Pakistan's National Healthcare Challenges and their Mitigation through the Emerging Information Technologies: A Narrative Review

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Abstract

Pakistan's healthcare system faces numerous challenges. These include insufficient budget, inadequate healthcare infrastructure, and a shortage of human resources. Limited access to healthcare services, affordability issues, and concerns about the quality of care further compound the problem. Healthcare system is also suffering from shortage of skilled healthcare professionals, lack of health data management and analysis, and the absence of public health surveillance/disease management systems. Patient safety is another critical concern. This study strives to undertake the analysis of these challenges within two main domains: what Pakistan's Government is doing to mitigate these obstacles; and how modern information technologies can support in solving these problems and revitalise Pakistan's healthcare system.

Keywords

Health Information Technologies, Healthcare Infrastructure, Health Policy Making, Health System Challenges, Healthcare Delivery System

Introduction

As public needs are continuously evolving, new public health issues emerge, and demographic patterns differ across the globe, no healthcare system can be considered ideal. So, there is no exception to this rule in Pakistan's healthcare system (PHS) (Hasan et al., 2022). The accessibility of sustainable health care to the people of Pakistan, which is a low- and

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middle-income nation (LMIC), is hampered by a lack of funds, a substandard healthcare infrastructure, and a shortage of medical professionals. Pakistan is not alone in facing the above-mentioned challenges: numerous other LMICs throughout the world are with it (Khattak et al., 2023). All systems should be thoroughly assessed for their weaknesses and strengths and must be continuously updated to meet the demands of people (Khan et al., 2023).

Health information technologies (HIT) are developed through integration of a wide spectrum of technological innovations, which may be used by all the stakeholders involved in the exchange and management of healthcare data. Healthcare stakeholders include the whole breath of beneficiaries and providers (Blumenthal & Glaser, 2007). Serving a population of over 241 million (Pakistan Bureau of Statistics, 2023a), PHS spans government and private healthcare systems (Hasan et al., 2022). PHS is facing several difficulties, such as inadequate financing, limited infrastructure, the migration of healthcare professionals (brain drain), insufficient concentration on the preventative healthcare, and disparities in resource allocation (Khan et al., 2023). Given the large population size the country, low GHS (Global Security Health) index, and higher scales of poverty, the government's responsibility becomes critical in terms of planning, execution, and monitoring of health system enhancement (UNDP, 2023).

A healthcare system must have the capability to adapt to the changing population requirements and continuously emerging new public health issues. Its management must be aware of its limitations and ought to be continuously working to overcome its shortcomings by taking lessons from other healthcare models throughout the world. This article strives to examine the major obstacles that PHS must overcome, assesses the country's first all-encompassing attempt to attain universal access to health coverage, and examine the impact of the integration of the health information system with public and private hospitals.

The key issues that PHS is facing include brain drain, resource disparities, low healthcare funding, and poor adherence to preventative treatment. Nevertheless, a major achievement of the nation's healthcare system is the recently implemented Sehat Sahulat Programme (SSP),

which is designed to ensure universal health coverage (Khan et al., 2023). The Government of Pakistan has set a vision to improve the overall health system of Pakistan and published the National Health Vision 2016-2025 in the form of a report. It describes the Government's vision as "to improve the health of all Pakistanis, especially women and children, by ensuring equitable access to essential, high quality, and affordable health services. It seeks a resilient and responsive health system: ready to attain Sustainable Development Goals and fulfil its other global health responsibilities." The government has also set up a National Digital Health Framework in November 2021 (Ministry of National Health Services, 2016).

Integration of Health Information System for Public and Private Hospitals

All the public-owned hospitals at the district level are connected to the National Health Information System from all provinces and areas of Pakistan, including Punjab, Khyber Pakhtunkhwa, Sindh, Baluchistan, Islamabad Capital Territory, Azad Jammu and Kashmir, and Gilgit Baltistan. However, there is a need to adopt a common framework so that private hospitals, clinics, telehealth, telemedicine, mHealth, eHealth, public and private diagnostics centres, and other different health projects can be integrated with the National Health Information System. There is a need to enhance collaborations among the stockholders on data sharing (Malik et al., 2021). HMIS (Health Management Information System) is an indispensable tool for any hospital these days to run all the hospital operations in an efficient way. HMIS has different goals, spanning across operational, informational, and decision-making. Apart from these, HMIS compiles data from other sources to make it available to the researchers, strategic planners, and decision makers. Medical institutions can use it for learning purposes with demonstrations to the students comprising real data on diseases as well as patients (Malik et al., 2021).

