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White paper- Innovation Think Tank Era's Lucknow Medical College and Hospital

Co-creation on the Future of Healthcare in India at Era's Lucknow Medical College and Hospital

Trends, disease pathways, technologies & innovation best practices

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Co-creation on the Future of Healthcare in India at Era's Lucknow Medical College and Hospital

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Abstract

India is a strong emerging economy, with healthcare being one of its largest contributing sectors. With increasing interest in access to care and local capacity building, the Indian healthcare sector continues to boost frugal innovations in terms of products, services, and expertise development. Several healthcare institutions are focusing on developing their own ecosystem of stakeholders. Innovation Think Tank (ITT) at Siemens Healthineers has been maneuvering this by actively engaging regional healthcare institutions and establishing local innovation infrastructures.

The aim is to bring stakeholders from healthcare disciplines together to share their distinctive perspectives, leverage innovations and define implementation roadmaps. ITT organized two co-creation activities along with Era's Lucknow Medical College and Hospital (ELMCH) 1) ITT certification program (ITT CP) at ELMCH, where interdisciplinary teams were trained on the ITT methodology, which they followed to create solution proposals with a focus on the Future of Healthcare in India and 2) Co-creation workshop to address strategic business targets of healthcare institutions. The goal of the co-creation programs was to capture and validate trends in the Indian healthcare system for resolving the system's gaps and issues. Key opinion leader voices were collected, and local challenges and needs were identified using ITT methodology training and ITT's Healthcare System Framework with a special emphasis on India's healthcare future.

The responses gathered during these co-creation events could cater to inputs towards future co-creation and co-implementation in India. As an outcome of the programs, ELMCH engaged ITT for the setup of an incubation center to further foster innovation and entrepreneurship culture and driving commercialization of the products out of ELMCH start-ups and companies.

Introduction

Governments across the world agreed to achieve "Health for All" by the year 2000 in the Alma Ata Declaration of 1978, emphasizing on better access to primary health facilities and services by defining country-specific healthcare targets. However, the goals were not met, and there are still significant gaps in the delivery and accessibility of healthcare services, particularly in developing nations. In terms of measurable health inequities, large differences persist prominently and dramatically across emerging countries [1].

Today, India is a country of 1.39 billion people representing a huge diversity and, as a result, a huge challenge for the healthcare delivery system. The Indian healthcare system presents a range of conflicting situations. At one end of the system there are defined structures delivering high tech medical care, primarily in urban regions. At the other end, there are remote regions which are still struggling to have proper health subcenters for primary care. Other than geographic distributions, education, wealth, and gender discrimination are causes of healthcare disparity among the population. With the current rate of change, this spectrum is expected to spread considerably further, resulting in even more complexity in the future [2].

The rapidly changing disease burden, aging population and urbanization have a huge toll on the healthcare delivery in India [3]. To tackle the emerging health crisis in India and enable access to care, the government has launched certain initiatives in the recent years. With a focus on comprehensive primary healthcare, the Ayushman Bharat Pradhan

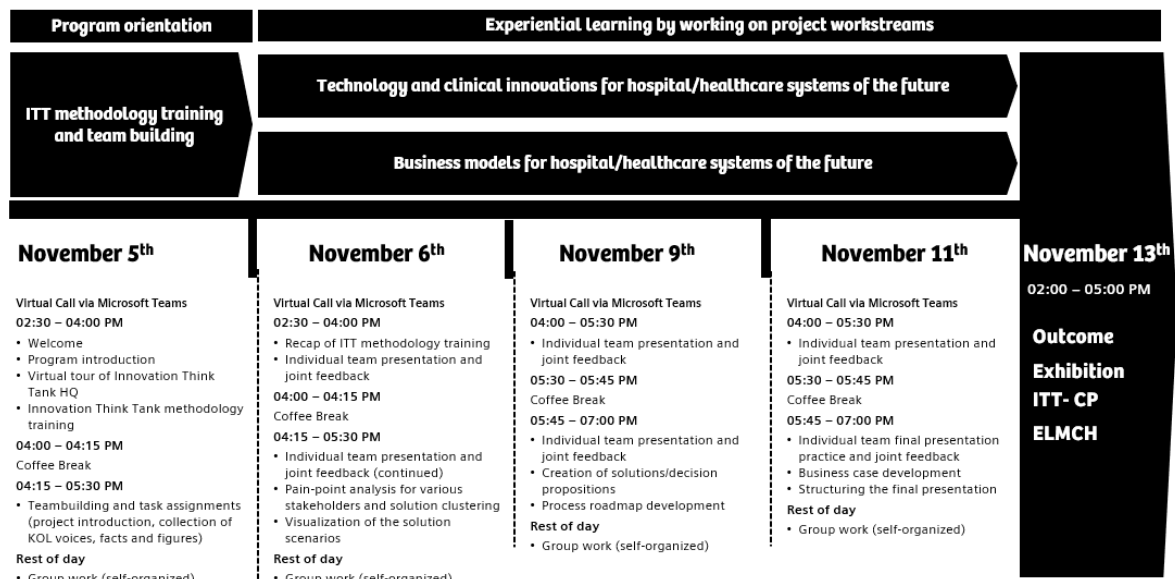local challenges, and bridge the gap through translational solutions.

Figure 1: Roadmap for ITT CP at ELMCH

Co-creation internal event: Workshop

A co-creation workshop was briefly organized by ITT with a focus on "Addressing strategic business targets of healthcare institutions" and was effectuated on February 5, 2022, at ELMCH. During the program, participation was in a hybrid format, participants gathered in-person at the ELMCH campus and also remotely from various locations within and outside India. Attendees of the workshop included healthcare professionals (hospital administrators, biomedical engineers, radiologists, operators etc.) and colleagues from SHS. Impulse speeches from key opinion leaders (KOLs) within ELMCH and SHS initiated discussions on the focused topic of targeted healthcare challenges, followed by a survey on healthcare system framework for capturing and validating trends for future of healthcare in India.

In an effort to recognize and validate the local healthcare trends and cross-departmental dependencies, the respective trends and proposals were gathered, assessed and confirmed through the Innovation Think Tank Healthcare System Framework (ITT HSF) survey, which amalgamates 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 2]** [13].

22 disease pathways and various departmental workflows were analyzed to make customized healthcare system framework surveys to co-create tailored solutions for validated challenges. Templates were updated and validated according to the Indian healthcare system specific requirements.
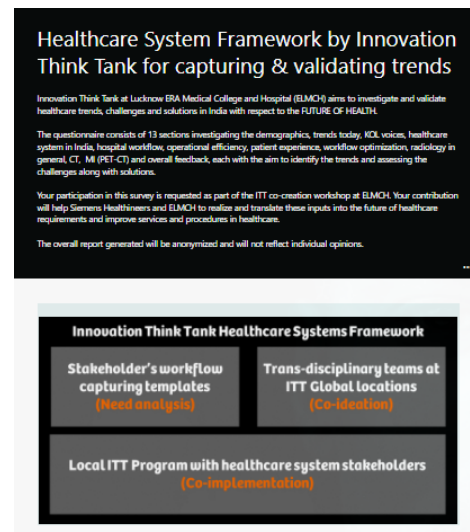

Figure 2: **Innovation Think Tank Healthcare System Framework for capturing and validating trends**

From the above-mentioned co-creation events, the identified healthcare challenges were addressed via solutions and proposals; the information was then collected and compiled for further analysis and discussions.

