

**TO STUDY THE CURRENT STATE OF AI
APPLICATION IN HEALTHCARE START-UPS WITHIN
INDIA**

Dissertation Submitted to



The IIHMR University, Jaipur

for the partial fulfilment for the award of the degree

of Master of Business Administration

(MBA) in

Hospital and Health Management

by

Dr. Snehasish Ghosh

Under the Supervision and Guidance of

Dr. Kajal Sitlani

2022

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled ‘To study the current state of AI application in the healthcare start-ups within India’ is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Name of Student: Dr. Snehasish Ghosh

Date: 1/07/2022

CERTIFICATE

This is to certify that Dr. Snehasish Ghosh in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her/his internship at Clarivate Healthcare Business Insights during January 17, 2022 to May 3, 2022.

Place: United States

Date: 30/06/2022

**Preceptor/Head of the
Organization**

Selby Rodriguez

Name of the organization:
Clarivate Healthcare Business
Insights

CERTIFICATE

This is to certify that dissertation titled ‘To study the current state of AI application in the healthcare start-ups within India’ is a record of the research work undertaken by Dr. Snehasish Ghosh in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide
IIHMR University, Jaipur

Date

School Dean
IIHMR University, Jaipur

Date

ACKNOWLEDGEMENT

Learning is a never ending process. Our quest to learn more and more by grabbing every possible opportunity that comes our way, proves to be the reason behind our success one day.

I would like to thank the management for providing me with this learning opportunity which has enhanced my knowledge related to current state of AI application in the healthcare start-ups within India. Working on this report has made it possible for me to explore the topic in all possible dimensions to extract best out of all the data available and turn this opportunity into a beautiful learning experience.

My sincere thanks to my mentor **Dr. Kajal Sitlani** who has been a constant support and has guided me in the correct direction throughout my learning process.

My heart felt gratitude and appreciation are also extended towards **Selby Rodriguez** (Organization - Manager) for her useful advice and constant support in the completion of my project report.

Lastly, I admit my inability to express my emotions through words for my loving parents and for their encouragement, support and constant faith in me.

Above all I thank the Almighty for giving me patience and strength to overcome the difficulties, which crossed my way in accomplishment at this endeavour.

Title: To study the current state of AI application in healthcare start-ups within India

Executive Summary:

The use of AI in healthcare in India is expanding as new start-ups and big ICT enterprises provide AI solutions for the nation's healthcare issues. Examples of such problems and their solutions include providing individualised healthcare and high-quality healthcare in remote locations, as well as instructing physicians and nurses in difficult techniques. Others include correcting the imbalance in the number of qualified physicians to patients and improving the efficiency of doctors in their work. Businesses are providing a range of solutions, including automated medical diagnosis, automated medical test analysis, disease detection and screening, wearable sensor-based medical equipment and monitoring devices, patient management systems, predictive healthcare diagnosis, and disease prevention. The absence of thorough, representative, interoperable, and clean data has been frequently noted as a problem in the development of these solutions. Access to free databases of medical information and practitioner adoption are further difficulties.

Research Objectives

- To understand the different applications of AI in healthcare and how does it work
- To study the available AI based solution in healthcare start-up industry

Methodology

The report is based on the descriptive secondary research data. To offer a complete knowledge of AI application in Indian healthcare industry, a literature search was done through published research papers, journals and reports to integrate the material accessible online.

Table of Contents

Sl. No.	Content	Page
1	Introduction	9
2	Literature review	20
3	Rationale	22
4	Research question	22
5	Objectives	22
6	Methodology	22
7	Findings	24
8	Discussion	28
9	Conclusion	35
10	References	36

CHAPTER 1: Introduction

Something like 50,000 specialists are delivered in India every year, which is deficient to meet fundamental measures. By 2030, India will require 2.3 million specialists to accomplish the WHO-prescribed least specialist to-patient proportion of 1:1000. Early tests by essentially twelve medical care business visionaries might hold the way to moving Indian medical services forward and reducing the tension on the country's medical care framework.

Registering, programming improvement, and information transport are a couple of the ideas that are essentially founded on man-made reasoning (AI). Instances of AI innovation incorporate profound learning, AI, voice acknowledgment, advanced mechanics, and biometric recognizable proof. Medical services, assembling, and business are only a couple of the enterprises that utilize AI. Also, the vehicle area utilizes it.

Not at all like insight moved by people or other living creatures, man-made consciousness (AI) alludes to knowledge moved by machines. Man-made brainpower (AI) and related advancements are multiplying in trade and society, and they are likewise starting to show up in medical services. Man-made intelligence intends to emulate human mental cycles. Because of the extension of medical services information accessibility and the quick improvement of examination innovations, it is bringing about a worldview change in medical services. It can possibly expand the efficiency and effectiveness of care conveyance, empowering medical services associations to give better consideration to additional patients.

Artificial intelligence can work on the experience of medical services suppliers by permitting them to invest more energy straightforwardly focusing on patients and diminishing burnout. Man-made consciousness, which gets done with jobs usually finished by individuals in a small part of the time and for a portion of the expense, simplifies life for patients, doctors, and medical clinic the executives.

1.1 All about AI?

Man-made consciousness (AI) is an expression used to make sense of how machines that have been educated to think and behave like individuals re-enact human mind. A

humanoid is any machine that displays characteristics related with the human psyche, for example, learning and critical thinking.

Man-made brainpower's ideal quality is its ability to reason out and do activities that have the most elevated likelihood of accomplishing a given goal. A subset of man-made consciousness known as "AI" alludes to the thought that PC frameworks are equipped for gaining from and adjusting to new information without the help of people. This independent learning is made conceivable by profound learning calculations, which take in enormous measures of unstructured information including text, pictures, and video.

The premise behind artificial intelligence is that human intellect can be described in a way that a machine can easily reproduce it and do tasks ranging from the simplest to the most complex. The objectives of artificial intelligence include cognitive process simulation. Researchers and programmers in the subject are advancing remarkably quickly in replicating skills like learning, reasoning, and perception to the point that they can be specifically characterised. Some believe that soon, inventors will be able to develop systems that are faster than humans at learning and reasoning about any topic. Others, however, are sceptical and maintain that all cognitive work is weighed down with value judgements derived from human experience.

-Source: Investopedia

The field of software engineering known as man-made consciousness (AI), frequently alluded to as machine insight, is worried about making and overseeing apparatuses that can figure out how to simply decide and make moves for individuals.

Various advances are incorporated under the umbrella of AI. It fills in as a sweeping term for any piece of equipment or programming that works with AI, PC vision, normal language figuring out (NLU), and regular language handling (NLP).

