, and in particular the usability of systems that are designed to be used on a computer screen as opposed to a smartphone app has not been investigated. In this research, Ada (smartphone), WebMD (smartphone), Isabel (computer-based) and Symcat (computer-based) symptom checkers will be analyzed in terms of their usability and perceived usefulness using two instruments, a think-aloud protocol, and a modified TAM questionnaire.

### **1.2. Objective of the research**

The aim of this research is to investigate and compare four symptom checkers (two computer-based and two smartphone app-based) and study the issues with respect to usability. Each participant was asked to test each system using imaginary symptoms in a single session using a think-aloud protocol followed by a modified technology acceptance questionnaire. The

accuracy of the symptom checkers is not being tested and no real medical information was used. 10 participants were involved in the study. Although small, this number should detect a majority of usability issues related to the different modes of interaction.

This research addresses the below mentioned questions:

RQ1. What are the issues of usability associated with symptom-checkers based on conventional computer screens and smartphone app?

RQ2. What are the perceived benefits associated with symptom-checkers based on conventional computer screens and smartphone app?

Answering these questions paved the way to another two questions:

RQ3. Which is more preferable: PC based or smartphone-based applications?

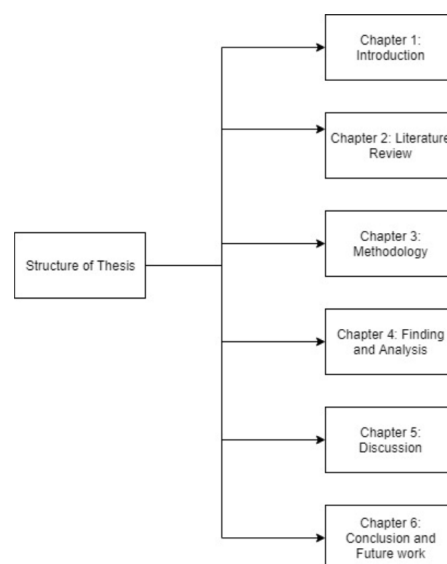
Further, this question was investigated based on age of users that resulted in another sub-question: What is the acceptance level of the applications based on age classification?

RQ4. Which is more preferred: Is it the functionality of smartphones or the features of PC?

### 1.3. Structure of the research

The structure of the research has 6 chapters as depicted in the figure 1.1:

Figure 1.1 Structure of Research



Chapter 1 gives a brief introduction describing the background, objective of the research and what are the research questions this research aims to answer.

Chapter 2 is the literature review where smartphone vs PC is analyzed and in-depth features of symptom checkers are listed down. The potential benefits and risks are described in this section.

Chapter 3 has details on the methods that have been adopted in this research. That is explanations on the technology acceptance model and think-aloud protocol is given. The target participants and the task scenarios are listed. Also, a pilot test was conducted. The results and analysis of the pilot study are briefed in this chapter.

Chapter 4 presents the findings and analysis of the data collected by following the methodology process prescribed in Chapter 3. The difficulties faced by the researcher is also mentioned in this chapter.

Chapter 5 begins with the result summary from findings followed by answering all the research questions.

Chapter 6 concludes the research and gives the scope for future work

#### **1.4.Publications**

Work from this thesis has been accepted to present at the Health Informatics New Zealand conference in November 2019



## **1. Literature Review**

### **1.1.Introduction: Smartphone vs PC based system**

This chapter has a detailed difference of smartphone and PC based system in terms of navigation, security, screen measure, usage of cookies and bandwidth. Further considering how the systems work, the symptom checker analysis is described considering the interpretations and accuracy measure. Then their benefits and risks are also given that briefs on the positive version for using symptom checkers.

#### **1.1.1. Smartphone System**

The screen size of the smartphone is small. Portable Apps must preserve screen space wherever they can, because of their smaller screen measure. Generally, smartphone applications allow easy switching between app screens and orientation. However, this can make design more complex. Scrolling and resizing using multitouch interface is also supported. However, it is possible that users may become disorientated and lost inside the apps that are originally designed for use with bigger screens. Page-to-page navigation is possible. Reduced screen size means that users using search application for example are more likely need to scroll or move between screens and this may prevent them finding the most relevant results. You can't float or rollover on Mobile Apps (IOMworld 2018). When briefed about search results it is easy for information access (IA). The users will devote their complete attention to the task and retrieval not easy to do as the task results are split up (Sweeney and Crestani 2006). In a smartphone, typing involves using only your thumbs. However, smartphones can be very convenient, they can be sitting on the lounge chair at home, strolling around, inside or outside, queuing for something, waiting for transport, train, or plane, or voyaging, searching for a particular snippet of data. The bandwidth capacity ranges up to 5-12 Mbps for downloads. Along these lines, a site containing heaps of diagrams, pictures can make the application run slowly. Smartphones, often do not have sophisticated file storage structures (Heart 2017). In terms of privacy, cookies play significant role. Each application runs as an independent item and may have very restricted capacity to share information from different applications. However, cookies can store users preferences inside an application and different applications can't access these data (Pulse 2016). As far as security, some smartphones are not structured with sufficient security, for example, a few devices are difficult to update, and some have not many patches accessible for updates. If a cell phone is tainted with portable spyware, it can record passwords for the applications and report it to an outsider. Malware disease can degenerate your cell operating system and make it unusable (Papadopoulos, Diamantaris et al. 2017).

The Pros and Cons of smartphone system are stated below (IOMworld 2018):

### **Pros**

- Faster than Web Apps
- Greater functionality as they have access to system resources
- Can work offline
- Safe and secure — Mobile Apps must first be approved by the App Store
- May be easier to build due to the availability of developer tools, interface elements and SDKs (Software Development Kits)

### **Cons**

- More expensive to build than Web Apps
- Compatibility with different platforms (i.e. iOS and Android) usually means designing and building the App from scratch
- Expensive to maintain and update
- It may prove difficult to get a Mobile App approved by the App Store

#### **1.1.2. PC Based system**

The screen size of the PC based framework is much larger than a smartphone screen. The large screen with fixed navigation bars is very powerful for visibility, since users can see wider range of options. Design functionality is that the desktop content can appear in a traditional multi-column format in a single mode—just like print content in newspapers and magazines. This offers a lot of flexibility for designing layouts and positioning text, images and UI elements. The navigation here is the cursor interactivity: to hover text or cursor-triggered animations. This allows Desktop Apps to feature entire screens full of pictures, with descriptive text appearing on hover (IOMworld 2018). When briefed about search results it is easy for Information Retrieval (IR) and access: results of a search are presented on a large screen display and there exists a rich environment for interaction (Sweeney and Crestani 2006). In a PC typing is using a desktop can allow a much broader ease of typing to these networks with access to a full physical keyboard; desktop keyboard is easier because of the access to keys using all ten fingers. The portable features include sitting at a desk, frequently in an office environment, often working, sometimes randomly surfing the web and focused on the computer, not so much on their environment. The bandwidth is up to 50Mbps for a broadband internet user. Hence it can have documents and lot of flashy things that the mobile app cannot have (Heart 2017). In terms of privacy, cookies play a significant role here. While users always have the ability to delete their cookies and may use more than one browser, overall, desktop remains a relatively

hospitable environment for a comprehensive cookie profile (Pulse 2016). In terms of security, web sites keep track of users and sessions by using cookies. So, by storing some state (in the form of cookies) on the client side, an advertising or analytics company can identify a user along with interests, preferences, or past stored details (Papadopoulos, Diamantaris et al. 2017). The Pros and Cons of PC based systems are stated below (IOMworld 2018):

### **Pros**

- Do not need to be downloaded or installed — Web Apps function in-browser
- Easy to maintain — they have a common codebase regardless of the mobile platform
- Centrally updated
- Quicker and easier to build than Mobile Apps
- Do not require App Store approval, so can be launched quickly

### **Cons**

- Do not work offline
- Slower than Mobile Apps, and less advanced in terms of features
- May not be as discoverable as Mobile Apps as they are not listed in a specific database, such as the App Store
- Quality and security are not always guaranteed — Web Apps do not need to be approved by the App Store
- Being internet dependent, they cost more on bandwidth usage.

## **1.2. Healthcare System Usability**

This article from (Christopher Copeland 2018) takes support from earlier works where the mobile user is imagined as patient and medical applications. This article also discusses about m-health philosophy and UI. Hence the project is being further refined to improve the HCI and symptom-checking paving way to future design prospects.

Some design concepts from prior work can be added as a reference for how good a symptom checker can be designed

- User interface design, for example, straightforwardness, consistency, and input are given priority
- Popular applications, for example, Instagram, Twitter, and Netflix have a common format that may prefer to a greater extent

Smartphones are quickly developing from being exclusively tools for correspondence and amusement to incorporate particular applications (Kassianos, Emery et al. 2015).

### 1.3.Symptom Checker

Symptom checkers are programs that enable users to present a lot of symptoms and produce a diagnosis list, wellbeing data or triage. Utilizing modernized calculations, Symptom checkers ask users a progression of inquiries about their symptoms. The algorithms may be constantly updating. Symptom checkers serve two principle capacities: to encourage self-analysis and to suggest next action (Semigran, Linder et al. 2015).

#### 1.3.1. Smartphone-based symptom checker

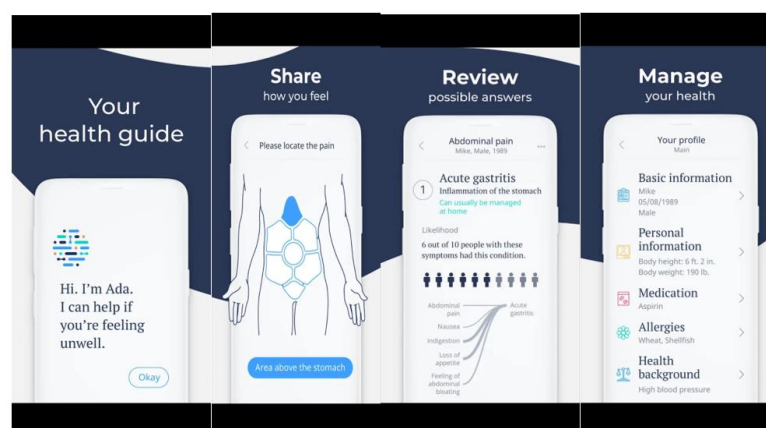
##### 1.3.1.1.Ada

#### Description

Established in 2011 by a group of specialists, researchers, and designers to help clinical basic leadership services. Ada was introduced in 2016 and has been used in more than 130 nations (DigitalHealthConnect 2018). The application works with a conversational interface (Shead 2017).

#### Ada Screenshot

Figure 2.1. Ada Screenshot



Source: (Ada mobile application)

#### Features

The features for Ada are listed below (DigitalHealthConnect 2018):

Developer: ada's fundament is medical expert-knowledge condensed in MDL (Model Description Language) transformed into a heuristic reasoning-engine sharpened by data learning.

Price: There is no associated cost with this app.

Platform: AI-powered health platform.

