RESEARCH IN PROGRESS

Overview of Asthma Related Smartphone Applications on Google Play and Apple App Stores

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Climate change, as a result of rising levels of greenhouse gases, is causing havoc around the world. This affects respiratory systems thus causing unprecedented rise in asthma and chronic obstructive pulmonary disease (COPD) cases. Making an individual aware of the surrounding climate conditions enables them to take preventative measures. One way to deliver this type of information is through smartphone applications. Thus, this paper surveyed the two major Australian application stores, Google Play and Apple App, for asthma related smartphone applications.

Keywords:
asthma, pollen, air quality, smartphone applications, app stores

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1 Introduction

Climate change is closely associated with the rise in the number of allergic respiratory diseases due to the changes in weather, pollen levels and air pollution (D'Amato et al., 2020). The fast-changing climate around the world is the result of increased levels of Carbon Dioxide (CO_2) emissions produced by the burning of fossil fuels, industrial revolution, agriculture and forestry, bushfires, and other sources of CO_2 (Pacheco et al., 2021). As the CO_2 levels continue to climb, long exposure to such harmful element and other air pollutants is linked to adverse effects on the respiratory system (Eguiluz-Gracia et al., 2020). Two of the major non-communicable respiratory diseases linked to such changes in climate conditions are asthma, and chronic obstructive pulmonary disease (COPD) (Tran et al., 2023). Self-management of asthma using smartphone applications is one of the methods people with asthma are adhering to for managing their condition. With such reliance on applications, this serves as the motivation for this short paper to analyze the types of applications available for people with asthma, examine the information delivered through the applications, and understand their limitations. The focus of this paper is around applications that provide weather, pollen, and air quality information.

2 Literature Review

Asthma is considered a chronic non-communicable condition where the airways carrying the air to the lungs are irritated thus causing shortness of breath or wheezing (Porsbjerg et al., 2023). Whereas COPD is a chronic lung disease and is a result of long-term exposure to cigarette smoke, air pollution, and occupational dust (Tran et al., 2023). The association between climate change and respiratory diseases is due to the events that are created by the changing weather which produces various conditions that trigger respiratory reactions. With the ever-increasing fluctuations in climate conditions, they pose a threat to individuals with asthma as frequency of unpredictable and often changing weather conditions can exacerbate asthma (Kelly et al., 2023). Chronic respiratory diseases require appropriate and on-time diagnosis, response, and therapy (Gurbeta et al., 2018). Appropriate information related to weather that is delivered in a timely manner can render great aid for people with asthma (Johnston et al., 2018). One of the options available for people with asthma to self-care and management is smartphone applications developed for people with asthma. Asthma patients with access to mobile phones demonstrated the willingness

to use the technology to access care for asthma and receive information using social networks and smartphone applications (Nabovati et al., 2020). The availability of weather, pollen levels, and air quality information are key to people with asthma in taking preventative measures when managing their condition. Google Play and Apple App stores are the two primary key players in the smartphone applications market, and they provide a variety of applications.

3 Data Collection

The term 'asthma' was used to search the Australian Google Play and Apple App store across both online and mobile stores to obtain a sense of how the search engine operates. Subsequently, multiple searches were performed on both versions of the application stores for both platforms for Australia using terms from the study that covered 'asthma', 'pollen', and 'air quality'. Once the search was completed, a list of applications was collected and extracted from both platforms for examination. The search was conducted in November 2023.

After filtering and reviewing the list of collected applications, a total of 159 applications were excluded from further analysis for the following reasons:

- Applications developed in languages other than English as the study focused on applications developed in English.
- Applications not updated for more than one year (one year and above), as this demonstrated that the application is not maintained.
- Applications developed for specific countries such as Indonesia, Africa, England, Europe, or Wales as the focus of this study is applications available in Australia.
- Applications available through invite only from medical professionals.
- Applications not written nor developed in English.

All other applications were included in the review and for further examination.

4 Data Analysis

The first step of the analysis involved reviewing each application using the application description and the accompanied screenshots to develop a list of categories that best describe the purpose of the application. Once an application was

categorized, a SWOT analysis followed and was applied against each application. However, applications that exhibited features that covered weather, air quality, and pollen information were further examined to understand:

- Count of how many weather-related features the app provided (Weather, Air Quality, and Pollen Information).
- Source of the information (satellites, local pollen monitoring stations, local air quality monitoring stations).
- Relevance of the information, and whether the application focused on one feature than the other.
- Geographical region that the information covered.
- Information timeliness, specifically checking if the information was forecast or real time based.

The examination of the applications was conducted by installing each of the shortlisted applications on an iPhone and a Samsung phone to test the features.

5 Results

5.1 Unique Applications

At the end of the comprehensive search and analysis on both Google Play and Apple App stores, a total of 74 applications were found to be related to asthma and provided information that assisted people with asthma. Upon close analysis of the applications names, the total number of unique applications was 70. As illustrated in Figure 1, a small number of applications exhibited features that covered weather, pollen, and air quality measures in one single application.

