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Unveiling the Communication Dynamics: A Comprehensive Review of Mobile Health Applications

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ABSTRACT

Technology has penetrated every aspect of our lives since the pandemic ended, from work to entertainment. The seamless integration of work, leisure, and learning with portable devices highlights the criticality of instantaneous information access. This escalation of technological change has given rise to mobile health applications that offer timely alerts, easily accessible information, and a range of responsibilities. This exhaustive evaluation examines these applications using data from the WoS and Scopus index-reviewed literature. Additional responsibilities, reminders, and the dissemination of knowledge are the three primary components of this study. Critical as healthcare technology evolves are mobile health applications that have been reviewed. In addition to aiding in recall, they also furnish vital health information. Health education programmes that are technology-mediated and patient-focused align well with this. This study incorporates the most recent research on mobile health applications into the ongoing discourse. The applications' multidimensional architecture facilitates a comprehensive and intuitive healthcare experience through the provision of reminders, notifications, and information dissemination. A commitment to the most recent literature in the English language and a multimethod, multimeasure assessment underscore the significance of technology that is centred around the patient. As we incorporate these technologies, healthcare is expected to undergo a paradigm shift towards patient-centric, evidence-based practices.

1. Introduction

The utilization of health-related apps and wearable technologies has increased the population maintaining their health data. The issues of cost and accessibility significantly hinder human-

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operated health promotion activities. The healthcare sector has lately prioritized the development of AI-based health guidance systems as a reaction to staffing shortages and cost reduction efforts [1]. Generally, mHealth technology can help refugees access healthcare. According to research, mobile phone-based reminder systems promote prompt and thorough healthcare access. However, there are few refugee views on design processes and research on their development for displaced people. COVID-19, which has damaged public health worldwide, is engulfing the planet. Every nation is focusing on public and mental health and creating COVID-19 vaccines. To avoid infection, COVID-19 requires a clean environment. Nonetheless, due to filth, COVID infection rates are rising in most nations. Through a mobile application, parents can view the list of nearby vaccination facilities where they want to immunize their child and make changes to the vaccination establishment, avoiding the long and difficult process currently required to change the vaccination establishment [2].

The metaverse, a digital environment for the Fourth Industrial Revolution (IR 4.0), is one of the internet's most important uses. The expansion of the Internet enhances individuals' quality of life and alters their patterns of expenditure. Thanks to technological advancements, such as instant communication regardless of physical barriers or time constraints, information may now be acquired quickly [3]. Besides, mobile health or medical services apps aim for patient monitoring, documentation, and service intimations. These mobile apps are becoming more valuable to any user who is linked to accessing or utilizing these smartphone or mobile phone apps. The ease of access and speed with which medical personnel may get clinical data and reference material, as well as react to it, can be significantly improved by using mobile applications designed for the healthcare industry. The uniqueness of this study exists in the fact that most users or patients said forgetfulness contributed to frequent vaccination [4].

Policymakers want mobile-phone reminders to boost children's immunisation rates. Nevertheless, there is little data on patient and carer acceptance of mobile-phone reminders. This systematic review and meta-analysis examined mobile-phone ownership and readiness to receive reminders among Nigerian mothers/caregivers using regular paediatric vaccination programmes. Most mothers preferred morning text messages in English (52.8%) reminders 24 hours before regular vaccine appointments. Besides, mobile-phone reminder approaches to promote regular kid vaccination coverage and timeliness seem well-accepted. However, further research is required to determine regional preferences, long-term impacts, operational costs, as well as hazards with regard to this intervention [5].

The adoption of mobile health applications can enhance the patient experience, particularly in obtaining health information, facilitating physician-patient contact, guaranteeing transparency in medical charge, and enhancing short-term results. All of these things could help people's health in some way. Because of this, we need to promote the use of mobile health applications in healthcare facilities to give patients a better overall experience. This article is written with the intention of providing a condensed summary of current advancements in a certain field. In general, the article provides a summary of the present level of knowledge about the subject. Then, a discussion of the results reported in recent research publications helps the reader develop a knowledge of the subject at hand.

