IBERIAN
CONFERENCE
ON MCDM/MCDA
University of Coimbra
May 8th to 9th, 2025
COIMBRA, PORTUGAL

ORGANIZERS:

PARTNERS:

Grant RED2022-134540-T funded by MICIU/AEI/10.13039/501100011033

A collaborative dashboard-building approach combining BI and socio-technical MCDA: a tool to assist decision-makers in health settings

Rafael Miranda [1,2], Mónica Oliveira [1,3], Filipa Baptista [2], Isabel Albuquerque [4]

09:40 – 11:00 | Contributed session 4 | 09.05.2025

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Context

Remote Patient Monitoring (RPM): Context and Challenges

RPM:

*"a **mode of health care delivery** that gathers and integrates patient data outside of traditional health care settings, allowing providers to **track, assess, and engage** patients **regardless of location**"*

Fail to meet the expectations

Remote care proliferated in the pandemic, but preference for hospital-based returned post-restrictions.

Struggle to scale up

Programs struggle to overcome pilot phases. Most initiatives engage few patients and are limited in scope.

Expensive to implement

High setup and operating costs hinder adoption for both public and private providers.

Lack standardisation

No standard approaches for implementation, monitoring, or evaluation; traditional HTA have drawbacks in RPM assessment

Casale PN et al. The Promise of Remote Patient Monitoring. *Am J Med Qual* 2021; 36: 139–144.
Azevedo S, Rodrigues TC, Londral AR. Domains and Methods Used to Assess Home Telemonitoring Scalability: Systematic Review. *JMIR mHealth uHealth* 2021; 9: e29381.

Context

Health Technology Assessment (HTA) for RPM

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CHALLENGES

Assessing RPM is complex and fragmented

Traditional HTA is static and narrowly focused

Uncertainty and change complicate assessment

Stakeholder engagement is often lacking

CONSIDERATIONS

Explainable, objective complete and actionable

Must capture all value aspects of remote care

Ongoing HTA fosters continuous improvement

Incorporate stakeholder perspectives and goals

Angelis A, Kanavos P. Towards a Robust Methodological Framework for the Application of MCDA in the Context of Health Technology Assessment. *Pharmacoeconomics* 2016; 34: 435–446.
Hogervorst MA et al. Reported Challenges in Health Technology Assessment of Complex Health Technologies. *Value Heal* 2022; 25: 992–1001.

Context

Health Technology Assessment (HTA) for RPM

CHALLENGES

CONSIDERATIONS

To develop an actionable tool that aligns continuous program monitoring with evaluation

Explainable, objective complete and actionable

Must capture all value aspects of remote care

Ongoing HTA fosters continuous improvement

Incorporate stakeholder perspectives and goals

Angelis A, Kanavos P. Towards a Robust Methodological Framework for the Application of MCDA in the Context of Health Technology Assessment. *Pharmacoeconomics* 2016; 34: 435–446.
Hogervorst MA et al. Reported Challenges in Health Technology Assessment of Complex Health Technologies. *Value Heal* 2022; 25: 992–1001.

Proposed Approach

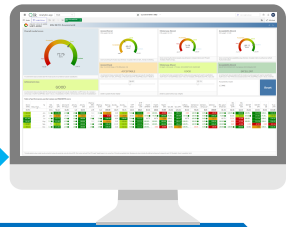
A Stepped Approach Towards MMD Implementation

SBI-MD

Structuring, **B**uilding and **I**mplementing a **M**ultidimensional **D**ashboard with **S**takeholders, **B**usiness **I**ntelligence and **M**ulticriteria **D**ecision-aiding

Phase 1: Structure RPM value dimensions and indicators

Phase 2: Build the multidimensional management dashboard (MMD)



Phase 3: Implement the multidimensional management dashboard

Proposed Approach

Methodological Setting

MCDA

- Value modelling through MACBETH (Bana e Costa, De Corte and Vansnick, 2016)
- Model structuring:

Value interrelations analysis (Rodrigues et al., 2017; Vitacca and Vitacca, 2019)

Composite indices and criteria (Bana e Costa, 2012; Greco et al., 2019)

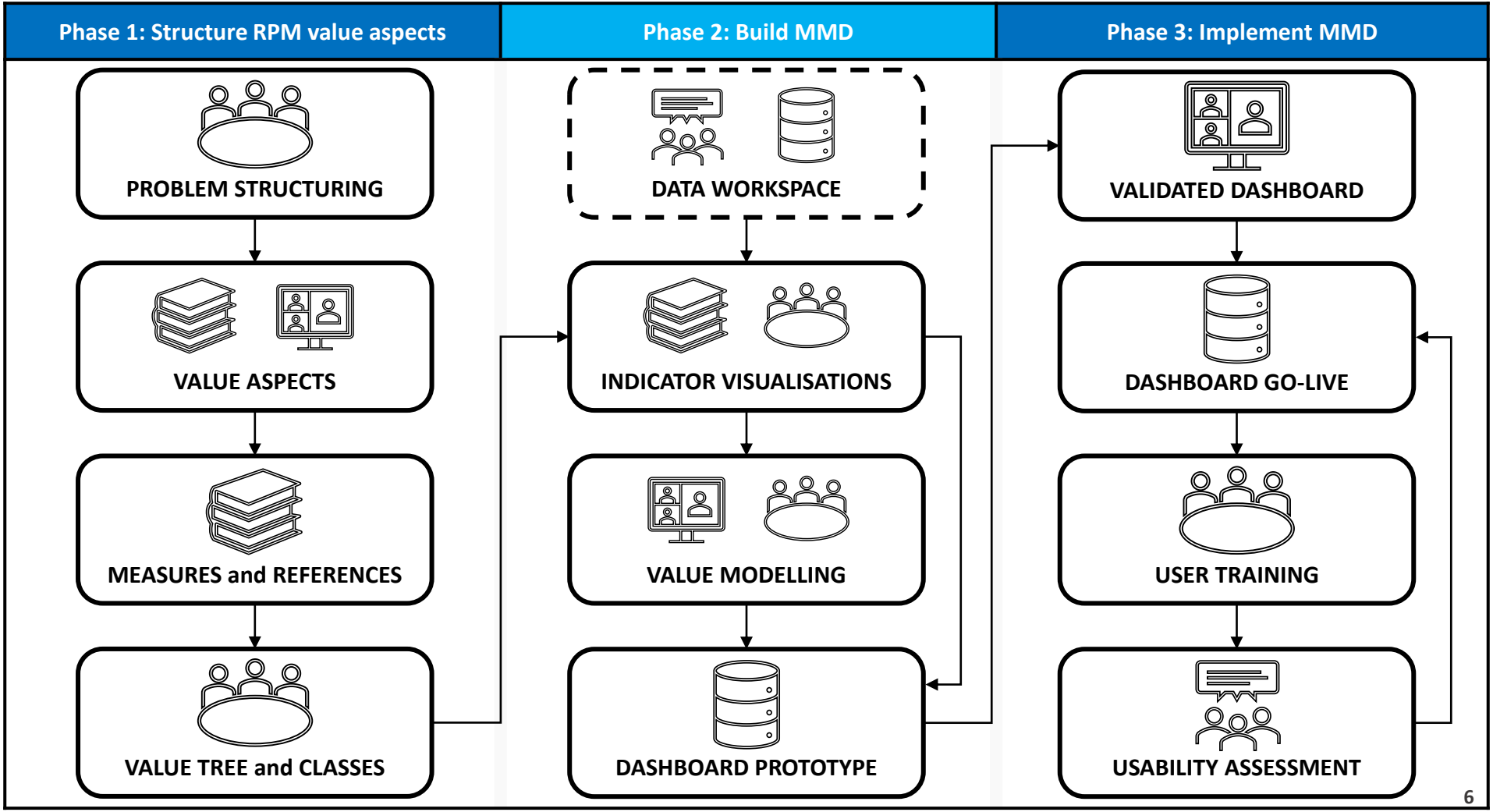
- Value function reconciliation (Kirkwood and Sarin, 1980; Corner, 1994)
- MCDA classification (Bana e Costa et al., 2012; Figueira et al., 2023)

