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Challenges for adoption of smart healthcare strategies: An Indian perspective

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Summary

Smart healthcare management strategies have shown great promise in delivering the best quality healthcare to all and is the best possible solution to address the challenges in meeting the goal of quality healthcare to all. The Indian Government has set out ambitiously in this regard through the Ayushman Bharath Digital Mission (ABDM) which "aims to develop the backbone necessary to support the integrated digital health infrastructure of the country". As this flagship project is rolled out, it is important to understand the various challenges to the successful uptake of this mission. The objective of this review is to systematically examine published literature to identify and compile a list of such challenges. The knowledge of such challenges is critical to make the ABDM successful. EBSCOHost, PubMed, Scopus, Science Direct and Open Access databases were systematically searched for full text, peer reviewed, English articles that have listed such challenges in the adoption of smart healthcare. In addition to these searches, the ABDM portal and the document store have also been used for analyses since the scope for this review is India.

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were used to select eligible articles. After the full screening,12 articles that met the criteria were analysed and used to identify 11 key challenges for adopting smart healthcare management strategies. Identified challenges will enable Indian health sector policy makers and healthcare leaders to understand and accurately evaluate potential solutions of adopting ABDM strategies. It is important to emphasise that the success of ABDM is dependent on its adoption by public and private sector entities and by individuals and decision makers. It is concluded that future research is needed in identifying key smart healthcare management strategies and key drivers for adopting smart healthcare management strategies.

Keywords: Healthcare services, smart technology, smart healthcare, challenges, digital health, eHealth.

- **Track 22**: Organisational Transformation Change and Development
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Introduction

Healthcare systems across the India are facing unprecedented pressure. Healthcare in India has long been provided in unconnected silos by individual doctors and in small hospitals (Thakur, et al., 2018). Care is typically initiated by patients who seek treatment in the private sector for which they pay providers an “out-of-pocket” fee. Additionally, the urban-rural divide too is stark with most doctors and the healthcare infrastructure being concentrated in the urban areas. The United Nations Population Fund reported that the aging population of India is expected to grow to 173 million by 2025 and approximately 240 million by 2050. The population share of senior citizens is expected to increase from 8% in 2015 to 19% in 2050 and 34% by the end of the century. This predicted scenario demonstrates the reality and severity of the situation, the country is expected to face, and at the same time provides the ground to plan and exercise measures for a healthy self-sufficient society. India needs to effectively adapt to the situation and bring changes for the well-being of elderly. It is imperative therefore to adopt digital or smart healthcare systems to bridge this gap and make healthcare more equally accessible to all. Therefore, India and many other countries are looking to digital transformation to close this gap but progress has been slow and the digital maturity of providers, both within and between countries, varies widely (Deloitte, 2020). India is signatory to Sustainable Development Goals 2030 - Goal 3: Good health and well-being and Universal Health Care Framework adopted by the UN General Assembly in 2019. In response, on 26 September 2021, the prime minister of India, Narendra Modi, officially launched the Ayushman Bharat Digital Mission (ABDM).

This ambitious digital initiative aims to improve care and reduce costs across healthcare by creating a database of health records that will connect patients to a digital ecosystem with providers and payers. However, digital transformation is not simply about technology. It is about adopting a change management process enabled by technologies to increase the benefits for patients, clinicians and healthcare systems as a whole. Because of India’s size and variegations, this endeavour will have challenges (Nundy, 2021). Digitising health in the rest of the world has been challenging and will be in India, too. Smart healthcare management strategies have shown great promise in delivering the best quality healthcare to all and is the best possible solution to address the challenges in meeting the goal of quality healthcare to all. Also, delivering any public service effectively requires an efficient public health workforce. India has a rather low density of healthcare workers (Narain, 2016).

Indian Government laid out the key principles in the National Health Policy (NHP) blueprint (2017) to include universality, citizen-centricity, quality of care and accountability for performance. The NHP aims to attainment of the highest possible level of health and wellbeing for all at all ages, through a preventive and promotive health care orientation in all developmental policies, and universal access to good quality health care services without anyone having to face financial hardship as a consequence. This evolved through the National Health Stack (NHS, 2018) to the present ABDM (2021) (see Table 1). The journey of the ABDM provides a view of the transformation of policy to a digital blueprint that encompasses goals, components and implementation guidelines.

