Discussion About Gap Between Necessary Healthcare Trends and Apps Used

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Abstract: *The fast pace of technological improvement and the rapid development and adoption of healthcare applications present crucial challenges for clinicians, users and policy makers. [39] Pandemic forced everyone to explore options that require minimal human interaction. This brought a surge in medical and health related app development. When initially conceived, these mobile medical applications performed basic functions e.g., BMI calculator, accessing reference materials etc; however, increasing complexity offers clinicians and patients a range of functionalities. [2] With more awareness amongst people, the apps started incorporating more features pertaining to healthcare. Even with the increase in medical apps usage today, it cannot be determined if the apps are enough to replace real doctors and adopt a completely app-dependent system for healthcare. In this paper, all the new trends that became increasingly popular related to medical apps have been explored. Then, these trends have been discussed and also what distinguishes them compared to the already existing features. We then take a look at the data of 130 existing apps that provide support for the mentioned trends in one way or another from a list of most used apps of last year in the Indian android market. With the analysis of the features in the apps, we take a look at what support is already provided. We then take a look at what could be done further to improve the already existing apps. With the combination of apps analysis and discussion on improvements, we can also draw a conclusion if the treatment of real doctors can be substituted with such apps.*

Key Word: *Medical Services, Mobile Applications, Public Healthcare*

1. INTRODUCTION

With the increase in technology, our dependence on gadgets is increasing as well. Today, there are applications related to medicine too. Although there are a lot of functionalities being added, the question often arises if it will ever be enough to completely replace the treatment of real doctors. There have been a lot of new mobile apps and physical devices arriving everyday with an increase in health awareness amongst people. We see a lot of paid and unpaid applications in the app stores that boast about the range of functionalities they provide. The reason healthcare app ideas become a reality is twofold – one because the customers demand it. The second is healthcare innovation. With technological advancements, healthcare should focus on digital viability. [3] Given the increasing number of users, the collection of data for these apps is increasing as well. And with a global pandemic, the need for such apps is now more than ever. With such increased use, the global medical app market will generate a revenue of 111.1 billion dollars by 2025. [4] Healthcare application development companies are capturing endless opportunities to develop web & mobile apps for patient management, Electronic Health Records (EHR), Electronic Medical Records (EMR), online consultation & prescription, appointment scheduling, medical training, diagnosis, health monitoring, insurance policy sale, purchase, claim settlement, and many others. [5] The development of mobile applications for health care is the process of applying digital technologies to create an application for mobile devices to help

patients monitor health conditions, hospital vital signs, fitness goals physically, find doctors, etc. mHealth (refers to mobile health) is a common term used to apply mobile technologies and devices (smartphones, wearable devices, tablets) for healthcare purposes. [6] According to a survey [7], in January 2021 alone, 4.66 billion people around the world used the Internet. Almost 5.22 billion people use a mobile phone today. Unique mobile users have grown by 1.8 percent (93 million) since January 2020. [8] The main objective here is to analyse the various recent trends in the healthcare application development, take a look at the applications that are most popularly used, compare the features with the trends, the kind of facilities they provide and discuss about the improvements that are needed in order to align mobile apps with the healthcare services for everyday lives.

2.   METHODS

For the selection of various trends over the past years, content from various websites has been taken and then the frequency of occurrence of a particular trend was taken into account. The most frequently occurring trends have been selected and used for the purpose of analysis. The frequency of various trends over a number of websites is as shown in graph 1. For selection of applications, Android store is used due to the ease of availability and the range of users. The selection has been done from a list of maximum used applications from Google play store. The applications have been selected from various categories like medical, health and fitness, android wear that are related to healthcare. The visibility score for all the apps were gathered. Visibility score indicates the app's overall discoverability inside the app store. Every app gets a grade out of 100 based on keyword rankings, category rankings and review/rating performance. A higher visibility score means better discoverability. [9] From over 200 apps, the apps with a visibility score less than 50 as of 9th October 2021 have been filtered out along with the ones that are not relevant to the current analysis. As for the remaining ones, the apps were then sorted in the descending order of the visibility score. The application features are then analysed and categorised into the existing listed trends. The list of apps has been taken from the data present in a website. After the categorising of 130 apps, a graph has been created depicting the relation between the apps and the trend. This graph was divided into 2 for the sake of better visibility which led us to depicting the information in 2 graphs with visuals of 65 apps each. The analysis has been done from these graphs and the final bar graph that gives the relation between the trends and the apps in total.
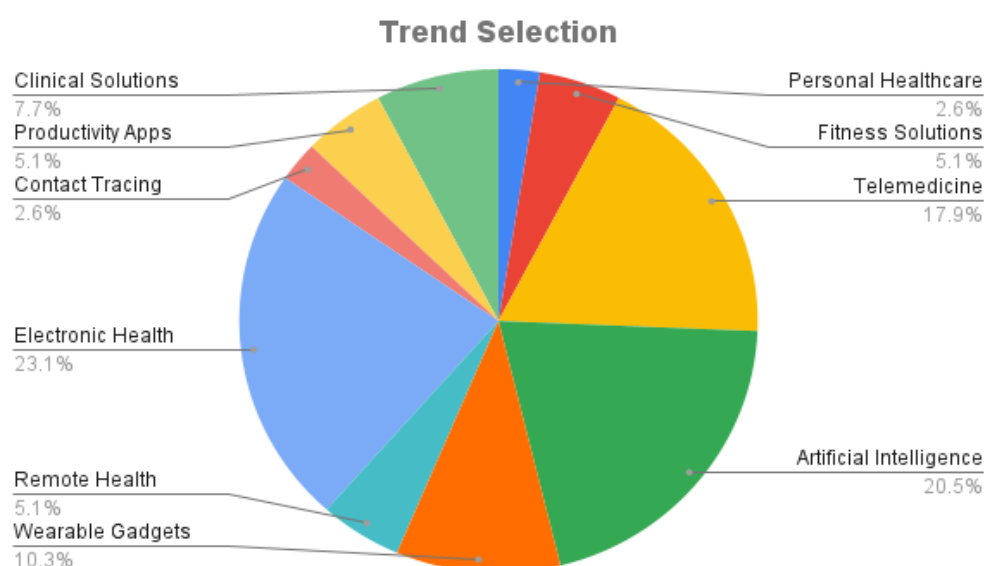

