SIEMENS Healthineers

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Co-creation addressing the future of healthcare in UAE

Trends, disease pathways, technologies & innovation best practices

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Co-creation addressing the future of healthcare in UAE at Innovation Think Tank Fakeeh University Hospital

Sultan Haider[1], Fatih Gul[2], Jayati Vasavada[3], Niharika N[4], Apoorva Goenka[4], Syed Mehdi[5], Dahlia Hassan[5], Osama Abdullah[6]

Innovation Think Tank, Siemens Healthineers, [1]Erlangen, [3]Gurgaon, [4]Bengaluru, [5]Dubai
[2]Fakeeh University Hospital, Dubai
[6]New York University Abu Dhabi, UAE

Abstract

There is an increasing interest in developing the knowledge economy and entrepreneurship culture in the United Arab Emirates (UAE), especially within the healthcare domain to address local needs. Innovation Think Tank (ITT), part of Siemens Healthineers, has been addressing this need by actively engaging healthcare institutions in the region and developing local innovation infrastructure. The goal of this program was firstly to capture and validate healthcare and hospital trends in the UAE and secondly to develop an implementation roadmap for addressing the gaps and challenges in the local healthcare system. The latest ITT program was organized at Fakeeh University Hospital in January 2022. It included 40 multidisciplinary participants from 21 institutions and 15 Emirati students and researchers. The multidisciplinary teams received training on the ITT healthcare innovation methodology entailing healthcare system and challenges analysis, identification of opportunities, exploration of best practices, healthcare system comparison, and solution requirement creation. The teams also performed hospital observations, captured key healthcare trends and challenges, and consolidated solution proposals using ITT's Healthcare System Framework with a focus on the Future of Healthcare in UAE. The data were combined and validated in the following categories: 1) Key current trends that will transform healthcare delivery in UAE and the degree of their impact on its healthcare system 2) Key opinion leaders, institutional challenges and goals of healthcare institutions and stakeholders in the UAE with their degrees of importance 3) UAE Healthcare System 4) Hospital workflow, challenges and potential solutions under operational efficiency, patient experience, and workflow optimization for various hospital departments. An implementation roadmap for further development was proposed with key performance indicators (KPIs) and requirements. The consolidated data provides inputs for future co-creation and solution development in the UAE.

Keywords: Healthcare Systems, Healthcare System Framework, Innovation Think Tank, Co-creation, Future of Healthcare, Fakeeh University Hospital, Siemens Healthineers

Introduction

Due to limited healthcare expenditures and an exponential increase in patient populations, healthcare systems around the world are confronting critical issues. Governmental healthcare initiatives as well as hospitals have been trying to find and integrate innovations for optimum care delivery as well as improving the quality of life. For successful implementation of disruptive solutions, they require firstly a thorough understanding of the various healthcare systems, secondly, an engagement with the key stakeholders starting from the planning phase, and thirdly interdisciplinary co-creation infrastructure for building and validating proof of concepts that address the needs. Finally, a long-term business model is essential to enable solution deployment and continued development [1].

The United Arab Emirates (UAE) has quickly grown to be an economic and diversely marketed frontier in the Middle East with its healthcare infrastructures growing in parallel to its success. The UAE government has placed healthcare system infrastructure as precedence and even more so under the pandemic conditions. This focus has allowed the healthcare sector to advance and expand substantially during the last few years. Healthcare is particularly vital and pressured by the rising demand for it from the increased lifestyle disease trends in the UAE, given that a third of the adult population is obese and one out of five people are diabetic [2].

Moreover, with the growing population and metropolitan infrastructure, there is an increased demand for energy which inversely affects the water

and air quality in the region. According to World Health Organization (WHO), the current air pollution levels are considered unsafe in the UAE which may further increase the demand for novel, innovative, and enhanced approaches from the local healthcare system [3]. Nonetheless, pollution may very well become less of a healthcare challenge in UAE's the near future with the announcement of its Net Zero Strategic Initiative in line with its 2050 vision to achieve 'net-zero' emissions [4].

The fast and rapid growth of the healthcare sector in the UAE prompted by the recent vast investments in regional healthcare has also introduced a new series of challenges to the system. These challenges may include large institutions taking over smaller private healthcare institutions, supplier imbalance, the unwise use of technology or not using technology to its full potential, and the absence of healthcare standardization across the country [5].

Furthermore, the Covid-19 pandemic has provided a new perspective and outlook on healthcare systems in the post-pandemic era. With previous healthcare infrastructures, health surveillance programs, and contingency plans proving to be lacking during the pandemic, the UAE has prioritized avoiding threats to any significant downstream healthcare impacts. Hence, the UAE has drawn much of its focus on developing digital healthcare models, planning interventional strategies, and investigating new medical investments to avoid future unprecedented healthcare complications. Trends and challenges, different stakeholders, and policymakers may face post-pandemic challenges which remains a grey area that demands a further investigation for the development of comprehensive understandings and solutions.

In UAE, healthcare is regulated by both the federal and emirate governments. The Ministry of Health and Prevention is the federal regulating entity in the UAE's healthcare sector. To attract foreign investments and raise healthcare industry standards, governments are now liberalizing conventional policies. Hospitals, ambulatory services, clinics, polyclinics, and primary care centers account for over 70% of the 4,000 establishments which have international accreditation locally. According to the country's 2040 vision, healthcare is a focus area for the UAE government and will continue to be a desirable place for developing a regional distribution center for healthcare services [2].

The UAE has tried to expand its current medical education and training capacity to fulfill its growing need for qualified healthcare professionals. Furthermore, it aims to establish the country as a regional center for medical research and events [2]. ITT at Siemens Healthineers has been proactive in impacting several healthcare systems and aims to promote UAE healthcare goals by initiating local activities in the region.

ITT at Siemens Healthineers has a global infrastructure consisting of co-creation labs, stakeholder engagement activities, and a network of several prestigious universities and hospitals. The ITT teams developed comprehensive methodology and frameworks under the vision to understand and analyze healthcare systems and their challenges, identification of opportunities, explore best practices, compare different healthcare systems, and create solution requirements [6] – we call it the "ITT Methodology". It is vital that the forecasted post-pandemic challenges must be addressed in the region. Among these, industrial prospects include increasing partnerships to pave the way for extended global and regional mergers and acquisitions, engaging with key opinion leaders, developing local innovation infrastructure, accentuating healthcare expenditure as a focal point for the government, and establishing global inter-governmental collaborations. Emphasizing these points could potentially enhance policy and decision-making, present new models of care and augmented digitalization, and address the consequent liquidity challenges introduced by the declining revenue streams brought by the pandemic [7].

ITT enables host institutions to establish self-sustaining innovation structures addressing their needs [6]. Fakeeh University Hospital located in Dubai, UAE drawn from renown from Fakeeh Care Group based in Saudi Arabia, is the first university hospital in Dubai with the mission to drive the transformation of lives through clinical excellence, innovation, and health education [8]. Following 3 years of engagement with FUH, in September 2021, a memorandum of understanding (MoU) was signed for establishing ITT at FUH [9]. The scope of ITT FUH is to 1) develop own innovation infrastructure through establishing ITT programs and lab, 2) develop the knowledge economy and entrepreneurship culture for local research, and development in the UAE, 3) define local innovation projects relevant to patient experience, workflow

optimization, operational excellence, etc., 4) co-development of products. The first ITT FUH certification program was organized from the 19th-27th January 2022 in a hybrid format where participants have joined at FUH and virtually from several global locations.