2. Literature Review

2.1 As Reminder

Short Message Service (SMS) reminders may increase children's vaccination rates, although they are seldom utilised. Many reminder and recall solutions do not address language difficulties, which might hinder vaccination programme delivery [6]. HPV Vaccine: Same Way, Same Day software

simulates role-play situations between a doctor avatar and an animated mom who is afraid to vaccinate her kid. The app delivers vaccination information and uses deliberate practice, a methodical way to enhance performance, to teach evidence-based vaccine-recommended techniques, which includes motivational interviewing. Note that a purposeful practice app might improve human papillomavirus (HPV) vaccination counselling abilities, according to paediatric residents [7].

Figure 1 states that HPV-related malignancies are avoidable. However, HPV vaccination rates are low. HPVCancerFree (HPVCF) is a mHealth campaign that raises HPV awareness, reduces HPV vaccine obstacles, and allows HPV vaccination reminders, as well as schedules using a smartphone app to influence parental HPV vaccination decisions. The user experience concerning mHealth treatments is crucial to measuring their quality and effectiveness, yet it is often underreported [8]. Reminders and recalls were found to boost appointment attendance and remind parents about vaccines [9]. Moreover, parents of HPV-Vaccine-Eligible Children may use the Vax4HPV Mobile App [10]. These everyday responsibilities make it challenging to provide and maintain complex behavioural treatments to improve adherence. Correspondingly, mHealth reminders and direct adherence measures have improved therapeutic results [11]. In addition, Scaling the Children Immunization App (CIMA) assists child parents, as well as refugees, during the COVID-19 pandemic located in Zaatari Camp, Jordan, which is regarded as a Social Capital Approach were possible. In refugee circumstances, children's immunisation requirements are more significant, especially for COVID-19 [12].

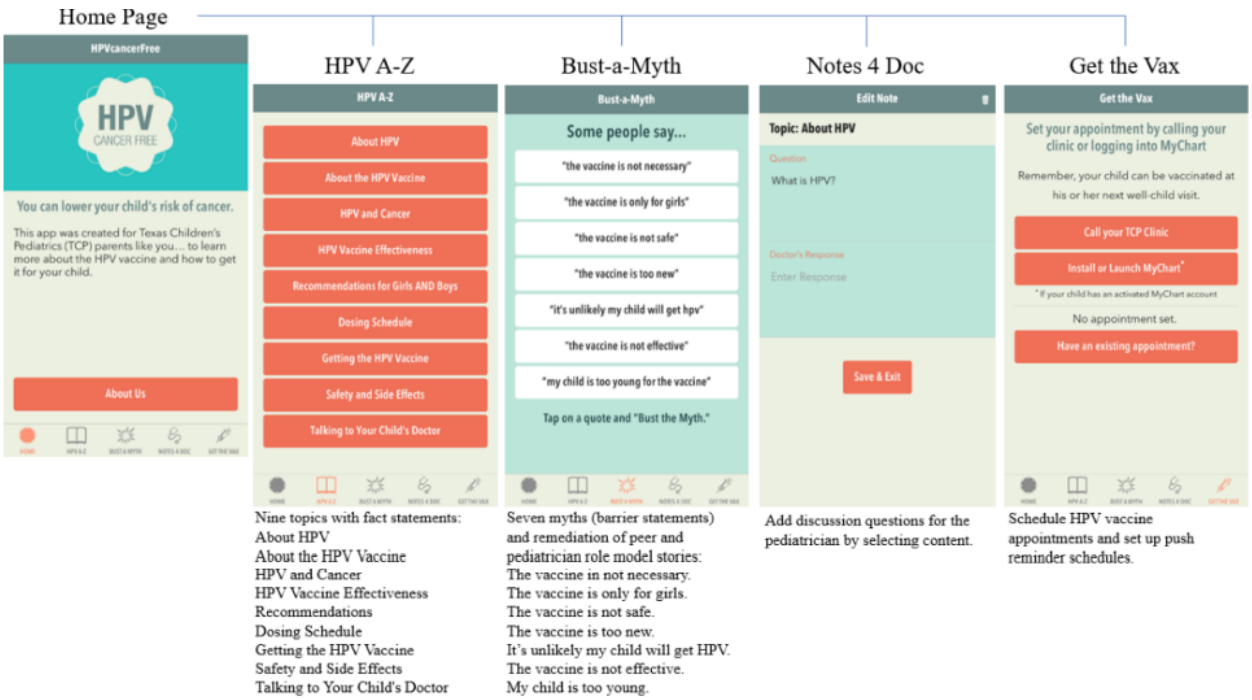

Fig. 1. HPVCancerFree (HPVCF) components. HPV: human papillomavirus [8]

