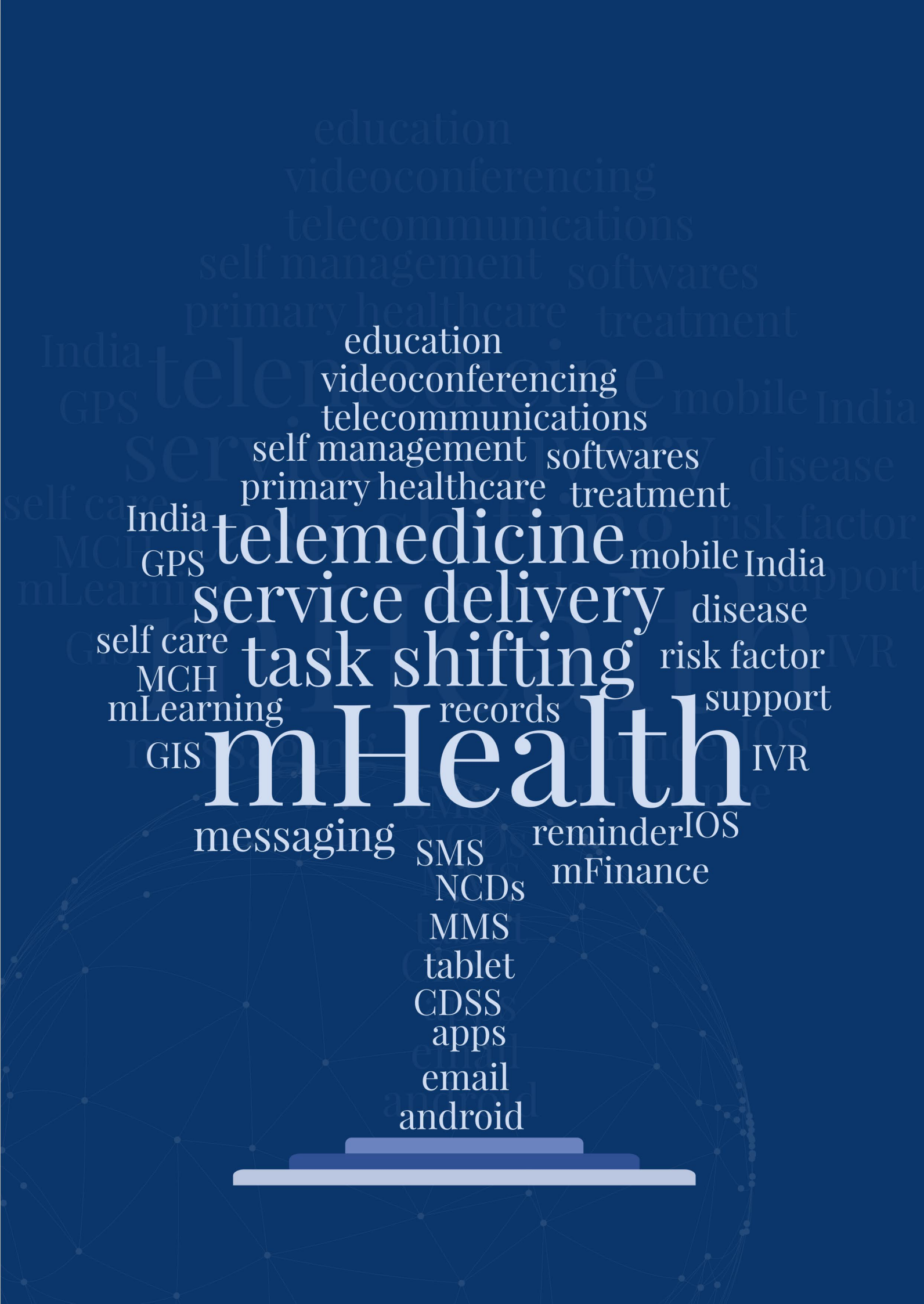
mHealth Interventions for Health System Strengthening in India

A Scoping Study Report

The George Institute for Global Health India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Abbreviations

CCRCT	**Cochrane Central Register of Controlled Trials**
CKD	**Chronic Kidney Disease**
COPD	**Chronic Obstructive Pulmonary Disease**
CTRI	**Clinical Trial Registry - India**
FDA	**Food and Drug Administration**
FTC	**Federal Trade Commission**
GBD	**Global Burden of Diseases**
HIV	**Human Immunodeficiency Virus**
JBI	**Joanna Briggs Institute**
mHealth	**Mobile Health**
NCDs	**Non-communicable Diseases**
PDA	**Personal Digital Assistant**
SDGs	**Sustainable Development Goals**
TB	**Tuberculosis**
WHO	**World Health Organization**

Foreword

India, like most developing countries, is undergoing an epidemiological transition, with rapid onslaught of chronic diseases on top of the burden of infections and diseases related to pregnancy and childbirth. Chronic diseases like hypertension, diabetes and kidney diseases remain undiagnosed in early stages, leading to complications, poor quality of life and premature mortality. The economic costs of these diseases is huge. Diseases of this nature also present a unique healthcare opportunity, as most of them are preventable if quality primary health care is made available at a population level. This however, requires a radical change in the model of healthcare delivery to bring it to the doorstep of the consumer, address the longstanding problems of population disparities, non-availability and unaffordability of the quality services and shortfall of trained human resources.

India is on the cusp of a major initiative to digitally empower the country. This revolution has the ability to address many of the healthcare needs. Use of mobile technology has not only a potential to increase the availability and accessibility of quality health care but can also be critical in optimizing the distressed health system by facilitating task-shifting, allowing monitoring of quality and long-term tracking. Use of clinical decision support systems and algorithms driven by evidence-based guidelines has created an environment that is conducive for enhancing the knowledge and skills of non-physician health workers drawn from the community to deliver timely and quality essential primary healthcare at community level, even in hard to reach terrains. Mobile phones are also powerful communication tools, and several programs provide communities and patients with health information, making them a part of the health system and in control of their own health.

Use of mobile devices for healthcare is being explored by government and non-government stakeholders in India. At present the information related to these interventions is disseminated through academic journals, organizational websites and also through the mobile applications store and is scattered. This scoping study report presents a comprehensive landscape of the current mobile healthcare technology in India and provides suggestions about future action that can be to be taken for a comprehensive inclusion of mHealth as a tool for health system strengthening.

We hope that the findings from this report would be useful for mHealth programme planners, implementers, evaluators, research institutions, policy makers and individual developers of mHealth solutions to develop comprehensive and context appropriate initiatives that will help in reducing the disease burden in India.

Professor Vivekanand Jha
Executive Director
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Contents

Group of ASHAs being trained on using mHealth tools for primary healthcare in Andhra Pradesh, India. Photo Credit: Kishor Mogulluru

Background

The health of peoples around the world are set to a enter phase of transformation, primarily guided by the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 (1). The hallmark of the sustainable development agenda is the value it gives to safeguarding the health and well-being of people of all ages. Despite impressive gains in several health indicators, India and other low and middle income countries still face a sizeable burden of communicable diseases, maternal and child mortality, with the additional burden of relatively new epidemiological challenge in form of the non-communicable diseases (2,3). According to the Global Burden of Disease 2015 Report, 5 of the top 10 causes of death in India are now NCDs (4). To add to this dual burden is the third burden of a stressed health system that has been inadequate in addressing concerns related to access, quality and equity of healthcare (5). Among many health system related challenges, the unequal distribution and lack of qualified health personnel is a harsh reality. Nearly 30% of India's health human resource is working for the rural population which accounts for nearly 70% of the total population (6).

Rapid technological innovations have expanded the scope of a mobile phone from a simple communication device to being used in many other areas including health. Reduction in cost of handsets and increase in coverage of network have enabled higher ownership of mobile phones. India reached a subscriber base of 1 billion mobile subscribers in the year 2015, with a second largest base of 220 million active smartphone users (7, 8). Of note, the mobile telecommunication penetration is strong in rural areas as well with about 42% of all subscribers (7). This mix of a weakness in the health system and proliferation of mobile phones sector presents an opportunity for utilization of mobile health (mHealth) technology to

realign the healthcare delivery and strengthen the health system. This scenario is applicable not only to India, but also to other emerging countries with similar system-level challenges.

The Global Observatory for e-health defines mHealth or mobile health as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, PDAs, and other wireless devices" (9). mHealth technology can help in expanding the scope of service delivery, reducing the response time by using trained non-physician health workers, minimising the variability in quality of delivered care, providing opportunities for monitoring and patient engagement and reducing the cost of care (10). A broad range of public health initiatives are currently tapping the potential of mobile devices for delivering health care at low cost, such as for maternal and child health, management of NCDs, HIV and tuberculosis prevention and control, as well as collecting data for disease surveillance. The competencies of mHealth technology are moving forward at a rapid pace. Attempts have been made to identify the current initiatives and upcoming opportunities related to mHealth in India but the information in the current state is scattered and requires updating, considering the rapid pace of advent of new initiatives (10, 11, 12, 13). Given the considerable financial and human resources being invested in planning, development and implementation of these initiatives, it is critical to have an overview that could be used to streamline the current initiatives, inform potential new programs and explore areas that require urgent attention.

