EHTEL
Collaborating for Digital Health and Care in Europe

Uzbekistan Digital Health Masterplan
Peer-review report

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Version number 1.0 – 16 August 2021
Version number 1.1 – 16 November 2021

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Collaborating for Digital Health and Care in Europe

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1 Introduction

1.1 Background and scope of the review

In recent years, the Republic of Uzbekistan has initiated an ambitious health reform programme to improve its national health system. Approved by Presidential Decree No. 5590 in December 2018, the Concept of Health System Reform of the Republic of Uzbekistan sets forth the overarching reform process with the objectives of improving population health, access and quality health care services across the country. The reform Concept underlines disease prevention and focuses on conditions with the highest burden of illness, equitable distribution of resources and access to health care, financial protection of the population and increased efficiency of the health system.

The Ministry of Health of Uzbekistan has requested an expert peer review of the "Digital Health Masterplan (DHM) - Feasibility Study for Support to Digital Reforms in the Health Sector in Uzbekistan" that has been elaborated with the support of KfW and AME International.

This peer-review report aims at providing recommendations for improving the formulation, adoption, implementation and evaluation of the DHM. This review is facilitated by EHTEL in the context of the EHTELconnect service package that the Association offers to Member States. EHTELconnect is intended to enable access to information, experience and expertise across the eHealth domain for countries in their journey to modernise health care systems through digital health.

1.2 Methodology

Reviewers have evaluated the digital health strategy of the Republic of Uzbekistan by revising the DHM and its appendices complemented with a desk review of related legal texts and documents. Interviews with Deputy Minister of Health Mr. Abdulla Azizov, Mr Farhod Akbarov (IT-Med director) and Mr Avaz Khasankhodjaev (IT-Med IT architect), Mr Olegas Niaksu (AME International) and Ms Rukhshona Sinavbarova (KfW Tashkent Office) were held on 30 July, 6 and 13 August 2021 to clarify doubts and address questions not covered in the Plan.

The review follows an evaluation of the different components of the DHM in support of the healthcare reform for better health outcomes, quality health processes and overall health system efficiency. It is structured as agreed with the national counterpart and consists of five blocks and a set of key recommendations. In chapter 2, the governance and leadership model are analysed. Chapter 3, 4 and 5 covers the review of the three eHealth components – architecture, health data, and services. Chapter 6 delve into the implementation strengths and weaknesses and provides a risk management strategy. Finally, chapter 7 summarises the key recommendations derived from the assessment and based on lessons learned from other countries.

2 Governance and participation

2.1 Alignment with the health strategy

Digital health strategies are more effective when they are aligned with the national health strategy and priorities. Digitalisation of healthcare in Uzbekistan aims to improve quality of care, increase access and achieve Universal Health Coverage. Deploying the strategic actions described in the DHM will allow a more reliable health system with, for instance, quality assurance embedded in health information systems (e.g., antimicrobial resistance), data integrity and accountability, and a future-proof and integrated health data ecosystem to facilitate advanced clinical decision support systems powered by artificial intelligence (AI).

DHM goals are well aligned with the concept of healthcare reform set forth by Presidential Decree No. 5590 which includes a call to action for modernising healthcare in Uzbekistan through investments in digital infrastructures and services for the improvement of quality and efficiency of the national health service delivery system.

Healthcare services are the main component of the DHM. However, the scope of the Plan encompasses public health services, national registries and the National Health Insurance Fund (NHIF) information system, thereby covering all levels of the health sector. It is the reviewers opinion that the plan capitalises on lessons learned from other countries to speed-up the implementation and avoid past failures, for instance, adopting international standards to recycle knowledge and connect with other countries.

2.2 Governance model fit-for-purpose

The main challenges for governing digital health in Uzbekistan are to ensure the project management capacity to implement the DHM, and to ensure the long-term sustainability of eHealth investments. To that end, as recommended in 4.1.2 “Considerations for Digital Health Governance in Uzbekistan”, moving from a project-based to an organizational-based governance model goes in the right direction and ensures digital health is part of the healthcare core business.

The Digital Health Management Unit (DHMU) is foreseen as the first governance body that together with IT-Med report to the Department for Digitization of Health Care Systems of the Ministry of Health. IT-Med configuration reassures the fulfilment of the DHM mission as the main layer in implementation capacity. To cope with the execution of parallel projects, IT-Med requires to be structured in eHealth projects combining technical and functional teams to provide the technical and business views. The roles of the IT architect combined with a healthcare architect – a sort of Chief Medical Innovation Officer - will guarantee alignment and coherence across projects and teams, reducing further the risks of implementation. Decisions about standards and classifiers should be centralised in IT-Med, hence creating the Standards Office.

A second governance body will be the Digital Health Board for implementation oversight and for moving to an organizational or system governance. This transition will contribute to fortify digital health from a health system perspective and will be responsible for steering and monitoring the DHM implementation.

Engagement with key stakeholders at national and local level have been crucial in the development of eHealth systems in other countries. This engagement, however, needs to be adapted to the level of complexity of health system governance structures and the level of centralisation in decision-making. Regional and local digital health councils could play an important role in deploying change management and ensuring a successful local implementation. Among key stakeholders, engaging with doctors’ and patients’ associations will be critical for addressing implementation concerns of the different eHealth building blocks.

2.3 Legislation, policy and compliance

Strengthening digital health legal and regulatory framework is one of the enabling strategic areas in the DHM. As in other countries, the use of Presidential or Ministerial decrees is a common regulatory approach to drive and support the implementation of digital health.

Reviewers have observed that the current regulatory framework in Uzbekistan underpins the Plan endeavours to ensure transition to digital workflows, but some additional regulations are needed, for instance in the field of personal data protection or to regulate how digital health services will be reimbursed. The foreseen legal advisory workgroup should be involved in the governance of the DHM implementation to anticipate further regulatory needs.