Figure 1: Trend Selection

3.   TRENDS

Following are the various trends in the healthcare apps from 2020:

PERSONAL HEALTHCARE:

These apps focus on tracking the personal health status of the user. It records the daily steps, calorie intake, water intake, heartbeat, and more. These apps usually connect through a wearable gadget or device. Certain healthcare apps for consumers can track their complete diet and activity status. It then suggests a plan of action to stay fit through following a proper diet and living a healthy lifestyle. Some apps also monitor the stress level and sleep status, taking digital healthcare to the next level. [3] With the rise in cloud computing, all the data can be stored and accessed from any device anytime. Cloud computing allows multiple business benefits including secure access, storage, and management of voluminous data generated by countless devices and healthcare applications. Health organizations are embracing subscription-based data and application storage, IT infrastructure, and security architecture to achieve consistent productivity and lowered operational costs. Analysts predict that the value of cloud computing aspects in the healthcare would reach $35 billion by 2022. [5] The worldwide market for cloud technologies in the healthcare domain was $16.1 billion in 2016. With Customized HealthTech Mobile App Development [10] and advanced technologies, the cloud computing market should reach out $35 billion by 2022 [11], maturing at an impactful CAGR. [12]

FITNESS SOLUTIONS:

The next trend in the digital healthcare sector is the evolution of fitness apps. These solutions for healthcare have exercise regimes. It includes live and recorded classes by expert fitness trainers. They provide sessions on Yoga, Strength Training, Dance, and more. These apps also focus on mental fitness and offer meditation classes as well. Fitness apps were the #1 healthcare apps during the pandemic, keeping people fit in their homes. [3] As per the survey [13], approximately 45% of Americans have tried fitness trackers or mobile health apps. And 20% are using both fitness trackers and apps. We are used to devices that usually work with mobile apps. They count steps, calories, our water intake, and more. And also check heartbeat rate and blood pressure, monitor physical activity, etc. [8]

TELEMEDICINE:

While telemedicine was the need of the hour during covid, it is now a popular choice for both patients and doctors. Telemedical apps enable patients and doctors to exchange information online. For common health issues, patients can consult doctors and get prescriptions without physically visiting the clinic. It saves both a lot of time, while the doctors can see critical patients requiring immediate attention. Contactless healthcare is the result of telemedicine apps. [3] While CMS and big payers relaxed [14] regulations on telehealth to help providers continue safely offering care during the pandemic, hospitals and health systems will continue addressing how to incorporate virtual care as part of their long-term care strategy after the public health emergency ends. [15] A chatbot allows users to get 24/7 assistance with basic medical questions. With the help of medical chatbots, you can set medication reminders to take pills on time or make drug references to access information considering specific drugs: names, etc. For instance, Britain's national health service [16] has been using chatbots to reduce the pressure on non-emergency helplines since 2017. The app, developed by UK start-up Babylon, asks people questions about their illnesses in a chat window before giving them advice — whether they need to visit a doctor, or if the problem is likely to pass in time. [8] According to Fortune Business Insights, the global telehealth market size is expected to reach USD 266.8 billion by 2026. [17]

ARTIFICIAL INTELLIGENCE:

Some of the best healthcare apps for patients [18] and the best medical apps for doctors incorporate AI for better outcomes. Machine Learning algorithms, the core of AI, help generate valuable insights from a patient's health data. They are also helping in diagnosing terminal diseases at an early age. Apart from that, AI connects healthcare facilities through intelligent chatbots [19] helpful in answering different patient queries. [3] Global AI in the Healthcare Market is to reach $35,892.2 Million [20] by 2030. Now we have access to more health data than ever. With AI we have the possibility to process large amounts of information and gain insights that were impossible before. AI apps will help us with faster, cheaper, and more accurate ways to make medical diagnoses. Having the ability to analyse information, recognize patterns, and derive

trends in ways that humans can't, algorithms can identify long-term health dangers. [8] Artificial intelligence or AI has the potential to deal with a humongous amount of data in seconds. The technology can fetch data from different sources, process it within the blink of an eye, and provide actionable insights. The integration of this technology into healthcare apps will make them easier and faster to use. Also, it can help in offering support services to answer health-related queries of the patients. According to the Accenture report, AI in healthcare is projected to reach $6.6 billion by 2021. [17]