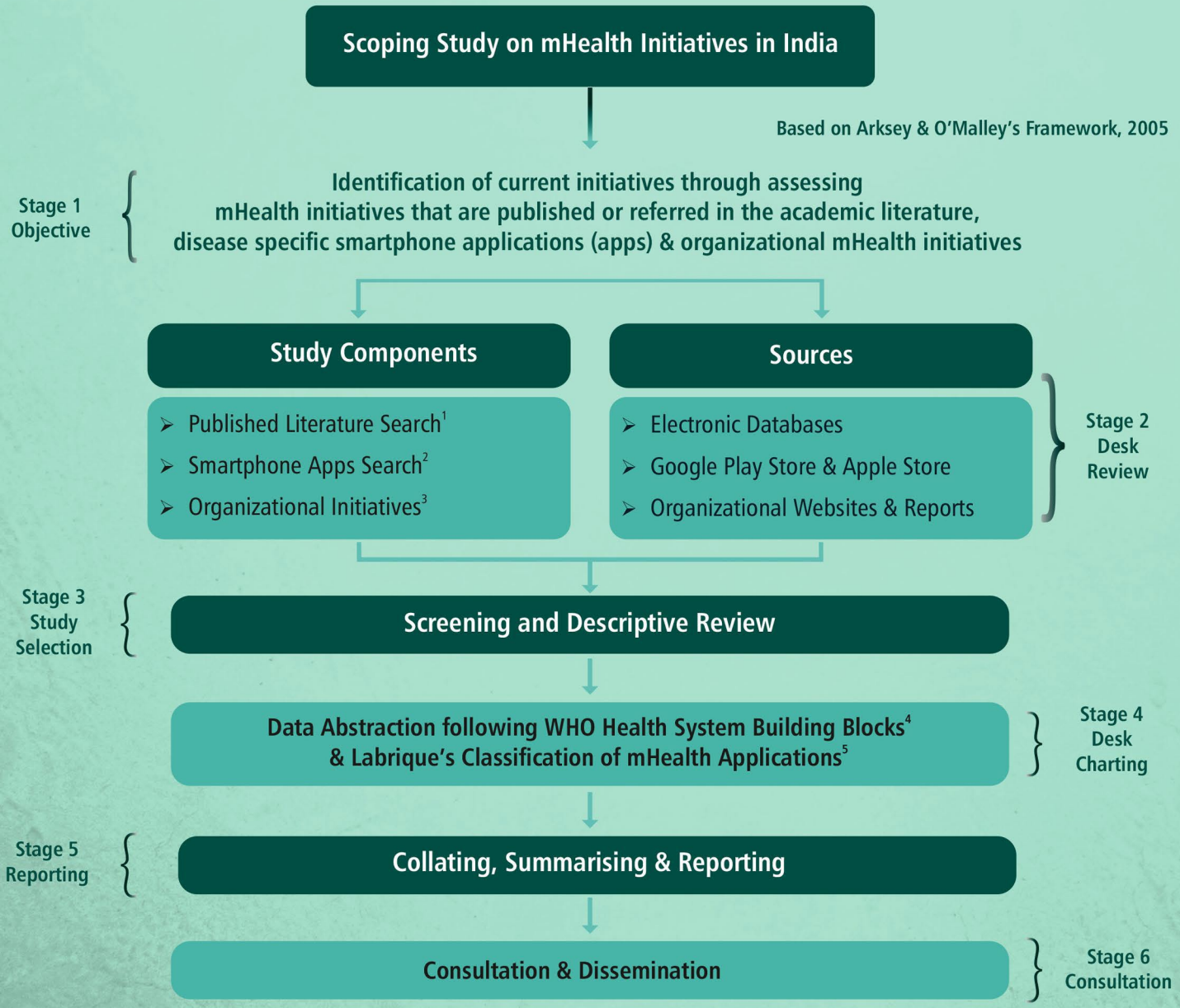
Digital India and mHealth Services

In the year 2015, the Government of India launched the Digital India Programme that aims to advance the digital infrastructure and make it accessible to every citizen (14). The intended impact of this programme goes beyond building technological infrastructure to connecting and empowering people in the areas such as health and education. From the health systems perspective, this programme creates a conducive environment for increasing access to health related knowledge, services and transparency in delivery of care. As a part of this programme, the Ministry of Health and Family Welfare launched four mHealth initiatives: Kilkari, Mobile Academy, mCessation and TB Missed Call Initiative. These programmes are targeted towards improving maternal and child health, training community health workers, providing tobacco cessation services and for treatment and counseling services for the tuberculosis patients, respectively.

Scoping Study on mHealth Initiatives in India

This study was conducted to assess the existing status of mHealth initiatives in India. The report presents the changing trends of the mHealth initiatives in terms of their disease focus, preference of IT device, targeted health system domain and beneficiaries. Finally, the report lists some future actions required for ensuring an effective role of mHealth interventions in strengthening the Indian health system.

Methodology



Scoping study methodology chart

1 **Published Literature Search**- A search of the literature (for articles within the period of 1997 to August 2016) that had mobile electronic device as a primary intervention (mHealth or telemedicine) was conducted on electronic bibliographic databases such as MEDLINE, EMBASE, CCRCT, Psych Info and JBI Library. A total of 4792 articles were screened out of which 189 were included for synthesis. Articles were not included if use of information technology device was not a primary intervention or if the study was related to the health effect of mobile usage.

Key Search Terms
Published Literature Search

Device (smartphones, cell phone, mobile phone, tablet, PDA, laptop, personal computer); service (IVR, text message, GPS, videoconferencing); intervention (primary care, secondary care, tertiary care, disease prevention, disease control, disease management, risk factor control, telemedicine, mHealth); diseases (NCDs, communicable diseases, maternal and child health); India.

2 **Smartphone Apps Search** - 'Google Play Store' and 'Apple Store' were searched for apps related to top 10 causes of death (as per GBD, 2015 data) and five common NCDs including cancer, diabetes, cardiovascular diseases and chronic respiratory diseases, depression and anxiety disorders. Apps supporting practice of medicine and public health for the identified diseases were selected and unrelated, prank or games apps were removed from the review. A total of 4600 apps were identified based on the title of which 1159 were selected. These included 858 from Google Play Store and 396 from Apple Store (95 apps were found in both the stores). A total of 557 were reviewed for their functionalities and features.

3 **Organizational Initiative Search** - A Google search was conducted to search identifying organisations and their key 'mHealth initiatives' in India. Existing reports identify organisations relevant to this study were also reviewed (16).

4 **Health Systems Building Blocks** - The selected academic literature, smartphone app and organizational initiative were examined in relation to intended objective of supporting or strengthening the Indian health system. For this, we used the WHO Health System Building Block Framework, to arrange the abstracted information (17).

5 **Classification of mHealth tools** - A framework developed by Labrique et al. was used to classify the identified mHealth tools as per their types and uses (18).

Key Search Terms
Smartphone App Stores

Diabetes, blood sugar, depression, anxiety, cancer, heart diseases, cardiovascular diseases, chronic kidney disease, stroke, chronic obstructive pulmonary disease, tuberculosis, diarrhoea, preterm birth, respiratory infections, road injuries.