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Results

Co-creation external event: ITT CP

ITT CP ELMCH was held in November 2021 where a total of 36 participants from 14 different institutes across 10 countries took part in hybrid (both virtual and in person) format. The program was successfully concluded on November 13, 2021, where 5 teams presented their final outcomes on the healthcare of future challenges, focusing on technological and clinical innovations, and business models for hospitals/ healthcare systems of the future. The impact of the program was such that there were 100+ KOL voices captured, 200+ pain points analyzed, 25+ technologies researched, 50+ solution ideas collected, and 15+ solutions proposed by the participants over the course of the 5-day ITT certification program at ELMCH. The top three projects were selected based on the votes from the jury members.

Co-creation internal event: Workshop

The co-creation workshop on "Addressing strategic business targets of healthcare institutions" resulted in discussions among KOLs from SHS and ELMCH (Additional Director Research and Development, Principal of the Medical College, Head of Radiology Department) on the Indian healthcare system, strengths and weaknesses of hospitals, biggest cost drivers and opportunities for better financial performance, key performance indicators (KPIs) tracked today and planned to be tracked in future, key challenges or problem statements that are to be solved in hospitals and radiology department in particular, ongoing research and development activities at ELMCH and future research topics for collaboration. The discussions were observed and considered by SHS colleagues. During the session, participants were also briefed about the digital survey on healthcare system framework by ITT for capturing and validating trends.

Survey results

52 participants took part in the survey after the co-creation session. The data gathered and validated from the survey on India's healthcare system was organized into the following categories:

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

Healthcare trends

Healthcare trends based on the degree of their impact are shown in **[Figure 3]**. In accordance with the observations in the Indian healthcare system, the healthcare trend rated with the highest impact was access to care (42%). Decentralization of healthcare was rated as having high impact by 33% participants and moderate impact by 60%. Individualization of diagnosis and treatment, changing patient role to consumer, and participation of non-healthcare players such as wearables had a moderate impact in transforming healthcare delivery in India as per the polls. Digitalization of healthcare and technological innovations were other healthcare trends identified.
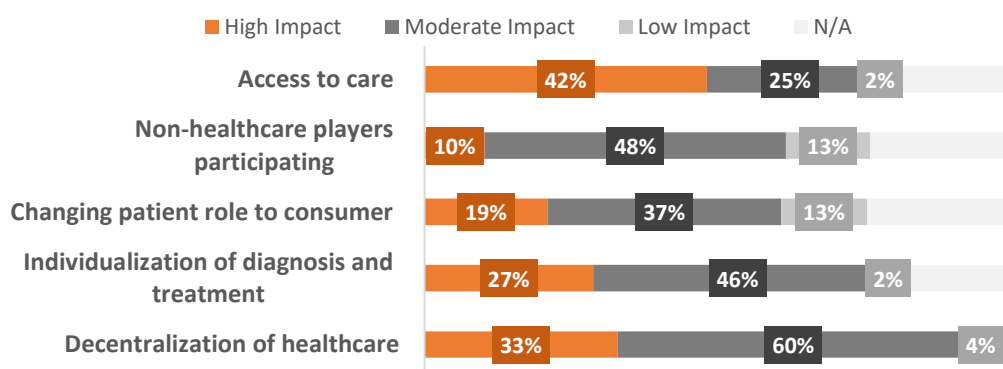

Figure 3: **Healthcare Trends Outcome Analysis**

Technology trends

To capture and validate the technological advancements in healthcare, we analyzed the technology trends in the survey. **[Figure 4]** illustrates the technology trends with their associated degrees of impact, based on the responses by the participants. Trends with the highest impact were 3D printing (46%), digitalization (44%), and healthcare apps (42%). 50% responders considered digitalization to have a moderate impact. Automation and robotics also had a moderate impact according to 48% participants. Additional technology trends identified by the participants were telemedicine and cloud computing.
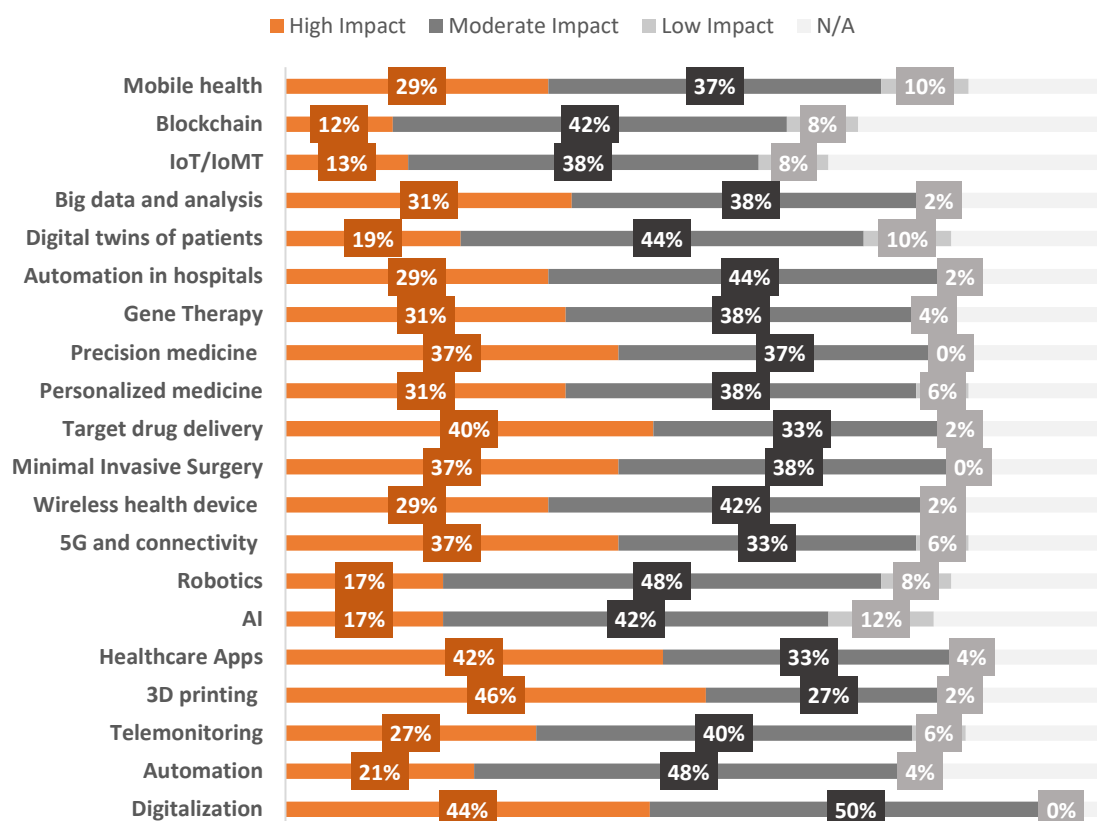