Material and methods

A co-creation program was organized by ITT FUH with a focus on the future of healthcare. Multidisciplinary participants (students, researchers, clinicians, and Key Opinion Leaders [KOLs]) were selected to ensure diversity of qualifications (biomedical, medicine engineering and business), nationalities, gender, experience, and locations. These participants came from institutions worldwide (local institutions such as Khalifa University, UAE University, Abu Dhabi University, American University of Sharjah, Rochester Institute of Technology, Ajman University, Al-Ain Fertility Center, and FUH and global institutions including Georgia Institute of Technology, Technical University of Munich, German Jordanian University, Singapore Management Institute, and University of Hull). The participants were trained throughout a 7-day program including individual group work over a weekend **[Figure 1]**.

The participants were trained in the ITT methodology, combining expertise from the industrial, academic, and end-customer world. This allowed the participants to adopt an innovative mindset and approach to the observed healthcare system, trends, best practices, challenges, and KOL (Key Opinion Leaders) voices. After team building, participants were introduced to different concepts and inspirational speeches from heads of different departments at FUH including quality, nursing, patient experience, IT (Information Technology), and biomedical **[Figure 2]**. They were also guided through a hospital tour to identify different best practices and areas of improvement they would later use to build on their pain-point identification and solution vectors during the program. Among the departments they visited include the radiology department, pharmacy, in-patient rooms, operating rooms, waiting areas, hyperbaric therapy rooms, clinics, reception, etc.

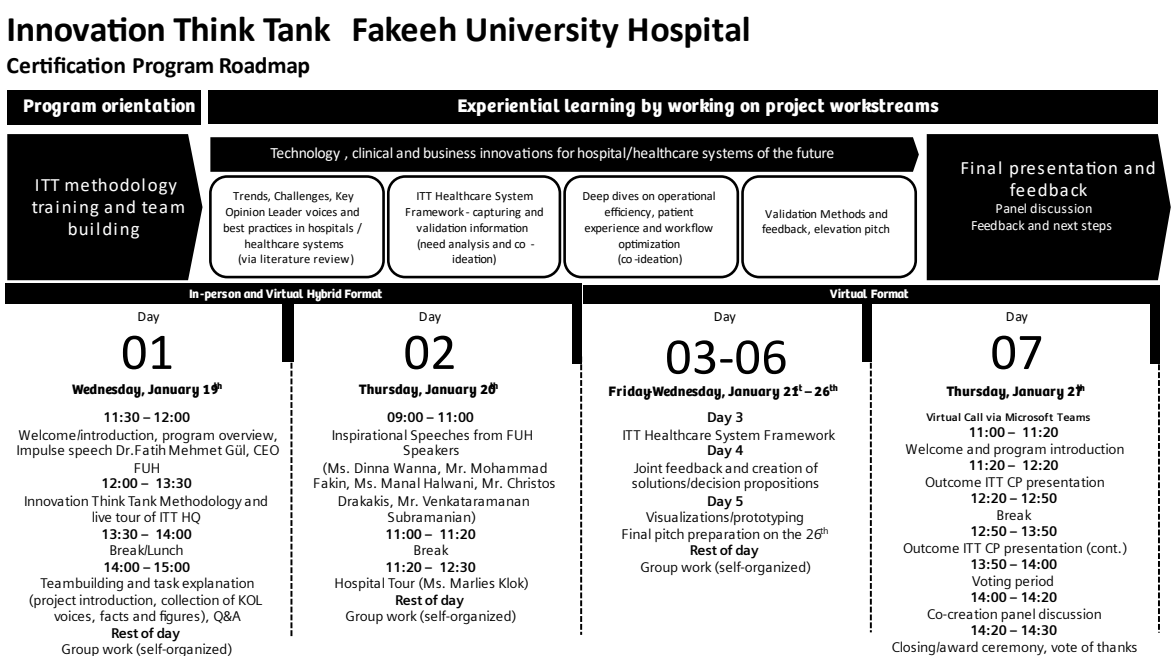

Figure 1: ITT FUH certification program roadmap

The Innovation Think Tank Healthcare System Framework (ITT HSF) was used for gathering, assessing, and confirming trends and proposals. ITT HSF integrates 1) Need analysis by capturing stakeholder's workflow, 2) Co-ideation by trans-disciplinary ITT teams globally and 3) Co-implementation with healthcare system stakeholders by local ITT programs **[Figure 3]** [1]. Templates were updated and validated according to the UAE-specific requirements.

Figure 2: Keynote speeches from KOLs of FUH

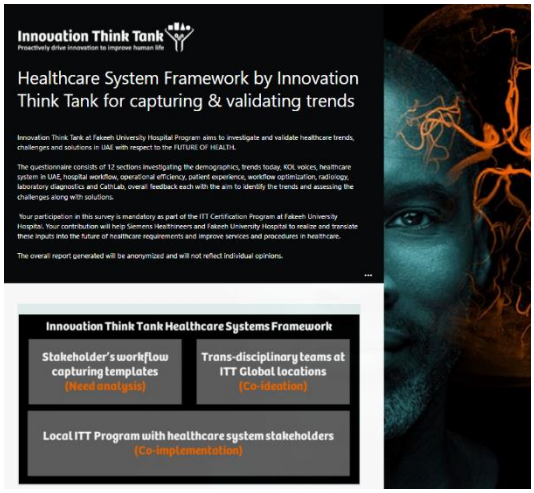

Figure 3: Innovation Think Tank Healthcare System Framework for capturing and validating trends

UAE healthcare systems were analyzed for various key trends (healthcare, technological, clinical, and business models), major stakeholders (e.g., hospitals, healthcare professionals, pharmaceutical companies, medical technology industry), financing bodies (Ministries of Health, insurance agencies), and financial and clinical flow parameters (e.g., healthcare expenditures, admissions, referrals). Identified KPIs, success factors, business models, and workflow steps have been analyzed concerning the accountable pain points and interdisciplinary project teams and locations (from observations conducted for various hospital departments e.g., radiology, laboratory, operating room) [1].

Challenges and trends consolidated by the teams were analyzed from their respective outcome presentations as well as from the 35-question poll, *Healthcare System Framework by ITT for capturing and validating trends* **[Figure 3]**, participants, experts, and KOLs partook in [1]. 41 multidisciplinary individuals participated in the survey from different local and global institutions and backgrounds **[Figure 4]**.

The visualizations of the overall program outcomes were presented to a jury which discussed them in a panel and rated the solution proposals.

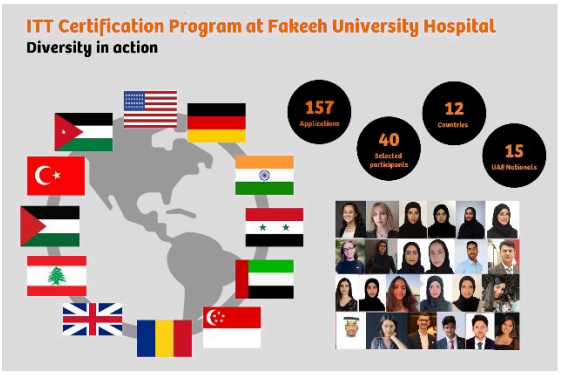

Figure 4: In the ITT FUH certification program, 157 applications were received and 40 were selected from 12 different countries. These participants worked on the future of healthcare challenges and needs.