The report presents its findings in three parts

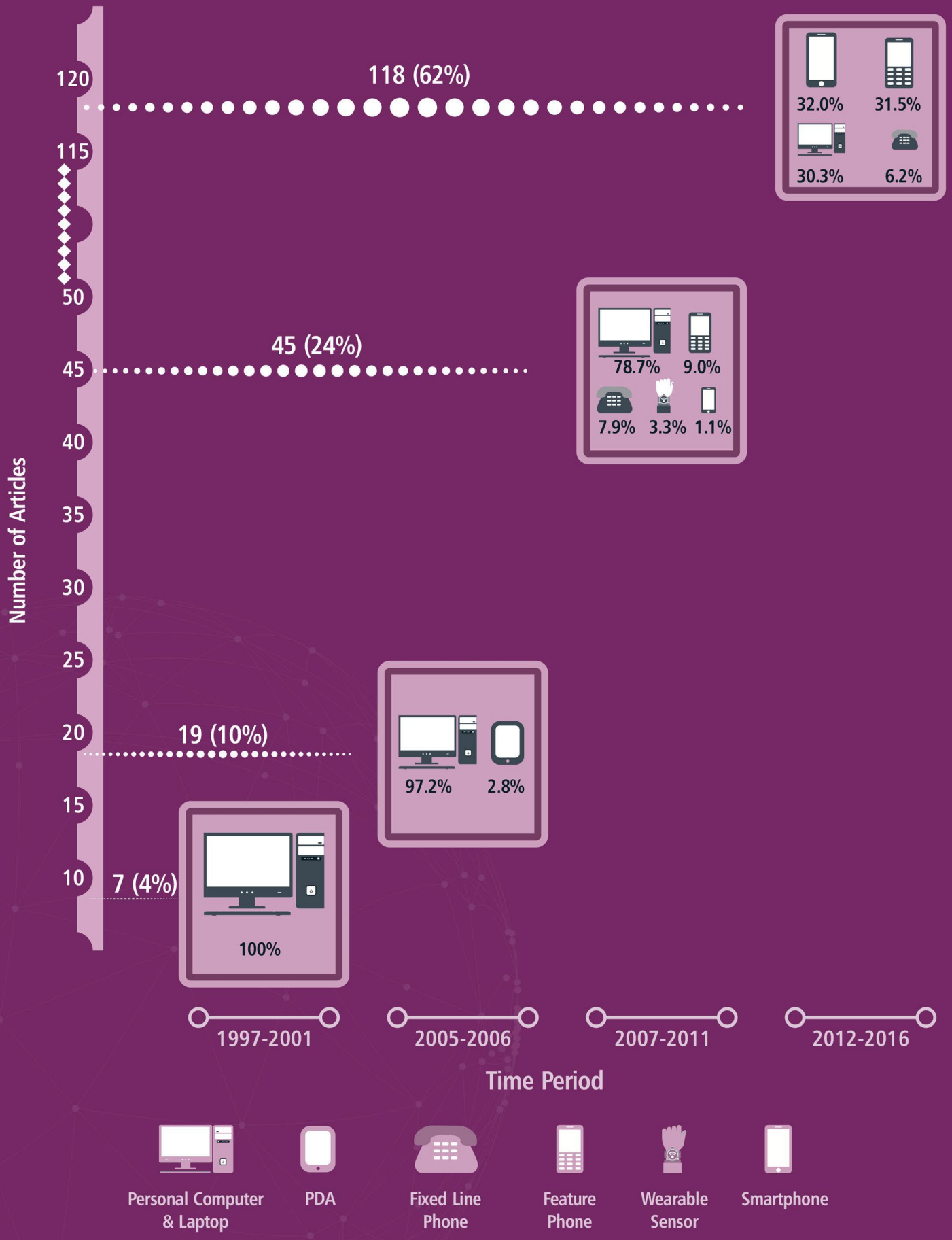
Section A
summarizes the findings of mHealth initiatives published in peer-reviewed journals

Section B
describes the smartphone apps available in app stores

Section C
expands on organizational mHealth initiatives in India

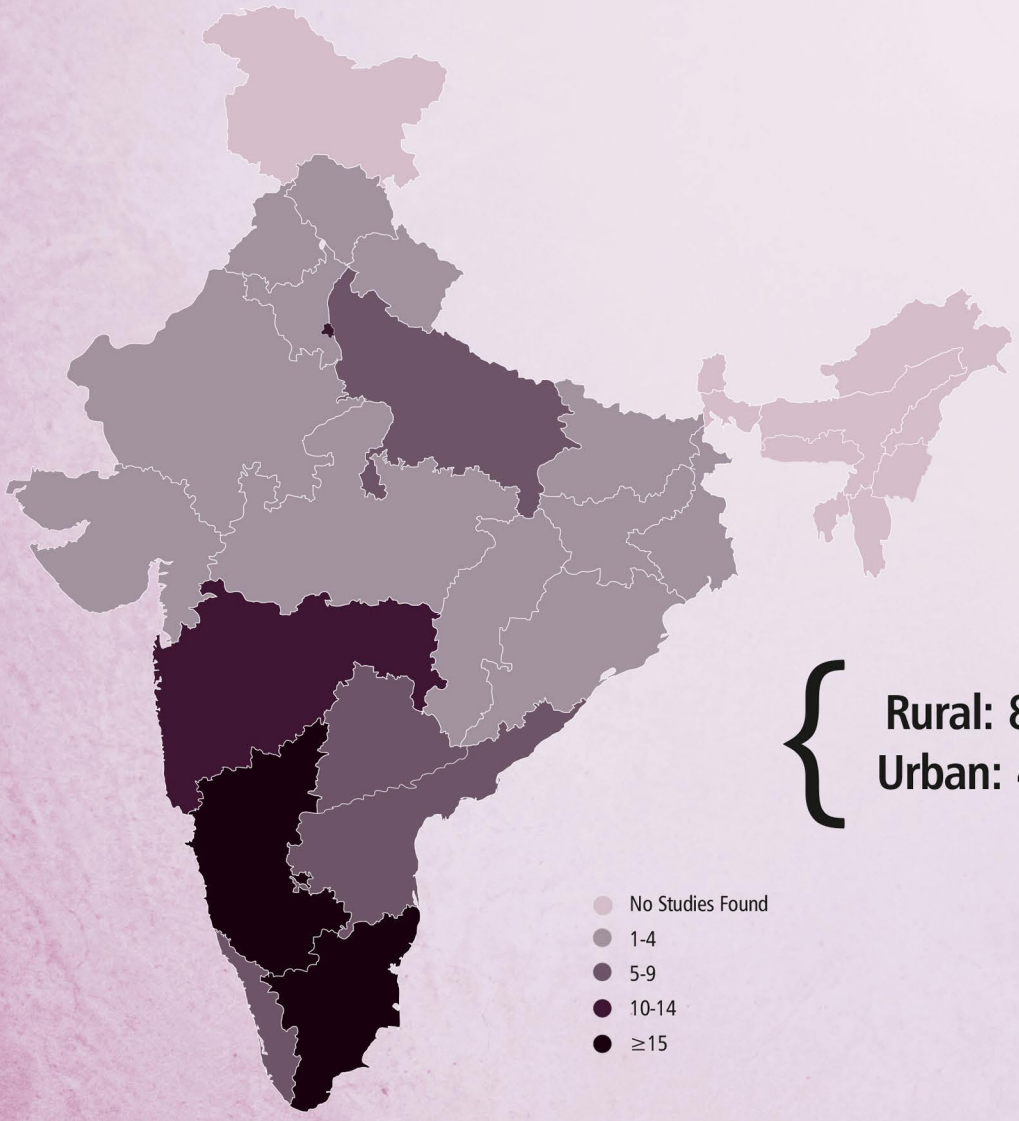
Findings

Section A: mHealth Initiatives Published in Peer-reviewed Journals (January 1997 – August 2016)



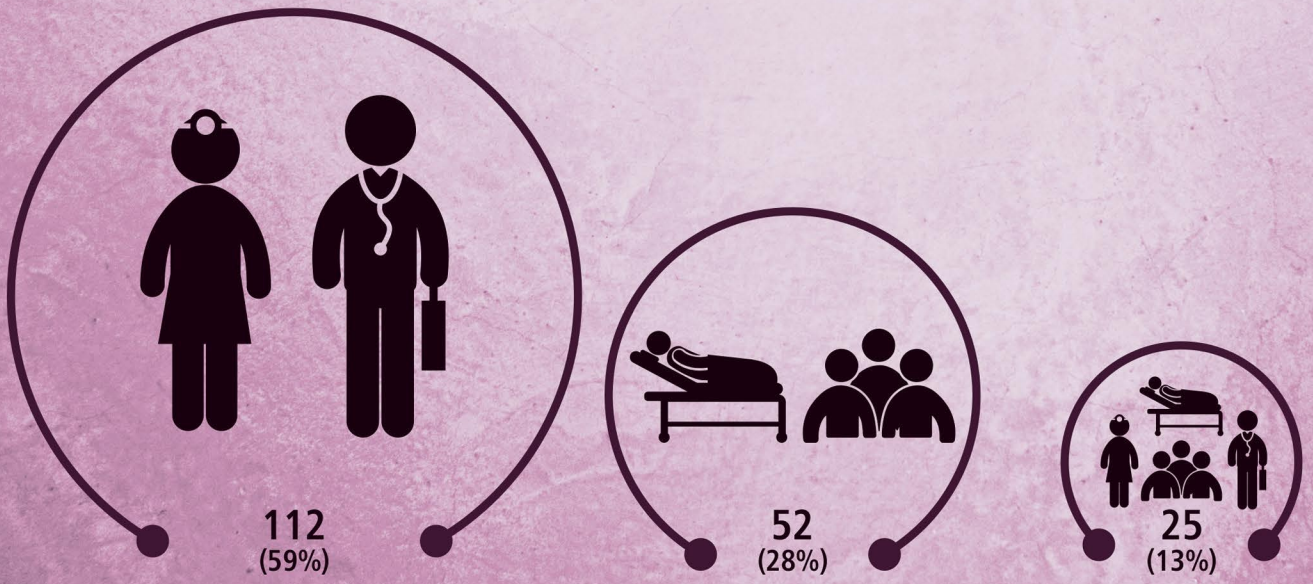
Year-wise distribution of the published articles
& changing preference of device for intervention delivery (n=189)

*A mobile phone having features such as the ability to access the Internet but lacks the advanced functionality of a smartphone
Wearable sensors are used to gather physiological and movement data that enables patient's status monitoring



Rural: 81 studies (62%)
Urban: 49 studies (38%)

Geographic distribution of the study sites of the published articles (n=130*)