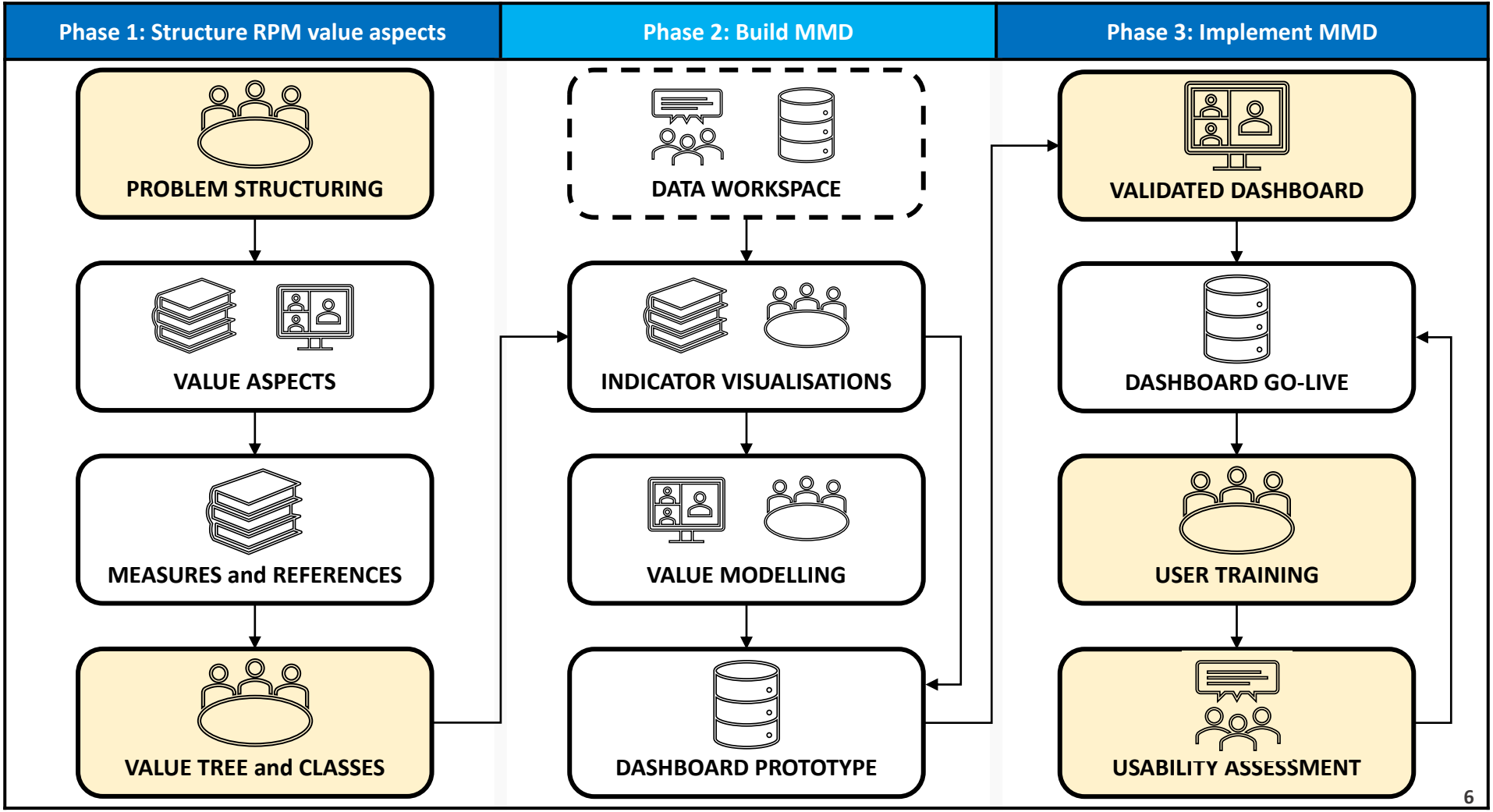
Business intelligence

- Indicator selection (Miranda et al., 2024)
- DataViz format pre-set selection (Ignatenko et al., 2022)
- Dashboard user-adjusted weighting (Kasparian and Rolland, 2012)
- System usability assessment (Brooke, 1996)

Stakeholder participation

- Collaborative Value Modelling (Vieira et al., 2020)
- MACBETH-voting (Mateus et al., 2017)
- Decision conference, Delphi, interviews, nominal group technique, questionnaires, workshops, …