Results

Program outcomes

In addition to ITT's ongoing collaboration with FUH, the 7 days certification program was completed successfully on the 27th of January 2022. A final report was framed according to the information collected from various ITT HSF templates during the program. A total of 348 trends, 87 KOL voices, 75 stakeholders, 124 pain points, 27 solutions, and 17 focused solution clusters have been identified and proposed by the participants throughout the course of the ITT certification program at FUH.

Survey Findings

The following categories were defined to consolidate and validate the collected information respective to the overall healthcare system in the UAE:

Category 1: *The key current trends that will transform healthcare delivery in UAE and the degree of their impact on its healthcare system*

Healthcare Trends

Participants have ranked common healthcare trends based on their comprehended impacts. **Figure 5** illustrates that there is a common consensus that access to care is the trend with the highest impact

(83%) and non-healthcare players participating with the lowest impact (39%). Individualization of diagnosis and treatment (73%) and decentralization of healthcare (54%) are also ranked relatively high on a perceived impact scale.

Some additional healthcare trends identified by the participants were cross-country collaborative healthcare decision-making for patient management, health tourism, telemedicine, customer service and patient satisfaction, security in healthcare, community health programs, and healthcare governance.

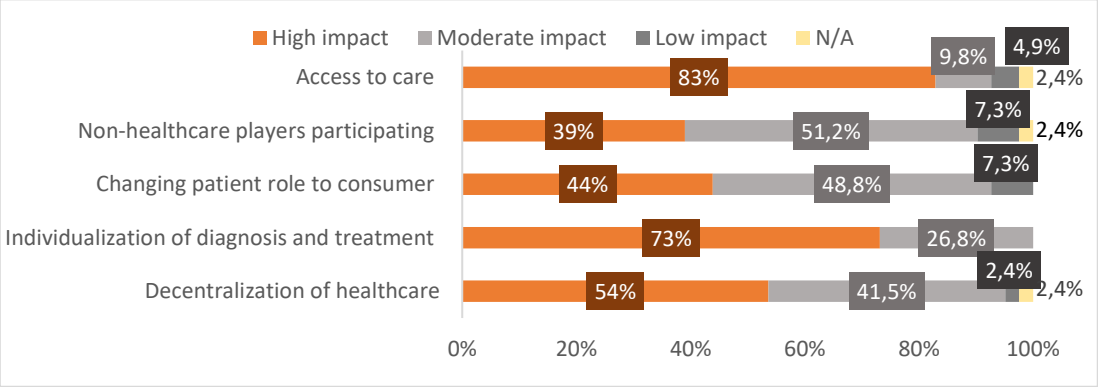

Figure 5: UAE Healthcare Trends Outcome Analysis

Technology Trends

Aligned with the UAE's vision to digitalize hospitals and healthcare, the outcomes for regional technological trends **[Figure 6]** have shown that the largest apparent impacts (>80%) are given to digitalization, automation, and artificial intelligence (AI). Less popular trends (≤50%) perceived by regional outcomes were seen in digital twins of patients, 5G and connectivity, IoT/IoMT, and blockchain.

Medical equipment, global positioning system (GPS) technology, augmented and virtual reality, nanotechnology, stem cells, electronic medical record (EMR) and hospital information system (HIS) were other technological trends listed.

Business Model Trends

The need analysis integrates the degree of impact for different business trends that is required for the rapidly changing healthcare ecosystem which is shown in **[Figure 7]**. From the responses, out of various business trends, the major impactful trends were focused on digitalization in reimbursement processes, and simulations for learning, training, and guidance requirements (68.3% each), followed by cross-institutional collaborations, value-based healthcare, and consolidation of healthcare providers (hospitals/clinic chains) at 65.9% each.

Participants also suggested other business trends such as franchising healthcare facilities, partnerships with other hospitals, investing in emergency health, accreditations, centralization of medical data, and establishing long-term patient relationships.

Clinical Trends

To understand the current requirements in the aspect of clinical areas for optimizing overall disease pathways from diagnosis to treatment, the survey analyses key clinical trends **[Figure 8]**. The results from the responses are inclined towards prevention of diseases (85.4%), increase in chronic diseases (80.5%), role of patient experience (73.2%), and precision medicine (70.7%).

Other clinical trends identified were primary care, wound care, physiotherapy, rehabilitation, sports medicine, neonatal and pediatric care, infectious diseases, tissue engineering, and decentralized trials.