Legend: ■ High Impact ■ Moderate Impact ■ Low Impact ■ N/A

Technology	High Impact	Moderate Impact	Low Impact
Mobile health	29%	37%	10%
Blockchain	12%	42%	8%
IoT/IoMT	13%	38%	8%
Big data and analysis	31%	38%	2%
Digital twins of patients	19%	44%	10%
Automation in hospitals	29%	44%	2%
Gene Therapy	31%	38%	4%
Precision medicine	37%	37%	0%
Personalized medicine	31%	38%	6%
Target drug delivery	40%	33%	2%
Minimal Invasive Surgery	37%	38%	0%
Wireless health device	29%	42%	2%
5G and connectivity	37%	33%	6%
Robotics	17%	48%	8%
AI	17%	42%	12%
Healthcare Apps	42%	33%	4%
3D printing	46%	27%	2%
Telemonitoring	27%	40%	6%
Automation	21%	48%	4%
Digitalization	44%	50%	0%

Figure 4: **Technology Trends Outcome Analysis**

Business trends

With the rapidly evolving healthcare delivery systems and business models in healthcare, it was necessary to understand their impact **[Figure 5]**. A relatively high impact was observed for digital referrals from general practitioners to specialists/hospitals (35%), followed by cross-institutional collaborations (33%), consolidation of healthcare providers (hospitals/clinic chains) and healthcare start-ups focusing on the challenges in Indian healthcare system (31% each). Value-based healthcare, mergers and acquisitions, and digitalization in reimbursement processes had a relatively moderate impact.

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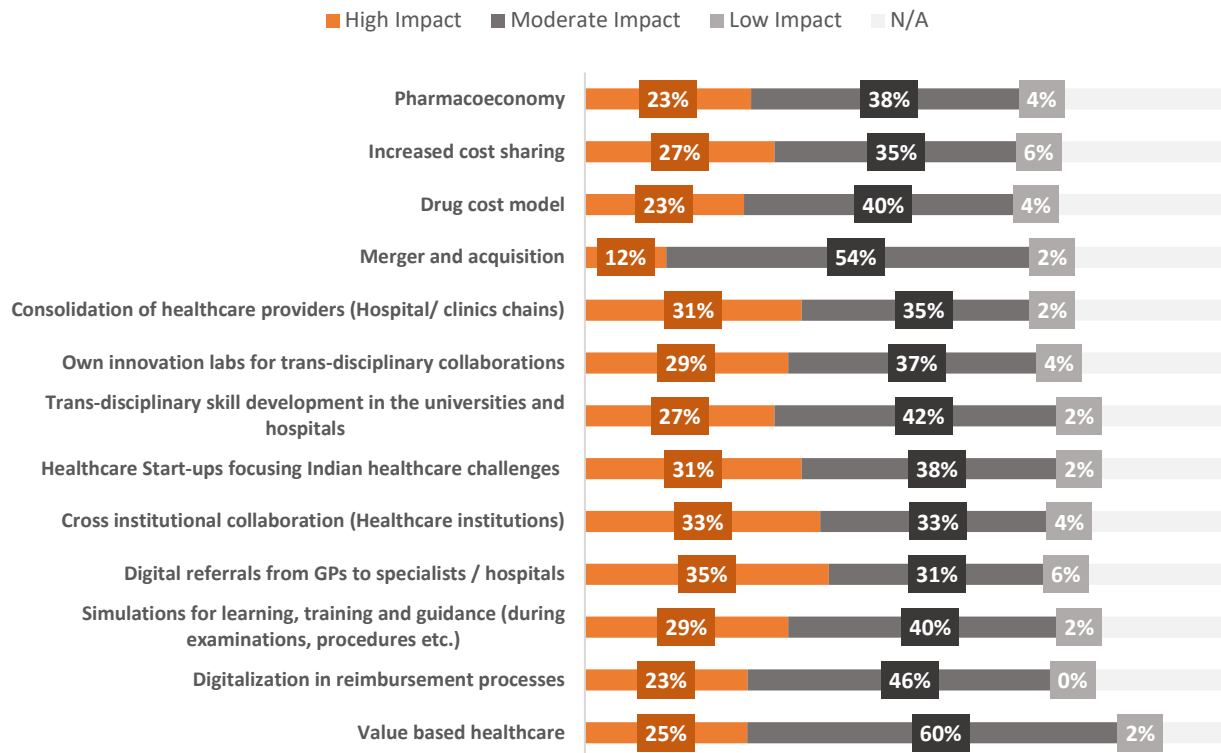
High Impact ■ **Moderate Impact** ■ **Low Impact** ■ **N/A**

	High Impact	Moderate Impact	Low Impact
Pharmacoeconomy	23%	38%	4%
Increased cost sharing	27%	35%	6%
Drug cost model	23%	40%	4%
Merger and acquisition	12%	54%	2%
Consolidation of healthcare providers (Hospital/ clinics chains)	31%	35%	2%
Own innovation labs for trans-disciplinary collaborations	29%	37%	4%
Trans-disciplinary skill development in the universities and hospitals	27%	42%	2%
Healthcare Start-ups focusing Indian healthcare challenges	31%	38%	2%
Cross institutional collaboration (Healthcare institutions)	33%	33%	4%
Digital referrals from GPs to specialists / hospitals	35%	31%	6%
Simulations for learning, training and guidance (during examinations, procedures etc.)	29%	40%	2%
Digitalization in reimbursement processes	23%	46%	0%
Value based healthcare	25%	60%	2%

Figure 5: **Business Trends Outcome Analysis**

High Impact ■ **Moderate Impact** ■ **Low Impact** ■ **N/A**

	High Impact	Moderate Impact	Low Impact
Geriatric care	31%	35%	2%
Gene therapy	27%	42%	2%
Precision medicine	27%	42%	0%
Service while travelling	17%	48%	6%
Worksite clinics	15%	52%	4%
Para-clinic	15%	46%	10%
Remote diagnosis	23%	46%	2%
Homecare	27%	37%	6%
Role of patient experience	33%	37%	2%
Prevention	42%	27%	2%
Increase in chronic diseases	25%	50%	15%
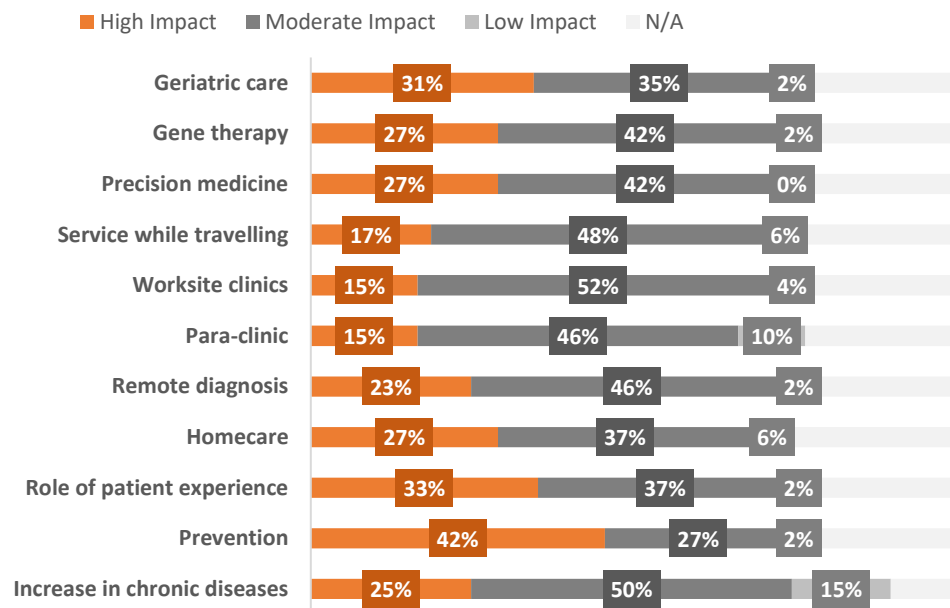
Figure 6: **Clinical Trends Outcome Analysis**

Clinical trends

We also analyzed the key clinical trends and their degrees of impact to understand the clinical needs and identify the focus areas which would help in optimization of the clinical care pathway. 42% participants marked prevention as a major clinical trend **[Figure 6]**, which is also evident from the current healthcare initiatives that emphasize the role of prevention. Role of patient experience was identified to have a high impact by 33% responders, and geriatric care by 31%. Increase in chronic diseases was voted by 50% participants as having a moderate impact. Other clinical trends that the responders mentioned were palliative care, medical ethics, and tele-devices and alerts.