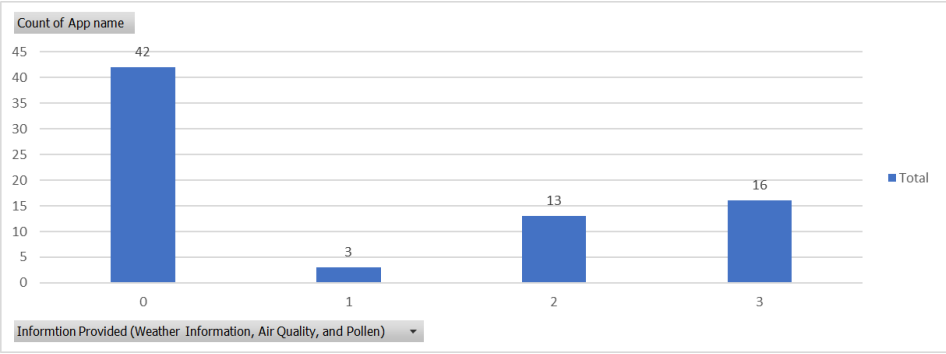

Figure 1: Count of Applications with features covering Weather, Air Quality and Pollen

5.2 Types of Applications

A list of themes was developed during the analysis of the applications that aided in generating the categories that best describe the intended use for the applications. These are defined below:

- Add on: These are applications developed for use in conjunction with Bluetooth connected smart attachments such as Bluetooth enabled asthma puffers that synchronize with the application to collect information about the patient use of the puffers.
- Diary: Applications developed for assisting people taking notes of their conditions that can be later retrieved for discussion with their medical professional.
- Educational: Applications developed to educate people about asthma and how to best manage the condition.
- Game: Applications developed to make learning about asthma and adherence to asthma medications more fun.
- Management: To learn how to best manage asthma, including usage of asthma puffers, and breathing techniques.
- Tracker: Applications developed to assist asthma patients with tracking their asthma condition, medications and noting things about their condition that can be later retrieved for discussion with medical professionals.

- Weather Tracker: Applications specifically designed to educate people with asthma about their surrounding climate conditions including weather conditions, air quality measures, and pollen levels. This is to prevent asthma exacerbation.

Table 1 provides a breakdown of the number of applications discovered for each category.

Table 1: Application Categories

Category	Number of Applications
Addon	14
Diary	5
Educational	7
Game	6
Management	5
Tracker	8
Weather Tracker	29

5.3 SWOT and TOWS Results

During the analysis of the shortlisted applications, a key critical factor in understanding the quality of the information provided by the applications was based on the source of the information. Weather information was provided by the official government agency Bureau of Meteorology, pollen was provided by a limited number of pollen sensors installed around the country, and air quality information was provided by Environment Protection Authority (EPA) agency that has limited number of sensors installed around the country too.

As such, the analysis provided in Table 2 presents the results of SWOT analysis coupled with TOWS method of the shortlisted applications. The specific focus on those applications is led by the underlying research background which focuses on understanding solutions available to people with asthma that can help people avoid asthma exacerbation due to fluctuating climate conditions.

Table 4: SWOT & TOWS Analysis

SWOT/TOWS	**Strengths**	**Weaknesses**
	- Applications available that provide weather, pollen and air quality information. - Air quality applications available with information sourced from Environment Protection Authority. - Pollen levels applications available with information sourced from limited local pollen sensors.	- Not clinically endorsed. - Near realtime information. - Limited number of air quality and pollen sensors around the country. - Each state presents its own set of information limited to their sensors. - Most applications are the result of a research activity, not officially endorsed. - Limited spatial coverage of air quality and pollen monitoring.
Opportunities	**SO – Strategies**	**WO - Strategies**
- Integrate realtime weather. - Leverage other weather sources such as satellites, and street maps. - Automate sourcing of information to provide more national coverage. - Build an application that provides all 3 key weather information elements at a national level.	- Combine new sources of data to provide greater coverage. - Automate the collection and distribution of information in realtime. - Seek new input source for air quality and pollen data.	- Co-design the applications with medical professionals. - Seek new data sources for air quality and pollen information.
Threats	**ST – Strategies**	**WT - Strategies**
- Sensors going offline, thus impacting sensor readings. - Telecommunications outages or maintenace taking down sensors.	- Seek backup source of data to cover for when sensors go offline. - Build a mirror site for applications to provide end users with alternative ways to access the information.	- New smarter technology to faciliate better infrastructure for building better platform.

6 Discussion

Applications provide an exceptional advantage for delivering tailored information to individuals with specific needs. The tailored custom experience is a way of encouraging end users to make use of the application which can potentially influence their behaviour towards managing their medical condition. Despite the benefits, a common weakness is around the coverage. Applications that provided climate information were based on the locally available Pollen and Air quality sensors. As the population continues to grow, the reliance on physical limited number of sensors becomes inadequate as the population outweighs the number of required sensors (Li et al., 2022). These sensors are limited in number thus limiting the area of coverage. New sources such as satellites have new capabilities where pollen and air quality can be measured from space (Bechle et al., 2013). Satellites have the ability of measuring different air pollutants and particulate matter (Lin et al., 2021). This requires further exploration and research to understand the quality of the data from space, the measuring distance it covers, the frequency of the data, and spatial coverage.

7 Conclusion and Future Work

The Google Play and Apple App stores contained a large collection of various smartphone applications, including health applications designed to cover a range of medical services. The analysed mobile applications illustrate how they can be an effective tool for creating and delivering custom tailored information specific to a medical condition or group. In the context of asthma, they can be an effective method of enhancing peoples' knowledge of their condition and providing climate information surrounding the patients to ensure a timely management of their asthma. However, with climate information (weather, pollen, and air quality) lacking a larger spatial coverage, this proves to be a key weakness that requires further investigation. As such, the issue of coverage should be investigated and studied further to explore different ways Air Quality and Pollen data can be collected and processed so that it can be transmitted to people with asthma in almost real time.

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