-Source: Techopedia

Artificial intelligence alludes to knowledge showed by robots rather than normal insight showed by creatures like people. The investigation of wise specialists, or any framework that sees its environmental elements and makes moves to work on its possibilities accomplishing its objectives, is implied when we discuss AI research.

Already, robots that imitate and display "human" mental capacities, for example, "learning" and "critical thinking," that are associated with the human psyche, were alluded to as having "man-made reasoning." Major AI scientists have now dismissed this hypothesis, describing AI rather as far as sanity and acting objectively, which puts no limits on the outflow of insight.

The few subfields of AI study are centered around specific targets and the utilization of specific techniques. Regular AI research points incorporate the advancement of thinking, information portrayal, arranging, learning, normal language handling, detecting, and the ability to move and control objects. General insight is one of the field's drawn out goals (the ability to tackle any issue). To address these difficulties, AI scientists have adjusted and consolidated an extensive variety of critical thinking procedures, like hunt and numerical streamlining, formal rationale, counterfeit brain organizations, and approaches from insights, likelihood, and financial matters. Simulated intelligence draws on many scholarly fields, including software engineering, brain research, phonetics, and theory.

-Source: Wikipedia

1.2 AI in healthcare

Man-made reasoning (AI) is a vital part of working on clinical results and administrative viability in the medical services area. Past investigations have exhibited how man-made brainpower (AI) could improve medical care administrations by encouraging mental health, upgrading human capacities, and offering exact analyses. Because of AI innovation, we can gather information, process it, and give clinical experts an unmistakable outcome. Forecast, determination, and treatment are made conceivable by AI innovation' information mining and example acknowledgment capacities. Early endeavors to apply AI innovation in medication attempted to imitate the elements of the human mind and make a standard based system to help clinical thinking.

Future AI advancements expected to impersonate the mental capacities of specialists. Then again, contemporary AI innovation is conquering the impediments of doctors and the intricacy of the medical care framework. Simulated intelligence based answers for mental commitment further develop diagnostics, improve prognostic treatment, and increment medical services efficiency by changing scientific information.

The move from regular emergency clinic settings to patient-focused care conditions like mobile medical procedure communities, retail centers, and home consideration may be sped quicker by man-made consciousness (AI). What's more, wearable innovation and home consideration might have the option to reduce medical care expenses by 20 to 32 percent in general. Man-made intelligence empowered advancements have made it attainable for home imbue and perception care models, which are supposed to increment by over 18% throughout the following five years. Clinicians may now remotely screen patients getting home consideration or involving connected gadgets because of progressions in prescient examination, simplifying it to survey their wellbeing designs. In this manner, worked on safeguard, demonstrative, and therapy strategies have helped clinical experts.

Then again, the modern production network, endeavors, and partners face serious dangers because of AI's characteristic power. Research from the past recommends that as AI creates, the dangers and issues it brings to humankind will develop. Chances related with AI incorporate those connected with the security of significant AI frameworks, the security and protection of client information, and cultural risks. For example, the assortment of patient information by AI frameworks raises serious protection, straightforwardness, and data spillage issues. People have been presented to various dangers at different phases of information assortment and handling because of the utilization of such state of the art innovations.

Thus, individuals are more stressed than any other time over the moral and legitimate issues that encompass AI innovation. Among late years, there has been a critical arrangement of worry about AI in India's bunch gatherings, organizations, and government offices. The Medical Council of India has laid out information security rules to direct "confidential information." accordingly, the accentuation has moved to the creation and utilization of socially cognizant AI advancements.

1.3 Uses of AI in healthcare

In the medical services area, computerized reasoning (AI) is applied in various settings. To understand the many types of "Artificial intelligence" that different arrangements are being worked around, the use of AI in medical services might be partitioned into the accompanying general classifications:

1.3.1 Descriptive Analysis

Right now, spellbinding AI is utilized the most often in medical services, and it offers the most prompt potential¹⁹. It counts prior events and utilizes this information to get further bits of knowledge, for example, distinguishing patterns and moment changes that could somehow or another slip through the cracks by clinical experts. For example, this method might be used to distinguish designs in the analysis of skin conditions and cracks. Besides, it has been shown that these advances are prevalent than individuals in the finding of little wrist cracks.

1.3.2 Predictive Analysis

Prescient AI utilizes illustrative information to make future forecasts. To give estimate bits of knowledge and activities, clinical experts utilize man-made reasoning (AI). Medical care innovation and emergency clinic organization may be totally changed by AI. Instances of strategies to increment proficiency and lessen costs include:

1. Laying out tolerant boundaries in light of their criticality will diminish dreariness and lift clinical efficiency. The strategy of focusing on a patient's consideration relying upon the seriousness of their sickness is known as emergency. The interaction can utilize prescient AI.
2. Through rushing the determination of diseases and decentralizing symptomatic tests.
3. Foreseeing cardiovascular failures utilizing a similar ECG-like examination of pulses.
4. By expanding functional viability, for example, the hours expected for patient affirmation and release.

5. By improving and adjusting Health Management Information Systems to empower the production of continuous revealing.
6. Applying investigation to medical care information to improve managerial systems

There is an ongoing lack of essential consideration doctors in different districts of India. Restricting requirements incorporate the absence of doctors and the limit of medical care programs. Man-made brainpower (AI) can be helpful in this present circumstance. In understaffed provincial areas, Artelus means to utilize man-made brainpower to help with beginning screening. For example, Wysa can screen and anticipate emotional well-being issues. Elevated degrees of commitment are additionally conceivable with this innovation (where every patient is offered individual consideration). Accidental nonverbal signals like judgment can't be spoken, and the conventional progressive design among clinicians and patients isn't felt. Virtual individuals are consequently bound to be honest with their patients, and patients are bound to stick to their training and treatment regimens.

1.3.3 Predictive Analysis

By not simply distinguishing designs that people wouldn't have the option to foresee, yet additionally by making treatment suggestions in view of nuances in the determination, prescriptive AI propels the point of prescient AI. Because of its capacity to decide, prescriptive AI is the most captivating and disruptive use case soon. To lessen the tension on human mental capacities, prescriptive AI might be used as a mental specialist that imitates the mind. The medical services industry is one of the most information serious businesses. The latest clinical data might be looked for, found, introduced, and utilized by AI-fuelled shrewd specialists working close by specialists, medical attendants, and scientists. This incredibly further develops clinician productivity and limit as well as the norm of treatment.

