

DISSERTATION AT- ENIRA CONSULTING PRIVATE LIMITED

**INTEGRATION OF MINIMALIST IOMT IN AYUSHMAN BHARAT
HEALTH AND WELLNESS CENTRES:
A FEASIBILITY STUDY**

Submitted by

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Batch – 25

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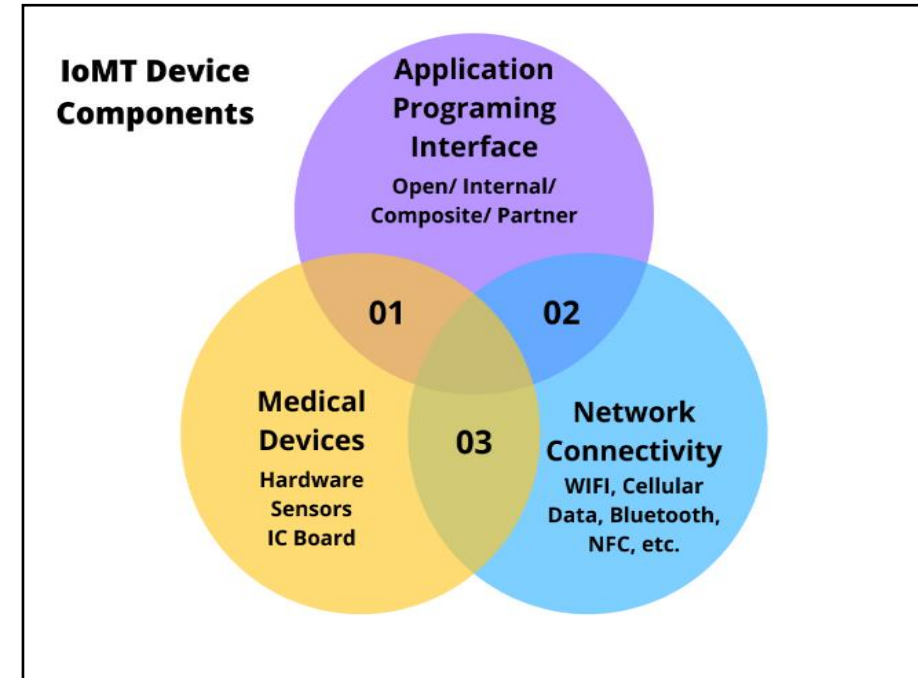


Minimalist IoMT-

Minimalists is the ideology of less is more, can be defined in terms of structural, technical and economical minimalism in devices.

IoT are group of connected devices via M2M communication protocols and they functions as a common unit as per digital programming.

IoMT is the collection of medical devices that connect to healthcare IT systems through online computer networks.



Minimalist IoMT are devices with minimal required sensors, have clinical feasibility & are powered by simple software and hardware integration. Such devices effectively reduce the physical appearance as well as operating cost of the device & deliver results equivalent to gold-standard devices



Attempt towards minimalism-



Claim-

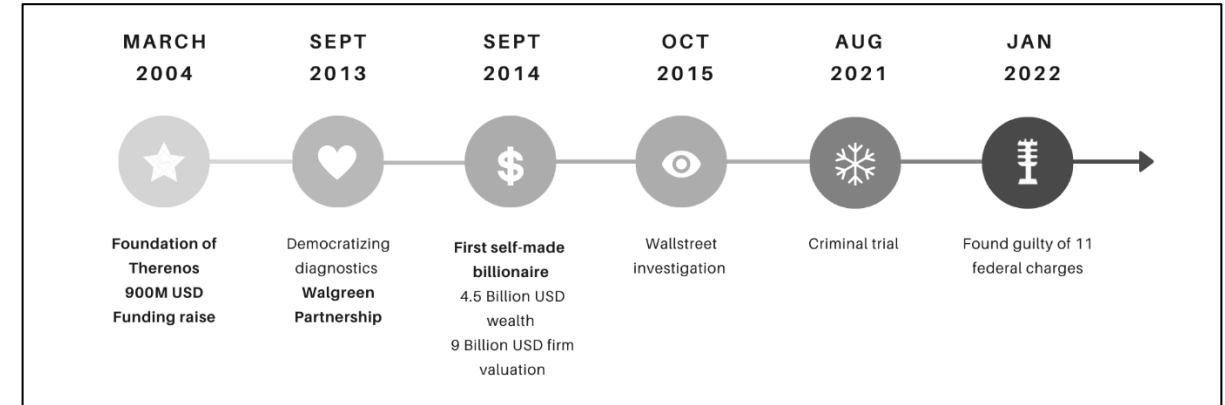
- More than 200 diagnostic test from a single drop of blood from fingertip prick
- 900 Million USD – Raised

Business Model-

- Democratization of diagnostics market
- Self prescribed diagnostic test

Actual Situation-

- Lowest market price
- Using third party equipment
- Inaccurate test results



Problems-

- Lack of clinical validity, only one test was approved by FDA
- No peer review studies
- Non- technical advisory board

Literature Review



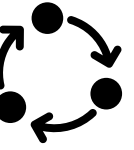
#	Author	Year of publication	Place of study	Title	Methodology	Findings	Limitations
1	Swati Swayamsiddhaa & Chandana Mohanty	2020	KIIT University, Bhubaneswar	Application of cognitive Internet of Medical Things for COVID-19 pandemic	Literature review	IoMT is a promising technology for rapid diagnosis, dynamic monitoring, tracking, and better treatment and control without spreading the virus to others.	Information Bias & confounding bias
2	Ambade M, Sarwal R, Mor N, Kim R Subramanian S.	2022	MoHF W	Components of Out-of-Pocket Expenditure and Their Relative Contribution to Economic Burden of Diseases in India.	Cross-sectional descriptive study	INR 2711 is spent on diagnostics for outpatient department patients while 5337 is spent on diagnostics for indoor patient department This comes out to be 12 percent of the total healthcare expenses and 10 percent of total household income despite of free diagnostics scheme by government.	Information bias
3	MEITY	2020	MEITY	IoT Revised Policy Draft	Literature review	On part of IoMT's only remote monitoring devices are considered, further policy development is needed No regulation of software as medical device	Information Bias