The credibility of Information: According to the website, “Ada asks about the most important symptoms and gives the appropriate diagnoses as Ada can be integrated into provider websites, portals, and apps”.

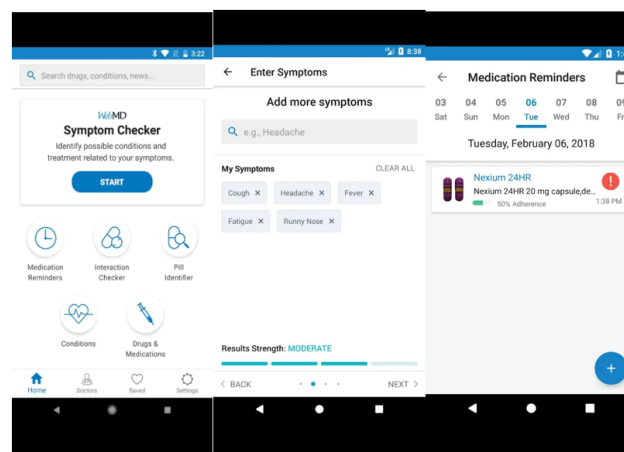
### 1.3.1.2. WebMD

#### Description

WebMD Health Corp (WebMD) is a US-based organization, occupied with giving health data administrations to buyers, doctors and other social insurance experts, bosses and wellbeing plans through its open and private online entries and health-centered distributions. (WebMDHealthCorporation 2017).

#### WebMD Screenshot

Figure 2.2. WebMD Screenshot



Source: (WebMD mobile application)

#### Features

There are several features that can be considered to say that WebMD app was created to interact and provide service, support, and advice. The features are listed below: (Krauskopf 2018).

Developer: The app was developed by WebMD, a large well-known physician-led organization that delivers credible health information on the internet.

Price: There is no associated cost with this app.

Platform: The app is available in the iOS operating system

The credibility of Information: Information available on this app has been reviewed for accuracy by numerous WebMD board-certified physicians and staff. This information is from the WebMD website to specify their source of information is credible.

However, it is argued that the app does not replace the care of a treating health care provider, but it provides resources to aid the patient in tracking and monitoring her pregnancy (Nathan 2013).

### 1.3.2. PC based Symptom Checker

#### 1.3.2.1. Symcat

##### Description

A free application that enables clients to put in various Symptoms and get analyzed dependent on Symptom scoring, information and wellbeing patterns. Symcat is a symptom checker that utilizes existing patients records to compare with the data the user has entered. At present, it covers 474 side effects, around equivalent to WebMD (NationalAcademicofSciences 2015).

##### Screenshot

Figure 2.3 Symcat Screenshot

The screenshot displays the Symcat website interface. At the top, there is a navigation bar with the Symcat logo, 'Sign in', 'Sign up!', and a search bar labeled 'Search all topics'. Below this, a large white box asks 'What is bothering you today?' with an 'Enter a symptom' input field and a 'Find' button. An example list of symptoms is provided: 'Cough Fever Sharp abdominal pain Headache Vomiting Sharp chest pain Back pain Sore throat Shortness of breath Nasal congestion'. Below the example, there are three icons: 'Dashboard', 'Hospital Shopper', and 'Medication Checker'. The main content area is divided into two sections. The left section has a sidebar with 'Symptoms', 'Demographics', 'History', 'Pathways', and 'Find care'. The right section is a form titled 'You are...' with a 'Female' gender selection, an 'Age' field, and a 'years' unit. Below this, there are buttons for 'Asian', 'Black', 'Hispanic', 'Indian', 'White', 'Middle Eastern', 'Native American', and 'Other race'. A 'Next' button and a 'Medical history' link are also present. On the far right, a green box titled 'Thinking about...' lists several conditions with their percentages: 'Common cold (20%)', 'Hypertension (20%)', 'Osteoarthritis (15%)', 'Hypocalemia (8%)', 'Infectious gastroenteritis (7%)', and 'Pneumonia (5%)'. A 'Review my responses so far' button is at the bottom of this list.

Source: (Symcat 2019)

## Features

**Developer:** It's a data-driven diagnosis developed with the use of machine learning algorithms to calculate disease frequency and likelihood based on patient data.

**Platform:** This app serves as a license to health plans to offer Symcat technology as an API (Application Programming Interface) and widget form.

**Price:** There is no associated cost with this app.

**The credibility of Information:** According to the website, “the software's simple interface lets users type symptoms into a search box, prompts them with follow-up questions, and then compares the responses against patient data from the Centers for Disease Control and other public sources”.

### 1.3.2.2.Isabel

## Description

The Isabel framework was initially begun as philanthropy in 2000 yet changed over to revenue driven business in 2004 to guarantee that it had adequate subsidizing to keep building up its system.

## Screenshot

Figure 2.4 Isabel Screenshot

The screenshot displays the Isabel Symptom Checker interface, which is divided into three main sections: a form for entering symptoms, a list of possible conditions, and a query details section.

**Enter your symptoms:** This section includes fields for Age (Please select), Gender (Female, Male), and Region (select region). Below these is a text area for "Describe in your own words OR select symptoms from list:" and a "Search" button.

**Possible Conditions:** This section lists conditions such as Scarlet Fever, Dengue Fever, Hodgkin Disease, Relapsing Fever, Chikungunya, Endocarditis, Malaria, Acute Appendicitis, Crohn Disease, and Cat-Scratch Disease. Each condition has a "show 10" button and a "common" label.

**Isabel Symptom Checker:** This section displays the "Query Details" table, which contains the following information:

Query Details	
Age	young adult (17 - 29 yrs)
Gender	female
Pregnancy	not-pregnant
Region	South Asia
Speciality	General
Symptoms	fever

Below the query details is a "comments" section with a "show 10" button and a "common" label.

Source: (Isabel 2019)

## Features

The features are listed below (Berwick 2014):

**Developer:** They are developed using statistical natural language processing (SNLP) applied to a database. SNLP software understands the meaning and concepts within natural language. The most important part of the SNLP application is the database and how the system is trained.

**Platform:** Isabel can integrate at a 'light level' using the address query string method or be fully built into another system using published Application Programming Interfaces (API).

**Price:** Weekly, monthly and annual subscriptions are available to meet varying needs. With the weekly option, use Isabel for those important case challenges for less amount as a donation to the charity cause taken by Isabel. Please note that the app is free to download but you need to take out a subscription to access the system.

**The credibility of Information:** According to the website, "Isabel has undergone a continual validation process since 2002. The published papers can be accessed from the Isabel Healthcare website".

The approval procedure extensively falls into three classes:

- Accuracy considers all things considered when given the underlying exhibiting clinical highlights, Isabel included what ended up being the last finding in 95% of cases.
- Utility examinations: all in all, around 10-12% of situations when Isabel was utilized it helped the clinician to remember a significant determination which doctors foresee. At the point when done live crosswise over three NHS emergency clinics, it was discovered that in a fourth of these cases it ended up being the right analysis.
- Impact examines: These examinations are not homogeneous and can be hard to complete since not very many foundations as of now take a gander at the effect of postponements in analysis all alone tasks (Berwick 2014). The impact is related to use. The system that is hard to use will have less impact.

It very well may be expressed that the upside of the way Isabel works utilizing free content is that it empowers it to incorporate effectively with different frameworks and keep away from the requirement for encoded information that has been the incredible shortcoming of different frameworks.



## **1.4.Implications of using Symptom checker**

### **1.4.1. How accurate is Symptom checker?**

This thesis is not focussed on accuracy but focusses on perceived usability and benefits. However, there has been some tests on accuracy.

A paper in 2015 (Semigran, Linder et al. 2015) makes examinations with 23 Symptom checkers and 45 patients. They selected Symptom checker that was in English, was allowed to utilize free of cost, was accessible to open, just for people (not for a veterinary reason) and applications that were not used to decide just a single situation. From this article, with 20 scenarios, 58% of the results from symptom checkers were similar to that of human experts. Taking the help from (Lupton and Jutel 2015) symptom checkers are expressed as its like having doctor in the pocket. Likewise, it indicates that Symptom checkers enable the users to choose the piece of the body from body part diagram that is disturbing, at that point pick the side effects and discover an answer subsequently being precise. These are the applications that are created to inspire and deal with the wellbeing. The principal goal of uses is to furnish patients with accurate details.

### **1.4.2. How Symptoms are interpreted**

As per (Nancy McMillan 2014) from the time dataset is transferred in the SQL database, age of queries and explained time arrangement model is resolved. A framework for foreseeing the rate of illness or confusion incorporates a PC based Symptom checker for creating an organized dataset, an information examination segment for delivering a multivariate dataset from the organized dataset, and an element development part for delivering a direct mix of symmetrical images illustrative of an ailment or turmoil.

## **1.5.Potential Benefits and Drawbacks of symptom checker**

There are diverse positive conceivable outcomes of Symptom Checker. Despite the fact that there are restrictions, it gives an end symptomatic precision of Symptom checkers can be improved after fitting input. There is dependably a developing dimension for symptom checkers which is sufficient to make a future degree to become more grounded. The principal advantage that is engaged here is Symptom checkers cannot exclusively be the advantageous instruments for specialists yet, in addition, give the entrance to social insurance in low asset settings, for example, in country regions or creating nations. Symptom checkers are calculation based instruments for self-finding and self-triage. The expanding access to the Internet empowered these sorts of electronic human services administration including Symptom

checkers. Symptom checkers cannot exclusively be the gainful devices for patients yet additionally give the entrance to social insurance in low asset settings, for example, in country regions or developing countries. They make a conclusion of an ailment dependent on the information on the commonness of illness and its affectability and specificity of symptoms (Morita, Rahman et al. 2017).

People want to discover answers to their issues or their infirmities. An individual experiencing a sore throat may Google it and locate any number of answers to their issues, and there might be fulfillment or expanded stress. This makes self-finding famous among people. Conversely, the advantages just as the downsides make it as an adequate contention. The point of seeing how the web is being utilized identified with self-analysis, advance the positive activities, and demoralize the negative ones makes this article pertinent for research. The benefits and risks are expressed below (Gass 2016):

#### **1.5.1. Benefits**

Health data is in bounty on the World Wide Web, giving individuals the chance to investigate their health from the solace of their homes. For patients, it is the entryway to the wiped-out job that legitimizes experiencing and take-off ordinary social jobs as suitable and irreproachable. Decides if the faulty manifestations could suggest a significant issue or whether they are unsupported. Individuals can utilize the web to comprehend potential conditions before observing their specialist. Ready to recognize dangers or signs that somebody may need further therapeutic consideration.

#### **1.5.2. Risks**

Web access might be constrained in specific territories. Question is the means by how precise is the data. It may not comprehend the data introduced to them accurately and attempt medications that can hurt them and difficult for certain individuals to recognize realities and thoughts.