Phase 1: Structure RPM value aspects
Phase 2: Build MMD
Phase 3: Implement MMD
PROBLEM STRUCTURING
VALUE ASPECTS
MEASURES and REFERENCES
VALUE TREE and CLASSES
DATA WORKSPACE
INDICATOR VISUALISATIONS
VALUE MODELLING
DASHBOARD PROTOTYPE
VALIDATED DASHBOARD
DASHBOARD GO-LIVE
USER TRAINING
USABILITY ASSESSMENT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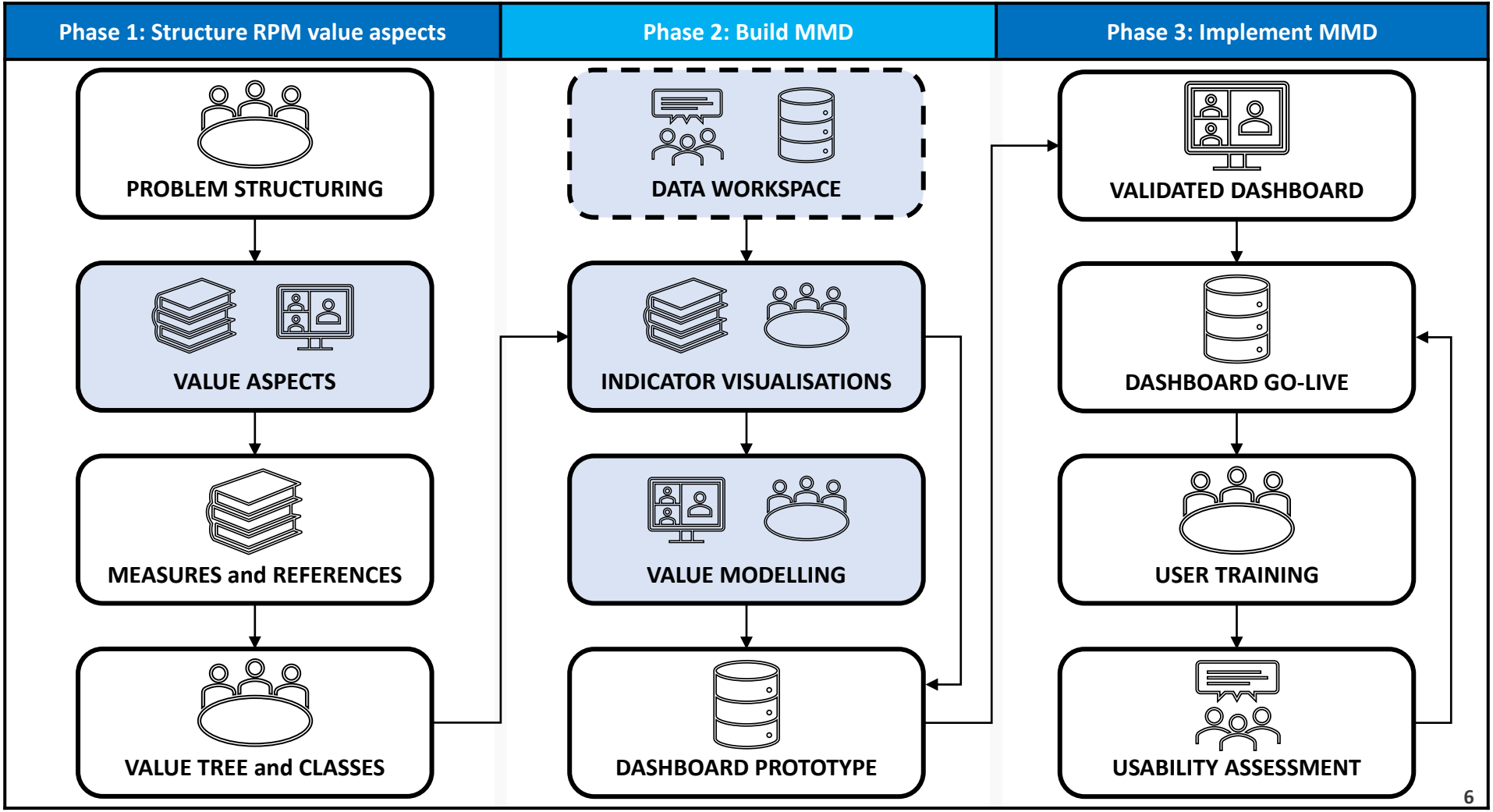
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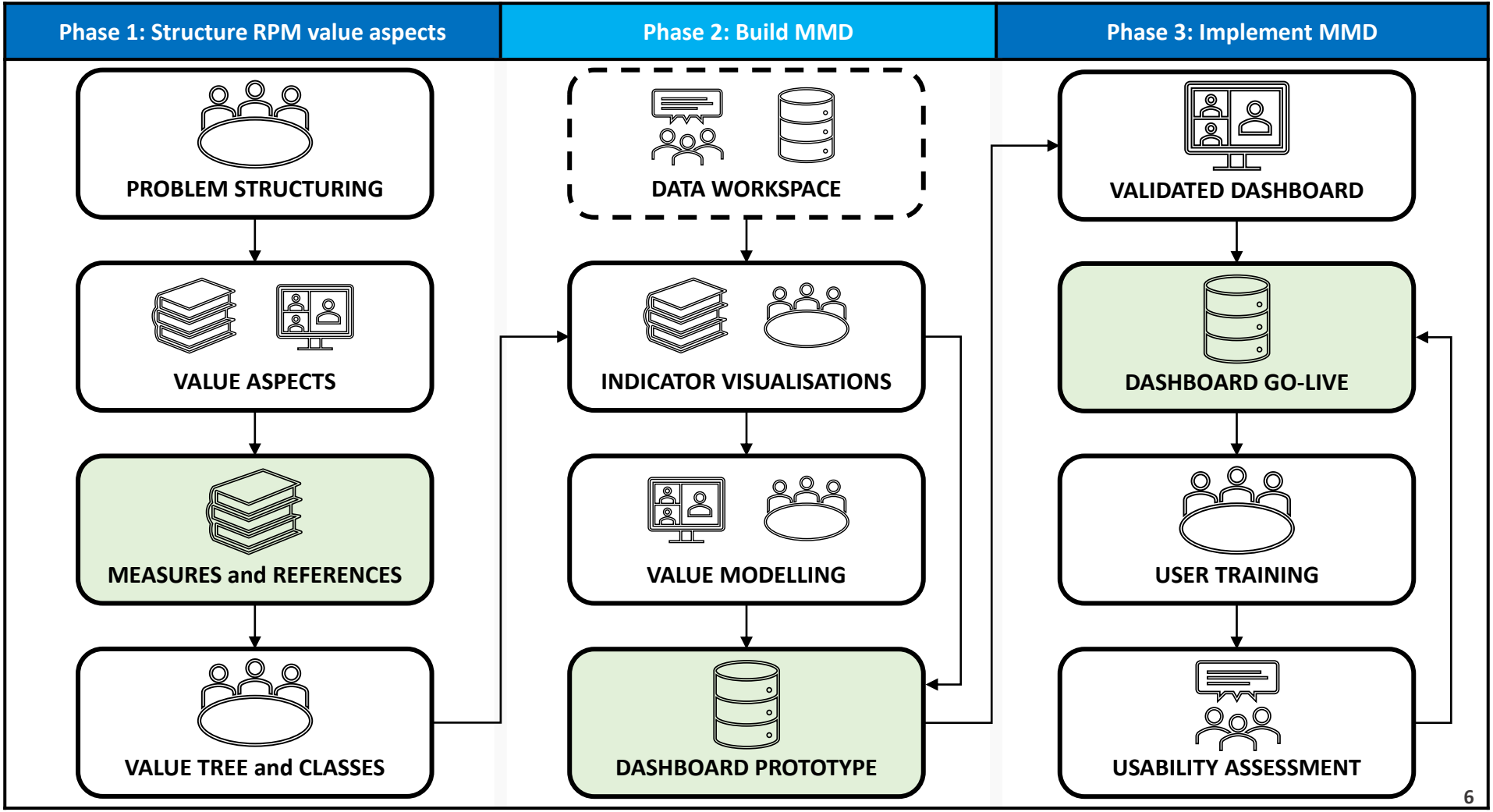
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Application case