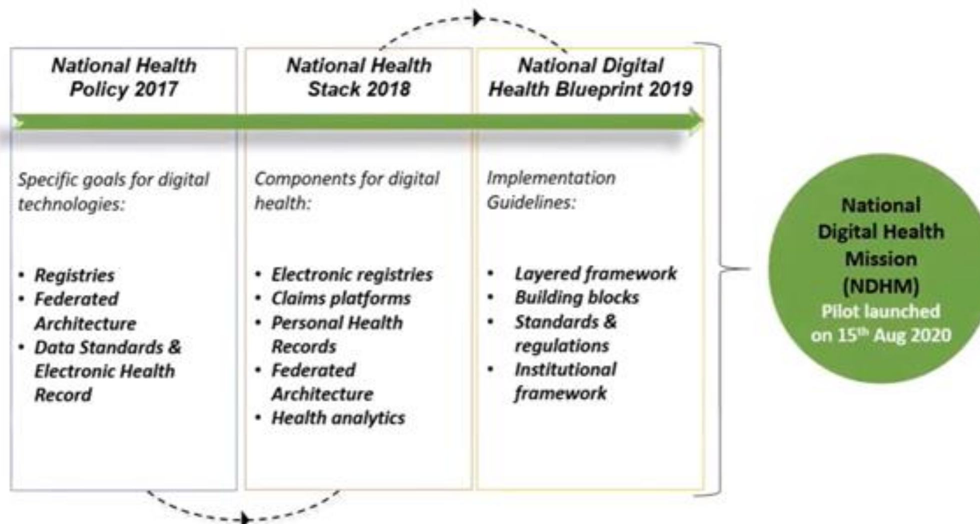

Figure 1: India's journey towards National Digital Health Mission
Source: ABDM (2021)

The National Digital Health Blueprint lays out the implementation framework for the National Health Stack (NHS). This blueprint takes into account the global best practices in adoption of smart or digital technologies. However, a clear assessment of the challenges in adopting smart healthcare strategies, especially in the Indian context is critical to the success of the ABDM. This review aims to fill this knowledge gap.

Digital technology is the enabling instrument for the realisation of this goal. Understandably, the mission itself was christened 'National Digital Health Mission'. The present name is 'Ayushman Bharath Digital (Health) Mission' (ABDM). Following the clear policy statement, an implementation blueprint - the National Digital Health Blueprint- based on adopting digital technology was produced. The vision states thus "universal health coverage in an efficient, accessible, inclusive, affordable, timely and safe manner, that provides a wide-range of data, information and infrastructure services, duly leveraging open, interoperable, standards based digital systems, and ensures the security, confidentiality and privacy of health-related personal information." Therefore, it is easy to see that the entire health mission is resting on digital technology to deliver. However, there are many risks and challenges in adopting technology itself. Technology adoption and concomitant adoption strategies themselves can potentially carry their own set of risks. It is important therefore to identify them and ensure that the implementation strategy of the ABDM takes into account these and addresses them.

Van Doorn (2015) explains what these smart technologies mean. Smart technologies are technologies that use electronic devices or systems that can be connected to the Internet, used interactively, and are to some extent intelligent. Smart healthcare is also a collection of mobile devices, web based applications and digital technologies Treisman et al (2016). Tian, et al., (2019) explain that smart healthcare uses a combination of new generation information technology solutions like internet of things (IoT), big data, cloud computing and artificial intelligence to make healthcare more efficient, convenient and personalised.

Research Gap

The words smart healthcare, eHealth and digital health are used interchangeably in the literature. da Fonseca et al., (2021) provides another definition of e-health where e-health can

be defined as a set of technologies applied with the help of the internet, in which healthcare services are provided to improve quality of life and facilitate healthcare delivery. Yaqoob et al., (2021) noted that handling smart healthcare systems in a secure manner has become very challenging because the data is spread across various medical facilities. Most of existing healthcare systems are centralized that are vulnerable to single point of failures and information leakage due to the rise of cybersecurity attacks. The leakage of patients' personal and critical information can lead to serious consequences. Also, the current medical systems fall short to provide transparency, trustful traceability, immutability, audit, privacy, and security. Since the strategies and even the guiding policies are relatively new, there is insufficient 'on the ground experience' to determine factors of success or failure yet. This is true especially in the Indian context. The NHP is itself from 2017 and the newer ABDM is as nascent as mid-2021. Therefore, the purpose of this systematic literature review is to investigate and identify challenges that hinder the successful adoption of ABDM within Indian healthcare sector organisations. Identified challenges enable policy makers and healthcare leaders to understand and accurately evaluate potential challenges of adopting smart healthcare strategies ensuring proactive interventions are put in place to address these challenges as and when they arise thus improving the chances of successfully adopting smart healthcare strategies.