WEARABLE GADGETS:

As discussed briefly in personal healthcare apps, wearable gadgets are useful for tracking the patient's health. There are separate healthcare apps for consumers that connect with wearable devices. They track heart rate, oxygen, blood pressure, and even stress – all in real-time. These features are commonly seen in smartwatches, which also have various workout modes to track your fitness. These devices are on the rise and people become more conscious of their health. [3] IoT-embedded applications for wearables are gaining traction due to contactless operations across healthcare functions. These healthcare mobile apps help to connect medical practitioners to their patients instantly. Wearable devices with applications built over the internet of things can monitor patients' health and assist them remotely anytime and from anywhere. [5] According to a renowned market research firm IDTechEx, the wearable technology market is projected to reach $100 billion by 2023. [17]

REMOTE HEALTH MONITORING:

Healthcare app development companies [21] use some of the best healthcare app development frameworks like Ruby on Rails and Django to build remote health apps. These solutions for healthcare focus on monitoring the health of patients through on-demand mobile apps. There are patients that require regular tracking of their health as a part of their treatment plan. Since they cannot stay and visit the hospital every day, remote apps assist with health tracking. [3] For this, interoperability is a great step forward too. Interoperability involves creating a universal database that can be accessed by all clinics that serve a particular patient. Since the systems of the human body are interrelated, a comprehensive medical picture can promote much better results than a limited set of data that encompasses a few reported symptoms but not the core reasons for health disorders. US authorities encourage medical organizations to shift from an enterprise-centred to a patient-centred approach and jointly maintain patient records. The European Union is introducing cross-border interoperability and enhanced data protection. Developing Asian and African countries will adopt interoperability in the framework of general eHealth policies designed to make medical data more accessible and manage it more effectively within those regions. [22]

ELECTRONIC HEALTH RECORDS:

EHRs have been the digital healthcare priority since their inception. But with the introduction of Blockchain technology, the game is changing. A patient's health data is more secure, decentralized and reduces data fraud. A blockchain network enables healthcare facilities to keep track of health records and minimize the chances of errors. EHRs are essential to understand the patient's history so that a proper treatment plan is in action. [3] As digital voice assistants like Amazon Alexa and Google Home have secured a place in consumers' living rooms, hospitals and health systems are inviting similar technologies into patient rooms. With tech developments increasingly focused on natural language processing and ambient listening capabilities, EHR vendors Epic [23] and Cerner [24] both inked deals to integrate Nuance's virtual assistant in their software this year, and Epic is working on its own ambient voice tech called Hey Epic! AI start-up Saykara launched [25] a new voice assistant this year that operates both ambiently and autonomously, so it can listen to and understand the context of a patient-physician conversation without being prompted by voice commands. The company counts New York City-based New York-Presbyterian's innovation arm as an investor, and Seattle-based Swedish Medical Group is a customer. [15]

CONTACT TRACING:

The recent trend that uses the healthcare app development tools/software is contact tracing technology. A unique kind of digital health solution, it helps to trace and track people who got infected from covid. It is assisting governments by tracking covid patients and monitoring their health. This way, they can reduce the cases of covid by identifying how people got infected. Singapore, India, the US, and several other countries continue to use this technology to help their covid relief plans. [3] The growth in the amount of data collected on our health, from our interaction with health services as well as our own devices and online activities, means providers have an increasingly accurate picture of where and when intervention

may be needed. The coronavirus pandemic has shown us that there is a willingness to share our personal data when the benefits to our health are clearly communicated. This has been proven by track-and-trace systems that have reliably kept infection levels in check in some regions (though less so in others). [26]

PRODUCTIVITY APPS:

As workers continue with work from home, productivity apps are becoming critical. They are a part of the mental health and wellness regime. Healthcare app development languages like Ruby [27] and Python [28] help to build productivity apps. These solutions for healthcare focus on improving focus, monitoring tasks and activities, and enhancing productivity and output. When employees feel more productive, their overall well-being ultimately improves. [3] These apps have gained a lot of popularity in the past year due to the pandemic. The outside world was shut down and people needed a way to keep up with their lives effectively. There have been numerous apps that provide facilities like setting reminders for drinking water, reminding about unfinished tasks, keeping track of what your day consists of, reminders about taking medicines, keeping track of your appointments etc.

