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Symmetrical Model of Smart Healthcare Data Management: A Cybernetics Perspective

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Abstract: Issues such as maintaining the security and integrity of data in digital healthcare are growing day-by-day in terms of size and cost. The healthcare industry needs to work on effective mechanisms to manage these concerns and prevent any debilitating crisis that might affect patients as well as the overall health management. To tackle such critical issues in a simple, feasible, and symmetrical manner, the authors considered the ideology of cybernetics. Working towards this intent, this paper proposes a symmetrical model that illustrates a compact version of the adopted ideology as a pathway for future researchers. Furthermore, the proposed ideology of cybernetics specifically focuses on how to plan the entire design concept more effectively. It is important for the designer to prepare for the future and manage the design structure from a product perspective. Therefore, the proposed ideology provides a symmetric mechanism that includes a variety of estimation and evaluation techniques as well as their management. The proposed model generates a symmetric, variety-issue, reduced infrastructure that can produce highly effective results due to an efficient usability, operatability, and symmetric operation execution which are the benefits of the proposed model. Furthermore, the study also performed a performance simulation assessment by adopting a multi-criteria decision-making approach that helped the authors compare the various existing and proposed models based on their levels of effectiveness.

Keywords: healthcare data; data management; digital services; cybernetics; symmetrical designing

1. Introduction

Management of smart services is a challenging and crucial task, especially in the current scenario of an unprecedented surge in the number of cyber-attacks. As cited by several studies, digital healthcare services are major targets of these cyber invasions and have been severely affected [1]. Hence, the management and security of smart healthcare facilities that directly depend on digital infrastructure have become essential. In an environment where cybercrime is on the rise, security and healthcare experts must work on more productive and efficacious mechanisms to strengthen smart services [1–4].

There is a need for the healthcare sector to define its digital transactions and infrastructure from a new perspective. In this line, several experts and researchers iterate on the techniques and methodologies that are in use at present, which subscribe to universally accepted standards such as the Health Insurance Portability and Accountability Act (HIPPA), and these techniques are perfectly updated and secure for digital and smart healthcare infrastructure. However, the picture drawn by the cyber-attack census report is alarming, especially in the context of healthcare exploitation incidents. The figures clearly show that the policies described in these standards are not adequate in terms of security and failure management. Thus, the authors strongly believe that such a scenario calls for reconstructing or developing symmetric steps from different perspectives to ensure security and digital maintenance in healthcare infrastructure.

In addition, the present state of the pandemic that has arisen all over the world has exposed the fault lines that exist and are cropping up in smart healthcare services. In the event of emergency and massive cases, digital healthcare services have been found to be inadequate [5–10]. Managing such a major health catastrophe with foolproof security is a difficult and challenging task for healthcare organizations. Thus, the prevailing uncertainty in the present context has motivated the authors to work on redefining the healthcare infrastructure by identifying the possible drawbacks in the existing healthcare infrastructure. The research study conducted in this context cites the various ways cyber invaders are able to exploit the vulnerabilities present in the healthcare infrastructure [11–15]. These exploit possibilities are present in both the organizational assets and its structure.

Furthermore, conceptualizing these vulnerability points indicates that "variety" is the main difficulty in the management of healthcare infrastructure [16–20]. Variety, as a concept, means different states of the same thing. This can be explained with the analogy of a smart room heater. If a heater were automatically set to manage the maximum temperature of 5 °C but suddenly the temperature fell below 5 °C, then the heater would not function properly because it had not been configured to function in temperatures below 5 °C. This example clearly displays that variety is always an issue in any type of system because every system has its limitations, but the application of the systems has diversity in nature.

Additionally, to bridge the lack of understanding about this issue in the healthcare sector, the authors present a brief descriptive analysis of the issue of variety in healthcare. The study also proposes a conceptual framework that can be adopted for managing the healthcare infrastructure symmetrically. For the envisioned model, the authors adopted the cybernetics concept that has significant potential in providing effective solutions in healthcare service management.

2. Materials and Methods

2.1. Previous Similar Research Initiatives

Defining any new concept and methodology is a challenging task. It requires an extensive review of the literature and critical analysis of domain centric sources. To understand the scenario of healthcare variety issues and devise a conceptual model for a symmetric smart healthcare system by adopting cybernetics concepts in healthcare, the authors perused the relevant research initiatives completed in this field. The literature search process and information about the literature examination is illustrated in Appendix A. Despite a thorough search, the authors found only a few partially similar papers that discuss healthcare modeling and its management. There are no specific studies on the management of healthcare data through cybernetics ideology, which is the key objective of the proposed study.

The core concept and idea of the proposed work is to portray a symmetric model that would enable experts to make healthcare infrastructure more symmetric and secure it from variety-related issues. To achieve this goal, the authors adopted the cybernetics approach. However, after conducting the initial search, the authors concluded that there was no similar research work available in data repositories. Another important aspect that needs to be underlined in this context is that cybernetics is not an approach or technique with predefined symmetric steps. An ideology of thinking processes gives benefit in designing development steps. We used cybernetics in this form in this study, whereas several studies we refer to only align cybernetics with engineering and some type of system development. In addition, various other methods and techniques are available which specifically focus on the healthcare domain. Nevertheless, there is a need to redefine the complete healthcare data management due to its complexity and vastness. Before proposing any specific technique that would solve any specific healthcare loopholes, it is necessary to define the complete healthcare data management from a novel design perspective. This type of approach gives an ideal pathway for creating a systematic and a simple system. The proposed study aimed to achieve this goal by portraying a systematic ideology for future researchers.

Some of the relevant studies that can be cited in the context of adapting cybernetics ideology are mentioned below:

Korotkova's article discusses the role of IT and cybernetics in Russian healthcare. The article describes the current situation and the scope of cybernetics in healthcare with the help of fundamental analysis and examples [4]. The main focus of the article is clearly on the evolution of information technology in the country's healthcare infrastructure. Korotkova stated that health is a domain which is never going to end because if humans are present on the earth then they will get ill or suffer from any disease because it is the basic nature of the human body. The researcher further adds that information technology association in healthcare is also going to be a big revolution because every aspect of daily life and business sectors are very frequently adopting computers. The author adds that this balance can be achieved by applying cybernetics ideology in between digitalization and healthcare.