Methodology

The study follows a systematic literature review, which can be defined as a tool to identify, evaluate and interpret available and relevant studies regarding a particular research question (Kitchenham, 2004). The review is guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). The bottom line question – 'What are the different challenges and barriers in the adoption of Smart Healthcare at scale in India through the Ayushman Bharath Digital Mission? ' is addressed with this review.

Literature Search and Study Selection

The search was done on various electronic databases like PubMed, EBSCOHost, Open Access and Science Direct. In addition to this search on the databases, literature directly available from the ABDM portal has been used in the review. A hierarchical drill down search approach was used and in-built search engines with advanced capabilities provided by the databases themselves were used independently to narrow down to relevant content. The searches were then merged, sanitised, duplicates removed and filtered down to the most relevant articles related to the area of interest. The search algorithm followed the below steps:

Start with an initial scope of all articles with terms like "smart healthcare" OR "digital health" or "e-health" or m-health" in the abstract. Then, when these were identified, further filters were added. Of the identified articles in the first step which would emit a large set, filters like "challenges" OR "barriers" OR "failures" OR "implementation" were added to search terms in ALL_TEXT. This reduced the set size considerably. At this search stage, the search result can be regarded as comprising of articles "being related to health/e-health, smart health" AND which are having some content related to 'challenges' or 'barriers' or 'implementation'. Since our area of interest geographically is 'India', an additional filter term, 'India' was added. Some search engines specifically allow adding 'country' to limit the results while in some others 'India' is just an additional search term. Applying the 'country' filter brought the result set down to a very limited number. At this stage even a manual assessment of the content in each article was possible. An exact result of the above methodology as applied on the PubMed and OpenAccess databases is elaborated below. The query: ((Smart healthcare) OR (ehealth) or (digital healthcare) or (mhealth)) AND (((challenges) OR (barriers) OR (Implementation))

resulted in 928 count. Additional filters leads to English (928 counts), Full text articles (916 counts), last 5 years only (600 counts) and review articles (846 counts). The articles types included in the filters: 'Books and Documents', Dataset, Review, Systematic Review.

On the above result, since our scope was India, 'India' was added to the 'country' filter. This resulted in 38 counts. Additional filters lead to English (38 counts), Full text articles (37 counts), last 5 years only (27 counts) and review articles (36 counts). The exercise of carefully selecting the relevant articles yielded 12 relevant results. These results too do not directly yield material to identify challenges to adoption of smart healthcare in the Indian context. They are specific in nature to particular applications, like Wickramasinghe et al, (2016). It is evident that India specific literature is very sparse in this area.