### **1.6. Usability of Symptom Checker**

#### **1.6.1. What is usability testing?**

Usability deals with the degree to which an item can be utilized by determined clients to accomplish indicated objectives with effectiveness, efficiency, and satisfaction in a predetermined set of utilization outline the objective of convenience. The learnability, efficiency, memorability, error rate and satisfaction are also elements of usability. These are techniques for testing and watching the conduct of the users to discover what works and what

doesn't work. Users are given explicit errands to finish and when they are grinding away, onlookers watch their activities and encourage them to think aloud whatever strikes a chord while utilizing the application. Doing this activity, the qualitative and quantitative information can be accumulated and the usability issues can be related to the application (Hustak and Krejcar 2016).

### 1.6.2. Why usability testing is important

Usability testing diminishes the danger of utilizing the wrong application from the perception procedure by the users along these lines sparing time, cash and different assets. During the time spent in usability testing the nature of the item is showing signs of improvement, the interface is likewise improving. In this manner, the item is acknowledged all the more promptly by the end users. It finds those bugs that had not been seen by the designers or had been missed during the presentation of different sorts of testing. Some of the other benefits are stated below (Quovantis 2017):

- To check if the product meets the user's expectations
- Matches business decisions to real-world use
- Removes flaws in the application and recommends what the users expect
- Allows to see how successful users are with their tasks
- Useful for getting user reactions and feedback about the application

### 1.6.3. Components of Usability to be tested in this research

Below are the usability criteria in table 2.1 considered through in this research and the brief description of the principles adopted (Alan J. Dix, Janet E. Finlay et al. 1980).

Table 2.1 Usability Components

Usability Components	Principles
Learnability - The ease with which users can do effective interaction and achieve maximal performance	Familiarity
	Consistency
Flexibility - The multiplicity of ways the user and system exchange information	Task Migratability
Robustness – The level of support provided to the user in determining successful achievement and assessment of the goals	Recoverability

Source: (Alan J. Dix, Janet E. Finlay et al. 1980)

**Familiarity**– For new user, familiarity estimates the relationship between users existing learning and the information required for successful communication. It is the user's early introduction of utilizing the application.

Consistency – It is the most broadly utilized rule in the interface plan. It tends to be communicated as far as information articulations or yield reactions. For instance: the position of keys in the keyboard like the up, down, left or right key which is available in the framework and not in portable.

Task Migratability – It worries on managing the assignment between the user and the framework. For instance: Spell-check and auto-suggest of words.

Recoverability – It is the capacity to achieve the yield regardless of whether a few issues happened. The activities incorporate can the activity be fixed rather than re-try, adaptation to internal failure, can the information be recuperated after each login and so on.

## **2. Methodology**

### **2.1.Introduction**

In the previous chapter, the literature articles were discussed on comparing the pros and cons of using PC and smartphones. Based on it, the information on the Symptom checkers used in this research was presented. The possible perceived benefits and usability issues were also analyzed. In this chapter, the different research methodology sections adopted in this study is analyzed.

### **2.2.Think-Aloud Protocol**

Think-aloud is a technique that begun in cognitive psychology and was adjusted to give usability analysts understanding of the participants psychological procedure when utilizing a system. The think-aloud methodology permits the location of more serious and repeating issues than master based techniques. The think-aloud process procedure involves mentioning that people verbally process while dealing with an issue and analyzing the resulting verbal output. The think-aloud strategy is a stand-out of information on intellectual methods (Maarten W. van Someren, Yvonne F. Barnard et al. 1994). The assessment procedure of usability testing utilized in this exploration is the think-aloud protocol. The think-aloud process during the use of the product reveals fundamental suggestions about how they are contemplating the thing or system they are using and whether the manner in which it works organizes with the way in which it was made (Rubin. and Chisnell 2008)

### **2.3.TAM**

The TAM questionnaire has been broadly utilized and approved and for this situation is altered with the goal that it is suitable for this kind of programming. TAM utilizes a Likert scale to distinguish how much users concur with statements identified with the usability and potential value of an item. This methodology enables both triangulation between how much individuals are happy with the interface and furthermore enables the researcher to find whether the members believe the product would be valuable for them later on. The TAM model suggests that individuals are likely to utilize software that is easy to use and possibly helpful and these outcomes will be utilized as a component of the comparison between the systems (Qingxiong Ma and Liu 2004).

### **2.4.Approach**

Usability testing with the think-aloud protocol is an interpretivist approach, where the researcher would like to distinguish usability issues dependent on what the members state about

their experience of utilizing a device while they are utilizing it. This qualitative information is coded to recognize basic issues and topics. In practical terms, the participants will be given a rundown of various imaginary symptoms for each trial (one for each system being tried) and requested to utilize the system to discover a conclusion. During this procedure they are approached to state what they are doing, and particularly state if there are any points at which they are uncertain what to do straight away, why they are making the following action and whether they are especially frustrated or assisted by the interface being utilized. The users may make recommendations with respect to how the interface could be improved. The researcher makes notes and sound records the procedure so as to make a transcript and code this. Toward the end, the participant is asked as to whether they might want to make many general remarks or have any impressions of the procedure.

#### **2.4.1. Process of Think-Aloud protocol and TAM**

After welcoming the participant, explaining the experiment and answering any questions the participant was asked to read and sign the consent form by the researcher. For each of the four software products, the participant was given a list of imaginary symptoms and asked to use the software to find a diagnosis. The participant was asked to say what they are doing and what they were thinking during the process. The researcher is present and audio recording the participant. If the participant is not speaking the researcher may prompt them, in some cases the researcher may ask for clarification, but the objective is to avoid coaching or leading the participant. This section ends with the participant either obtaining a diagnosis or giving up. The participant was then invited to make any general comments or observation. The participant was then be asked to complete the TAM questionnaire. This process is then repeated for the next 3 software products. They are presented in random order and with a different set of imaginary symptoms for each one. At the end of the study the researcher thanked the participant and asked if there is anything they want to add. The participants can withdraw at any time and the whole process takes an hour.

Thematic network analysis was used for the think-aloud data and descriptive statistics for the TAM results.

Some TAM model-based questions that are used for this research are as follows:

EOU3: My interaction with the symptom checker is clear and understandable

EOU6: I find the symptom checker easy to use

EU4: Learning to operate the symptom checker is easy for me

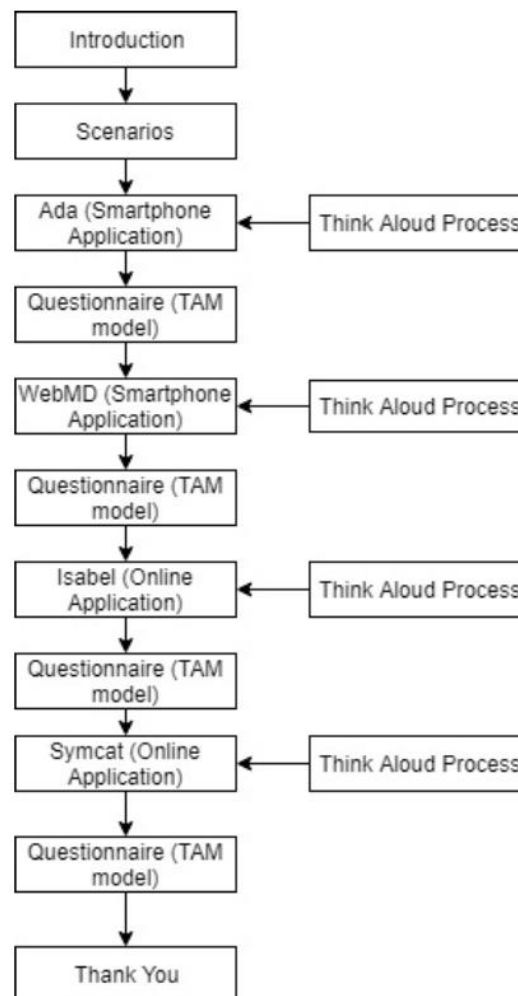
A1: Using this symptom checker is a good idea

Affect1: I like using this symptom checker

## 2.5.Process Flowchart

The process flowchart used in this research is depicted in the figure 3.1:

Figure 3.1 Process Flowchart



## 2.6.Benefits of TAM

TAM incorporates Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) which are the significant determinants of innovation acknowledgment and users conduct. These two variables make TAM a powerful model. Likewise, it is a parsimonious hypothesis which means that individual reactions toward innovation can trigger expectations or interest to utilize the innovation, which at the appropriate time can impact real use. PU is the degree to which an individual trust that using a specific strategy or system would improve his or her activity

execution or routine obligation. PEOU is the degree to which an individual think that utilization of a particular system would be easy and hassle-free. Accordingly, an application that is seen to be simpler to utilize is commonly acknowledged and used by more individuals. TAM is a well-known model for foreseeing user acceptance of information technologies (Durodolu 2016). Due to these benefits, TAM has been used in this research.

### **2.7.Benefits of Think Aloud Protocol**

Think Aloud protocol is a discerning and instructive technique and when utilized successfully can result in a lot of data, with respect to an interface. The principal focal points of this strategy are as per the following(Wilson 2015):

- Rapid, high caliber, subjective user criticism (for example as compared with a questionnaire).
- Data is accessible from a wide scope of sources
- Direct perception of what the subject is doing.
- Hearing what the subject needs, or is attempting, to do.
- If the subject gets into challenges, the spectator gets the opportunity to explain the circumstance.
- High level of adaptability; the analysis may effortlessly be guided by the spectator.
- The nearness of two individuals permits important, direct exchange.
- It is inexpensive since it doesn't require any unique equipment. You simply sit beside the participants of the test and record their thinking and conclusions with respect to your item;
- It is anything but difficult to learn;
- In such a way the engineers can comprehend the user's perspective. They can likewise decide and report the issue that the user (or users) can confront.

### **2.8.Target Participants**

As defined by the AUT policy, ethics approval was obtained and then the recruitment of participants was accomplished (Refer **Appendix I Ethics Approval**). Adults who are 25 years and older who are able to use English -language applications effectively and applicants who can be able to use standard online applications.



## 2.9.Symptoms and Task Scenarios

There are four scenarios (Refer **Appendix III Symptoms**) considered which are taken in a randomised order in this research to be tested in the symptom checker applications.

The four symptoms taken into considerations are as follows:

- Skin Problems like Rashes, Acne, Bites
- Flu, Cold, Fever, Sore Throat
- Eye Infections
- Vomiting, Diarrhoea

These are considered as they are familiar and target participants will be happy to use.

## 2.10. Pilot Test

I used the following set of layout and form to record the results obtained from the pilot test.