There is a dire need to formulate a secure framework for Medical Information Exchange among the healthcare providers. For example, the latest FHIR (Fast Healthcare Interoperability Resources) developed by Health Level Seven International (HL7) is a world-renowned standard for exchanging healthcare information electronically. For more than two

decades, HL7 has tackled these issues by producing healthcare data exchange and information modelling standards. FHIR is a modern specification built on emerging industry approaches, but informed by years of lessons around requirements, successes, and challenges gained through defining and implementing HL7 version 2, HL7 version 3, HL7 RIM (HL7 Reference Information Model), and HL7 CDA (HL7 Clinical Documentation Architecture) (Health Level Seven International, 2023). FHIR may serve as a stand-alone data exchange standard but can and will also be used in partnership with existing widely used standards. FHIR is designed to be flexible and adaptive, so that it can be used to accommodate a wide range of Healthcare Information Systems. FHIR facilitates both new applications and legacy applications since it is based on open standards (Aborisade et al., 2023).

Majority of digital health initiatives are siloed and narrowly focused. There is inadequate collaboration between the government and stakeholders on aligning efforts and data exchange. Consequently, many digital health programmes remain poor in interoperability. Integration between diverse data sources and the national health database of Pakistan Health Information System (PHIS) is largely absent. Interoperability across systems and databases remains weak (Pakistan Bureau of Statistics, 2023a). A broader study is required to create interoperability among all such systems to synchronize and collaborate data to improve decision-making (Malik et al., 2021). Recognising the dynamic needs of healthcare system, a Health Planning, Systems Strengthening, and Information Analysis Unit (HPSIU) has been instituted within the Ministry of National Health Services Regulations and Coordination. It will support in managing and coordinating the health information data, via an integrated online Health Information system – the PHIS – which functioning as a National level knowledge hub anchored in District Health Information System, M&E, surveys and vertical programmes data (Alotaibi & Federico, 2017).

In Pakistan, the telemedicine project was first initiated by the Electronics Government Directorate (EDG), Ministry of Information Technology, Islamabad, in 2007 in Holy Family Hospital Rawalpindi, Jinnah Postgraduate Medical Centre (JPMC) Karachi, and Mayo Hospital Lahore. The project is ongoing in Mayo Hospital, Lahore, and Holy

Family Hospital, Rawalpindi (Kazi et al., 2020). Punjab Information and Technology Board (PITB) is in the process of establishing a consolidated Telemedicine platform throughout Punjab Province. Similarly, Khyber Pakhtunkhwa Information Technology Board (KPITB), in collaboration with the Health Department, has launched the second E-Ilaj Telemedicine centre (Ministry of National Health Services, 2022). It is a health care facility, which will cater to remote areas with the provision of facilities like Video Conference System, Vital Sign Monitor, Digital Stethoscope, ENT (Ear, Nose, and Throat) Scope, and Ultrasound, etc, at their doorstep. By establishing e-health policies, distributing reliable public health information, and opening up telemedicine services, the usage of ICT (Information and Communication Technologies) may be increased (Pakistan Bureau of Statistics, 2023b). Stable healthcare institutions at all community levels, suitable health policies and organizational frameworks, and meritorious, transparent, and accountable innovations are all important factors in fostering effective healthcare governance and leadership. Finally, through establishing compatible practices and revising the laws and rules that oversee medical teaching institutions, it is important to enhance the entire human resource associated with healthcare (Khattak et al., 2023).

Methodology

To ensure breadth and depth, an extensive review of literature spanning the years from 2007 through 2024 forms the basis of this research. More than thirty sources were collected, which were mostly based on government and international reports, peer-reviewed literature, and expert interviews. The quantitative and qualitative data collected during field research were classified using the World Health Organization's (WHO) suggested foundational elements for health systems research, and the data were analysed using a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis technique. Important content was collected from many Pakistani health department publications, boards, and official websites maintained by different agencies and Health organisations of Pakistan’s government around the country, as well as the WHO.

Research Question

The overall perspective of this study is to understand the overall landscape of the health care system of Pakistan, the Government's role and vision, identify gaps, and how modern information technology techniques can be leveraged to enhance the overall health care of the Pakistani population.