Khayal et al. worked on personalized health service modeling. The proposed model in the paper uses engineering dynamic theories to portray organizational and personal healthcare needs of patients from personalized level [5]. The approaches and methods used in the paper have the ability to provide beneficial results in the healthcare sector. This study also motivated us to develop a symmetrical model for the healthcare sector.

Further, Faggini et al. proposed a model that was developed to maintain sustainability in healthcare by various digital infrastructures. The paper proposed a theoretical model named DocBox24, which is based on the online sustainable healthcare service delivery [18]. To validate the work of their study, the authors also portrayed real time examples and provided a comparison analysis based on various facts. The study illustrated the power and significance of digital infrastructure in healthcare very effectively.

To manage the digital infrastructure and data management of healthcare, another study discusses the blockchain based secure data management and travel in an Internet of Things (IoT) environment [19]. In the current era of digitalization, the demand and significance of this type of methodology and work is very high. The work portrays a blockchain-based model that discusses secure communication and works on all types of data layers in healthcare.

Moreover, another researcher, Yang et al., worked on data security and its validation in healthcare. The study assesses a data validation scenario and then proposes an effective and efficient security assured model, which deals with data validation issues in healthcare [20]. The findings of the study are a significant contribution to the research being conducted in this domain.

A technical report discusses the use of sociocybernetics in health management [6]. Though the application of cybernetics discussed in this paper is related to the social perspective, we were able to relate it to the scope of cybernetics in healthcare.

2.2. Symmetric Variety: A Significant Topic in Healthcare

Issues are a common and a frequent occurrence in healthcare infrastructures. However, inspite of being a critical aspect, the issue of variety has not been addressed or raised emphatically by the research community yet. Admittedly, exceptions are always available in society, so the authors believe that there might be some research teams that have worked previously, or are working, on the variety-related issues of healthcare. Variety, as a concept, is also used for addressing the failure of the infrastructure or breaches in healthcare [7].

From a general perspective though, variety is considered as the diversity of any system, process or product for a certain state of domain. This means that every resource of any system has its own variety or diversity. For example, an automated room heater has various resources, such as atmosphere changes, room temperature, electronics of machines, etc. Every resource has its own diversity, for example, the atmosphere has a nature of changing, so it could be anything after a period of 1 h. Temperature can also be changed, depending on the atmospheric condition.

In this framework, the key question is whether the issues pertaining to variety can have any adverse effects. Most certainly, the issue of variety can cause exploitation and failure situations in any type of system and process. To understand this more clearly, let us allude to an example of a healthcare organization or a hospital that has a capacity of 100 beds. The digitalized infrastructure that is implanted in the organization also has the data capacity of carrying information of 100 patients. Now in a panic situation such as COVID-19 spread, if the patients count in healthcare organizations becomes more than 100, the infrastructure would not be able to maintain the data structure properly. However, consider that every system has some extra space to carry resources, so the infrastructure would also have the capacity of carrying approximately 200 patients' data at a given time. More specifically, in the context of COVID-19, when the count of COVID-19 positive cases in many countries of the world is not less than 5000 per day, unless the infrastructure is engineered to tackle variety related issues, it would be unable to carry the extra burden. Evidently, the storage capacity is modified in variety and its adverse effect is digital failure.

Moreover, to build a strong research base for the issue of variety, authors found a study that discussed about the attributes that affect the quality of healthcare. This study also illustrated the issue of variety in their work. The work discusses about the quality issues that happen in any healthcare scenario and the factors that lead to this situation [15]. According to the study, management and perfection from every end in the healthcare system is necessary for a faultless process. There are various factors such as resource disturbances, delay in availability, interruption in digital environment, etc., that portray a situation of failure or exploitation in the system. These factors simply illustrate a specific situation of fault or vulnerability, but the analysis of the causes behind these factors clearly shows that these issues are also associated with the issue of variety in healthcare.

Hence, the issue of variety is a critical aspect in healthcare. It is imperative for the research community to focus more intently on mechanisms that can provide effective solutions in this domain. Furthermore, to gauge the broader picture of this situation in real time scenarios, the following studies that mention infrastructure failures that have happened in the healthcare infrastructure in the recent past have been cited below:

Another technical report discusses that the systems failure in healthcare is a disaster for structural activities and services [7]. The article also focuses on the significance of diversity or variety in healthcare as well as its adverse effects. The non-stop increase in population is one of the biggest variety changes and a critical issue in healthcare. The article cites that capacity has a significant role in variety related issues. Such issues demand extra attention in healthcare infrastructures.

A news report talks about the weak points of healthcare infrastructure that were exposed to the public during the pandemic situation of COVID-19 [8]. The report shows that there are many infrastructural bug points that can cause a failure of any healthcare structure. Most of these issues, directly or indirectly, stem from the issue of variety.

A report from India points out that an increasing number of cases have already caused healthcare infrastructure failures in many cities in India [9]. The report highlights that Maharashtra, a state of India, had more than 100,000 Corona cases until the time the report was drafted. Moreover, the official figure for the number of beds in the government hospitals of Maharashtra is approximately 52,000. However, these data are for regular, non- pandemic situations. In the wake of a health emergency such as the COVID-19 pandemic, the situation would worsen because the health infrastructure of the hospitals would not be able to cater to the increased number of COVID-19 cases.

In addition to discussing the situation and its possible adverse effects on healthcare, it is also important to understand the scenario from a digital perspective. The abovementioned incidents and examples do not discuss the digital perspective of healthcare. However, it is important to understand that the incidents that are happening and affecting healthcare infrastructure physically, or from any other perspective, are also affecting the digital infrastructure. The reason for this is that all the processes that are applicable in healthcare organizations, and the infrastructures that are employed, are implemented by digital platforms. This can be done only when the services are smart or digitalized. Physical or any other type of variety issue, directly or indirectly, affects the digital infrastructure.

