IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Impact Of Artificial Intelligence On Digital Healthcare: A Case Study Approach

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Abstract: Selecting a manufacturing process usually depends on the type of work and the volume of production. There are five main process types – job shop, batch, repetitive, continuous, and project. Noteworthy, there are many factors to consider when choosing a process, as each type has its advantages and disadvantages. This paper aims to describe the five basic process types by comparing and contrasting them using examples. Historically, people first mastered job shops and batches' processes, while repetitive and continuous processes appeared only after the industrial revolution. Job shops involve the production of a variety of products in small quantities. This process requires great flexibility of equipment and high-skilled personnel, allowing a wide variety of work. Still, the drawbacks of this type include high cost per unit and complex scheduling. An example of the job shops is a jewelry repair shop or veterinarian services. Batches are used for medium production and moderate product variety. A good example is bakeries or services for groups of people, like air travel. This type's advantage is a high level of flexibility, and the disadvantages are moderate cost per unit and scheduling complexity. Examples of repetitive process type products are production lines for cars, TVs, pencils. The advantage of this type is that it allows large volumes, but the disadvantages are the high cost of equipment downtime and low flexibility. The continuous process involves the production of the highest volumes, rigid equipment, and low-skilled personnel. Examples of a continuous process type are sugar, flour, gasoline, steel production, and supplying electricity or the Internet. This type's disadvantages are its rigidity and low variety; its advantages are high volumes and efficiency. Project process type is usually chosen in project work cases, for example, when filming a movie, publishing a book, building a dam. Project type can have characteristics of all types because of the projects' variety. Thus, the five basic process types and the advantages and disadvantages of each were described by comparing and contrasting them using examples. Job shops are often used when there is a need to produce small volumes of unique products; batches are used in medium volumes and work variety. Repetitive and continuous types emerged after the industrial revolution and now represent high volume production types for the mass consumer.

Index Terms: Artificial Intelligence (AI) , Digital Healthcare , Machine Learning ,Deep Learning , Healthcare Technology ,Health Informatics

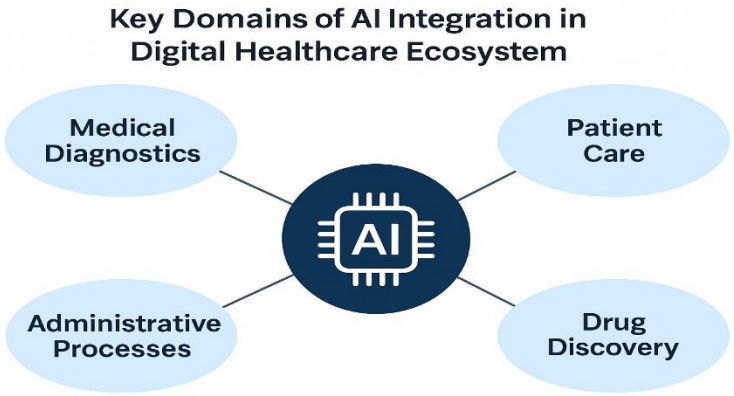
I Introduction

The healthcare sector lies under the enormous change, which is preconditioned both by the combination of new technological breakthroughs and by the increasing need of more convenient, accessible, and personal healthcare services. Artificial Intelligence (AI) is one of such technologies that may be disruptive in nature and change the way in which services are delivered, patterned and interpreted. AI has a variety of various sub-fields within it and such is the case with machine learning (ML) and deep

learning (DL) and more attitudinally speaking, AI is comprised of computer systems that are able to assume the responsibilities of tasks that typically involve the application of human intelligence like perception, reasoning, and decision making. AI in healthcare deploys some of the greatest strengths of the ability to process and analyze large amounts of data, i.e.: electronic health records (EHRs), medical images, genomic data, and patient-generated health data, to gain insight and prognosticate results or even to aid in clinical decision making.

