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I. INTRODUCTION

The economic growth of unindustrialized marketplaces along with the digital revolution fuelled by the development of Artificial Intelligence (AI), biotechnology, neurotechnologies, cloud computing and others are currently transforming the delivery of health and social services (Ćwiklicki et al., 2020). Despite the fact that the emerging world lingers behind when it comes to an effective digital revolution, giving magnificent primary care underscore Bates & Bitton (2010), is vital to the conveyance of excellent clinical consideration of the populations. Perhaps the main current characteristic is that robots work as human substitutes in a wide scope of businesses, not just medical services. Updating digital business ideas is adaptable, loaded with innovations and investigations (Antoniuk et al., 2017).

The genuine story here is that the future will be better. Technology will progress and there will consistently be new and energizing arrangements. Caution to make is that, technology is and will remain a multi-facets tool designed to improve efficiency and effectiveness in our lives (Thielst, 2007). Today, Robotic Process Automation (RPA) has been received in numerous walks of our lives and things continue to improve while other technologies get invented and or adopted. We have keen choice guides to improve finding that speak specifically to our realities in the emerging markets, and they will just improve. A few groups would highlight the hidden drivers: technology is getting quicker, better and more modest. Is this the response to our expectations? Moore's Law says the speed of innovation is on steroids. Are the emerging markets keeping up with this speed?

While many questions fuelled our minds, it is safe to agree that healthcare offerings present multiple choices because of technological breakthroughs. Future innovation will continue to change healthcare while advancements such as new medications and medicines, new gadgets, new online media support for healthcare, and so on will drive innovation (Thimbleby, 2013). This is

on the grounds that the forward energy in the developing circle of computerized medication has opened up new universes of revelation that all circuit together to shape a tidal wave of innovation, alongside sociological and social changes. The dramatic pace of technological change makes significant sociological changes and these elements influence the clinical field (Lotem & Shani, 2018).

These days like never before, the developing countries are just beginning to redesign the digital economy. Notwithstanding this reality, it colossally affects the improvement of business and economies during late years. Also, digital transformations and quick principal changes in medical care are among prevailing aspects of the Fourth Industrial Revolution (4IR) of the 21th century (Antoniuk et al., 2017). The straightforward story underscores Thimbleby (2013) is we will simply appreciate the ride. Notwithstanding, the more intricate story uncovered compromises. For instance, 4IR technologies are surely a lot quicker, however to exploit them, we initially have to discard the more slow legacy systems adopted and implemented as an interim solution to digital transformation without any scalability so they can be supplanted, and afterward we may well find the patient data on the legacy platforms will not work on the new ones. However, the above can constitute the topic of investigation for other projects.

Reality of the ground is that every healthcare system in the emerging market is not the same and the dynamics that govern the adoption of technologies in that industry are also complex, but they blindly share the same problems due chiefly to the process of diffusion of innovation. This process is understood as the acknowledgment over the long haul of some particular thing - a thought or practice by people, gatherings or other embracing units, connected to explicit channels of correspondence, to a social design and to a given arrangement of qualities, or culture (Cain et al., 2002; Kaminski, 2011; Katz et al., 1963). In simple terms, the diffusion of innovation in this paper refers to the plethora of issues identified across the board in the healthcare industry through the lenses of 4IR technologies in the emerging market.

The problem above the threshold of countless issues is that the emerging world continues to face various health challenges exacerbated by environmental change, legacy medical care frameworks, restricted medical infrastructures, and an absence of qualified medical experts. Looking through the precious stone of capacities in which 4IR technologies can be transformational, this paper is a brief on how essential medical care at the family level and the degree of first contact with drug stores, crisis paramedics and general specialists could be improved in the emerging world. It suggests a practical solution as its contribution to the body of knowledge.

Despite the fact that literature speaks about healthcare to be one of the prime developing afflictions of an economy, governments are still facing severe issues to prioritise healthcare in their programmes notwithstanding expanding levels of sickness and medical conditions as the populace keeps on developing. Imaginably, the best activities being executed in one form or another today are home medical services (Alaiad & Zhou, 2014). It is within our scope that we feel constraint to state the following – *"the current state of home and community healthcare in the merging world is still evolving and it is difficult at this point in time to determine on which stage of the diffusion of innovation many states found themselves as some contemplations continue to be reviewed*".

Nevertheless, a few nations move past existing patterns because of their speed of reception. Accordingly, there are changes in their medical services industry or area. Specifically, new types of working together, including cloud computing frameworks and RPA, and collaboration with innovative monsters like Microsoft, IBM, Oracle, General Electric, Siemens and various partners continue to grow and be created. There are new sorts of services through Internet of things, better approaches for utilisation and commercialisation of the current services into computerized checking

and control framework advancements in addition to other related considerations.

II. SIGNIFICANCE OF THE TOPIC

Numerous variables in our general public proceed to drive and change the scene of our daily lives in different ranges of healthcare, however technology drives healthcare more than some other power, and later on it will keep on creating dramatically. The author stays wary that extrapolation of latest things is a helpless method to consider the future, especially on occasion of incredible change like this. He remains confident in the power of technology in dictating the rules of the game in driving our daily lives.

The current preoccupation with technology shifting and innovation accelerating focus on improving health and healthcare value for patients. Should there be any best technique to anticipate what is to come? Would it be advisable for us to concur with one or a gathering of not many incredible personalities to the cost of others? Or on the other hand ought to rather believe in the power of data exploited by a group of people with interest in the subject? While we can joyfully express and discuss the subtleties of future patterns in healthcare explicitly in the developing countries, we should be clear about the drivers born with the 4IR so we can line up with them and effectively work to guarantee the best results for society in general.

The adoption of various technologies in healthcare around the globe has resulted in an improved determination to develop platforms, both at the hardware level as well as the core software level (Qadri et al., 2020). While the emerging markets set up the major growth opportunity in the progressing world economic order (Arnold & Quelch, 1998), this topic in regard with the pressure brought by 4IR technologies stands as a call to leaders of these markets. It can be an introduction and or a review of available literature to capacity building in light of the nearest future of healthcare through 4IR technologies in the emerging markets.

III. BACKGROUND : TRANSFORMATION IN HEALTHCARE

Albeit each healthcare framework is unique, no healthcare framework on the planet is steady, and every leader of the digital age would agree with the author that all frameworks would go through impressive change in the next decade or beyond because of the speed of digital transformation. It is important however to state that the drivers of progress in the developed world are arriving at the constraints of the government assistance state, debilitating customary techniques and devices for containing cost, and encountering expanded shopper refinement and requests. Change is being driven in the emerging markets by the development of the working class, more noteworthy requests from that working class, and the globalization of economies as these nations are more presented to what the industrialised world has to bring to the table and experience more prominent rivalry and economic pressing factor inside their own economies (Smith, 1997).

Recent studies show the far-reaching integration of 4IR technologies in healthcare leading to a architype shift in all capacities of human-machine interactions (Qadri et al., 2020). While the combination of physical, computerized and organic universes depicts 4IR, its technologies have decidedly impacted uncommon changes in the medical care industry to date. These progressions are observable and are embodied in various circles (Diño & Ong, 2019). The 4IR has risen up out of a popular expression to turn into a basic spine of progress in the developing business sectors. It has empowered answers to mitigate dangers of cracked medical care frameworks to assemble economical medical care for all.

Arrangements range from guaranteeing that patients skip lines in emergency clinics, set aside cash as everything is conveyed at the force of fingers, infection anticipation and successful homecare conveyance through on request benefits. Along with its technologies, 4IR addresses also long-term clinical consideration necessities at huge lower uses in walking settings or patients' homes by Information and Communication Technology (ICT) applications

(Haluza & Jungwirth, 2015). Together with the spread of 4IR technologies, these solutions have empowered the emerging world with access to healthcare for populations.