In the context of analyzing other issues that impede the efficacy of smart healthcare services, the authors have recently presented the Census of Cyber Attacks. The data depict the pattern in which the attackers are penetrating the healthcare infrastructure to exploit various inherited vulnerability points for implementing attacks. A report on the financial information about healthcare breaches tells that the cost of a breach in healthcare is around USD 1.8 million [10]. This is a huge figure. Another survey reports that 53% of the healthcare organizations are currently suffering from breach incidents all around the world. To make this more specific and simple, we have enlisted only July's statistics [11] of healthcare data breaches in Figure 1.

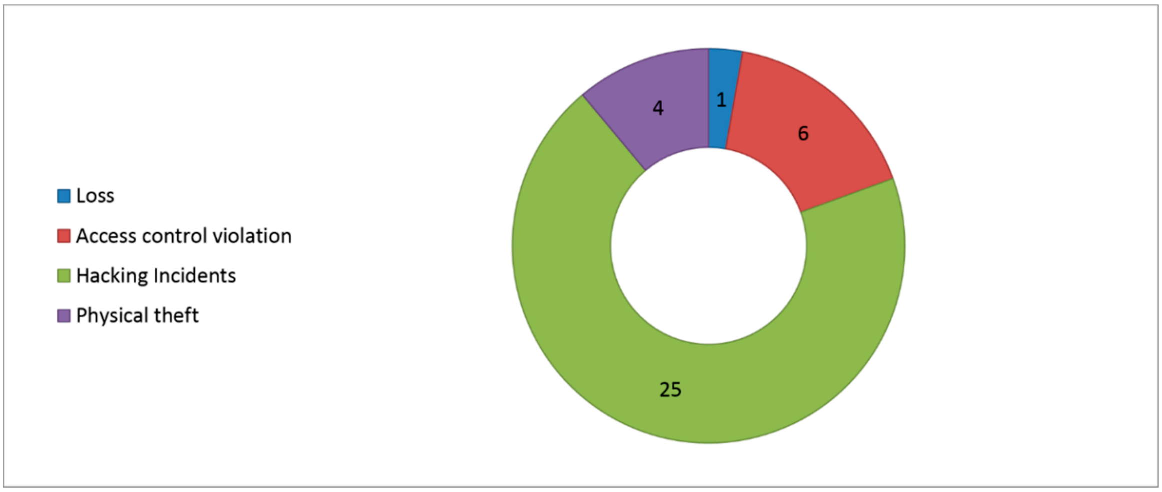

Figure 1. Health Record Breach Census (July 2020).

Figure 1 portrays the number of highly sensitive healthcare breach incidents that have been reported by the host agencies in the past. The analysis of the Census clearly shows that most of the breach incidents were performed and deployed by hacking. This shows the possibilities of exploitation and the loopholes in digital infrastructure of healthcare organizations. These types of incidents necessitate redefining the management of data and digital infrastructure in healthcare.

2.3. Tools and Techniques

Healthcare infrastructure is an association of various components and it has vast complexity in its various attributes. Thus, in order to acquire a method and the materials for redefining the digital infrastructure of healthcare, authors needed to focus on a large domain. The authors found that it is very complex to address all these attributes in one paper because the paper, as well as the concept, would be hard to understand. Therefore, the proposed paper addresses the infrastructure of healthcare from a data perspective.

2.4. Data Perspective Based Symmetrical Modeling of Healthcare Infrastructure

Defining any system and architecture is challenging, more so if it comprises a large amount of attributes and number of domains. The healthcare infrastructure is the most complex and difficult to understand system, particularly in the current situation. This is because several techniques, approaches and ideas are employed by an uncountable number of experts and researchers across the world at present. In such a scenario, it was difficult for the authors to portray a unified infrastructure and incorporate every aspect of healthcare in one paper. To tackle this premise, the authors have defined the healthcare infrastructure from a data perspective in this paper.

Modeling healthcare from a data perspective enabled the authors to simplify every aspect and the complexity of healthcare. To understand the significance of data perspective modeling, it is imperative to pay attention to the changes that have been brought about by the current digitalized era. Every business and sector that is digitally connected is producing data and operating on the basis of data. In such a context, layering healthcare infrastructure from a data perspective would be beneficial for the research community and the authors of the proposed paper.

Thus, we have analyzed the data usage in healthcare for defining the healthcare model from a data perspective. Identifying data usage gives us an idea about how the healthcare data works and is produced or managed. As per the analysis, healthcare infrastructure can be categorized into a four layer model from the data perspective. The layers are: a data production layer, data transaction layer, data storage layer and data application layer. These layers handle the entire data management in healthcare infrastructure by assuring their layered work. A detailed description for better understanding is given in the ensuing paragraphs and a graphical representation of the same is given in Figure 2.