2.4 Leadership and participation

The Ministry of Health drives the DHM design, implementation and evaluation through the described and foreseen governance structures and mechanisms, and under the leadership of the DHM programme director, Deputy Minister of Health Mr Abdulla Azizov. The role of the Ministry of ICT is more operational, providing certain IT infrastructure. Given its mandate, the National Health Insurance Fund will become a relevant actor in the near future, and it is one of the beneficiaries of the digital transformation plan.

In terms of participation, the involvement of end-users - health professionals, managers and patients - will be necessary during the design and implementation phase. One of the elements of the DHM to be strengthened is the business or healthcare view. Participatory mechanisms along with the governance mechanisms described above will help to provide a user-centric approach to the design of digital health processes, involving end-users. This approach is especially relevant for the first phases of the DHM where traditional healthcare processes need to be reengineered through the implementation of eHealth services, namely ePrescription, eReferral, eScheduling and EMRs. Combining business process reengineering with co-design methodologies involving health professionals and managers will increase user adoption while improving the overall efficiency of the health system. Ultimately, one should avoid converting existing inefficient paper-based processes into digital. In other countries, the involvement of clinical champions from the field in the design phase has proved to be a winning strategy at the expense of more time for design.

3 eHealth architecture

3.1 Enterprise architecture

The Ministry of Health of Uzbekistan has selected The Open Group Architecture Framework (TOGAF) as their enterprise architecture framework. TOGAF supports tailoring for specific needs, and implementers may choose to realize only a subset of development phases and content model. The DHM architecture section focuses on information system and technology views. Major aspects of the discussion focus on the landscape of eHealth applications, interoperability standards, and integration patterns - Enterprise Service Bus.

The eHealth applications layer will be arranged as a set of zones. In the centre, there is a zone of application services based on the new Data Centre. This Data Centre zone includes components of process coordination (eScheduling, ePrescription...), registries of master data (patients, practitioners, facilities, drugs...), stores of clinical data, and facades for external access (public APIs). The central zone is surrounded by external systems, new and existing applications, including new tools for patient, clinical, and administrative use. Among external systems are shared services of e-government (authentication system - OneID, residents registry, etc) and healthcare related existing services (e.g., blood donations system).

Current view places the Digital Health Platform (DHP) in the centre of communication, where each integration is solved via adding more APIs to the system. A generic data exchange would materialise the body of experience and the technical platform, which reduces the effort needed for general exchange design for future developments. The generic data exchange is probably implicitly included, for a better control over risk of duplication.

DHM suggests the Enterprise Service Bus (ESB) as the pattern of integration of the components of the DHM core (Data Centre zone). ESB is seen as a central mediator of calls between the components, where the mediation enables enforcement of messaging standards, access control, and process orchestration. In practice, ESB is often implemented as custom software modules in specific implementation language running typically only on a specific software platform (a ESB product). The ESB product and the custom modules become essential elements of the data flows through the enterprise systems. In a simplest example of ESB orchestrated communication between two application services, there will be an additional custom software component on ESB platform, and in every change of the shape of the data flow, this additional ESB component needs revision too. This practice of integration is also called “smart pipes”, which denotes the specific knowledge of each data flow that needs to be accumulated into the ESB development. In small to medium scale applications, where the development work can be easily coordinated and synchronized, an ESB may efficiently be used as a software development platform. In case of large ecosystems, where work shall take place in less coordinated and in a massively parallel way, an ESB needs to be broken into loosely coupled subsystems. Without this decoupling, a critical team of ESB experts will become a bottleneck. Instead of “smart pipes” one could consider “dumb pipes”, which represent data exchange layer, which is much more “passive” towards actual data flows and favours choreographic coordination of application services rather than direct orchestration. Choreography may provide much more scalability both infrastructure-wise and development-wise. ESB may still be a candidate for internal implementation of loosely coupled application services, but then it’s a routine choice of a favourite programming language of an implementation team.

DHM is ambitious in its presented timeframe and scope. Enterprise Architecture (EA) principles stated in the DHM seem to exclude the problem of development coordination and throughput. The only principle that stresses the evolutionary dynamics of the solution is the principle of scalability. An endeavour of the scale needs substantial parallelism of development. In order to support the parallelism, the subsystems shall be properly isolated. In addition to the API and ESB based integration strategy (“smart pipes”) an additional event-driven/event-sourced layer of microservices (“dumb pipes”) could support the desired isolation of the subsystems. The proposed HL7 FHIR data exchange protocols support the distinction between communication abstraction (generic REST or FHIR

Bundle messaging), syntax abstraction (HL7 FHIR resources and profiles), and semantic abstraction (name systems, code systems, value sets) very well.

The EA model presented in DHM seems to ignore the business view aspects. The description of the applications focuses primarily on the usage of particular systems. The business view should explicitly discuss the flow of information from the perspective of the healthcare digitalization objectives. It is important to coordinate the digital transformation so that the continuity of the information flow is in place. The business view shall also elaborate the roles of the business workers. The focus on the roles participating in the future digitalized flows of information can help to avoid misplacement of the application features, also prevents overloading users with too many separate applications, and may reduce the need for duplicate development of the features. However, the presented landscape of the applications is an approximation of the classical three-tier model, which guides implementers' focus on the business worker needs and the business flow coordination. In the early stages of the digitalization, it may be appropriate to approach the business transformation in a bottom-up manner, where the features of the applications shall drive the change.

