

White Paper- Innovation Think Tank

Co-creation on Access to Care

Trends, disease pathways, technologies and innovations

2023

Co-creation on Access to Care

Sultan Haider¹, Narinder Paul², James Lacefield³, David W. Holdsworth³, Maria Drangova³, Neset Hikmet⁴, Dilek Akgun⁴, Saleem Sayani⁵, Thuong Phan⁶, Fareha Naqvi⁷, Jayati Vasavada⁸, Niharika N⁹

Innovation Think Tank, Siemens Healthineers, ¹Erlangen, ⁶Princeton, ⁷Oakville, ⁸Gurgaon, ⁹Bengaluru

²London Health Sciences Centre, St. Joseph's Healthcare London, Western University, Canada

³Western University, Canada

⁴University of South Carolina, United States

⁵Aga Khan University, Pakistan

Abstract

Providing access to effective care is one of the challenges affecting the growth of the global economy. Frugal innovations foster opportunities in healthcare for new discoveries and advancements while promoting economic and sustainable development worldwide. By maximizing valuable innovations and at the same time utilizing minimal resources, frugal innovations can overcome global challenges in healthcare accessibility. To address the challenges in access to care and discuss innovative solutions, Innovation Think Tank (ITT) Certification Programs were carried out at the University of South Carolina, Columbia, USA and Western University, Canada. The aims of the ITT CP were to: 1) provide ITT methodology training; 2) facilitate on-site interdisciplinary expertise and capacity building through experiential learning; 3) capture and validate access to care trends; and 4) develop workstream-focused proposals for frugal biomedical innovations in low-resource settings.

The two ITT experiential learning programs, Access to Care and Frugal Biomedical Innovations, were developed and offered at the University of South Carolina and Western University, respectively. Together, they included the participation of 75 students, academics, industry professionals, and executives from 25 different institutions and 16 countries. The responses and proposed solutions from the participants were compiled to address access to care trends and frugal biomedical innovations. The outcomes from the programs were presented to juries, including academic and industry experts. The workshops identified common trends in under resourced settings in North America and low- and middle-income settings. With its global infrastructure and network, ITT aims to advance future engagements

in under resourced regions to boost initiatives in frugal innovations and optimize healthcare systems worldwide.

Keywords: Access to Care, Frugal Biomedical Innovations, Innovation Think Tank, Co-creation, Future of Healthcare, Siemens Healthineers.

Introduction.

The globalization of the economy influences health trends worldwide. Providing access to effective care is one of the challenges affecting the growth of the global economy. The disparity in access to healthcare results from multiple socioeconomic factors varying by country and location. Rural communities across the world often receive lower quality healthcare and have worse outcomes on several measures compared to urban and suburban communities [1]. Furthermore, access to care is a major factor in bridging the socio-economic gaps between rural communities and urban communities by providing patients with professional clinical judgement and care in a timely manner. These gaps include observed challenges caused by high costs; physical distance from the nearest healthcare institutions; lack of understanding of the local culture and practices; lack of health literacy; and trust in the healthcare system, among many others [2–3]. A need to bridge the healthcare gap between different communities, specifically for marginalized and remote communities in North America, as well as for patients in low and lower-middle income countries (Uganda, Kenya, Pakistan), was identified as a priority for the institutions involved in the making of this white paper [4]. Research and commercialization of frugal biomedical devices (including development, testing, and deployment) is necessary to encourage the design of sophisticated products, services, and systems that

can impact consumers in remote and low-resource settings.

Innovation Think Tank (ITT), a part of the Chief Technology Office at Siemens Healthineers, is a global infrastructure of labs and programs established within different business lines at Siemens Healthineers, as well as at various hospitals, research institutions, and universities globally. By empowering regional institutions and the local healthcare stakeholders, ITT leverages its co-creation activities to offer a sustainable co-creation environment for the development and commercialization of healthcare solutions. The ITT Certification Program (ITT CP), specifically, is an important tool for capacity and expertise building on-site, while initiating open innovation projects for developing patent and invention disclosures. Subsequently, ITT labs nurture deep-dive research projects, each individually prioritized according to the local challenges and interests, resulting in savings generated due to synergies through the creation of additional revenue potential stemming from new product offerings. Several ITT labs have also seen transformation into incubation centers, funded by joint governmental funding programs.

The ITT at Siemens Healthineers welcomes representatives from several universities and hospitals to their external exhibition (eITT), an annual summer event where brief update speeches and joint outcomes of ITT projects are delivered by various representatives of Siemens Healthineers and partner institutions as well as venture capitalists. While several project ideas are presented at the eITT, it is also an instrumental venue for initiating and nourishing collaboration. For example, following the visit by Dr. Neset Hikmet to eITT 2018, the University of South Carolina Innovation Think Tank (USC ITT) lab was quickly implemented in 2019. On a national and international scale, the USC ITT lab continues to drive projects and develop and sustain strong collaborations with institutions such as Prisma Health, Big Data Health Science Center, and others.