Literature Review- *Cont.*



#	Author	Year of publication	Place of study	Title	Methodology	Findings	Limitations
4	Cross J, Street A	2022	University of Glasgow Scotland	To Fail at Scale!: Minimalism and Maximalism in Humanitarian Entrepreneurship. Social Anthropology/Anthropologie social.	Literature review	Theory of 'less is more' Minimalism is new driving force for design thinkers and entrepreneur	Information bias
5	Ayuningtyas D, Haq H, Utami R, Susilia S.	2021	Faculty of Public Health, Indonesia	Requestioning the Indonesia Government's Public Policy Response to the COVID-19 Pandemic: Black Box Analysis for the Period of January–July 2020	Cross-sectional descriptive study	Use of system's framework of policy analysis via collection of data by variety of sources.	Information bias
6	Angelis A, Lange A, Kanavos P.	2018	LSE Health, London	Using health technology assessment to assess the value of new medicines: results of a systematic review and expert consultation across eight European countries	Systematic review	Use of health technology assessment framework in deployment of new technology	Information bias

Methodology



Research Questions-

How can minimalist IoMT devices created? Are there any gaps in government policies related to IoMT devices?
How can IoMT devices be integrated in health and wellness centers of India?

General Objective –

To create a IoMT device framework for the health and wellness centres

Specific Objectives-

To understand the extent of possible minimalism of IoMT devices.

To identify and analyze the gaps in the policies laid by Government of India in the field of IoMT devices via
Systems framework of policy analysis

To assess IoMT devices in light of Health Technology Assessment Framework.

To create a IoMT device virtual framework for the health and wellness centre.

Methodology- *Cont.*

Type of study- Cross-sectional Descriptive Study

Duration of study- February 2022- June 2022

Type of data- Mixed

Primary- Costs of IoMT devices

Secondary- Government policies and their implementation documents

Data Collection Method-

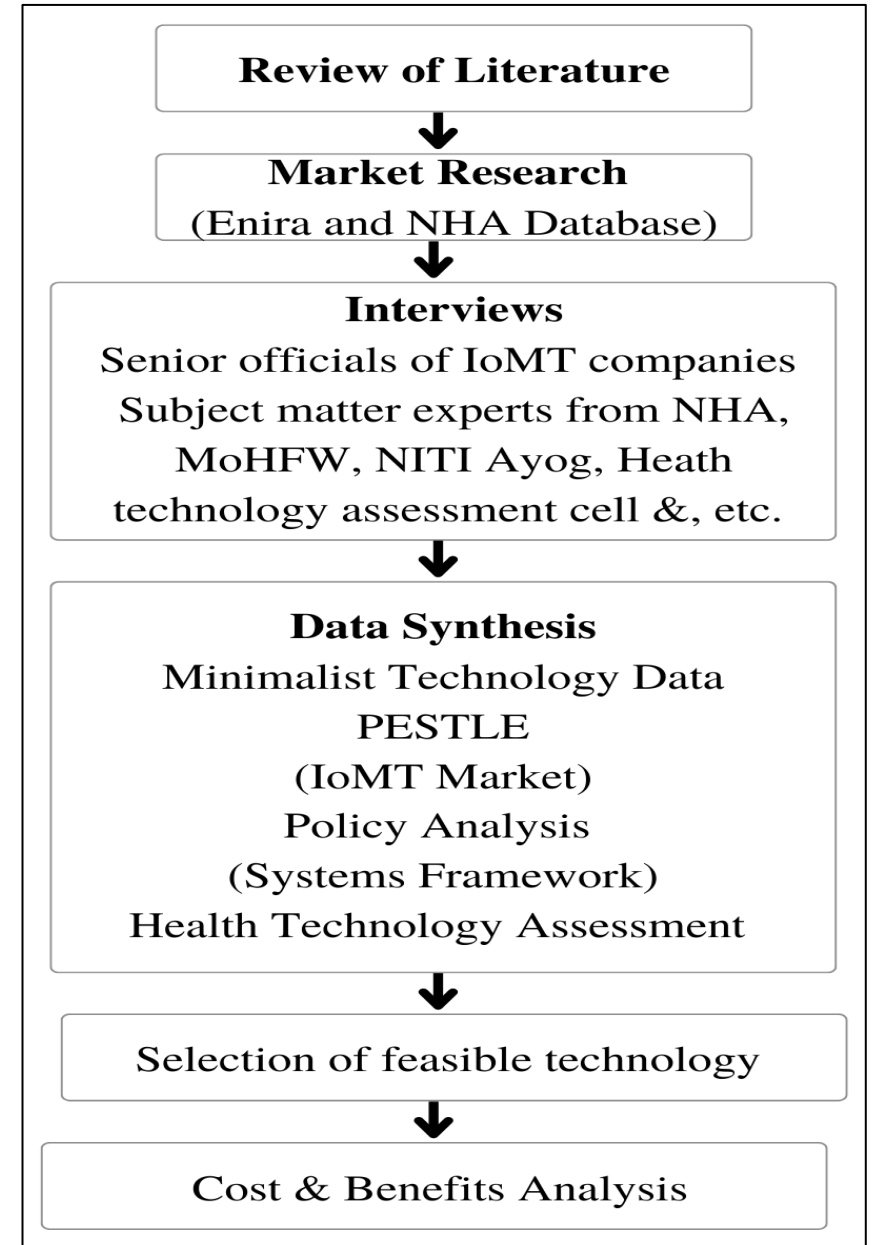
Semi- Structured interviews and review of records

Selection of IoMT

Inclusion criteria- IoMT must a Point of care device

Exclusion criteria- All the personal care devices are excluded from the study.