Building an MMD for monitoring and evaluating an HF RPM program

- Heart failure (HF) telemonitoring at Hospital de Santa Maria (HSM), Lisbon, Portugal
- Structuring and building an MMD prototype for the tactical and strategic management of the HF telemonitoring program

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CEGIST
Centro de Estudos de Gestão do Instituto Superior Técnico

FACULDADE DE MEDICINA LISBOA

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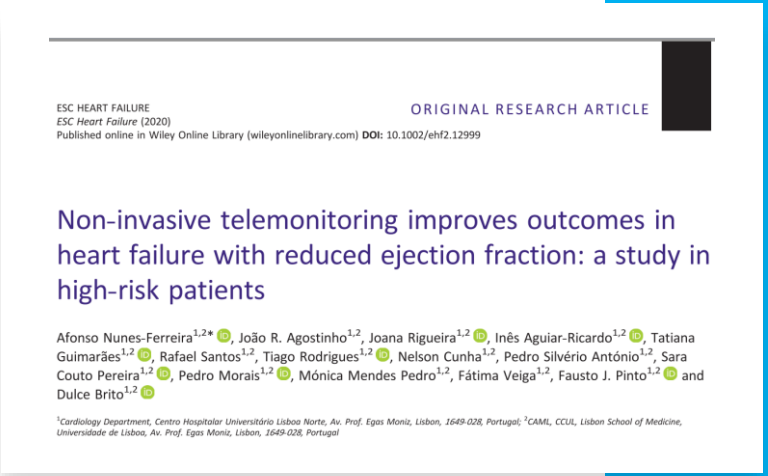
- Non-invasive **telemonitoring program for HF** patients with reduced left ventricular ejection fraction
- **Mature program**, operating since 2017, with a stable clinical team
- **However**, lack of resources and exclusive dedication limit patient enrolment (around 40 patients)
- **5 decision-makers** – cardiologists from HSM



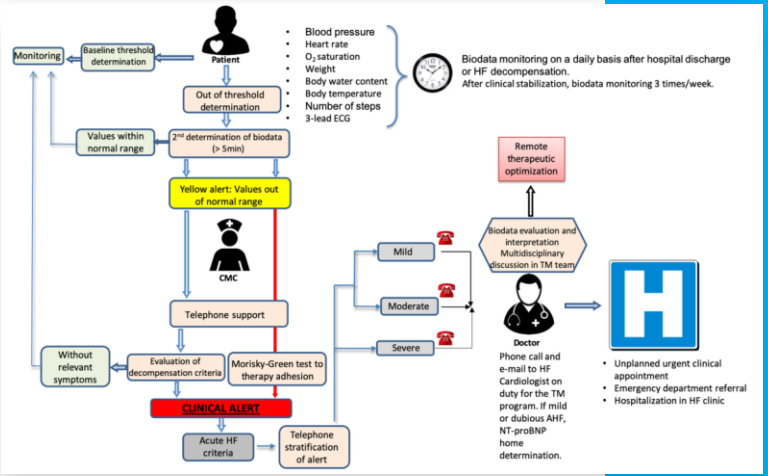
ESC HEART FAILURE
ESC Heart Failure (2020)
Published online in Wiley Online Library (wileyonlinelibrary.com) **DOI:** 10.1002/ehf2.12999