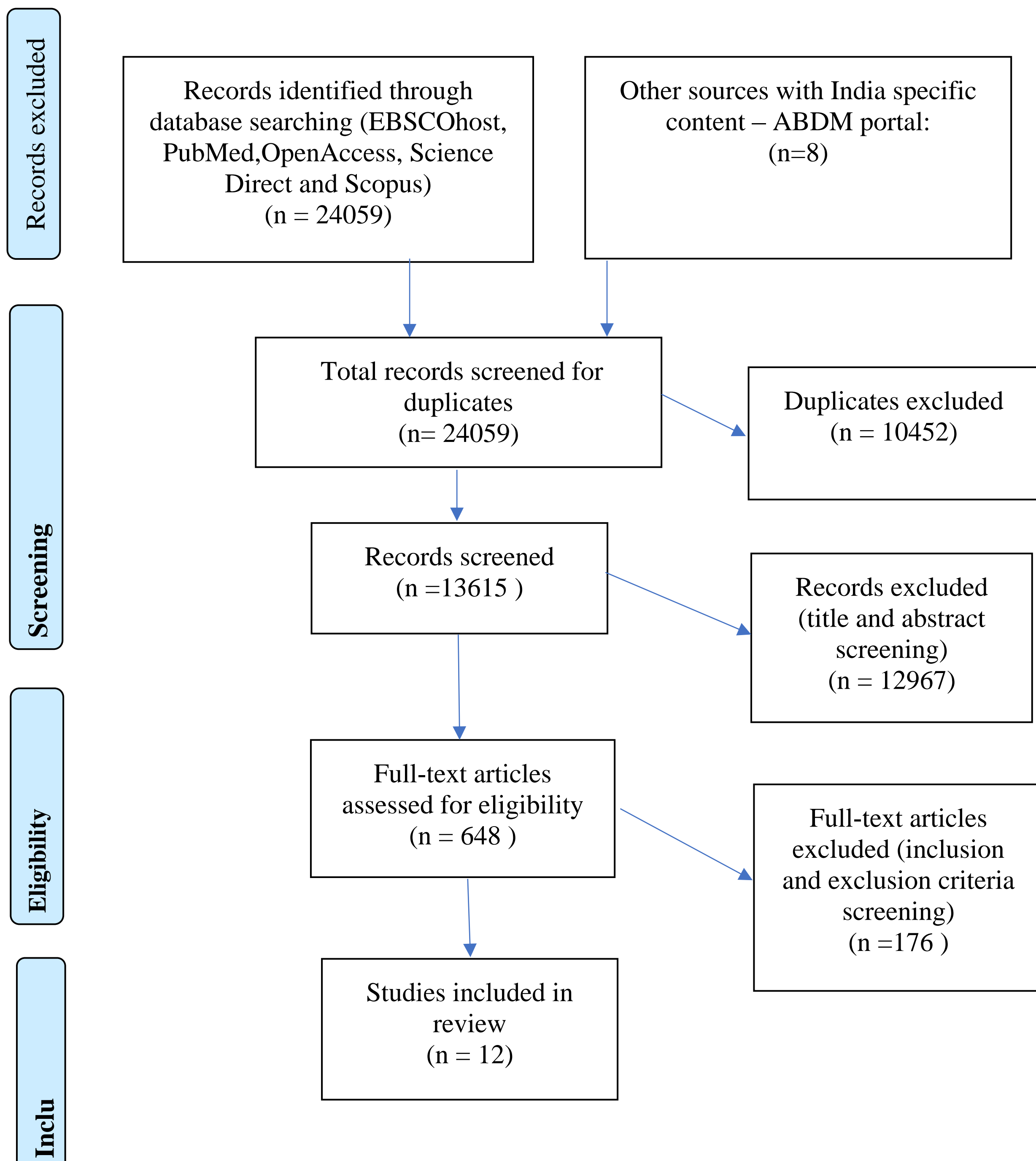

Figure 1: PRISMA article screening process.

As shown in the PRISMA diagram in Figure 1, the search initial broad-based search retrieved 24059 articles and 8 additional records were identified from other sources. All 24059 articles were screened for duplicates and 10452 duplicates were identified and excluded. Title and abstract screening was conducted on the remaining 12967 articles and 740 potentially eligible articles were selected for the next stage. A full-text review of the remaining 176 articles was then conducted using inclusion and exclusion criteria described in the earlier article screening and selection section and a total of 12 articles were identified as eligible and therefore analysed for this systematic review.

FINDINGS

After reviewing relevant literature, eleven main smart healthcare adoption challenges emerged. Each of these key challenges is discussed in detail below. The understanding of the entire ABDM ecosystem (see Figure 2) with its different stakeholders provides a perspective on how these challenges can be categorised and how they impact the different stakeholders.

Figure 2: The ABDM Ecosystem
Source: ABDM (2021)

FINDINGS AND DISCUSSIONS

1. Privacy and security issues

Data Privacy and security is always a big challenge and adoption of any digital strategy must consider these carefully. Digital healthcare especially has to be robust in its handling of privacy as it involves personal and sensitive data of patients (Ameri et al., 2020; Poudel and Nissen, 2016). This data, when transmitted over the internet is all the more vulnerable to be compromised if sufficient privacy and security safeguards aren't in place. The healthcare system deals with a lot of sensitive data that the patients would certainly not want shared or compromised. For any strategy of smart healthcare to be successful, it is imperative that the patients trust the system with their data. Melchiorre et al. (2018) document how a smart health programme in Germany faced challenges due to a lack of trust in data safety.