Category 2: *Key opinion leaders, institutional challenges and goals of hospitals, healthcare system in India and their degrees of impact*

KOL voices

Several KOL voices were captured. **Figure 7** illustrates the challenges and goals identified by KOLs and their degrees of importance. Those with the highest impact were quality of care (48%), healthcare for all (46%), pandemic management (44%), and shortage of skilled workforce (40%). Institutional occupancy rate was perceived to have a moderate impact.
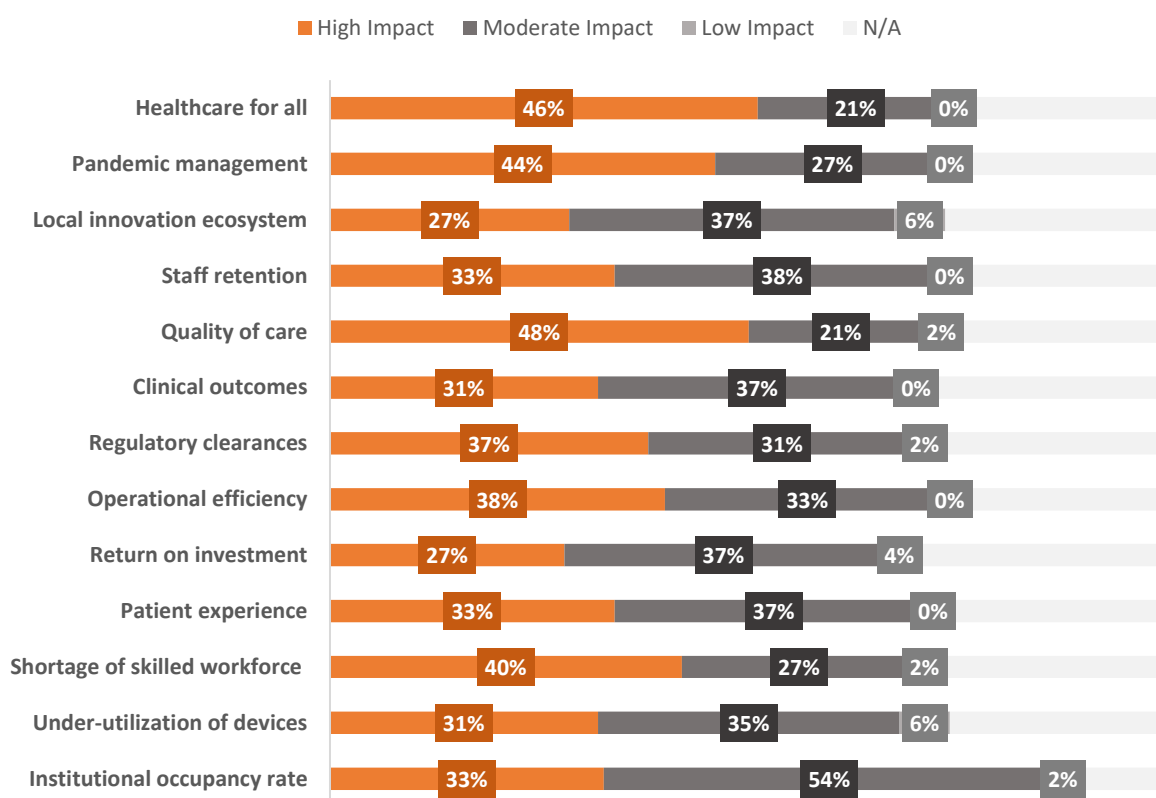
Figure 7: KOL voices Outcome Analysis

Category 3: *Healthcare system of India*

We visualized the healthcare system of India based on its population, healthcare infrastructure, manpower, patient pathway, healthcare expenditure, insurances and many more factors, and also represented the interdependencies between various stakeholders **[Figure 8]** [14-23]. This visualization was shared with the participants and after reviewing it, they provided their feedback on the differences observed and the requirements for the healthcare system of India, based on their knowledge and research.
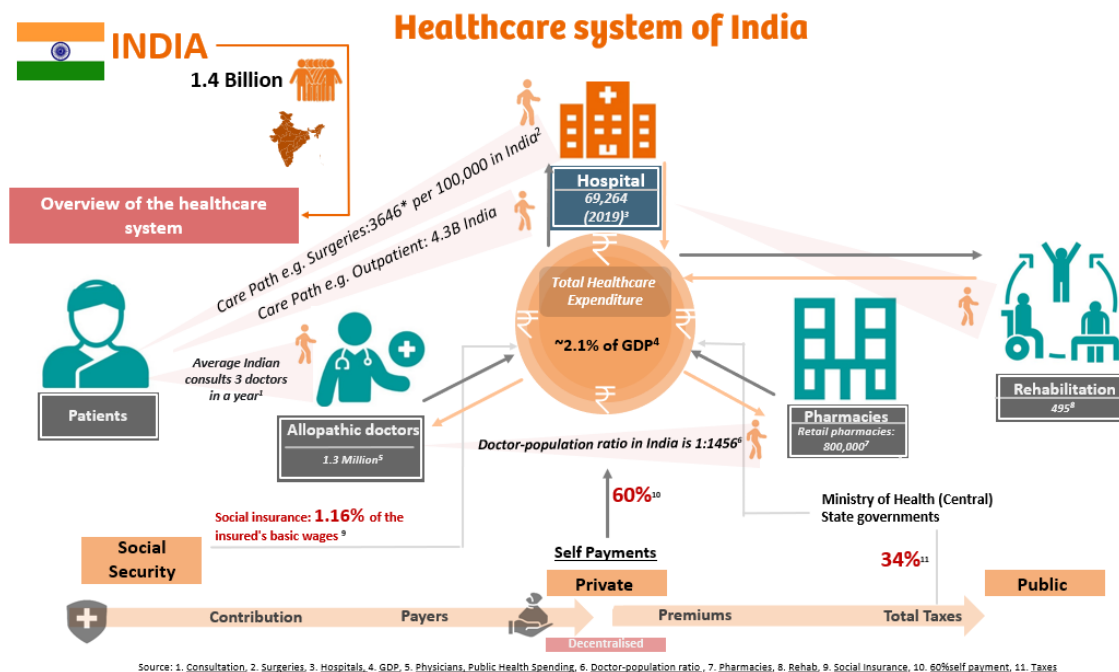
Figure 8: Healthcare system of India

The key inputs provided by the responders were:

- Low government healthcare expenditure in India and a need to increase funds for healthcare
- Ensuring access to care for both urban and rural population of India
- Gap between the public and private hospitals in terms of care, expenses, and hygiene

- Increasing the number of physicians, hospitals, and rehabilitation centers
- Other healthcare professionals like pharmacists, ancillary health professionals that can be included in the visualization of the healthcare system of India

Category 4: *Hospital and departmental workflow - challenges and potential solutions under operational efficiency, patient experience, workflow optimization*

Hospital workflow

The participants were asked to rank various challenges and potential solutions with respect to improving hospital operations, enhancing patient experience, and optimizing the workflow in hospitals and its various departments.