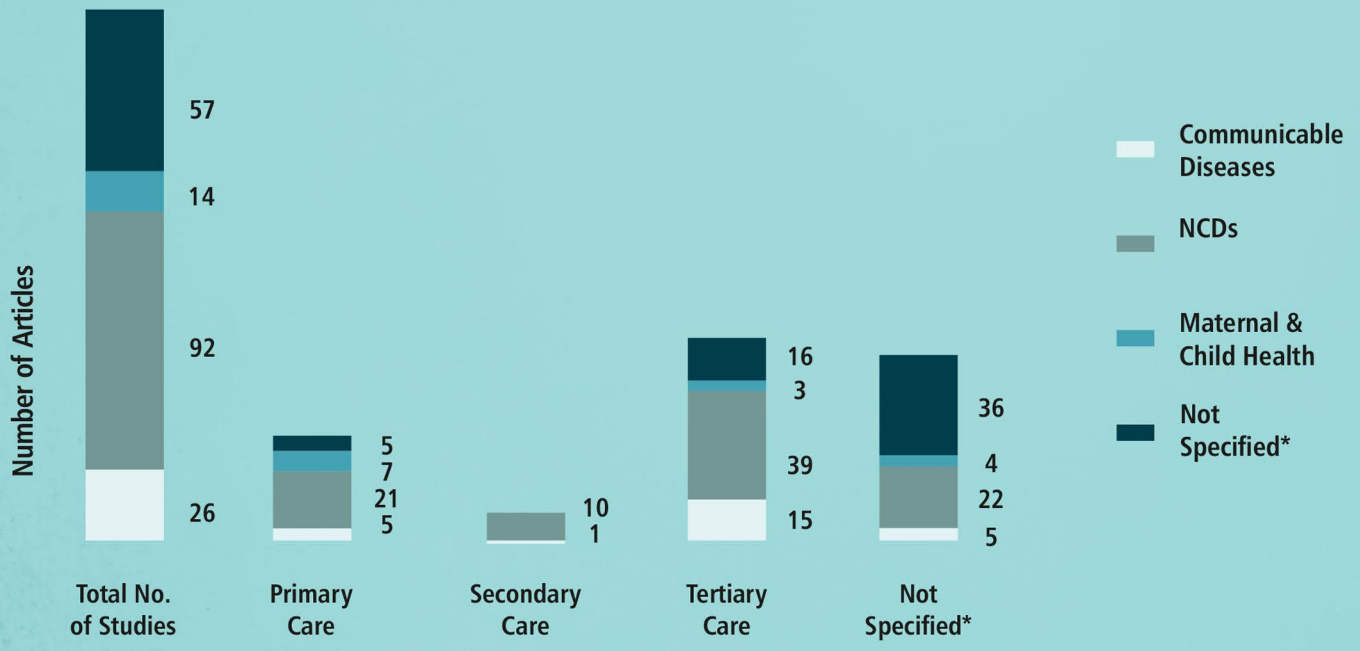
Community Health Workers or Healthcare Providers

Community or Patient Groups

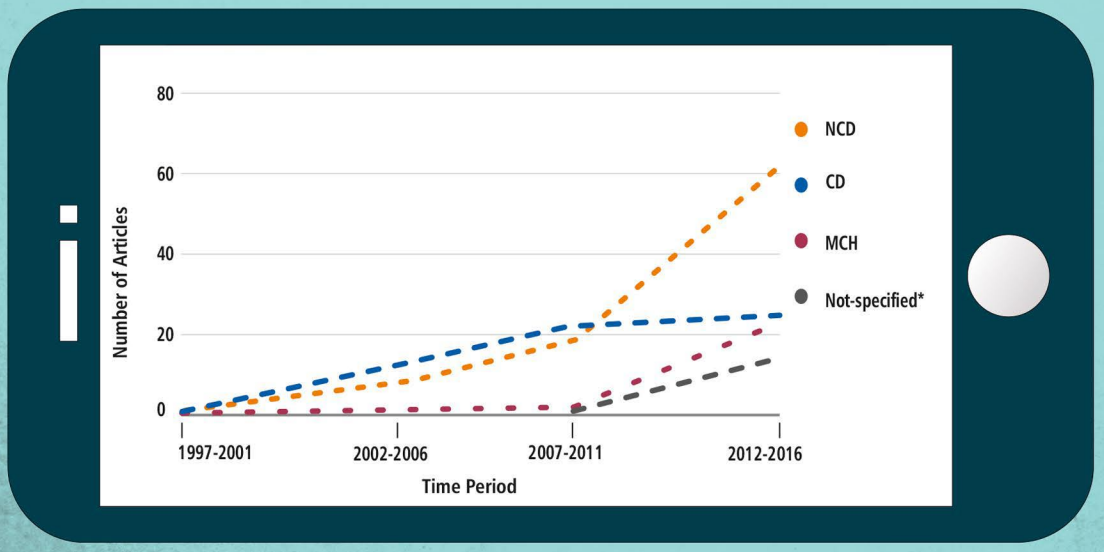
Not Specified

Intended technology end users mentioned in the published articles (n=189)

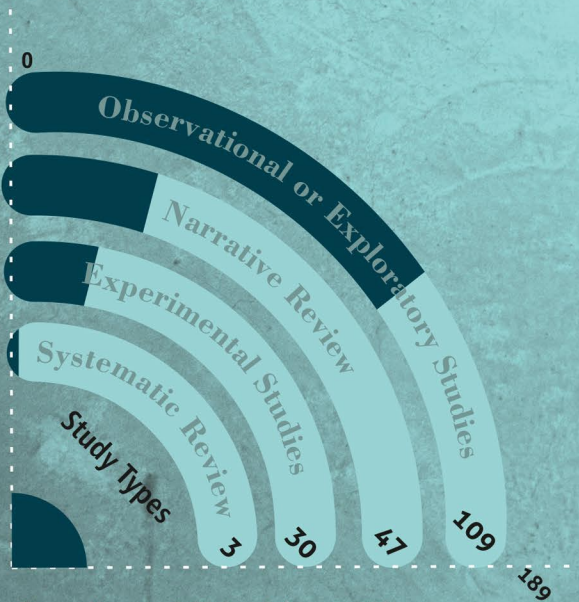
*Data available only for observational, exploratory & experimental studies



Disease type & level of care addressed in the published articles (n=189)



Changing focus of the published articles over time (n=189)

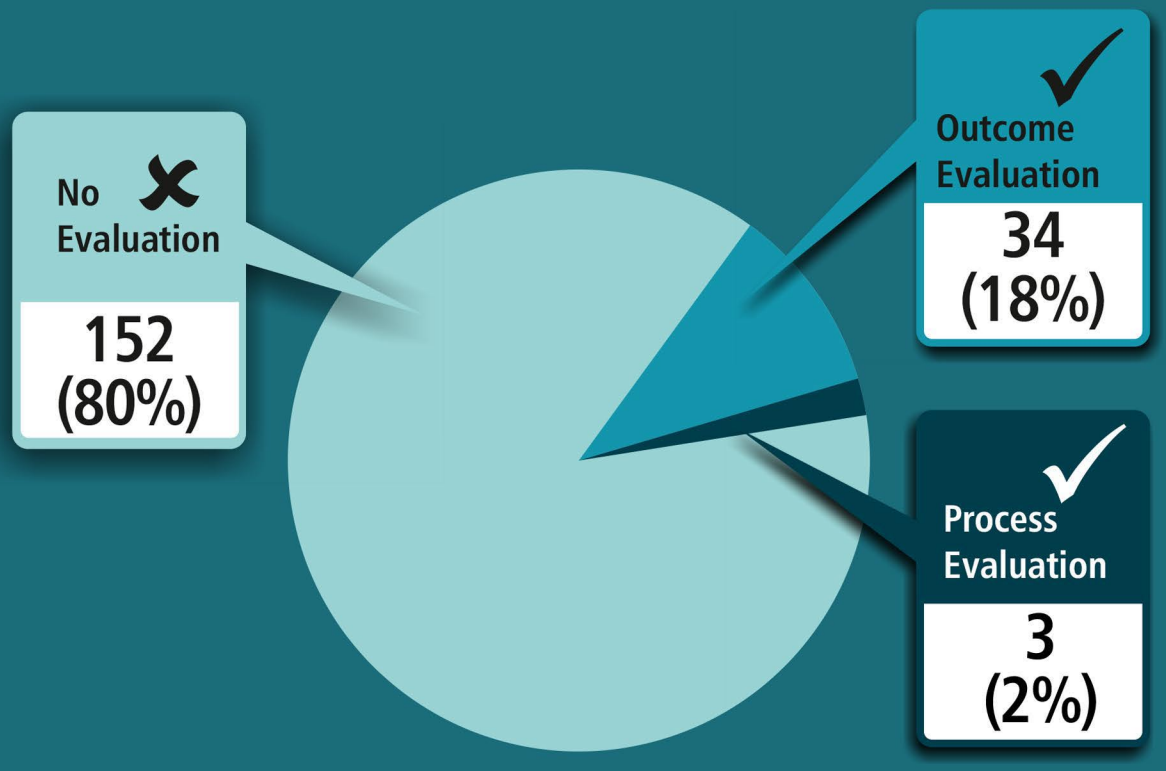


Types of studies published (n=189)