<b>Total Time:</b> 11.40AM to 01.10PM (1.5 hours)			
<b>Introduction and Scenarios brief:</b> 11.30 to 11.40AM			
<b>Demography of participant</b>	Age- 30	Gender- Female	Profession- Working

Smartphone Symptom Checker- Ada		
<b>Scenario</b>	2	Rashes/ Arm burning/ scratches/ Redness
<b>Time</b>	11.40AM – 12.05PM	
<b>Generic Observation/details required</b>	Sign in using FB, privacy policy acceptance, name/gender/DOB/pregnancy state/smoker/BP/diabetes/start	
<b>Symptoms entered</b>	Rashes, Rash on the back of arms and front of legs	
<b>End result Observation</b>	Repeated questions for every symptom Asks several questions to bring at the right symptom Easy to navigate and says whether physical examiner is required or not No help/ FAQ option available	

Smartphone Symptom Checker- WebMD		
<b>Scenario</b>	1	Fever/ sore throat/ malaise/ dropping nose/ headache
<b>Time</b>	12.05PM – 12.20PM	
<b>Generic Observation/details required</b>	Sign in is not mandatory, age, gender	
<b>Symptoms entered</b>	Fever (how frequent), headache, sore throat, runny nose, MALAISE not found under symptom	

<b>End result Observation</b>	Can select all the symptom at the same time and then can narrow down by ranking which symptom bothers the most. This difference makes the symptom accurate Self-care steps are given It says if we enter zip code says nearby physicians will be displayed but the search button doesn't work No help/ FAQ option available but can give feedback
-------------------------------	--

<b>PC based Symptom Checker- Isabel</b>		
<b>Scenario</b>	3	Sore eye, reddening, blurred vision, headache
<b>Time</b>	12.30PM – 12.45PM	
<b>Generic Observation/details required</b>	Age, gender, region, and symptoms Sign in not mandatory, download guide available	
<b>Symptoms entered</b>	Sore eye and reddening	
<b>End result Observation</b>	Doesn't show relevant results when the sore eye and reddening symptoms added. It gives different suggestions which are medical terms not easy to understand When selected a result displayed for symptoms, it gives explanation from different websites No medications are given	

<b>PC based Symptom Checker- Symcat</b>		
<b>Scenario</b>	4	Stomach pain, diarrhoea, nausea
<b>Time</b>	12.50PM – 13.10PM	
<b>Generic Observation/ details required</b>	Straight into symptoms no details collected, sign in not mandatory Can select all associated symptoms one after other Asks for additional symptoms. Not mandate to select Then asks for demographics and medical history	
<b>Symptoms entered</b>	Stomach pain, diarrhea, nausea	
<b>End result Observation</b>	Gives detailed classification like primary and secondary treatment with an appropriate cost that's helpful	

### 3. Findings and Analysis

#### 3.1.Introduction

The responses collected by the TAM process and Think Aloud process is discussed in this chapter.

#### 3.2.Demography

There were ten participants involved in the interview process. The minimum age criteria for this research was taken as 25 and above. The demography is represented in the table 4.1. It can be seen that 83% of the participant were in the age range of 25-30 and the other age group covered the remaining 17%.

Table 4.1 Demography on Age Factor

Age	Male	Female
25-30	2	2
31-35	1	1
36-40	0	1
41-45	0	1
46-50	1	0
51+	0	1

#### 3.3.TAM Process

Smartphone and PC based applications as mentioned in table 4.2 was taken in this research and TAM process was performed. The questionnaire (Refer **Appendix II Questionnaire**) had 13 questions with different TAM criteria. The participant had to answer these questions on a 7-point Likert scale basis.

Table 4.2 Applications: Smartphone vs PC

Smartphone	PC Based
Ada	Isabel
WebMD	Symcat

The following are the analysis for all the TAM questions. The questions are in the appendix II for reference

##### 3.3.1. Performance Expectancy Q1

Q1- Using the symptom checker enables me to accomplish tasks easily

Table 4.3 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q1 which measures the performance expectancy. The research suggested that this is one of the most important predictors of the intention to use technology (Viswanath

Venkatesh, Michael G. Morris et al. 2003). The highest mean value is for Isabel. This indicates that Isabel has greater performance expectancy that is the Isabel enables the participant to accomplish tasks easily. A least preferred application is Ada.

Table 4.3 Response to Q1

Applications	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ1	10	<b>1.7000</b>	1.25167	1.567
WebMD	AnswerQ1	10	2.1000	0.73786	0.544
Isabel	AnswerQ1	10	<b>4.4000</b>	1.89737	3.600
Symcat	AnswerQ1	10	2.6000	1.34990	1.822

Source: (SPSS)

### 3.3.2. Effort Expectancy Q2, Q3, Q4

Q2- My interaction with the symptom checker be clear and understandable
Q3- I find the symptom checker easy to use
Q4- Learning to operate the symptom checker is easy for me

Table 4.4 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q2, Q3, and Q4 which measures the effort expectancy. Effort expectancy is found to be the strongest predictor, closely followed by performance expectancy (Viswanath Venkatesh, Michael G. Morris et al. 2003). Isabel takes the lead in Q2 which means the participants feel that the interaction with the symptom checker is clear and understandable. Symcat takes the lead for both Q3 and Q4. This means that Symcat is easy to use and learning to operate this application is easy. The least preferred is Ada in terms of effort expectancy.

Table 2.4 Response to Q2, Q3 and Q4

Applications	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ2	10	<b>1.4000</b>	0.51640	0.267
	AnswerQ3	10	<b>1.4000</b>	0.96609	0.933
	AnswerQ4	10	<b>1.4000</b>	0.51640	0.267
WebMD	AnswerQ2	10	2.2000	0.42164	0.178
	AnswerQ3	10	2.3000	0.48305	0.233
	AnswerQ4	10	2.3000	0.48305	0.233
Isabel	AnswerQ2	10	<b>3.5000</b>	1.71594	2.944
	AnswerQ3	10	2.2000	0.63246	0.400
	AnswerQ4	10	2.5000	1.08012	1.167
Symcat	AnswerQ2	10	2.7000	1.33749	1.789
	AnswerQ3	10	<b>2.5000</b>	1.35401	1.833
	AnswerQ4	10	<b>2.6000</b>	1.34990	1.822

Source: (SPSS)

### 3.3.3. Attitude towards using technology Q5, Q6

Q5- Using this symptom checker is a good idea
Q6- I like using this symptom checker

Table 4.5 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q5 and Q6 which measures the attitude towards using technology. The attitude towards using the technology is inter-related by perceived ease of use as well as perceived usefulness (Viswanath Venkatesh, Michael G. Morris et al. 2003). Here Isabel is again preferred by the participants. This means that using Isabel is a good idea and people like using it. Ada takes the least preference.

Table 4.5 Response to Q5 and Q6

Applications	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ5	10	<b>1.8000</b>	0.91894	0.844
	AnswerQ6	10	<b>1.7000</b>	1.25167	1.567
WebMD	AnswerQ5	10	2.5000	0.70711	0.500
	AnswerQ6	10	2.4000	0.96609	0.933
Isabel	AnswerQ5	10	<b>4.0000</b>	1.49071	2.222
	AnswerQ6	10	<b>4.1000</b>	2.02485	4.100
Symcat	AnswerQ5	10	3.2000	1.39841	1.956
	AnswerQ6	10	3.1000	1.37032	1.878

Source: (SPSS)

### 3.3.4. Facilitating Condition Q7

Q7- The symptom checker is not compatible with the other systems I use
--

Table 4.6 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q7 which measures the facilitating conditions. Here Isabel takes the least value as the participants feel that this symptom checker is not compatible with the other systems.

Table 4.6 Response to Q7

Application	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ7	10	3.7000	1.33749	1.789
WebMD	AnswerQ7	10	<b>4.6000</b>	1.17379	1.378
Isabel	AnswerQ7	10	<b>3.6000</b>	0.96609	0.933
Symcat	AnswerQ7	10	3.8000	1.39841	1.956

Source: (SPSS)

### 3.3.5. Self-Efficacy Q8, Q9

Q8- I will complete a task using the symptom checker when no one around me to tell what to do
---

Q9- I will complete a task using the symptom checker if I had the built-in help facility for assistance
---

Table 4.7 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q8 and Q9 which measures the self-efficacy. Higher the self-efficacy there will be a greater sense of satisfaction and people prefer it for the more difficult task and will not avoid using the application (Chen 2014). Here Symcat takes the lead in both Q8 and Q9. This means that the participants find it easier to use without anyone to help compared to the other applications. Also, if there was a built-in help facility for assistance, they would be able to complete the task more efficiently. Here, again the least preferred application is Ada.

Table 4.7 Response to Q8 and Q9

Application	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ8	10	<b>1.7000</b>	0.67495	0.456
	AnswerQ9	10	<b>3.2000</b>	2.20101	4.844
WebMD	AnswerQ8	10	2.5000	1.64992	2.722
	AnswerQ9	10	3.7000	2.00278	4.011
Isabel	AnswerQ8	10	2.7000	1.33749	1.789
	AnswerQ9	10	3.4000	1.77639	3.156
Symcat	AnswerQ8	10	<b>3.6000</b>	2.22111	4.933
	AnswerQ9	10	<b>4.0000</b>	2.05480	4.222

Source: (SPSS)

### 3.3.6. Anxiety Q10, Q11, Q12

Q10- I feel apprehensive using this symptom checker
Q11- It scares me to think that I could lose a lot of information using the system by hitting the wrong key
Q12- I hesitate to use the system for fear of making mistakes I cannot correct

Table 4.8 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q10, Q11, and Q12 which measures the anxiety of using the application. This part has a slight variation when compared to the other questions. Anxiety is system-independent, anchoring constructs that play a critical role in shaping perceived ease of use about a new system, particularly in the early stages of user experience with a system. Lower the anxiety better is the performance (Chen 2014). Here the WebMD takes the lead in all the three questions. This means that participants feel apprehensive using this symptom checker. This is not a positive response for the application as people fear that something bad or unpleasant will happen. That is, they fear some sort of information which they entered might get lost by hitting one wrong key and it can't be corrected easily. Thereby, participants refuse to use this

application. Here, Isabel is the application which people don't feel apprehensive to use. There might be some glitches in retaining the information they enter like age, gender, some previous medical complications, etc in Isabel which result in repeated entries and therefore Symcat is preferred as they are no possibilities of making mistakes.

Table 4.8 Response to Q10, Q11 and Q12

Application	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ10	10	5.0000	1.63299	2.667
	AnswerQ11	10	5.8000	1.61933	2.622
	AnswerQ12	10	5.9000	1.66333	2.767
WebMD	AnswerQ10	10	<b>5.2000</b>	1.61933	2.622
	AnswerQ11	10	<b>6.0000</b>	0.94281	0.889
	AnswerQ12	10	<b>6.0000</b>	0.94281	0.889
Isabel	AnswerQ10	10	<b>4.8000</b>	1.54919	2.400
	AnswerQ11	10	5.7000	0.82327	0.678
	AnswerQ12	10	5.9000	0.87560	0.767
Symcat	AnswerQ10	10	5.0000	1.49071	2.222
	AnswerQ11	10	<b>5.5000</b>	1.17851	1.389
	AnswerQ12	10	<b>5.8000</b>	1.03280	1.067

Source: (SPSS)

### 3.3.7. Behavioral Intention to use the system Q13

Q13- I plan to use the system in the next few months

Table 4.9 summarises the responses measured in terms of Mean, Standard deviation and Variance for Q13 which measures the behavioral intention to use the system. Behavioral intention means technology acceptance. Also, even the inexperienced and experienced people are willing to use this technology (Alharbi, Saleh et al. 2014). Isabel takes the lead mean value which implies that the participants prefer to use this symptom checker in the next few months. The least value again Ada takes.