Number of interviews- 48



Equipment	Gold standard	Sensitivity	HWCs Infrastructure	Minimalist technology	Sensitivity
Sphygmomanometer	Mercury Sphygmomanometer	99%	Digital/ Analogous Sphygmomanometer	Digital Sphygmomanometer	99%
Stethoscope	Dual Head Stethoscope	99%	Single Head Clinical Stethoscope	Digital tubeless stethoscope	99%
Weighing Scale	Digital Weighing Scale	99%	Analogous/ Digital Weighing Scale	Digital Adult Weighing Scale	99%
Baby Weighing Scale	Digital Baby Weighing Scale	99%	Analogous/ Digital Baby Weighing Scale	Digital Baby Weighing Scale	99%
Thermometer	Mercury Thermometer	99%	Digital thermometer/ Infrared laser thermometer	Infrared laser thermometer	97%
Haemoglobinometer	Auto Analyser	99%	Digital Haemoglobinometer	Non-invasive Digital Haemoglobinometer- Near-infrared Spectroscopy	94%
Glucometer	Digital Glucometer	99%	Digital Glucometer	Photo-Spectrometry method	95%
Direct Ophthalmoscope	Binocular Ophthalmoscope	99%	Binocular Ophthalmoscope	Software as medical device solutions	94%
Snellen Chart	Autorefractor	99%	Snellen Chart	Autorefractor	99%
Pulse Oximeter	Arterial blood gas analyser	99%	Digital Pulse Oximeter	Digital Pulse Oximeter	99%
ESR Analyser	Automated ESR Analyzer	99%	Automated ESR Analyzer	Automated ESR Analyzer	99%
3 Part Haematology analyser	Automatic 3 Part Haematology analyser	99%	Automatic 3 Part Haematology analyser	3 Part Haematology analyser	99%
Biochemistry analyser	Automatic Biochemistry analyser	99%	Automatic Biochemistry analyser	Automatic Biochemistry analyser	99%

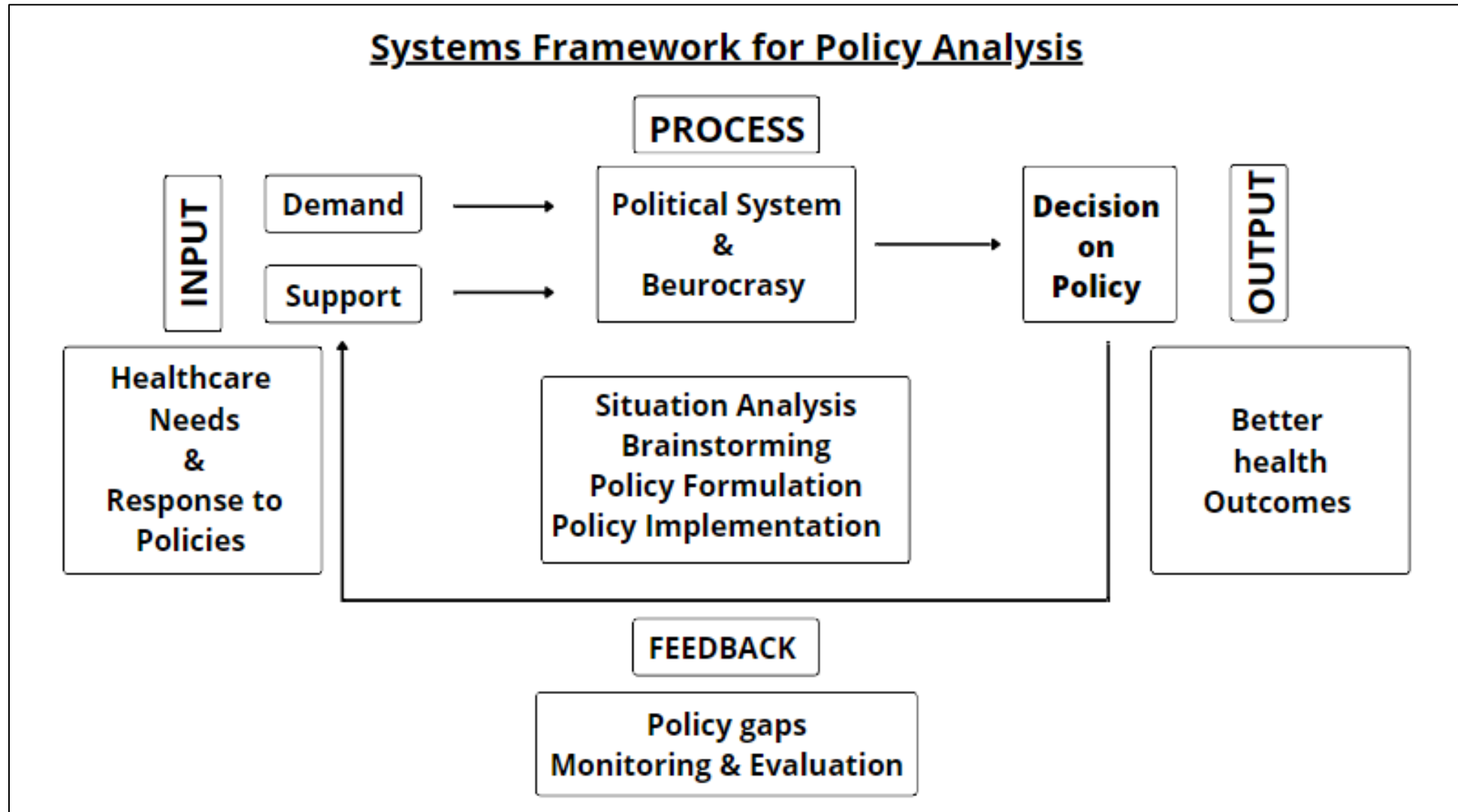


IoMT Market PESTEL Analysis

	Political	Economic	Social	Technology	Environment	Legal
Enabler	Politically stable situation since 2014	Fast paced growth of health tech	Development of digital payment methods and low terrif of internet connections up to the grassroots.	Increased access to internet with the growth of cell phone industry.	Raised participation of private sector in Indian economy.	Expedited process of registration of MSMEs and DIIP (Department of Industrial Policy and Promotion)
	Focus of policies towards development of private sector.					
	Launch of Start-up India initiative back in 2016, followed by launch of Make in India program & National digital health mission in 2020.	Policies to grant economic support to newly launched start-ups- Atal Innovation Mission, MSME grants, start-up research grants, and etc.	Increased penetration of technical education in the Tier III and Tier IV cities.	Increased access to venture capitals with growth of technology.	Growth of remote monitoring solutions in response to national lockdown due to covid-19 pandemic.	
			Development of social entrepreneurs			
Positive perception towards entrepreneurs in society						
Disabler	Responsive nature of policies instead of visionary productive policies.	High cost of technology & capacity development	Increased poverty due to de- monetization followed by onset of covid-19 pandemic.	Inequitable concentration of network coverage and technology.	Geographic and demographic differences across Indian subcontinent.	Exhaustive CDCSO (Central Drugs Standard Control Org.) & FDA approval process
	Lack of capacity building in bureaucracy	High cost of IoMT devices	Cultural diversity: 22 national languages and more than 19,500 regional mother tongues.		Lack of technical skills in the front-line health workers	
	Lack of retention in bureaucracy	Lack of expenditure for CROs				