The fundamental empowering technologies upheld by a few new technologies incorporate the correspondence frameworks between the detecting hubs and the processors; and the preparing calculations powered by algorithms for creating a yield from the data gathered by the sensors (Qadri et al., 2020). While the big data permits dealing with a tremendous measure of data, the Software Defined Networks (SDNs) carry adaptability to the new framework of healthcare in the industrialised world (Lotem & Shani, 2018). In addition, the blockchains technologies brought in the game are tracking down the most novel use cases of the 21st century coupled with the internet of things (IoT) in healthcare (Diño & Ong, 2019).

Through all accessible technologies on the commercial centre, patients are currently utilizing the internet and different technologies just as individual patients to analyse their own issues, track down the best treatment, and constantly enhance their medicines, and even asset and direct exploration. They are doing this not with gratitude to, yet in spite of, medical care (Riggare, 2018). Albeit the clinical culture is comparable, there have been sensational innovative changes, and really these progressions would be difficult to clarify. The “E” utility of 4IR technologies is now leading the transition of traditional healthcare to modern E-health capabilities. The use of Artificial Intelligence has contributed to accelerating E-health systems at almost every level.

What should the new healthcare resemble? We don't know without a doubt, yet 20 years prior, Tom Ferguson, a health informatics professor, contended that doctors and other healthcare professionals should accept the endeavours of dynamic patients. He said that conceding patients' desires for more online correspondence with their doctors could lessen conference times. He begat the expression "E-patients" to mean patients or their companions or family members who look for health related data online, which brings about "better health data and administrations, and extraordinary (however not in every case better) associations with their doctors (Ferguson & Frydman, 2004; Riggare, 2018).

While for some residents of most developed nations, the internet has become an incredible and natural healthcare instrument (Ferguson & Frydman, 2004), for several emerging markets in 2021, the internet is still a luxury and the cost of internet access for poor communities and rural areas is still above the common threshold. However, with the quick development of online long range interpersonal communication for health, healthcare frameworks are encountering an inevitable expansion in intricacy (Griffiths et al., 2012). Today notwithstanding, experience-based plan can emphatically add to the healthcare encounters of patients and their families on the worldwide scale. What this developing space of exploration has featured is a more extensive change in healthcare advancement, which is progressively about planning with patients and not just for them (Reay et al., 2017).

In any case, patients are utilizing person to person communication to get to and contribute health data and they are the reason for healthcare (Thimbleby, 2013). Systems administration among health care supplier organisations is empowering more prominent misuse of health data for health care positioning. The foundations of communication are likewise evolving. Patient–specialist experiences are presently more penetrable to impact from informal communities and professional organisations (Griffiths et al., 2012). The high-minded triangle have uplifted freedoms for data social occasion and examination for more focused on and successful admittance to healthcare methodologies in the developed world so it is occurring in the developing markets.

IV. 4IR TECHNOLOGIES FACTORS

As seen through the ground-breaking force of remote and portable technologies under 4IR technologies, the accompanying table typifies arrangements tried and embraced with the goal of improving clinical data and healthcare administration conveyance in the arising scene.

The emerging markets have in the contemporary years incorporated a growing number of ingenuities that aim to address complex healthcare needs and challenges through 'innovation'.

While many of these ingenuities take the form of a 'national endeavour', they are in many cases also a collaborative platform committed to the growth of social innovation through investigation, scrutiny and rapid experimentation (Reay et al., 2017). The table below is a condensed example of the ingenuities embraced by some emerging markets.

Table 1: Powered 4IR solutions in the emerging markets

4IR Technologies	Solution in Practice	Specific Place
Cloud Computing (Wireless Communication)	• Mtrac - a real-time monitoring of disease prevalence, medicine stock-outs and health service delivery complaints • Khon Kaen Smart Health - incorporates a smart ambulance service that uses GPS to coordinate patient pick-up, coupled with real-time video and data transmission to prep the hospital ahead of patient delivery.	• Public healthcare workers of Uganda • Thailand
Technology and process optimization (Robotic)	• Incorporation of drones into health care system, using autonomous air vehicles (flying Robot) to deliver blood transfusions to remote regions.	• Rwanda
Artificial Intelligence	• Slowly implementation to help medical professionals correctly diagnose cervical cancer and other abnormalities • To determine the optimal methods for eradicating malaria in specific locations and using game theory and deep learning data analytics to diagnose pathological diseases and birth asphyxia	• Ethiopia • IBM Africa
Big data/IOT	• The Rwandan Health Management Information System: Improving Collection and Management of Health Service Data to Support Informed Decision • Brazil Health Data - point of collaboration and use of structured data combined with Artificial Intelligence and Predictive Analysis to alleviate the suffering of the people	• Rwanda • Brazil
Digitalisation	• Adoption of digital health systems to improve hospital administration and patient care • Khon Kaen Smart Health - It also includes a sensor platform that monitors the activity and condition, including the blood pressure and sugar levels, of elderly residents with chronic diseases, enabling them to remain at home. The data is then integrated with the patient's EHR information	• Kenya, Rwanda, Morocco • Thailand

V. ELUCIDATIONS

The investigation of healthcare frameworks in the industrialised countries by and large spotlights on three significant sorts: the Beveridge framework where the state is essentially engaged with healthcare financing and arrangement, the Bismarck model which depends on friendly protection and capacities inside a corporatist state, and the market-ruled framework where private protection plays a significant role. Healthcare in the non-industrial or emerging nations, be that as it may, do not typically fall perfectly into any of these three significant sorts. Most are described by an enormous private, here and there casual, supplier area because of the

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deficiency of state healthcare; and financing is regularly from cash on hand (Chee, 2008). The following paragraphs highpoint a non-exhaustive list of contemplations coupled with some solutions in the emerging markets when it comes to healthcare.

5.1 Definition of an Emerging market

While there is no universally accepted definition of an emerging market (Arnold & Quelch, 1998), the scope of this paper in looking to the future of healthcare in these particular markets forces the researcher to clarify this keyword in context of this exploration. Additionally, the internet search of the concept provides a rich heave of definitions as its definition is somewhat up for debate (Frick et al., 2019; Michas, 2011). The above in context is true as there are over 150 emerging markets according to the International Monetary Fund (IMF). The researcher has since compiled the following definitions to fit the purpose of this paper.

- Emerging economy is the market of a developing economy that is becoming more involved with global markets as it grows (Scott, 2020);
- Emerging market is a market moving away from its traditional economy that depended heavily on agriculture and the export of raw materials (Amadeo & Eric Estevez, 2020).
- Emerging markets (or EME, for the emerging market economy) are economies of nations that are in the transition of becoming an industrialized nation state and characteristically are moving toward mixed or free markets(Sraders, 2018).

For the sake of this paper and for future reference, emerging markets are defined as nation states that are transitioning from the "unindustrialized" stage to the "technologically advanced" phase with substantial economic growth and hold some characteristics of an industrialized nation. The five most well-known emerging economies are: Brazil, Russia, India, China and South Africa. The five countries are coined under the acronym of 'BRICS'.

5.2 Healthcare through the Connected Patient

Digitalization and 4IR technologies applied to healthcare in the industrialised nations has generated one of the most dynamic and competitive markets within medical technology. This has not stopped there as the emerging markets all azimuth have in return emulated the same capabilities here and there to respond effectively to this trend. This dynamic however has drastically changed the face of healthcare and can be described or explained through the diffusion of innovations by Rogers in both, the developed and developing markets in the upcoming study.