CLINICAL SOLUTIONS:

The best medical apps for doctors and patients are clinical solutions. Healthcare facilities and clinics often use them. Patients can schedule appointments through these apps, get answers to common queries, exchange information with their doctors, and do much more. People can also get reminders for their appointments, pay their bills online, and connect with the medical staff in case of any emergencies. Holistic apps are one of the leading healthcare app development trends in 2021. [3] The pandemic ushered in a newfound era of social distancing, which has forced healthcare organizations to ramp up their digital presence and capabilities to stay connected to patients. With the "digital front door," serving as the first impression potential patients have of a health system, online experience has become a critical component of their overall reputation. As hospitals and health systems look to the future, many, such as Greensboro, N.C.-based Cone Health [29] and SCL Health [30] in Broomfield, Colo., are investing in a digital front door, which includes the organization's website and mobile apps that host the online patient portal, scheduling, telehealth visits and educational resources. [15]
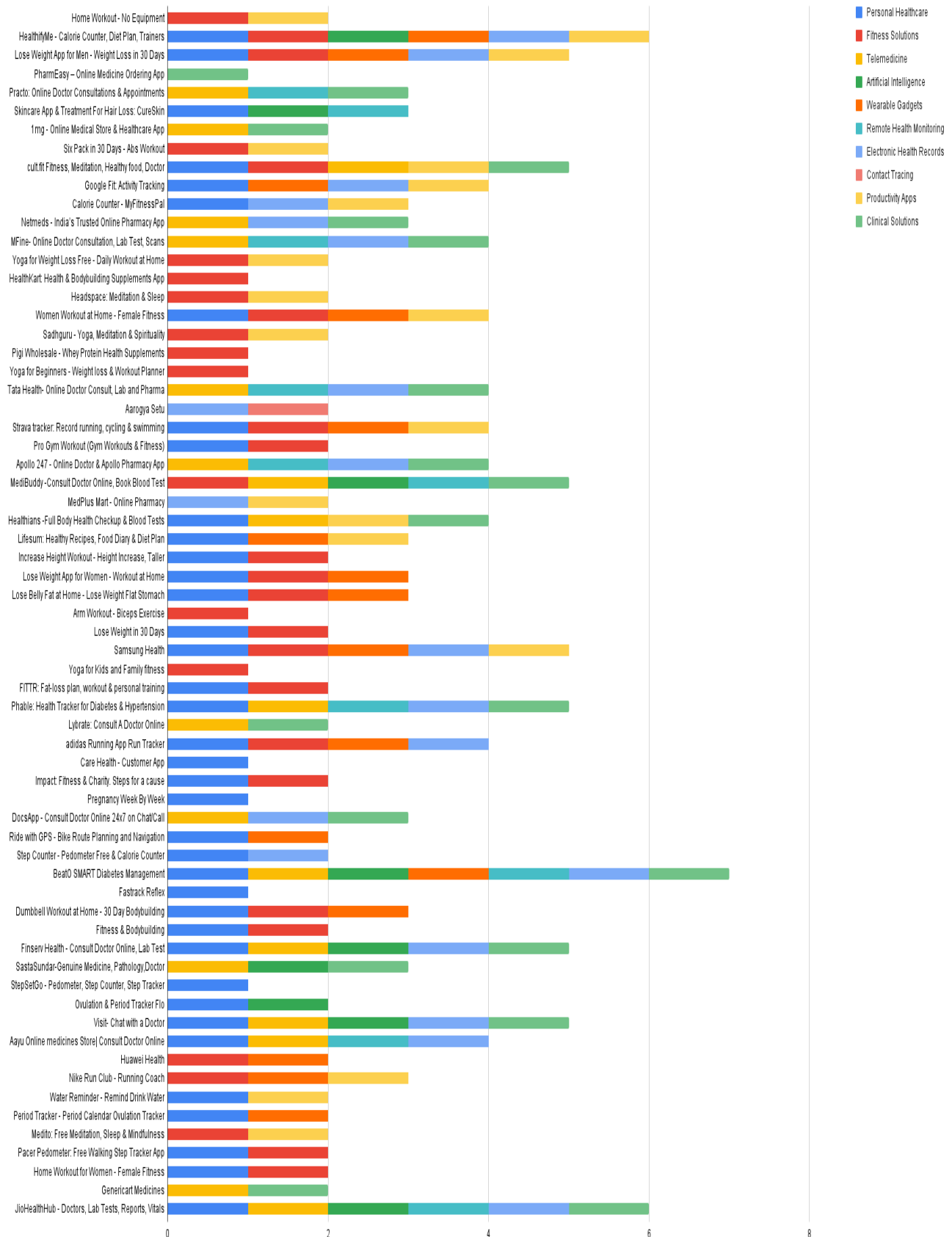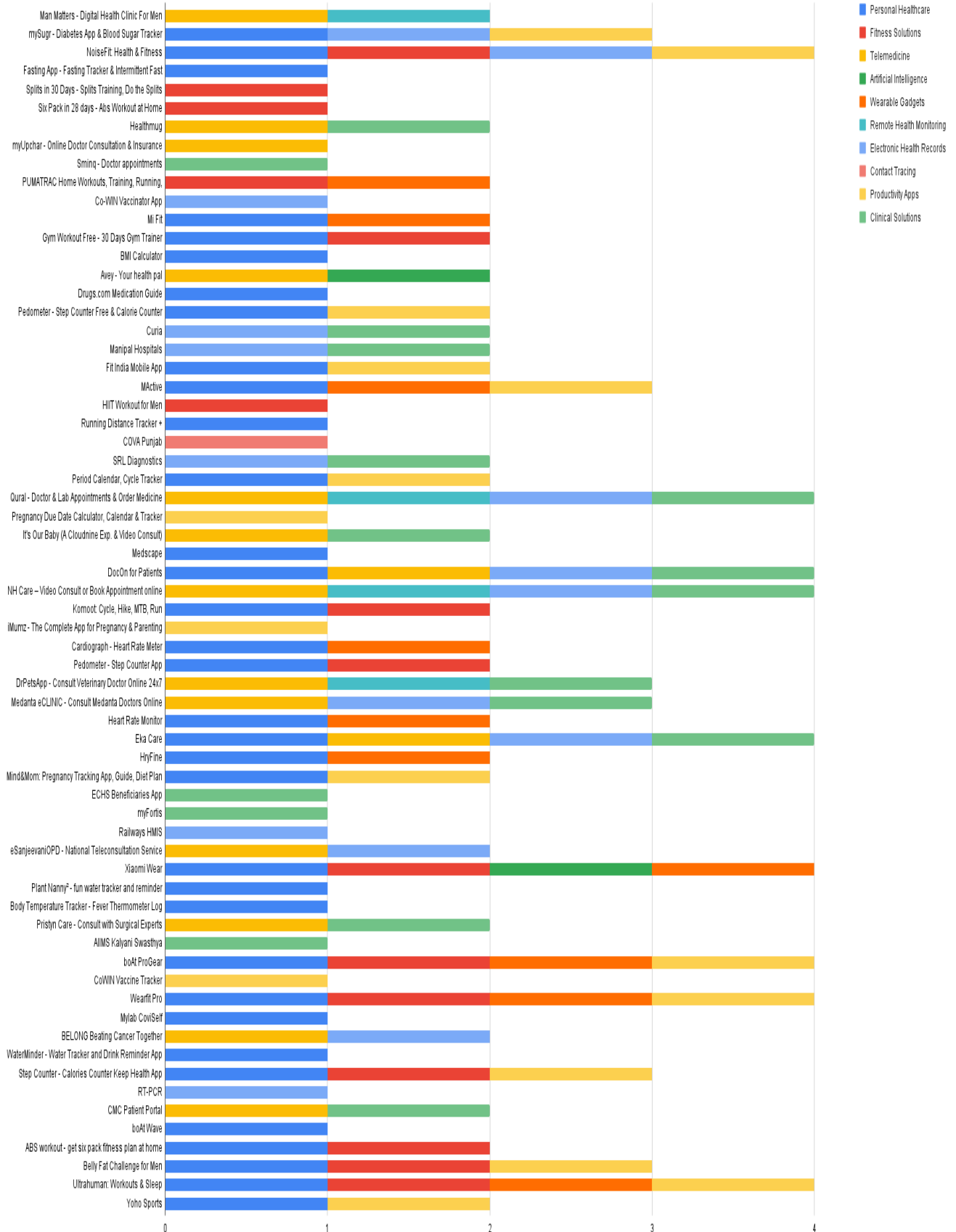
Apps I