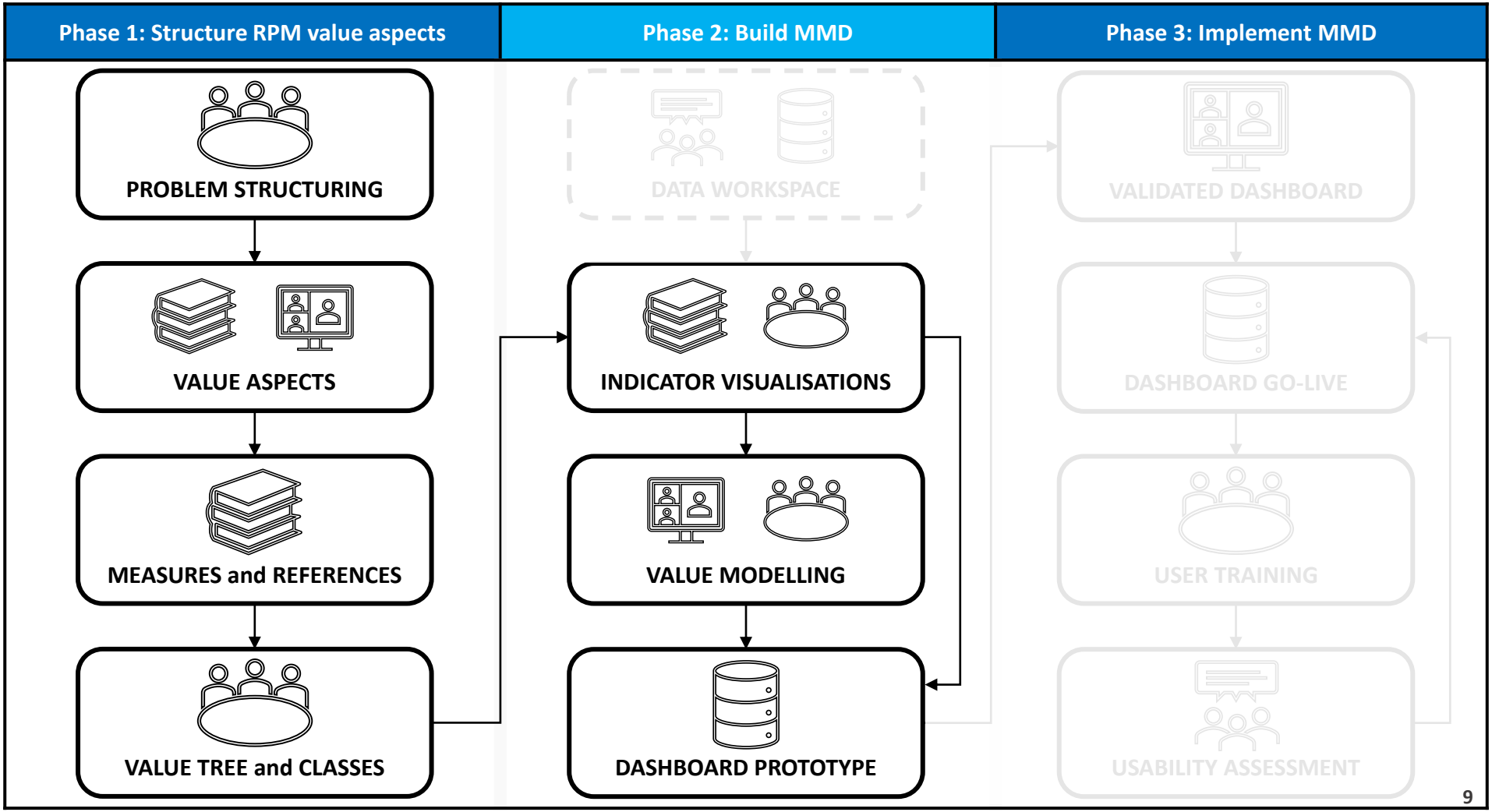
ORIGINAL RESEARCH ARTICLE

Non-invasive telemonitoring improves outcomes in heart failure with reduced ejection fraction: a study in high-risk patients

Afonso Nunes-Ferreira[1,2*], João R. Agostinho[1,2], Joana Rigueira[1,2], Inês Aguiar-Ricardo[1,2], Tatiana Guimarães[1,2], Rafael Santos[1,2], Tiago Rodrigues[1,2], Nelson Cunha[1,2], Pedro Silvério António[1,2], Sara Couto Pereira[1,2], Pedro Morais[1,2], Mónica Mendes Pedro[1,2], Fátima Veiga[1,2], Fausto J. Pinto[1,2] and Dulce Brito[1,2]

[1]*Cardiology Department, Centro Hospitalar Universitário Lisboa Norte, Av. Prof. Egas Moniz, Lisbon, 1649-028, Portugal;* [2]*CAML, CCUL, Lisbon School of Medicine, Universidade de Lisboa, Av. Prof. Egas Moniz, Lisbon, 1649-028, Portugal*

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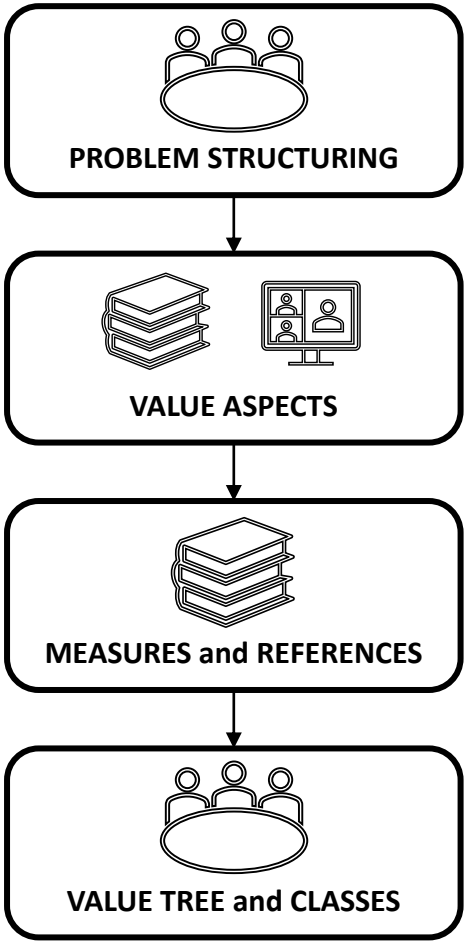


Table 4. Final list of HF RPM value dimensions and indicators.

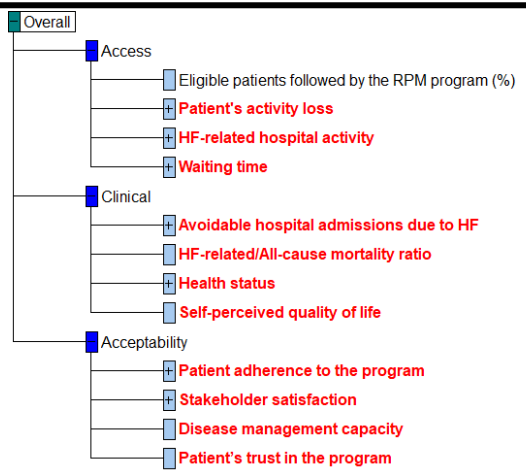
Access	Clinical aspects	Acceptability
Eligible pa[tient]		
Length of [stay]		
Length of [stay]		
Number of [days of activity lost]		[regiver overload]
Number of HF-related emergency visits	Number of alerts generated and severity of alerts	Disease management capacity after the program

4 DIMENSIONS, 36 KPIs, 8 CASE-MIX PARAMETERS

Departing from Miranda, R. *et al*. Unlocking Continuous Improvement in Heart Failure Remote Monitoring: A Participatory Approach to Unveil Value Dimensions and Performance Indicators. *Telemed. e-Health* (2024) doi:10.1089/tmj.2023.0560.