Table 4.9 Response to Q13

Application	Question	N	Mean	Standard Deviation	Variance
Ada	AnswerQ13	10	<b>2.0000</b>	1.41421	2.000
WebMD	AnswerQ13	10	3.4000	1.42984	2.044
Isabel	AnswerQ13	10	<b>5.0000</b>	1.76383	3.111
Symcat	AnswerQ13	10	3.2000	1.54919	2.400

Source: (SPSS)

### 3.3.8. Results of TAM

The total mean value of all the four applications is depicted in table 4.10:

Table 4.10 TAM result summary

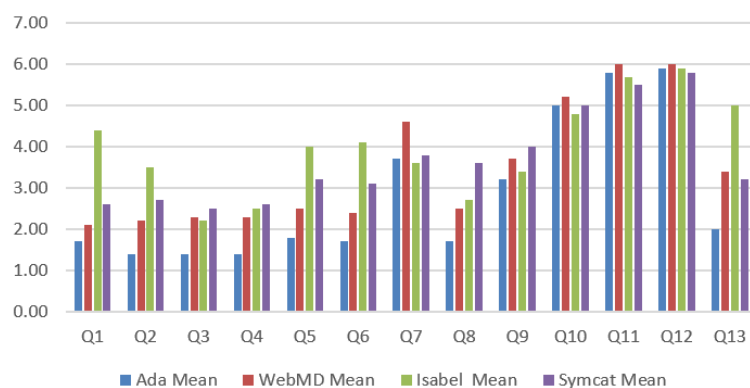
Application	Ada		WebMD		Isabel		Symcat	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Question1	1.7000	1.25167	2.1000	0.73786	4.4000	1.89737	2.6000	1.34990
Question2	1.4000	0.51640	2.2000	0.42164	3.5000	1.71594	2.7000	1.33749
Question3	1.4000	0.96609	2.3000	0.48305	2.2000	0.63246	2.5000	1.35401
Question4	1.4000	0.51640	2.3000	0.48305	2.5000	1.08012	2.6000	1.34990
Question5	1.8000	0.91894	2.5000	0.70711	4.0000	1.49071	3.2000	1.39841
Question6	1.7000	1.25167	2.4000	0.96609	4.1000	2.02485	3.1000	1.37032
Question7	3.7000	1.33749	4.6000	1.17379	3.6000	0.96609	3.8000	1.39841
Question8	1.7000	0.67495	2.5000	1.64992	2.7000	1.33749	3.6000	2.22111
Question9	3.2000	2.20101	3.7000	2.00278	3.4000	1.77639	4.0000	2.05480
Question10	5.0000	1.63299	5.2000	1.61933	4.8000	1.54919	5.0000	1.49071
Question11	5.8000	1.61933	6.0000	0.94281	5.7000	0.82327	5.5000	1.17851
Question12	5.9000	1.66333	6.0000	0.94281	5.9000	0.87560	5.8000	1.03280
Question13	2.0000	1.41421	3.4000	1.42984	5.0000	1.76383	3.2000	1.54919
Total Mean	36.70000		45.20000		51.80000		47.60000	

Source: (SPSS)

It can be seen that Isabel having the highest mean value indicates that all participants prefer using Isabel. The least mean value is Ada which means it is the least preferred application in terms of TAM analysis.

The graphical representation of the mean value comparison is found in figure 4.1.

Figure 4.1 TAM mean results



Another keen observation from TAM result is that participants prefer PC based symptom checker compared to mobile-based symptom checker.



### 3.4.Think Aloud Process

For the same applications with Smartphone and PC based, think aloud process was also performed. Participants after answering 13 questions or during the process of working on the applications gave several inputs featuring both positive and negative impacts.

#### 3.4.1. Participant responses

Although the participants were provided enough time to think aloud, in most cases, they said little. All the responses given by the participants are summarised in table 4.11 for all the symptom checkers considered in this research.

Table 4.11 Participant Think Aloud Responses

	Ada	WebMD	Isabel	Symcat
P1	*Suitable for all ages *Only asks yes/No questions * Time-consuming	*Complicated *More medical terms	*Difficult for unknown symptoms *It is like Google *No reports * no need to install as readily available	*Not suited for elderly *Not Legible *Not user-friendly *Single question- too many options *Easy desktop navigation *Easy Visualisation
P2	*routed symptoms * asks too many questions * Not accurate. Gives only possible causes * No speech recognition	* asks age/gender details * asks for current medications * faster than Ada	*gives a wider range of results * Red flag is there. Appreciated	* Navigation not good * Not clear on what is happening
P3	*Easy *Gives doctor advice *Outcome is decent	* not preferred * Not relevant answer * Messy	* was ok * Similar to WebMD * Asks only symptoms	* Nice to start with * didn't answer for the symptoms * not to use
P4	*very good *so many questions but are relevant	* excellent explanation * variety of choices	* simple symptoms have more medical terms * difficult to understand the terms	* more informative * straight forward * simple * easy to understand
P5	*easy navigation * clear questions * simple * relevant result * like most of the recent applications	* similar to Ada * easy/quick result * Navigation good as it shows process steps	* no dropdown options * more information	* fast * adjacent tabs are confusing
P6	*better accuracy *asks too many questions	*fast *asks only a few questions * format is good * not relevant result	* Fewer options * complicated if illiterate	*too many questions * not good navigation * complicated but better than Isabel
P7	*can be better * too many questions * cannot have patience in terms of pain	*not comfortable to use *less user-friendly	* wider result * can learn new terms	* similar to Isabel * not user-friendly
P8	I used all symptom checker and found it useful.			
P9	I tried all the symptom checker as recommended. I found Ada more useful. The downside is it asks too many questions. Found WebMD has a good format. The other two is complicated.			
P10	While using Isabel the user option changed automatically. No list to select symptoms from.			

The smaller number of statements received from the participants may imply that in most cases users find the symptom checker easy to use.

Some of the quotes given by the participants are listed below

- Ada- pops out 'if doubt asks the doctor'. Then why use this symptom checker?

- The functionality of Ada in the format of Isabel preferred
- WebMD- If symptoms are for head, it asks symptoms for eyes
- WebMD- It's like seeing a doctor. No detail
- Symcat- No point when it prescribes doctor

### **3.5.Observation and Difficulties**

Few other observations and difficulties are summarised as follows:

#### **3.5.1. Researcher Observation**

The participants did not like the functionality but liked the feature of the application. After studying participants, it felt that they prefer Ada from the way they are featured. For participants who performed the task on Ada first, liked it. For participants who worked on other symptom checkers first before performing the task on Ada, didn't like the feature of Ada.

Order of use appears to be important. Participants when working on with Isabel didn't like it at first. But when the final reports were displayed, they felt its more informative. That is evident from the result of TAM. From think aloud perspective, people liked the features of Ada but didn't like its functionality.

Time taken to complete tasks varied with participants. The allotted time for each participant was 60 minutes. For participants who were above the age of 40 took more than 60 minutes as they are not used to work with these applications. On the other hand, young age group above 25 and less than 40, was able to finish it in 25 minutes on all the four applications. The other reason for this rapid response is that they are technically sound people.

Speech recognition may be important but there is none there in the applications used. Participants raised questions on how these applications would work for elderly and disabled people. There is no speech recognition like Siri in Apple.

Participants felt it would be better if language compatibility was there in the applications. All these applications are in only one language. It would be better if any translations or different language options would be available.

Saving the result of the report appeared to be a priority. Symptoms were checked and reports were generated as a summary. Most of the participants felt that there could have been an option either to save or print.

### **3.5.2. Difficulties**

Not all the participants gave a detailed think aloud opinion. Was able to get detailed information only from 7 participants. The other 3 participants gave very generic answers like symptom checkers are useful, yes, I worked on all symptom checkers.

Recording the response from the participants was not a smooth process. In between recording had to pause and resume repeatedly as participants had questions about the protocol including should I register or do randomly as a guest, why are you giving me the task scenarios, Should I record after every application or give a summary at the end.

I had to answer questions in-between the process asked by the participants. Instructions were given to use the provided symptoms for the four applications in random order. However, questions were put forth by the participants as to why cannot we use our own symptoms or the same symptoms for the application. In order to preserve privacy and conditions of ethics approval, instructions were again provided to make clear to use the symptoms provided by the researcher.

## **4. Discussion**

### **4.1.Introduction**

This part has the answers to the research questions that are derived from the findings and analysis (Refer Section 4: **Findings and Analysis**). Literature review results are compared with the research findings and discussed.

It is then followed by some recommendations and future scope of this research.

### **4.2.Result Summary**

PC based (Isabel and Symcat) and smartphone-based (Ada and WebMD) symptom checkers were analyzed with 10 participants. Each participant responses were analyzed based on TAM and Think Aloud process. Several positive and negative feedbacks were gathered on all four applications. There is a contrast in TAM and Think aloud results. With TAM, based on SPSS analysis, mean was calculated and it was found that Isabel is highly preferred. On analyzing think aloud, more positive feedback was for Ada. So, it appeared that Ada was preferred. On the whole, the main observation is Ada's feature set was preferred but with Isabel functionality. This also led to a conclusion that PC based application has an edge over a smartphone application. Participants also preferred additional functions like Speech recognition (Siri in apple), Language compatibility, Print and save command. The time taken was related to the age of the user. That is, older adults (40-50+) took more time whereas young adults (25-40) took less time. This paved the way to answer all the research questions which are described in the below sections.

### **4.3.Research Question 1**

- What are the perceived benefits of using symptom checker?

This research investigates what are all the perceived benefits observed in this research. The detailed description is stated below.

- **Facilitate self-diagnosis**

Self-diagnosis is a major benefit that makes people find answers to their ailments. As specified by (Gass 2016) people use the internet to understand possible conditions before seeing a doctor or even making a decision to see a doctor or not. Not using Google, but using the symptom checker to know an answer makes self-diagnosis more popular. The positive feedback from participants supporting the previous study includes it gives doctor advice and it is like Google (Refer Table of **Participant responses**).

However, it is not completely useful for self-diagnosis. Some negative feedbacks from participants include simple symptoms have more complicated terms, gives a wider range of results and difficult for illiterates. For example: When participant entered symptom as 'sore throat', it was asking questions related to ulcer which is not the right question to be asked and also it resulted in providing links to websites which explains what the medical term is. Promoting positive actions and discouraging the negative outcomes in future developments will make self-diagnosis easier.

- **Learn medical terms**

Learning new medical terms is a bonus not only to patients but to students and doctors as well. Isabel is a well fit for this benefit. Participants have said that using Isabel facilitates learning new medical terms. This makes integration of the application with the user to be more active.