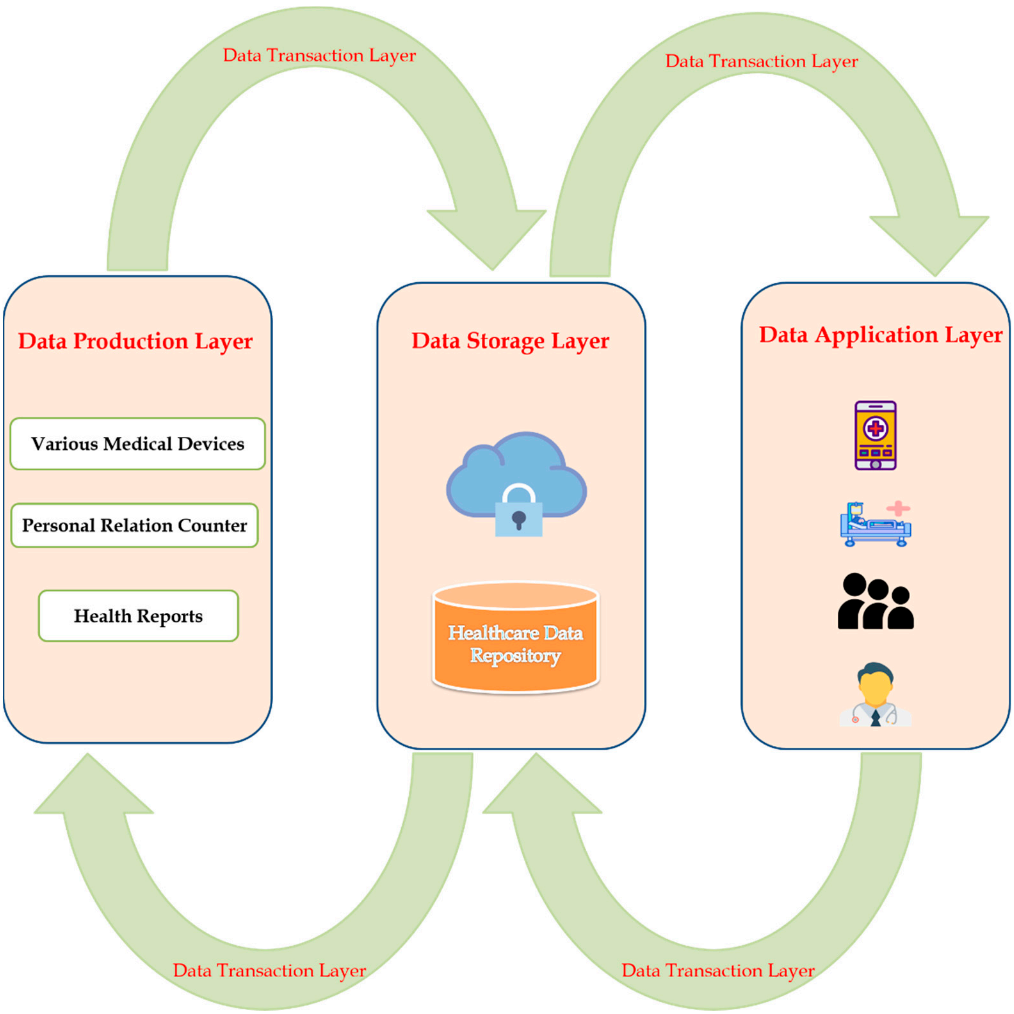

Figure 2. Layered Modeling of Healthcare Infrastructure.

The data production layer: this layer deals with the origin of healthcare data [1]. In simpler words, a data production layer generates or produces data by various types of its attributes such as personal relation counters where new patients come and discuss their previous and current medical history for obtaining the relevant medical assistance. Various medical devices are the next attribute that include IoMT (Internet of Medical Things) and many other medical digital equipment that give health and medical information about the patient. Health reports generated from various types of tests also come under the production layer, which includes medical condition, and numerical data that are very sensitive for the patients' health. The data that come under this layer are generated or acquired by the healthcare organizations for the treatment of the patients.

The data storage layer: this layer deals with data storing techniques and their management. All types of data that are used and acquired from healthcare services are stored and managed by this layer through various databases and cloud platforms [1]. This layer is responsible for managing data storage and its security. It is imperative for the healthcare security experts to employ assured security on this layer because it is the second most penetrated layer by the attackers.

The data application layer: this layer deals with the post data usage domains. This implies that the application layer is responsible for the use of healthcare data from its different platforms, processes and vectors [1]. Different telemedicine projects such as health apps and SMS services regarding lab tests are considered in this layer of healthcare. Confidential data related to patients and healthcare services that can be accessed by various doctors and administrative bodies also come under this layer because they are directly using the acquired or stored information in healthcare organizations. This is the most vulnerable layer as it is frequently penetrated upon and exploited by the attackers.

The data transaction layer: transaction is associated with traffic or interchange in-between one place or node with another. Hence, as evident from its name, the data transaction layer is associated with various techniques and methods as well as ways of data travel in between the organizational infrastructure [1]. This type of layer often becomes exposed and unsecured in a non-managed healthcare organizational structure. Moreover, considering the possibilities of exploitation, the security of this layer requires approaches such as the blockchain and psudomation. Overall, this layer solely deals with the data that are transmitted from one node to another in the healthcare infrastructure.

The given backdrop as regards the layered view of the healthcare organization and its infrastructure from a data perspective, makes it easier to solve the variety issue in healthcare by adopting the cybernetics ideology.

2.5. Adopted Symmetrical Ideology

Selecting an approach and the idea for the intended research work is a very significant task. It becomes even more critical when the research subject pertains to an extra sensitive domain such as healthcare and working on its redefinition process. That is why the authors have adopted an *ideology of thinking* instead of adopting a specific approach or technique. The authors selected cybernetics ideology for redefining healthcare data's management infrastructure.

Cybernetics is an ideology or *path of thinking* for design structures and defining them [12]. The word cybernetics originated from a Greek ancient word called Kybernetike which means governance. However, many researchers and scientists strongly believe that the actual meaning of the word is "*steering*". More specifically, the term is defined as "*the art of steering*". This is the key point around which the whole concept of second order cybernetics works.

The authors adopted the cybernetics ideology called the second order cybernetics. Second order cybernetics is the next generation or version of cybernetics ideology that gives solutions to the problems that are wicked [13]. Wicked problems are defined as problems that are hard or impossible to solve completely in the system. Thus, for tackling these situations, a next second order cybernetics version was introduced by the researchers to minimize the negative effects of the problems. This type of ideology can be applied in various real time situations and problems.

The second order cybernetics clearly reflects the ideology that is based on the art of steering. We applied this concept on redefining healthcare. Further, to understand the idea of steering, it is important to assume that every design process or idea that the designers envision is done with a desired outcome or result or purpose of design in their mind. The art of steering or cybernetics provides them the ability to produce the desired outcomes by associating conversation and feedback loops to tackle obstacles in the design process [13].