The majority said that the online application is useful and efficient since it permits the change of health facility for many parents who had to move to the countryside due to a lack of jobs and fear of COVID-19 infection [2]. After a literature review of [13] on mixed methods study design directed by the Mobile Health Agile Development and Evaluation Lifecycle, CANImmunize Inc. advanced the Immunize PediatricTransplant app, and stakeholders completed the Mobile Application Rating Scale

(uMARS)'s user version in evaluating the app's quality and functionality. To enhance pretransplant vaccination distribution, Immunise PediatricTransplant was created for Android and Apple. The app shares news concerning automatic vaccine reminders, a communication tool for care providers and parents, a comprehensive immunisation record for every kid, as well as pretransplant vaccine usage [13].

Note that Indonesian youngsters are under-immunised as they have a high child death rate. The government's PrimaKu app provides immunisation information and reminders. However, the app's immunisation features have not been extensively examined [14]. Hence, modernising reminders/recalls was popular since it seldom included educational or language-overcoming tactics. This is because text messaging and automation were supported in reminder/recall systems. Novel delivery techniques were encouraged due to the systems work best when reminders/recalls are tailored to target demographics—modernising delivery, solving language hurdles, giving instructional content, and allowing local reminder/recall management flexibility [9].

Parental concerns about COVID-19 exposure during child visits could lead to the observed decrement. Improving vaccination rates requires innovative and cost-effective mHealth initiatives. To express the extremely relevant nature of the personalised healthcare experience, end-user demands must be understood. They needed native-language apps to grasp better and communicate relevant information. For example, 95.2% of our participants accepted SMS immunisation updates, which is high [4]. Furthermore, it can be seen that Taiwanese mothers are under-vaccinated and research-tested an "Influenza Vaccination Reminder Application" to enhance vaccination intention among pregnant Taiwanese mothers. Moreover, the "Influenza Vaccination Reminder Application" may encourage pregnant Taiwanese women to vaccinate [15].

Table 1 is about 11 mobile health applications have specific functions in promoting and overseeing vaccines, particularly for youngsters and expectant moms. Every application is loaded with distinct features designed to improve user experience and guarantee prompt and well-informed healthcare choices. These programmes provide a variety of functions, such as sending SMS reminders for children's vaccines and monitoring specialised HPV injections. Significantly, they integrate notification systems to alert users about future vaccinations and provide vital information on themes linked to vaccines. These applications jointly help to enhancing vaccination knowledge, compliance, and general public health.

Table 1
Mobile health apps – purpose, feature, notification and information

No.	Mobile Health Apps	Purpose	Feature	Notification	Information
1	Short Message Service (SMS)	Children Vaccination	SMS reminders for upcoming vaccination appointments Personalized vaccination schedules	For missed vaccinations	About vaccine-preventable diseases
2	HPV Vaccine: Same Way, Same Day	HPV Vaccination	Education about HPV vaccination	Reminders for follow-up doses	Importance of timely HPV vaccination. Side effects information
3	HPVCancerFree (HPVCF)	HPV Vaccination	HPV vaccination schedule tracking. Progress tracking for completed doses.	Reminders for upcoming vaccinations	Educational content about HPV and cancer prevention

4	Appointment Reminder and Recalls	Children Vaccination	Appointment scheduling and tracking. Automated reminders for vaccination appointments.	Recall notifications for missed vaccinations	Immunization records and history
5	Vax4HPV Mobile Apps	HPV Vaccination	Progress tracking and completion certificates. FAQ section addressing common concerns.	Reminder system for HPV vaccination series	Information on HPV and related vaccines
6	mHealth Apps	Children Vaccination	Centralized platform for children's health information. Secure storage of vaccination records.	Vaccine schedule customization	Integration with healthcare providers
7	Children Immunization App (CIMA)	Children Vaccination	Immunization tracking and scheduling. Integration with healtcare providers.	Alerts for missed vaccinations	Educational resources on childhood vaccines
8	Mobile Applications	Children Vaccination	User-friendly interface for parents or guardians. Secure and private storage of health information.	Notifications for upcoming and overdue vaccinations	Vaccine information sheets
9	Immunise PediatricTransplant	Children Vaccination	Specialized vaccination schedules for pediatric transplant recipients.	Alerts for immuno suppressed individuals	Educational content on vaccinations post-transplant
10	Primaku	Children Vaccination	Customizable vaccination schedules. Progress tracking for multiple children.	Automated reminders for parents	Educational content on vaccine safety
11	Influenza Vaccination Reminder Application	Pregnant mothers Vaccination	Pregnancy-specific vaccination schedules	Reminder system for flu shots	The importance of influenza vaccination during pregnancy Post-vaccination .safety information
	Total : 11 Apps				