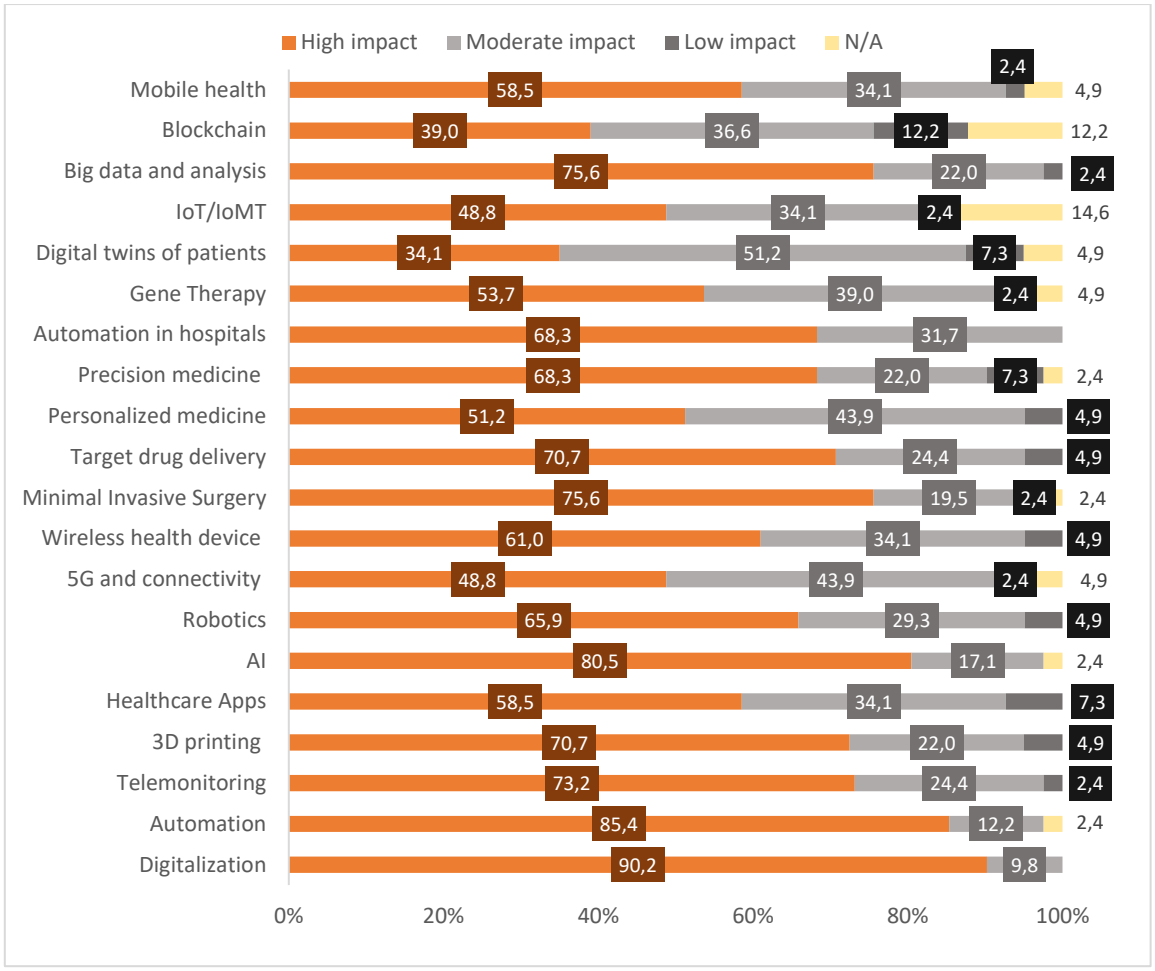

Figure 6: Technology Trends Outcome Analysis

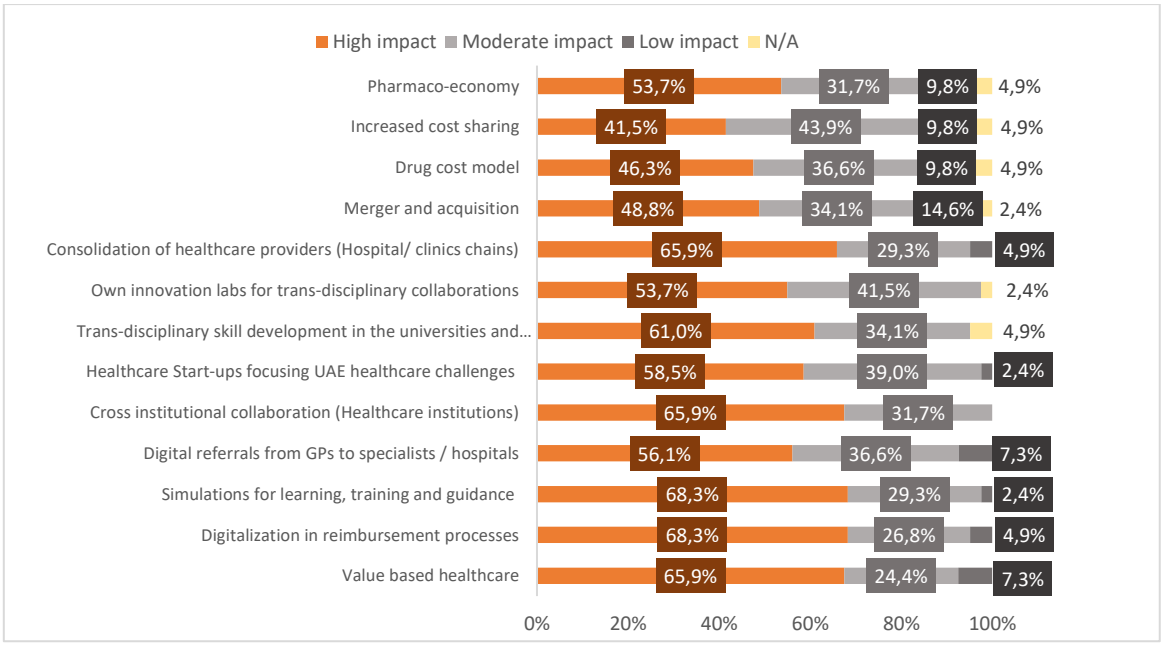

Figure 7: Business Trends Outcome Analysis

Category 2: *Key opinion leaders, institutional challenges and goals of hospitals, the healthcare system in UAE, and their degrees of importance*

KOL Voices

The degree of importance of the challenges and goals of various key opinion leaders are represented in **Figure 9**. The most important challenges and goals of various KOL voices were identified to be quality of care and shortage of skilled workforce (90.2% each), followed by clinical outcomes (85.4%). Regulatory clearances were the least ranked at 43.9%.