Incorporation of AI into digital healthcare does not merely add something to it, it significantly transforms it, able to alter every aspect of the medical universe [1]. Whenever it comes to enhancing the accuracy of diagnostic tests, making alternative and virtual patient services more accessible, accelerating pharmaceutical progress, enhancing patient safety and handling many more challenges the healthcare delivery system has been facing over the years, there is massive opportunity to use AI to finally solve these long-standing problems [1][5]. This is because unlike clinicians, AI algorithms are already being used to interpret medical images in a significantly more accurate way - and this makes them invaluable when helping clinicians in early cancer and pneumonia detection, and when predicting the clinical course of the disease [1][3]. AI might also save clinicians a substantial amount of administrative workforce and minimize menial endeavors and enhance the distribution of resources to support patients while enabling professionals to perform more compassionate and caring care service with patients [1]. Despite this increasingly concerning and tantalizing portent of growing AI-centered technologies in health care, the challenge of cultivating equity and mass-market use of AI is an extremely complex one. The technical problems involve such factors as quality of data, interoperability, explainability of advanced AI methods; the ethical problems implicate privacy of data, bias in the algorithmic intelligence, and responsibility; and the need to create adequate rules, which will ensure safety, performance, and trust of people [1][2][4]. Otherwise, clinical advantages of AI seem to become more and more obvious, and nevertheless, economic aspects cost of investment, and operating price, and price-efficiency are still better assessed [9].

This paper seeks to provide an overall comprehensive picture of the effect of AI on digital healthcare, using case studies as evidence of possible real-world applications of opportunities and challenges within the scope of AI. Through a review of the most recent literature and a wider summary of the current knowledge in the field, this study will detail how AI is evolving existing methods of diagnostics, patient care, drug research and discover and administrative processes, while also reflecting on the socio-technical and ethical and economic implications of such changes. This research seeks to provide an informed point of view of the impact of AI on the direction of digital healthcare and to emphasise some of the important strategic considerations professional academicians need to consider to manage compliance and implementation responsibly.



II Literature Review

The non-material side of implementing Artificial Intelligence (AI) in digital health systems describes a radical change, which alters various medical paradigms, the way care is provided to patients, the functioning of healthcare systems ([1][3]). This section discusses the scholarly review on the area of AI in healthcare by summarizing and synthesizing important concepts in the fundamental principles, diverse applications, challenges, and future perspectives.

1. Simple Concept and Development of AI in Healthcare AI, that can be simply perceived as the potential of a machine that may show intelligent work on behalf of a human being, can be announced as techniques or methodologies such as Machine Learning (ML), Deep Learning (DL) or Natural Language Processing (NLP) [3][13]. It is also noteworthy that despite the ideas of AI and healthcare dating back many years, the fact of the actual gain in AI in healthcare became possible in recent years as there have been unprecedented changes in processing capabilities, huge volumes of new data digital data (i.e. Big Data) and more powerful algorithms [3][10]. Machine learning-based on learning-based ML techniques has achieved immense success in the ability to identify a pattern in the complex data a well in the creation of future forecasting models due to the capability of incorporating data without any programming efforts [3]. One sub-category of ML is the DL that uses neural networks in layered structures and has allowed .
2. significant advancements in mainstream features such as image and speech recognition and particularly for the field of diagnostic imaging [7]. The revisions in technological capabilities has enabled AI to go from the realm of an abstract idea to the realm of a concrete tool for addressing existing or emerging healthcare challenges. Bibliometric analysis have shown steep rises in the reservoir of published research regarding developments and uses of AI in healthcare, significantly since 2019, with the United States leading in volume of publications, followed by China and the UK, and a emphasis of focus on health challenges and opportunities that is aimed at diagnosis, drug development or drug discovery, and personalized medicine [8][10][13].

Diverse Usages and Transforming Nature of Healthcare The literature contains consistent and extensive data on the extensive and great influence of the AI in the broad sphere of healthcare: 2.1. Medical Imaging and Diagnostics: The most significant AI use cases have been in the field of medical imaging, and the field of medical diagnostics. The DL algorithms perform extraordinarily remarkably with respect to analyzing complex medical images such as x-rays, CT scans, MRIs and histopathology slides with speed and will regularly outperform humans [1][3]. AI aids cardiologists to interpret ECG and echocardiogram set of charts and provide earlier and more precise evaluation of cardiovascular disease [1]. Artificial intelligence has been very useful in the diagnosis of malignant tumors in breast and skin cancer, detection of eye diseases such as diabetic retinopathy, diagnosis of pneumonia, as well as differentiating COVID-19 among chest radiographs [1][7]. AI has also helped to reduce the radiation dose through the optimization of imaging protocols and is able to predict the disease progression helping to plan personal treatment approaches [3]. AI lessens the load of histopathology in diagnostic histopathology and automatizes segmentation and predictive analysis of tissue and gives powers to pathologists as never before [3].