One of the core principles of the EA is Privacy and Security: "Ensure that data are properly protected, prevent unauthorized access and changes, and maintain confidentiality to protect patient safety and privacy.". Cybersecurity is also marked multiple times in the National Digital Health Measure Plan, where it surfaces in relation with the development of legislative environment and development of core components of the DHP. Typically, due to the needs for specific expertise, cybersecurity and data security are separated into an explicit section of an EA model. Cybersecurity is a topic that affects the design business (privacy policies, separation of duties, availability of critical functions, integrity/accountability of changes), applications (authentication, authorization, encryption, non-repudiation), and infrastructure (network segmentation, premises, hardware redundancy, backups, end-user devices). Vendors and specialists working on any of the mentioned components need to understand their duties in regards of the information security in implementing their specific modules. These cybersecurity and data protection aspects need some coordination in the EA and should be explicitly discussed in a separate section of the EA model. An explicit feature/module of EA lends itself for a separate governance action and supports capacity of the planned role of Security Manager of IT-Med too.

3.2 Communication networks

The current situation analysis of the DHM establishes a baseline for estimating the investment needs. In summary, the DHM suggests specifying a set of standard network service level packages. These standard packages would support planning of investments, procuring the equipment and services, assessing the implementations, and planning the digital health solutions. The latter is especially useful for increasing the isolation of EA modules (units of control). The clear standards of communication network capacities and capabilities are one of the hard constraints for planning of the investments into software systems. In case of network capacity planning, it may seem that the more is the better, but for large scale solutions with heterogenous set of network capacity consumers, a line between general infrastructure and specific solutions needs to be drawn. The planned capacity, availability, security, access, and other features of the underlying networks shall be synchronized with the business and information system planning.

The EA could introduce the dependency management rationale/principles/policy between its modules. Obviously, there shall be left some space for agile readjustments, but for the sake of compartmentalization of the implementation projects, there shall be a clear line of control of the service level to be expected from the communication networks (and other infrastructures).

The required capacity and availability of networks varies for different information system services. If the networks are generally stable and fast, more synchronous information system services can be allowed. And, in the contrary, if the networks are less stable, the design of information systems shall tolerate disruptions and apply more asynchronous interactions.

From the cybersecurity perspective, design and implementation of communication networks is always one of the areas of concern. The specification of the standard networking services shall be explicit on the cybersecurity aspects in a way, which supports clear coordination of activities between security architects, network consumers, and network providers.

The main driver for throughput capacity is usually the need for sharing of diagnostic images/videos. In order to plan for the network performance, a strategic estimate for the volume of image diagnostics would be required. This type of estimates would result from the design of EA business view. As the DHM is based on the Uzbekistan healthcare development programmes, the business level estimates are probably defined in those overarching forums.

3.3 National data centre

The section of the DHM dedicated to the National Data Centre (NDC) is currently empty. In line with the strategy of decoupling health data from digital health applications, the definition and dimension of the NDC is critical for the long-term sustainability of the national eHealth architecture and the primary and secondary uses of health data. To right size the NDC, further information about data storage needs from a business perspective is needed, particularly about demanding data resources such as medical image and video.

3.4 ICT equipment

The DHM analyses the current situation with the ICT equipment at healthcare facilities. The analysis reveals that there is a considerable need for upgrade and increase the number of workplaces in the facilities. The plan is structured into 3 phases of supply. The first wave introduces new workplaces for administration. The second wave supplies basic level ICT equipment into wards, laboratories, and radiology departments. The third wave provides some maintenance replacement for the equipment from the first and second phases and starts supplying physicians with digitalized workplaces.

The distribution and the availability of the computerized workplaces is clearly one of the major challenges for introduction of the digital workflows. The total number of workstations required is estimated at 65 thousand. The DHM takes a phased approach, where the supply is distributed over time by municipal units (Syrdarya pilot), roles of users, and types of facilities.

This phased approach to infrastructure supply certainly has its impact on the rollout of the business changes. The flow of information between the organizations and users will be disrupted here and there due to the lack of the access caused by the inadequate ICT infrastructure. The digitalization plan should support “multi-speed” adoption of the digitalized processes. It seems important to enable clear benefits to the early adopters. It also raises a question if and how the digitalization programme should balance its focus between critical infrastructure supply and advanced health information processing. The latter would be a motivation for the first, but the former shall be accomplished for the second.

In general, the required level of ICT equipment supply shall be standardized, and the computerization thread of work can be kept separate from the thread of information system development. The DHM has introduced essential elements of these ICT standards already.

4 Health data interoperability and uses

4.1 Data source integration

Around 30 health information systems co-exist with a different degree of adoption. According to the situation analysis, there are no data exchange amongst the eHealth systems at present, so no data exchange standards are used. Integrating them into the new digital health infrastructure will be at the owner expense and will not be covered by public funds.

Only data exchange standards are used with non-eHealth information systems (oAuth 2.0 with authentication service provider OneID and REST API with the Registry of Residents). ICD10 is used in e.Policlinics IS and local HIS.

Use of international standards and terminologies is encouraged to ensure health data integration across healthcare organisations and internationally. However, the Plan describes options without deciding or indicating the standards to be followed.

HL7 as part of the CDA (Clinical Document Architecture)[1] suggests a three-level approach to the health data interoperability design. In the first level only the facts of health care encounters are recorded as structured data, and the specific clinical data is recorded as free text or as attached files. The second level of interoperability design adds structured records of the health care activities, but still keeps details of those activities in free text form. Only on the final, third level of maturity, the implementers attempt to structure the content in the maximum extent. The Uzbekistan healthcare digitalization programme would benefit from a staged approach to the maturity of interoperability. The clearly distinguished stages reduce the risk of over commitment in the initial design of the information systems and interoperability standards.