1.4 State of AI in the Indian healthcare industry

By 2035, man-made consciousness (AI) is anticipated to contribute USD 957 billion (or 15% of the country's ongoing gross worth added) to its economy, and it additionally looks that more cash is being put resources into the country's medical care area. For instance,

among July and September 2017, somewhere around 16 Indian medical care IT organizations got capital from the USD 5.5 billion raised by worldwide computerized wellbeing new companies. Legislatures at the state level are additionally helping AI endeavors; as indicated by projections, the Karnataka government would burn through 2,000 crore by 2020. To help AI undertakings, the territory of Karnataka has a Start-up Policy and a Karnataka Information Technology Venture Capital Fund. Partners like the FICCI and the Prime Minister's Office advocate AI reconciliation in medical services in India as a critical innovation for raising the viability, quality, reasonableness, and openness of medical care. In India, advancements that can supplant doctors have the most minimal odds of coming out on top since, for instance, there are irreconcilable situations inside the clinical framework, though assistive AI has the most elevated improvement potential. Most of AI-based medical services drives in India, as per a survey of AI and wellbeing arrangements, reports, and news things, have as their essential objective the expansion of clinical benefits to generally underserved populaces in India, for example, provincial regions coming up short on the necessary foundation or essential doctors and financially impeded bunches unfit to bear the cost of explicit clinical offices. Therefore, as opposed to what some have expected, AI in India is by all accounts tending to stresses over monetary awkwardness. An investigation of AI and medical care organizations in India likewise proposes that unfamiliar organizations are creating and testing new thoughts there.

1.4.1 AI and healthcare segments in India

There are a few sections in India's medical care industry. Artificial intelligence is utilized in various ways across the various classes - as per a review of organizations creating AI answers for wellbeing, wellbeing specialists utilizing AI, and scientists investigating the conceivable outcomes of AI and wellbeing:

1. Hospital: Government clinics, for example, medical care communities, locale clinics, and general emergency clinics, and confidential emergency clinics, like nursing homes and mid-level and top-level confidential emergency clinics, are among them. As per an evaluation of arrangements utilized, clinics in India are utilizing spellbinding and prescient AI. The Manipal Group of Hospitals, for instance, has collaborated with IBM's Watson for Oncology to help clinicians analyze and treat seven unique types of malignant

growth. Watson for Oncology is utilized across the organization's offices, which treat more than 2,000,000 disease patients every year. For this situation, AI is utilized to break down information and study proof to further develop the report's quality and, accordingly, increment patient trust. Patients should be completely educated about the system and give their express assent. The secrecy of the patients is in like manner safeguarded.

Aravind Eye Care Systems is at present teaming up with Google Brain, having recently helped Google in the advancement of their retinal screening framework by providing photographs to prepare its picture parsing calculations. It is presently endeavoring to place it into routine use with patients after fruitful clinical preliminaries to identify marks of diabetes-related eye harm.

Confidential medical services suppliers like Fortis Healthcare, Apollo Hospitals, L V Prasad Eye Institute (LVPEI), Narayana Health, and Max Healthcare utilize Microsoft Azure, Machine Learning, Data Analytics, CRM on the web, and Office 365 to work on quiet consideration.

2. Pharmaceuticals: Producing, extraction, handling, refinement, and bundling of synthetic mixtures for use as human or creature drugs are among them. As per an evaluation of arrangements utilized, drug organizations in India are utilizing expressive and prescient AI, with prescriptive AI models being fabricated and tried.

The most pervasive utilization of AI in drugs is drug disclosure, in which AI is utilized to filter all suitable writing on a specific particle for a medication (for example designated particle disclosure), which would be hard for even a gathering of people to physically do.

As well as smoothing out the medication disclosure process, AI in pharma gives extra advantages, for example, recognizing both unmistakable and immaterial improved offers, upgraded contender separation, ideal asset allotment for most extreme piece of the pie gain, income and benefit, capacity to expand development, tweaking deals and advertising informing for more noteworthy client commitment, and computerization of deals and showcasing messages and beat the board. 48 Abbott Healthcare has involved India as a proving ground for creative innovation, including heart and liver applications, as well as dizziness works out (which utilize increased and computer generated reality). 49 Pharmedica is a cloud-based programming as-a-administration (SaaS) program that utilizes computerized reasoning (AI) to mechanize drug store network the board.

3. Diagnostics: Organizations and research facilities that offer scientific or demonstrative types of assistance fall into this classification. Notwithstanding bigger organizations, for example, Google and IBM, India is home to a huge number of new businesses zeroed in on utilizing man-made brainpower to distinguish illness. As per an overview of arrangements utilized, diagnostics in India are utilizing graphic and prescient AI.

Niramai Health Analytix, for instance, utilizes warm examination to identify beginning phase bosom disease, while Advenio Tecnosys utilizes chest x-beams and ultrasound pictures to recognize tuberculosis and intense contaminations. Qure.AI uses profound figuring out how to analyze sickness and proposition individualized therapy systems in light of medical services imaging information, though Orbuculum utilizes AI to estimate illnesses like malignant growth, diabetes, neurological problems, and cardiovascular sicknesses in view of genomic information. Cureskin is a versatile application that recognizes and proposes treatment regimens for six normal skin conditions: pimples, skin inflammation, scars, dull spots, pigmentation, and dark circles. It flaunts that its profound learning calculations are precise to the degree of dermatologists for the six skin issues it as of now deals with.

As indicated by the World Health Organization, India has more than five crore individuals experiencing melancholy and is a significant supporter of suicides around the world. Getting care for emotional wellness hardships, then again, is as yet disliked.

Wysa is a chatbot with the capacity to understand people on a profound level that fills in as an emotional well-being and conduct guide. It recognizes and helps patients in need utilizing cell phone sensors. Its AI innovation takes information from cell phones and sensors and utilizations it to distinguish potential medical conditions in view of changes in correspondence, action, and rest propensities (which are all followed through cell phone), as well as admonitions in the event that the client is discouraged. Woebot is an equivalent help that records changes in client mind-set consistently and searches for designs, as well as giving answers for these issues.

4. Medical equipment and supplies: This classification contains organizations that have practical experience in the creation of clinical hardware and supplies, for example, careful, dental, muscular, ophthalmologic, and research center devices. Organizations

creating clinical gear and supplies in India give off an impression of being utilizing graphic and prescient AI, as per a review of arrangements utilized.