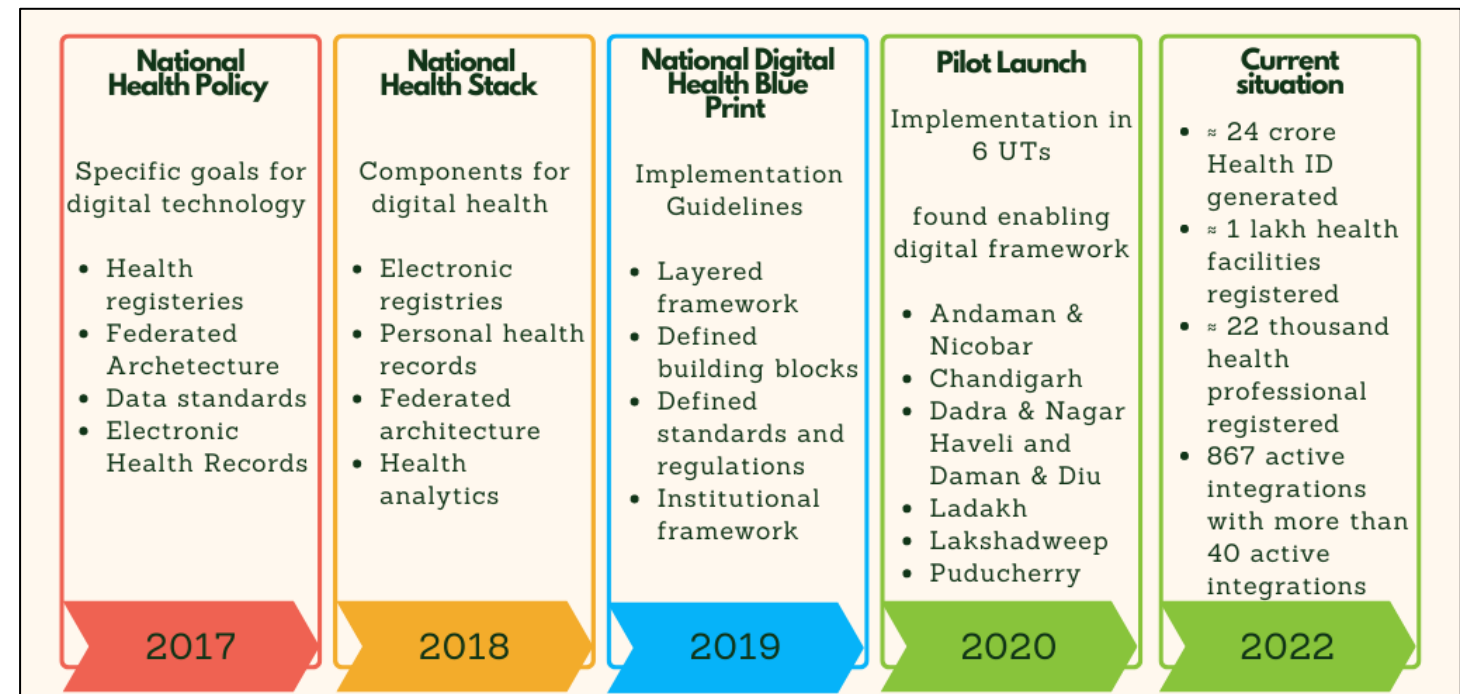
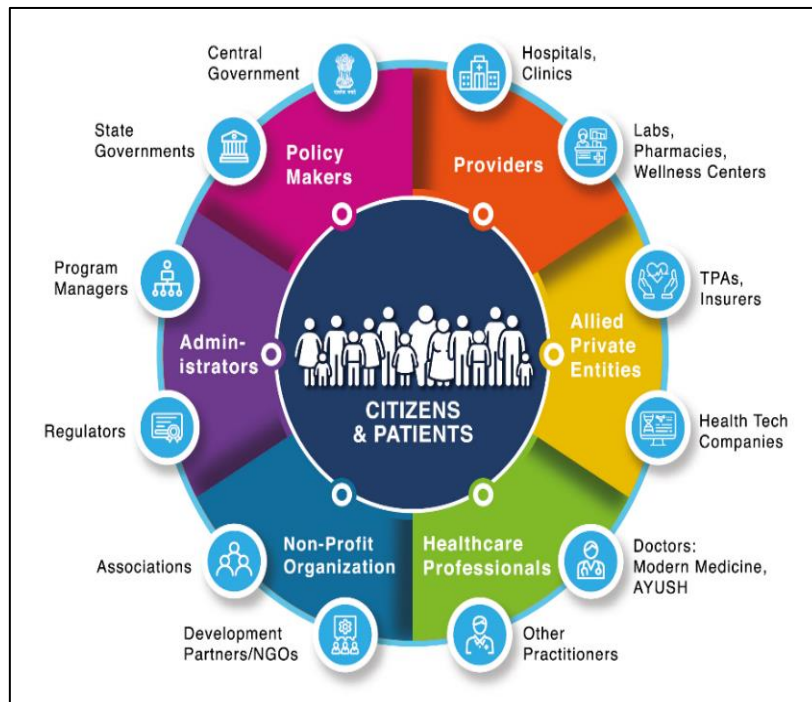


Policy analysis- System's framework of Policy Analysis





Ayushman Bharat Digital Mission





ABDM Systems Framework for Policy Analysis

INPUT

Increased digital access
Infrastructure deficit
Gaps in Access
Slow flow of Information
Leverage digital technology
Covid-19- Enabler

PROCESS

Technology integration with ABDM
Creation of a national healthcare registry
Creation of ABHA

OUTPUT

24 crores ABHA
22K Doctors registered
867 undergoing integration
40 integration done