The connected patient will be in other terms an acceptable form of healthcare that might operate within any healthcare frameworks in the future (Reay et al., 2017). With a tipping point of Cloud Computing adoption and the early stages of Artificial Intelligence (AI) driven analytics for diagnosis in the emerging markets, patients will have access to insights and will be capable of controlling their own health with less consultations to the professionals. As the above scenario takes a visible shape in many countries, the emerging markets will by that time reach a full radical interoperable data stage. What this paper means by "radically interoperable data" is the stage of the next decade or two where "collection and convenience of a multiplicity of data sources and data sets from different aspects of a consumer's life and that they are willing and able to share that data like financial status, behavioural health status, health status, their environment and activity, and could be paired up with data that describes more fully what's going on with weather and population health," (Siwicki, 2019).

An illustration of the above can be described in detail with Discovery health in South Africa tapping into the digital bank through connected devices to reward healthcare and financial behaviours with the assistance of the virtuous triangle of the 4IR technologies notably – Big data, Internet of Things (IoT) and AI to some extent. The connected patient is stimulated to comply, eat and live healthy and will be rewarded

in the trade off of his data. This alone has significantly reduced patient visits to health professionals in recent years in South Africa. This example prompts however the radically interoperable data (Information age healthcare) stage in the emerging markets where healthcare practitioners and professionals will be regarded as the support to a healthcare framework that focuses on self-care of patients to the detriment of the traditional Industrial age of healthcare.

Figure 1 below shows how "information age healthcare" inverts the traditional pyramid of "industrial age medicine." Healthcare providers will headway in this stage from treatment of disease to stimulating health, and they will do this over and done with lifetime plans that are built on intimate and detailed knowledge of patients (Smith, 1997). The patient in return will only ask the right questions when deemed necessary.

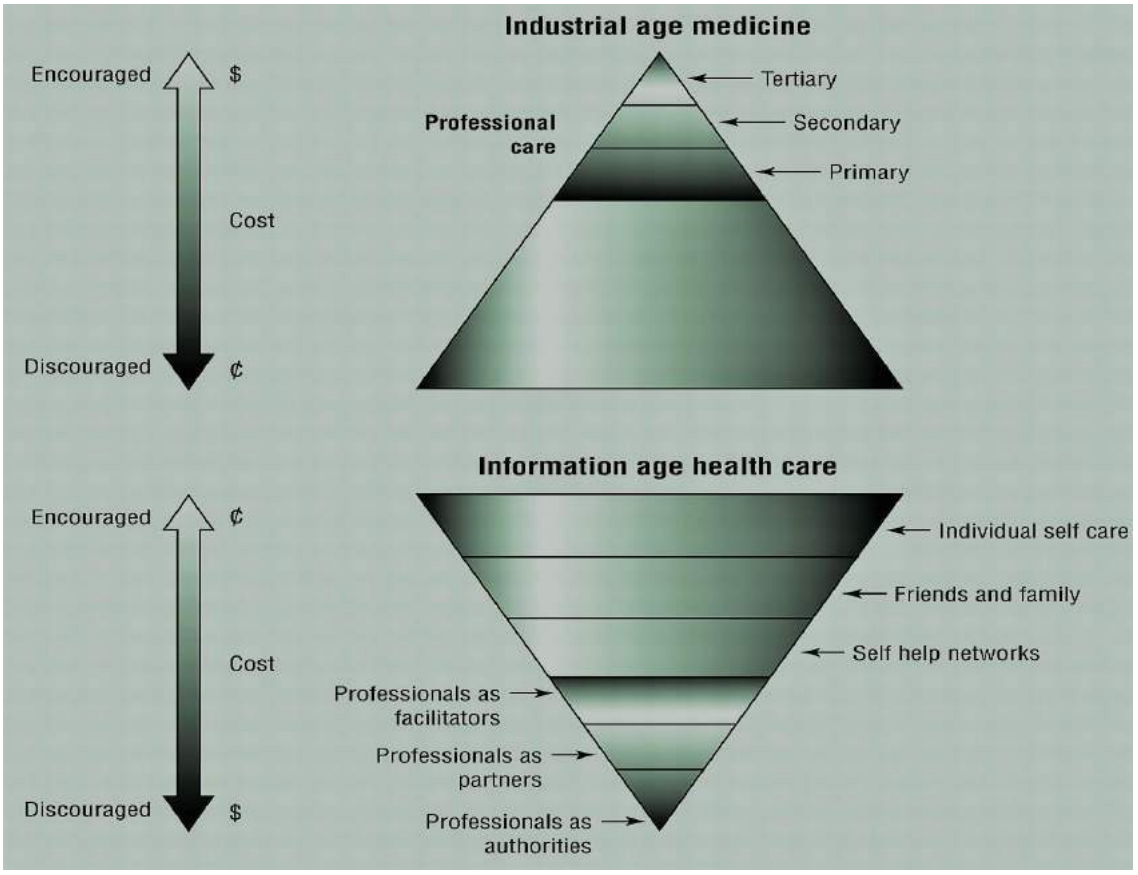

Figure 1: How "industrial age medicine" will invert to become "information age healthcare (source: (Smith, 1997))

5.3 Healthcare through Cloud Computing and others technologies

Considering the degree escaped in this paper, unquestionably, the 4IR presents basic freedoms similarly as troubles for the healthcare industry in the developing markets. Since finding person's clinical records can be troublesome in these nations, the digitization of clinical records and the headway of shrewd gadgets, among others, are not simply bringing practically better and seriously convincing healthcare arrangements, however moreover engage healthcare professionals to get to patients faster in the care of their families or through drug stores in their networks as well as with the aid of Robotic Process Automation (RPA) with the like of drones. This methodology is by all accounts bearing organic products in a few nations in the creating scene as an independent arrangement or through associations including a fast reception of the prudent triangle of 4IR Technologies.

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Talking about arrangements in this unique circumstance, distributed computing and mass appointment of phones in the emerging market stay the central members. Cloud computing here encompasses Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform-as-a-Service (PaaS), and Function as a Service (FaaS), with further consideration for deployment types such as private, public, and hybrid and community cloud.

Although the service providers of these deployments are GE Healthcare, CareCloud, Agfa HealthCare, Microsoft, Google, Amazon to name these few popular brands, the chance in the emerging markets however is for techpreneurs to create applications utilizing Amazon Web Services (AWS) that interface patients to impartial thusly more brilliant home clinical benefits on-request, at whatever point and anyplace required. Albeit the arrangement includes various layers of 4IR technologies at its centre, it works on cycles and business activities to improve healthcare conveyance.

Without drilling deeper into much details of the solution as the scope of this paper remains at the very higher level subject to a fleeting look; this application will alarms the healthcare providers through a dashboard in the emergency room that uses a blend of not many components comprehensive of the catchphrases and area to convey paramedics or reach out to the patient remotely. The solution is however called 4IR healthcare simply because cloud computing alone will not cater for all the requirements. Its deployment is often done at small scale outpatient facilities and clinics. Some RPA devices might be deployed in combination with others rich technologies to make a solution fit for purpose. On-request healthcare eases the weight of patients in far off networks to make a trip significant distances to look for clinical consideration from healthcare specialists regularly found in huge urban communities as it is seen in the developing markets to date. The theoretical structure underneath addresses the arrangement in the nutshell.

As a result for a sustainable healthcare in the emerging markets, “Upomyaji Nyumbani” healing at home in Swahili creates value for investors. Questions could arose to why a Swahili name for a proposed solution – simply because “Kiswahili is an official language of the African Union and the lingua franca in most of east Africa and parts of central and southern Africa”(Mlemwa, 2019). Likewise, Africa is a continent of emerging economies.

While many empirical studies introduced the future of healthcare in multiple forms and different technological considerations, the truth beyond this particular view of 4IR Healthcare is that the technologies associated in the mix hold the perspectives for boosting meagre medical resources in the emerging markets to guarantee both infection counteraction and more controlling medical services are executed in family units and communities at affordable cost for the general public. The shift is noticed in isolation case by case with the pace of adoption of innovation coupled with regulatory reforms required.