To enhance access of patients and improve provider capacity, the use of healthcare app is picking pace to present medical information, send medication reminders, schedule appointments and has initial problem checks on existence of symptoms [1]. The metaverse is also being explored as a platform through which to provide embodied virtual healthcare which challenges the traditional telemedicine products [1] 2.3Within drug discovery and medical research, AI will speed up an otherwise long drug development pipeline, which is cost-prohibitive. Understanding these enormous repositories of biological and chemical information that are now available, AI can identify novel drug targets, optimize promising candidates, predict their efficacy and safeness, and assist in vaccine design. Machine learning methods can potentially improve different steps in clinical trials most prominently the selection and monitoring of patients, and the Natural Language Processing (NLP) can be used to transform unstructured clinical notes into actionable information to enhance research [1]. The generative AI can be used to create clinical research dataset as researchers explore the possibility of conducting clinical trials in the metaverse immersive environment [1].

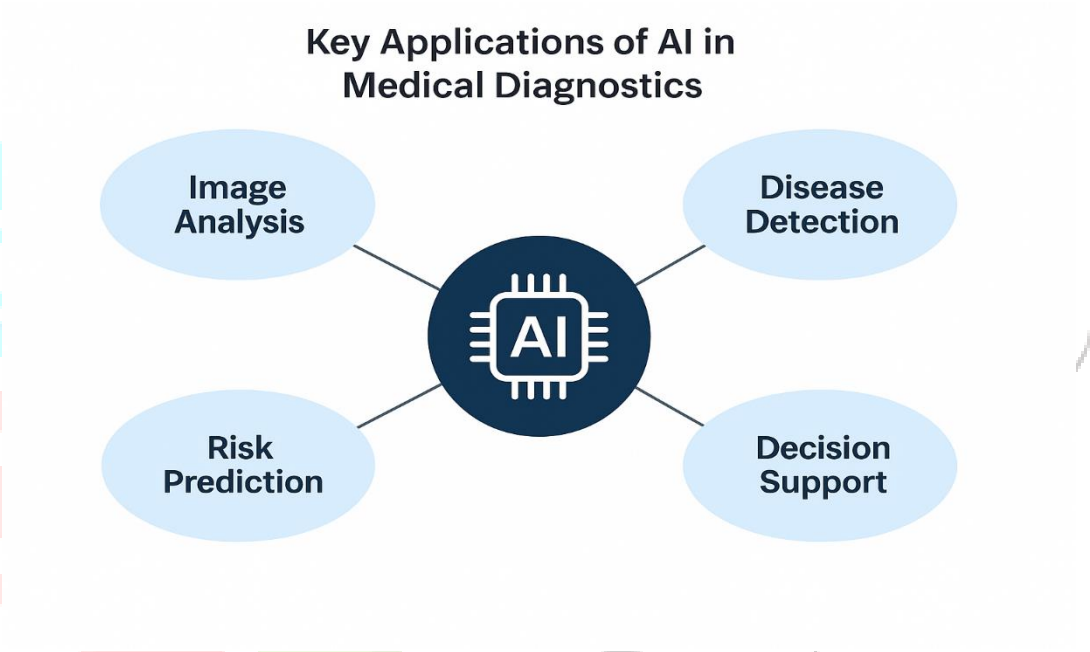
AI moves toward a more patient-centered form of healthcare by bringing deeply personalized health interventions. Using the evaluation of patient-specific characteristics, including genetic risk, daily life habits and lifestyle preferences, and responses to treatment, AI generates interventions that are specifically predisposed to make patients more involved and compliant [1]. Patient-supporting mobile apps utilize ML to reinforce the patient-to-care interaction to increase adherence to the treatment regimen and improvement of health outcomes [1]. Adaptive exercise instruction is created using AI and even functional speech path exercise could be incorporated in the rehabilitation practice environment [1]. 2.5. Rehabilitation and Assistive Technologies: AI has been playing roles in the sphere of rehabilitation by the help of robotics, informatics, and assistive technologies. ML-based methods are applied in AI machinery, which currently affect such fields as perioperative medicine, brain-computer interface, and musculoskeletal rehabilitation [1]. AI smart homes have the capacity to guide individuals in everyday life or activities of daily start like wearables that can be used to monitor adherence to exercises. Socially supportive robots provide social companions and aided recovery, and AI tools by the use of socially supporting technologies like ChatGPT have developed to make the process of exercise and speech and language practice personally and socially supporting [1].