Figure 2: Apps I

Apps II

Legend:
- Personal Healthcare
- Fitness Solutions
- Telemedicine
- Artificial Intelligence
- Wearable Gadgets
- Remote Health Monitoring
- Electronic Health Records
- Contact Tracing
- Productivity Apps
- Clinical Solutions

Figure 3: Apps II

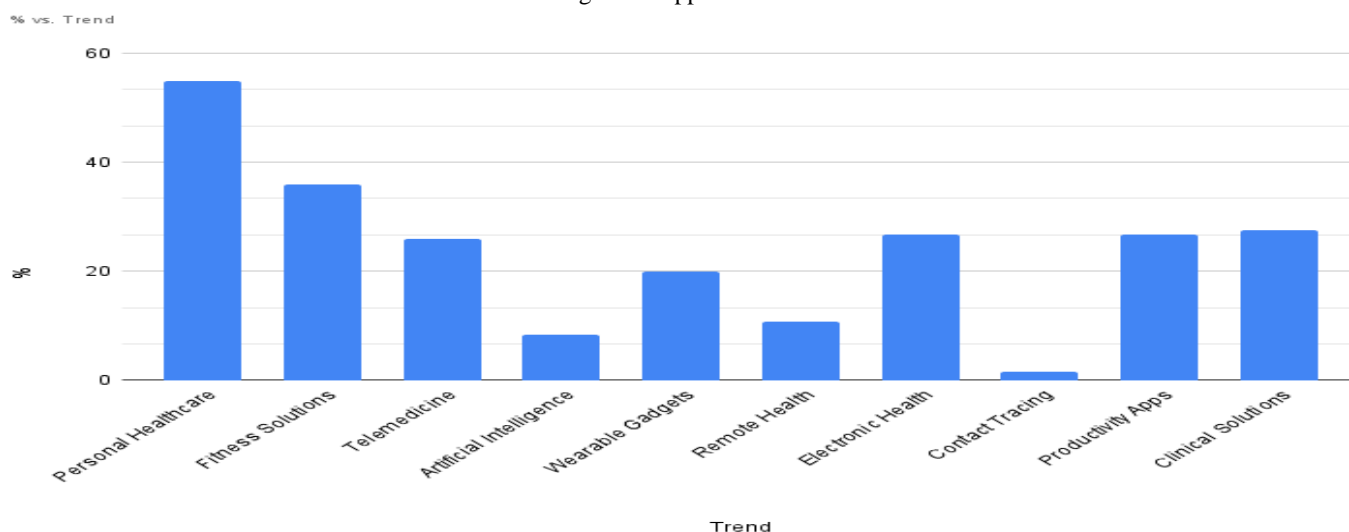Figure 4: App percentage v/s Trend

4.   ANALYSIS

There are 130 Android apps that were analysed. The functionalities of each of the apps were analysed in order to categorize each one into the trends. Having multiple features in a single app would be usually preferred because people would not want to have a different app for every single requirement. Even then, there were 35 apps that provided just 1 feature and yet had a visibility rating of more than 50. Looking at the trends graph of apps, it is clear that personal healthcare apps have been a very popular choice with 72 apps (55.4%) in the category. With the outside world shut down, people are embracing technology for taking better care of themselves. The least famous trend was contact tracing with only 2 apps (1.5%) providing support for the same. This is mainly due to the fact that contact tracing was done by government affiliated apps which made it more centralized and only those apps provided the feature. Looking at telemedicine, it is provided by 34 apps (26.2%) while remote health monitoring is provided by 14 apps (11%) which shows that while a fair amount of apps provide the facility of virtual consultations, a majority of those do not provide regular follow-up for the same. This is something that could be improved upon because providing a one-time interaction might not be enough in all cases. Another popular trend has been that of fitness solutions with 47 apps (36%) providing support for it. Pandemic fatigue brought the increase in usage of these apps and became a popular trend. In terms of artificial intelligence, the data was disappointing. Even though it is a very popular part of current technologies, there are not a good number of apps that support it. From the data, AI has been implemented in 11 apps (8.5%) only. The AI found in these apps was mostly an assistant who guides the user through the procedure. It might not be much but it is still a start and holds a lot of potential in the future. Wearable gadgets are something that are gaining momentum too. There was an increase in its sales in the past year which is why a lot of apps are now syncing data with the wearable gadgets and attracting new users. Comparing this with the productivity apps that are 35 (27%) in number shows that there are apps that provide feature for keeping track of activities but not all of them are getting data from wearable gadgets. This means that these apps collect manual data which is far less accurate than the one obtained from wearables. The lack of accuracy might make these apps less favourable in the future. The rising trend of electronic health records gives a glimpse of a future that is completely cloud dependant. There are 35 apps (27%) following this trend which gives an insight into how people do not prefer physical documents and would rather keep it online so they can access it from any place they want.

5.   DISCUSSION ON IMPROVEMENTS

In spite of a lot of applications existing now provide support for a lot of features, there is still a long way to go. In order for medical apps to evolve, improved oversight and continuous quality review is required. Centralized oversight by regulatory bodies has the advantage of regulatory expertise and powers to sanction. However, these regulatory bodies are too under-resourced to wade through the sheer volume of apps and there appears to be little appetite to get involved. In an accredited

environment, the speed and revision of review is an important factor when review processes take months or years, while apps can be updated in a matter of weeks and hardware changes regularly. An alternative might be for developers to self-certify according to a checklist in order to reassure the public and maintain their own quality assurance. However, systematic self-certification [31] or a systematic rating scale [32] do not bring more observers to the table but rather rely on the developers' honesty and competence. [33] The lack of seamless access to patient information across the care pathway remains one of the most pressing issues in healthcare. [34] The absence of an integrated system poses a threat to care quality and patient safety as important clinical decisions have to be made after referring to multiple electronic systems, raising further issues in terms of governance and handling of confidential data. One solution to safe access to patient-level data through mobile devices is for organizations to have clear security and governance rules in place. These may include the provision of devices or registering of all mobile devices used within the organization; registration of individual users; the use of virtual secure networks; and utilization of apps designed to prevent data being stored locally on the device. For those apps that provide patient-level decision support, mechanisms to maintain a decision-making audit trail must be developed. This may entail digital logs or print-out-and-sign signatures of healthcare professionals that should be retrievable and shareable amongst the various apps and electronic and paper systems used to document the care provided for individual patients. [1]