Results and Discussion

Fifty-one digital health projects in Pakistan have been studied during the previous five years. Of these initiatives, 46 percent (23/51) utilised technology for research, 30 percent (15/51) for execution, and 12 percent (6/51) for app development. The health domains that were addressed were general health (23/51, 46 percent), vaccination (13/51, 26 percent), and diagnostics (5/51, 10 percent). Smartphones were employed in 55 percent (28/51) of the interventions, and 59 percent (30/51) of the programmes had expansion plans. Artificial Intelligence (AI) or machine learning (ML) was applied in 31 percent (16/51) of initiatives, while 74 percent (38/51) of treatments were assessed. The challenges experienced by developers during the implementation phase included the population's incapacity to use the technology or mobile phones in 21 percent (11/51) of the projects (Kazi et al., 2020).

According to the Bureau of Statistics, Government of Pakistan, the population of Pakistan is 241.49 million with a growth rate of 2.55 percent, based on the unanimously approved results of the 7th Population and Housing Census 2023 by the Council of Common Interests (CCI) (Pakistan Bureau of Statistics, 2023a).

Table 1) Rural and urban population distribution in Pakistan and its Provinces (1998-2023)

ADMN UNIT	RURAL POPULATION (%)			URBAN POPULATION (%)		
	1998	2017	2023	1998	2017	2023
PAKISTAN	67.5	63.56	61.18	32.5	36.44	38.82
KHYBER PAKHTUNKHWA	83.1	83.45	84.99	16.9	16.55	15.01
PUNJAB	68.7	63.14	59.30	31.3	36.86	40.70

SINDH	51.1	48.11	46.27	48.9	51.89	53.73
BALOCHISTAN	76.7	72.38	69.04	23.3	27.62	30.96
ISLAMABAD	34.4	49.63	53.10	65.6	50.37	46.90

In Pakistan, 61.18 percent of the population lives in rural areas, while 38.82 percent resides in urban areas. According to reports published by the Global Health Security Index, Pakistan is ranks 130th out of 195 countries and 8th among 9 South Asian countries (Malik et al., 2021).

A Ministry of Finance report indicates that Pakistan allocated 1.2 percent of its GDP to public health in 2020-2021 as compared to 1.1 percent in 2019-2020 (UNDP, 2023).

Table 2) Public sector health expenditure in Pakistan (2015–2021)

Fiscal Year	**Public Sector Expenditure: Federal and Provincial (Rs million)**			**Health Expenditure (% of GDP)**
	Current Expenditure	**Development Expenditure**	**Total Health Expenditure**	
2015-16	192,704	75,249	267,953	0.8
2016-17	229,957	99,005	328,962	0.9
2017-18	329,033	87,434	416,467	1.1
2018-19	363,154	58,624	421,778	1.0
2019-20 ([1]R)	427,915	77,496	505,411	1.1
2020-21 ([2]P)	534,318	122,867	657,185	1.2

[1]R: Revised [2]P: Provisional

Source: Poverty Reduction Strategy Paper (PRSP) Budgetary Expenditures, (External Finance Policy Wing), Finance Division, Islamabad

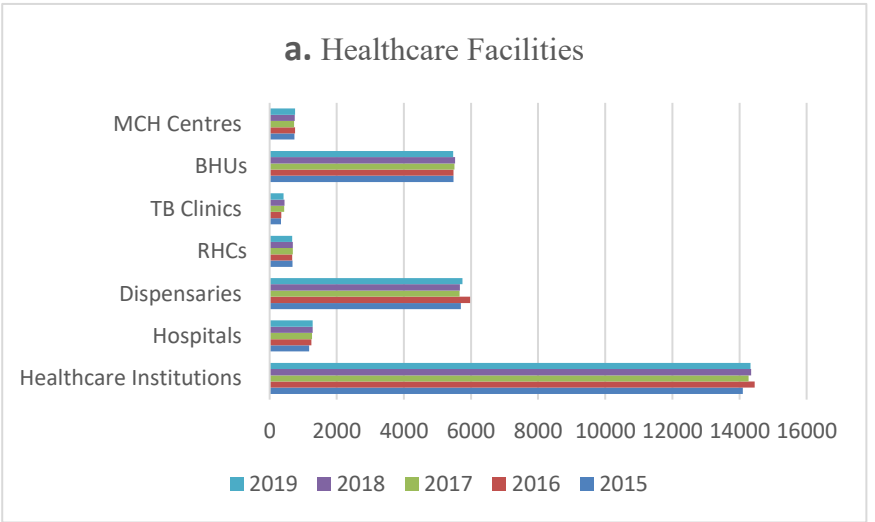
Based on 2019 World Bank data, only 1.084 physicians are available per 1000 people in Pakistan. Pakistan faces a shortage of healthcare professionals, particularly in rural areas. Obviously, the count would have increased in terms of hospitals, beds, and professionals as of 2024. However, the gap remains significant, especially in rural areas (Khan et al., 2023).