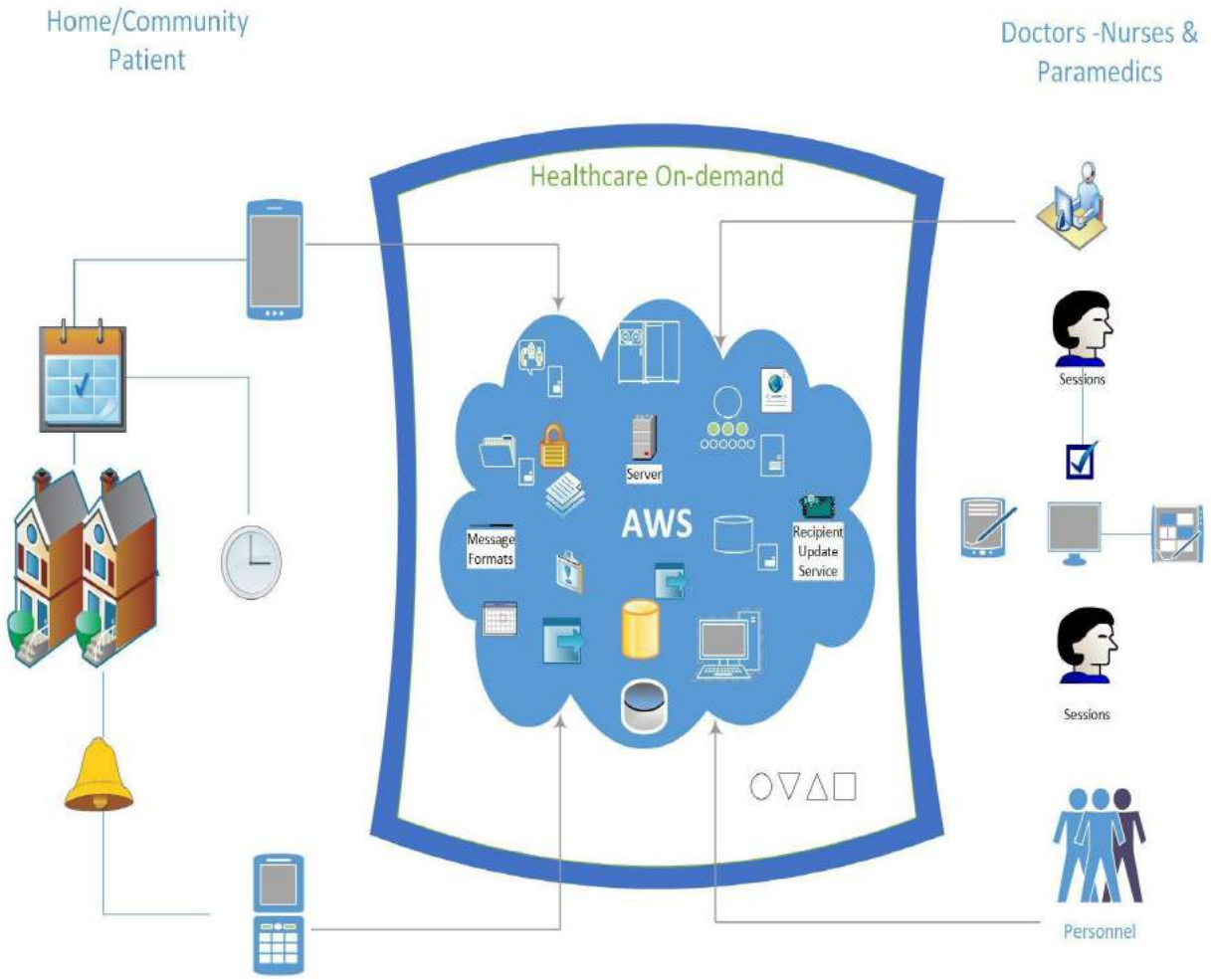

Figure 2: Conceptual framework of healthcare On-demand

5.4 Healthcare through Robotic Process Automation (RPA)

Recognised as a foundational 4IR technology because of its wide adoption and funding scale as 4IR at the moment, RPA is about enacting a process, which in essence is a sequence of activities and tasks that ultimately fulfil a certain goal or outcome (Armstrong & Lee, 2021). Unmanned Aerial Vehicles (UAVs), commonly known as drones, is regarded as a RPA solution in healthcare as an autonomous runner. The devices have been used for more than one to two decades over delivery of medical supplies in many emerging markets to date.

As new technology has the potential to accelerate access to decent healthcare, in emerging economies such as Rwanda and Ghana, partnerships developed by local governments with private companies like Zipline are currently operating drones that deliver much-needed medical supplies to rural hospitals (Kamnqa, 2021). Despite the fact that this 4IR technology has been widely argued and reported to change the delivery of healthcare; Madagascar, Malawi and Senegal were among a group of early adopters following the diffusion of innovation diagram by Rogers piloting the use of bi-directional transport drones for health systems in sub-Saharan Africa (Knoblauch et al., 2019).

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While many tongues argue the importance of deploying such 4IR technology in the emerging markets, the question that arises for this problem is how to optimize delivery of medical supplies times in-home healthcare made up of drones? A quick response in light of the future applications of drones in healthcare include delivering items such as blood samples, medications, vaccines, and organs, between healthcare institutions and directly to patients' homes (Cawthorne & Robbins-van Wynsberghe, 2020). Another question however is to know if it is safe to project a solution or a response into the future while the technology has been widely used and has even registered positive impact in the emerging markets?

It is therefore safe to state that beyond the debate on the robot ethics in light of various reflections to privacy, human rights and autonomy of the industry of healthcare, the developing countries have been at the core of many dilemmas due to poor or lack of political economy of healthcare (Braun et al., 2019). In addition, this flying device controlled remotely by a person or a computer known as a drone, has become real working tools, a big deal in the emerging markets beyond its own scope of exploration (Euchi, 2021). As "Rescue Robotics" outside of Kigali in Rwanda, drones now carry 35% of blood supplied for transfusion. In Ghana they are beginning to deliver COVID-19 testing materials (Baker, 2020). The technology is finding supporters in other emerging countries as well. India, a country with serious healthcare disparities, has also acknowledged the need for drone delivery solutions (Santhanam, 2020). This in essence bridges some of many serious gaps between the industrialised world and the emerging markets, as well as the distances often encounters by patients of major metropolitan centres and distant rural communities separated by unpractical roads and related enquiries(Braun et al., 2019)

If the future of healthcare is attached to any technology in the emerging markets, drones in that sector is a big deal and is drastically closing the gaps. While numbers remain astonishing and delivery and implementation of many initiatives through RPA /drones have been affected by the global pandemic of COVID-19, the digital future promises great success in healthcare through drones and other 4IR technologies. As underscored previously, RPA is widely funded and holds the potential for immediate adoption (Armstrong & Lee, 2021); below are some details in light of this technology in particular.

Table 2: The promising future of drones in prehospital medical care and its application to battlefield medicine (Source: (Braun et al., 2019))

	Zipline	DrOne	Matternet	Flirtey	Parcelcopter 4.0
Configuration	Fixed wing	Fixed wing	Quad Copter	Hexa Copter	Fixed wing tilt rotor
Maximal speed	128km/h	-	40km/h	-	140km/h
Range (single battery charge)	160km	100km	20km (1kg cargo)	32Km	65 Km
Cargo capacity	1,75Kg	2Kg	2,2Kg	2Kg	4Kg
Take-off	runway	VTOL	VTOL	VTOL	VTOL
Developers	Zipline and UPS	Drones for development	Matternet	Flirtey	Deutsche Post DHL

While literature suggests that the drone technology can be traced back to the 1800 and early 1900 for military operations; "This is in fact a medical Kitty Hawk moment" (Balasingam, 2017). The world is witnessing the rise of intelligent machines in many walks of life to date and healthcare is no longer immune to embrace the changes. Several predictions were made and some of them fade away for multiple reasons while some have seen the light at the end of tunnel as announced. According to Industry trend, Medical Drones Market size was valued at USD 88.2 million in 2018 and is expected to witness 24.7% CAGR from 2019 to 2025 (Ugalmugle, 2019).