Operational efficiency

Challenges

Figure 9 demonstrates some challenges in operational efficiency, and their degrees of impact as perceived by the participants. Based on the responses, it is evident that bed availability, underutilization/ overutilization of resources, and biomedical waste management had a higher impact (40% each), followed by workforce management and skill development. Waiting times had a relatively moderate to low impact on operational efficiency.

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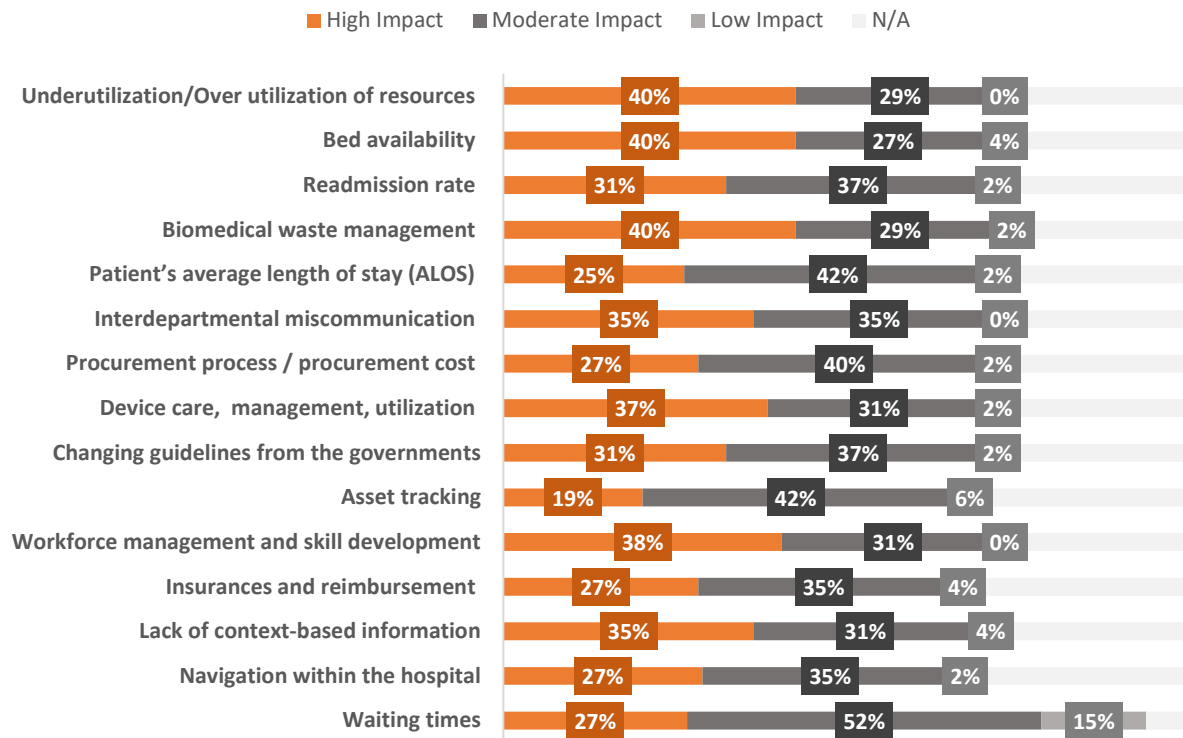

Figure 9: Outcome analysis for challenges in operational efficiency
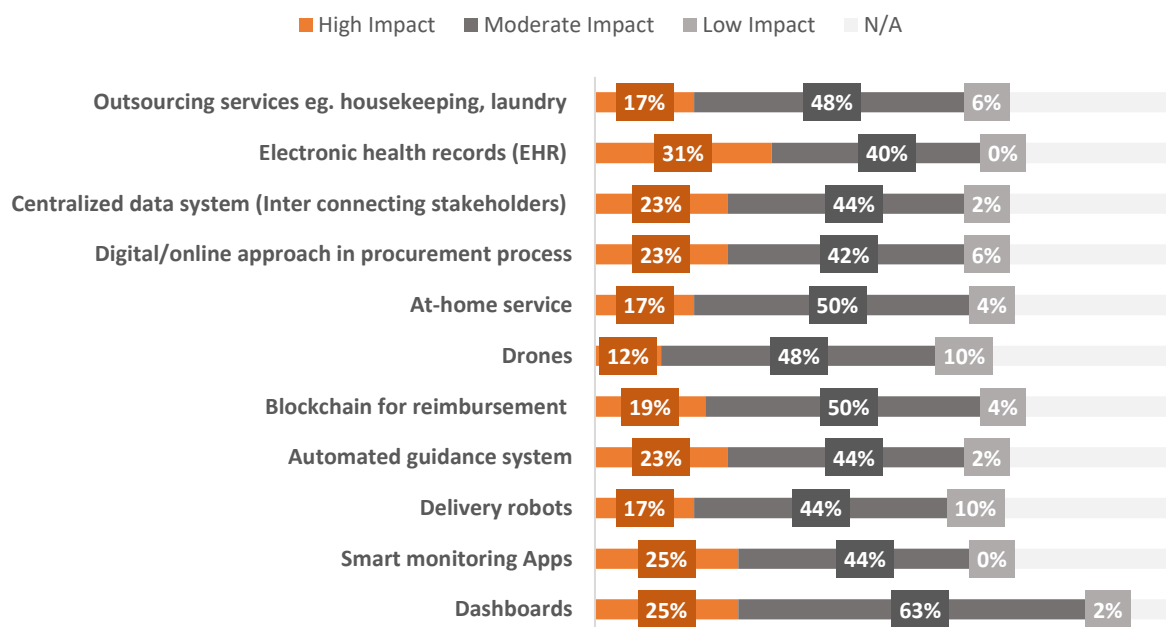

Figure 10: Outcome analysis for best practices/solutions in operational efficiency

Best practices

Best practices/ potential solutions to achieve operational efficiency are depicted in **[Figure 10]**. Electronic health records (EHR) were rated with the highest impact (31%), followed by smart monitoring apps and dashboards (25% each). 63% participants rated dashboards to have a moderate impact. According to 50% participants, at-home service and blockchain for reimbursement had a relatively moderate impact. Drones and delivery robots were found to have a low impact on achieving operational efficiency.