	Proposed measure	Min. acc.	Target
Clinical aspects			
Avoidable hospital admissions due to HF	% Admissions w/ unresponded clinical alerts within 24h	33%	0%
Biosignals	# Clinical alerts per month	170	113
HF-related/All-cause mortality ratio	Ratio between HF and all-cause mortality	33%	10%
Number of alerts generated and severity of alerts	# Alerts per alert severity (green, yellow, red) per year	-	-
Level of physical activity	6MWT score	316 (50%)	417 (75%)
Patients with ΔNT-ProBNP < +30% (%)	% Patients w/ NT-ProBNP decrease or increase by less than 30%	50%	75%
Mental health self-perception	HADS score	11 to 21 (50%)	0 to 7 (75%)

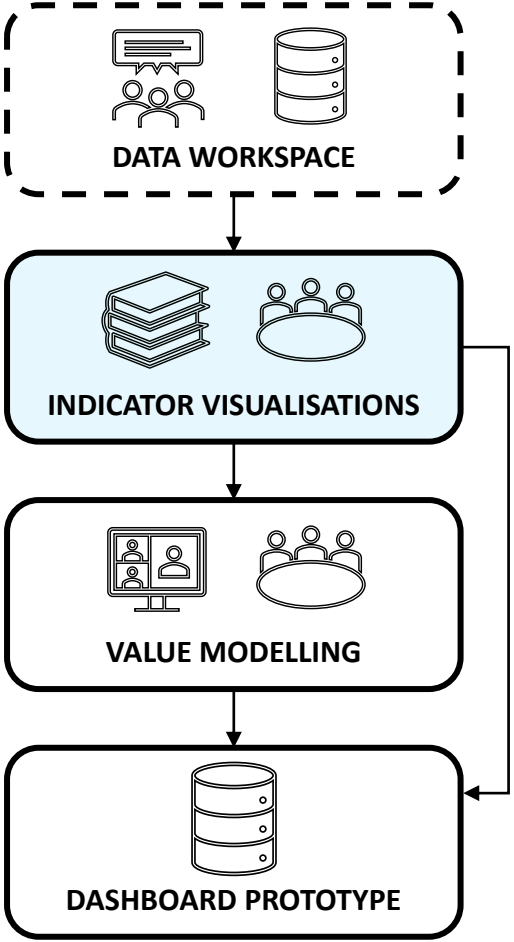
- **MIN. ACCEPTABLE: lowest level** of performance **considered satisfactory**.
- **TARGET: an attainable "good performance"** within the program.



11 CRITERIA

Costs to be assessed separately.

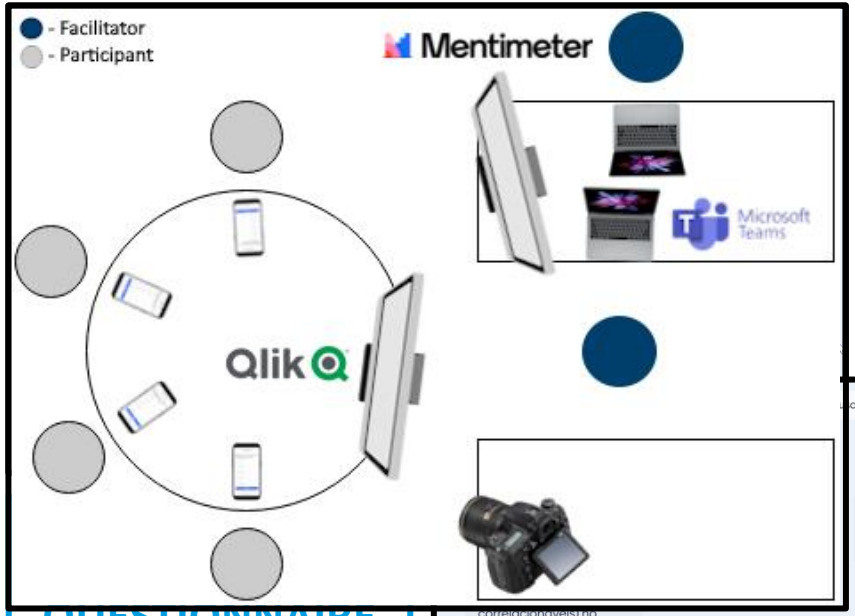
Phase 2: Build MMD



		Aggregated KPIs	New data structure	DataViz formats
Acceptability				
Patient adherence to the program	Compliance	Compliance with biosignal transfer Medication/therapy adherence Dropout rate	QQC	(Stacked) Area Chart Line Chart Streamgraph
Stakeholder satisfaction	Satisfaction	Patient satisfaction Caregiver overload Health professional satisfaction	QCC	Dot Plot Grouped Bar Chart Two-sided Bar Chart (100%) Stacked Bar Chart (if *Showing changes over time*)

32 DATAVIZ SETS

24 KPIs + 8 case-mix parameters



CDB WORKSHOP

Resulted in 5 prototype reports:

- *Case-mix*, 8 visuals
- *Access*, 7 visuals
- *Clinical asp.*, 9 visuals
- *Acceptability*, 6 visuals
- *Costs*, 6 visuals

QUESTIONNAIRE

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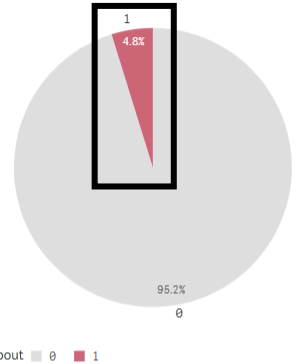
Monitoring (Acceptability dimension)

Dropout rate

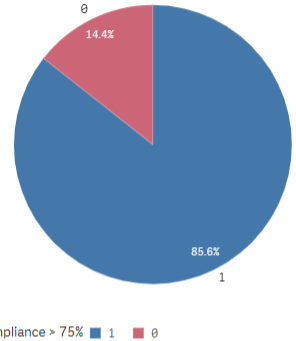
Target (MA): 1 (i.e., Dropout) = 0.0% (8.8%)



Percentage of patients who abandoned the program before completion. Patients are considered dropouts if they transmit biosignals fewer than one day per week on