Niramai (which means "Harmless Risk Assessment with Machine Intelligence") is a high-goal warm detecting gadget that filters the chest region like a camera and examinations the warm pictures for early signs of bosom malignant growth utilizing cloud-facilitated investigation frameworks. Ten3T has fostered a remote fix for cardiovascular patients to wear. This fix constantly screens fundamental signs and sends the data to the cloud, where clinicians can follow it progressively. In ICUs, AI is additionally being used to screen patients' important bodily functions and ready specialists assuming that something turns out badly, as with Philips IntelliSpace Consultative Critical Care. It can likewise be utilized restoratively, like in the Implantable Cardiovascular Defibrillator (ICD), which screens heart rhythms and regulates stuns naturally on the off chance that an abnormality is recognized.

5. Medical insurance: This incorporates health care coverage and clinical repayment administrations, which cover an individual's hospitalization costs on the off chance that they become sick. In light of an overview of arrangements utilized, apparently clinical insurance agency in India are utilizing clear and prescient AI.

Overwhelmingly of information quicker than expected, AI might computerize claims organization, lessening handling time and taking care of expenses while additionally further developing client experience. Distinguishing dubious patterns in information can likewise support the location of fake cases, maybe accelerating the settlement of authentic cases. Guarantors can investigate shoppers' way of life ways of behaving and give them with customized contributions by coordinating huge information and AI. Guarantors can utilize large information to identify beginning phase sicknesses and lower the probability of therapy related issues. In India, safety net providers are as yet restricted to overseeing activities. Boing, a chatbot that responds to client inquiries concerning auto and health care coverage, is utilized by Bajaj Allianz General Insurance. ICICI Lombard sells insurance contracts through its MyRA chatbot stage. Spok, an email bot from HDFC Life, vows to be the first in Quite a while to peruse, decipher, order, focus on, and reply to client messages consequently.

6. Telemedicine: Telemedicine alludes to the utilization of electronic correspondences and programming to give remedial medicines to patients from a good ways. Follow-up visits, ongoing condition care, prescription administration, expert meeting, and other clinical administrations that can be offered remotely by means of secure video and sound connections are normal purposes. This kills time and geological limits, considering the fast exchange of clinical mastery to far off regions. Organizations creating telemedicine stages in India give off an impression of being utilizing elucidating and prescient AI, as per an overview of arrangements utilized.

Telemedicine can assist with tending to the difficulties of medical care conveyance in rustic and far off areas, as well as perform different obligations in the wellbeing area like schooling, preparing, and the executives. Telemedicine, then again, is currently assailed by framework issues and is dependent on the nature of administrations provided by clinical experts. Artificial intelligence normalizes the nature of care by disposing of the human part.

Without the assistance of a pathologist, SigTuple can break down blood slides and make a pathology report. This help can be utilized in rustic spots for a negligible part of the typical cost.

Microsoft has collaborated with the Government of Telangana to use cloud-based examination for the Rashtriya Bal Swasthya Karyakram drive, which uses MINE (Microsoft Intelligent Network for Eyecare), an AI stage to assist young people with keeping away from visual impairment. In Bengaluru, the Philips Innovation Campus (PIC) is utilizing innovation to make medical care more economical and available. They've made programming to analyze tuberculosis from chest x-beams and a product framework to recognize and oversee high-risk pregnancies (Mobile Obstetrics Monitoring). It has collaborated with Fortis Escorts Heart Institute in Delhi to send off Philips IntelliSpace Consultative Critical Care, which permits medical clinics to manage a few concentrated care units (ICUs) from a solitary, geologically disengaged war room.

CHAPTER 2: Literature review

The research paper “**Artificial Intelligence for Healthcare: Insights from India**”, Claire Muñoz Parry and Dr. Urvashi Aneja outlines a few of the key potential and difficulties associated with employing AI in healthcare. The discussion then shifts to a case study of the use of AI in India's healthcare system, highlighting major applications, difficulties, and hazards in this setting. An example of a nation that aggressively promotes the use of AI to meet healthcare problems is India. However, especially for clinical interventions, AI implementation in India is still in its very early stages. The paper discusses that the adoption of AI applications is most likely to occur at India's well-established private hospitals due to factors such as the quality of the digital infrastructure, affordability, and differences in capabilities between states and medical experts. This might then lead to new disparities in access to high-quality healthcare.

Thomas Davenport and Ravi Kalakota predicts in their health journal “**The potential for artificial intelligence in healthcare**”, that Artificial intelligence (AI) will be used more and more in the healthcare industry as a result of the complexity and growth of the data therein. Further, they discuss that payers, care providers, and life sciences organisations currently use a variety of AI technologies. The main application categories include patient involvement and adherence, diagnosis and treatment recommendations, and administrative duties. Although there are many situations in which AI can execute healthcare duties as well as or better than humans, implementation issues will keep occupations for health care professionals from being automated widely for a substantial amount of time. The use of AI in healthcare and ethical concerns are also covered.

In the research “**Rise of Artificial Intelligence in Healthcare Startups in India**”, Vijai C and Worakamol Wisetri talks about a new development in healthcare, i.e., artificial intelligence (AI). AI aids in the prediction of illness patients for surgical procedures. Further, they discuss about the several ways that AI is used in healthcare, including by patients, drug companies, healthcare providers, insurance companies, and medical facilities. Additionally, AI aids in a variety of medical procedures, including dermatology, angiography, echocardiography, neurology screening, and retinal care. Both doctors and patients can easily use it, and it gets

patient feedback ready for the medical community's study. AI aids in patient monitoring, screening, and the provision of clinical and medical investigations.

Vijai C. and Worakamol Wisetri discuss a recent breakthrough in healthcare, namely artificial intelligence, in their study **"Rise of Artificial Intelligence in Healthcare Startups in India"** (AI). AI helps in the prediction of surgery patients who will be unwell. They also go over the various applications of AI in healthcare, including those utilised by patients, pharmaceutical companies, healthcare providers, insurance firms, and hospitals. Aside from that, AI is helpful in a range of medical treatments, including dermatology, angiography, echocardiography, neurology screening, and eye care. It is simple to use for both patients and clinicians, and it prepares patient feedback for research by the medical community. AI supports clinical and medical investigations, screening, and patient monitoring.

Pradeep Kumar, Yogesh K. Dwivedi and Ambuj Anand talks about the reception of computerized reasoning (AI) innovation in the medical care industry in their article **Responsible Artificial Intelligence (AI) for Value Formation and Market Performance in Healthcare: the Mediating Role of Patient's Cognitive Engagement**". There has been a ton of study and discussion on the subject of mindful AI because of the idea of the administrations and the defenselessness of a sizeable number of end clients. To distinguish the components of moral AI in the medical services area and explore what it means for market execution and worth creation, we directed a blended strategy study. The examination setting is India, where AI advances are still in the beginning phases of improvement. How we might interpret how different mindful AI parts assist medical care associations with conveying better understanding focused care and proof based medication is worked on by the aftereffects of 12 inside and out interviews. The PLS-SEM examination of 290 review reactions, which positions capable AI as a third-request part, approves the hypothetical system.