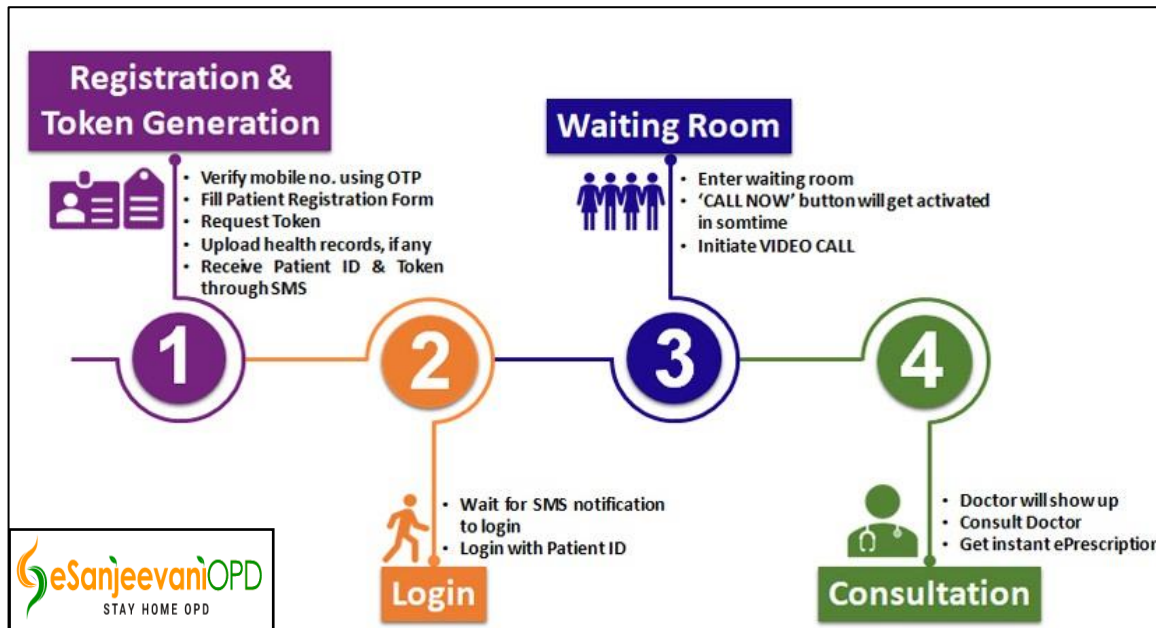
FEEDBACK

NHA-ABDM-UHI- Git Hub Community
ABDM Sandbox
ABDM open database



e- Sanjeevani

National Teleconsultation Services



- Joint efforts of MoHFW & MeitY
- Free of cost service
- Inception- November 2019
- 3 crore- Teleconsultations
- Waiting time $\approx$ 8 minutes
- Consultation time $\approx$ 2.5 minutes



e-Sanjeevani Systems Framework for Policy Analysis

INPUT

Lack of specialist doctors
5.2 million medical errors
Inequitable distribution
Covid-19 Enabler
Digital presence- More business

PROCESS

For Teleconsultation
Register
Upload health records if any
Wait
Consult
e- Prescription/ referral

For doctors
Government doctors registered
Generate roaster
Login links
Consult/ Follow-up

OUTPUT

3 crore OPDs done
2291 hubs with
33297 spokes
1.10 Lakh patient/day
Specialty services available
Collaboration- Old age homes & prisons
ABDM Integration

FEEDBACK

Senior doctors don't attend E-Sanjeevani OPD
Need of POC- IoMT
Pilots- IoMT integration at public healthcare facilities

Applications for ASHA & ANM



Application Name	Purpose/ Program name	State
Asha Soft	Forms- RCH, ANMOL, JSY, etc. Payments, Appraisals	Rajasthan
Poshan tracker	Poshan Abhiyan	GoI
Asha Pay	Forms- RCH, ANMOL, JSY, etc. Payments, Appraisals	Haryana
MDM 360	Tracking of daily targets and location of ASHA workers	Haryana
Asha disease profile	EHR creation	Telangana
mSakhi	Digitalise and supervise the work of ASHA	Uttar Pradesh
Integrated AAA app	Integration of data of MoHFW and WCD to streamline the works of ASHA, ANM and AWW	Rajasthan
House to house surveillance	Tracing symptoms of covid, TB, DM, BP and Asthma	Punjab

Number of ASHA workers- 10.4 Lakhs

Number of ANM workers- 9 Lakh

Smart phones distributed- 865577

Issues found-

- Protest against the slow working of application
- Protest against the application due to privacy concerns
- 21500 ASHA workers in Punjab and 15000 don't have smartphones
- Frequent application crash
- Job- dissatisfaction
- Delayed incentives
- Preference to diary



Various ASHA/ ANM Applications Systems Framework for Policy Analysis

INPUT

**Slow flow of
Information in the
government system
Data collection at the
point of care
Monitoring of FLHWs**



PROCESS



OUTPUT

Training

Notice by CDMO
Hands-on training on
application
Dedicated TA/ DA & Lunch
Training sessions in groups