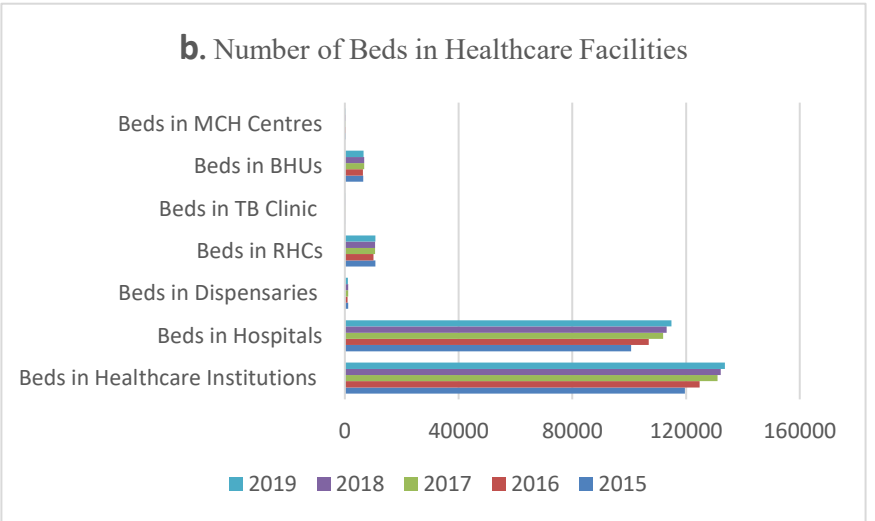
According to the Multidimensional Poverty Index 2023 report published by UNDP, Pakistan's intensity of deprivations is 51.7 percent.

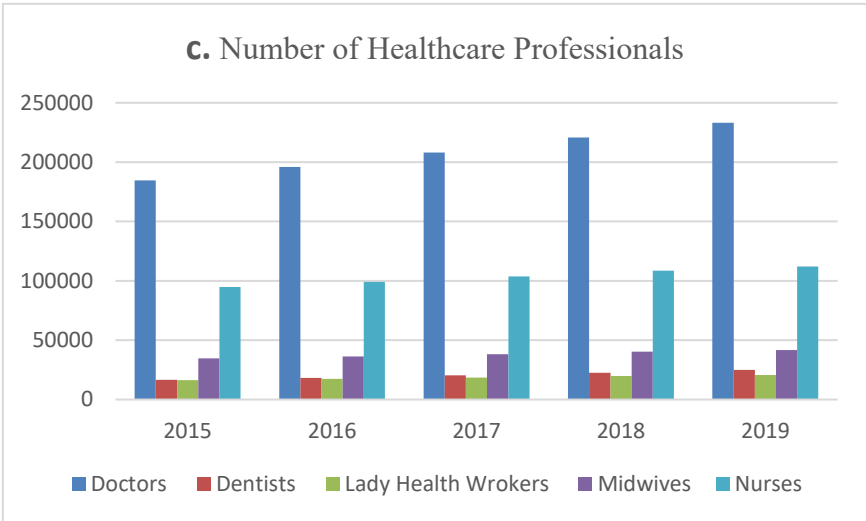
This figure represent the intensity of deprivation among the people living in multidimensional poverty (Ministry of National Health Services, 2022).

According to the report published by the Pakistan Bureau of Statistics, the number of Health Institutions and Professionals in Pakistan is as follows (UNDP, 2023):

Table 3) Healthcare Infrastructure and Medical Staff in Pakistan (2015-2019)

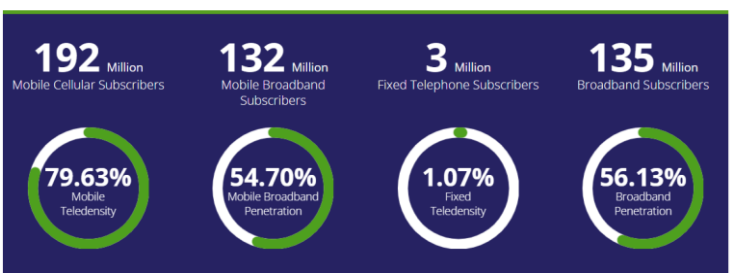






So, to strengthen healthcare services, IT-based platforms can facilitate training and continuing education for healthcare workers through online courses, webinars, and virtual workshops. Furthermore, telemedicine platforms can connect rural healthcare providers with specialists in urban centres for consultations and guidance. To achieve this, we need to focus on mobile and data coverage across the country. As per the current telecom indicators published by Pakistan Telecommunication Authority (PTA), around 192 million Mobile Cellular subscribers exist as of March 2024 in Pakistan (Pakistan Telecommunication Authority, 2024).