Meanwhile, ITT activities in Canada kicked-off in October 2021, with the first ITT CP in the country hosted by Siemens Healthineers Canada, Western University, Schulich School of Medicine & Dentistry, Robarts Research Institute, London Health Sciences Centre (LHSC), Lawson Health Research Institute, and St. Joseph's Health Care London.

Material and Methods

Initiatives like the Innovation Think Tank are critical in encouraging the next generation of unique thinkers. Throughout this process, our healthcare system stakeholders – technology user, researchers, students, and industrial experts – from across a wide array of disciplines joined together – in-person and virtually – to learn more about innovation management methodologies and rigorously apply them to real-life challenges.

In October 2021, the first ITT CP focusing on key healthcare challenges was held at the BioNext medtech incubator at Western University, London, Canada. While the participants successfully completed the program, the investigators at Western University noted that the ITT process was geared toward highly resourced health care settings and encouraged the ITT team to develop a program specifically targeting the needs of low resourced settings.

Soon after the workshop, the Western University researchers wrote a proposal to the University's Strategic Priorities Fund to establish a new program in Frugal Biomedical Innovation within the School of Biomedical Engineering. ITT was happy to support the application through a letter of support as an industrial partner willing to collaborate on the delivery of ITT programming targeting the effective development of medical devices and medical imaging technology for low-resource settings.

Following the grant approval, Western University researchers and Siemens Healthineers collaboratively organized the second ITT CP in July 2022, focusing on frugal biomedical innovations. Along with the London institutions and Siemens Healthineers, partners from universities in Kenya and Uganda – Kenyatta University, Mbarara University of Science & Technology, and Makerere University – were involved in the organization and delivery of the workshop. The program focused on translational solutions to address identified healthcare needs in remote and low-resource settings. The program brochures were circulated on various social platforms and 50+ applications were received. The participants were chosen based on their multidisciplinary backgrounds, skills, and qualifications. Biomedical Engineering, Mechanical and Mechatronics Engineering, Electrical and Computer Engineering, Medical Physics, Biophysics and Chemistry, and Medical Radiation

Sciences were among the backgrounds represented by the selected participants. Nine institutions from around the world (**Appendix A**) were represented by the participants.

This hybrid program consisted of a total of 39 participants split into 8 teams. The participants gathered in-person at the BioNext incubator at Robarts Research Institute in London, Ontario, and remotely from various locations within and outside Canada. During this certification program, the participants received training on the ITT methodology and learned about problem solving through working on real-life challenges. The concepts of “frugal innovation” were woven throughout the program to encourage the design of sophisticated products, services, and systems that can impact patients in remote and low-resource settings.

Importantly, to inspire the participants and highlight the importance of access to care, Key Opinion Leaders (KOLs) delivered speeches on health inequities in low-resource settings and the need for focusing on translational solutions for marginalized or underserved populations. Dr. Margaret Mutumba from the University of Waterloo elaborated on the need to focus on non-communicable diseases as well as ensuring support for local innovation and implementation and the importance of digital literacy. Dr. James Lacefield from Western University shared his insights on health inequities and design considerations of frugal medical devices. Dr. Kenneth Iloka from Kenyatta University drew the participants’ attention towards challenges in low resource countries, the critical role of hospitals in the development of any country, and the importance of technology. All these encouraged the participants to develop a creative mindset and enabled them to gain a deeper understanding of the core topic.

Similarly, the 2022 annual ITT CP at USC focused on cost-effective clinical and technical innovations, as well as potential business models for hospitals and healthcare systems of the future to address access to care challenges. The virtual program included the recipients of the NIH-funded T35 Research Traineeship Program and gathered a total of 23 participants from 17 institutions listed in **Appendix A** and 8 countries. Additionally, inspiring speeches from subject matter experts on selected workstreams motivated the participants to develop their project

ideas as well as implement them. The program was successfully completed on June 17th, 2022.

On the final day of each program, the outcomes were presented to the jury and experts, where the solution proposals were scored followed by a brief discussion with KOLs, researchers, and industry experts.

The Innovation Think Tank Healthcare System Framework (ITT HSF) was used to collect, examine, and validate information about trends and challenges related to access to care. ITT HSF incorporates three processes that include: 1) Need analysis by capturing stakeholders’ workflow, 2) Co-ideation by trans-disciplinary ITT teams globally, and 3) Co-implementation with healthcare system stakeholders by local ITT programs.