2.2 As an Information / Knowledge

Smartphone applications may educate, remind, and connect parents to a multidisciplinary medical team, increasing vaccination rates. After the pandemic, pharmaceutical and non-pharmacological techniques will work together to control the virus. The research reveals that adherence to the COVID-19 vaccination and the national contact tracking app are not predicted by similar characteristics, despite their importance in preventing SARS-CoV-2 [16]. The latest SARS-CoV-2 communication challenges and vaccine campaign demonstrate this [17]. Apart from that, vaccination against SARS-CoV-2 is the best way to fight COVID-19, in which non-usage and

unawareness of the Arogya Setu App are key predictors of vaccination reluctance [18]. Japan has always had vaccination safety worries. Mobile chat applications and COVID-19 vaccination reluctance are seldom studied. For example, LINE, Japan's most popular communication service, released Corowa-kun, a free chatbot, on 6th February 2021. Corowa-kun answers 70 COVID-19 vaccination FAQs instantly and automatically [19].

However, the World Health Organization (WHO) faced a major problem stopping SARS-CoV-2 transmission because of COVID-19. Though the MySejahtera smartphone app from Malaysia's Ministry of Health (MOH) tracks health and contacts, people in public spaces need to wear face masks. Other than that, staff must ensure visitors wear masks, check in using MySejahtera and are healthy before entering a building. To lower overhead cost, a cheap solution is required. Hence, the AI-Based Low-Cost Real-Time Face Mask Detection and Health Status Monitoring System (AFMHS) detects face masks and MySejahtera check-in tickets in real time. Face and face mask detection and identification were made using MobileNetV2. Meanwhile, YOLOv3 detected the visitor's health and immunisation status for the MySejahtera check-in tickets. Similarly, optical character recognition (OCR) detects and encodes text in images. Note that Tesseract is AFMHS's OCR engine, while Raspberry Pi Generation 4 Model B (Raspberry-Pi-4B), equipped with 4 GB RAM, is AFMHS's processing unit [20].

A Vax4HPV Mobile Application for parents of HPV Vaccine-Eligible Children was established to stimulate and enlighten parents' HPV vaccination decisions and help them act on them [10]. Using "C.D.S. Five Rights," the primary care clinic develops and uses a scheduling and self-registration web-based mobile application. The Moderna vaccine drive's scheduling and self-registration online interface and SMS messaging mobile platform increased immunisation ingest compared to our municipality, county, and state. Other than that, primary care clinics (PCCs) have enormous influence as "invaluable warriors" to commit patients for vaccine consumption, which spreads national preventive health and decreases acute sickness and hospitalisation costs [21]. However, another app may display the user's danger level and warn them to safeguard themselves. Aarogya Setu App might inhibit significant viral transmission, according to this study. Each user's risk status is shown via this app, improving viral transmission prevention. Controlling viral transmission is possible using the six-sigma Defining, Measuring, Analysing, Improving and Controlling (DMAIC) principle. Therefore, the proposed application has the best probability of preventing fast viral transmission [22].

Parents could not immunise their children and moved to the countryside for fear of COVID-19 contagion. The shortage of work due to the state's measures in response to significant increases in COVID-19 infections led to a drop in childhood immunisation to 61.1% [2]. As a result, all young and old residents may have a heart attack since it strikes unexpectedly and is a catastrophic emergency that can happen anywhere. Other than that, they also need greater medical control to avoid it. For this reason, a smartphone app was created to assist in preventing heart disease and better track check-ups and regular activities. Arduino's pulse sensor, coupled with the programme through Bluetooth, may inform trusted persons and send a message to the closest hospital. Scrum was utilised for the development of the control system, while Balsamiq was used for the prototype design in this endeavour [23].