System to system integrations, especially when the integrations cross the borders between organizations or domains of governance, are prone to extra costs in development, implementation, and management. The cost is driven by the need to agree and manage the interoperability specifications, synchronize the changes, prepare for loss of availability, protect the data in transit, authenticate and authorize the access, etc. Therefore, it is advisable to minimize the number of integrations as the first priority. However, the modern systems need to support the cross-module and cross-organization workflows, and the integrations are needed for the continuity of data processing pipelines.

The health information exchange platform addresses the problem of integration costs by replacing point-to-point integrations with a hub-and-spoke model. Depending on the architecture principles, a common protocol for communication is defined on organizational (procedural), on data sharing (syntactic, semantic), and/or on network connection level. The DHM aims to launch several innovative projects in parallel. Potentially, all information systems developed shall implement a common agreement on all interoperability levels. Achievement of this common agreement would require tight cooperation between these projects. Tight cooperation is another word for tight dependency, which will result in loss of freedom for experimentation and slow down the pace of the projects. To support the required agility and pace of the development, the integration and interoperability policy shall enable the eventual interoperability principle. The projects should initially be allowed to move on with the local interoperability agreements but need to comply with a common standard in a future phase. This policy would enable standardization to take place in its own pace. The migration of application systems on a common interoperability model shall have strategic support and strong governance. The DHM could elaborate the approach to the interoperability standardization more deeply.

[1] HL7 CDA: http://iehr.eu/knowledge/what-is-hl7-cda/

According to the information collected from the interviews with the UZB DHM experts, there is ongoing health data and terminology standardization initiative. The digitalization of health data has not yet started, however. The DHM proposes a list of international standards to consider. The IT-Med plans to designate a team of digital health standards. This team aims to support all the rest of the projects with the standardization issues. The idea seems to align with the above proposed eventual interoperability scenario. However, there is a risk that the standardization team gets tightly involved with all the implementations projects and becomes an obstacle to fast advancement. Therefore, the standardization shall happen in an asynchronous way, where the suggestions shall affect only the future iterations of the applications.

4.2 Primary use of data

The terms primary and secondary use of data are often used in explaining the requirements for health data exchange. Primary use refers to the use of data, which was known at the time of design of data capture and processing. Secondary use refers to the use of data, which was not the original aim of the data capture.

In the era of digital data, where the cost of transport of data is nearing zero, and data processing is increasingly a job of computers, the line between primary and secondary use of data is also changing. AI, and the need for automated near-real-time analytics, blurs the boundary between primary and secondary use. The willingness to spend time and energy on manually transforming data from one form to another for decision making is decreasing. If the data is captured for multi-purpose, it is all primary use (patient engagement, clinical decisions, public health, healthcare management, research).

The data interoperability strategy of DHM could elaborate the scope of data re(use). A more precise scope of the purpose of the collected data would support better planning of the work of both data standards developers and application systems developers.

4.3 Secondary use of data

The approach described under subchapter 5.3.1.1. “The components of Digital Health Platform” related to “clinical data repositories and registries” is tantamount based on the experience gathered in other countries where clinical data has not been standardised across different health information systems and has led to significant interoperability issues. Adopting a common health data model from the beginning will help to build the eHealth system for the future based on data instead of applications, avoid vendor lock-in and boost health innovation and research.

5 eHealth services

This section reviews the digital health applications portfolio from an end-user perspective, namely patients and citizens, healthcare workers, and healthcare managers, and assess the development and deployment planning, observing their interdependencies.

5.1 End-users' perspectives

Citizens and patients

In the first round of digital health applications, patients are not targeted as end-users and therefore not involved in the design process. Given the experience gained during the first year of digital health development, it would be important to apply co-design principles and processes involving patients and citizens.

According to the timeline, the patient engagement portal is foreseen for 2024 which may seem late given the public impact of providing access to health data and information to citizens. Issues with electronic identification have been reported which prevent an earlier deployment. However, the development of mobile health apps and eventually a patient portal with health education contents can advance the benefits of digital health to patients and citizens.

Digital health literacy is a major concern in all health systems, especially for vulnerable groups. Expanding the capacity building programme to people could help to bridge the literacy gap of end-users.

Healthcare professionals

As stated in previous chapters, it is critical to complement the technical view with the business or healthcare view in the design phase of the digital health platform and applications. This could be achieved involving clinical champions in the project management teams, appointing a business architect at IT-Med and applying co-design principles and processes during the design phase of each digital health application where health professionals are key as end-users.

Healthcare management information systems are chief to improve quality of care services. Business intelligence or dashboards are planned for healthcare managers (page 84, Business Intelligence for DHM core), but they are also important for clinicians, allowing quality benchmarking and can eventually be linked to pay-for-performance schemes, and to support the functions of health insurance. Therefore, its access and use should be extended to healthcare professionals to measure quality of care at individual, group or HF level.

Healthcare managers

In paper-based systems, information does not flow at the speed quality modern healthcare management needs. Although the main component of the plan is healthcare services, health information systems and the secondary use of health and non-health data are fundamental to upgrade decision-making to evidence-based. Therefore, it is crucial to involve healthcare managers in the design of management information systems (e.g., BI, dashboards) assisted by business reengineering to take advantage of digital without replicating excessive control mechanisms that deter clinicians from time to care.

5.2 Completeness of the building blocks

eReferral, eScheduling and ePrescription are the first digital health applications empowering patients according to the DHM. It is right to state that eReferral and eScheduling should go hand-in-hand. However, from a business perspective, allowing patients to get appointments with secondary care specialists can hamper the virtue of a

health system based on primary health care. eScheduling should then focus first on eAppointments with primary care doctors and teams while eReferrals should be an internal business process between healthcare providers.