Compliance with biosignal transfer

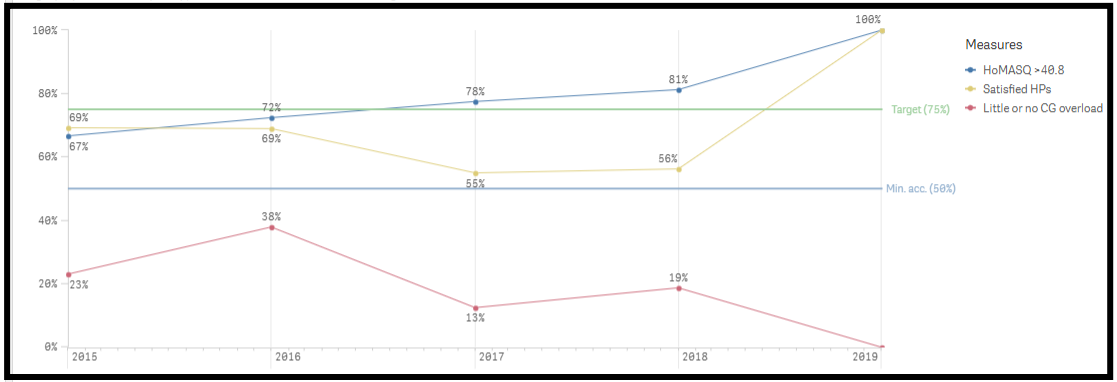
Target (MA): 1 (i.e., Compliant) > 88.0% (66.7%)



Measurement of patient adherence to transmit at least 75% of scheduled biosignal measurements, as recommended by the care team.

Stakeholder satisfaction

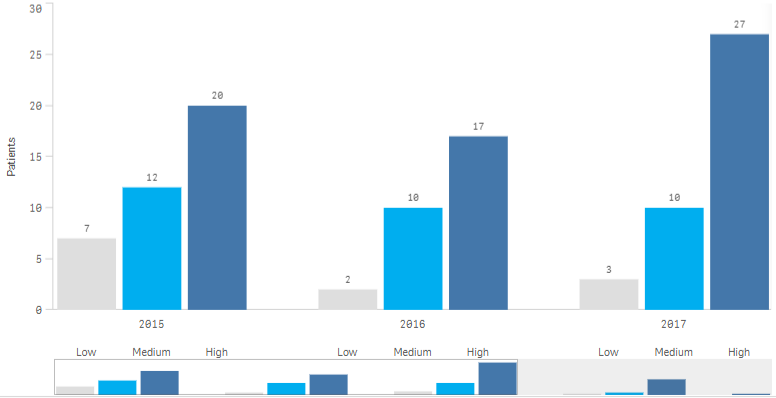
Target (MA): Class > 75.0% (50.0%) | Current: Patient = 73.6%; HP = 63.2%; Caregiver = 22.4%



Combined measurement of patient and health professional (HPs) satisfaction and caregiver (CGs) overload within the telemonitoring program. Patients: Home Monitoring Acceptance and Satisfaction Questionnaire (HoMASQ); HPs: Job Satisfaction Survey (JSS); CGs: 4-item Zarit Burden Interview (ZBI-4).

Medication/therapy adherence

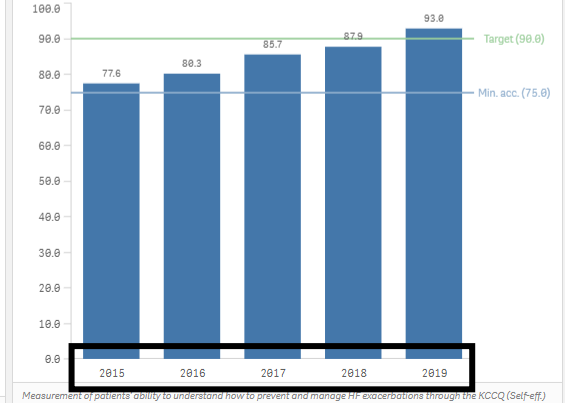
Target (MA): High > 75.0% (50.0%) | Current: 62.4%



Measurement of patient adherence to medication intake and therapy through the Portuguese version of the Morisky Medication Adherence Scale (MMAS).

Disease management capacity

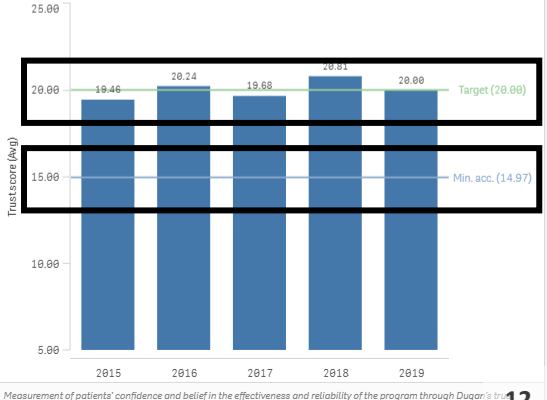
Target (MA): Avg > 90.0 (75.0) | Current: 82.2 (68.8% >= 90)



Measurement of patients' ability to understand how to prevent and manage HF exacerbations through the KCCQ (Self-eff.) scale.

Patient's trust in the program

Target (MA): Avg > 20.00 (14.97) | Current: 19.89 (72.80% >= 20)



Measurement of patients' confidence and belief in the effectiveness and reliability of the program through Dugan's tru... scale.

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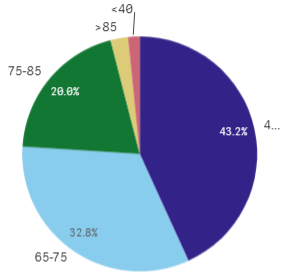
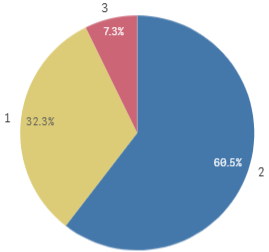
HF RPM program case-mix

Age group



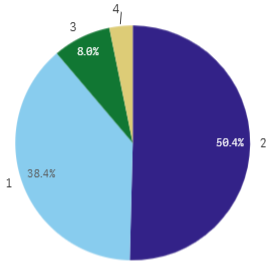
Categorization of individuals based on their age range for demographic analysis and care planning.

Distance to the nearest healthcare facility



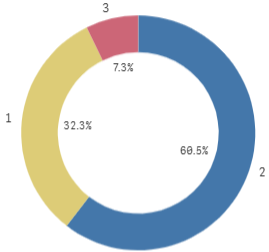
Distance, in kilometres, from the patient's residence to the program's base institution.