Collection of data plays a very important role in taking a step further in the development of AI related functionalities. In the existing apps, the AI support was very basic. Once a data store has been built from many different sources—EHR data, payer data, device and IoT data, patient survey responses, consumer health data—and has been integrated into a unified data structure, then AI can yield meaningful insights. AI, after all, is about pattern recognition, comparing a particular pattern of data around a given individual with similar (not necessarily identical) patterns found elsewhere, and making predictive recommendations based on what happened in those other situations. This is very much what clinicians do when exercising "clinical judgement"— identifying a pattern, taking into account medical problems, medications, labs values, personal and family history, and comparing it to similar patterns from the clinician's experience. A new generation of "Health Coaches", Tele-Carers or Digital Health Advisors can be trained to make these AI-derived recommendations useful. [35] They need to be easy-to-use, consumer-orientated persons who can connect to the aggregated data store and the AI analytics engines that sit on top of that. [36] A very popular trend as analysed was fitness solutions. We can summarize the major limitations of current user-focused apps for weight management, characterized by: (1) simplistic capabilities that lack high-level personalization to complex user needs and preferences, (2) a lack of health care expert involvement during app development, (3) minimal use of evidence-based strategies for the management of obesity, and (4) the absence of scientific evaluation of these tools. Current capabilities for promoting behaviour change for weight management through mobile apps have low fidelity and do not reflect the individually tailored practices employed in clinical obesity interventions. Apps tend to possess a singular focus on either the physical activity or dieting practices for weight loss. Moreover, apps do not comprehensively address the full range of cognitive, behavioural, and environmental factors that can impact a person's ability to manage their weight over the long term. Moreover, the self-monitoring capabilities of current mobile apps are limited by the manual input demands on the user, requiring that users remember and be consistently motivated to input multiple types of data frequently in order to be successful. Future efforts by both researchers and commercial developers should aim to address the limitations discussed. More stringent standards for the provision of medical apps should be established and incorporated into the process of submission to an app store. More comprehensive use of evidence-based strategies used in routine behavioural counselling for weight loss should be integrated into apps' functionality and content. This is not a straightforward objective because many of these strategies would require complex, intelligent interaction with the device (e.g., such as providing tailored feedback) and would also need to be adapted to the usability constraints of a mobile device interface (e.g., screen size). In addition, health care experts need to become more integral to the development and distribution of medical apps. The concerns of any medical treatment, such as safety and efficacy, must be equally considered to those more typically focused on by app developers, namely the user interface and keeping the user engaged. [37]

Indian regulation on medical apps are at the ground zero and stringent regulations should be incorporated in order to develop and protect the interests of the general public to avoid unforeseen conditions. India needs to be also vigilant among the medical and healthcare app developers because the apps are assigned to third party clients where the people working in the domain are mainly related to non-medical field and also Indian app developers should also privately frame guidelines for app developers till the enforcement agencies frame the necessary guidelines. Indian app developers should also be proficient in handling issues related to content development. The Indian and European markets are good markets to look at. The underserved rural healthcare market in India is still challenged by healthcare affordability and availability and thus is a strong market for mobile medical applications, especially with the recent penetration of mobile across rural India. Further, the regulatory authority in India is open to mobile medical apps. A homologation framework can guide a mobile medical application's introduction

through multiple geographies, by taking care of the legal, environmental, quality systems, distribution cycle, and end of life cycle. Such a framework manages engineering changes that may be needed to meet various local regulatory requirements. It also acts as a vehicle to handle customer complaints and regulatory reporting, to provide field service bulletin and field modifications instructions, (FMI) and to manage the end-of-life stages of the application. It comprises elements of a robust assurance case framework including safety assessment, failure modes effects and criticality analysis (FMECA), fault-tree analysis (FTA), static code analysis, system verification, and risks to health, among other analyses. A framework helps manufacturers focus on implementing a risk-management process beginning with the design function and moving all the way through to the end-of-life phase for a global application. [38]

The major technological improvements of both hardware and software are still relatively new and, thus, sometimes unreliable. Furthermore, older physicians and others less inclined to use or intimidated by new technologies may be at a disadvantage if the use of smartphones becomes more requisite within medicine. Similarly, elderly patients may find it difficult to use and interpret the information provided to them by their smartphone, possibly putting them at greater risk than those who are more technologically savvy. And finally, as we become more dependent on technology, we become more dependent on it working flawlessly, with catastrophic implications when it fails. [39] Taking a generalized look at what improvements could be brought in medical healthcare apps to make it better, we can consider 5 approaches.

Table 1: Improvements Oveview

Approach	Who leads the approach?	Emphasis of approach	Strengths	Weaknesses
Boost app literacy	The medical technology community	Educate consumers on how to make better decision	Empowering, educational, low-cost, no barrier to innovation	Difficult burden remains on patients, no oversight or enforcement
App safety consortium	App developers, safety researchers, regulators, patient advocates	Identify harms arising from health apps	Gathers data, raises concerns appropriately	Low yield, no current infrastructure, funding
Enforced transparency	App Stores and Researchers	Enable external validation by third parties	Continuous quality assessment, enforceable by app stores	Threat to competitiveness, additional work for developers
Active medical review	App Stores	Medical review of every app before release to the public	Robust, enforceable, drives quality and safety	Barrier to innovation, reduces number and diversity of apps, costly, slow
Government regulation	Regulators, e.g., Food and Drugs Administration, Medicines and Healthcare products Regulatory Agency	Medical review of every app before release to the public	Existing powers, enforceable, drives quality and safety	Very slow, cost borne by government, barrier to innovation