As mentioned in Figure 3, there is a process of designing which can be achieved simply by some desired steps represented by the green straight line. However, the cybernetics ideology believes that there are some obstacles that misguide the designers from the desired path and move the process towards a different line. The cybernetics ideology empowers the designers to reduce or correct this obstacle and achieve the desired objective through conversation and feedback loop applications. Conversation and feedback loops are processes that work on action–reaction rules.

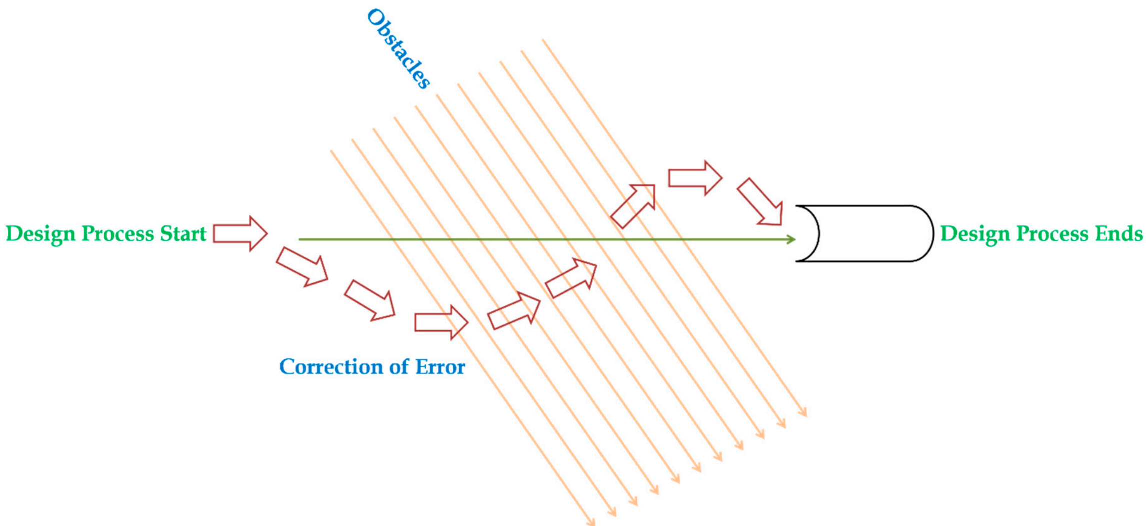

Figure 3. Cybernetics Ideology in Conceptual Way.

To explicate further, there is a simple and a proper path for achieving a goal that is necessary for the designers to follow so as to achieve the intended objective in a design process. However, maximum design processes are influenced by various obstacles that work as distractions and the precise goal is lost. Hence, to avoid any deviations, conversation based feedback loops provide continuous comparison options in a design process. This gives additional awareness to the designers about their path of designs and model.

The biggest and the most significant challenge for the designer during the framing of the design process is to understand the context along with the available attributes and their relation or use to achieve the desired goal in the end. A famous cybernetician, Rittel, states that conversation is always the best option and solution for improving, discussing and examining the design goal [13]. A great and iconic cybernetics genius in history, Ross Ashby, quoted in his book "An Introduction to Cybernetics" that cybernetics is not a concept that deals with "*what is this thing*" in design process, rather than that, it deals with "*what does it do*" [14]. In simple words, cybernetics teaches the way of proper designing instead of teaching a specific technique or approach. Therefore, it is always beneficial for a designer to understand the soul of designing instead of understanding a specific approach.

Furthermore in the context of healthcare, the authors have applied the conversational feedback loop based structuring of models that can be employed at any layer of the healthcare infrastructure. Cybernetics based models that can be achieved by this adopted ideology will help the designers to develop a more systematic healthcare infrastructure by minimizing the issue of variety and various other issues that are associated with the cybernetics concept. The adopted ideology is a way of achieving things by applying true and appropriate thinking.

2.6. Symmetrical Model

Redefining the data management of healthcare infrastructure demands a model instead of any process and approach. There is a specification related difference between a model and process. The proposed model defines a pathway for designing healthcare infrastructure from every layer.

The current healthcare infrastructure does not have any standardized set of models that can be adopted by every healthcare organization for developing its digital structure. To solve this issue and give a new perspective to the healthcare sector, the authors have devised a model premised on the cybernetics ideology. The model summarizes the infrastructure from a data perspective and works on the idea of conversation directed by cybernetics.

Figure 4 illustrates the model premised on cybernetics. The model is named ARAR based on the authors' names who have developed this model: Abhishek, Rajeev, Alka and Raees. The model has simple conversation based steps that intend to produce effective healthcare digital infrastructure from a data perspective. The first step, as formulated by the ARAR model, is data initiation. This is a primary step in any healthcare data infrastructure. After the successful initiation of data from various data sources based on the nature of the layer, the next step is to classify the variety of every source with respect to the data carrying and management in between the healthcare design processes. This type of classification gives us an idea about the position of the source in various possible conditions. After classifying the variety of sources, the next step is to evaluate the severity of various classified varieties. This gives the designer an overview of the possible conditions of sources. The evaluated results from these steps are compared with the desired outcome or goals of the design as a next step. This type of information is more of a reality check for the designers, helping them to ensure that the design process is on the right track. If the results are compatible and the designers as well as the experts find a perfect alignment between the development and the planned target, only then does the model allows the designer for the next step. The next step is to decide on the evaluated variety that is compatible with the goal of the design. Similarly, if the variety classification and its severity levels do not have the potential to achieve the goal of the design process, that model sends the process again to the first initial stage. There are two possibilities for designers at the decision stage of a model. The possibilities are whether to choose ignorance or the minimization/extract option. The decision stage is solely based on the severity of the variety and goal of the design process. The decision taken, or the choices made, at this stage directly affect the design of structure.