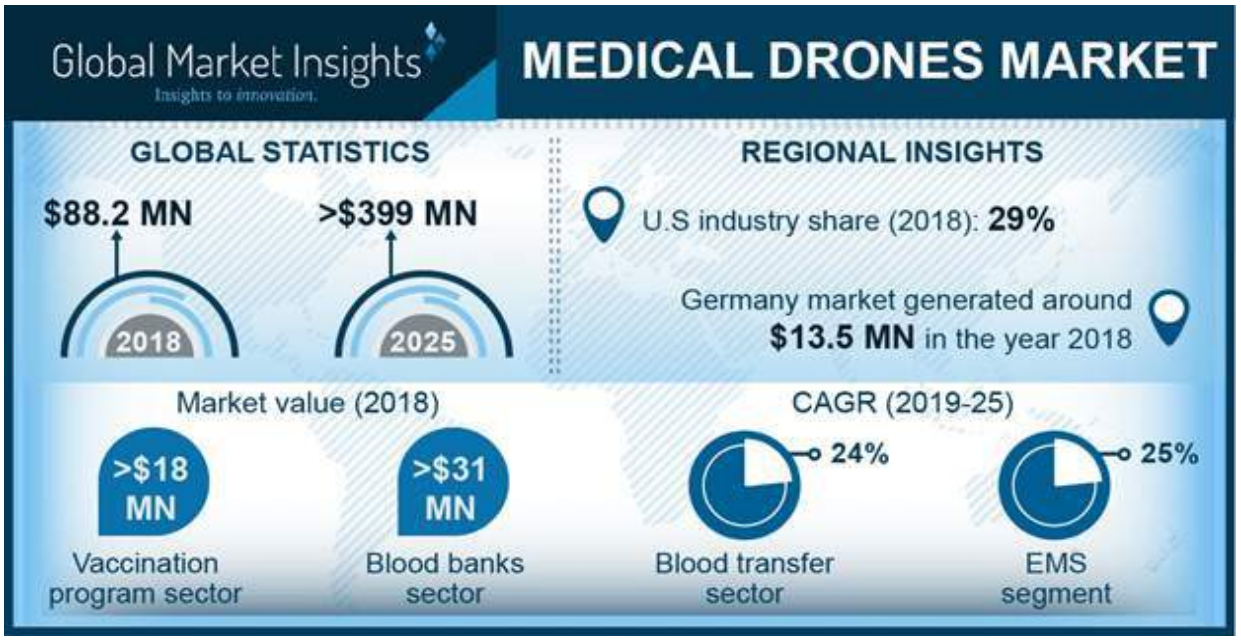

Figure 3: Global Market Insights (source : (Ugalmugle, 2019))

Many cases identified in the emerging markets to date can back up the above findings beyond detailed observation for the future of healthcare through the lenses of the 4IR technologies. RPA technology in particular has gone the extra mile to deliver beyond the scope of its deliverables in the healthcare industry both, in the developed and developing world.

5.5 Healthcare through Blockchain Technology

While Blockchain is understood to go beyond Bitcoin – the cryptocurrency that have faith in this technology and has been at the helm of its wide publicity (Mackey et al., 2019), many advocates including the author are quite certain of its potentials on the transformation of healthcare in the emerging markets. The technology provides decentralization, security and shareability features beyond the traditional databases. Blockchain constitutes a disruptive force that healthcare continues to build capacities upon (Rosalind, 2019). Its first major feature is that information is safeguarded in 'blocks' of data (Armstrong & Lee, 2021).

Though it has been hailed as a ground-breaking technology, the technology remains one of developing knowhow both uptight with unexpected challenges and the promise of unrealized perspective in healthcare (Ribitzky et al., 2018). "Blockchain is an advanced methodology for record keeping, a digital architecture, consisting of a shared, immutable ledger that can better ensure the resilience, provenance, traceability, and management of health data and capable of achieving better advantages over traditional databases"(Armstrong & Lee, 2021; Mackey et al., 2019). One cannot jump to the potential of blockchains to healthcare in the emerging markets without underlining a novice understanding of this disruptive technology.

Similar to cloud computing deployments, blockchain allows limit sharing and access to or allotment of data (Abdellatif et al., 2020). There are therefore, public blockchains such as cryptocurrency platforms and other analogous platforms where anyone can buy, sell, store and trade. There are also private blockchains where access is controlled and available to trusted and verified parties only, as well as permissioned blockchains which in simple terms can be described as hybrid blockchains. This blockchain has both private and public features and allows

multiple customizations. The technology has potentials to enable others technologies as well as acting like a backbone for others 4IR technologies such as cloud computing, artificial intelligence, e-Health and m-Health devices, applications, and to interface to a comprehensive Internet of Medical Things (Abdellatif et al., 2020; Brogan et al., 2018; Firdaus et al., 2018).

Many advocates will back up this technology in the emerging markets as many studies on its application in healthcare are available in the library of knowledge but few will stop one time and ask the right question to whether or not these nations have the means to sustain such technology. While the above might create an atmosphere of division between several parties, the possibility of seeing this adoption in the emerging markets remains plausible. Below are a few reviews that attracted our attention from the available literature.

Fusco et al., (2020) in their paper titled "*Blockchain in Healthcare: Insights on COVID-19*" stated that, the author directly quotes "The use of blockchain and its combination with artificial intelligence systems here "machine learning" allows the creation of a generalizable predictive system "Big data – Predictive analytics" that, included in the wider risk management process, could contribute decisively to the containment of pandemic risk on national territory". The argument drawn behind the use of predictive models is that the aftereffects of a continually refreshed predictive model, in view of data on and clinical information of patients, can specifically impact clinical practice as well as more for the most part the automatic strategies of hazard control at territorial and public levels (Fusco et al., 2020; Mackey et al., 2019; Ribitzky et al., 2018). Below are a few considerations for the emerging markets with the adoption or use of blockchain in the future of healthcare.

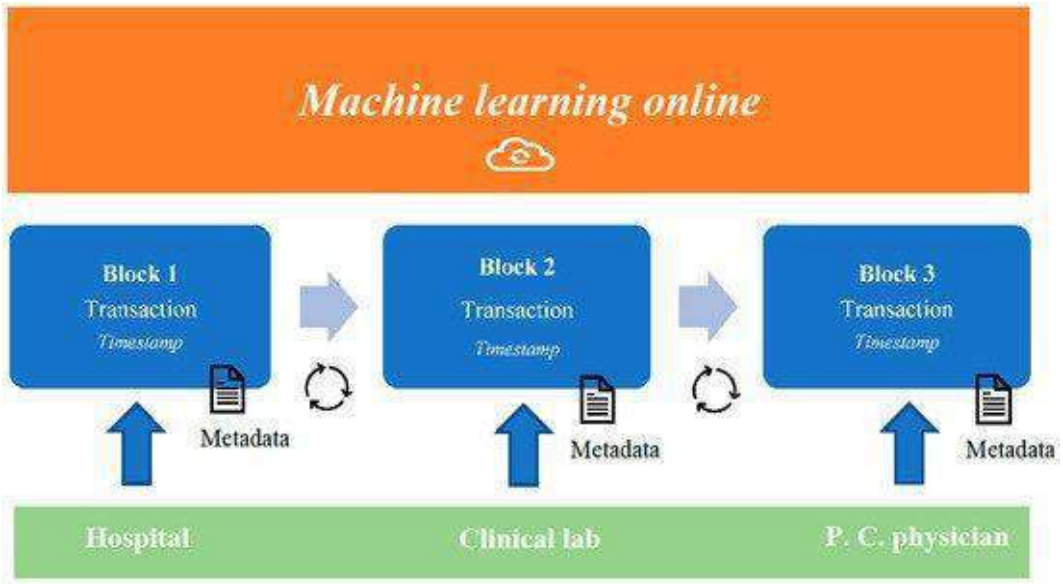

Figure 4: The concept of a blockchain-based predictive model (Source: (Fusco et al., 2020))

This model provides some leverages in management of healthcare of the future in the emerging markets. It requires serial testing and updates to deliver reliability.