BOOST APP LITERACY

The most light-touch approach would be a bottom-up strategy to educate consumers about how to evaluate and interpret their own data in health apps. [40] App developers could voluntarily choose to increase transparency through prominent placement of documentation in the app store that highlights the testing, reliability/validity, data privacy policies, and business model of their medical app. This information could include lay descriptions of the populations(s) on which the app was tested, the context of testing, the validity and reliability of the data collected by the app, and how the app developer will make money or otherwise fund future improvements in the app. Consumers could then place greater faith in what they read if developers have submitted their documentation for independent review and approval. The information provided might also improve a user's health literacy by highlighting important aspects of the app that they should consider before installation. The challenge to this approach is that even a trained clinician might struggle to access all the relevant literature and systematically assess every version of every app in every permutation of user, much less understand complex security and privacy issues and synthesize them to make a rational decision—most patients could also find this extremely challenging. [33]

APP SAFETY CONSORTIUM

Given the need for multiple stakeholders to tackle the problem but bearing in mind the view of developers who would resist active control, a second approach would be to convene an app safety consortium of developers, safety researchers, patient advocates, and regulators, which might investigate systems for consumer reporting of adverse events resulting from app use, such as insulin overdose, an approach that has been proposed for patient-reported outcomes in clinical trials of drugs and medical devices. [41] Properly elucidating the level of harm arising from poor app design might draw greater scrutiny, encourage the sharing of best practices, or, while rarely the desired mechanism, encourage litigation that sharpens focus on addressing these issues robustly. Such a consortium would serve as an organizing force to further develop regulatory and risk management frameworks. [33]

ENFORCED TRANSPARENCY

A third approach would be for the owners of the app stores to enforce the ability to evaluate medical calculator apps transparently in the same way that ClinicalTrials.gov permits external third parties to look for deviations in protocols, changes in statistical planning, or lack of publication [42] without manually reviewing every trial themselves. In order to access their population of consumers, app developers would be required to submit documentation (viewable by all and accessible through an open database) to be reviewed by anyone but particularly amenable to review by consortia of researchers and clinicians who could evaluate relevant aspects of each app with automated software. This would effectively be "whiteboxing" what was previously a "black box" and allow third parties to develop software that checks the functioning of apps as a service to developers, app store owners, clinicians, and the public. The degree of transparency enforced may require tweaking to ensure the competitive advantage is not eliminated for those developers who have done the hard work to ensure the quality of their product. [33]

ACTIVE MEDICAL REVIEW

A more active approach would be that those running app stores, such as Apple and Google, take full responsibility for every aspect of security and quality for medical apps as a "benign dictatorship." After withdrawing all current medical apps in their app stores (which we know from these studies include under-developed programs created by amateurs with no intention of providing ongoing support), they would need to implement a robust testing program staffed by clinicians, security experts, and quality assurance software engineers who would thoroughly vet medical apps before they were released to the public. While this most conservative approach might sound appealing to clinicians and safety enthusiasts, it is also the least likely to succeed. For instance, Apple already has a complex set of App guidelines in place [43], although as one commentator claims, "the rules are subjective and poorly enforced" [44]. Apps already take a substantial amount of time and energy to review just for basic functionality, let alone the complex verification steps that would be required to remedy some of the issues described by Huckvale and colleagues, and because health apps probably account for a very small proportion of revenue, it would be hard to imagine technology companies taking on the administrative burden as well as the potential for liability should harms arise from apps that have undergone a more rigorous review. [33]

GOVERNMENT REGULATION

Any of these approaches is probably still preferable to the final extreme: government regulation of smartphone apps. Only a tiny number of health apps, such as OncoAssist, have gone through European Union Kitemark certification to be qualified as a medical device, a rigorous process that ensures the data they present can be relied upon for clinical decision-making [45]. If the public wanted to be more confident of safety and app store owners did not want to hire a brigade of technologically minded clinicians to review each app, governments could decide to increase the resources available to the existing regulatory bodies to enhance their capabilities and increase the throughput of testing programs. However, this approach likely carries more burden than opportunities. [33]

6.   CONCLUSION

From the analysis of the existing apps, it is very clear how the apps that people use currently are not at par with the trends in healthcare. Something lacking from majority of the apps was presence of multiple features. In an age of minimalization, users can not be expected to use a different app for every single feature. Latest technologies like AI should be implemented in more apps. And even above that, it is very necessary to take into consideration how easily people of all ages and understanding will be able to navigate through the app. Manual entry of data only leads to fatigue and decreases the need to want to use the app regularly. Personal data might be an invasion of privacy but common statistics could be made available for the developers to analyse and use. Reduction of redundancy in app development is also a fair step. Due to people being sceptical about their security, even in today's digital age, users are not completely open to sharing and uploading their data to apps and thus prefer offline treatments. Steps to improve security are thus equally necessary. From the points discussed till now, it is safe to say that the gap between technological trends for healthcare apps and app usage for the same is fairly big in the existing market. It will thus require a lot of efforts from the stakeholders before the app performance matches the standards of treatment provided by a real-time doctor.

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