Patient experience

Challenges

Healthcare settings aim towards providing a positive patient experience. We captured the key challenges affecting patient experience and asked the participants to rate the same based on their degrees of impact **[Figure 11]**. Treatment time/ efficiency had the highest impact on patient experience as per 46% participants, followed by hygiene practices and facilities available in the hospital (40% each). Patient compliance had a relatively moderate impact on patient experience according to 63% responders.
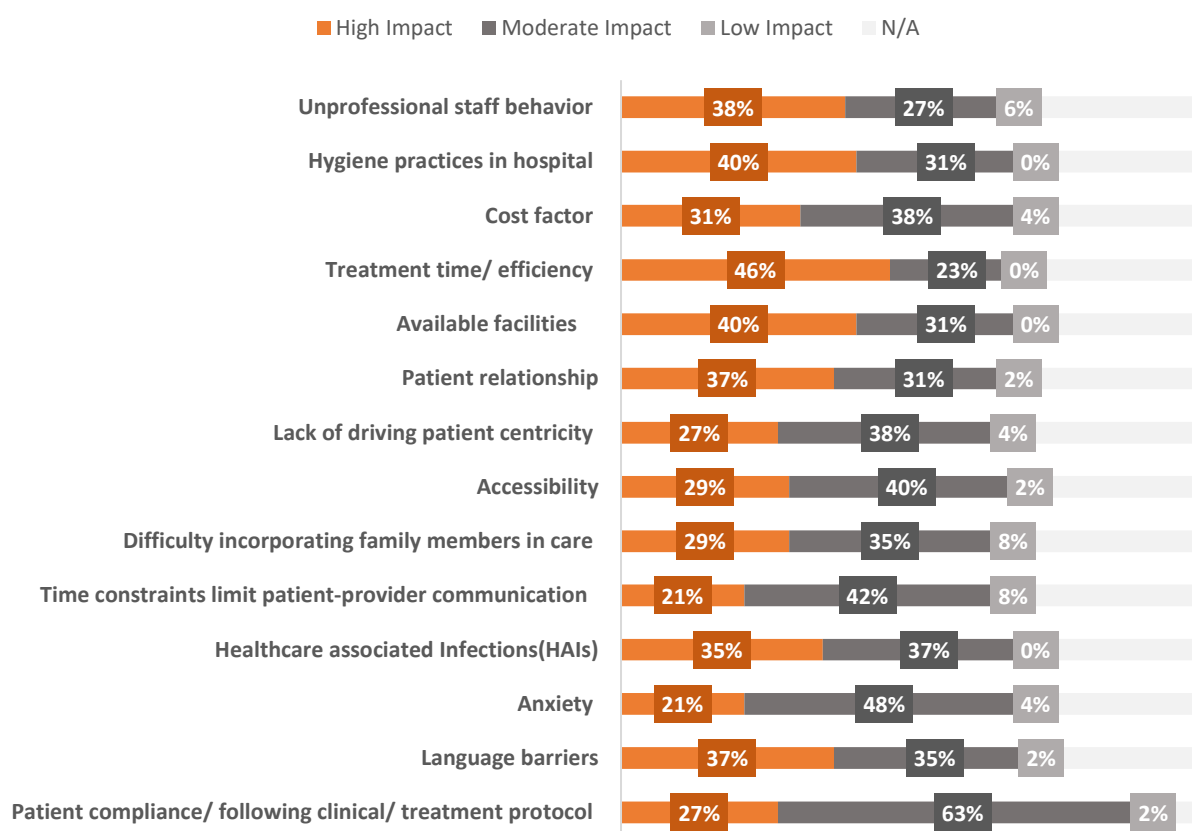
Figure 11: **Outcome analysis for challenges in patient experience**

Best practices

Figure 12 shows the degrees of impact of best practices/ solutions in patient experience. Hygiene was found to be the most important factor for a positive patient experience as it was rated to have a high impact by 48% participants. Patient-centered care also had a high impact (35%). Custom illumination and patient friendly environments were found to have a relatively moderate impact on patient experience by 65% participants.

Workflow

Challenges

Key challenges in workflow were identified and participants ranked them based on their degrees of impact **[Figure 13]**. Digitalization was observed to have a high impact (37%), followed by cross-department communication, and pandemic related requirements (35% each). Complex treatment pathways, appointment cancellation/ rescheduling,

silos, turnaround time and waiting time had relatively moderate impact on the workflow.

High Impact ◾ **Moderate Impact** ◾ **Low Impact** ◾ **N/A**

	High Impact	Moderate Impact	Low Impact
Assistance in paper works	29%	38%	2%
Amazon type web service in healthcare	23%	40%	8%
Hygiene	48%	21%	4%
Understanding the evolving needs of patients in hand with technology/ advancements in facilities	21%	48%	2%
Patient-centered care	35%	33%	4%
Patient companion HW and SW (iPAD which accompanies patient during the care process)	19%	44%	6%
Information APPs	17%	46%	2%
Custom illumination, patient friendly environments	23%	65%	2%

Figure 12: Outcome analysis for best practices/solutions in patient experience

High Impact ◾ **Moderate Impact** ◾ **Low Impact** ◾ **N/A**

	High Impact	Moderate Impact	Low Impact
Appointment cancellation/ rescheduling	21%	48%	0%
Pandemic related requirements : additional disinfection needed, resources, new protocols	35%	31%	6%
Work pressure / stress	29%	31%	8%
Cross-department communication	35%	33%	2%
Digitalization	37%	37%	2%
Waiting time	25%	42%	4%
Turnaround time – OPD, ER, pharmacy, lab, radiology, discharge process etc.	27%	44%	2%
Silos	10%	48%	0%
Complex treatment pathways	25%	63%	2%

Figure 13: Outcome analysis for challenges in workflow

Best practices

Among the best practices/ solutions for workflow optimization **[Figure 14]**, standard operating procedures/ specific protocols were rated to have the highest impact (35%), followed by patient compliance to the treatment plan, and referral process (31% each). Automating scheduling, and

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clinical communication and collaboration platforms had a relatively moderate impact on optimizing workflow as per the responders.

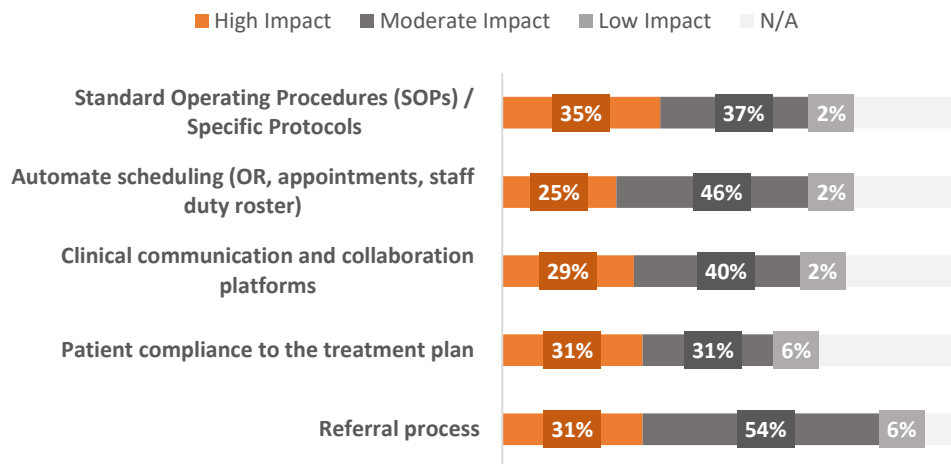Legend: High Impact, Moderate Impact, Low Impact, N/A

	High Impact	Moderate Impact	Low Impact
Standard Operating Procedures (SOPs) / Specific Protocols	35%	37%	2%
Automate scheduling (OR, appointments, staff duty roster)	25%	46%	2%
Clinical communication and collaboration platforms	29%	40%	2%
Patient compliance to the treatment plan	31%	31%	6%
Referral process	31%	54%	6%