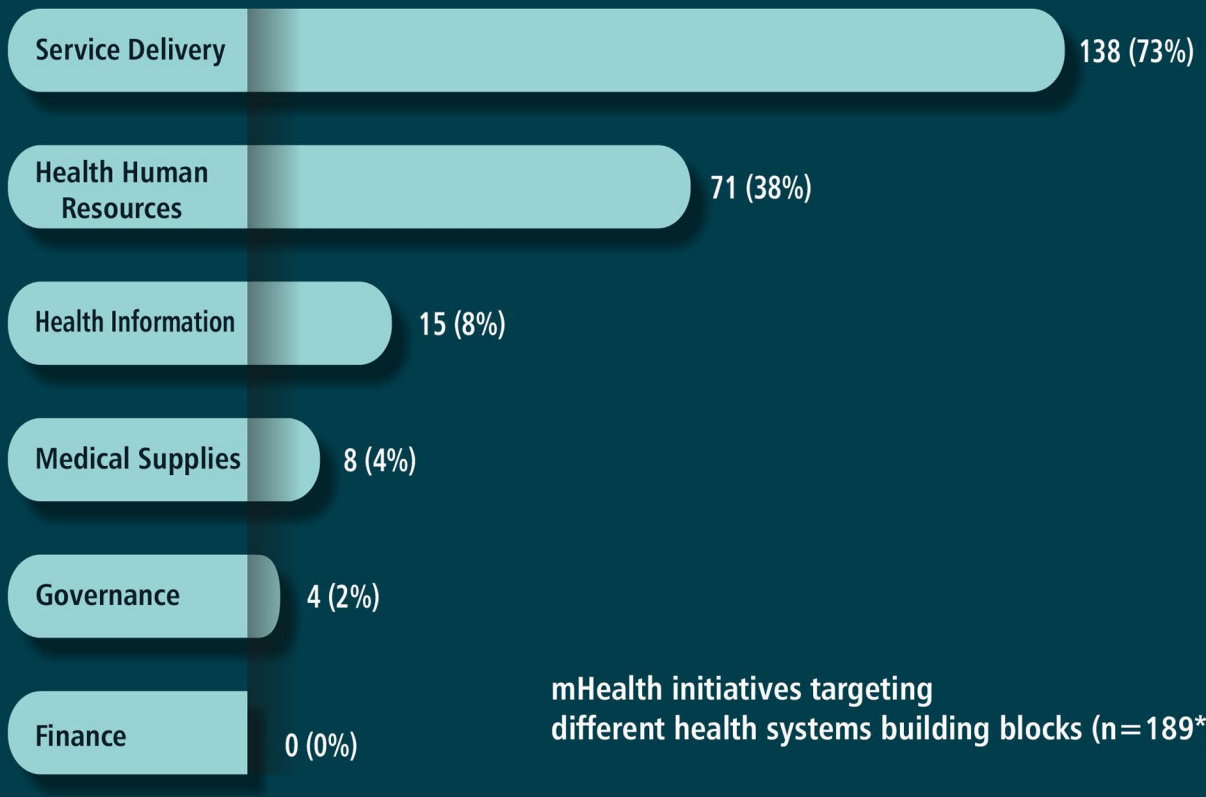
Evidence Generation

At present there are five mHealth related clinical trials registered with the Clinical Trials Registry of India. These interventions aim to test the effectiveness of the mobile based interventions in management of NCDs risk factors through clinical decision support systems (CDSS), mobile based screening of cancer and client education for diabetes prevention among high risk individuals (19).

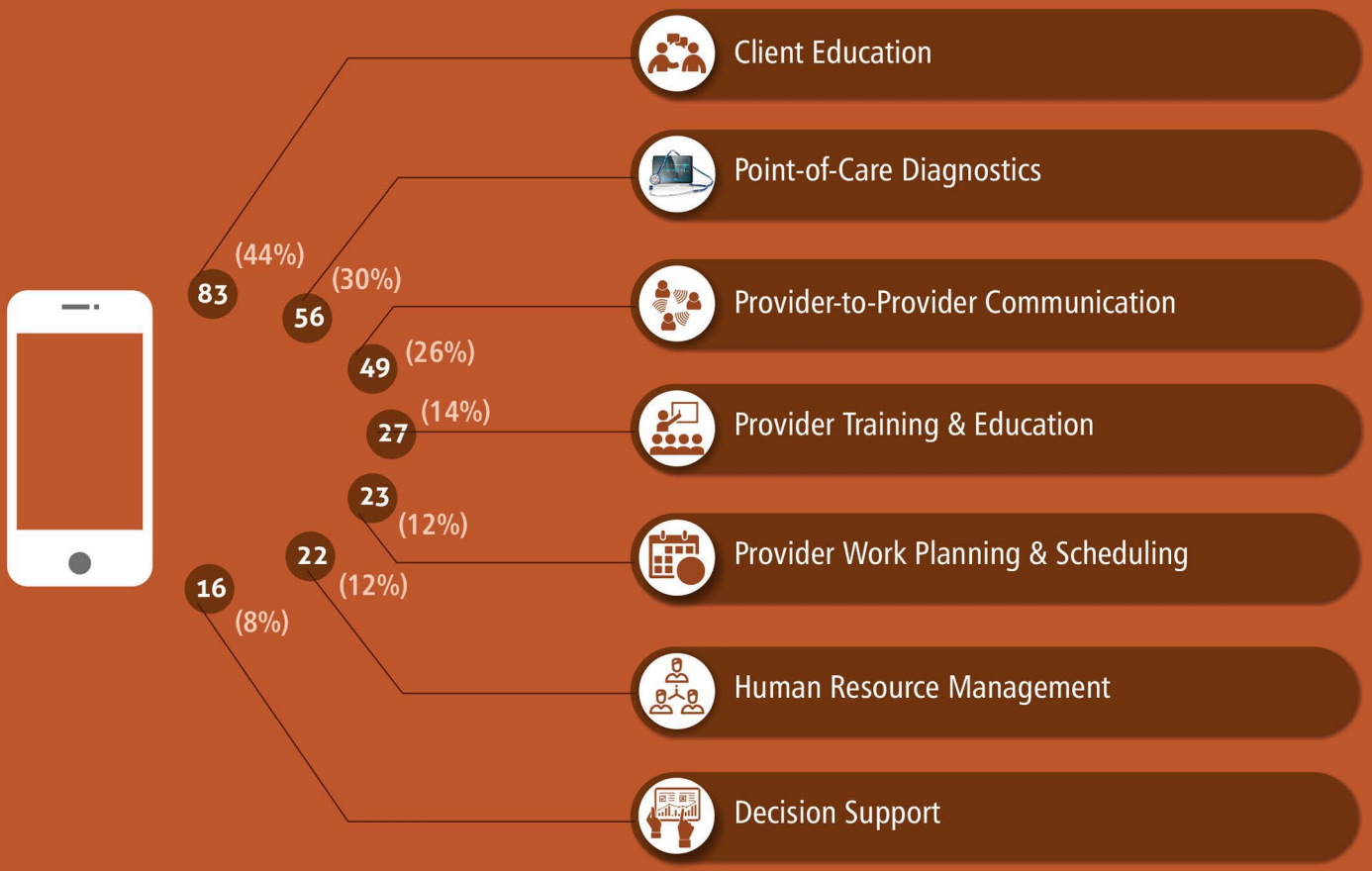
*Not specified domain discussed in the literature included use of mHealth or telemedicine for improvement of overall health extending beyond a particular disease type & to multiple levels of care



Evaluation status of the published articles (n=189)



mHealth initiatives targeting different health systems building blocks (n=189*)



mHealth initiatives as per the tool used, based on Labrique classification (n=189*)

Summary of findings for published literature search

- A rapid increase in the number of published articles was seen starting in 2012.
- Nearly half of the published studies used mhealth or telemedicine to target NCDs.
- A majority of these studies have been conducted in the South Indian states - Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. No published articles from Jammu and Kashmir and North-East Indian states were captured in review.
- Use of smartphone as the medium of intervention delivery emerged after 2012.
- About 40% of initiatives were aimed at strengthening tertiary care delivery.
- Out of the total of 189 studies reviewed, 109 followed an observational or an exploratory design, while 30 were experimental in nature.
- Around 80% of the initiatives reviewed were pilot studies or reviews, providing initial evidences of feasibility. Only 20% of these initiatives followed a design that facilitated some evaluation of the interventions.
- Health service delivery was the most targeted health systems building block followed by strengthening human resources for health. mHealth or telemedicine initiatives have had limited use in improving medical supplies, governance, gathering health information or improving the financial system.
- Published initiatives commonly used or mentioned client education, point of care diagnostics and provider - provider communication tools for improving the health systems.