Moreover, to make it more understandable and clear, the authors have classified the whole framed model into five steps. These steps are: initiation; classification; assessment; result; application. The proposed model is a combination of these five steps, respectively, as displayed in Figure 5.

Further, as clearly portrayed in the framed model, it reflects and works on the cybernetics ideology in order to remediate variety related issues from digital infrastructure of healthcare. As observed in the earlier section of this study, variety is a wicked problem. A wicked problem is a problem that cannot be extracted or removed completely from the system because it is a part of the system. Such problems are related to the inevitable characteristics that are built into the system. To overcome issues that are variety-centric, the proposed model can be adopted by experts for redefining digital healthcare infrastructure.

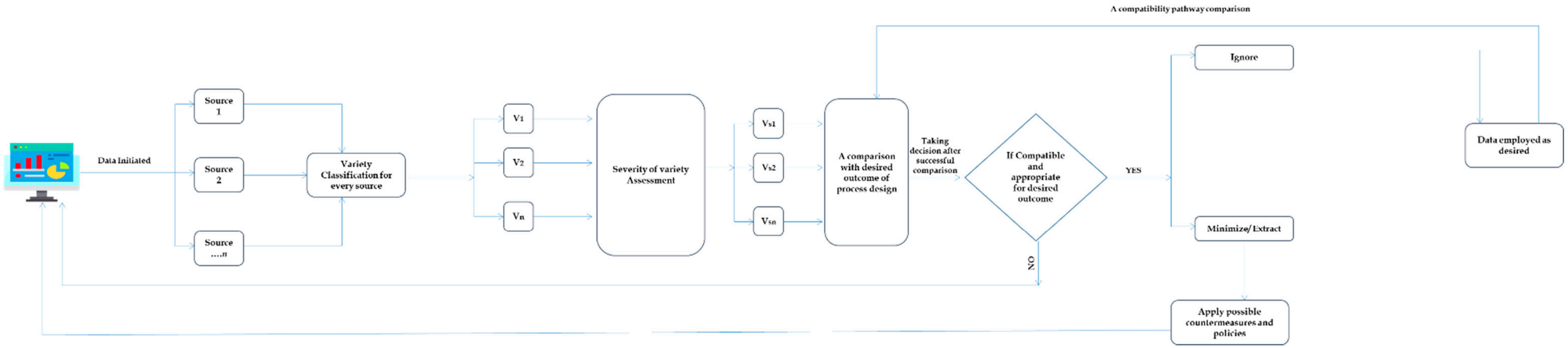

Figure 4. Symmetrical ARAR Model.

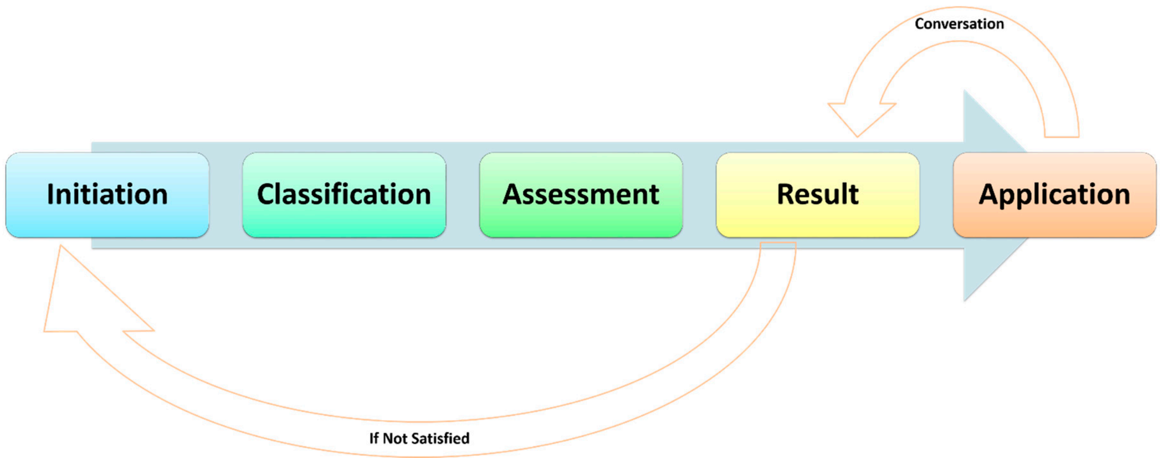

Figure 5. Conceptual Idea of Symmetrical Model.

2.7. Performance Simulation

To establish the efficacy of the proposed ARAR mode, the authors conducted a comparative analysis by simulating the effectiveness of the results of the proposed and other similar frameworks. Such an analysis and numerical quantification portrays an evident understanding about the effectiveness of the proposed model. The authors selected six different models for evaluation, including the proposed one. The names of the selected models are P5 Cybernetics Health (FW1); Personalized Health Dynamic System Model (FW2); Data Validation Model (FW3); DocBox 24 (FW4); Proposed ARAR Model (FW5) and DITrustblockchainIoHT Model (FW6). The initial serial numbers for all the selected models were assigned by the experts.

Further, to perform a numerical simulation of performance and prioritization of models, the authors adopted the popular hybrid multi criteria decision-making methodology, named the analytical hierarchy process combined with fuzzy set theory (Fuzzy-AHP) [16,17]. This methodology was used as a mechanism to simulate the effectiveness of the proposed model vis-à-vis the various selected models. This gives an idea about the performance of the models. The methodology has been detailed in the supplementary material of this paper. Fuzzy-AHP is a process that gives accurate results that are widely acceptable and validated. It is a well-established methodology. Simulation of the performance will help the future researchers in identifying the most effective model. The adopted methodology of prioritization works on the membership functions, and the numerical evaluation is adopted by [21–23]. To conduct the numerical evaluation, Table 1 illustrates the triangular fuzzy number for every specific model in a pair-wise comparison matrix. After identifying the pair-wise fuzzy numbers, the examiners defuzzified the values by adopting an α cut approach [24]. Table 2 portrays the value acquired by the α cut approach and the defuzzified value of the triangular fuzzy numbers. The final weights and ranking are described in Table 3 and Figure 6.