2.3 Others Roles

Buzzy may reduce measles-mumps-rubella (MMR) vaccination discomfort by examining how the Buzzy gadget, which uses vibration and cold, reduces discomfort during MMR vaccination administration in 12-month-old babies [24]. On the other hand, "Diagnost" analyses X-rays with normal and pneumonia chests. A control group and 33 medical staff members who utilised the app

were studied. Three indicators, comprising accuracy, detection time, as well as medical aid reduction, were applied to assess the data. The findings indicated that the convolutional neural network (CNN)-based mobile app might diagnose pneumonia early and reduce medical intervention. However, the accuracy of the diagnosis has to be improved to achieve greater accuracy [25]. Besides, researchers created an Internet of Things (IoT)-Galvanized Pandemic Special E-Toilet to clean off the grime. The suggested architecture includes Auto Flush, Occupancy Check, as well as Mobile Application Appliance Control [26].

Amidst the COVID-19 outbreak, personal health records (PHRs) allowed people to manage as well as monitor their medical data without visiting hospitals, reducing their infection risk. Note that Nationwide Health Insurance Administration (NHIA) in Taiwan established the My Health Bank (MHB) service. It is known as a national PHR system that allows insured people to access their cross-hospital medical data. Moreover, in 2019, the NHIA launched the MHB software development kit (SDK), allowing mobile app developers to obtain insured persons' MHB data. Nevertheless, the NHIA MHB programme has restrictions, and insured persons participate at low rates [27].

Geosocial networking (GSN) applications catalyse sexual partnerships, particularly among males who have sex with men. This platform may be excellent for preventive interventions to target this hard-to-reach community [28], as anal cancer and HPV-related oropharyngeal cancer have been rising for 30 years, particularly in men. This research applied SCRUFF, Jack'd, GSN and dating apps for males who engage in male sex (MSM) to assess the LGBTQ+ community's understanding of HPV-related illness and promote the HPV vaccine as an effective and safe cancer prevention technique. It was discovered that Thai Chana is one contact tracking app used to reduce COVID-19 contraction. However, the rabies programme in other countries must adapt to pandemics to increase dog vaccination and monitoring. In the meantime, COVID-19 in Bali, Indonesia, created a rabies control (RaCon) smartphone app for community-based monitoring [29].

The official COVID-19 app of France, TousAntiCovid, has expanded to hold test and vaccination paperwork in keeping with the government's goal, originally focused on contact tracking. It was downloaded by a minority of respondents. Note that one-quarter of respondents used Bluetooth to trace contacts, while a third used it to save their health pass. The app was used more among people with education, money, and younger age. Most non-vaccinated responders (85%) have never downloaded TousAntiCovid. The poll also verified prior findings that socioeconomic status affects app usage. This is troublesome since the pandemic's extended duration may need the government to maintain many methods, including contact tracking. Thus, the French contact tracking app's existing and future functions must be discussed publicly [30].

Table 2
The poll verified prior findings that socioeconomic status affects app usage

Authors	Title	Year	Source Title	Result
[21]	COVID-19 Vaccination Drive in a Low-Volume Primary Care Clinic: Challenges & Lessons Learned in Using Homegrown Self-Scheduling Web-Based Mobile Platforms	2022	Vaccines	The Moderna vaccine drive's scheduling and self-registration online site, as well as the SMS messaging mobile platform, increased vaccination intake by 51% in comparison to our town, country, and state (36%, 39%, and 39%) from April to July 2021.