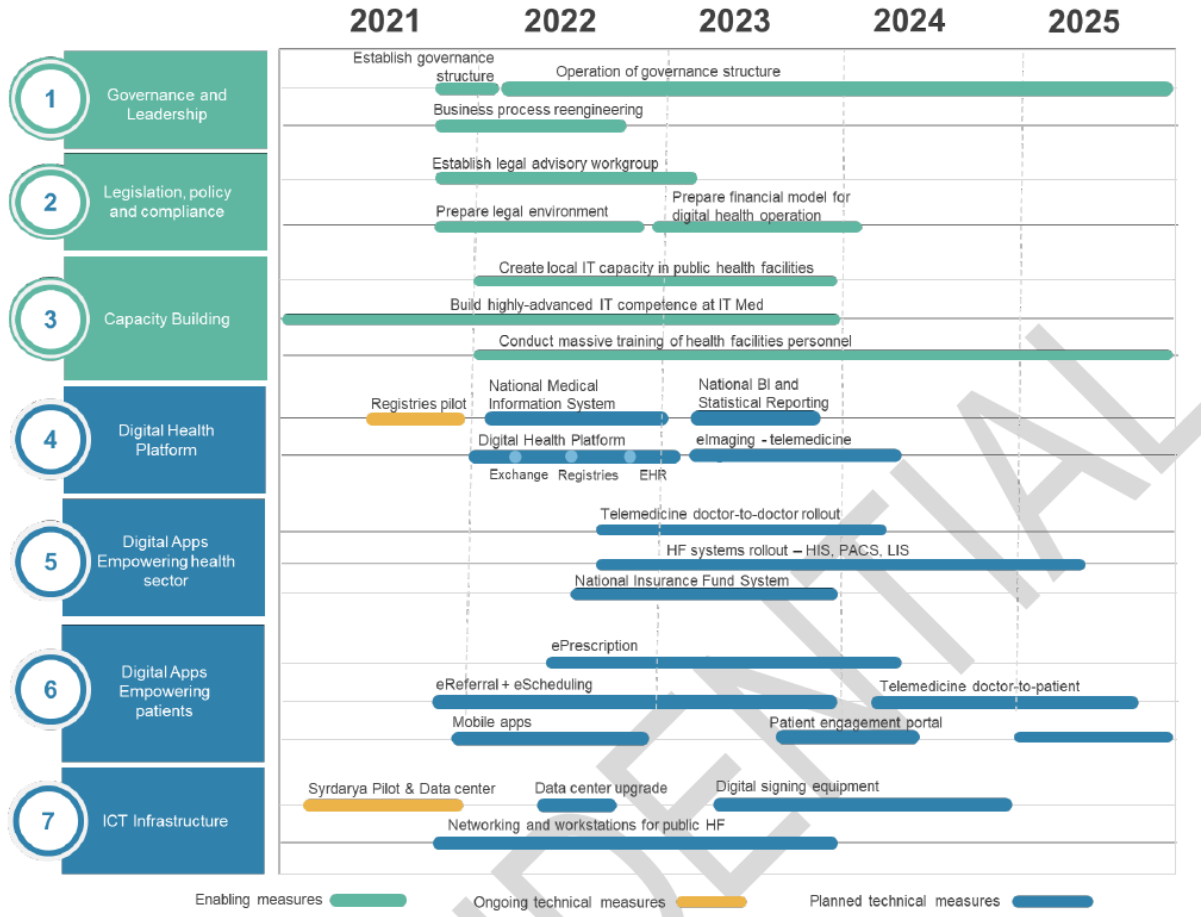

Figure 1. Implementation plan of major masterplan measures and activities

The architectural blueprint of DHM (Figure 13) indicates that the National Patient Services (ePrescription, eReferral, eScheduling) deliver their functions to end-users via some other systems in the area of the National Digital Health Systems and Digital Apps, namely the National MIS that includes e.Policlinics and HIS. The roadmap of projects (Figure 4) plans to run the projects largely in parallel. For instance, the prescribing functionality will be the first integrated element of the emerging e.Policlinics software (EMR). A more detailed plan for the development and implementation of the National MIS is needed to coordinate the integration with other digital health applications and to establish strategic priorities.

The ePrescription may be an excellent way to bring awareness about the benefits of integrated health data into society. Initially, the prescription system project may allow limited data quality and integrations which can be improved later when the habit of electronic data exchange is already there.

According to the DHM, Business Intelligence (BI) for the Digital Health Platform core shall publish standard indicators about eHealth development. The insight should drive the data quality and adoption of the applications. However, the DHM is not drawing a link between the BI project and the definition of specific, measurable objectives for the implementation projects. The BI section describes only the technical perspective. Specific KPIs would enable implementers to self-assess the success of their projects.

For the completeness of the master plan, each of the application areas (ePrescription, eReferral, etc) should have their own plans of iterative development of features. This would empower the enterprise architect and the implementation teams with some control over the scope of the first iterations.

6 Organizational and technical implementation

6.1 Implementation feasibility

The breadth of ambition of the DHM is remarkably large. It aims to roll out a comprehensive eHealth infrastructure and a range of eHealth services, nation-wide and in a tight timeframe that could resemble a national eHealth hackathon. The risk of fulfilment is hence at stake, and it could be strategically managed by setting the foundational blocks and prioritising must-be digital health interventions and services. An achievable milestone planning with thresholds of successful implementation together with quality plan for each eHealth project would ease coordination of multiple and concurrent projects.

IT-Med is a newly created organisation with capacity to kickstart the implementation of DHM and carry out a number of projects with its current staff (approximately 60 officers). A hybrid implementation approach is recommended. Relying on external software development companies can help to increase capacity in the mid-term while conserving decision-making. In the long run, portfolio management requires the development of internal project managers to coordinate outsourced services.