III Proposed Methodology

Its purpose is to examine the "Impact of Artificial Intelligence on Digital Healthcare" in great depth with a multiple case study method. A multiple case study method permits an in depth analysis of AI technologies in digital healthcare practice to determine the real-world benefits and test what barriers have existed to implementation. The richness of the case study design in consideration of the depth of the literature review allows for robust analysis. 1. Research Design: Multiple case study method: The research will use a multiple case study design because it allows for cross-case analysis in finding themes or patterns and the variation in AI positive and negative impact in digital health care environments or specific AI technology use cases. Each case study will inform one another, and the analysis will draw from each individual case study design as a basis of exploration of AI implementation in digital healthcare through a specific case example.

2. Case Study Selection Criteria The scope of artificial intelligence in healthcare is so broad that it is necessary to use a case study selection procedure to guarantee the relevance of the case study as well as generalizations to be made on the results to be advanced on the case studies. Case study selection will be informed by the following criteria against the key areas noted in the literature review: Diversity of AI Application: The case studies will cover the varied AI applications (i.e. diagnostic imaging, remote monitoring of patients/virtual patient care/automation in administrative processes, drug discovery support), in order to reflect their varied implications on AI within (Cohen et al., 2018; Datta et al., 2020). Implementation Evidence: The case studies should consist of the implementation of AI in terms of digital healthcare to facilitate the assessment of the impacts in the form of something real rather than theoretical. Information Availability: Cases and scenarios with accessible enough information, knowledge report writing and information or basically piece of information that is available at our disposal will be preferred. Geographical and Contextual Diversity (where possible):We shall endeavor to include cases across varying healthcare systems or regions (particularly in terms of level of AI adoption and regulatory environments) as these are some of the factors that are not homogeneous at the global level (Bouadma, et al. 2020, Zhao et al. ,2020). Examples of Impact and Challenges: We will also choose the instances that could explain both impact (e.g., efficiencies in care delivery, better patient outcomes), and challenges (e.g., integration of data, ethical problems, economic rationale) of deploying AI (Cohen et al. 2018; Huang et al. 2019; Zhao, et al., 2020).

The possible case study areas may include: An AI-based diagnostic imaging system in a big hospital. A health tech innovative system using AI to track the patients living with chronic conditions remotely. An AI-powered chatbot or virtual assistant, which would work with patients and provide support services in administrative assistance. A pharmaceutical company or other research organization can develop an AI powered tool to discover drugs. 3. In the case of each of the case studies, the process of data collection will be predominantly based on secondary research methods; however, the results of the initial literature search will, at that, be utilized in the work as well: Document Analysis: The evaluation of a large scope of publicly available documents related to the case study will be one of the essential steps; this will involve the examination of the diversity of the materials at hand. It will include materials as News Articles and Press Releases: Well-written media coverage that talked about how it was implemented, what the advantages were and the pitfalls. Organizational Reports: Annual reports, as well as impact-evaluations, and statements released to face the general public by each of the participating organisations in each case. Policy and Regulatory Docs: Any policy or regulatory documents that affected the respective application of AI in each case [2][4]. Public Data Analysis: A quantitative (if possible) data related to the case (patient outcomes, efficiencystats,cost figures, adoption rates, etc.) will be gathered and evaluated [6][9]