Mirroring the expanded consideration given to blockchain in medical care and life sciences, the quantity of PubMed filed articles incorporating the catchphrase 'blockchain' in the title or theoretical fields has expanded drastically, from simply 5 in 2016 to 64 out of 2018 (Mackey et al., 2019). This is an evidence of the impact of 4IR technologies in healthcare not only in the Industrialised world but equally so in the emerging markets. In addition, as many types of blockchain technology have been identified for healthcare (Firdaus et al., 2018), the key features of a blockchain-based healthcare systems in light of recent related literature are highlighted in figure 5 and table 3 (Abdellatif et al., 2020; Hasselgren et al., 2020).

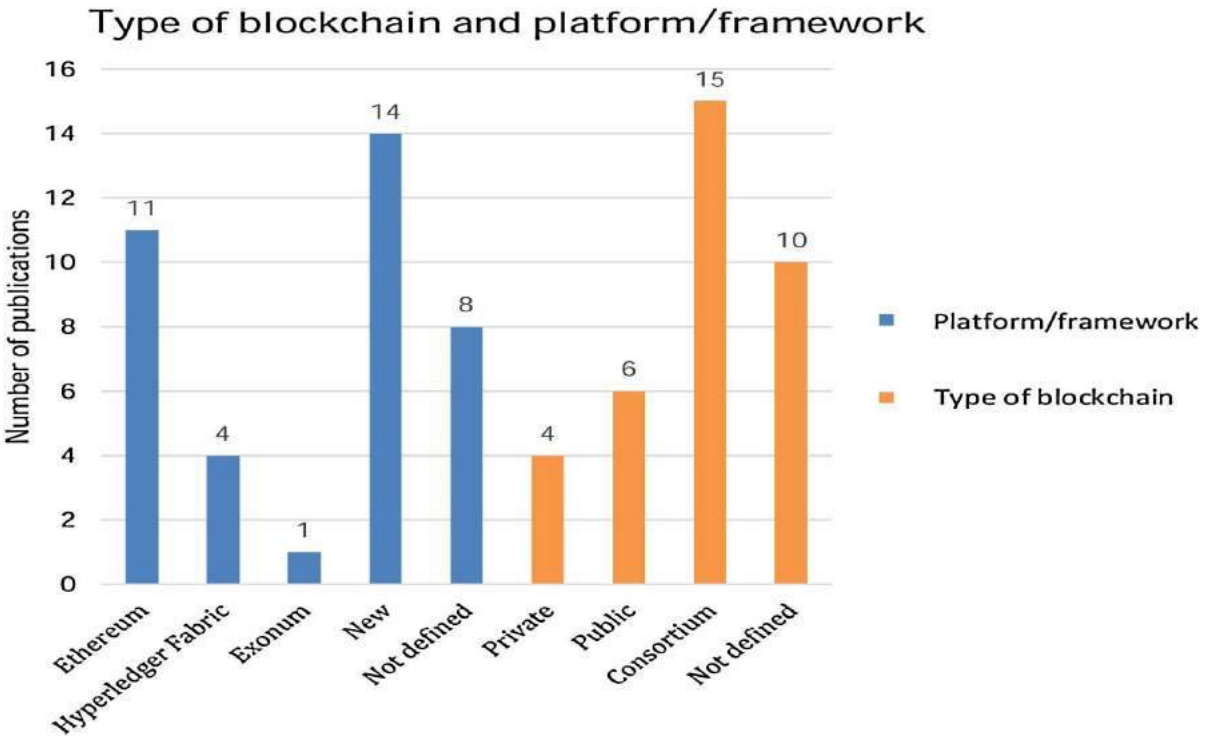

Figure 5: Type of blockchains and platform/framework (source : (Hasselgren et al., 2020))

Table 3: Summary of the relevant work on blockchain in healthcare systems (source: (Abdellatif et al., 2020))

Blockchain type	Description	Limitations	Entities
Private (Ethereum) Consensus: Practical Byzantine Fault Tolerance (PBFT) class: patient [4]	Blockchain system links patients with doctors using customized smart contract to record all events on the blockchain	Latency, scalability	Patients, hospitals
Private (Ethereum) Consensus: Proof of Work (PoW) class: patient [5]	A blockchain framework is proposed for searching encrypted index of electronic health records (EHRs) while real data stored in database	Scalability	Patients, hospitals, medical labs, insurance companies
Private (consortium) Consensus: delegated proof of stake (DPoS) class: patient [2]	Parallel healthcare system using blockchain, technology is proposed to link various parties for medical data sharing	Latency, scalability, security	Patients, hospitals, healthcare communities, researchers
Private (Ethereum) Consensus: PoW class: patient [6]	Blockchain framework is proposed to connect the patients with the hospitals to enable health-related information exchange	Scalability	Patients, hospitals, healthcare Institutions
Private (Hyperledger fabric) Consensus: Byzantine fault-tolerant state machine replication class: patient [7]	Blockchain framework is proposed for sharing processed medical data between different healthcare entities	Scalability, patients approval	Patients, healthcare providers
Private (Ethereum) Consensus: proof of conformance class: entity [8]	Framework of dual blockchains is proposed, one to store and share the index of the EHR with multiple hospitals, and the other to store the original data	Storage scalability	System manager, hospitals
Public (Ethereum) Consensus: PoW class: entity [9]	Propose a framework of two coupled blockchains for managing the storage of two types of data to enhance the throughput, accessibility, and fairness among users	Latency, scalability, computational cost	Patients, medical institutions
Private (MeDShare) Consensus: using consensus nodes class: patient [10]	Blockchain system is proposed to provide medical data sharing, auditing, and control over diverse entities	Privacy scalability	Patients, hospitals, research Institutions
Private (Hyperledger fabric) Consensus: voting-based approach class: patient [11]	Blockchain has been integrated with a tree-based method for medical data sharing between different entities	Privacy, scalability	Patients, doctors, insurance companies

The above table is a condensed report of recent works in 4IR technologies here blockchain with its encryption techniques, consensus algorithms adopted for each solution, and the limitations each unveil. The above also depict the scalability (expansion) of blockchain and the flexibility of its adoption in use cases in healthcare and beyond (Mackey et al., 2019). The picture below paints a simple and self-explanatory summary of blockchain architecture.