The template for ITT HSF illustrated in **Figure 1** was modified by incorporating inputs from previous surveys and customized to the specific requirements for capturing and validating access to care challenges. The survey consisted of sections on the investigation of institutional challenges, the trends related to technology, clinics, healthcare systems, and business models and their degrees of impact and importance. The survey was filled in by the participants and the responses were aggregated.



Figure 1: Innovation Think Tank Healthcare System Framework for capturing and validating trends

Results

During the ITT co-creation program convened in the City of London in July, 2022, multidisciplinary teams brainstormed for 8 days, researched, ideated, and analyzed over 500 pain points, identified more than 80 stakeholders, 70 key opinion leader voices, created visualizations, and proposed 23 solution clusters to tackle the challenges in the three focus areas: (1) Innovative Medical Equipment/Services, (2) Infrastructure Development for Underserved Patient Groups and (3) Diagnostic Tests in Low Resource Settings.

The ITT CP at the University of South Carolina discussed the critical workstreams of the hospitals and healthcare systems of the future. More specifically, it focused on 1) cost-effective technology and clinical innovations via modality workflow, fleet management, clinical operations, stakeholder experience, and digitally enabled services; and 2) business models and strategies focusing on access to care for marginalized or underserved communities with regards to customer models, patient-oriented, customer service, and training. The program garnered 56 KOL voices, identified 75 pain points, and proposed 17 solution clusters.

Throughout the course of these two ITT certification programs on Access to Care, the participants listed a total of 126 KOL voices, identified 575 pain points, and proposed 40 solution clusters.

Survey Findings

To consolidate and validate the information gathered regarding the comprehensive access to care and frugal innovation areas, the following categories were created:

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

Healthcare Trends.

Based on their perceived effects, participants ranked prevalent healthcare trends.

Figure 2 illustrates that healthcare for all: affordable healthcare coverages is the trend with the highest impact (82%) followed by incentive benefits for providing services in rural areas for physicians (53%). Digitalization and automation, hospitals providing at-home services, together with mobile medical units (e.g., portable MRI) (47% each) were ranked as the least high-impact trends among all.

Technology Trends

Technology trends and their degrees of impact are illustrated in **Figure 3**. 76% of the participants ranked AR/VR (Augmented Reality/Virtual Reality) for understanding procedures (patient and physician education) as the technology trend with the highest impact. This is followed by artificial intelligence (AI) supported diagnosis (59%) and rise in telemedicine, telesurgery, and telehealth for rural areas (53%).

Clinical Trends

Various clinical trends and their degree of impact were ranked by participants as shown in **Figure 4**. More than 90% of participants (94%) considered improved cost structures for drug availability and even free vaccine campaigns to have the highest impact. While the rise in demand for at-home services, e.g., self-testing kits; and the shift from treatment of diseases to preventative care for early diagnosis were ranked next (76% each), this was followed by improved care for the elderly in rural regions and prediction of diseases based on patient health data (digital twin) with a 71% rating (each) given by participants.

Business Trends

Participants ranked the business trends according to the degree of their impact, as indicated in **Figure 5**. According to 76% of the participants (each), cross-institutional collaborations for leveraging regional engagements and partnerships with government for social care were ranked as having the highest impact among the business trends listed. This was followed by equipment sharing for health systems with rural regions (65%). Lastly, fee-per-service was ranked as the business trend with the least high impact (12%).