The ABHM has accorded primacy to data security and privacy. The HDM policy (2019) deals with this issue in substantial detail. This policy is the first step in realising the ABDM's guiding principle of "Security and Privacy by Design" for the protection of individuals'/data principal's personal digital health data privacy." Therefore, at the HDM policy level, sufficient care has been taken to ensure data security and to mitigate the risks from data privacy and security vulnerabilities. Furthermore, the HDM policy addressed the technical challenges related to data security and privacy, including end-user usage and non-conformance to best practices. Also, NDHB has provided the guidelines, based on which the following three policies have been defined. 1. NDHM Information Security Policy for Internal Ecosystem; 2. NDHM Information Security Policy for External Ecosystem; and 3. NDHM Strategic Control Policy.

Privacy and Security challenges pan across the eco system, right from the end users to the policy makers to the implementing organisations. The first step however starts with the correct security and privacy policy in addressing this challenge. With a tight policy in place, it then becomes a technological challenge in implementing it.

2. Data governance

The term 'data governance' emerged to describe how organizations manage and influence the collection and utilization of data. Data is now one of the most valuable assets in any organisation, especially as healthcare transitions into a more digitally-driven industry (KPMG, 2018). According to Gagnon et al. (2016), Data governance is the ownership, control and management of information. This means, the ownership of data and the ethical handling of it has to be very well defined. The legal framework has to be robust too and has to specifically cover smart healthcare. Even when data privacy regulations are well defined, legal frameworks may be lacking. Melchiorre et al. (2018) point out that though many countries in Europe have national legislation to protect privacy of electronic data, there is still a lack of dedicated legislative frameworks relating to smart healthcare data.

The ABDM has a well outlined Health Data Management policy. The governance of data is also addressed particularly in Chapter II: Entities under the NDHE, Applicable Law and Governance Structure. The Consent Framework along with the Rights of Data Principals have found elaboration in the policy document underlining the importance of 'Strong Data Governance' is also a guiding principle in the design of the National Health Stack. Section - 'Guiding Principles for the Overall Design of the National Health Stack'. A data governance strategy should reflect an organisation's strategic goals, risk appetite, culture, and economic

and regulatory environment. Data and analytics is a dynamic area and Indian healthcare organisations and systems need to be agile to respond to constant change.

The data governance challenge is addressed with clear policies and is mitigated with a strict implementation by the providers. This is an administrative and policy challenge to the extent of defining very clear data governance policies, but is an organisational and a technological challenge in the policy implementation.

3. Interoperability issues

Smart healthcare involves an elaborate and a complex ecosystem. It is not a monolithic solution that simply can be created entirely newly. With new models of care emerging and evolving, there is a clear need for more effective information sharing between care settings, organisations and geographies, as well as between professionals and citizens, to optimise patient outcomes and quality of care. This is reliant on the ability of digital systems across health and care to be interoperable with one another and is key to the delivery of the future vision of care in India.

More integrated ways of working across health and care are necessary to enabling care professionals and citizens to better manage care. It is an ecosystem involving many entities and stakeholders – doctors, patients, clinics, hospitals, diagnostic labs, research centres, insurance providers, pharmacies, etc. Any solution involving such a complex and eclectic ecosystem will be successful only if interoperability is possible and is as seamless as possible. Other than just the stakeholders in the ecosystem, technical considerations like mobile connectivity, protocol compatibility (e.g., 2G, 4G, 5G, etc), cloud-based solutions, legacy systems, electronics' dependencies etc. pose huge challenges to interoperability, thus also making it a very critical area for successful adoption. The fundamental motivation for interoperability is the seamless movement and sharing of data amongst the ecosystem pieces. It is important to note here that many entities could already be using custom-built (legacy) digital solutions. It is a huge challenge to integrate existing systems into the new one.

Paaske et al., (2017) noted that many diagnostic labs could be using their custom-built solutions. They will have a lot of patient data. How to reconcile this with the new standards taking into consideration security of data and technical incompatibilities. This naturally has a huge cost factor too. It is a prohibitive expenditure to coerce existing entities to completely move to a new system. Therefore, interoperability with existing systems is a key part of the solution.