*The total exceeds 189, as 71 initiatives used more than one tool

Section B: Smartphone Apps on Health Available in Mobile App Stores

Health Condition	Number of Apps Reviewed	
	Google Play Store	Apple Store
Diabetes	247	138
Depression & Anxiety	198	25
Cancer	154	80
Heart Diseases	81	104
Chronic Kidney Diseases (CKD)	77	14
Stroke	42	14
Chronic Obstructive Pulmonary Diseases (COPD)	31	5
Tuberculosis (TB)	12	2
Diarrhoea	7	1
Pre-term Birth	4	0
Respiratory Infections	3	13
Road Injuries	2	0
Total	**858**	**396**

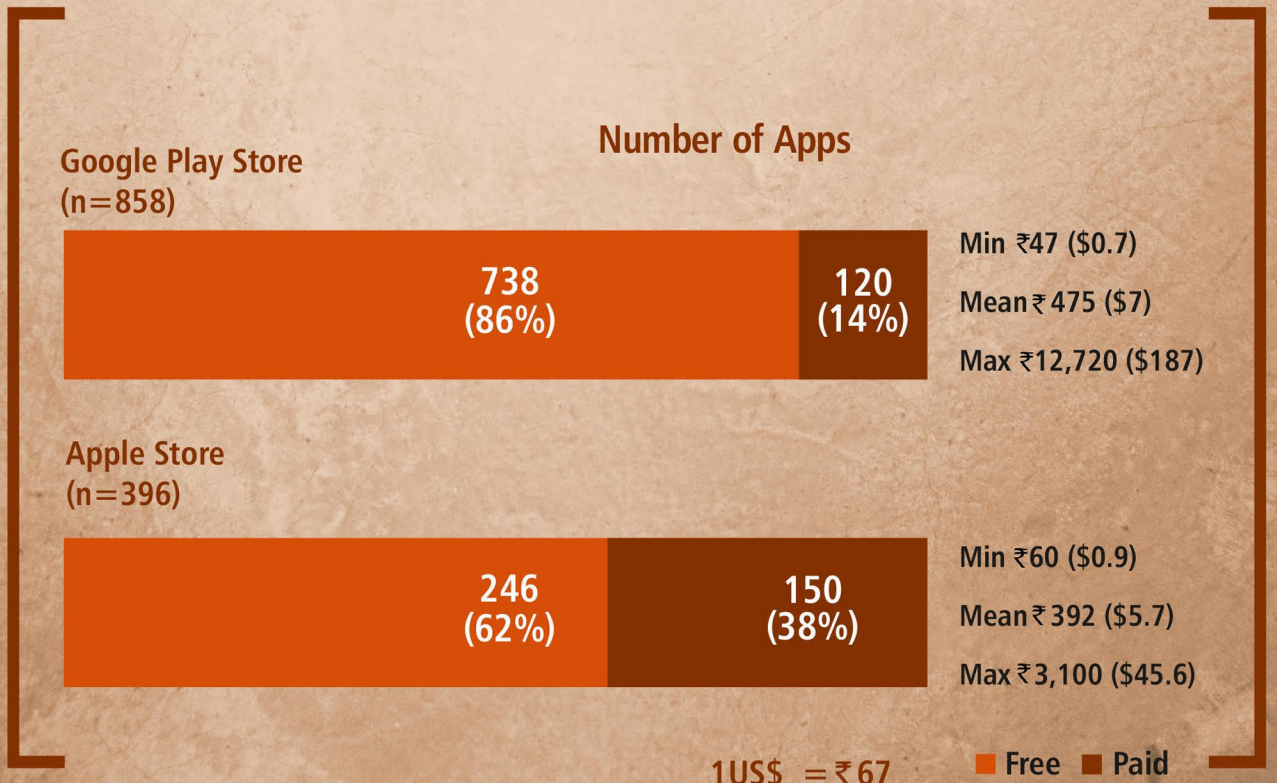
Health conditions & number of apps reviewed (n=1254)

User Reviews*

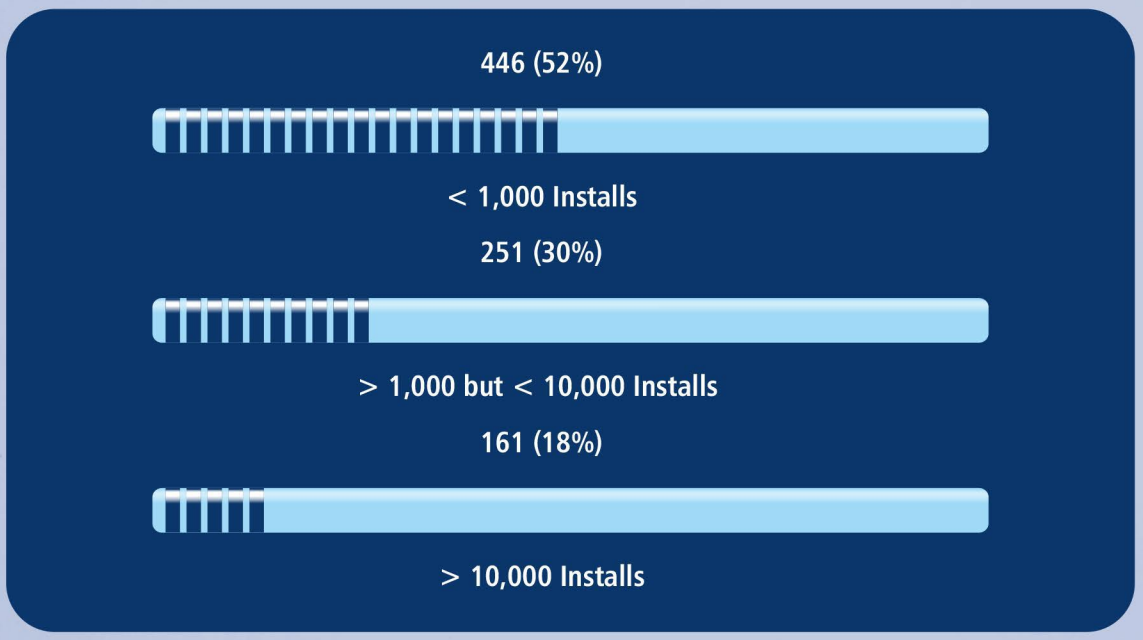
Average Rating

Mean % of the positive ratings (4 or 5 stars)

70%



Type and cost of the mobile app (n=1254)

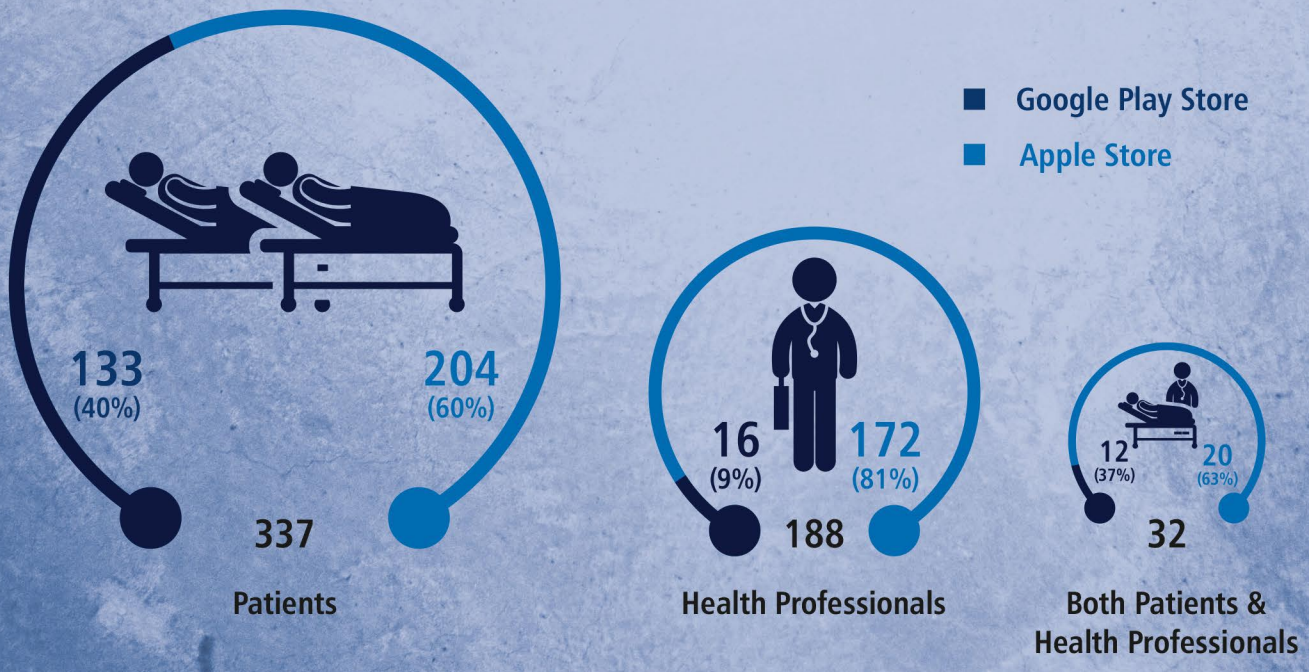


Number of installs for the apps available on Google Play Store (n=858*)

App Developers

A total of 93 (11%) Google Play Store and 98 (25%) Apple Store apps were developed by healthcare organizations and professional societies while others were developed by independent developers.