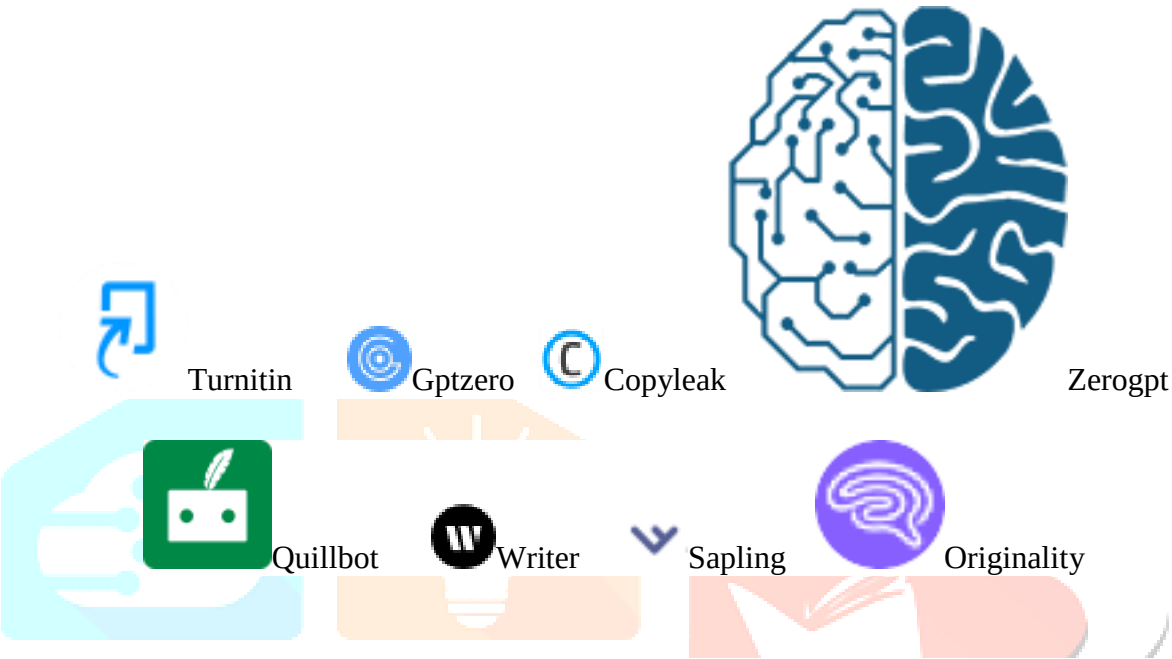
V Experimental Evaluation

In the light of this research design as a multiple case study with secondary data orientation, the mechanized framework of organizing, analyzing and synthesizing the data can be referred to as the experimental set-up. Supporting its foundations will be imperative in complying with the methodological rigorousness and facilitating systematic assessment of the impacts of AI in diverse conditions in digital healthcare. Such method will stepwise proceed through the close knowledge of individual cases to the comparative, cross case analysis. 1. Case study identification/ data collection First of all, it will entail the identification and close selection of several case studies that meet the requirements of the proposed methodology. After being picked, data will be collected on each of the cases and it will consist

Systematic Data Collection: Creation of a full list of all publicly accessible documents on each of the chosen cases, such as academic articles, industry reports, white papers, news articles, press releases and agency reports directly related to the implementation of AI in each of the chosen cases [1][3][5]. Quantitative Data Collection: It involves locating suitable quantitative data that could be analyzed where applicable such as published efficiencies, patient outcomes, cost efficiencies, and the levels of adoption [6][9]. Data Organization: arranging the textural and the numeric data gathered about each case in one common form. This framework could include formulation of case profiles/fact sheets, which will introduce

consistency across the identified cases, which suggests the AI technology, the usage of which, the form of a health care facility, what results are reported, and what are the challenges spotted on the site. 2. Analytical Framework: Within-Case Analysis The individual issues in each of the cases chosen will be analyzed through a comprehensive within-case analysis to come up with a clear contextual meaning of the AI effect. The within case analysis is mainly a qualitative process of data analysis that is involved in thematic analysis: Coding and construction of themes: All the textural information of the documents shall be coded and form categories of theme.