Figure 14: **Outcome analysis for best practices in workflow**

Department workflow
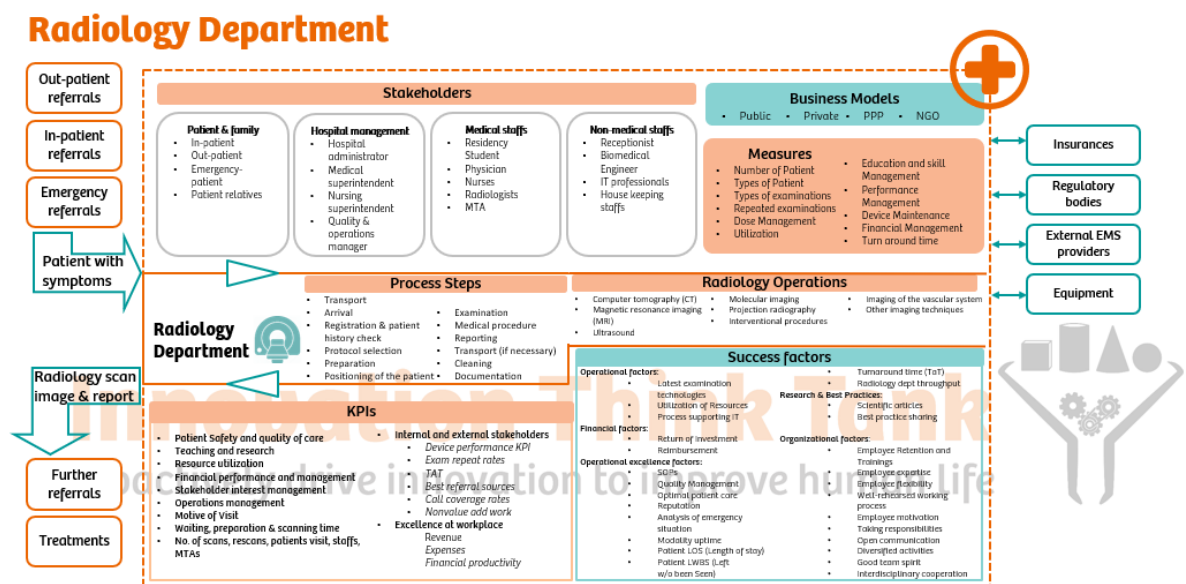
Figure 15: **Radiology department overview (stakeholders, workflow, business models, radiology operations, KPIs, success factors). Similar templates were given for CT and MRI department**

Participants were provided with a visualization of the radiology department **[Figure 15]**, with information pertaining to the stakeholders, process steps, radiology operations, business models, key performance indicators, and success factors.

Key differences

Based on their observations, experience, or research, most of the participants mentioned that there was no significant difference between the provided department visualization and the radiology department of their institution. Moreover, some responders mentioned that the functioning of the radiology department at ELMCH is smooth, they use the best machines with advanced technologies which enables them to acquire good quality thin slice

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images, and aids in faster diagnosis. They follow the given protocol and provide patient reports on time. However, patients here do not usually have insurance and the business model of the department varies from the one provided in the picture.

Challenges/ concerns raised for the radiology department

- To get proper patient history and clinical diagnosis from other departments
- Inter-departmental coordination
- Staff training
- Radiation exposure and provision of thermo-luminescent dosimeter (TLD) badges to monitor the same
- High cost of investigations
- Need for fast reporting and turn-around time
- Lack of patient awareness about the radiology investigations
- Electricity issues/ Power breakdowns
- Device maintenance
- Provision of correct report with all possible differential diagnosis
- Patient safety
- Patient follow-up
- Unavailability of online scans
- Provision of reports to patients via an app

Other challenges were observed during emergency night duties, ICU patients, obese patients, and for patients requiring investigation with full bladder.

Time consuming steps in daily routine

- Obtaining detailed patient history from clinical departments
- Collecting patient reports and related documents
- Patient preparation and positioning

Similar to the radiology department, we provided visualizations for the CT and MRI department. In addition to the observations made for the radiology department, specific concerns raised for the CT and MRI departments were on financial viability, digitalization, patient shifting, patient co-operation, patient load, time consumed during the scan, and machine noise (MRI).

The compiled responses for trends, workflows, and related challenges with the support of ITT Healthcare system framework templates would be further utilized to co-ideate and co-implement the translational and innovative solutions for optimizing Indian healthcare system.

Discussion

Indian healthcare system is complex yet evolving, where technological and infrastructural developments are still being explored and experimented, which yields opportunities for cost-effective innovations in the region. With India's growing population, shifting disease burden, and scarce resources, it is imperative to focus on the country's healthcare future. Many healthcare startups in India have emerged over the years with the aim to address local healthcare challenges by novel digital solutions. Government initiatives have also been launched in the recent years to tackle these challenges, and emphasis is being laid on access to safe, affordable, efficient, equitable and quality patient-centered care.

Various disparities exist in the country among geographic distributions, gender, education, and wealth which causes healthcare challenges like access to care, impedance to disruptive innovations, and various other bottlenecks to the system. To overcome these challenges, it is required to first understand the current scenario and recent trends in the local healthcare system. ITT assists in this by integrating ITT HSF framework for not only addressing and capturing trends but also by analyzing various KOLs' needs and challenges within the local healthcare system. As evident, the responses collected during the co-creation event highlight access to care as one of the major healthcare trends.

Following the COVID-19 pandemic, India has witnessed a trend towards digitalization and healthcare apps, which was also supported by the technological trend analysis from ITT HSF results. Moreover, newer business models are being developed to enhance healthcare delivery in the country and some of the trending business models identified were digital-referrals, cross institutional collaborations, and value-based healthcare, which could help in improving care delivery. The outcomes from the survey also depict major clinical trends in India such as prevention, patient experience and geriatric care, which resonates with the vision of global health systems. Hence, by integrating such HSF framework, ITT focuses on tailoring solutions to

problem statements to get feedback in real time with respect to feasibility, desirability and customer acceptance.

ITT has leveraged its global infrastructure to co-create the future of healthcare in India by addressing strategic business targets of healthcare institutions. Innovation Think Tank team is currently engaged in defining and designing an ITT Lab at ELMCH. During a site visit to ELMCH, a proposed site space was inspected by the Global ITT infrastructure project manager and a tentative design for the lab has been developed as illustrated in **[Figure 16]**. The lab will