CHAPTER 3: Methodology

Rationale

The move from traditional emergency clinic settings to patient-focused care conditions like mobile careful focuses, retail centers, and home consideration could be sped quicker with computerized reasoning (AI). Man-made intelligence is valuable in various spaces, including dermatology, echocardiography, nervous system science screening, retinal consideration, diagnostics, medical procedure, and angiography. The two specialists and patients can without much of a stretch access it, and it likewise gives information to the clinical local area to dissect. Clinical and clinical examinations, screening, and patient observing are completely made simpler by AI. On the opposite side, the inborn force of AI presents serious dangers to associations, partners, and the business store network. Chances related with AI incorporate those connected with the security of vital AI frameworks, the security and protection of client information, and cultural perils.

This study will look at the hazards connected with AI in a developing nation like India, as well as how it is currently used and implemented in the Indian healthcare start-up market.

Research Question

What is the current state of AI application in Indian healthcare start-ups within India?

Research Objectives

1. To understand the different applications of AI and how does it work
2. To study the available AI based solution in healthcare start-up industry

Research Design - Systematic Literature Review

Data collection method - To offer a complete knowledge of the following criteria, a literature search has been done through published research papers, journals and reports to integrate the material accessible online:

- 1) How does AI and machine learning works?
- 2) Available AI-based solution in Indian healthcare start-up industry.

Inclusion criteria - Any information that will discuss about the different applications of AI, how it works and challenges related to AI applications in India

Exclusion criteria - Articles before 2016 will not be included in the study

Duration of study: 3 months

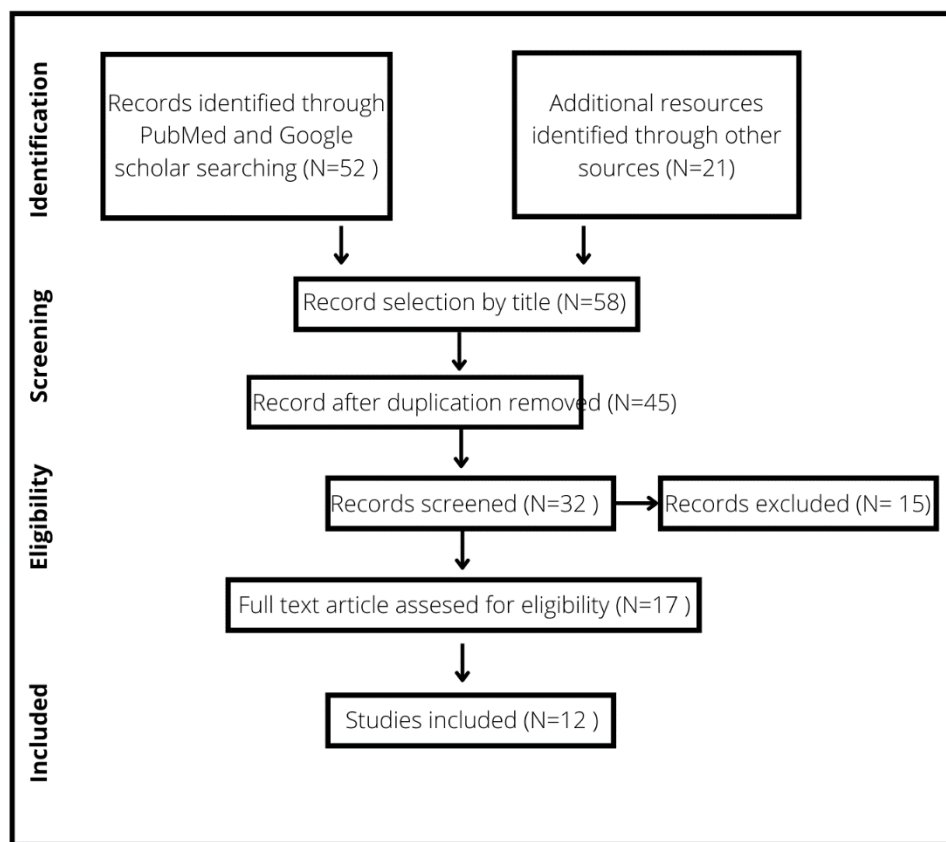


Figure: Flow diagram depicting the search process

CHAPTER 4: Findings

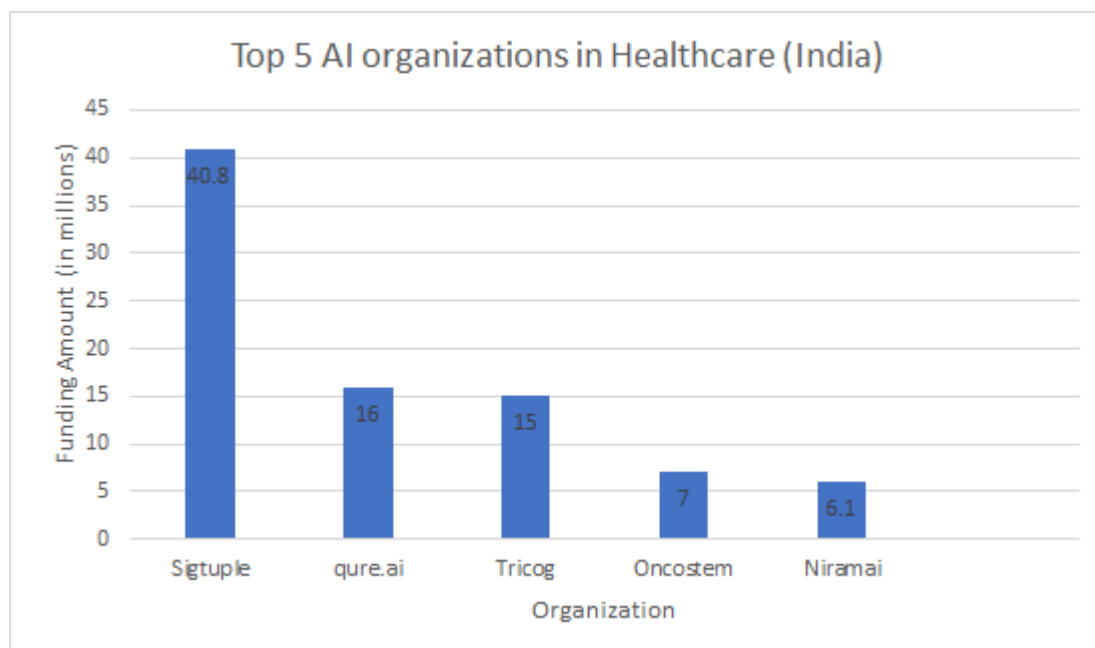


Figure: Top Five Artificial Intelligence (AI) organizations in healthcare in India in terms of funding amount