[8]	Parents' Experience with a Mobile Health Intervention to Influence Human Papillomavirus Vaccination Decision Making: Mixed Methods Study	2022	JMIR Paediatrics and Parenting	HPVCF was used 197 times by parents, with an average visit length of 3.5 minutes. Moreover, the quality of the uMARS app was good (4.2/5). Information (4.46 [SD 0.53]) had the greatest mean rating, while engagement had the lowest (3.74 [SD 0.69]).
[16]	Joint analysis of the intention to vaccinate and to use contact tracing apps during the COVID-19 pandemic	2022	Scientific Reports	The readiness to be COVID-19 vaccinated and download the national contact tracking app was examined using a Bayesian bivariate Gaussian regression model. Here, the incentive to take one of the two preventative actions was examined using a mixed-effects cumulative logistic model.
[15]	Efficacy of a Smartphone Application to Promote Maternal Influenza Vaccination: A Randomized Controlled Trial	2022	Vaccines	Taiwan's maternal vaccine coverage rate is poor. Thus, they created an "Influenza Vaccination Reminder Application" and tested its usefulness in raising vaccination intentions among pregnant women. As a result, the app improved pregnant women's understanding of influenza and vaccinations, according to 126 experimental and 117 control participants.
[13]	A Smartphone App to Increase Immunisations in the Paediatric Solid Organ Transplant Population: Development and Initial Usability Study	2022	JMIR Formative Research	CANImmunize created Immunise Paediatric Transplant, an Android and iOS app that improves pretransplant vaccine distribution. The app provides pretransplant vaccination information, a full immunisation record for every kid, a communication mechanism for parents and care professionals as well as automatic immunisation reminders.
[2]	Design of a Mobile Application to Change the Child Vaccination Establishment under the COVID-19 Pandemic	2022	International Journal of Emerging Technology and Advanced Engineering	The survey of parents showed that most agreed that the web application is important and efficient because it helps many parents who had to move to the countryside due to lack of work and COVID-19 fears of changing health facilities.
[25]	Implementation of a Mobile Application based on the Convolutional Neural Network for the Diagnosis of Pneumonia	2022	International Journal of Advanced Computer Science and Applications	The study analysed Chest X-rays with normal and pneumonia using a mobile app named "Diagnost" to investigate the impact of a CNN-based app for diagnosing pneumonia. The findings showed that the CNN-based mobile app might identify pneumonia early and reduce medical intervention, but the diagnostic accuracy has to be improved.
[28]	Engagement With HIV and COVID-19 Prevention: Nationwide Cross-sectional Analysis of Users on a Geosocial Networking App	2022	Journal of Medical Internet Research	GSN applications boost sexual partnerships, particularly among men who have sex with men. Additionally, 384 rural as well as 1889 urban profiles were assessed. Urban profiles averaged 32.9 (SD 9.6) years, while rural profiles averaged 33.5 (SD 12.1) years with (P=0.41).

[26]	IoT-Galvanized pandemic special E-Toilet for generation of sanitised environment	2022	Journal of Discrete Mathematical Sciences and Cryptography	The researchers in this study designed an IoT-Galvanized Pandemic Special E-Toilet to disinfect the environment and address griminess. The suggested design includes Occupancy Check, Auto Flush as well as Mobile App Appliance Control.
[31]	Awareness of hepatitis B post-exposure prophylaxis among healthcare providers in Wakiso district, Central Uganda	2022	PLoS ONE	Results among the 306 HCPs indicate that 30.4% had already heard of hepatitis B PEP while 5.2% received training. Moreover, 6.2% and 4.6% mentioned hepatitis B immunoglobulin (HBIG) and vaccination as PEP alternatives, respectively. The maternity department had lower awareness of hepatitis B PEP. Hepatitis B PEP knowledge increased with urban healthcare institution employment.
[9]	Childhood immunisation appointment reminders and recalls: strengths, weaknesses and opportunities to increase vaccine coverage	2021	Public Health	One of the most often cited benefits of appointment reminders and vaccine recalls is their capacity to remind parents about immunisations. Their drawback is that they need a lot of effort and time to complete. There was widespread agreement among respondents that more cutting-edge distribution mechanisms would lead to better reminders and remembers.
[4]	Usability and acceptability of a mobile app for behaviour change and to improve immunisation coverage among children in Pakistan: A mixed-methods study	2021	International Journal of Environmental Research and Public Health	Immunisation protects children from deadly diseases, according to most participants. Pre-appointments at vaccination centres cut waiting time, according to the majority. AI-based immunisation behaviour modification applications also intrigued participants. They desired apps in their local language to better comprehend and communicate important information. Moreover, in this research, 95.2% of respondents accepted SMS immunisation reminders.
[12]	Scaling the Children Immunization App (CIMA) to Support Child Refugees and Parents in the Time of the COVID-19 Pandemic: A Social Capital Approach to Scale a Smartphone Application in Zaatari Camp, Jordan	2022	Journal of Epidemiology and Global Health	Here, 1100 children up to 15 months old eligible for vaccination were registered in CIMA, and professionals taught the app's immunisation schedule and parenting techniques to their careers, as well as health promotion materials. Furthermore, the volunteers found 70 children with incomplete immunisation records (42/70 females, 60%) during home visits. Scaling the app was also covered.
[10]	A Vax4HPV Mobile Application for Parents of Human Papillomavirus Vaccine-Eligible Children: Iterative Formative Assessments	2022	CIN - Computers Informatics Nursing	This research revealed that theory-based, user-centred apps that provide directions to clinics and nurse-recommended HPV vaccines might reduce hesitation by reducing intention-behaviour gaps.