As stated in the leadership and participation section, business process reengineering should be considered as part of the design phase combined with the involvement of end-users in co-creation. This stage would increase the odds of an effective implementation, increasing user-friendliness and therefore easier uptake.
From the technical side, documentation of developments should be published and shared to facilitate overall coordination and interdependencies between projects. Furthermore, the standardisation committee shall contribute to ensure the quality of data of the digital health enterprise.

Given the number of concurrent projects and in addition to the needs of process reengineering and co-creation, it is important to do not underestimate the time needed for preparing the technical specifications of tenders. Project planning should be revised with this constraint that may delay implementation but ensure successful uptake.

6.2 Financial sustainability

Fine-grained actions described in the Plan do not go along with a detailed and phased budget that would provide the right dimension of the funding needs required for implementation over the forthcoming years, even at risk of guesstimate.

Different funding sources are clearly identified in the National Digital Health Measure Plan (pages 34-46) combining contributions from the government (MoH, MoIT, MoF, NHIF, regional authorities, state budget), international agencies (ADB, WB, WHO), international donors (GITEC, GIZ, KfW) and private companies (ISPs).

Fragmented and ear-marked funding sources could interfere with the priorities set forth by the DHM and affect sustainability in the long-term if investments are not accompanied with running costs budgets. Funding management strategies like pooling resources and centralising the assignment of funds to projects would prevent these risks and ensure a sustained implementation.

6.3 Change management approach

According to the survey conducted in the situation analysis, the level of use of IT by health professionals is low (33% of doctors and 22% of nurses). Capacity building is addressed in the DHM mainly through an ambitious

training programme based on standardised training packages on digital literacy for health professionals as part of continuing medical education. However, the modules outlined in Table 8 do not cover training in eHealth services such as EMR, telemedicine or ePrescription.

Besides training, communication campaigns are critical to raise awareness of the scope and ambition of the digitisation strategy both for health professionals and citizens. Open communication channels such as an online portal, social media or direct email communications are recommended to increase end-users' engagement and ultimately provide.

Large scale e-health implementations possess a diverse set of challenging aspects, which require their specific expertise and focus. The aspects include workflow coordination, data security, interoperability, data quality, usability, stakeholder governance, sustainability, etc. These aspects cannot be developed in complete isolation as there are dependencies among them. Several capability maturity models supporting the balanced development of digital health ecosystems exist.[2] MITRE, a US think tank, suggested a model that elaborates capabilities needed for health information sharing maturity model (HISMM).[3] HISMM focuses on 3 capability dimensions, which divide into 11 capabilities. Each capability has 5 levels of maturity. Those 5 levels of maturity represent the gradual advancing of an e-health ecosystem.

While the HISMM has customised the maturity criteria for the specific health information exchange capability, the Capability Maturity Model Integration has a more general definition of maturity levels[4]. The maturity dimension suggests focusing first on the ability to complete projects. Higher maturity levels bring reuse of the experienced teams and proven technologies, standards and organisational training, and performance measurement capacity. Eventually, a mature ecosystem can proceed to continual optimisation. The HISMM provides indicators for the levels of maturity.

A framework of success metrics would enable a phased and balanced approach to eHealth development. The maturity model referenced above is one of the options for structuring the steps towards a more excellent vision. It is advisable to enable capability maturation through focused, clearly scoped projects, enabling the teams to deliver value while keeping an eye on the wide spectre of the aspects, balancing the advancement of the whole ecosystem.

6.4 Risk management

Different implementation risks have been identified. A risk management strategy should be developed to address and mitigate these potential risks. The following table outlines examples of identified risks and mitigation actions.

Identified risk	Risk level	Mitigation action
IT supplier lock-in.	High	Reinforce the technical steering role of IT-Med, diversify supply and force adopting international standards.
Overreliance on developing software in-house.	Medium	Count on outsourced IT services coordinated by IT-Med and internal project managers.

[2] Carvalho, J.V., Rocha, Á. and Abreu, A., 2016. Maturity models of healthcare information systems and technologies: a literature review. Journal of medical systems, 40(6), p.131. https://link.springer.com/article/10.1007/s10916-016-0486-5
[3] Health Information Sharing Maturity Model: https://health.mitre.org/blog/health-information-sharing-maturity-model-2/
[4] Capability Maturity Model Integration https://cmmiinstitute.com/cmmi/intro

A top-down approach, while ensuring implementation, can risk end-users' uptake.	Medium	Involve end-users early in the design phase and develop local governance and participation mechanisms.
Dependence on fragmented external funding.	High	Pooling funds and centralising decision-making
No compensation for integrating existing systems	Medium	Review strategically which are the systems providing value that are not covered in the DHM implementation and support their connection.

6.5 Monitoring and evaluation

According to the Strategic Area 1 "Leadership and governance", Specific Objective 1 "develop leadership capacity for digital health innovation", the Digital Health Board will be responsible for the development of the monitoring and evaluation plan, but it is unclear who and how will implement the necessary processes to ensure continuing monitoring and evaluation.

Structured in the 7 Strategic Areas, the National Digital Health Measure Plan contains 53 strategic objectives with activities, results, responsible institution, and implementation deadlines. This Measure Plan is key to serve as the monitoring and evaluation of the DHM implementation.

However, a more detailed monitoring and evaluation dashboard should be defined to follow closely implementation activities based on selected KPIs attached to strategic objectives with annual and geographical targets (e.g., % of HF using the new EMR). The list of digitalization indicators from PD 6079 and PD 5590 are in this direction, but with only 2022 or 2025 targets respectively.