- **Other Perceived benefits**

The other benefits observed from this research can be summarised for all four applications. Ada: it's like most of the recently developed application hence used for upcoming generations. WebMD: time-saving. Isabel: Has a red flag which indicates if it's a serious issue or immediate alert is required. Symcat: straight forward questions that in turns saves time.

#### **4.4. Research Question 2**

- What are the usability issues of using symptom checker?

This research investigates what are all the usability issues observed in this research. Usability is important because it specifies how much the product is accepted by the end users. The usability components considered in this research include learnability, flexibility, and robustness. The issues on these usability components observed in this research are addressed below:

- **Irrelevant Details**

Participants felt that sometimes it asks irrelevant questions for the symptoms they entered and eventually decided it will give irrelevant results. For example: If participant entered symptoms related to headache, it asks questions related to arm sore.

Resulting in irrelevant answers to the symptoms participant checked was a major threat to accuracy. Outcomes for Ada was, it is not accurate as it gives only possible causes and it asks only yes/no questions. Many participants felt that it asked too many questions; some are

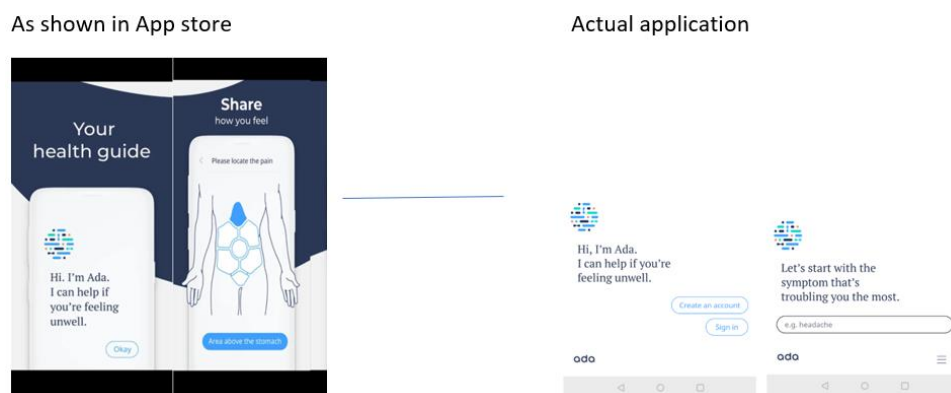
relevant and some are out of focus. WebMD and Isabel are better when compared to Ada. They felt the application asks too many questions but still produces less accurate results. This issue is restricting the users to use the application.

Taking the support from (Lupton and Jutel 2015), it is highly said that symptom checkers are like having physicians in the pocket and the main objective of symptom checker are to provide accurate results to patients. Hence, not providing accurate results is a major usability issue.

A strong recommendation to this from previous studies (Refer section from **How accurate is Symptom checker?**) is that symptom checkers should have body parts diagram so that it allows the user to select the part that is troubling them the most. By doing so, selecting the problem area is highly accurate and thereby the interpretation of the results will also be accurate.

This issue is highly reflected on Ada because while downloading the application from either Google play store or apple store, it gives information saying users can select from the diagram and can specify the symptoms. Once installed and when operating with the application, it directly goes to questions and there are no diagrams. The difference is shown in the figure 5.1.

Figure 5.1 Ada advertised vs actual application



Source: (Ada mobile application)

### ○ Language Compatibility

Participants felt it would have been better if the symptom checkers supports different languages. Questions of how the applications can be used if its available in only one language is another usability issue to be considered. Some of the outcomes are: it is difficult to understand the technical terms. If the same is explained in terms of their comfort language will yield better usage.

When Ada is a global application over 130 countries (DigitalHealthConnect 2018) and said it has a good conversational interface like speaking with a trusted doctor, it has to be available in global languages. It has language options such as US English, UK English, Deutsch, Española, and French which doesn't cover all languages. This makes the application not user-friendly and not suitable for the elders and disabled people who will need language support. For new users, it becomes there is no effective interaction and the first impression of the users using the application is broken. Due to these issues, it is inconsistent resulting in learnability issue which is the usability component.

Here some participants felt it would have been better if there is a speech recognition that can be integrated.

- **Interface Design**

Poor interface design with no proper user-friendly navigation makes it a major usability issue. When there is an interface issue it means there is no consistency. Due to this, participant says that WebMD is messy and less user-friendly whereas in Isabel there is no dropdown option. These are the features of not having good interface design. When considering Symcat the start of the page has good design but as when it progresses, the adjacent tabs are confusing and it is not legible. Participants prefer everything being on a single page like a newspaper.

This can be matched with the previous study that specifies in mobile, we can just alter between portrait and landscape mode but not all information is available in a single view whereas in PC most of the results are in one single page (IOMworld 2018). Hence, this mode of design in a smartphone is another usability issue.

Recommended suggestion taken from the previous study (Refer section from **Healthcare System Usability**) is that to have a consistent layout that users are familiar with applications like Instagram, Twitter, and Netflix (Christopher Copeland 2018).

- **Recoverability**

This is important because it is the level of support provided to the user (Alan J. Dix, Janet E. Finlay et al. 1980). Three questions (Q10, Q11, and Q12) in TAM measuring anxiety exclusively speaks about it. From that result, WebMD is an application where people have the thought that one wrong information, they have to re-enter all the data all over again as the progress is not saved. Participants felt that it is complicated, asks for age/gender/medical history/current medications but no option to save it and have to rework if data is lost. Here

Symcat is preferred compared to all the other three applications, as they don't ask these questions and there is no fear of losing information. Hence, this is supported by a previous study (Refer section **WebMD**) (Nathan 2013) saying that these applications are not a replacement for treating healthcare it serves just like a tracker for monitoring healthcare mostly pregnancies. If there are save, download, print options available it would be a good option to improve recoverability.

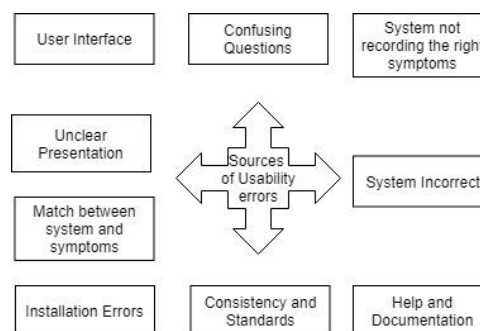
#### ○ **Other usability issues**

The other usability issue observed from this research can be summarised for all four applications. Ada: time-consuming, not enough patience to answer all the questions in terms of pain and has too many routed symptoms. WebMD asks only a few questions and not comfortable to use. Isabel: No overall report generated related to symptom. Symcat: Not suited for elders and the single question has too many options.

### **Summary of the source of the usability errors**

Usability errors are a common occurrence in usability tests and are the result of problems in an interface and imperfect human actions. All the usability issues have a source where the root cause error appears. Generally, it happens by slips i.e. data entry errors, mistakes like clicking wrong field-hint, user interface problems and scenario errors (Souro 2012). Some of these were also identified in this research which is given in the figure 5.2:

Figure 5.2 Summary of usability errors



### **4.5. Research Question 3**

- Which is more preferable: PC based or smartphone-based applications?

This research investigates which is more preferred by participants either the PC based or smartphone-based applications. This can be identified by deriving at the result in regards to security and navigation which were stated as necessary by the participants.



Generally, PC based systems are more popular. People find it easy to use.

- **Security**

In terms of smartphone security, people feel that it is insecure since it is all a third-party service. If an application is not updated or force stopped it cannot be retrieved and cannot be downloaded again. This is so true as said by (Papadopoulos, Diamantaris et al. 2017) mobile spyware is dangerous and does not have sufficient security protection.

In terms of PC security, people feel information retrieval is easy and hence security can be better when compared to a smartphone. This is because of the privacy cookies that make the desktop environment more secure. It is also easy to refer logs to get the attacker details to a certain extent.

- **Navigation**

Most of the participants gave statements saying that both Ada and WebMD (smartphone applications) has good navigation and the process is simple. At the same time, PC applications were stated as navigation is not good. The way it is designed is preferred but the navigation is better in smartphones.

There are relevant explanations given in previous studies (Refer **Smartphone System**) on why it is easier in a smartphone (Sweeney and Crestani 2006). This is because in smartphones navigation is horizontal and hence it is easy for users. Also, the relevant results appear on the first page and users are satisfied with it. There is no necessity for them to hover to different pages. On the other hand, in PC the contents are in a traditional multi-column format with multiple information in a single page. It might be a good display as it is seen in a large screen but just cursor interactivity which is less preferred.

It is seen that in terms of security, people prefer PC based applications and in terms of navigation, people prefer smartphone applications. On considering the results from this research, people prefer using PC based application, Isabel. It takes the lead in both security and navigation as well. Hence, from this research, the answer to the research question is that people prefer PC based applications.

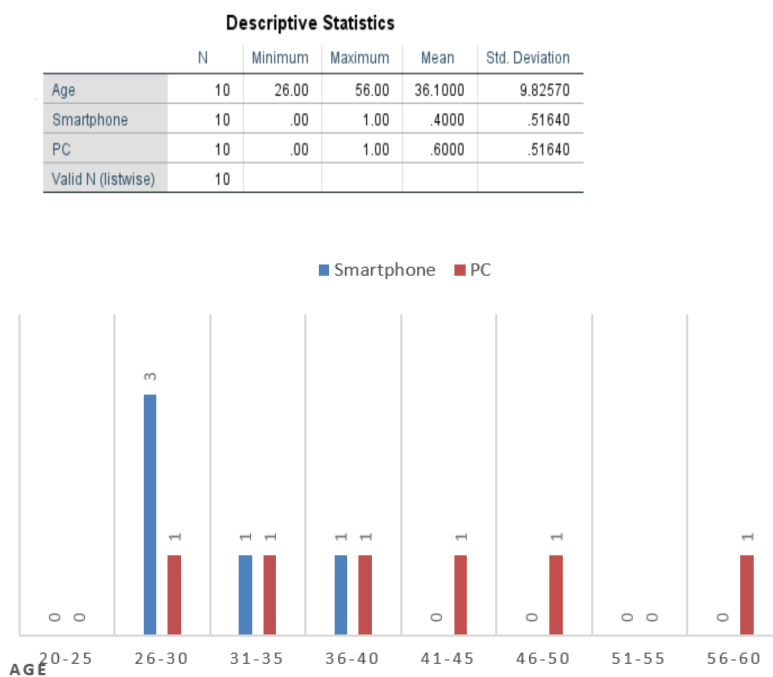
Answering this research question has routed to adding sub-question.

#### **4.5.1. Sub-question for research question 3**

What is the acceptance level of the applications based on age classification?

To answer this question, the below graph and table (figure 5.3) was considered recording the age group of the participants along with their gender and applications used in this research. It can be seen that out of 10 participants, 6 participants preferred PC based application and 4 preferred using smartphone applications. Further, people in the age group of 25-35 mostly prefer using smartphones as they are convenient. But people falling in the age group of 40 and above all preferred PC. In all the age groups, female participants preferred PC applications more than male participants.