Source: <https://innohealthmagazine.com/2020/trends/top-artificial-intelligence-organizations-in-healthcare-in-india/>

1. The market for man-made brainpower applications in the medical services industry is anticipated to arrive at INR 431.97 billion by 2021, increasing at a pace of 40%, as per a report by Research and Markets. As per forecasts made based on the multiplication of AI applications in medical care, India's PCP patient proportion will ascend from 4.8:1000 in 2017 to 6.9:1,000 by 2023. The capacity of AI applications to expand specialists' efficiency can help address issues like lopsided specialist patient proportions by offering great medical services to rustic populaces and teaching specialists and attendants on the most proficient method to execute testing clinical tasks.

2. Here is a list of stat-up firms implementing AI in healthcare, as reported by Analytics India:

- **Niramai:**

Bengaluru-based Niramai Health Analytix was laid out in 2016 by Geetha Manjunath and Nidhi Mathur. Rather than utilizing conventional methods like

self-assessment, the wellbeing tech business Thermalytix joins man-made brainpower (AI) and a high-goal warm sensor gadget. The minimal expense, mechanization, and transportability of the product based clinical contraption have made disease screening open in all centers. The essential innovation is based on ML calculations.

- **Qure.ai:**

Prashant Warier and Pooja Rao made the Mumbai-based business Qure.ai in 2016. It makes medical care arrangements accessible and reasonable by utilizing AI. Utilizing profound learning calculations, it quickly investigations clinical pictures and outputs, for example, chest X-beams, head CT examines, POQUS, chest CT filters, and so on. It additionally gives neighborhood medicines to tuberculosis, general wellbeing, and COVID-19.

- **HealthifyMe:**

A Bengaluru-based computerized wellbeing and health gateway called HealthifyMe was made in 2012. Tushar Vashisht, Sachin Shenoy, and Mathew Cherian, the organization's three pioneers, set off to give advanced medical care to Indians. It utilizes Ria, an AI-based menial helper that speaks with clients and answers their inquiries regarding wellbeing, exercise, and nourishment in ten distinct dialects. Also, the application proposes dietary thoughts, tracks calorie utilization utilizing AI, and offers proper sound recipes and exhortation.

- **PharmEasy:**

The Mumbai-based business PharmEasy was established in 2015 by Dharmil Sheth, Mikhil Innani, and Dhaval Shah determined to foster a stage that joins clients with drug stores. By utilizing the cell phone based programming, clients may advantageously arrange solutions from these drug stores.

PharmEasy utilizes various ML and Big Data apparatuses, including Tensorflow, Hadoop, HBase, Kafka, Spark, and Hive. Moreover, the application utilizes a ton of information handling and investigation innovations. Through associations with in excess of 80,000 drug stores in excess of 1200 American areas, it serves in excess of 5,000,000 clients.

- **SigTuple Technologies:**

In Bengaluru, India, Tathagoto Rai Dastidar, Apurv Anand, and Rohit Pandey laid out SigTuple Technologies in 2015. The goal of SigTuple is to utilize man-made reasoning to independently break down clinical information from blood tests, pee and semen microscopy, and retinal picture investigation. It offers arrangements that work in the areas of pathology and ophthalmology, like a robotized computerized magnifying lens and an AI stage. Tathagoto took over as CEO after the flight of two fellow benefactors prior in the year.

- **OncoStem Diagnostics:**

2011-established OncoStem Diagnostics incorporates ML calculations to recognize the qualities of repeat risk more than a five-year time span and evaluate the forcefulness of growths. CanAssist, the organization's principal item, utilizes information support vector machine-based factual models to relegate risk scores to every patient in light of five biomarkers and clinicopathological information. The gathering utilizes strategies including typical blend displaying, Random Forest, Elastic Net, and Support Vector Machines with direct and spiral premise capability parts.

- **Artelus:**

Bengaluru-based Artelus was established in 2015 by Pradeep Walia, Rajarajeshwari K, and Vish Durga. The wellbeing tech startup tests for diabetic retinopathy utilizing profound learning advancements. Simulated intelligence controlled PCs assess the pictures to make a determination.

Altogether, Artelus has aided the screening of in excess of 81,000 patients and is dynamic in 502 locales (remembering those for India, the US, and Dubai). A contactless, AI-controlled innovation for distinguishing diabetic retinopathy was as of late evolved by the wellbeing tech industry, and it can do an eye assessment in less than three minutes.

- **Tricog:**

The medical care examination business Tricog was established in Bengaluru in 2014 by Chirat Bhograj, Zainul Charbiwala, Udayan Dasgupta, and Abhinav Gujjar. Its parts include:

- o InstaECG: This cloud-associated gadget's leader thing helps with deciphering and surveying ECG readings in only 10 minutes.
- o InstaEcho: An alternate heart item called InstaEcho helps clinical experts in rapidly and precisely diagnosing an echocardiogram.

Tricog has worked in more than 12 countries so far, empowering over 2,600 healthcare professionals, impacting over three million patients, and saving over 90,000 lives. The 2018 NASSCOM Artificial Intelligence Game Changer Award was also given to it.

CHAPTER 5: Discussion

5.1 Ethical, legal and cultural considerations

1. Social acknowledgment: This is regularly a hindrance to the acknowledgment of AI since it raises "trust concerns" that patients might have, for example, the requirement for specialists to be genuinely present or the hesitance of the old to take on new innovations. Contingent upon the locale or setting in which they are utilized, machine errands should be culture-explicit to think about different social standards.

The Wysa group had comparative perspectives, expressing that it was challenging to draw in new clients since getting through conventional thoughts of trust, especially in India was troublesome. For example, it is trying for organizations to fund-raise even with horrible press titles stating that AI represents a danger to occupations. Furthermore, India's absence of mechanical framework implies that AI doesn't yet have the profound learning abilities important to manage the country's variety in semantic frameworks. This could be a significant boundary to AI reception, particularly in essential medical care.

2. Characterizing acceptable way of behaving: Each application area's OK AI conduct should be exactly characterized, and it ought to preferably affect plan choices, designing cycles, and unwavering quality. Man-made intelligence advances should work in a manner that is easy to comprehend, and the consequences of its applications should be in accordance with neighborhood social standards and originations of decency and correspondence.