The NDHM Blueprint has a full section devoted to Standards and Regulations Section 3. - Interoperability in the context of digital health is of two types, technical interoperability and semantic and syntactic interoperability. This section defines the minimum requirements of interoperability of both the types. Therefore, at a policy and a level of blueprint, interoperability and the challenges thereof have been addressed in sufficient measure. The technical specifications of communication protocols and technical interoperability standards have been dealt with in the National Health Stack- Strategy and Approach. Interoperability has been addressed through the usage of Open APIs and Open Standards which is one of the guiding principles for the overall design of the Stack. Refer section - Guiding Principles for the Overall Design of the National Health Stack. Bajpai et al (2020) noted six barriers that were identified in the US that hampered interoperability: There is no universal patient identifier – ABDM addresses this with unique patient IDs; Electronic health information is not structured or standardized to the extent that it can be fully computerized. ABDM defines clear digital

standards for all information; Lack of financial motives to share information; Differences in relevant statutes, policies and regulations. ABDM centralises the policies and regulations; Lack of reliable and systematic method to establish trust across different networks. ABDM extensively deals with interoperability and secure data transfers across networks and components; and Patient portals don't connect with multiple providers and therefore provide less value for patients, especially for those who receive treatment from multiple providers for chronic or complex conditions. ABDM addresses this with the proposal of the United Health Interface (UHI). The NDHM BluePrint also proposes a Health Information Exchange (HIE) which allows real-time seamless exchange of data between all the actors of the health ecosystem. This is achieved through open APIs and other data exchange mechanisms. This is mostly a technological challenge and impacts most the service developers and providers.

4. Standards for data representation

Eden et al. (2016) explain that lack of data and terminology standards greatly affects the adoption of smart healthcare strategies. Especially in a complex solution that encompasses an entire ecosystem, definition of standards has to start by defining the terminology. There has to be clear articulation of the meaning of entities, principals, data, building-blocks, etc. The BluePrint has a full section devoted to Standards and Regulations – Section 3, The Health Data Management Policy. Chapter1- Section 4 and 5 are about 'Definitions' and 'Entities'. Though the definitions and entities are explained as used in the policy document, it is nevertheless important in the context of the policy itself. Data representation is mostly a technological challenge. The Administration and Policy stakeholders however have to provide unambiguous clarity in the standards for data representation. These standards are then used across the ecosystem from the policy definitions to the technological implementations.

5. Poor data quality

Data quality plays a very important role in any digital-based solution. Poor data quality can potentially affect the entire solution. In healthcare, it can even affect the quality of treatment of a patient or affect important policy decisions. Data quality is also tied into data governance directly. Governance policies, adherence to best end-user practices and a strong technical stack are all required to maintain good data quality. The final measure of data quality is the confidence the user has on it. The data has to be accurate, reliable, valid and complete – these are the most essential characteristics of data quality.

In a highly heterogeneous system involving many diverse building blocks of the ecosystem, data quality can get compromised in many different ways and in many different places. It is important therefore that all the critical data, however massive may it be, has to be centralised or at least centrally governed. For this, the ABDM proposes that the entire master data of health will be in massive electronic registries. These registries can contain various data of and for the stakeholders. It could be healthcare providers, beneficiaries, doctors, insurers, etc. It could be even data/information about various health programmes. These registries with well-defined and secure APIs to interact with form the basis for good data in the National Health Stack. The section –'Principles of well-designed registries' enumerates good design principles that directly help in enhancing and maintaining data quality. The NDHM Blueprint, in the section 3.6- 'Standards for Patient Safety & Data Quality' – discusses how standards are defined and imposed on electrical and electronic equipment and instruments and how these standards help to maintain data quality. Though all of these are addressed in policy documents, it will be some

time before the real issues on the ground pertaining to poor data start surfacing. But, it is imperative that at least these challenges are foreseen and proactive measures are suggested. This challenge falls primarily in the 'technological challenge' category. Though poor data quality finally has an impact on the end user the most, it affects the other stakeholders too like the policy makers, the administrators and the providers.

6. Functional and non-functional system issues

These are challenges that can affect the actual use of smart healthcare technology. Complexity of usage, being user-unfriendly, unintuitive user experience, etc. can slow down the adoption of digital solutions. In addition, slowness of user-experience, systems not being available 100 percent of the times or requiring regular disruptive maintenance are factors that could restrict users from embracing the system. Any digital system is meant to make our work efficient and quick. If they on the contrary slow us down, it causes enough frustration leading to avoid using the solution altogether.

The ABDM does not yet define the service level expectations or agreements. Or at least they are not publicly available. A seamless and highly responsive user experience across a heterogeneous ecosystem is very hard to achieve. Though the National Health Stack defines the architecture and design of the stack and encompasses good user experience as a design goal, how it pans out in actual implementation is yet to be seen. There could be many factors like quality of internet connections that could influence the final user experience.