include various best practices of ITT innovation infrastructure including various zones such as research and working zone for workstations and project work, requirement creation zone for displaying clinical workflow models and digital links to ITT world, prototyping and implementation zone for 3D printing, electronics, and workshop work and lastly a recreational zone. The lab will be used to conduct project deep dives on topics jointly defined by the ELMCH management and ITT team based on outcomes from various co-creations programs and projects.
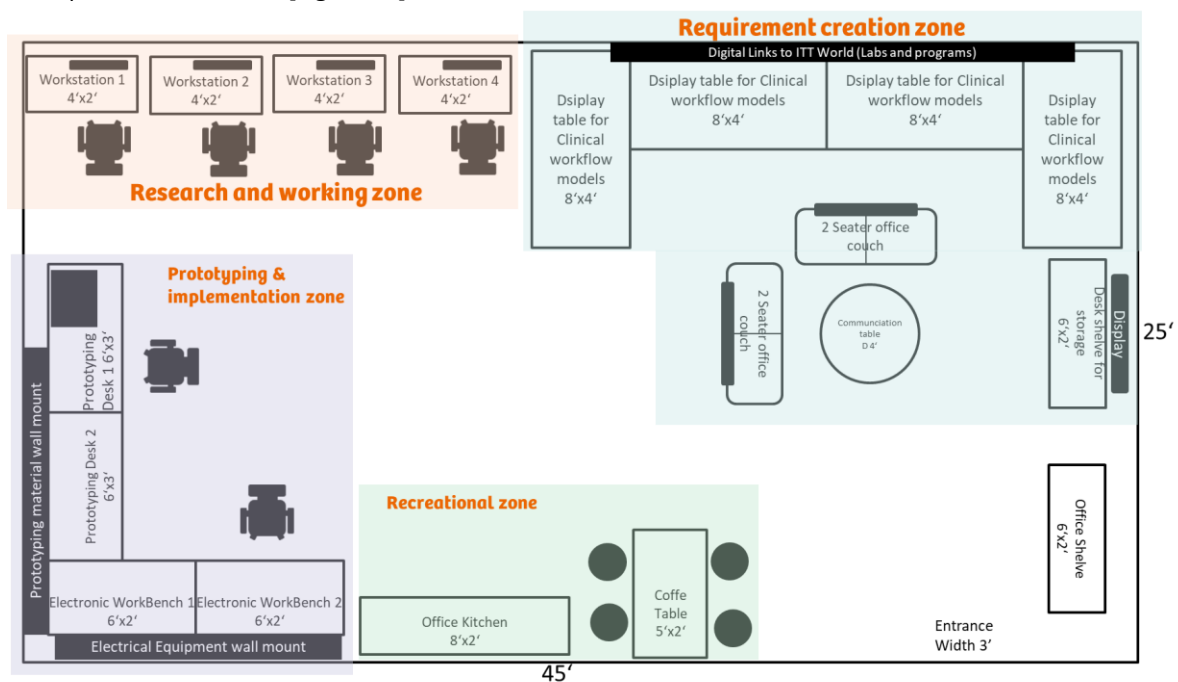
Figure 16: Tentative lab design for ITT lab at ELMCH

ITT and ELMCH are in further discussions for piloting an incubation center, which will include thorough advisory to ELMCH management board for setting up this startup incubation center **[Figure 17]**. The framework consists of 3 dimensions including 9 different elements. The 3 dimensions of our incubation center framework are namely foundational enablement, functional orchestration, and business impact. Foundational enablement consists of 3 elements that form the foundation of the incubation center. The first element of foundational enablement is organization and governance which allows for defining, building, and nurturing an incubation team having an entrepreneurial mindset. The second element is infrastructure which enables service delivery, and the third element is capabilities which enables an incubation center to leverage existing capabilities,

build capacity and outsource capabilities in alignment with the overarching strategic vision of the incubation center. Functional orchestration forms the core of the incubation center and consists of 2 elements, programs & activities, and support & services. Programs & activities provide a framework for the incubation center to engage stakeholders with trainings and events and leverage external capabilities, while support and services offered by the incubation center provides solutions for start-ups at an incubation center that helps them to develop, grow and nurture their products.

Together the foundational enablement and functional orchestration dimensions help an incubation center to create impact for the ecosystem which is represented by the third dimension of the ITT incubation center framework, i.e., business

impact. It also consists of 2 elements namely eco-system partnerships and financial assistance. Ecosystem partnerships includes partnering with start-up ecosystem players, academia, mentors, corporates, and government agencies. Lastly financial assistance focuses on the real world needs of the start-ups by catering to their financial needs.
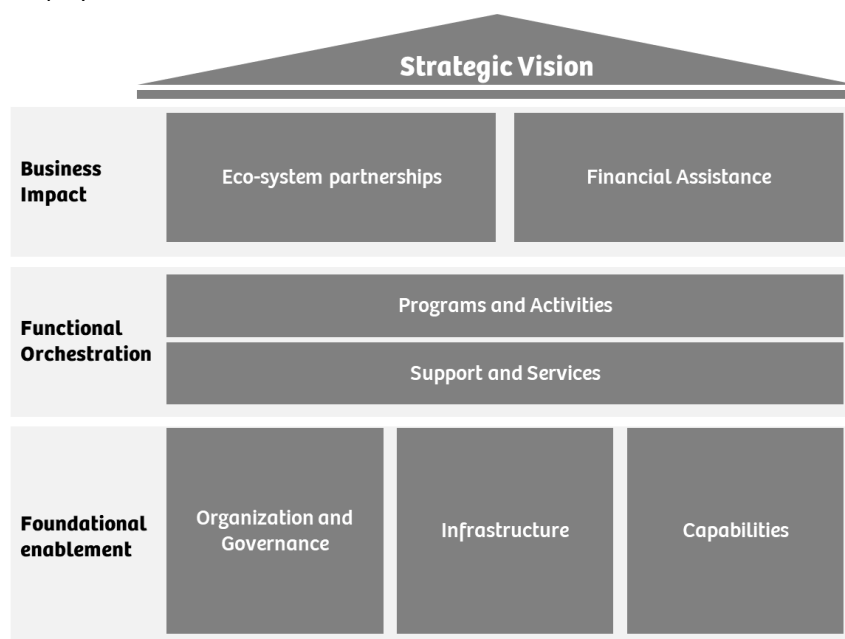

Figure 17: Framework of ITT incubation center at ELMCH

The findings of the study are limited by a small sample size. The challenges and trends analyzed through this study will be updated in the near future based on the local health system needs. An ITT lab and incubation center at ELMCH will foster an innovation culture and encourage stakeholders to further engage in research and development activities locally with a focus on the future of healthcare in India.

Conclusion

The Indian healthcare industry is booming as the government plans to allocate more percentage of gross domestic product (GDP) to the healthcare sector. However, disparities exist between the public and private sector, as well as in urban and rural population of India. ITT, part of SHS, has been addressing India's healthcare needs by boosting innovation culture in the country and by initiating co-creation activities with several prestigious universities and hospitals. The two ITT co-creation workshops outlined in this paper were hosted by ELMCH with a focus on the future of healthcare in India. The responses were compiled from the ITT HSF online survey conducted to capture and validate trends, KOL challenges, healthcare system, and the

hospital and departmental workflows within the Indian healthcare framework. Outcomes of the programs held by ELMCH illustrates findings on different areas of unmet needs in the country including critical topics such as treatment efficiency, utilization and availability of resources, and biomedical waste management. Following the success of co-creation events at ELMCH, ITT also looks forward to building an ITT lab and incubation center at ELMCH for boosting innovation and entrepreneurship culture in their local healthcare system. ITT further foresees opportunities for commercialization of products and services through startups at ELMCH.

Acknowledgements

Authors Statement

SH has established and confirmed the paper's framework as well as guided and initiated the paper's context. ZK has provided crucial insights and aspirations for creation of the proposed healthcare system framework and its implementation in the Indian context. JV, MA, SJH, NN, and AG collected the data, analyzed the survey results, and added content to the whitepaper. All authors contributed to the paper's drafting and approved the final version. The authors do not state any competing interests.

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