Table 1. Triangular Fuzzy Numbers for Every Specific Model.

	FW1	FW2	FW3	FW4	FW5	FW6
P5 Cybernetics Health (FW1)	1.00000, 1.00000, 1.00000	0.97000, 1.25000, 1.61000	1.05900, 1.58500, 2.22100	0.77300, 1.01200, 1.28800	0.76100, 0.91200, 1.09700	1.12800, 1.55400, 1.98800
Personalized Health Dynamic System Model (FW2)	-	1.00000, 1.00000, 1.00000	0.63500, 0.91400, 1.34300	0.42700, 0.63400, 0.96600	0.34800, 0.49000, 0.87300	0.56900, 0.72000, 0.97000
Data Validation Model (FW3)	-	-	1.00000, 1.00000, 1.00000	0.51500, 0.65800, 0.78500	0.52100, 0.66000, 0.91900	0.62700, 0.81200, 1.07200

Table 1. *Cont.*

	FW1	FW2	FW3	FW4	FW5	FW6
DocBox 24 (FW4)	-	-	-	1.00000, 1.00000, 1.00000	0.55600, 0.64500, 0.81200	1.48300, 1.95800, 2.52900
Proposed ARAR Model (FW5)	-	-	-	-	1.00000, 1.00000, 1.00000	0.56900, 0.78600, 1.15600
DITrustblockchainIoHT Model (FW6)	-	-	-	-	-	1.00000, 1.00000, 1.00000

Table 2. Defuzzified TFN value.

	FW1	FW2	FW3	FW4	FW5	FW6
P5 Cybernetics Health (FW1)	1.00000	1.26900	1.61200	1.02100	0.92100	1.55600
Personalized Health Dynamic System Model (FW2)	0.78800	1.00000	1.26900	0.66500	0.55000	0.74500
Data Validation Model (FW3)	0.62000	0.78800	1.00000	0.65400	0.69000	0.83100
DocBox 24 (FW4)	0.97900	1.50400	1.53000	1.00000	0.66500	1.98200
Proposed ARAR Model (FW5)	1.08700	1.81700	1.44900	1.50500	1.00000	0.82400
DITrustblockchainIoHT Model (FW6)	0.64300	1.34300	1.20400	0.50500	1.21300	1.00000
C.R. = 0.006129						

Table 3. Final Ranking.

S. No.	Models/Frameworks	Weights	Ranks
1	P5 Cybernetics Health (FW1)	0.193206	3
2	Personalized Health Dynamic System Model (FW2)	0.129727	5
3	Data Validation Model (FW3)	0.121105	6
4	DocBox 24 (FW4)	0.197429	2
5	Proposed ARAR Model (FW5)	0.204062	1
6	DITrustblockchainIoHT Model (FW6)	0.154471	4

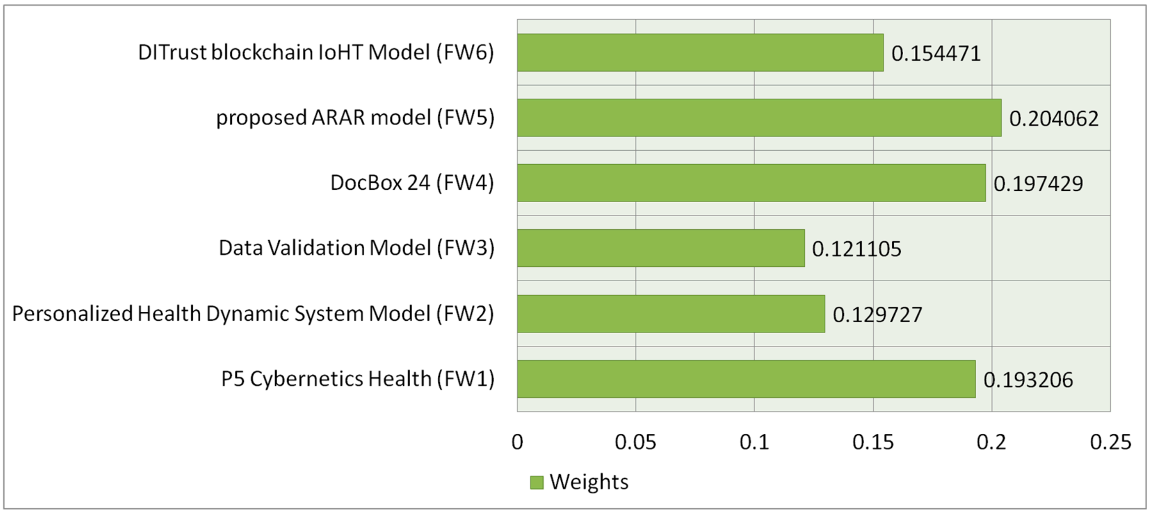

Figure 6. Graphical Illustration of Priority.

However, defining healthcare and its functionality for achieving a secure and systematic workflow is a challenging task, yet as discussed in this paper, various effective models are present in relevant fields to accomplish this ideal goal. Hence, it is a confusing job for researchers and experts to decide which model is effective and which is not. To simplify this challenge and portray a systematic and numerically assessed effectiveness order, this section illustrates an ideal pathway. The result obtained from numerical assessment shows that the proposed model ARAR has the highest effect ratio in all of the selected models with the weight of 0.204062 and Consistency Ratio (CR) value of 0.006129.

The descending order of the prioritization for the selected model is FW5 > FW4 > FW1 > FWW6 > FW2 > FW3. The results discussed in this section of performance simulation portray that FW5 has highest effectiveness and priority and FW3 has the lowest. Overall, the proposed model is one of the most suitable frameworks and ideologies that can be adopted by the researchers and future practitioners in their domain.