[19]	Corowa-kun: A messenger app chatbot delivers COVID-19 vaccine information, Japan 2021	2022	Vaccine	Here, 59,676 people utilised Corowa-kun in February–April 2021. The study included 10,192 users (17%). 74% were female, and the median age was 55 ranging from 16 to 97. After utilising Corowa-kun, COVID-19 vaccination reluctance dropped from 41% to 20%. On the other hand, 20% were apprehensive, 16% (1,675) were doubtful, and 4% (3,644) did not want to get vaccinated.
[18]	COVID-19 vaccine acceptance and its determinants: A cross-sectional study among the socioeconomically disadvantaged communities living in Delhi, India	2022	Vaccine: X	Multinomial logistic regression indicated low perceived vulnerability to COVID-19, older age, low perceived severity, poor self-efficacy to prevent COVID-19, as well as non-use and unawareness of Arogya Setu App were substantial predictors of vaccination reluctance. Here, 2/3 of Delhi's poor would embrace the SARS-CoV-2 vaccination.
[6].	Text Message Reminders to Improve Immunisation Appointment Attendance in Alberta, Canada: The Childhood Immunization Reminder Project Pilot Study	2022	JMIR mHealth and uHealth	The Edmonton Health Centre saw 6.4% drop-in appointment no-shows (95% CI 3%-9.8%) after the intervention, but the Lethbridge Health Centre had no change (0.8%, 95% CI -1.4% to 3%). Twenty-two staff members and 222 parents (23.9% response rate) completed the acceptance questionnaires. The reminders were helpful and gave good recommendations for development for 95% of responders.
[29]	Designing a rabies control mobile application for a community-based rabies surveillance system during the COVID-19 pandemic in Bali, Indonesia	2022	Veterinary World	This project created a RaCon smartphone app for a community-based rabies monitoring system in Bali, Indonesia, during COVID-19. The One Health concept and community involvement in rabies programmes depend on integrating animal health and public health into the rabies monitoring system.
[32]	Perceptions on a mobile health intervention to improve maternal child health for Syrian refugees in Turkey: Opportunities and challenges for end-user acceptability	2022	Frontiers in Public Health	mHealth technologies can solve numerous refugee healthcare concerns. Refugees' opinions of the mHealth app's usage were highly impacted by their contextual and issues healthcare experiences. In-depth refugee end-user interviews revealed that mHealth apps must have data security, offline functionality, clear user guidance, as well as data retrievability.
[22]	Six sigma DMAIC approach-based mobile application for statistical analysis of COVID-19 data	2022	International Journal of Pervasive Computing and Communications	Aarogya Setu can inhibit significant viral transmission, according to the planned study. Each user's risk status is shown via this app. Thus, it improves viral transmission prevention.