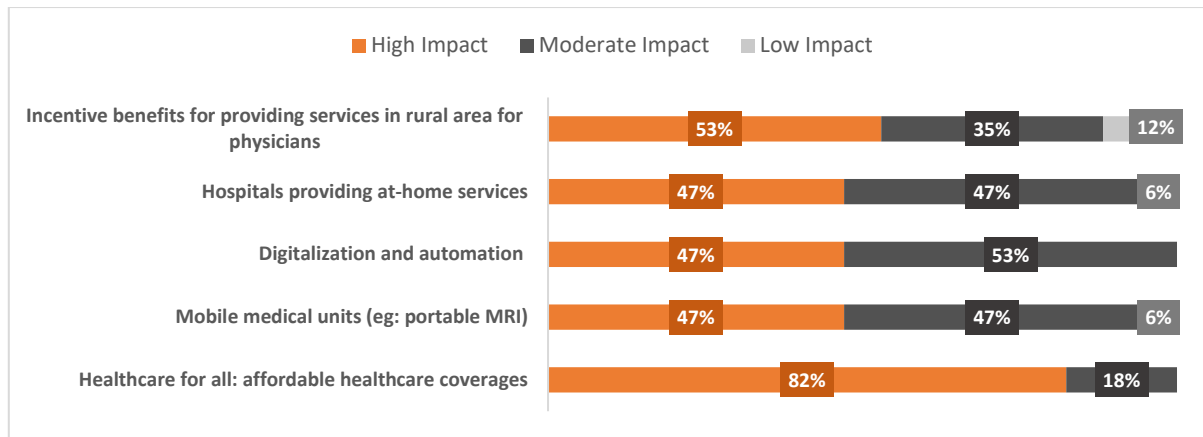


Figure 2: Healthcare Trends Outcome Analysis*

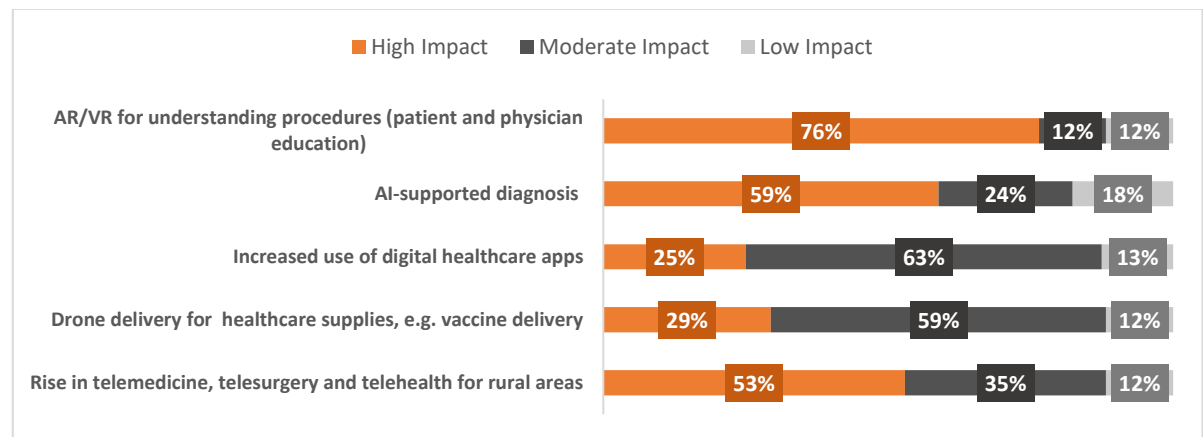


Figure 3: Technological Trends Outcome Analysis*

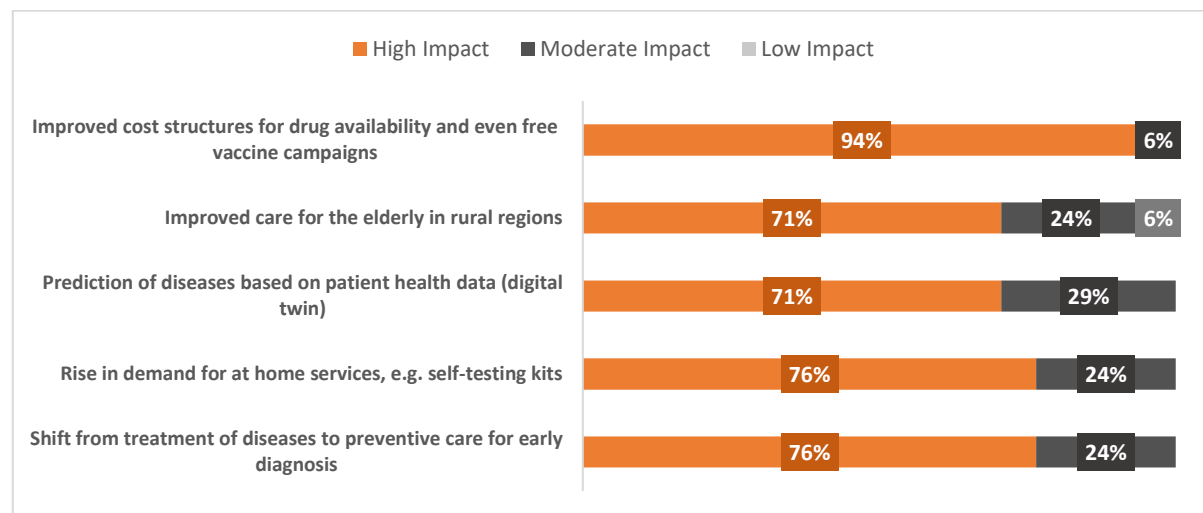


Figure 4: Clinical Trends Outcome Analysis*

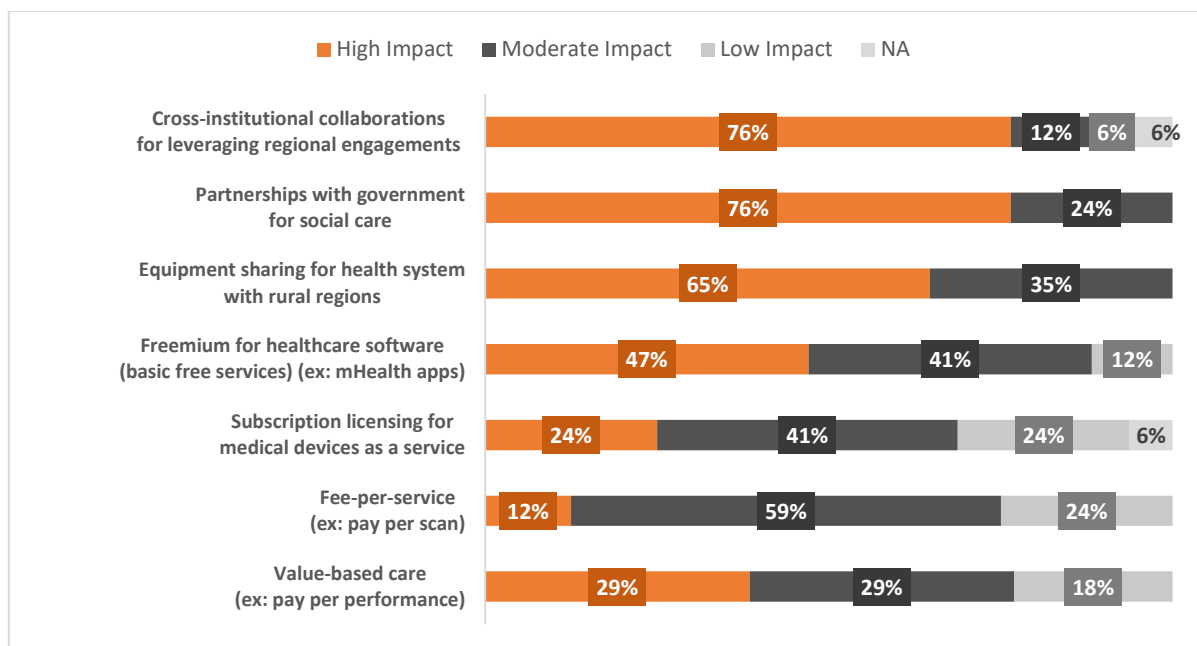


Figure 5: Business model Trends Outcome Analysis*

Category 2: Institutional challenges w.r.t. access to care and their degrees of importance.

According to their degrees of importance, several institutional challenges related to access to care were ranked by participants, as shown in **Figure 6**. All participants unanimously (100%) voted the shortage of a skilled workforce as the most important institutional challenge with respect to access to care.