The following figures in the section present the functionalities & feature related findings for apps (n=557), that include Google Play Store apps with more than 10,000 installs (n=161) & apps reviewed on Apple Store (n=396)



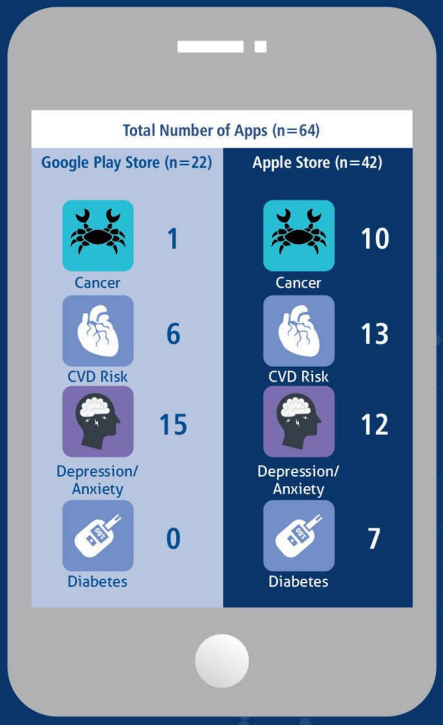
Intended end users of the mobile apps (n=557)

*This information is not available for Apple Store apps

	Google Play Store (n=161)	Apple Store (n=396)
Clinical Tools, Knowledge & Capacity Building	79	104
Risk, Test or Self Exam	70	112
Reminders or Medicine Adherence	35	46
Monitoring & Tracking	22	42
Awareness & Education	17	184

Functionalities of the apps (n=557)

Support External Device#	9 out of 557	Transforming Phone to a medical Device	8 out of 557



Risk assessment features available in the apps (n=64)

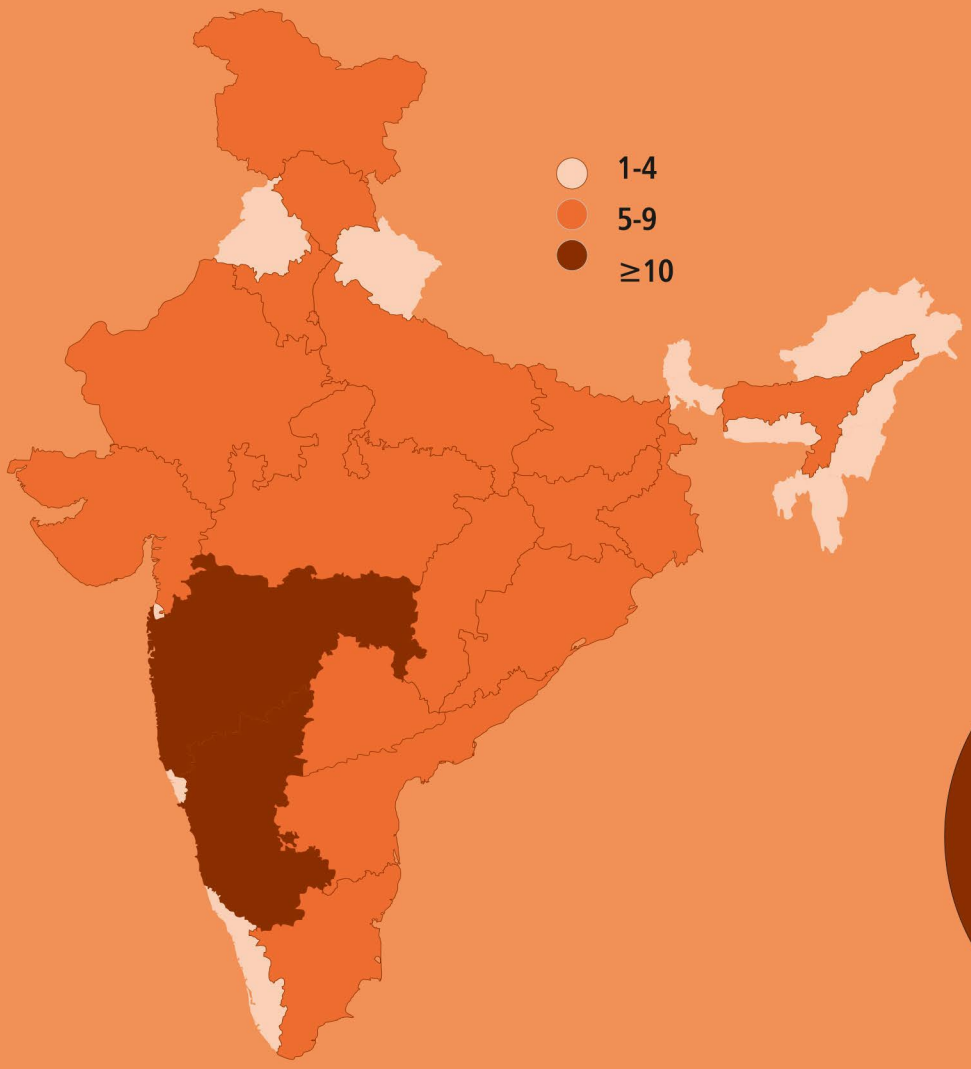
Summary of findings for smartphone app search

- More than 79% of the apps were free for downloading, with Apple Store having larger proportion of paid apps (38%) as compared to Google Play Store (14%).
- About 52% of the apps available on Google Play Store have been installed less than 1000 times. In comparison, less than 20% of the apps were installed more than 10,000 times. Apps targeting diabetes, heart diseases, depression and anxiety had a higher proportion of 10,000 or more installs.
- A total of 60% of the apps were for the patients, 34% were targeted towards healthcare professionals only and 6% were for both patients and health professionals. More than 80% of the apps targeted towards health professionals were available only on Apple Store.
- Client awareness and education, tracking of metabolic risk factors were found to be the most common functionalities of the apps with more than 10,000 installs. Apps on Apple Store were targeted more towards developing knowledge and clinical tools for health professionals.
- About 3% of the apps claimed support for an external device such as blood pressure or blood sugar machines, and nearly same number of the apps claimed to transform the phone to a pulse rate and heart rate measuring device, without any external support.
- A total of 64 apps have an objective of calculation of risk of various diseases, with 27 apps calculating the risk of mental disorders, 19 for cardiovascular risk and 11 for risk of cancer.

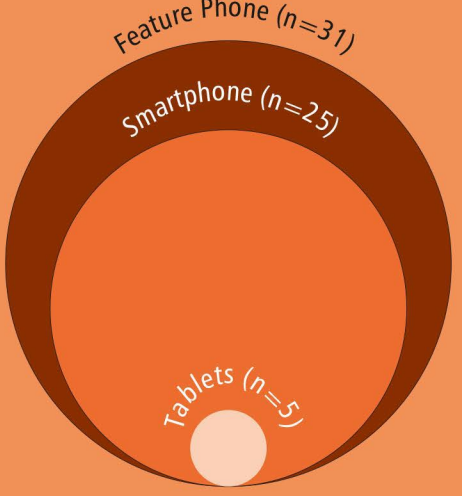
*The total number for the graph exceeds 557 because of 168 apps having multiple functionalities

Support transfer of data & readings from a machine through bluetooth

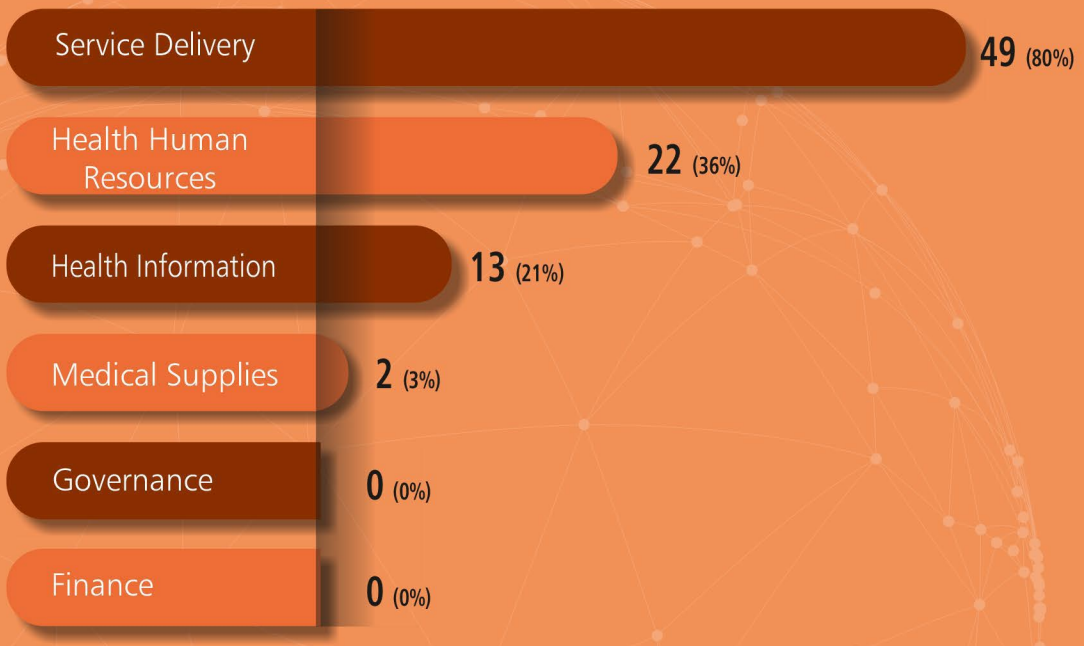
Section C: mHealth Related Organizational Initiatives in India