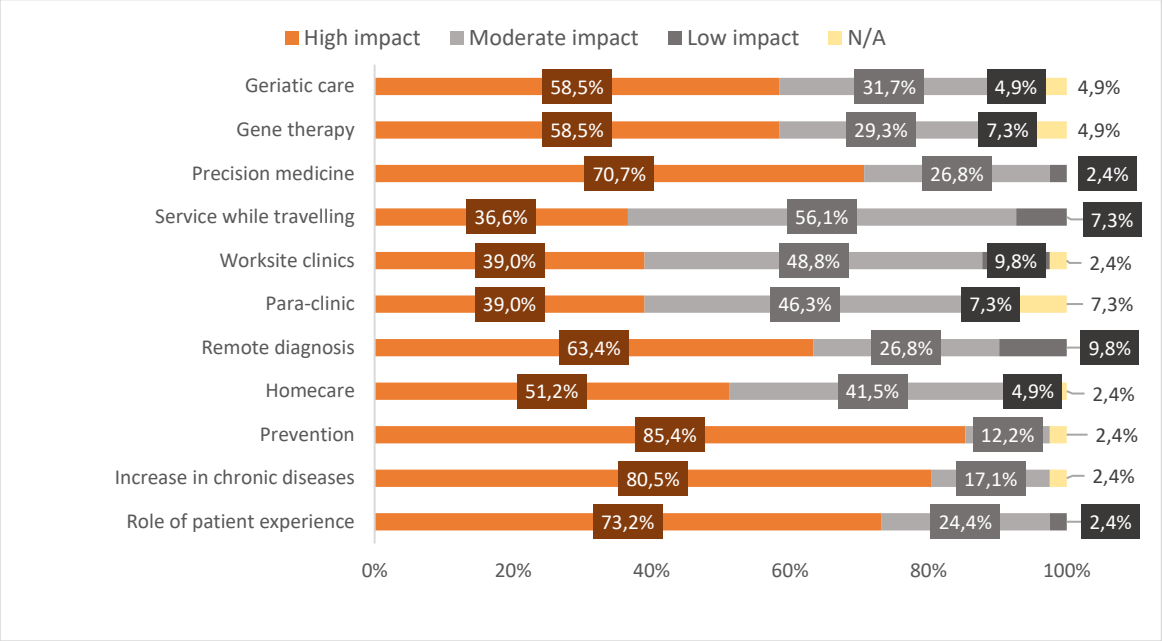

Figure 8: Clinical Trends Outcome Analysis

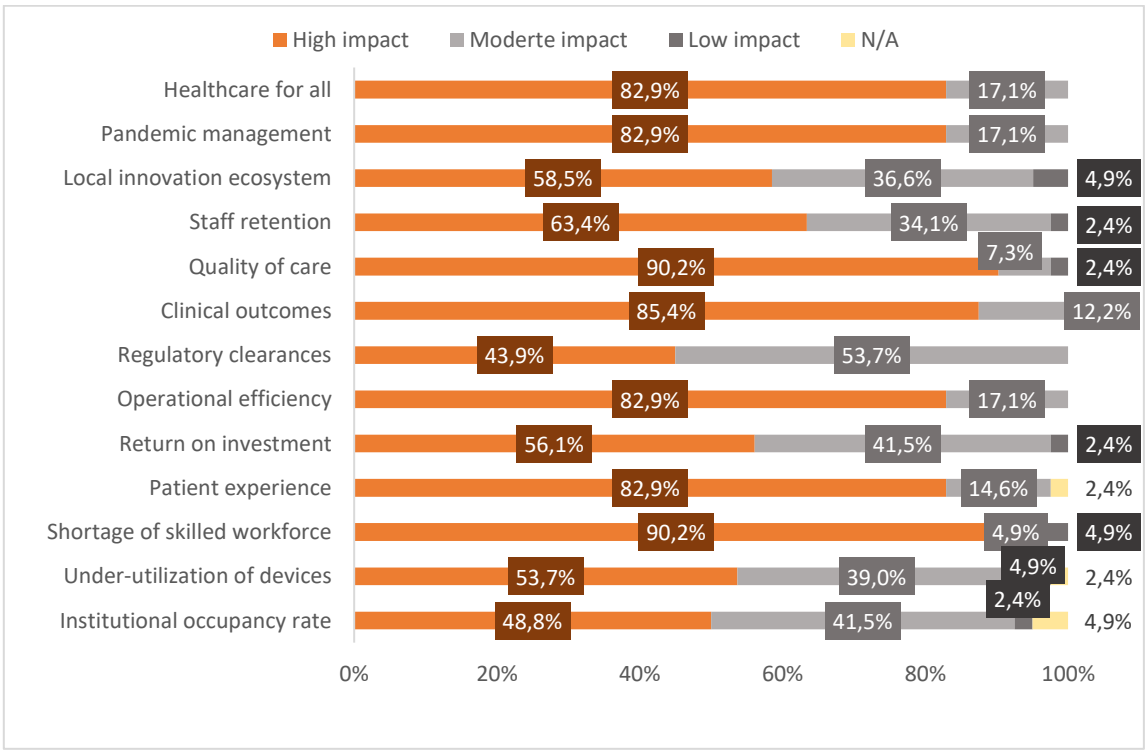

Figure 9: Outcome analysis of KOL/ institutional challenges & goals

Category 3*: UAE Healthcare System*

Visualization of the UAE healthcare system was provided to participants **[Figure 10]** and they were asked to review it. Based on their observations of the current state of the art, key differences from their research on UAE and the provided visualization of the UAE healthcare system were identified and analyzed.

Key differences were identified in the following areas:

- Role of the private sector in healthcare system delivery as there is an increase in private healthcare facilities
- Increasing healthcare expenditure in UAE
- The major expense in rehabilitation
- Diversity in different healthcare entities

Category 4: *Hospital workflow, challenges and potential solutions under operational efficiency, patient experience, workflow optimization for various departments*

The participants from the recent ITT program at FUH have identified different solution clusters to the identified pain points relating to areas such as patient experience, staff burn-out, hygiene, asset tracking, hospital interior structural and functional design, navigation, etc.

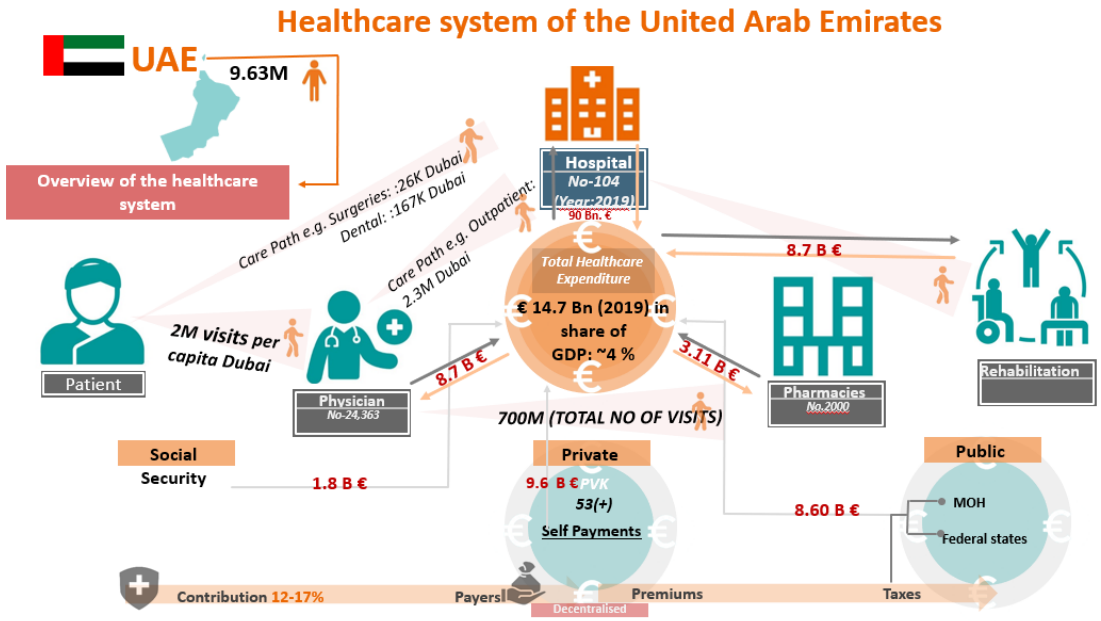

Figure 10: Healthcare system framework for the UAE region

Operation Efficiency

Challenges

Based on their observations, participants ranked the challenges affecting the operational efficiency of hospitals **[Figure 11].** Waiting time was seen to have a major impact (75.6%), followed by workforce management and skill development (73.2%), insurance/reimbursement, and interdepartmental miscommunication (70.7% each). Challenges such as asset tracking and readmission rate were ranked low.

Best Practices

To improve the operational efficiency of hospitals, the potential solution/best practice with the highest impact was electronic health records (EHR) at 90.2%. The centralized data system was at 82.9%, followed by smart monitoring applications at 80.5%. The least impact was observed for drones at 39%. The impact percentage breakdowns may be seen in **Figure 12**.