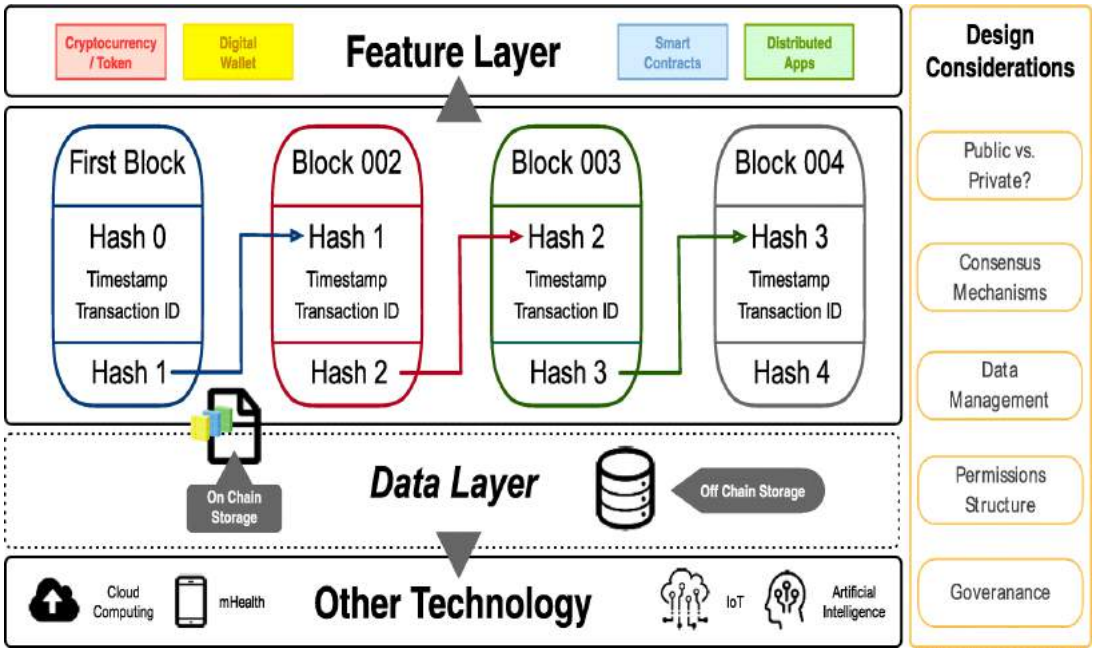

Figure 6: Depiction of blockchain data architecture components (source: (Mackey et al., 2019))

VI. FINDINGS

Healthcare is a significant recipient as the tech environment in the emerging markets keeps on developing (Rosalind, 2019). The discoveries through understanding of 4IR technologies assessed show that the conventional players in the healthcare ecosystem today will be compelled to advance as the scene turns out to be more patient driven. Society in general is moving from what has customarily been a business to business healthcare model, really past a business to shopper healthcare model, to a customer to plan of action (Siwicki, 2019). There is consequently a shift of parts in the master plan of healthcare fuelled by 4IR technologies reception and development in the emerging markets.

While analysts and others researchers concur that healthcare is a framework that involved various segments, first being patients, and including institutions to give care, providers of prescriptions or hardware, the healthcare labour force to convey administrations, instructive and research establishments to prepare the labour force, and payers and government financing systems (Ribitzky et al., 2018); its future is being formed by consolidating 4IR technologies to drive new models for patient consideration.

These are not, at this point, customary models of healthcare the way things are today. The researcher has through a checking of perceptions survey found that the explorative utilization of 4IR technologies in healthcare in the emerging markets is a scholarly examination subject in its early stages yet that the quantity of examination bunches approaches with centre around Africa and proposed arrangements at present is developing dramatically. The quality and amount of the papers are likewise on the ascent (Mackey et al., 2019). Cloud computing, information sharing and information mining, Robotic Process Automation, AI, man-made brainpower, and blockchain are the most affecting current systems for healthcare management (Balasingam, 2017; Braun et al., 2019; Fusco et al., 2020; Hasselgren et al., 2020; Riggare, 2018).

As digital transformation reshape healthcare all throughout the planet, the emerging markets can acknowledge the transition to wire and adventure these 4IR technologies on one hand, and think about genuine changes considering political, financial, social and technological contemplations then again. It is therefore indispensable to recognize the vested interests in healthcare today of social and political powers stubborn and hauling it in different ways. The proposal is for acclimated healthcare pioneers in the emerging markets to team up with techpreneurs and government offices to set up the transition to digital. It is basic for different players of healthcare to get ready for the digital move in light of the fact that the bearing and construction of a future healthcare framework will be resolved generally by the arrangement of healthcare planned with 4IR technologies in the emerging markets.

VII. CONCLUSION

Research on 4IR technologies in healthcare is taking shape as an academic field, and the number and quality of individual publications put together are exponentially growing. This trend is also noticeable in the emerging markets where the smartphone boom is cascading into the healthcare market together with some 4IR technologies are transforming the future of this industry, here healthcare.

In light of the above and context assigned, this paper has explored the future of healthcare in the developing markets using the lenses of 4IR technologies. It has therefore observed the various adoptions and applications of one or multiple 4IR technologies that currently have a stake in healthcare in these markets so far. There are other observations which were not examined in detail in this paper due to context and scope, notably cybersecurity, the virtuous triangle, virtual and augmented reality as well as biotechnology with a focus on neurotechnologies.

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REFERENCES

1. Abdellatif, A. A., Al-Marridi, A. Z., Mohamed, A., Erbad, A., Chiasserini, C. F., & Refaey, A. (2020). ssHealth: Toward Secure, Blockchain-Enabled Healthcare Systems. *IEEE Network*, *34*(4), 312–319. https://doi.org/10.1109/MNET.011.1900553
2. Alaiad, A., & Zhou, L. (2014). The determinants of home healthcare robots adoption: An empirical investigation. *International Journal of Medical Informatics*, *83*(11), 825–840. https://doi.org/10.1016/j.ijmedinf.2014.07.003
3. Amadeo, K. & Eric Estevez. (2020, August 31). *Five Defining Characteristics of Emerging Market Countries*. The Balance. https://www.thebalance.com/what-are-emerging-markets-3305927
4. Antoniuk, L., Gernego, I., Dyba, V., Polishchuk, Y., & Sybirianska, Y. (2017). Barriers and opportunities for hi-tech innovative small and medium enterprises development in the 4th industrial revolution era. *Problems and Perspectives in Management*, *15*(4), 100–113. https://www.ceeol.com/search/article-detail?id=621428
5. Armstrong, B., & Lee, G. (2021). *Digital Business* (2nd edition). Silk Route Press.
6. Arnold, D. J., & Quelch, J. A. (1998). New Strategies in Emerging Markets. *Sloan Management Review*, *40*(1), 7–20. https://www.proquest.com/docview/224965007/abstract/C7C6615D58CB4D67PQ/1
7. Baker, A. (2020, April 22). *Drones Are Delivering COVID-19 Tests in Ghana. Could the U.S. Be Next?* Time. https://time.com/5824914/drones-coronavirus-tests-ghana-zipline/