7 Key recommendations

The Digital Health Masterplan lays out an ambitious and comprehensive plan of action for the period 2021-2025 aiming at effectively transforming health service delivery and the entire health system of Uzbekistan, contributing to achieve Universal Health Coverage and ensure high-quality of care. To strengthen digital health planning and prevent mishaps occurred to similar endeavours in other countries, the following policy and technical recommendations could be considered.

On governance and participation

1. **Clearly state the scope of the plan is the whole health sector, including public health and not only healthcare services**. The COVID-19 crisis has shown how strong digital health systems have been able to provide a swift response by combining population health services (contact tracing, vaccination) with individual services (eConsultation, telemedicine, ePrescription).

2. **A dynamic approach to portfolio management based on autonomous eHealth projects would balance short-term agility to deliver results with long-term capacity of managing multiple and concurrent projects.** It is recommended to structure deployment activities through mixt project teams that work concurrently to achieve the plan deadlines, combining technical and business staff. The latter would provide the business or healthcare view that will ensure a user-centred co-creation and ultimately accelerate uptake.

3. **Moving from a project-based to an organization-based governance model should lead to a system-wide stewardship**. The digital health governance model should respond to the needs of the DHM implementation – executing eHealth projects and ensuring uptake and long-term sustainability. Managing stakeholder expectations and scaling-up eHealth solutions nation-wide could only be addressed with a well-structured governance anchored in the Ministry of Health.

4. **Combine business process reengineering with co-design methodologies involving health professionals and managers at an early design phase**. Planning of digital health applications should count with mixt project management teams, including clinical champions, and contemplate enough design time to ensure digitization guarantees modernization of healthcare operations.

On eHealth architecture

5. **ESB needs to be broken into loosely coupled subsystems and consider "dumb pipes" for choreographic coordination**. DHM delivers a large ecosystem where development work shall occur less coordinated than small or medium-scale applications and in a massively parallel way. Therefore, without this decoupling, a critical team of ESB experts can become a bottleneck. Unlike direct orchestration of "smart pipes", "dumb pipes" may provide much more scalability infrastructure-wise and development-wise.

6. **A business view of the DHM needs to be reinforced**. It is necessary to describe the flow of information from the perspective of the healthcare digitalization objectives and elaborate the roles of business end-users to avoid misplacement of the application features and prevent user overload.

7. **A separate section of the EA model should explicitly discuss cybersecurity and data protection aspects.** Cybersecurity affects the design of organisations, applications, and infrastructure. Explicitly standardised cybersecurity measures shall reduce the complexity of application development projects.

8. **A line between general infrastructure and specific solutions needs to be specified (standardized infrastructure services).** A clear separation of responsibility would simplify the coordination of work between the implementation projects. Application systems design decisions depend on the planned capacity, availability, security, access, and other features of the underlying infrastructure.

9. **Estimate required capacity from the business perspective.** Network, storage, and computation capacity planning for both the national data centre and the systems of the facilities shall take into account the estimated volume of business interactions and in particular, information about demanding data resources such as sharing of diagnostic images and videos.

10. **Support "multi-speed" adoption of the digitalized processes and enable clear benefits to early adopters.** The digitalization programme should balance its focus between critical infrastructure supply and advanced health information processing. The latter would motivate the first, but the former shall enable the second.

On health data interoperability and uses

11. **Uzbekistan healthcare digitalization programme would benefit from a staged approach to the maturity of interoperability**. The distinguished stages reduce the risk of over-commitment in the initial design of the information systems and interoperability standards. The maturity model stages could be takes from the suggestions of HL7 CDA specification: first register encounters, second register clinical activities, third include detail structured data from laboratory and imaging diagnostics and other inputs (vital signs, questionnaires, ...).

12. **Consider "eventual interoperability" as an implementation roadmap principle**. Initially, minimize the number of integrations to reduce the dependencies between parallel development projects. Allocate resources for later updates of systems, when integration readiness emerges and data standardisation capability improves. Allow organisational layer of interoperability to emerge together with the practical experience of digitalization.

13. **Provide a layered model of interoperability standards to isolate data transports, shared databases, terminology definition, and applications development work.** Coordinated prescription of technical options (i.e., international standards) would reduce the risk of conflicting decisions.

14. **Complete the scope of individual applications and interoperability specifications by specifying a complete list of data re(use) purposes with capability validation criteria.** An explicit scope of data usage objectives shall support the estimation of project efforts and risks.

On eHealth services

15. **Apply co-creation with end-users in the design phase of digital health applications enabling health professionals, managers and citizens.** Although it may delay implementation times, it reduces the risk of resistance to change and increase uptake levels.

16. **Target health professionals and managers in the design of business intelligence systems to support quality of care management.** Providing feedback to clinicians and managers about performance encourage the use of health information systems and serves as the basis for introducing pay-for-performance or pay-for-quality incentives.

17. **A more detailed plan for the development and implementation of the National MIS is needed** to coordinate the integration with other digital health applications and to establish strategic priorities.

18. **Business intelligence systems need to address data quality and adoption of applications**. Specific implementation KPIs would help digital health managers to monitor progress and self-assess projects' outcomes.

On organizational and technical implementation

19. **Establish a milestone planning and a quality plan for each eHealth project**. This would serve both for the overall coordination of DHM implementation as well as the management of concurrent eHealth projects.

20. **Enlarge and combine IT-Med capacity with external support** conserving decision-making and developing project management skills of own technical staff.

21. **Centralise the assignment of funds to projects through resources pooling**. Competing funds could alter the priorities of digital health developments and increase the complexity of implementation and integration.

22. **Complement the training programme addressed to health professionals with use of eHealth services** and consider addressing digital health literacy gaps of patients.

23. **Citizens' and health professionals' awareness-raising through tailored communication campaigns would help to engage with informed end-users and ultimately provide transparency**. Different digital tools can reach both target audiences, like an online portal showcasing goals and projects and reporting rollout progress. Social media could contribute to reach out to citizens and direct email marketing (newsletter) to health professionals.