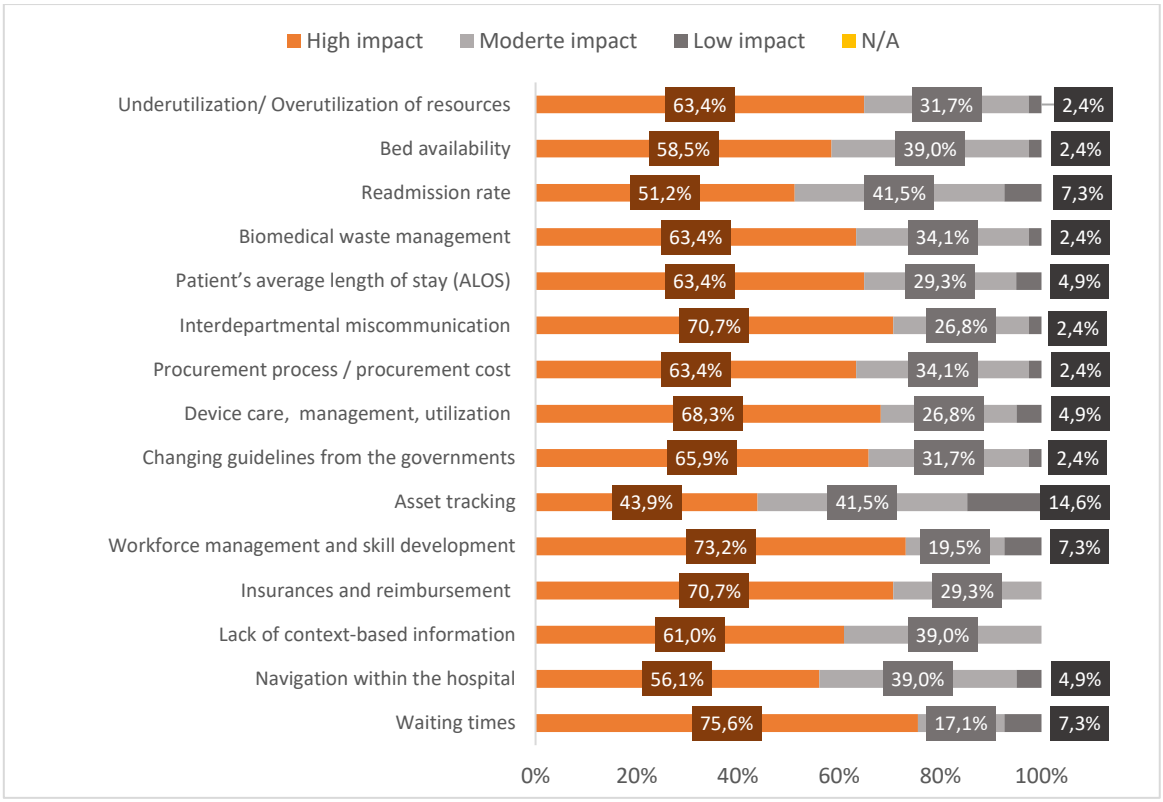

Figure 11: Analysis of the impact of different challenges on operational efficiency

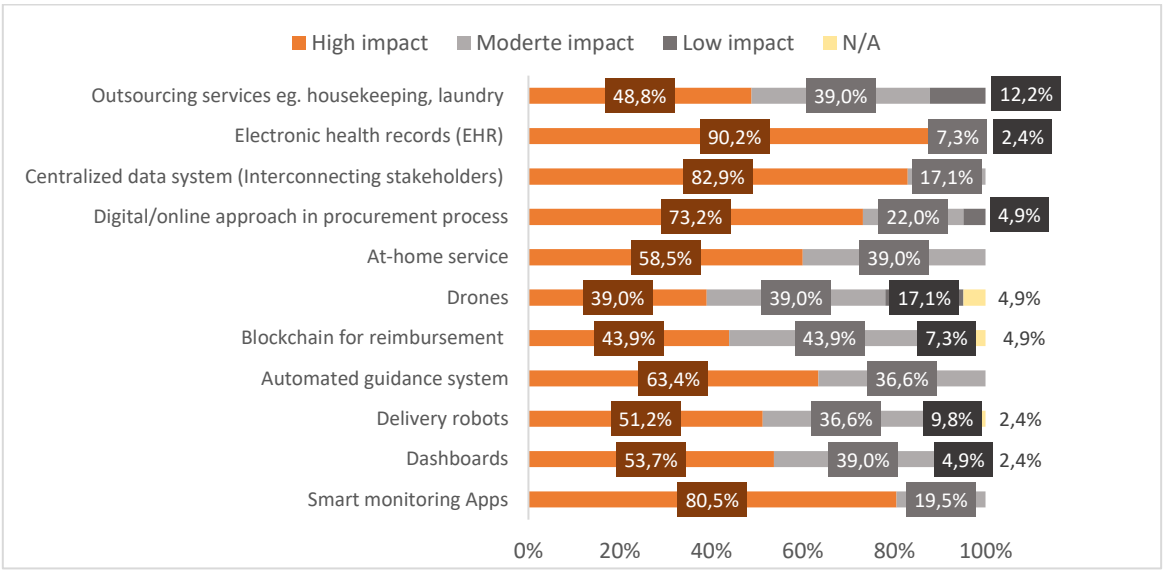

Figure 12: Analysis of the impact of best practices on the operational efficiency

Patient Experience

Challenges

Patient experience is influenced by certain factors and participants were asked to rate these challenges based on the degree of their impact **[Figure 13]**. It was observed that unprofessional staff behavior has a high impact (80.5%) on patient experience. Other major factors responsible for a negative patient experience include cost and patient compliance (75.6%

each), followed by treatment time/efficiency (68.3%).

Potential solutions

The degrees of impact of potential solutions for improving patient experience is illustrated in **[Figure 14]**. Hygiene has the highest impact (82.9%), and solutions in this area can lead to a positive patient experience. Patient-centered care (78%) and custom illumination, patient-friendly environments (70.7%) followed. Assistance in paper works was the lowest-rated (39%) in terms of patient experience.