Figure 5.3 Acceptance vs Age



Hence, the answer to the question is younger adults with an average age of 36 years preferred PC applications. Altogether, the lead is for PC based applications.

The limitation in this sub-question is that gender is unbalanced (6-female and 4-Male) and hence this question can be analyzed only in terms of age.

#### 4.6. Research Question 4

- Which is more preferred: Smartphone functionality or PC feature?

This research investigates which is more preferred by participants either the feature or the functionality of the applications. A quote specified by one of the participants was that “Functionality of Ada in the format of Isabel preferred”.

- **Feature**

One of the biggest disadvantage specified in the literature (IOMworld 2018) was that PC based applications are less advanced in terms of features. This statement has deviated from the result of this research when considering the above-said quote. This is because a feature of Isabel is highly preferred which is a PC based application. In fact, enabling the feature of PC based application in smartphones will increase the usage of a smartphone application. Good navigation and easy visualization are the positive outcomes observed in this research for PC based features. This makes the justification stronger.

#### ○ **Functionality**

One of the biggest advantage specified in the literature (IOMworld 2018) was that smartphone has greater functionality as they have access to system resources. This statement is consistent with this research when considering the above-said quote. This is because Ada is a smartphone application and participants find its functionality to be a plus. Less user-friendly, so many questions are being asked, time-consuming and not accurate as it gives only possible causes are some of the drawbacks observed in this research for smartphone-based functionality. This makes the justification of poor functionality stronger.

Therefore, the answer to the research question is that smartphone-based functionality integrated with PC based feature is preferred.

### **4.7. Discussion Summary**

The discussion included four research questions and the result for the research questions are stated in the table 5.1.

Table 5.1 Research Question Summary

Number	Research Question	Answer
1	What are the perceived benefits of using symptom checker?	Facilitate Self-diagnosis Learn medical terms
2	What are the usability issues of using symptom checker?	Irrelevant details Language compatibility Interface design Recoverability
3	Which is more preferable: PC based or smartphone-based applications?	PC based application
3.1	What is the acceptance level of the applications based on gender and age classification?	younger adults average age of 36 preferred PC applications
4	Which is more preferred: Smartphone functionality or PC feature?	smartphone functionality with PC features is preferred

Further discussion would be that target participants did not say much as they need more prompting by investigator during the process. As per (Carter 2007), talk aloud is a very

effective method to bring out peoples mind but however further clarifications are needed for the participants. For example, participant may be frowning as they find reasons to argue that the system is indecisive for them to proceed and go to completion. When too many questions pop up, they end up frowning as well. Hence having several prompts will prevent this from happening. The interview happened in only closed place and it was not tried in different places.

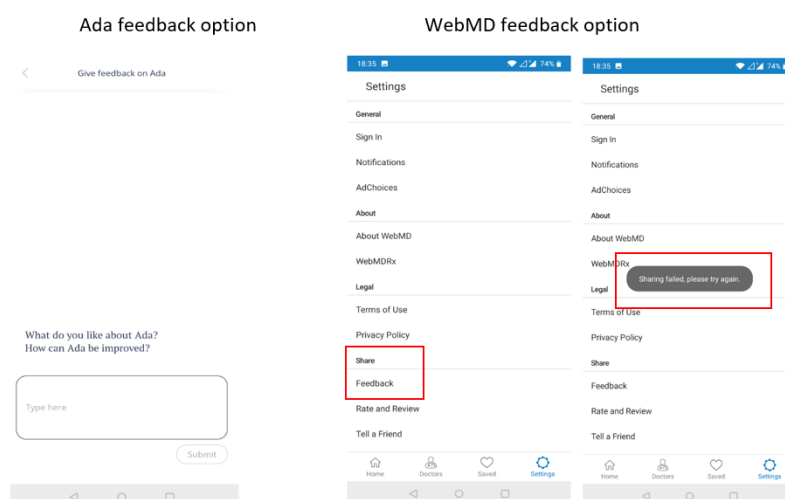
#### 4.8.Recommendation

Based on findings, results, and discussion explained in section **Findings and Analysis** and **Discussion**, various recommendations have been suggested by the participants for better usage of the symptom checker applications. Some are specified in findings. The recommendations are discussed below in detail.

- **Feedback option**

Another minor recommendation factor was to have feedback option where they can provide suggestions and get some solution for their questions that have been put through in feedback. Ada had a feedback option which the participants preferred. In WebMD, there was feedback option but it was under the share condition only. Participants were not able to send direct feedback like Ada. However, even the share condition failed continuously which has been highlighted in the figure 5.5. On the other hand, Isabel and Symcat never had such an option.

Figure 5.5 Ada vs WebMD feedback options

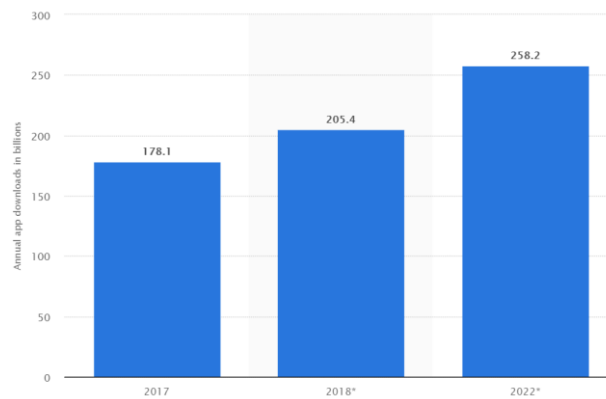


Source: (Ada and WebMD mobile application)

As per the recent study published in Statista specified in figure 5.8a, mobile app downloads will be more than 250 billion in the year 2022 (Statista 2019). This indicates there will be a lot

of competition for app developers and development. Having feedback option is important as it takes the people's opinion direct to the notice of the developer. It is a benefit for the application as well it will increase the people's mindset to use it more.

Figure 5.5 Number of mobile app downloads worldwide in 2017, 2018 and 2022 (in billions)



Source: (Statista 2019)

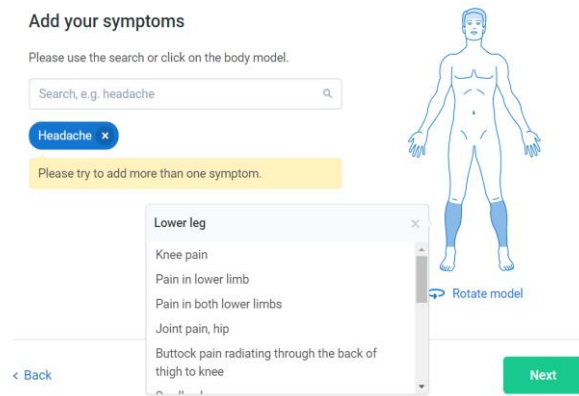
Hence, the suggestion is that having the feedback functionality from Ada incorporated in all the applications would make the application used by all.

- **Body part diagram**

Symptom checkers generally asks to enter symptoms manually followed by sub-questions to understand the symptoms better. Participants feel that in order to save time and have better accuracy, body part diagram is needed. They can select the parts of the body (i.e. if headache can select head) and then can proceed on with further reports.

For example, Symptomate app (Ref figure 5.6) has a body map as well as symptom box option. When you type in the symptom, that part is highlighted. Similarly, when part of the body is selected in the body map the symptoms associated with it is displayed (Symptomate 2019). This makes the application popular.

Figure 5.6 Symptomate Application: Body map

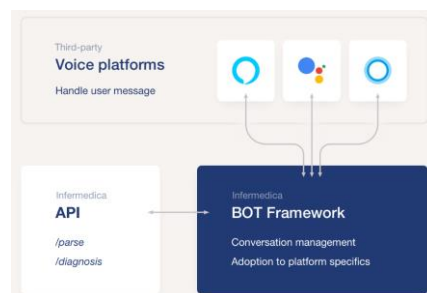


Source: (Symptomate 2019)

- **Speech Recognition**

Participants preferred having speech recognition concept in symptom checker like Siri in Apple. Not only Siri, integrating health check-up with a chatbot like Alexa, Cortana, and Google Assistant can also be implemented. This will increase the impression and increase the usage of symptom checkers because it will be like having an actual conversation. Refer below the figure 5.7 for the framework. This works like in the framework where questions will be asked (voice platforms where user messages are handled) and then digital differential diagnosis (API) will happen (Adam 2018).

Figure 5.7 Chatbot Framework



Source: (Adam 2018)

#### 4.9. Other suggested recommendations

Apart from the recommendations stated above, there were several other suggestions observed from the research and from statements made by participants. It includes having print, save or download option for the generated reports. They cannot repeat the whole process all over again every single time for the same symptom. Next is the layout option. If it is attractive or some similar layout like Instagram, Twitter or Netflix it is easy to attract participants to download

and use it more. These applications can be available in varied languages as language compatibility is another notable usability issue addressed in this research.

## **5. Conclusion and Future Work**

### **5.1.Conclusion**

In this research, four Symptom checkers based on smartphone and PC systems were analyzed and participants performed tasks on all the four applications (WebMD, Ada, Isabel, and Symcat). The results obtained from this research was related to the literature that answered the research questions by classifying the perceived benefits and usability issues faced by the participants. Additionally, this study also paved the way to know more about the features and functionality of smartphones and PCs. From the participant's response, it can be seen that the PC based application was much preferred among young adults with an average age of 36 years.

On the whole, this research has achieved its objective on studying the symptom checkers and providing insights on its usability. The recommendations provided in this research will make the applications be used nationwide by individuals. As the technology updates, the use and growth of Symptom checkers will find it place more dominant as portrayed in the literature as 'having a physician in a pocket'.

### **5.2.Future Work**

This research revealed that PC applications are better to use compared to smartphone applications. However, during the task navigation, it seems that people prefer smartphone. This is due to the reason entire information is in one single page within the screen of the smartphone. In this context, the experiment can be repeated with finding the symptom checker that has a similar feature of the PC (example: Symptomate application). Adopting some feature like chatbot is one of the recommendations given above. The applications can be cross-verified and compared with Symptomate's chatbot feature and can re-analyse how far it is preferred by the participants. This will also solve the speech recognition drawback reported in this research.

Second, in this research four tasks were given along with symptoms. Participants used these symptoms. The major suggestion provided by the participants is why cannot their own symptoms can be used? Hence, the study can be repeated by allowing participants to use their own real symptoms instead of imaginary symptoms. This will make the participants have more interest as it would have been like knowing the answer to their own symptoms.

Third, the age group in this research was 25 and above with a time limit of 60 minutes given to all participants to complete the task. As specified in results and findings, with age group there was a time delay as well as some finished very early. This research can be extended by considering a larger age group especially the elderly giving more time to complete.

Fourth, the article explained by (Semigran, Linder et al. 2015) makes analyses with 23 symptom checkers and 45 patients that resulted in the accurate analysis. By repeating this research with many symptom checkers and a wider range of participants, the result will be appealing and more accurate details can be observed. When said a wider range of participants this can also include involving people from both rural and urban areas, as well as real patients and even some medical professionals, can be included. Excluding medical professionals were part of this research.