In fact, just the non-uniform availability of internet connections itself builds a digital divide. But, there is no doubt that internet penetration is improving tremendously in the country with optic fibre cables connecting every village and bringing high speed internet to almost every nook and corner of the country. Affordability too has become easier. Yet, many non-functional issues exist that could affect the uptake of digital solutions. This is both a technological as well as an end-user challenge.

7. Costs

Smart healthcare technologies can involve very high costs. Infrastructure, software, implementations, maintenance, all add to high costs. Such initial high costs may even discourage healthcare providers from adopting these strategies (Kruse *et al.* 2015; Mileski *et al.* 2017). Governments have to support through generous budgetary allocations to provide required financial support to organisations. Lack of such support funding can be a significant problem (Lim *et al.*, 2018; Gagnon *et al.*, 2016).

The ABDM explains how the goal is in fact to reduce the cost of healthcare and provide quality health services to all. The ABDM is a mission based project funded largely by the government of India. The 'financing model' as explained in the NDHB considers the digital health infrastructure as a public good. The government will support through budgetary allocations to setup the core components and the core infrastructure. The NDHB also has assessed that the development cost (capital cost), people and property (operating cost) forms the major component of such organisations adopting smart healthcare strategies (NDHB, 2019). Costs affect every stakeholder. But, when the government is pushing a solution in a top-down manner, it becomes imperative for the government to absorb costs to the extent possible. Costs, can be categorised as a technological challenge, primarily owing to the fact that a very substantial and high cost is for the technology development and support. Though it is an

organisational challenge as well, in the context of ABDM being a digital mission, it can be categorised as a technological challenge.

8. Urban and rural divide of trained/skilled healthcare workforce and infrastructure

It is by now widely acknowledged that health workers, as an integral part of health systems, are a critical element in improving health outcomes. The absence of well-educated and properly managed health workers was also identified as one of the health systems constraints to achieve the SDGs, along with poor infrastructure, drugs and supply systems, and information systems (Travis et al., 2004). Patel et al., (2021) conclude that IT infrastructure to support digital healthcare is more frequently lacking in lower and mid-tier health facilities. Not only is there a gap in physical infrastructure, shortages in trained personnel is also a challenge. These factors impose significant constraints in adopting smart health interventions. Narain (2016) noted that concentration of health workforce in urban and semi-urban areas thereby catering only to about 20% of the population. Adding to this issue of skewed distribution of healthcare workforce, there are also challenges in adoption because of lack of training and skill. ABDM in its strategy overview has identified this issue and has proposed setting up of a 'NDHM capacity building team'. This team will help in capacity building of all stakeholders in the eco system.

9. Governance Challenges

India is a country with a federal governance setup where distribution of legislative and executive rights are distributed across the centre and the states. This poses many challenges in the successful adoption of healthcare strategies. It is imperative that the centre and states cooperate, adopting (localised) state level customisations where required to deliver healthcare to all. It is observed many a time that centre and the states may be represented by political opponents who may not be motivated equally for the implementation of central policies. These can cause issues in the implementation of smart healthcare policies too. Administrative and policy challenges can affect the entire ecosystem and can potentially joepardise the entire mission if not idenfied, tracked and mitigated.

10. End User Challenges

These are challenges faced by the end-users of the system. The end users are key stakeholders which has also been identified in the Unified Health Interface (UHI). The patients can be regarded as the end users in the context of the ABDM. End user behaviour is dictated mainly by the usefulness one finds in the system. Razmak et al., (2018) define perceived usefulness as the degree to which an end user considers that using any system will improve one's performance. Other than usefulness, reliability of the system too plays an important role in its adoption. Kapadia et al. (2015) explain how end users are reluctant to adopt smart healthcare strategies due to lack of reliability. The example cited is of false alarms. Such reliability factors are critical especially in healthcare where lives are involved directly. Another factor that determines the end users' adoption is the ease of use.

Razmak et al. (2018) define ease of use as the degree to which an end user deems the use of smart healthcare strategies as free of effort. Therefore, using the digital tools should be simple. User experience plays an important role in the acceptance of technology. A solution does not provide a good user experience due to factors such as: poor layout of information, poor design,

poor reliability and extensive use of technical jargon. (Lim et al., 2018; Gagnon et al., 2016; Kapadia et al., 2015 and Paaske et al., 2017)

The ABDM proposes UHI- Unified Health Interface. The section - Need for Standards in Digital Health Interactions in the UHI document discusses how this is important. Another important factor is the trust and privacy that the end user tools provide. Since this is patient health data, it is all the more imperative that there is absolute data privacy. This can bring confidence to the end user to use the system. This is discussed in section 3.5 of UHI, "Trust and Privacy in UHI and UHI Network".