With 82% of the vote, the second highest challenge is quality of care and insurance coverage, followed by under-utilization of devices due to lack of maintenance and servicing (76%), accessibility of transportation facilities to reach nearest healthcare providers (71%), and operational efficiency (waiting times, appointment availability, longer reporting time) (71%).

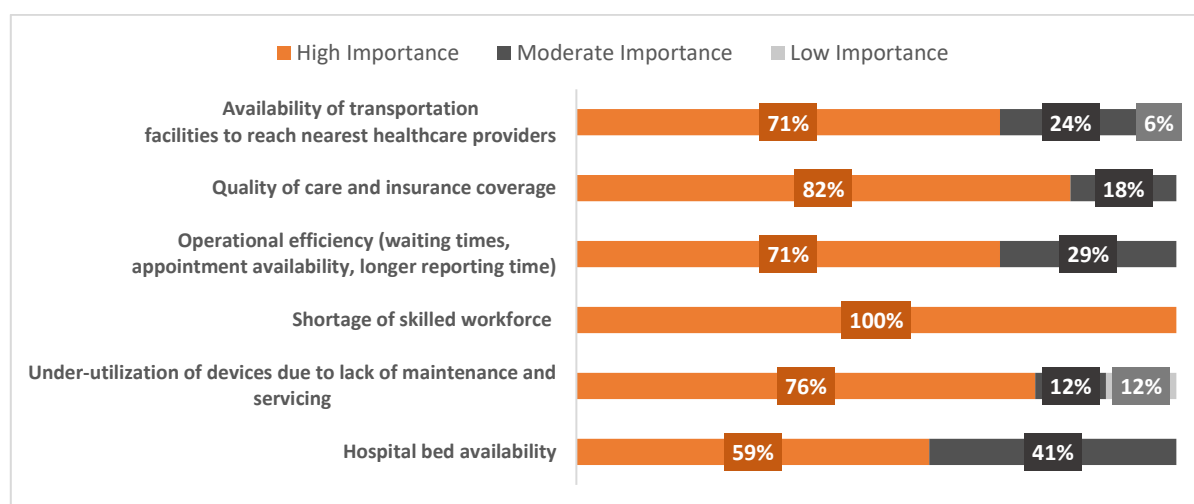


Figure 6: Institutional challenges w.r.t access to care Outcome Analysis*

Category 3: Key challenges mentioned w.r.t. access to care and healthcare system of participant's region