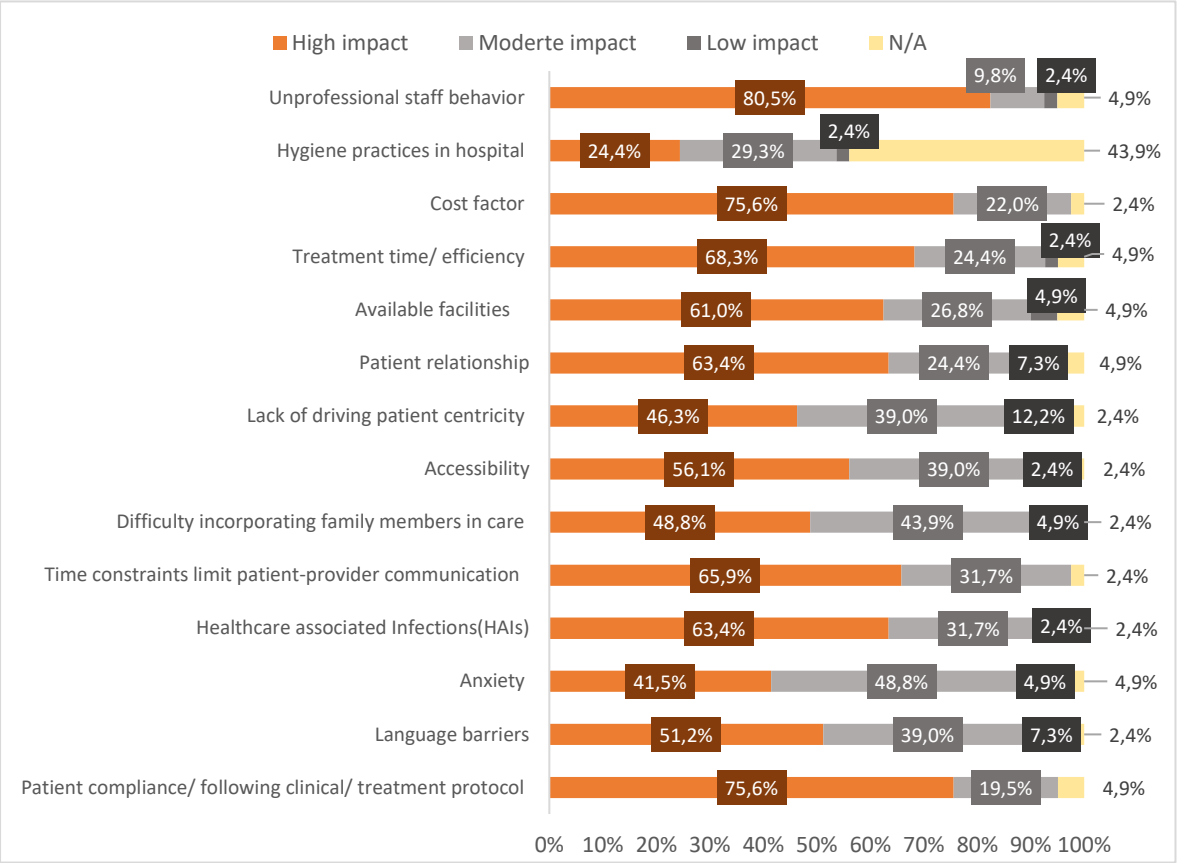

Figure 13: Key challenges in patient experience

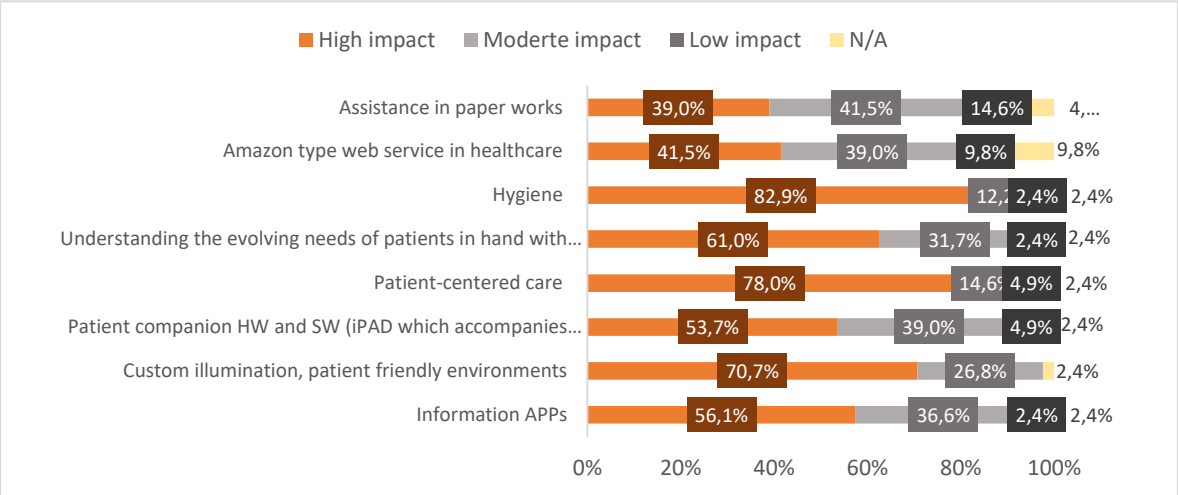

Figure 14: Potential solutions in patient experience

Workflow

Challenges

Among the key challenges that affect the workflow in hospitals, most participants voted for digitalization (78%), followed by waiting time (75.6%), and pandemic-related requirements (73.2%). Turnaround time in various departments, work pressure, and cross-department communication also had an impact on the workflow (70.7% each). The impact percentage breakdowns may be seen in **Figure 15**.

Best Practices

Participants voted for the best practices and potential solutions for workflow optimization. As seen in **Figure 16**, patient compliance to the treatment plan (78%) had the highest impact on the workflow. Other potential solutions for optimizing the hospital workflow included clinical communication and collaboration platforms (68.3%), automating scheduling (56.1%), standard operating procedures, and a better referral process (53.7% each).

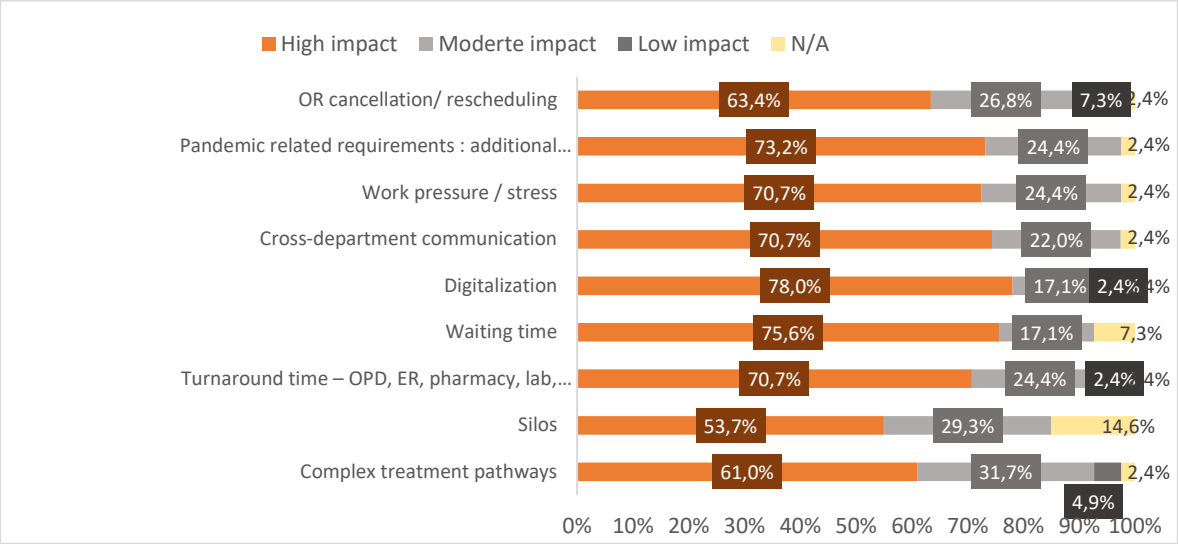

Figure 15: Key challenges in workflow

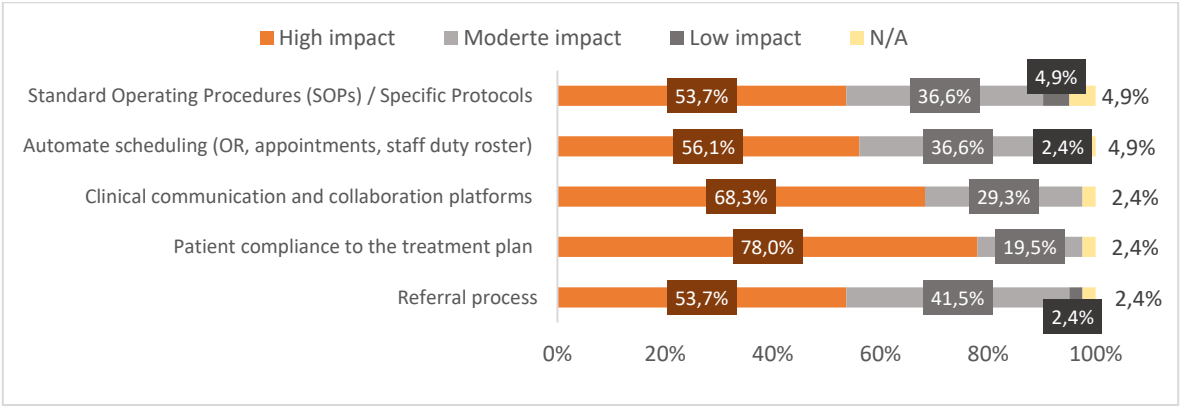

Figure 16: Potential solutions in workflow

Implementation Roadmap

After consolidating different results relative to the trends, challenges, and proposed solutions in the different clinical, technological, and administrative aspects of the healthcare system in the UAE, an implementation roadmap was established to address the gaps and challenges in the local healthcare system **[Figure 17]** and define the phases of translating the outcomes into tangible solutions. The implementation road map was divided into four core phases: design and setup phase, co-creation and co-development phase, implementation and

commercialization phase, and cross-organizational collaboration phase.