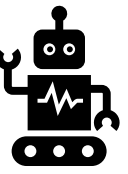
Application

UI- simple & in the
local language
Open API
Local data storage

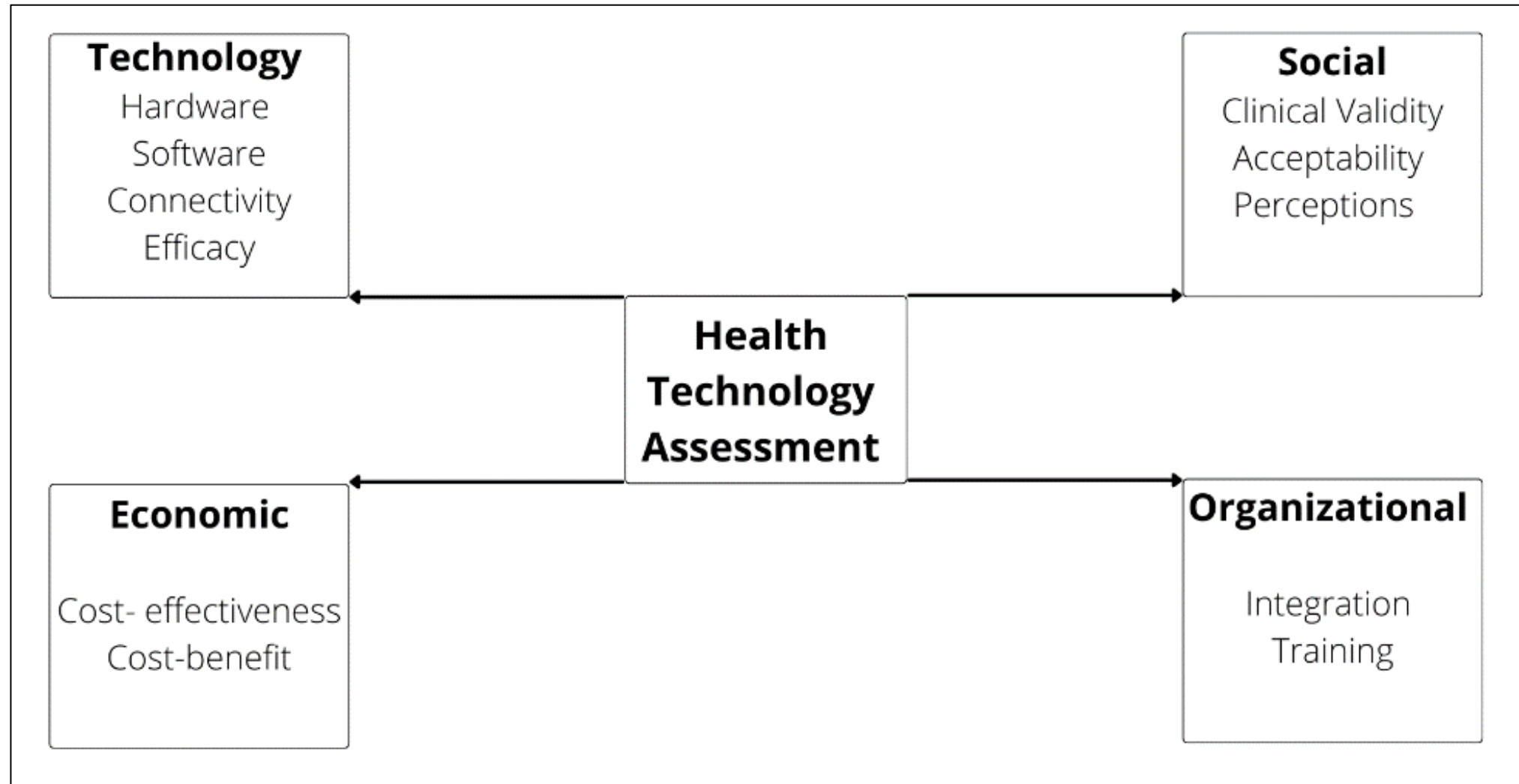
**Streamlined
Monitoring
Transparent
incentivization**

FEEDBACK

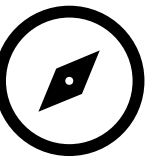
**Lack of technical skills to handle smartphones
Poor network coverage
Substandard quality of smartphones
No protective cases
Large Application Size
Frequent application crash
Frequent change sim cards**



Health Technology Assessment



Minimum Performing Indicators IPHS Guidelines for HWC- 2022



Number of diagnostic test done/ day (in case of auto-analyser)	200 test
Number of patients to ophthalmologist & optometrist/ day	40 patients
Ophthalmologist consultation days in year	52 days
Number of functional days in week	6.5 days
Number of functional days in year	339 days
Number of diagnostic test done/ year (in case of auto-analyser)	67,800 test
Number of patients to ophthalmologist & optometrist	2080 patients

HTA- Digital Sphygmomanometer



#	Product	Sphygmomanometer Digital/ Analogous											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Writzo	Silicon-based microelectromechanical systems (MEMS)	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	4592	-	Yes	Yes	Yes	CDSCO
2	E-med Tel	Silicon-based microelectromechanical systems (MEMS)	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	4578	-	Yes	Yes	Yes	CDSCO
3	Health Cubed	Silicon-based microelectromechanical systems (MEMS)	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	5 hours	4527	-	Yes	Yes	Yes	CDSCO FDA CE
4	Medongo	Silicon-based microelectromechanical systems (MEMS)	Internal	Wi-Fi and Wired	Yes- ML backed AI	95%	12 hours	4450	-	Yes	Yes	Yes	CDSCO
5	Braun Exact fit 5	Silicon-based microelectromechanical systems (MEMS)	Internal	Bluetooth	Yes- ML backed AI	90%	No battery	5292	-	No	With quick start guide	Yes	FDA CE CDSCO
6	Omron HEM 7120	Silicon-based microelectromechanical systems (MEMS)	Internal	Bluetooth	Yes- ML backed AI	90%	Wired	1749	-	No	With quick start guide	Yes	FDA CE CDSCO
7	Inbody Upload Pressurized Automatic BPBIO320	Air pressure sensors	Internal	Wi-Fi and Wired	Yes- ML backed AI	97%	Wired	116894	-	Yes	Yes	No	FDA CE

Health cubed Digital Sphygmomanometer is shortlisted on the ground of its lowest cost among the shortlisted IoMT products.

HTA: Digital Stethoscope



#	Single Head Clinical Stethoscope												
	Product	Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Writzo	Acoustic sensor with ECG	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	15,670	-	Yes	Yes	Yes	CDSCO
2	E-med Tel	Acoustic sensor	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	13,670	-	Yes	Yes	Yes	CDSCO
3	Health Cubed	Acoustic sensor	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	5 hours	13,257	-	Yes	Yes	Yes	CDSCO
4	Medongo	Acoustic sensor	Internal	Wi-Fi and Wired	Yes- ML backed AI	95%	12 hours	13,260	-	Yes	Yes	Yes	CDSCO
5	Chesto	Acoustic sensor	Open	Wi-Fi, Bluetooth	Yes- ML backed AI	92%	12 hours	11,000	-	Yes	Yes	Yes	CDSCO
6	Littman 3M	Acoustic sensor	Internal	Bluetooth	Yes, ML backed AI	99%	12 hours	29,000	-	No	No	Yes	FDA CE CDSCO
7	HD FonoDoc	Acoustic sensor	Internal	Bluetooth	No	89%	2 Hours	21,252	-	Yes	No	Yes	CDSCO

Chesto Digital Stethoscope is shortlisted on the ground of its lowest price among the shortlisted IoMT products as well as most innovative design.