Key challenges, according to their degrees of importance related to access to care, were evaluated by participants. As illustrated in **Figure 7**, 24% of participants rated the availability of appointments with physicians, specialists, dentists, etc. as a very important challenge with respect to improving access to care. Equipment maintenance and poor healthcare

education/language barriers were considered quite important challenges with 53% and 47% of participants' rating respectively. This was followed by crime/theft of medical devices and local healthcare policies and resource allocation (35%) as having moderate importance for improving access to care. Physical barriers (mountains, rivers, temperature, etc.) were rated as having a low impact on improving access to care by 47% of participants, with 12% rating it as of very low importance.

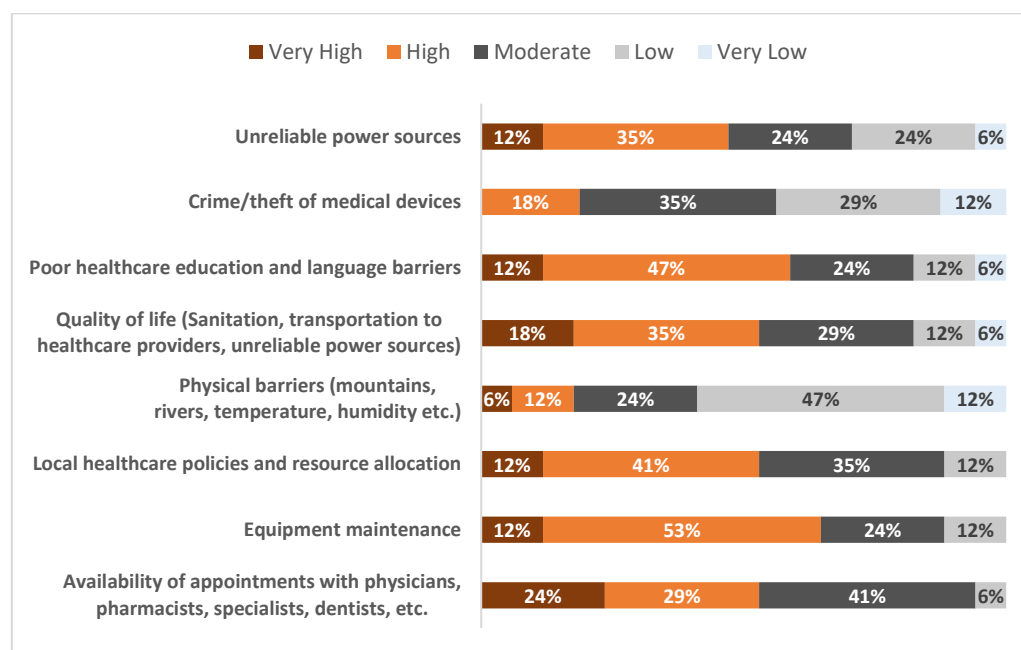


Figure 7: Degree of Importance for Most pressing challenges for improving access to care*

Category 4: Impact of key factors on the participant's region's access to care and healthcare system

Key factors were validated by participants, which impact access to care as shown in **Figure 8A-C**. When mentioned about rating the "difference between healthcare access in rural and urban communities", 41% of participants rated it as having a very high impact in the area of access to care and also the same percentage of participants rated it as having quite a high impact. Only 18% of participants rated it as having a moderate impact. No participants rated this

as having a low or very low impact. "Income disparity on healthcare access" was seen as having a very high impact by 53% of participants, while 41% of participants looked at it as having quite a high impact. Only 6% of participants evaluated income disparity as having a moderate impact, and no participants were in favor of considering it as having a low or very low impact. The "online platforms for remote care" was rated mostly by 59% of participants as having a moderate impact: 18% voted it as having quite a high impact; and 12% also rated it as having a low impact.