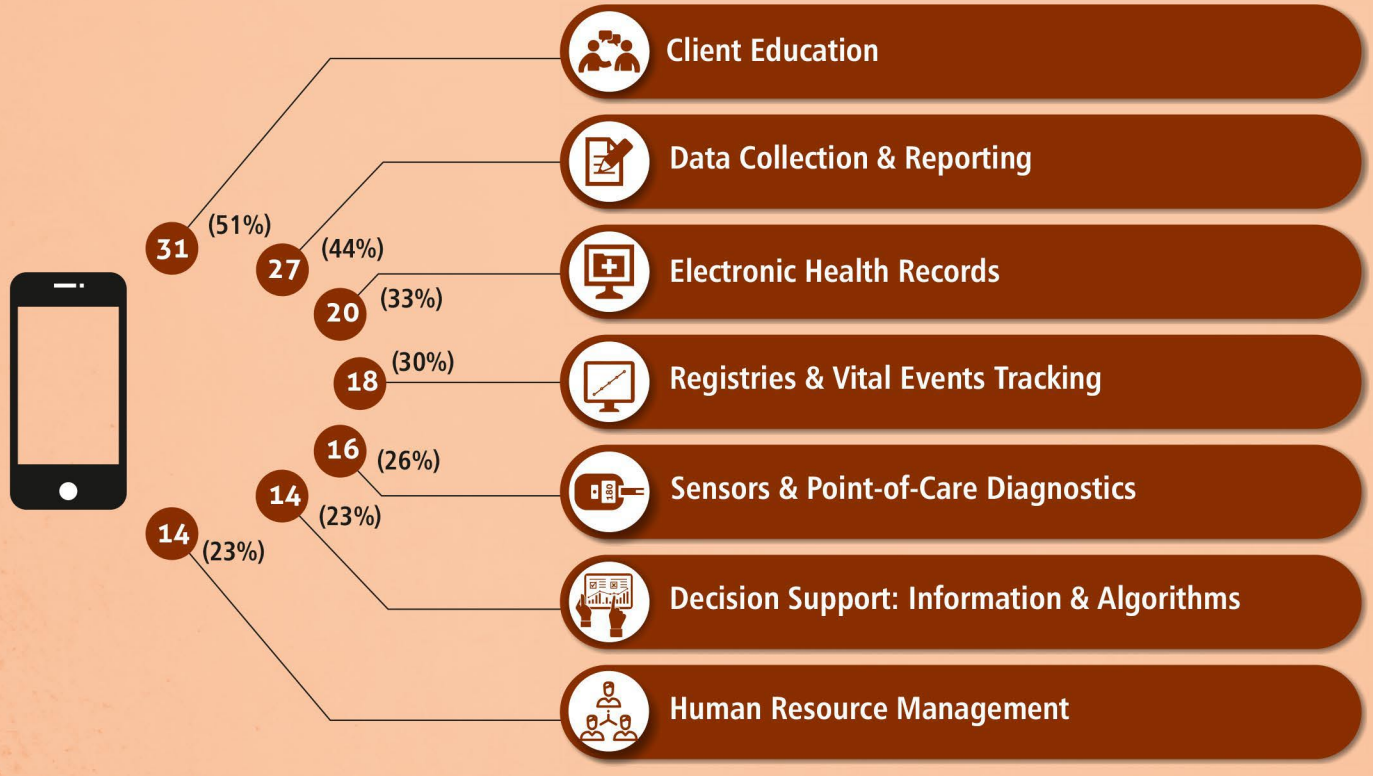
Geographic distribution of the organizational initiatives (n=61)



Types of phones used in the organizational initiatives (n=61)



mHealth organizational initiatives targeting different health systems building blocks (n=61)



mHealth organizational initiatives as per the tool used, based on Labrique classification (n=61)

Summary of findings for organizational search

- Organizational initiatives related to mHealth cover a larger geography across India as compared to the published mHealth evidence.
- More than half of the organizational initiatives were based on a basic feature phone.
- Service delivery and human resource for health are the most common building blocks of the health systems being targeted by these organizational initiatives.
- Client education, data collection and reporting are the two most common functionalities of mHealth deployment in the organizational initiatives.

Regulation of Medical Apps in India

Smartphone apps that have an objective of providing healthcare till the last mile could greatly complement the Indian health system, but not without perils. The content and the objective for these apps is often profit driven. Many apps are promoted without clinical validation. In addition to being ineffective and expensive, they can be harmful as well. Guidelines on health and medical mobile apps are critical for protection of user interest, ensuring the quality of services offered, avoid potential harms to users and engage non-government players in mHealth in a structured manner. The Indian government has started developing guidelines for sale of online medications after these medicines were marketed and sold online. The national health portal has a repository of health apps currently available for use in India. Many organizations are providing information and services related to various medical conditions through mobile apps or through other mobile means but till date, there are no regulations or guidelines for ensuring service quality. Considering the increasing usage of medical apps and remote patient monitoring, developed countries have started shaping the policies for governing this technology. In United States of America, FDA, and FTC have taken a lead in helping the mobile developers in complying with the existing regulations. Both FDA and FTC have released web based tools for applications developers that would help in increasing the compliance with Federal Food, Drug and Cosmetics Act. and FTC Act ensuring an overall content safety, privacy and security in medical apps (20). With more mHealth related apps coming into the market, development of such guidelines is a compelling priority and this could be done through a multi-sectoral approach in India.

Conclusions

- There is growing realization of the complementary role of mHealth solutions for strengthening health care delivery in India.
- The implementation of mHealth solutions have been concentrated to limited geographic regions with some parts being under-repersented.
- Evidence generation specific to the formative aspects of the intervention that include problem identification, needs assessment and community engagement in the planning stage is scarce. There is also a lack of evidence around the integration of these solutions within the existing and emerging health systems, effectiveness in bringing achieving the health objectives, cost-effectiveness, scalability and sustainability.
- Use of contemporary mobile technology has grown over time. However, there is limited accounts of consumers' technological know-how to prove the fit of the chosen technology with the user groups.
- Client education, which increases access to health information, has been the most widely used mHealth service delivery tool. Other service delivery related aspects such as treatment and management have received limited attention in the mHealth ecosystem in India.
- Supporting clinical practice through decision support is evolving and the process of development of these tools has not been mentioned clearly by the developers.
- mHealth solutions have not targeted the health systems domains of health governance, health financing and medical supplies.
- The private sector has shown a great deal of interest in development of smartphone apps. The existing apps are characterized by insufficient attention on health system integration with a disproportionate emphasis on technology.
- A majority of the apps have been developed by independent developers rather than healthcare organizations. Clinical validation and health benefits of these apps are inadequately documented, leaving uncertainty about their effectiveness and efficacy.
- Guidelines for ensuring equity, ethics, complementing government's mHealth agenda and showing the way to the non-government and private sector are not available.
- Plans for amalgamation of mHealth into the health sector or digital India are unknown.

Future Action

- Funding should be made available for ensuring robust and scientific evaluation of effectiveness of the mHealth initiatives through appropriately designed studies powered on clinical endpoints such as mortality and hospitalizations.
- Studies that take a health systems approach, use technology with appropriate human and sociological interventions and target vulnerable populations should be supported. There is a need to move beyond pilots to develop scalable models of care.
- Funding opportunities should target mHealth solutions in unmapped health system domains for establishing effective systems of health data and information, ensuring medical supplies, health financing and governance.

- Multi-sectoral partnerships should be established for ensuring a wider health system approach and usage of multiple mHealth functionalities to produce holistic solutions that complement various domains of Indian health system.
- Traditional qualitative research for needs assessment, formative planning and stakeholder mapping for ensuring context appropriate and successful implementation should complement standard.
- Negative or unfavourable findings should be reported for generating reliable evidence around effectiveness and cost-effectiveness.
- Academic organizations should form consortia and coalitions for knowledge sharing, resource pooling and advocacy.

- Steps should be taken towards developing an mHealth regulatory framework for ensuring quality of care and safeguarding the users.
- Public-private partnerships between healthcare and technology organizations should be developed for increasing the quality and reach of mHealth innovations without duplication of effort.
- The entrepreneurial digital community should be encouraged to work with medical professionals, using evidence-based guidelines for development of a plan for integration of mHealth in the Digital India approach for achievement of SDGs.

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The George Institute for Global Health was established in India in 2007 to generate high quality evidence and improve the health of millions of Indians by reducing premature deaths and disability from non-communicable diseases like cardiovascular disease, diabetes, kidney disease, stroke, mental health, and injuries. TGI India's research uses innovative approaches to create system-wide change for people at the bottom of the pyramid, develop affordable and scalable solutions, and to empower people to improve their own health.

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