11. Organisational challenges

The healthcare facilities like hospitals, dispensaries, clinics, diagnostic centres, pharmacies etc., both private and public are part of the healthcare ecosystem. While the governments, both centre and the state can be considered as large organisations in the federated ABDM structure, the challenges in adopting smart healthcare is more in the context of the aforesaid facilities. Organisational challenges are many. One important challenge related to the organisation is the readiness. Faber et al. (2017) define organisation readiness as the availability of the required resources for the successful adoption of smart healthcare strategies. The required resources include IT infrastructure, IT governance and security resources, skilled personnel to handle the IT infrastructure as well as operating the systems and financial resources. All of this require good planning and leadership at the organisational level. Changes to adopt smart healthcare strategies have to be driven from the top while also being sympathetic to the challenges posed to the end users in the period of change. Faber et al. (2017) notes the importance of good leadership in playing a crucial role in the acceptance of the smart healthcare strategies by end users. Good leadership has to articulate clearly the vision of the organisation and the benefits of the smart healthcare strategies.

Adopting new smart health strategies could even be disruptive. It is important for the organisational management to understand and have full knowledge of the systems. Zadvinskis et al., (2018) cites the lack of knowledge in healthcare provider organisations resulting in increased workflows and added requirements for clinicians. This also dovetails into the interoperability challenge where there is lack of knowledge of the existing workflows and of how newer smart strategies can be integrated with the old.

ABDM lays out elaborate ways in which facility providers can integrate with the mission. While interoperability standards allow existing systems to integrate with the new, the NDHM architecture, sec 1.5 in the UHI paper proposes a Unified Health services interface along with user applications. These user applications are where participants in the healthcare ecosystem, especially the facility organisations can greatly innovate and contribute. NDHM through some reference applications will demonstrate capabilities and will spur innovation by other organisations.

Conclusions and recommendations

There are 1.3 billion citizens in India and healthcare sector has been neglected for a long time. The COVID-19 pandemic has accelerated the pace of digitalisation of some aspects of healthcare in India. Increasing numbers of citizens across India are no longer prepared to be passive recipients of care, instead they expect to be able to access care quickly and easily when it suits them, and to have choices based on trusted advice and reliable information. In this

direction, ABDM is an ambitious public scheme and holds great promise. Digital technologies can integrate care, identify and reduce risks, predict and help manage population health needs, and improve the quality of data flow to deliver timely, efficient and safe care.

The current study reveals that achieving digital healthcare transformation means change for the health sector, and that such a process of change depends on the ability of stakeholders and individual healthcare providers and patients to manage and work with new knowledge. Digitising health in the rest of the world has been challenging and a number of failures are still being recorded. Having investigated on current literature, 11 main challenges are faced by healthcare provider organisations in India. The 11 challenges identified are: privacy and security issues, data governance, interoperability issues, standards for data representation, data quality, functional and non-functional system issues, costs, urban and rural divide of trained/skilled healthcare workforce and infrastructure, governance challenges, end user challenges and organisational challenges.

The paper concludes that digital transformation is an integrated and complex process. Digital transformation of Indian healthcare sector is not simply about technology. It is about change management enabled by technologies to help increase the efficiency and effectiveness of service delivery and the benefits to patients and clinicians. Therefore, it suggests that the Indian government needs to create a robust healthcare digital infrastructure that includes connectivity, safe data storage and consented access to health data and data sharing. Also, it is necessary to address the urban and rural divide of skilled healthcare workforce and digital infrastructure. Furthermore, establish a robust governance framework to support change management and a culture of digital transformation, including clarity over data ownership, cyber security, patient consent and patient education. The scarcity of knowledge and expertise associated with digital transformation is, and will continue to be, a huge challenge for many healthcare staff to recommend digital services and products to patients and service users. Therefore, training and education related to the digital literacy will help leaders, managers and change agents to understand better how to craft and recommend digital services and products to patients and service users.

Given that the research reported on in this paper is based on review of literature, the results presented here are only tentative and of limited value for the purpose of generalisation. Therefore, additional research with more elaborate and better articulated designs is therefore called for, to further explore the complex mix of key challenges which Indian healthcare sector face in achieving Indian Government's ambitious Ayushman Bharath Digital Mission.

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