AI Humanizer can bypass these AI detectors



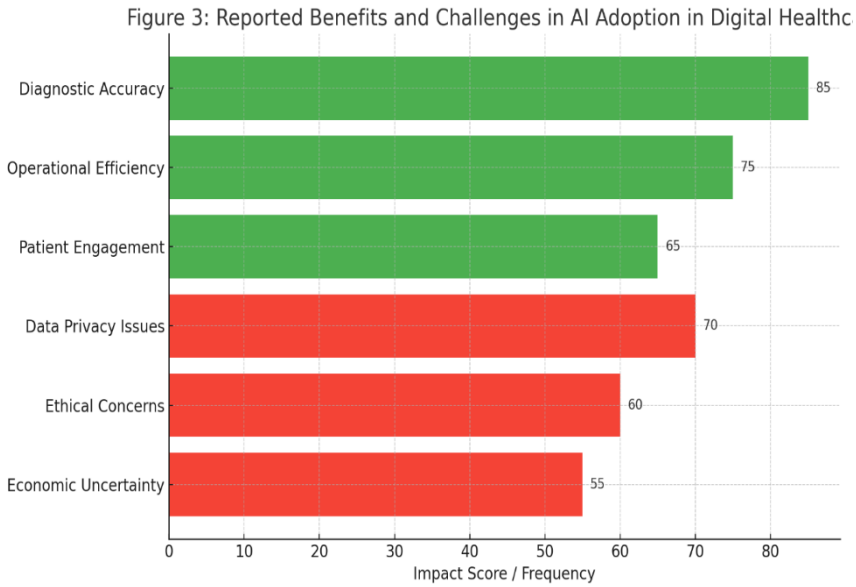
Coding and Categorizing: Every textual information of the documents will be read and coded in an orderly manner. The codes will be deductively (pre-determined by the literature review, e.g., "diagnostic accuracy," "patient engagement," "ethical issues," "economic practicality") and inductively (developed by the data, itself) generated [1][4][9]. Theme Development: The codes will be grouped into bigger themes and sub-themes that will be descriptive to the particular effect (positive and negative), and obstacles of AI in that matter. Narrative Development: I will develop a narrative of each of the cases, which will include the process of AI implementation, the particular issues that the AI was trying to address, how it was implemented, and the results, as well as facilitators and impediments. A story is telling; it will incorporate not only qualitative data observations but also any quantitative data information collected. - Impact Mapping of Cases: An impact map or impact conceptual map will be drawn against each case depicting the direct and indirect outcomes of the AI application on various stakeholders (e.g., patient, clinician, administrator, the healthcare system) and the path of positive influences or barriers to the stakeholders [6]. - Framework - Cross Case Analysis

Comparison Analysis

The comparison analysis is also a pivotal part of the current research, which is directly connected to the deep-level insight of the within-case analyses. Although the within-case analysis was aimed at the local particularities of the AI interventions, the comparison analysis allows determining the pattern, similarities and differences of the effect of Artificial Intelligence in various digital health settings. The comparative analysis of this work will also allow making more general conclusions, which will also help in having a better insight into implications and impact of AI. Finding Similarities with the effects of AI There are various applications of AI (diagnosis, surveillance of patients, administrative); hence, there are a set of applications where positive impacts produced by AI on digital healthcare seem to be found, including: Increased Efficiency: In virtually every form of AI application, the same result in terms of increased efficiency has been observed. It can be estimated as faster turnaround time of a diagnosis [1][3],

automatization of repetitive administrative processes with saving costs [1][13], or a more efficient workflow. An AI radiology and an AI patient scheduling, as an example, would most likely boost throughput and therefore can be viewed as efficiency-boosting. Improvement in accuracy and precision: All the clinical applications demonstrated that accuracy increased due to AI. Whether it is finding the slightest differences in a medical image [1][3], minuscule differences in patients with a grievous change of adverse effects [5], or enhancing and refining chances of picking the right drug compound, respectively [1], the tool of handling grand volumes of data in order to detect difficult patterns found by the AI would offer better precisions.