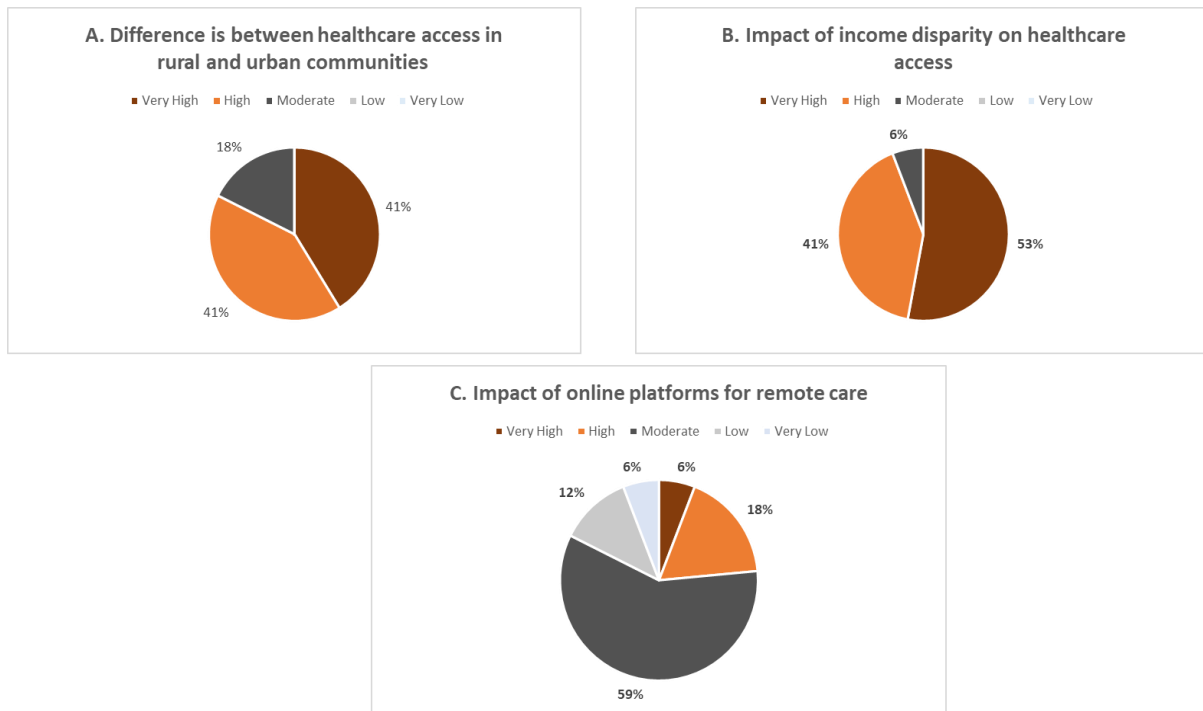


Figure 8A-C: Outcome analysis for validating degree of impact*

*The survey participants were from various countries and the results are a cumulative understanding of access to care situation in different countries.

Discussion

Resource limitations and ecological issues are pressuring organizations worldwide to create cost-effective, high-quality products in the current conditions of adversity [6]. In terms of healthcare innovations, there is indeed a need to overcome the challenges of healthcare accessibility with such economical and sustainable solutions. ITT offers a strong healthcare system framework that considers not only the requirements of key stakeholders but also the overall big picture of current trends and region-specific challenges and identifies innovative approaches to make a significant difference to the traditional model of healthcare delivery.

Participants from transdisciplinary fields were inspired by ITT methodology training and provided experiential learning during ITT CPs to develop innovative solution proposals and ideas for the areas of access to care and frugal biomedical innovations. By integrating ITT HSF as part of the certification program at USC and Western University, the insights were gathered and examined to evaluate the current trends and challenges with respect to access to care.

Healthcare for all: affordable healthcare coverage was rated as the most impactful healthcare trend within

the healthcare system. ITT HSF's technology trend responses also show that innovative education learning with AR/VR for understanding procedures (patient and physician education) is a highly impactful trend. Improved cost structures for drug availability and even free vaccine campaigns were identified as highly impactful clinical trends. It is also crucial to consider the impact of new business model trends that have an impact on the entire healthcare ecosystem, in addition to the technical and clinical aspects. According to the responses, cross-institutional collaborations, and partnerships with the government for social care have a high impact.

Various institutional challenges with respect to access to care were investigated, and all participants rated a shortage of a skilled workforce as the most important institutional challenge. The second important challenge is the quality of care and insurance coverage. While evaluating the most pressing challenges of access to care, participants rated the availability of appointments with healthcare professionals, equipment maintenance, and poor

healthcare education/language barriers as important challenges. Differences between healthcare access in rural and urban communities as well as income disparity on healthcare access were mostly seen as having the highest impact on access to care challenges by participants, and none of them rated it as having a low impact. Online platforms for remote care, on the other hand, were seen as having a moderate impact by most participants, with a few participants seeing them as having a low impact. Over the course of the programs, participants co-created innovative solutions to access to care challenges, with a focus on frugal innovations.