Figure 1) Telecom and Broadband Subscribers in Pakistan – March 2024



Modern information technologies have the potential to address various challenges in Pakistan's healthcare system by improving access,

efficiency, affordability, and quality of care. However, successful implementation requires collaboration between government agencies, healthcare providers, technology companies, and other stakeholders to overcome barriers such as infrastructure limitations, digital literacy, and regulatory hurdles.

Government's e-health initiative in the form of personal identification cards, that securely maintains patient records and health histories. It provides doctors and insurers with access to consistent patient histories to make informed decisions. Such government initiatives are also coupled with existing health policies, such as the Prime Minister's National Health Programme, which provides health facilities to underprivileged citizens of the country. The e-health service programme has its own challenges, still, it has directly impacted 3.1 million families in 40 districts, living below the poverty threshold of PKR 200 per day. It has been providing them a benefit of 0.3 million rupees per family per year.

Many of the female doctors leave clinical practice due to household and childcare responsibilities. Telemedicine initiatives like Oladoc (https://oladoc.com/), e-Doctor (SE Software Technologies: https://sesoftwaretech.com/e-prescribing/), and Sehat Kahani (Grocode.io) are worth mentioning in this regard. These platforms enable them to conduct their medical practices remotely via online patient consultation through a telehealth platform.

Conclusion

Modern IT has indeed a potential of improving Pakistan's healthcare by broadening access, efficiency, affordability, and quality. Effective implementation, however, requires collaboration among key stakeholders to overcome infrastructure, digital literacy, and regulatory hurdles. Government's e-health initiative, for instance, is a great effort in this regard. Along with supporting the timely and informed decisions, it has been providing thousands of families with a benefit of 0.3 million rupees per family per year. Lots of female doctors leave clinical practice due their family responsibilities. Telehealth platforms like Oladoc, e-Doctor, and Sehat Kahani (Grocode.io) can bring those female doctors into the

mainstream practice again. Mobile health applications can also facilitate health education and awareness campaigns, reaching even the most remote areas. Apart from this, other popular social media platforms should be efficiently utilized to run health awareness campaigns, circulation of authentic guidelines on nutrition and diet, and messaging on how to avoid the spread of communicable diseases, etc. Formal official channels ought to be created, and relevant media should be uploaded for the betterment of people, considering language barriers in mind. Centralised National Health Information System (NHIS) can better support finance teams with a better visibility of the budget utilisation and resource allocation. NHIS integration with other databases, like NADRA, would aid in tracking our population's health status through different indicators.

Key Challenges in Pakistan's Healthcare System

a). Lack of Access

- Rural areas are particularly underserved, with a shortage of hospitals, clinics, and medical professionals
- The healthcare infrastructure is concentrated in urban centres, leaving a substantial portion of the population without adequate medical care

b). Insufficient Workforce

- A shortage of doctors, nurses, and allied health professionals impacts the quality of care
- Brain drain – where healthcare professionals emigrate for better opportunities – further strains the healthcare system

c). Poor Healthcare Funding

- Pakistan spends a relatively low percentage of GDP on healthcare, resulting in underfunded public health facilities
- Out-of-pocket expenses are high, making healthcare inaccessible for many

d). Fragmented Healthcare System

- Both the public and private sectors operate in silos, leading to inefficiencies in service delivery and patient care
- Lack of coordination and data sharing between different healthcare providers is a major issue

e). Prevalence of Communicable and Non-Communicable Diseases

- Diseases such as tuberculosis, hepatitis, malaria, and non-communicable diseases like diabetes and cardiovascular conditions, put a significant strain on the system

f). Health Information Management

- Data collection is often paper based, which hampers decision-making and the ability to monitor public health trends effectively
- There is a need for more robust health data systems to track disease outbreaks, patient histories, and healthcare delivery metrics.