8. Balasingam, M. (2017). Drones in medicine—The rise of the machines. *International Journal of Clinical Practice*, *71*(9), e12989. https://doi.org/10.1111/ijcp.12989
9. Bates, D. W., & Bitton, A. (2010). The future of health information technology in the patient-centered medical home. *Health Affairs*, *29*(4), 614–621.
10. Braun, J., Gertz, S. D., Furer, A., Bader, T., Frenkel, H., Chen, J., Glassberg, E., & Nachman, D. (2019). The promising future of drones in prehospital medical care and its application to battlefield medicine. *Journal of Trauma and Acute Care Surgery*, *87*(1S), S28. https://doi.org/10.1097/TA.0000000000002221
11. Brogan, J., Baskaran, I., & Ramachandran, N. (2018). Authenticating Health Activity Data Using Distributed Ledger Technologies. *Computational and Structural Biotechnology Journal*, *16*, 257–266. https://doi.org/10.1016/j.csbj.2018.06.004
12. Cain, M., Mittman, R., Institute for the Future, & California HealthCare Foundation. (2002). *Diffusion of innovation in health care*. California Healthcare Foundation.
13. Cawthorne, D., & Robbins-van Wynsberghe, A. (2020). An Ethical Framework for the Design, Development, Implementation, and Assessment of Drones Used in Public Healthcare. *Science and Engineering Ethics*, *26*(5), 2867–2891. https://doi.org/10.1007/s11948-020-00233-1
14. Chee, H. L. (2008). Ownership, control, and contention: Challenges for the future of healthcare in Malaysia. *Social Science & Medicine*, *66*(10), 2145–2156. https://doi.org/10.1016/j.socscimed.2008.01.036
15. Ćwiklicki, M., Klich, J., & Chen, J. (2020). The adaptiveness of the healthcare system to the fourth industrial revolution: A preliminary analysis. *Futures*, *122*, 102602. https://doi.org/10.1016/j.futures.2020.102602
16. Diño, M. J. S., & Ong, I. L. (2019). Research, technology, education & scholarship in the fourth industrial revolution [4IR]: Influences in nursing and the health sciences. *The Journal of Medical Investigation*, *66*(1.2), 3–7.
17. Euchi, J. (2021). Do drones have a realistic place in a pandemic fight for delivering medical supplies in healthcare systems problems? *Chinese Journal of Aeronautics*, *34*(2), 182–190. https://doi.org/10.1016/j.cja.2020.06.006
18. Ferguson, T., & Frydman, G. (2004). The first generation of e-patients. *BMJ*, *328*(7449), 1148–1149. https://doi.org/10.1136/bmj.328.7449.1148
19. Firdaus, A., Anuar, N. B., Razak, M. F. A., Hashem, I. A. T., Bachok, S., & Sangaiah, A. K. (2018). Root Exploit Detection and Features Optimization: Mobile Device and Blockchain Based Medical Data Management. *Journal of Medical Systems*, *42*(6), 112. https://doi.org/10.1007/s10916-018-0966-x
20. Frick, S. A., Rodríguez-Pose, A., & Wong, M. D. (2019). Toward Economically Dynamic Special Economic Zones in Emerging Countries. *Economic Geography*, *95*(1), 30–64. https://doi.org/10.1080/00130095.2018.1467732
21. Fusco, A., Dicuonzo, G., Dell'Atti, V., & Tatullo, M. (2020). Blockchain in Healthcare: Insights on COVID-19. *International Journal of Environmental Research and Public Health*, *17*(19), 7167. https://doi.org/10.3390/ijerph17197167
22. Griffiths, F., Cave, J., Boardman, F., Ren, J., Pawlikowska, T., Ball, R., Clarke, A., & Cohen, A. (2012). Social networks – The future for health care delivery. *Social Science & Medicine*, *75*(12), 2233–2241. https://doi.org/10.1016/j.socscimed.2012.08.023
23. Haluza, D., & Jungwirth, D. (2015). ICT and the future of health care: Aspects of health promotion. *International Journal of Medical Informatics*, *84*(1), 48–57. https://doi.org/10.1016/j.ijmedinf.2014.09.005
24. Hasselgren, A., Kralevska, K., Gligoroski, D., Pedersen, S. A., & Faxvaag, A. (2020). Blockchain in healthcare and health sciences—A scoping review. *International Journal of Medical Informatics*, *134*, 104040. https://doi.org/10.1016/j.ijmedinf.2019.104040

25. Kaminski, J. (2011). Diffusion of innovation theory. *Canadian Journal of Nursing Informatics*, *6*(2), 1–6.
26. Kamnqa, S. (2021, April 26). *How drones are used in SA's health services • Spotlight*. Spotlight. https://www.spotlightnsp.co.za/2021/04/26/how-drones-are-used-in-sas-health-services/
27. Katz, E., Levin, M. L., & Hamilton, H. (1963). Traditions of Research on the Diffusion of Innovation. *American Sociological Review*, *28*(2), 237–252. https://doi.org/10.2307/2090611
28. Knoblauch, A. M., Rosa, S. de la, Sherman, J., Blauvelt, C., Matemba, C., Maxim, L., Defawe, O. D., Gueye, A., Robertson, J., McKinney, J., Brew, J., Paz, E., Small, P. M., Tanner, M., Rakotosamimanana, N., & Lapierre, S. G. (2019). Bi-directional drones to strengthen healthcare provision: Experiences and lessons from Madagascar, Malawi and Senegal. *BMJ Global Health*, *4*(4), e001541. https://doi.org/10.1136/bmjgh-2019-001541
29. Lotem, M. H., & Shani, M. (2018). [THE PARADIGM SHIFT IN MEDICINE FOLLOWING THE 4TH INDUSTRIAL REVOLUTION]. *Harefuah*, *157*(12), 797–801. https://europepmc.org/article/med/30582315
30. Mackey, T. K., Kuo, T.-T., Gummadi, B., Clauson, K. A., Church, G., Grishin, D., Obbad, K., Barkovich, R., & Palombini, M. (2019). 'Fit-for-purpose?'–challenges and opportunities for applications of blockchain technology in the future of healthcare. *BMC Medicine*, *17*(1), 68. https://doi.org/10.1186/s12916-019-1296-7
31. Michas, P. N. (2011). The Importance of Audit Profession Development in Emerging Market Countries. *The Accounting Review*, *86*(5), 1731–1764. https://doi.org/10.2308/accr-10097
32. Mlemwa, F. (2019, August 17). *16 African countries agree to adopt Kiswahili as a formal language*. Africanews. https://www.africanews.com/2019/08/17/16-african-countries-agree-to-adopt-kiswahili-as-a-formal-language/
33. Qadri, Y. A., Nauman, A., Zikria, Y. B., Vasilakos, A. V., & Kim, S. W. (2020). The Future of Healthcare Internet of Things: A Survey of Emerging Technologies. *IEEE Communications Surveys Tutorials*, *22*(2), 1121–1167. https://doi.org/10.1109/COMST.2020.2973314
34. Reay, S., Collier, G., Kennedy-Good, J., Old, A., Douglas, R., & Bill, A. (2017). Designing the future of healthcare together: Prototyping a hospital co-design space. *CoDesign*, *13*(4), 227–244. https://doi.org/10.1080/15710882.2016.1160127
35. Ribitzky, R., St. Clair, J., Houlding, D. I., McFarlane, C. T., Ahier, B., Gould, M., Flannery, H. L., Pupo, E., & Clauson, K. A. (2018). Pragmatic, Interdisciplinary Perspectives on Blockchain and Distributed Ledger Technology: Paving the Future for Healthcare. *Blockchain in Healthcare Today*. https://doi.org/10.30953/bhty.v1.24
36. Riggare, S. (2018). E-patients hold key to the future of healthcare. *BMJ*, *360*, k846. https://doi.org/10.1136/bmj.k846
37. Rosalind, M. (2019). AI, Blockchain, Drones—ProQuest. *Network Journal*, *26*(1), 44. https://www.proquest.com/openview/cbf5598a13d3fe41e8092373e881a7ac/1?pq-origsite=gscholar&cbl=43721
38. Santhanam, V. (2020, May 8). *How drones could change the future of healthcare delivery*. World Economic Forum. https://www.weforum.org/agenda/2020/05/medical-drone-delivery-india-africa-modernize-last-mile/
39. Scott, G. (2020, March 16). *Emerging Market Economy Definition*. Investopedia. https://www.investopedia.com/terms/e/emergingmarketeconomy.asp
40. Siwicki, B. (2019, January 30). *Health 2040: A look into the future*. Healthcare IT News. https://www.healthcareitnews.com/news/health-2040-look-future
41. Smith, R. (1997). The future of healthcare systems: Information technology and consumerism will transform health care worldwide. *BMJ*, *314*(7093), 1495. https://doi.org/10.1136/bmj.314.7093.1495

42. Sraders, A. (2018, December 31). *What Are Emerging Markets? Characteristics and List*. TheStreet. https://www.thestreet.com/markets/emerging-markets/what-are-emerging-markets-14819803
43. Thielst, C. B. (2007). The future of healthcare technology. *Journal of Healthcare Management*, *52*(1), 7.
44. Thimbleby, H. (2013). Technology and the Future of Healthcare. *Journal of Public Health Research*, *2*(3). https://doi.org/10.4081/jphr.2013.e28
45. Ugalmugle, S. (2019). *Medical Drones Market Forecast 2019-2025 Growth Statistics Report* (No. GMI3120; p. 85). https://www.gminsights.com/industry-analysis/medical-drones-market