Guidelines for privacy in the specialist patient-AI connect, informed assent (for different techniques and use/access of individual information - associated with wellbeing and then some), and AI-driven clinical exploration should be created with regards to the utilization of AI in medical services.

3. Information Safety/security: Artificial insight (AI) can be utilized by programmers to gather delicate and secret information, including Electronic Health Records. Improper use of AI calculations can bring about independent cycles that endanger the security and wellbeing of touchy information. By get-together and utilizing an abundance of data of

interest continuously, which could possibly be revealed to an individual as a notification with assent, AI frameworks can possibly think twice about.

The break of a symptomatic lab data set in Mumbai in 2016 prompted the divulgence of in excess of 35,000 patients' clinical data (counting HIV reports). This data set contained patient records from all through India, a large number of whom probably won't know that their data has been hacked.

This underscores the need of stricter protection and security guidelines in India for touchy individual information, as well as obligations prefer break warning. A worldwide program for independent and insightful frameworks has been created by the Institute of Electrical and Electronic Engineers (IEEE) that underlines ethical quality. It tries to pinpoint and spread out the basic thoughts that software engineers and planners ought to have as a main priority while making independent frameworks.

4. Assent: Long viewed as the most significant moral essential for clinical treatment and exploration, informed assent is upheld by rules for proficient classification and individual security. Indeed, even patients who are equipped for thinking might be convinced by their own nerves and promptly acknowledge the counsel of clinical experts who appear to be more educated, who might have some power, and whom they would rather not insult.

Information security dangers and issues are easy to disregard while utilizing new innovations. For example, it has been reprimanded that Google DeepMind's association with the Royal Free Hospital in London didn't completely teach clients about how and what information will be imparted to Google.

5. Risk: Who is at fault — the specialist or the product engineer — in case of a demonstrative mistake, a mechanical disappointment, or the utilization of erroneous or unseemly information? In India, the clinical expert is liable for any clinical carelessness and is dependent upon common and criminal lawful activity. Many individuals accept that the association answerable for composing the program ought to be controlled in light of the fact that code and programming are not free of innovation. The entire supplanting of clinical experts with AI (i.e., dynamic AI support) is presently unrealistic because of issues with trust and obligation as well as AI's ongoing abilities.

6. Information uprightness: In request to produce solid and fair outcomes, informational collections used to control AI frameworks should be exact and thorough. In India, there are numerous unstructured informational collections and a different populace, consequently information trustworthiness will require unique thought. Informational collections might contain hints of specific social predispositions, like position and sexual direction. In this way, it is essential that the information and information sources used to prepare the calculations of AI innovation come from an adequately enormous and different populace.

5.2 Challenges to AI in India

1. Advancement

Indeed, even while many variables are urgent at this phase of the exploration, two stick out: the difficulties in acquiring organized, complete, and delegate datasets, as well as the infrastructural, human, and monetary assets expected to foster AI arrangements. Regardless of the way that these issues are far reaching, the Indian setting aggravates them:

1.1 Access to information

India comes up short on concentrated information base for wellbeing records and has poor, conflicting, and non-normalized digitization rehearses. Another enrollment number or patient document is regularly made for each new persistent, and, surprisingly, in huge foundations, remedies are often composed manually. Bleeding edge medical services laborers in India keep patient records in journals utilizing their own custom explanation procedures. Subsequently, a sizeable portion of the populace is most likely underrepresented in the information that AI undertakings might access easily.

Wellbeing strategy is likewise settled by state legislatures as opposed to the central government. This shows that there are huge differences among states and various degrees of preparation to share wellbeing data. Since uncovering populace data could imperil express states' capacity to administer, they regularly abstain from doing as such. Wellbeing information are likewise routinely misrepresented or overstated. Inadequate or unrepresentative information can prompt unfortunate information quality and intelligence, which can prompt defective calculations and possible misdiagnosis.

1.2 Blind spots in information assortment

Right now, a couple of emergency clinics or research establishments have verifiable information that is utilized in AI projects. The issue with verifiable information is that it will by definition mirror specific cultural prejudicial cycles, as has been abundantly exhibited in before concentrates on AI. For example, there are now occurrences of ladies from lower standings being denied clinical consideration because of the clinical supplier's class bias. Since less individuals from these classifications are chosen for such preliminaries, clinical preliminary information used to illuminate AI additionally uncovers comparative underrepresentation regarding ladies, minorities, and the old. Thus, the prescriptions made using these information just advantage specific populaces.

In different cases, new businesses are utilizing open information stores, yet a ton of their work is for individuals who are situated in different spots. The probability of another misdiagnosis could ascend because of calculations that are trying to use with Indian populaces. To help specialists in recognizing and treating seven unique sorts of malignant growth, Manipal Hospitals in India has collaborated with IBM Watson for Oncology. Nonetheless, various clinical specialists have recently noticed that Watson's preparation populace is definitely not an exact portrayal of the variety of malignant growth patients around the world, and accordingly, the framework is vigorously one-sided for US patients and clinical standards.

1.3 Infrastructure and cost

It very well may be exorbitant to prepare, test, and send AI frameworks. It expects cash to accumulate datasets, and handling assets and extra room are additionally costly. Most medical services associations likewise come up short on information framework expected to gather the information important to prepare calculations to their greatest degree, including the capacity to test them for predisposition, make vital model enhancements, and constantly screen and assess field results. The shortfall of advanced foundation expected to foster AI frameworks is another obstruction. The immense majority of the servers used in the framework for distributed computing are arranged beyond India. Along these lines, an enormous number of new companies have likewise enlisted themselves beyond India. The utilization of AI in essential medical services in various

rustic settings would be particularly applicable to the test of building AI abilities across numerous dialects. The lack of capable information researchers is another obstruction.

2. Reception

The degree of status and affirmation inside spread out clinical benefits practices, as well as the gathering's structure and money related acceptability, are two parts that are projected to have a particularly gigantic impact in India.

2.1 Affordability and framework

The essential story encompassing the utilization of AI in medical care in India principally centers around the chance of coming to underserved populaces, especially in country regions with unfortunate framework or a deficiency of specialists or among monetarily hindered bunches where the populace misses the mark on assets to get to clinical offices.

Albeit a couple of pilot projects are being performed for country medical services, a more critical gander at AI reception uncovers that most of reception is restricted to sizable confidential emergency clinics or centers. For example, among the principal private organizations to involve the IBM Watson stage for disease finding were the Manipal and Apollo clinic gatherings. Confidential doctors, more modest centers, and peripheral medical clinics are probably not going to have the monetary assets to incorporate these arrangements or to have extra assets for testing and testing, consequently this is likely connected with financial variables.