The design and setup phase includes characterizing different local trends, KOL voices, challenges, workflows, and best practices. The ITT programs held at different institutions such as Fakeeh University Hospital, New York University Abu Dhabi, and External Innovation Think Tank (eITT) Siemens Healthineers are at the center of the identification of these variables. Different perceptions, inputs, and ideas are collected from participants from different disciplines through the program outcomes and surveys to develop a structured list of these healthcare variables.

The next phase, the co-creation and co-development phase, utilizes the data from the previous phase in more focused project deep dive definitions. Data is then further consolidated from other partner institutions for more comprehensive outlooks. Collaborations with different institutions are proposed and established in the UAE for co-developing solutions to the identified key challenges. This phase will include requirement engineering and minimum viable product (MVP) creation.

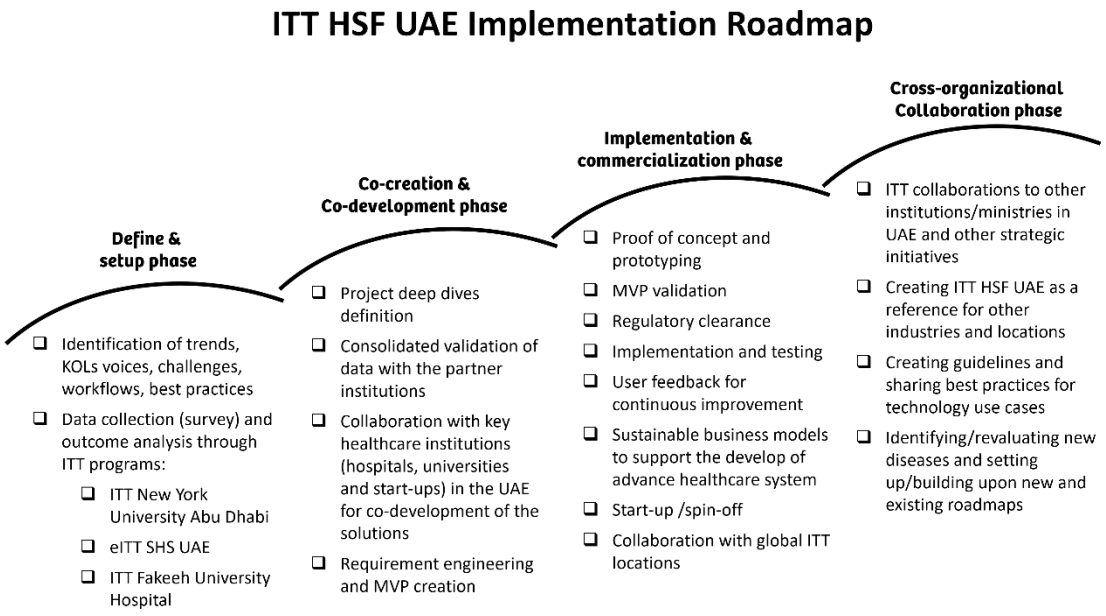

Figure 17: Implementation Roadmap

The third phase is the implementation and commercialization phase. This phase heavily involves prototyping, proof of concept, testing, and MVP validation alongside the collaboration of the different global ITT locations. Steps in this phase are also taken to proceed with regulatory clearances and federal approvals. The success of this stage is also measured through user feedback and countered improvements. Furthermore, this stage introduces the development of sustainable business models to enhance healthcare systems and initiate start-up and spin-off opportunities.

Finally, the last phase is the cross-organizational collaboration phase. In this stage, ITT extends its proposals to external collaborators from multiple organizations that could involve institutions and/or ministries to come together under shared strategic initiatives and visions. At this stage, the developed ITT HSF may be used as a reference guide for other industries and various locations as well. At this phase, guidelines, sharing best practices for technology use cases, and building upon both new and existing roadmaps are essential parts of seeding and affirming the framework.

Discussion

When observing the most in-demand trends and challenges in the UAE, the outcomes can be used to address and reverberate the vision the country has for its future healthcare systems. Particularly, the current challenges posed to the UAE's healthcare systems including the inefficient use of technology and absence of standardized healthcare across the

country may be met with the highly-rated technological trends such as big data analysis, AI, automation, and digitalization.

Moreover, the challenge of smaller healthcare providers being taken over by the much larger healthcare provider groups in the country could be met with identified trending business models such as the partnering of healthcare providers and cross-institutional collaborations to give more support to start-ups and smaller institutions. Additionally, an increase in the abundance of healthcare institutions of diverse sizes and focus on different healthcare key challenges across the country will significantly augment the UAE's healthcare economy.

With Dubai being a leading healthcare destination providing access to advanced infrastructure and adopting the latest technologies and systems for health transparency and international standards for patient care, medical tourism holds a strong position in the country. With 90% of internationally accredited hospitals and healthcare professionals from 110 different nationalities, there is a need for integrating activities and programs to welcome and enhance the culturally diverse and inclusive setting. Outcomes from this certification also included a section for addressing the enhancement of medical tourism in the region in line with the country's vision. This included innovative approaches to virtual solutions involving portals and applications as well as redefined hospital infrastructure to include dedicated departments for medical diversity, culture, and tourism.

For decades, healthcare has been advocating the importance of prevention in the field. With almost 90% of votes, prevention **[Figure 8]** and quality of care **[Figure 9]** have been recognized as core challenges in the UAE. This reported urgency will not only help direct solution development but will also raise the awareness needed to instigate reform and innovation.

It is important to comprehend how the consolidated data can be used to help shape the future of healthcare in the UAE. **Figure 17** illustrates the implementation roadmap for taking these categories of outcomes to unravel solutions, co-creation, and commercialization. With persistent updates on data from multi-disciplinary mindsets, volatile and unprecedented key challenges can efficiently be met with impactful trends. Outcomes from local ITT programs have provided a variety of content to fit into the HSF to effectively address these challenges.

This study is presented as a pilot that is to be updated frequently to further increase databases of trends, challenges, and fluctuating workflows in the country. The current models have been limited to the given sample size. The expansion of input and outcomes is to be strategically collected to comprehend different perspectives and HSF direction over time.

Conclusion

With unprecedented pandemic conditions and increasing morbid lifestyles adopted by a high percentage of the population, the fast-growing UAE has shown a heavier concentration on the future of healthcare in the country. By actively engaging healthcare institutions as well as developing local innovation infrastructures, ITT as part of Siemens Healthineers has been addressing the UAE's increasing interest in further developing the knowledge economy and entrepreneurship culture in the country. This paper has captured and validated information on healthcare and hospital trends in the UAE, Key Opinion Leader(KOL) and institutional challenges, the UAE healthcare system, and hospital workflows. It has also proposed a developed implementation roadmap to take the consolidated data forward into solution development and co-creation.

Future research may report and perform further in-depth analyses on solutions developed that follow the ITT Healthcare System Framework as well as updates on local trends and challenges.

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Authors Statement

Professor Sultan Haider has led and initiated the context of the paper as well as validated and established the framework of this paper. Dr. Fatih Gul has shared vital insights and visions necessary for the development and promotion of this proposed healthcare system framework and implementation in the UAE. Jayati Vasavada, Niharika N, Apoorva Goenka, Syed Ali Mehdi, and Dahlia Hassan have worked towards the content, data, survey, and analysis for this manuscript. All authors have contributed to the drafting of this paper and have read and approved the final manuscript and have consented its publication. There are no declared competing interests between the authors.

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Siemens Healthcare GmbH
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