8. Recommendations

Implementation of Emerging IT Technologies

i). Telemedicine

- Solution: Telemedicine can bridge the gap in rural healthcare access, allowing patients to consult doctors remotely.
- Impact: It would increases access to specialist consultations, reduces travel time, and cuts costs for rural patients

ii). Electronic Health Records (EHRs)

- Solution: Implementing a national EHR system to digitize patient records, can make it easier to share information across healthcare providers
- Impact: It will improve care coordination, reduce medical errors, and enhance patient safety

iii). Health Information Systems (HIS)

- Solution: Integrated health information systems can streamline hospital operations, track patient data, and ensure more effective use of resources
- Impact: HIS can improve decision-making for healthcare providers and public health officials by providing real-time data on diseases, hospital admissions, and other health metrics

iv). Artificial Intelligence (AI) in Diagnostics

- Solution: AI-powered diagnostic tools can assist in early detection of diseases like cancer, diabetes, and cardiovascular conditions
- Impact: It can reduce the burden on doctors by helping in diagnosis and screening, improving the accuracy and timeliness of medical interventions

v). Mobile Health (mHealth)

- Solution: Mobile apps for health monitoring, appointment scheduling, and medication reminders can empower patients to take control of their health
- Impact: Enhances patient engagement, particularly for chronic disease management (e.g., diabetes, hypertension), and reduces the number of hospital visits

vi). Blockchain for Health Data Security

- Solution: Blockchain technology can be used to secure health records and ensure that data is only accessed by authorised personnel
- Impact: It can enhance trust in healthcare system by ensuring that sensitive patient data remains confidential

vii). Big Data and Analytics

- Solution: Big data analytics can be used to predict disease outbreaks, track healthcare trends, and improve resource allocation
- Impact: It would support policymakers in making informed decisions, planning for health emergencies, and managing public health crises more effectively

viii). Internet of Things (IoT) in Healthcare

- Solution: IoT devices (e.g., wearable health monitors, connected medical devices) can collect real-time data on patients' vital signs and other health metrics
- Impact: It will enable continuous monitoring of patients, especially those with chronic conditions, reducing the need for in-person check-ups and improving overall healthcare efficiency

ix). Cloud Computing for Data Storage and Management

- Solution: Cloud-based healthcare systems can store substantial amounts of data, enabling easy access and collaboration among different healthcare providers
- Impact: Facilitates remote access to patient data, allows for faster data sharing, and reduces costs related to data storage

Here are few Recommendations:

- The Federal Government relevant authorities (like Ministry of National Health Services) must lead it from the front for policy direction, regulations, coordination, and monitoring, keeping all local and international agencies in the loop
- An environment should be created which brings together public-private partnerships, donor agencies, and the federal and provincial governments to provide funding to achieve the set goals
- Required legislation ought to be materialised for digital health initiatives and regulators at the Federal and Provincial levels. Digital health education needs to be included in the medical curricula
- An online registration system for healthcare services should be established
- An Electronic Health Record (EHR) at the national level should be developed
- Existing DHIS systems should be integrated at the national level
- New platforms ought to be integrated with the National Health Information System

A common, consistent mobile/web health application/portal should be developed and launched throughout the country with the consent of all four

provinces (Punjab, KP, Sindh & Baluchistan), ICT, AJK, and Gilgit Baltistan (GB), so that the services may be given without any discrimination and in a consistent way

- The Government of Pakistan must take some measures in terms of providing basic knowledge to the users (patients and the rural population in general)
- Social media platforms like Facebook, YouTube, TikTok, and Instagram should be efficiently utilised to run health awareness campaigns
- The integration of the National Health Information System with other databases like NADRA would aid in tracking our population's health status through different indicators
- Data consolidation at the national level is important so that big data analysis can be done. DHIS systems need to be connected. There is a need to link hospitals running under the private and philanthropic sector and OPD clinics (Physical and virtual), with the support of the National Health Information System
- There is a need to link the National Health Information System with the Pharmaceutical industry, Drug Regulatory Authority of Pakistan (DRAP), provincial DRAPs, and hospital pharmacies to track the inventory at the national, provincial, and even at the district level
- There is a need to link the National Health Information System with all the medical-related institutions, universities, associations, councils, regulators, etc. So that human resource records are available at all times for policy makers, researchers, and decision makers
- The government must develop a framework through which it can collect data from private hospitals' MIS
- A formal standard needs to be followed throughout the country Medical Information Exchange between healthcare providers (e.g., HL7 FHIR)
- The Ministry of National Health Services, Regulations & Coordination should formulate the minimum agreed framework and regulate Telemedicine, which can be applied and followed throughout the country in coordination with all provinces

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