2.2 Institutional limits and social acknowledgment

Reception in rustic or underserved regions is probably going to be affected by the degree of government support presently set up as opposed to relying upon direct admittance to individuals or market arrangements. India has a state-run medical services framework, as was at that point referenced. Each state has different institutional limits and information frameworks. Many states might not have the specialized skill expected to direct wellbeing guideline or to assemble an environment that extends access and supports advancement. Furthermore, information distortion is a typical event in failing to meet expectations states, and information straightforwardness is by and large deterred. This may likewise

recommend that failing to meet expectations systems are reluctant to let external checking and intercession.

3. Deployment

At the arrangement level, security, misuse, and responsibility are three significant test sets that should be considered.

3.1 Privacy

Since medical services data is so delicate, information breaks might affect an individual's more right than wrong to security, nobility, and even vocation possibilities. In excess of 35,000 people's clinical records, including HIV status tests, were uncovered in 2016 because of a hacking assault on a demonstrative research center data set situated in Mumbai. Because of the way that this data set contained clinical records from all through India, numerous people might in any case be ignorant that their own data has been hacked. The data set had been the survivor of a few assaults as of late, which regularly happened three times each week. The important research facility, in any case, had not made any move to protect the data.

India's Ministry of Health and Family Welfare delivered a draft of the proposed Digital Information Security in Healthcare Act (DISHA 2018) in March 2018, which will permit clinics and facilities to electronically share patient wellbeing records. Under DISHA's freedoms based system for clinical protection, patients would reserve the option to secrecy, security, and protection. Under the proposed regulation, which requires the unequivocal earlier authorisation of the proprietor for each occasion of transmission of advanced wellbeing information, patients would have the choice to decline assent for the age, stockpiling, and gathering of their information.

3.2 Misuse

The probability of new separation channels being opened up by the connecting of wellbeing information with different frameworks raises serious worries. For example, banks might use health care coverage information to decide a borrower's qualification for credits: a lackluster showing on wellbeing markers might be viewed as a clue that the

borrower can't work, expanding the gamble of non-installment. Transmission of wellbeing information to organizations outside the medical care industry might prompt separation in the working environment or concerning different qualifications and social advantages.

There have been questions communicated over the security of the biometric information put away in the Digilocker, which the Healthlocker would be designed according to. Security concerns are likewise raised in light of the fact that outsiders are involved and the Indian government presented the eSign electronic mark structure, which empowers an Aadhaar cardholder to sign a report carefully.

3.3. Accountability

On the one hand, AI systems are now thought of as decision-support systems. They are not intended to replace doctors, but rather to act as a first layer of screening. To put it another way, it is expected that a "person in the loop" will review the outcomes and point out any errors. It is crucial to take into account the kind of expert that individual might be, as well as their prospective motivations and capabilities for reviewing proposals for AI systems. Whether they are the product of blind obedience or passivity, mistakes can be made when decision-support technologies are overused. The uneven regulation of the Indian healthcare sector makes these challenges even more urgent. Even at respectable private institutions, there have been several reports of neglect and negligence in recent years. The lack of robust, uniform healthcare regulation countrywide is the main reason for these violations, which occur much too frequently.

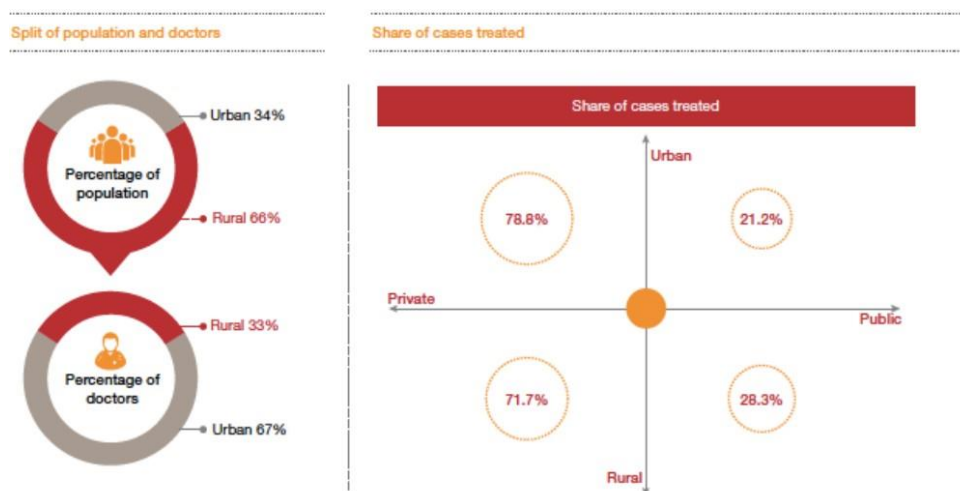


Figure: Accessibility of Healthcare across India.

Source: <https://ai4bharat.org/articles/overview-of-ai-in-indian-healthcare/>

CHAPTER 6: Conclusion

By giving more prominent proficiency and quality, AI may without a doubt further develop medical services brings about India. The hidden issues that the medical services industry faces today incorporate deficient financing, low guideline, an absence of satisfactory medical services framework, and well established sociocultural practices. These issues can't be settled simply utilizing AI.

Moreover, innovative commitment and acknowledgment of new advances are not exactly the same thing. India's anticipated sluggish and significantly heterogeneous reception of AI is impacted by various elements, including an insufficient computerized foundation, an immense, different, and uncontrolled confidential area, as well as various state and clinical professional limits. The likelihood that presumed private emergency clinics will loan the most help is expanded by similar rules. This would then suggest that a huge piece of the normal story or support for the progression of AI in medical services, concerning further developing value and quality, is probably not going to be tended to through market influences alone: these arrangements are bound to help populaces who as of now approach excellent consideration, commonly in urban communities with advanced computerized foundation. In numerous little medical clinics and single-supplier rehearses in India, authoritative frameworks have seldom progressed past fundamental ICT arrangements like invoicing and charging stages.

For these frameworks to work actually, issue distinguishing proof and coordinating with the proper arrangements will be pivotal. The present arrangements risk being issue driven as opposed to innovation driven, and subsequently, they commonly dismiss specific logical prerequisites or imperatives. For example, it may not be the best strategy to make constant or coordinated answers for computerized items intended for use in far off districts without a fundamental web association. Planning the right computerized mediations is trying because of the advanced split among clients and innovation engineers, who are regularly more skilled at utilizing innovation than clients. Preceding AI giving secure and fair medical services arrangements, protection, abuse, and responsibility concerns should be painstakingly thought of. These hardships are quite recently beginning to surface.

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