2.8. Significance of Symmetrical Model towards Healthcare

A conceptualized ideology can only be validated if it is proven efficacious. A proper discussion and analysis can only convince the industry about the potential of the model. The authors have provided an ideology of cybernetics from a new perspective for the research community. In this context, it is equally important to cite the significance and potential of the suggested ideology for the betterment of the healthcare sector. Thus for making this task little easier and more specific, the authors have discussed the significance of the proposed ideology for mapping the design process for healthcare.

The proposed cybernetics ideology states that there is a need to apply every step during the design process as a conversation approach [13]. Conversation approach is the best way to understand the gaps between the current and the next phase that need to be bridged [13].

The proposed model is the best example of the ideology discussed in the article about how this thinking can change the whole process of designing. Cybernetics in digital healthcare infrastructure designing will be a revolutionary step, if applied as discussed in this article, i.e., based on the conversation approach. The concept has been illustrated more emphatically through Figure 7.

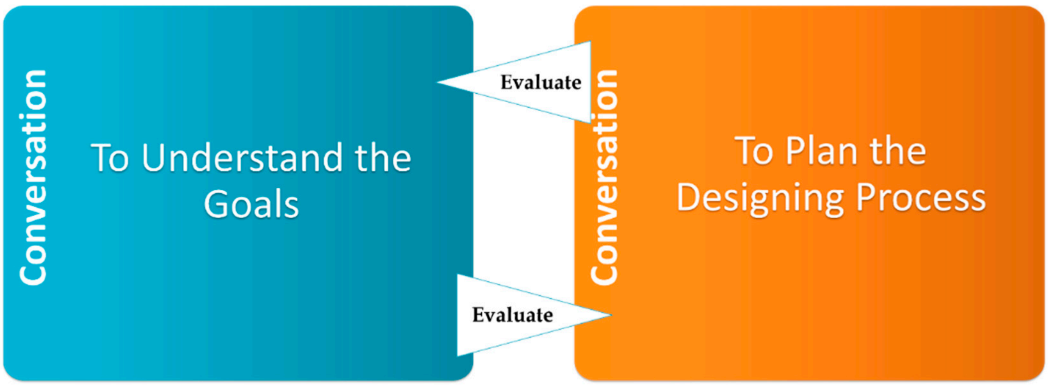

Figure 7. Summary of Proposed Symmetrical Ideology.

The above Figure 7 clearly describes a mutual conversation based technique that needs inter evaluation between the design processes. Designing the healthcare infrastructure from cybernetics perspective demands an initial but thorough understanding of the designer's idea. As shown in Figure 7, whenever the designers think about designing a process, they need to follow this basic understanding of clarifying the goals before designing and then preparing the whole design process according to the conversation-based results. Based on the assessment of the cybernetics methodology, it is very significant to apply the above ideology of conversation for effective results in symmetric designing.

Furthermore, if we talk about the significance of the proposed model in healthcare, then we need to analyze the usability of this model in layered categorization of healthcare. The most significant advantage of using the proposed model in healthcare layered categorization is that of the scope and space for possible variety of situations. As cited in the present study, variety affects almost every aspect in healthcare infrastructure and the experts must maintain requisite variety in healthcare for effective operatability of the system. Symmetric operation continuity is always important and required for any type of a system.

Moreover, numerical analysis always portrays a significant role in understanding the effect and usefulness of any proposed system. Thus, the authors have conducted a numerical analysis of the performance of the proposed model by conducting a comparative analysis. The results, as discussed in the previous section, clearly illustrate that the proposed ARAR model has the highest priority in all of the selected models. The analysis was done by using the well-established Multi Criteria Decision Making (MCDM) approach fuzzy AHP which provided accurate and conclusive results. This type of comparison and performance estimation is a novel concept and would prove to be a corroborative mechanism for researchers and practitioners working in this domain.

The cybernetics ideology that the authors have suggested in this study demands a conversation based process that firstly identifies the goal, and then prepares a symmetric designing process based on the requisites for achieving the planned goal. Hence, the proposed model would not only give optimum productivity but also save on the time, cost and other resources invested in developing the healthcare infrastructure. Moreover, this procedure demands a unique but conceptual thinking that is called the *modern day cybernetics.* The suggested model would provide symmetric operational system that is inherited from variety. The management of these issues would give usability without any interruption because the proposed model analyzes and effectively reduces the possibilities of failure by its conversation-based prioritization and remediation approach. The symmetric operatability thus obtained, produces efficient operation execution in the system because if usability is maintained in any system, without any interruption, then high operatability can be achieved automatically by any system [17].

3. Conclusions

It is a difficult task to manage the healthcare infrastructure smoothly in the current era. Every new update and patch in the system creates a loophole or possibilities for failure, thus posing a huge risk to the infrastructure. A thorough perusal of the issues in healthcare, as discussed in this study, cited that variety is one of the most critical issues. A symmetric understanding and perspective analysis is needed to tackle this issue in the present day healthcare infrastructure which is becoming even more complex because of digital deployment. Researching this premise, the authors proposed an ideology of cybernetics that has the potential to be an efficacious mechanism. Moreover, the variety issue of healthcare can only be minimized by managing its wicked nature. The suggested model would be successful in achieving the target of reducing the issues of variety by managing and comparing its different sources and its possible estimated variety. The propositioned model is only a conceptual overview of the vast work that is under development by the authors.

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Appendix A

The authors also applied keywords such as "Symmetrical Healthcare Model", "Cybernetics in Healthcare", and "Digital Model Healthcare", associating the arithmetic search operators AND and OR on various research data repositories such as Google Scholar, IEEE Xplore, ResearchGate, etc. The total number of search results found on these data repositories was around 10,000, but, unfortunately, many of them were duplicate and irrelevant to the topic. To exclude the irrelevant and duplicate papers from the search results, the authors performed various stage-wise analyses. In the first stage of the search, we excluded or included the studies based on their title. In the second step, we analyzed the abstracts of the papers and matched their requirements such as cybernetics and symmetrical modeling. Overall, the authors adopted a thorough review process of the previous research studies [16]. Among these as well, the authors found very few articles that were partially similar to the topic or its core intent.

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