HTA: Digital Weighing Scale (Adult)



#	Product	Digital Weighing Scale (Adult)											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Dr. Trust	Pressure sensors	Internal	Bluetooth	No	99%	360 Days	1,299	-	No	No	Yes	FDA CE CDSCO
2	Mi	Pressure sensors	Internal	Bluetooth	No	99%	360 Days	1,999	-	No	No	Yes	FDA CE CDSCO
3	Real me	Pressure sensors	Internal	Bluetooth	No	99%	360 Days	1,999	-	No	No	Yes	FDA CE CDSCO
4	Actofit	Pressure sensors	Open	Bluetooth	No	99%	360 Days	5,400	-	No	No	Yes	CDSCO
6	Omron	Pressure sensors	Internal	Bluetooth	No	99%	360 Days	9,999	-	No	No	Yes	FDA CE CDSCO
7	Fitbit Aria	Pressure sensors	Internal	Bluetooth	Yes, ML backed AI	99%	360 Days	11,094	-	No	No	Yes	FDA CE CDSCO
8	Health cubed	Pressure sensors	Open	Bluetooth	Yes, ML backed AI	99%	360 Days	1,134	-	Yes	No	Yes	CDSCO

Health cubed digital weighing scale is shortlisted on the ground of its lowest price among the shortlisted IoMT products.



HTA: Digital Weighing Scale (Baby)

#	Product	Digital Weighing Scale (Baby)											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	<u>Helyxon</u>	Pressure sensors with growth monitoring module	Open	Wi-Fi	Yes, ML backed AI	99%	Wired	4,500	-	Yes	Yes	No	CDSO
2	<u>Omron Karada</u>	Pressure sensors with growth monitoring module	Internal	Bluetooth	Yes, ML backed AI	99%	365 days	9,499	-	No	No	Yes	FDA CE CDSO

Helyxon digital weighing scale for babies is shortlisted on the ground of its lowest price among the shortlisted IoMT products.



HTA: Digital Thermometer

#	Product	Digital thermometer											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Health Cubed I.R. Thermometer FR400 Bluetooth	Infrared sensors	Open	Bluetooth	Yes, ML backed AI	99%	6 Months	1,135	-	Yes	Yes	Yes	CDSCO
2	<u>Helyxon</u>	Touch sensitive probe	Open	Bluetooth	Yes, ML backed AI	99%	6 Months	2,499	-	Yes	Yes	Yes	CDSCO
3	Writzo	Infrared sensors	Open	Bluetooth	Yes, ML backed AI	99%	6 Months	1,355	-	Yes	Yes	Yes	CDSCO

Health Cubed I.R. Thermometer FR400 Bluetooth is shortlisted on the ground of it's lowest price.

None of the products are rejected as all the shortlisted products have open API integration.

HTA: Digital Haemoglobinometer



#	Product	Digital Haemoglobinometer											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Eze check	Near-infrared Spectroscopy- Occlusion spectroscopy	Open	Bluetooth	Yes, ML backed AI	94%	8 hours	1,47,000	7	Yes	Yes	Yes	CDSCO ISO
2	<u>HaemoCue</u>	Narrow spectrum Photometry	Open	Bluetooth	Yes, ML backed AI	97%	12 hours	27,000	23	Yes	Yes	Yes	CDSCO FDA CE
3	Writzo	Broad spectrum photometry	Open	Bluetooth	Yes, ML backed AI	97%	12 hours	24,150	16	Yes	Yes	Yes	CDSCO
4	<u>E-Medtel</u>	Narrow spectrum Photometry	Open	Bluetooth	Yes, ML backed AI	97%	12 hours	27,500	22	Yes	Yes	Yes	CDSCO FDA CE
5	Medongo	Broad spectrum photometry	Internal	Bluetooth	Yes, ML backed AI	97%	12 hours	24,220	17	Yes	Yes	Yes	CDSCO
6	Health Cubed	Broad spectrum photometry	Open	Bluetooth	Yes, ML backed AI	97%	5 hours	24,150	17	Yes	Yes	Yes	CDSCO CE FDA

Eze check Haemoglobinometer is shortlisted on the part of its non-invasive nature of test and very low cost of test with instant results. Eze check is already engaged with government of Odisha, for mass anaemia screening, with more incoming data their Sensitivity of results will improve.

HTA: Digital Glucometer



#	Product	Digital Glucometer											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Roche-Sugar View	Photo-Spectrometre method	Open	Bluetooth	Yes, ML backed AI	95%	-	10	6	Yes	Yes	Yes	CDSCO FDA CE
2	Medongo	Amperometry method	Internal	Bluetooth	Yes, ML backed AI	97%	12 hours	22,109	22	Yes	Yes	Yes	CDSCO
3	Writzo	Amperometry method	Open	Bluetooth	Yes, ML backed AI	97%	4 hours	21,794	24	Yes	Yes	Yes	ISO
4	Cooye	Amperometry method	Open	Bluetooth	Yes, ML backed AI	97%	12 hours	1600	32	No	No	Yes	CDSCO
5	E-medtel	Amperometry method	Open	Bluetooth	Yes, ML backed AI	97%	4 hours	21,850	26	Yes	Yes	Yes	ISO
6	Health Cubed	Amperometry method	Open	Bluetooth	Yes, ML backed AI	97%	5 hours	21,850	7.3	Yes	Yes	Yes	CDSCO FDA
7	Eze check	NIR spectroscopy	Open	Bluetooth	Yes, ML backed AI	90%	8 hours	1,47,000	14	Yes	Yes	Yes	CDSCO ISO

Roche Sugar view is shortlisted on the part of very low device cost as well as per test cost, colour cards can be used multiple times.

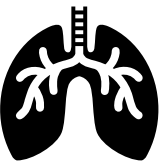
HTA: Digital Ophthalmoscope



#	Product	Digital Ophthalmoscope											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Bubitech	Binocular ophthalmoscopy	Open	Wi-Fi	Yes, ML based AI	95%	12 hours	1,20,000	-	Yes	Yes	Yes	FDA CDSCO CE
2	Allyn iExaminer	Binocular ophthalmoscopy	Internal	Wi-Fi	No	92%	-	7,099	-	No	Yes	Yes	CDSCO FDA
3	Logy.AI	Digital Image scanning	Open	Wi-Fi, Bluetooth, NFC	Yes, ML based AI	94%	-	-	1	Yes	Yes	Yes	CDCSO

Logy.AI is shortlisted on the part of very low cost of testing, Logy.AI is a Software based medical device, with incoming data it's Sensitivity will improve.