The ITT CPs successfully trained the participants and developed an approach for analyzing the problem space. This approach inculcates a multidisciplinary as well as a holistic point of view and promotes capacity building among the participants. The ITT co-creation programs focus on nurturing expertise development and experiential learning among their partakers through the ITT methodology and training.

Conclusion

Recent ITT activities and programs across North America have highlighted the need for innovations in both infrastructure development and cost-effective medical device or diagnostic testing. These offerings and services are meant to serve all patients, including those in limited-resource settings, either rural or under-developed regions of the world. ITT labs and programs enable successful cross-institutional collaborations and knowledge exchange between institutions in Canada and the United States, with partners in Kenya, Pakistan, and Uganda for ideation, validation, and the development of projects. However, it will be important to continue the discussion as well as drive the deep dive phase of proposed solutions and derive potential implementation roadmaps of these ideas by strengthening networks with local healthcare ecosystems in rural and underdeveloped regions.

Authors Statement

SH has established and confirmed the paper's framework as well as guided and initiated the paper's context. MD, DH, JL, SS, NH and DA have provided crucial insights and aspirations for the frugal innovation context. TP, NF, NN, and JV 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.

Acknowledgements

We are thankful to our ITT SHS and SHS Canada colleagues for their support in organizing the program and compiling this publication. We are obliged to Western University and the University of South Carolina for hosting the certification programs. Moreover, we would like to thank our jury members for providing their valuable insights during the program. We are also grateful to all the inspirational speakers for the inspiring speeches and insightful discussions during the co-creation event. A special note of thanks to Ms. Janice Da Silva for her cooperation and valuable input on the compilation of this white paper. Finally, we would like to acknowledge all the participants and respondents for their efforts and contributions during the ITT certification programs on access to care challenges and frugal biomedical innovations.

References

1. Special Needs in Rural America: Implications for Healthcare Workforce Education, Training, and Practice. Council on Graduate Medical Education. (2020) (<https://www.hrsa.gov/sites/default/files/hrsa/advisory-committees/graduate-medical-edu/publications/cogme-rural-health-policy-brief.pdf>)
2. David H. Peters et. al, Poverty and Access to Health Care in Developing Countries, New York Academy of Sciences. (2008) (<https://nyaspubs.onlinelibrary.wiley.com/doi/10.1196>)
3. Access to Healthcare, The Aspiring Medics. (<https://www.theaspiringmedics.co.uk/post/medical-school-interview-public-health-access-to-healthcare>)
4. Improve access to care, Siemens Healthineers. (<https://www.siemens-healthineers.com/insights/transforming-care-delivery/access-to-care>)
5. Haider, S., Vasavada, J., N, N., Goenka, A., Hassan, D., & Azem, G. (2022). Healthcare System Framework by Innovation Think Tank for understanding needs and defining solution requirements. Innovation Think Tank. (<https://www.siemens-healthineers.com/en-in/careers/innovation-think-tank>)
6. Rakhshanda Khan, How Frugal Innovation Promotes Social Sustainability, MDPI, (2016). (<https://www.mdpi.com/2071-1050/8/10/1034/pdf>)

Appendix

Appendix A. List of universities participated in ITT Certification Programs held at North America region

Certification program	List of universities participated
ITT CP at University of South Carolina, 2022	Clemson University
	Federal University of Uberlândia
	FH Aachen
	Friedrich-Alexander-University Erlangen-Nuremberg
	German Jordanian University
	Manipal Institute of Technology
	Politecnico di Milano
	Sogang University
	Federal University of Uberlândia
	Technical University Nürnberg
	Technische Hochschule Mittelhessen
	Universität Duisburg-Essen
	University of Applied Sciences Ansbach
	University of Duisburg-Essen
	University of Dukoh
	University of South Carolina Augusta University
ITT CP at Western University, 2022	Kenyatta University
	Indian Institute of Technology, Hyderabad
	Manipal Institute of Technology, India
	Duke University
	Egypt-Japan University of Science and Technology
	Makerere University
	Martin Luther University
	Mbarara University of Science & Technology
	Strathmore University
	Western University

Siemens Healthineers Headquarters

Siemens Healthcare GmbH
Henkestr. 127
Erlangen 91052, Germany

Published by

Siemens Healthcare GmbH
Technology Excellence
Technology and Innovation Management
Innovation Think Tank Global Headquarters
Henri-Dunant-Str. 50, 91058 Erlangen, Germany
Contact: innovationthinktank.team@siemens-healthineers.com
<https://www.siemens-healthineers.com/careers/innovation-think-tank>