24. **Consider capability maturity in the planned roadmap by focusing first on the successful projects**. Capture the experience from the successful projects, reuse the know-how in the new projects, and build organisational capacity and standards with this expertise.

25. **Expand the monitoring and evaluation framework with an implementation dashboard** to follow closely implementation activities based on selected KPIs attached to strategic objectives with annual and geographical targets.

8 Joint review of key recommendations

Coordination meetings between the Ministry of Health and the EHTEL review team have been organised to jointly review and clarify the key recommendations and agree on the derived actions to improve the DHMP on the five areas: governance, eHealth architecture, health data interoperability, eHealth services and organizational and technical implementation. The following table list the actions to improve the DHMP based on the joint review of key recommendations, stating required actions.

No	Key recommendation	Agreed actions
1	Clearly state the scope of the plan is the whole health sector, including public health and not only healthcare services.	Action required: Include in the scope of the plan "instrumentalise public health operations"
2	A dynamic approach to portfolio management based on autonomous eHealth projects would balance short-term agility to deliver results with long-term capacity of managing multiple and concurrent projects.	Action required: Add as a recommended task to DHMU
3	Moving from a project-based to an organization-based governance model should lead to a system-wide stewardship.	No action required: Strategic Area 1 "Leadership and Governance", measures no. 1, 3-5. Also, indirectly measures no. 6-7, 9-10
4	Combine business process reengineering with co-design methodologies involving health professionals and managers at an early design phase.	Action required: Section 2.5.1.2 may be amended with a paragraph explicitly stating that
5	ESB needs to be broken into loosely coupled subsystems and consider "dumb pipes" for choreographic coordination.	No action required: The current description already supports "dumb pipes" pattern for choreographic coordination
6	A business view of the DHM needs to be reinforced.	Action required in the implementation phase: Include it as a task of process reengineering in the implementation.
7	A separate section of the EA model should explicitly discuss cybersecurity and data protection aspects.	Action required in the implementation phase: Task DHMU/IT-Med to prepare a cybersecurity management plan and guideline
8	A line between general infrastructure and specific solutions needs to be specified (standardized infrastructure services).	Action required: Detailed NFRs are subject of further elaboration.
9	Estimate required capacity from the business perspective.	No action required: Technical architecture requirements of the data centre have been intentionally omitted in the DHMP.
10	Support "multi-speed" adoption of the digitalized processes and enable clear benefits to early adopters.	No action required: It is agreed that the DHMP follows this pattern of multi-speed adoption.
11	Uzbekistan healthcare digitalization programme would benefit from a staged approach to the maturity of interoperability.	Action required: Implementation shall follow this logic. Phrase it as principle of interoperability standards application in the DHMP.

No	Key recommendation	Agreed actions
12	Consider "eventual interoperability" as an implementation roadmap principle.	No action required: Covered in section 5.2.2 "Selected standards", attributed to the Standardization Committee
13	Provide a layered model of interoperability standards to isolate data transports, shared databases, terminology definition, and applications development work.	
14	Complete the scope of individual applications and interoperability specifications by specifying a complete list of data re(use) purposes with capability validation criteria.	Action required in the implementation phase: To be completed at application level and beyond the scope of the DHMP
15	Apply co-creation with end-users in the design phase of digital health applications enabling health professionals, managers and citizens.	No action required: Already stated in the DHMP, involving digital health leadership structures at local level (rayon, oblast)
16	Target health professionals and managers in the design of business intelligence systems to support quality of care management.	Action required: Covered in Annex 4.1 on eHealth development. It needs to be expanded to clinical governance involving healthcare quality managers.
17	A more detailed plan for the development and implementation of the National MIS is needed to coordinate the integration with other digital health applications and to establish strategic priorities.	No action required: Covered in Annex 4.1. Two-phased implementation approach
18	Business intelligence systems need to address data quality and adoption of applications.	Action required in the implementation phase: Definition of KPIs are beyond the scope of DHM
19	Establish a milestone planning and a quality plan for each eHealth project.	Action required: To be assigned to DHMU
20	Enlarge and combine IT-Med capacity with external support conserving decision-making and developing project management skills of own technical staff.	No action required: Already planned in DHMP measure 10
21	Centralise the assignment of funds to projects through resources pooling.	No action required: The option of centralising funds is complementary to two additional approaches: project list and expert pool
22	Complement the training programme addressed to health professionals with use of eHealth services and consider addressing digital health literacy gaps of patients.	No action required: Defined in Annex 3.2. Digital literacy is under Infocom (MoIT)
23	Citizens' and health professionals' awareness-raising through tailored communication campaigns would help to engage with informed end-users and ultimately provide transparency.	No action required: Covered in DHMP measures 1 (PR) and 44 (portal and apps)
24	Consider capability maturity in the planned roadmap by focusing first on the successful projects.	Action required: Add recommendation in Section 2.2. Guiding principles

No	Key recommendation	Agreed actions
25	Expand the monitoring and evaluation framework with an implementation dashboard	Action required: Add recommendation in Section in section 5.3.1.1
Other comments		
i	National data centre: technical architecture requirements have been omitted	No action required: In line with recommendation 9
ii	Data source integration: intentionally decided to leave certain standardization alternatives, not to block further development and not to fix it to one single possible route.	No action required: Agreed
iii	ICT equipment: DHMP exactly proposes multi-speed adoption.	No action required: Multi-speed adoption in line with recommendation 10
iv	Data source integration: "standardization shall happen in an asynchronous way" vs "Decisions about standards and classifiers should be centralized in IT-Med, hence creating the Standards Office."	No action required: Clarification provided