Also, testing the symptom checkers can be used in different environment with different range of people. It can be tried with a greater number of target participants. This will help to get more accurate wider results. When the usability testing is done in a social environment associating with the psychology of the participants will bridge the gap and help to have more wide opinions from them. This fulfils the user expectations and will provide critical understanding of the total research idea to the participants (Feather, Howson et al. 2016)

Finally, regarding the use of TAM questionnaire, instead of having a 7-point Likert scale, more questions can be included where participants can write and fill up their opinion. This is because in this research recording participant responses was a bigger challenge. The recording was not a continues process as participants stopped in-between the recording process and had some questions regards to the protocol steps. Also, this research was done in the environment feasible to the participants. It was not in a controlled environment. Hence, doing this research in a controlled environment will yield better response. By doing so the researcher will have the complete control over the tasks and can define the procedure goals more clearly, interference like noise, movement, interruptions by others can be discarded, observation and verbal data collection can be made easier and the time taken for the data collection phase can be reduced to half (Anne Kaikkonen, Titti Kallio et al. 2005).

### **5.3.Benefits, Drawbacks and Stimulation**

When participants had real symptoms either in past or present and when the results obtained from the symptom checkers were matching their expectations, there was a positive approach and eagerness to work on the symptom checkers. At the same time people who have different



ability for example: eyesight, tumour had too many routed questions to answer finding it difficult to arrive at a solution. That is because when participants opted for eyesight issue symptoms and when the questions routed to tumour, it caused difficulty for participants to answer. As a researcher, the stimulation is that these applications are being used in real time as people are unaware that these symptom checkers even exist.

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## 7. Appendices

### 7.1. Appendix I Ethics Approval

The logo for the Auckland University of Technology (AUT) is displayed in white text on a black rectangular background.

TE WĀNANGA ARONUI  
O TĀMAKI MAKĀU RAU

#### Auckland University of Technology Ethics Committee (AUTEC)

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E: [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz)  
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21 February 2019

Dave Parry  
Faculty of Design and Creative Technologies  
Dear Dave

**Ethics Application: 19/43 Comparison of usability of computer based and smartphone app symptom checkers**

Thank you for submitting your application for ethical review. I am pleased to advise that a subcommittee of the Auckland University of Technology Ethics Committee (AUTEC) approved your ethics application, subject to the following conditions:

1. The Committee believes that this may be classified as Health Research (A.7.2);
  - a. *Noted on the form*
2. Reflection as to whether the symptom applications might be presented in random order;
  - a. *Thanks – yes they will be*
3. Provision of a response to E.1 of the application form that answers the question being asked;

*New answer reads - The participants will be of a very similar social and cultural background to the student researcher. The researcher has a great deal of familiarity with the group of participants as they will be recruited from personal contacts. As a usability test, the focus is on the device and software being used. Although using a more diverse set of participants will be of interest at a later stage if the research was continued, this is very much a pilot study, to see if there are particular usability bugs or issues that can be discovered as part of a lightweight process, with a very simple recruitment protocol and avoiding the use of vulnerable people.*

4. Provision of the symptom lists that will be given to participants;
  - a. *Attached*

5. Clarification of how the research will ascertain 'the ideas around how people use technology in their lives' as suggested in the Information Sheet as this is not evident in the interview schedule;

*a. Phrase removed*

6. Reflection on the responses given in section K concerning conflict of interest, given that the researcher is recruiting through personal networks;

*Response changed to: There is no conflict of interest in terms of financial linkages. Although the researcher is asking personal contacts if they wish to participate, any potential conflict of interest is managed, by not treating this process as returning a favor or building up obligations. The potential participants are not known to the supervisor.*

*a.*

7. Clarification whether any koha or token of appreciation will be offered to participants;

*a. Question answered – no Koha will be offered*

8. Amendment of the Information Sheet as follows:

- a. Insert a date;
- b. Insert the costs of time;
- c. Review for complete sentences, including capital letters at the beginning;
- d. Align the feedback section with the offer of a summary report provided in the Consent Form.

*i. Updated information sheet attached*

Please provide me with a response to the points raised in these conditions, indicating either how you have satisfied these points or proposing an alternative approach. AUTECH also requires copies of any altered documents, such as Information Sheets, surveys etc. You are not required to resubmit the application form again. Any changes to responses in the form required by the committee in their conditions may be included in a supporting memorandum.

Please note that the Committee is always willing to discuss with applicants the points that have been made. There may be information that has not been made available to the Committee, or aspects of the research may not have been fully understood.

Once your response is received and confirmed as satisfying the Committee's points, you will be notified of the full approval of your ethics application. Full approval is not effective until all the conditions have been met. Data collection may not commence until full approval has been confirmed. If these conditions are not met within six months, your application may be closed and a new application will be required if you wish to continue with this research.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz).

I look forward to hearing from you,

Yours sincerely



Kate O'Connor  
Executive Manager  
**Auckland University of Technology Ethics Committee**

Cc: vrv2496@autuni.ac.nz

# Participant Information Sheet

## Date Information Sheet Produced:

25<sup>th</sup> March 2019

## Project Title

Comparison of Usability of web based and smartphone symptom checker

### An Invitation

I am a student currently taking Master of Computer and Information Sciences at Auckland University of Technology (AUT). I am undertaking a research study to compare four different symptom checkers that is operating via web and smartphone applications. This research will capture how the participants use scenario-based tasks to identify the symptoms.

You are invited to take part in this research study. Your participation in this study is voluntary, and you may withdraw from this study at any time prior to completion of data collection, without being disadvantaged in any way.

The data collected will be used for analysis in my master's study. It is important for you to understand the background and aim of this research study before you can commit to participating in this study.

## What is the purpose of this research?

Symptom checkers are software tools that allow users to submit a set of symptoms and receive advice related to them in the form of a diagnosis list, health information or triage. In this research, iTriage (smartphone), WebMD (smartphone), Isabel (online) and Symcat (web) symptom checkers are analyzed.

## How was I identified and why am I being invited to participate in this research?

You were identified as an adult aged 25 years and older able to use web-based and smartphone applications. You were invited based on personal contacts.

## How do I agree to participate in this research?

Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time. If you choose to withdraw from the study, then you will be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

## What will happen in this research?

This research study evaluates the usability of four symptom checkers. Your participation is helping to provide data on the usability of various symptom checker, the symptom checkers are being tested – not you! We also want to know your ideas around how people may use computing technology in their lives.

The researcher will agree a meeting place and time with you. Only you and researcher will be in a table at the quiet place in AUT. If you agree, the conversation would be recorded on a tape machine for the researcher to use at data analysis stage only. If not, the researcher will take written notes only. The researcher will ask you to use some symptom checkers, using some fictitious symptoms and say what you are thinking as you use them. For each symptom checker we will also ask you to fill out a short questionnaire about how usable and potentially useful you found the software. The meeting will take about 60 minutes.



## What are the discomforts and risks?

There should be little or no discomfort – you are being asked only to try to use the software and say what you are doing. There should be no actual risk

## How will these discomforts and risks be alleviated?

You are able to withdraw at any time from the study. If you are tired or find it frustrating to use the software you can take a break.

## What are the benefits?

The researcher will gain the MCIS qualification. Participants will have the opportunity to see how various symptom checkers work and the strengths and weaknesses of different approaches. Many people enjoy trying out different software in this way.

## How will my privacy be protected?

Your identity will not be used in data analysis, thesis report and any publications from this research study. Information that may be used to identify you e.g names of clinics, or locations or exact job titles will not be reported. All notes and recording taken at interview will be securely stored in a locked cabinet at AUT in New Zealand, accessible to the researcher and her supervisor only.

## What are the costs of participating in this research?

No financial costs, just an hour of your time.

## What opportunity do I have to consider this invitation?

I would appreciate your confirmation of participation within 5 working days.

## Will I receive feedback on the results of this research?

you wish, You may have a copy of the final report. to have a copy of the report

## What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, A/Prof Dave Parry, dave.parry@aut.ac.nz, +64 9 921 9999 xtn 8918.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTECH, Kate O'Connor, [ethics@aut.ac.nz](mailto:ethics@aut.ac.nz) , +64 921 9999 ext 6038.

## Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

### Researcher Contact Details:

Ruth Thephila, [rvv9476@autuni.co.nz](mailto:rvv9476@autuni.co.nz).

### Project Supervisor Contact Details:

A/Prof Dave Parry, [dave.parry@aut.ac.nz](mailto:dave.parry@aut.ac.nz), +64 9 921 9999 xtn 8918.

Approved by the Auckland University of Technology Ethics Committee on **21 February 2019**, AUTECH Reference number **19/43**.

## Consent Form

**Project title:** *Comparison of usability of web based and smartphone symptom checker*

**Project Supervisor:** *Assoc Prof. Dave Parry*

**Researcher:** *Ruth Thephila*

- ☐ I have read and understood the information provided about this research project in the Information Sheet dated 25 March 2019.
- ☐ I have had an opportunity to ask questions and to have them answered.
- ☐ I understand that notes will be taken during the usability test and that they will also be audio-taped and transcribed.
- ☐ I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- ☐ I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- ☐ I agree to take part in this research.
- ☐ I wish to receive a summary of the research findings (please tick one): Yes ☐ No ☐

Participant's signature: .....

Participant's name: .....

Participant's Contact Details (if appropriate):

.....  
.....  
.....  
.....

Date:

**Approved by the Auckland University of Technology Ethics Committee on 21 February 2019 AUTEC  
Reference number 19/43**

*Note The Participant should retain a copy of this form*

## 7.2. Appendix II Questionnaire

### Performance Expectancy

1. Using the symptom checker enables me to accomplish tasks easily

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### Effort Expectancy

2. My interaction with the symptom checker be clear and understandable

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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3. I find the symptom checker easy to use

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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4. Learning to operate the symptom checker is easy for me

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### Attitude toward using technology

5. Using this symptom checker is good idea?

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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6. I like using this symptom checker

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### Facilitating Condition

7. The symptom checker is not compatible with the other systems I use

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
-------------------	----------	-------------------	---------	----------------	-------	----------------

### Self-Efficacy

8. I will complete a task using the symptom checker when no one around me to tell what to do

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
-------------------	----------	-------------------	---------	----------------	-------	----------------

9. I will complete a task using the symptom checker if I had the built-in help facility for assistance

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### Anxiety

10. I feel apprehensive using this symptom checker

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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11. It scares me to think that I could lose a lot of information using the system by hitting the wrong key

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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12. I hesitate to use the system for fear of making mistakes I cannot correct

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### Behavioural intention to use the system

13. I plan to use the system in the next few months

Strongly disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
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### 7.3. Appendix III Symptoms

Symptoms			
Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fever	Rashes	Sore Eye	Stomach Pain
Sore Throat	Arm burning/ infection	Reddening	Diarrhea
Malaise	Redness	Blurred Vision	Nausea
Headache	Scratches	Watery Eyes	
Cold/ dropping nose	Irritation for longer than 1 week	Headache	