HTA: Pulse-Oximeter



#	Product	Pulse-Oximeter											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Writzo	SpO2 Probe	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	950	-	Yes	Yes	Yes	CDSCO
2	E-med Tel	SpO2 Probe	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	999	-	Yes	Yes	Yes	CDSCO
3	Health Cubed	SpO2 Probe	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	5 hours	928	-	Yes	Yes	Yes	CDSCO FDA CE
4	Medongo	SpO2 Probe	Internal	Wi-Fi and Wired	Yes- ML backed AI	95%	12 hours	1200	-	Yes	Yes	Yes	CDSCO
5	<u>Helyxon</u>	SpO2 Probe	Open	Bluetooth	Yes- ML backed AI	95%	Wired	2499	-	Yes	Yea	No	CDSCO
6	<u>Nelcor</u>	SpO2 Probe	Open	Wi-fi- Wired	Yes- ML backed AI	95%	Wired	74,000	-	Yes	Yes	No	CDSCO FDA CE

Health cubed Pulse-Oximeter is shortlisted on the ground of it's lowest cost of device.



HTA: ESR Analyser

#	Product	ESR Analyser											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Siemens Epoc	Micro ESR	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	4,00,000	33	Yes	Yes	No	CDSCO FDA CE
2	Medongo	Micro ESR	Internal	Wi-Fi and Wired	Yes- ML backed AI	95%	12 hours	60,000	42	Yes	Yes	No	CDSCO

Siemens Epoc system is shortlisted on the basis of open nature of API, although with product development ESR analysers can be upgraded with open API interface.

HTA: 3 Part Haematology Analyser



#	Product	3 Part Haematology Analyser											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Writzo	Auto cell counter	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	1,75,000	15	Yes	Yes	No	CDSCO
2	E-med Tel	Auto cell counter	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	1,89,000	13	Yes	Yes	No	CDSCO
3	Health Cubed	Auto cell counter	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	5 hours	1,43,000	10	Yes	Yes	No	CDSCO FDA CE
4	Medongo	Auto cell counter	Internal	Wi-Fi and Wired	Yes- ML backed AI	95%	12 hours	2,10,672	12	Yes	Yes	No	CDSCO

Health cubed 3 Part Haematology Analyser is shortlisted on ground of its lowest market cost.



HTA: Biochemistry Analyser

#	Product	Biochemistry Analyser											
		Technology						Economic			Organisational		Social
		Technology used	API Integration	Connectivity	Result Interpretation	Sensitivity	Battery life	Cost per device	Cost per test	AMC	Training	Portability	Clinical Validity
1	Writzo	Reagent based processing	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	1,25,000	15	Yes	Yes	No	CDSCO
2	E-med Tel	Reagent based processing	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	4 hours	1,67,000	13	Yes	Yes	No	CDSCO
3	Health Cubed	Reagent based processing	Open	Wi-Fi and Wired	Yes- ML backed AI	95%	5 hours	1,50,000	10	Yes	Yes	No	CDSCO FDA CE

Health Cubed Biochemistry analyser is shortlisted on ground of its lowest per test cost.

IoMT Integrated Network



Before Implementation			After Implementation		
Government			Shortlisted IoMT		
Medical Devices	Price of equipment (INR)	Price / Test (INR)	IoMT product name	Price of equipment (INR)	Price / Test (INR)
Sphygmomanometer	1500	-	Health Cubed	4527	-
Digital/ Analogous			Sphygmomanometer		
Single Head Clinical Stethoscope	1600	-	Chesto Digital Stethoscope	11000	-
Analogous/ Digital	500	-	Health Cubed Digital Weighing Scale	1134	-
Weighing Scale					
Analogous/ Digital	1200	-	Helyxon Digital	4500	-
Baby Weighing Scale			Baby Weighing Scale		
Digital thermometer/ Infrared laser thermometer	165	-	Health Cubed I.R. Thermometer FR400 Bluetooth	1,135	-
Haemoglobinometer	500	10	Eze check	147000	6
Digital Glucometer	1400	13	Roche- Sugar view	10	6
Direct Ophthalmoscope	2500	15	Logy. AI	-	1
Digital Pulse Oximeter	10000	0.03	Health Cubed Pulse Oximeter	928	-
Automated ESR Analyzer	30500	30	Siemens Epoc	400000	33
Automatic 3 Part Haematology analyser	156000	12	Health Cubed	1,43,000	10
			Haematology analyser		
Automatic Biochemistry analyser	44200	12	Health Cubed Biochemistry analyser	1,50,000	10

Feasibility of Project

Economic Feasibility

	Pre intervention	Post intervention
Cost of infrastructure	250065	863234
Net cost of diagnostic test as per minimum IPHS 2022 performance guidelines	5253834	4409080

- The one lime cost of IoMT integration at the health and wellness centres will be 2.45 times higher than the conventional setup.
- 16 percent reduction in the cost of diagnostics with IoMT integration
- It will take 15 years and 31 days to break even this additional cost, if the HWC operates as per minimum performance indicators.
- Economically feasible**



Feasibility of Project- *Cont.*

Technical

- The proposed integration was found technically feasible
- Open APIs streamline the integration process
- Technology deployment as per the need of area
- Technically feasible**

Social

- Positive perception towards digital health intervention
- Reduced cost
- Increased penetration
- Use of Simple User interface
- Use of Regional language
- Socially feasible**

Organisational

- Training modules
- Easy product design
- Portability- can deployed in community outreach
- Easy diffusion in Organisation
- Organisational feasible**



Challenges

- **Social challenges** - Lack of technical skills
- **Geographic challenge**- Gaps in Internet connectivity
- **Organisational challenges** - Maintaining supply chain of consumables, Job dissatisfaction in ASHA workers, Resistance to change, Nascent stage of personal data protection bill.
- **Technical challenges**- Lack of open APIs and Validation of technology
- **Economic challenges**- High cost of technology deployment.



Recommendations-

- To setup national centre of excellence for AI in healthcare- draft regulatory framework for software as medical devices
- Mandatory hands-on training of frontline health workers on the IoMT devices and setup of common achievable vision.
- Motivate companies to switch to open APIs
- Promotion of ABDM sandbox for universal healthcare interface

Conclusion-



Characteristics of ideal Minimalist IoMT

- Clinical validity
- Open API
- Hand holding sessions
- Simple and light UI
- Multi linguistic training module
- Battery powered
- Low cost of technology deployment
- Ensured supply chain

Future Prospects

- Adoption of value-based insurance models
- Development of doctor-less diagnosis via IoMT network at the HWC

Thank you