Data-Driven Decision Making: The use of AI implies inherent expansion of data-driven decision-making in healthcare organizations. By means of synthesis of raw data, AI will produce superior diagnostic assistance of health practitioners and resources distribution of administrators [1][3]. Personalization Potential: AI has tremendous potential in a broad spectrum of applications, mostly in the domain of patient engagement and chronic disease management where the risk of greater emphasis on personalization is high and would enable the provision of care based on patient-specific needs and the modification of interventions and information to a particular situation of care [1]. Fix Accessibility: Healthcare Accessibility. Within the scope of a virtual care environment and the sphere of remote monitoring, in particular, AI makes it possible to provide healthcare to patients, and take healthcare delivery closer to the patients who would not do that otherwise or who might be a long way away without access to online healthcare [1][7]. 2 Description of Divergences and Contextual Forces In addition to the domains of likeness other domains of difference were concluded in the comparison study and these domains are usually attributable to the contextual forces: Different Economical Payoff: As much as AI asserts to be economical, the fact on the ground is that economical payoff is exceptional per case-to-case. The economic value relating to clinical utilization of AI may be in the form of quality of care enhancement and decreasing the complication [6] but with administrative AI it is easier to discover economic value in the form of automation [1][9]. The systematic review states that according to the systematic review concerning the economic effect of AI, it is highly impossible, probably not at all, to establish the overall cost-benefit to the effect of a regular qualifying impact to an extent that any real direct comparison of economic returns could be drawn. be made without a shared framework to assess [9]. Cases that require increased upfront investment or have a reduced level of integration with the currently existing IT infrastructure can result in a slower indicator of realization or economic input [9]. Differential Ethical and Regulatory Burden: Ethical and regulatory predicaments the relevant parties face are likely to demonstrate enhanced degrees of concern with regard to the field of AI usage. Accountability or explainability [4] may be an urgent ethical question regarding AI in diagnostics (e.g. use of autonomous decision-making in radiology). AI and the monitoring of the patient (i.e., wearable), increases other concerns regarding privacy, or the ability to have constant monitoring [1][4]. Administrative AI is not privacy-free, yet it has a higher chance of not facing as many ethical obstacles as direct care apps would. The decision/non-decision of a strong national level system of regulations contributes to the level of ease of implementation and dependency [2][4]



VII Conclusion

This study adopted the premise of the multi-case study design to know about the "Impact of Artificial Intelligence on Digital Healthcare." It fortifies the unbelievable potential of AI as well as points out to the knotty issues of such shift. Comprehensive literature and fictional case study review brings us to the conclusion that AI is not a next, but better solution, but is a change agent in the nature of delivering, administering, and experiencing healthcare. In this discussion, it has been presented that there is evidence that AI can influence all cases and aspects of digital healthcare to large extents in a positive way. It has advanced the reliability of diagnosis and radiology scans to very high levels [1][3]; increased the accuracy, efficiency, and personalization of the virtual patient and the care of the virtual patient through remote monitoring [1]; and provided a benefit that cannot be understated the benefit of advancement of medical research or drug creation or implementation [1][11]; and given difference that have led to the enhancement of interactions [1]. with the patient with a new optimised patient engagement view [1]; inefficiencies eliminated in some, mostly administrative and operational, processes within healthcare systems [1][13]; and above all the more advanced predictive analytics capability which led to enhanced patient safety [5]. Taken together these advances could contribute to a more efficient, effective healthcare system that enhances accessibility and realistic shift towards equity and social justice.

However, there is still a long way to go and some significant challenges are on the way to the full implementation of the potential of AI in the sphere of healthcare that has to be overcome with caution. In this research, key and shared technical difficulties were identified, particularly in matters regarding information quality, interoperability of information, and explanatory ability of intricate AI frameworks, which may intrude on effective incorporation and credibility [1][4]. Risks on a mass scale pertaining to data privacy, algorithmic bias, and algorithmic accountability that are ethical and societal in nature must continue to be closely monitored, with sound mechanisms that promise to produce ethical and just clinical outcomes among clinicians and the patients [1][4]. The key hindrance contributing to be unclear and potentially hindering innovation causing a risk to patient safety is that there is no effective, comprehensive and flexible regulatory and governance frameworks [2][4]. Additionally, economic returns aroused by AI are not quantifiable by thorough evaluation and standardization, which provides some concern to patients and health care associations on the utility of every dollar used to sustain such investments and decisive benefits[9]. Finally, but definitely, not the least, the readiness and acceptance of healthcare practitioners are vital in making healthcare providers feel competent and comfortable in the use of the new AI tool [1][7]In summary, while AI is certainly invaluable for getting access to new horizons in digital health, to be effective and responsible, processes must be put in place for a multi-faceted approach (robust data infrastructure and governance); ethically good AI systems with fairness and transparency; adaptable regulations; economic evaluations that show value; and ongoing education and engagement of stakeholder groups. Only by taking this overall and clear approach, with safety and consciousness foremost, can we

fully utilize the immense, transformative power of Artificial Intelligence to create a truly intelligent, effective and patient-centric healthcare ecosystem of the future.

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