[14]	Using a mobile application ("PrimaKu") to promote childhood immunisation in Indonesia: A cross-sectional study.	2021	Belitung Nursing Journal	Note that 119 moms participated, with 44.5% of youngsters fully vaccinated. Mothers who supported vaccination were 3.58 times more prone to complete the basic immunisation, while those using the mobile app were 3.23 times.
[23]	Design of a Mobile Application to Improve the Treatment of Patients with Heart Problems using Pulse Sensors with Arduino.	2022	Journal of Emerging Technology and Advanced Engineering	The research will reduce heart attacks and increase security.
[7]	Usability Evaluation of the Novel Smartphone Application, HPV Vaccine: Same Way, Same Day, Among Paediatric Residents	2021	Academic Paediatrics	Self-management, internal monitoring, and motivating principles were our interview data categories. Residents regarded the app as simple to use, interactive, short, instructive, interesting, and useful. All locals would advise a colleague to use the HPV Vaccine: Same Way, Same Day app.
[30]	From contact tracing to COVID-19 pass holder; the tortured journey of the French TousAntiCovid contact tracing app	2022	Public Health	TousAntiCovid was utilised by 55.5% of respondents, while 41.0% had never downloaded it. A quarter (23.3%) utilised it for Bluetooth contact tracking, while 1/3 (32.2%) utilised it simply for health pass storage. It was used more by educated, wealthy, and younger people. TousAntiCovid was never downloaded by 85% of non-vaccinated respondents.
[24]	The Effect of Buzzy Application on Pain Level During Vaccine Injection in Infants.	2023	Journal of Nursing Care Quality	The research involved 60 newborns. Buzzy-equipped neonates exhibited reduced pain ratings during and after vaccination administration (P =.001).
[11]	A mHealth App to Promote Adherence to Immunosuppressant Medication and Track Symptoms in Children After Hematopoietic Stem Cell Transplant: Protocol for a Mixed Methods Usability Study	2022	JMIR Research Protocols	Enrolment started in September 2021, in which we enrolled seven carers. We expect strong usability ratings and a better knowledge of the app's special features for post-HSCT families. Enrolled individuals had usability ratings over 70%. Qualitative interviews helped add weekly records, phone provider choices, and voice-to-text to the app.
[17]	Approximate or accurate? Efficacy of daily use of weather and air quality mobile applications for pollen allergy sufferers?	2022	Paediatric Allergy and Immunology	This study investigated some of the most popular smartphone apps for pollen allergies, green places, gardens, parks, as well as air quality to demonstrate the pros and cons of rapid and accessible information. A lack of transparency on data sources and synthetic evaluation criteria typically confuses end users.

[27]	Exploring the COVID-19 Pandemic as a Catalyst for Behaviour Change Among Patient Health Record App Users in Taiwan: Development and Usability Study	2022	Journal of Medical Internet Research	Our mobile app now allows patients to access cross-hospital medical data, including COVID-19 quick and polymerase chain reaction testing, as well as immunisation progress and information, thanks to the MHB SDK. The log data of the app from July 2019-June 2021 was retroactively gathered. From January of the year 2020, the early findings showed continuous growth in the number of outpatient department (OPD) as well as emergency department (ED) patients who registered to establish a blockchain account to access their app subscribers and medical data.
[20]	AI-Based Low-Cost Real-Time Face Mask Detection and Health Status Monitoring System for COVID-19 Prevention	2022	WSEAS Transactions on Information Science and Applications	AFMHS performance was tested extensively. For 100% accuracy, the best operating configuration is suggested. The MySejahtera Check-In ticket detector and face mask detector operate well at 15cm and 1.5m.

3. Conclusions

Developing and executing digital solutions for dynamic environments is challenging since healthcare professionals must continually adapt to new and different challenges. The adoption hurdles at the system level need further research. Research in the future should investigate how the software might be used in different cultural settings. Therefore, it is important for public communication on these measures to include not just the anticipated danger connected with COVID-19 but also people's faith in science and politics, their fears and uncertainties about immunisations, and their work position. In addition, the findings indicate that the primary reason for adhering to these measures was not personal safety but rather the safety of others [16]. Apart from that, vaccination reminders and health information elements in children's mHealth apps need careful attention to several important characteristics and traits [32].

Furthermore, it identifies windows of opportunity for bridging care and knowledge gaps and indicates where research and development of successful treatments should go in the future [28]. Therefore, endeavours are required to resolve these problems as well as vaccine concerns in order to boost vaccination rates. People utilised the chatbot in large numbers in a short amount of time. Hence, messenger applications on mobile devices should provide factual data about vaccines as well as vaccination motivation and avoidance factors [19]. E-communication methods, including mobile text messaging, as well as other novel approaches, may be crucial in closing the knowledge gap [31]. The app's content and operation should be improved, and users offered suggestions on how to do so. The capacity to acquire knowledge is essential as it enables individuals to systematically recognise difficulties and devise satisfactory resolutions [33].

The importance of the health app is expanding, and as a result, it is becoming more comprehensive in fulfilling the needs for health education possessed by parents and their children. This kind of development was only possible because the level of trust between the other individuals in the process continued to rise. Last but not least, this article's purpose is to provide clarity, originality, and a contribution to the field of study, which requires a significant degree of in-depth knowledge of the topic at hand and a well-structured organisation of debates and arguments.

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