Literacy level



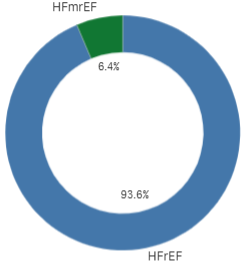
Individuals' ability to read, write, comprehend basic information and use digital tools, according to the Digital Health Technology

NYHA classification



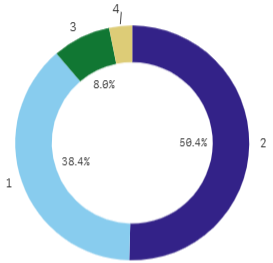
The New York Heart Association (NYHA) categorization of HF severity based on functional limitations, symptoms and the

Classification of HF according to LVEF



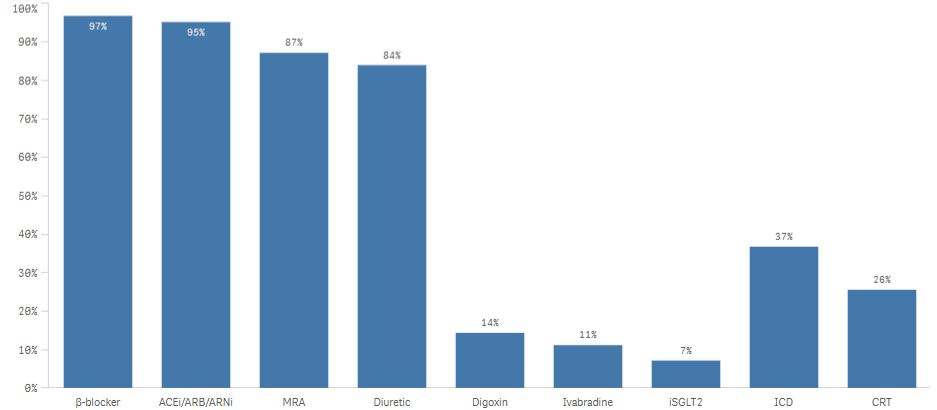
Categorization of HF based on LVEF. Three classes included: HF with reduced EF, HF with mildly reduced EF, and HF with preserved

Frailty index



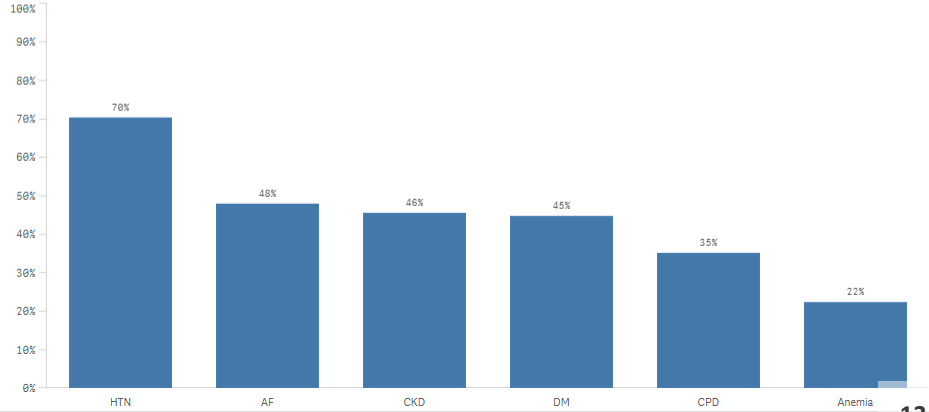
Patient classification according to the proportion of presented deficits out of the total age-related health variables considered.

Medication/therapy



Percentage of patients receiving a certain HF medication or therapy.

Comorbidities



Knowledge of additional ailments occurring alongside the program's primary condition.

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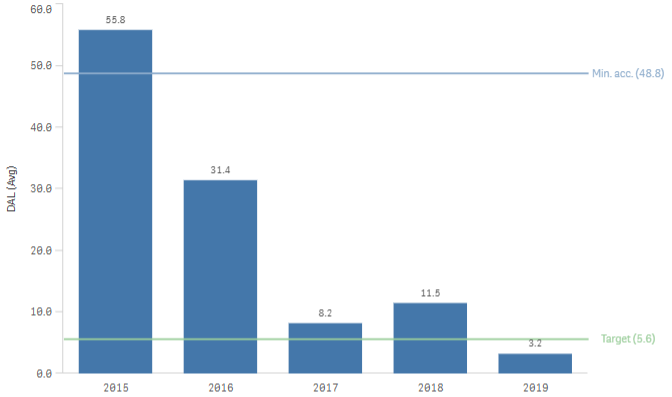
Monitoring (Access dimension)

Number of days of activity lost

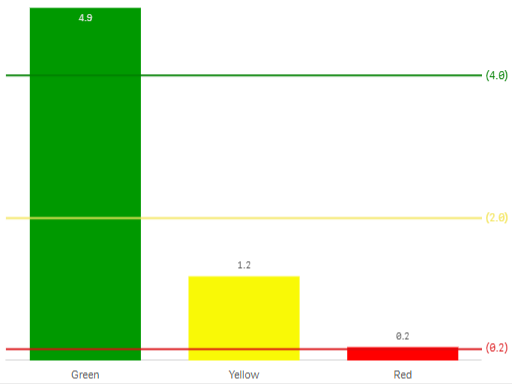
Target (MA): Avg < 5.6 (48.8) | Current: 28.8



Total days of absence or reduced activity due to health-related needs (e.g., emergency room admission, hospitalization, premature death).

Time to medical action

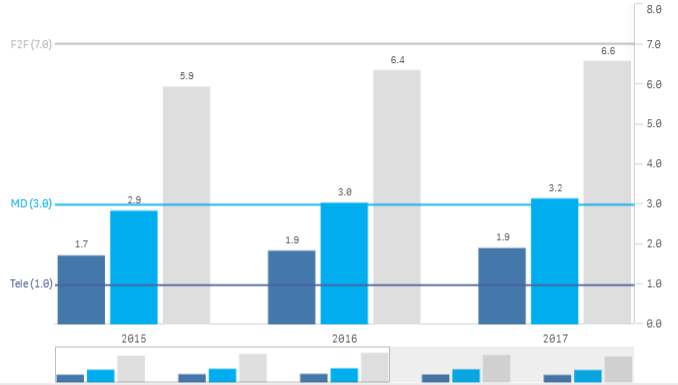
Target (MA): Avg < 3.0 (8.0) | Current: 3.0



Time, in hours and by alert severity, from an alert of patient decompensation to appropriate medical intervention and monitoring.

Waiting time

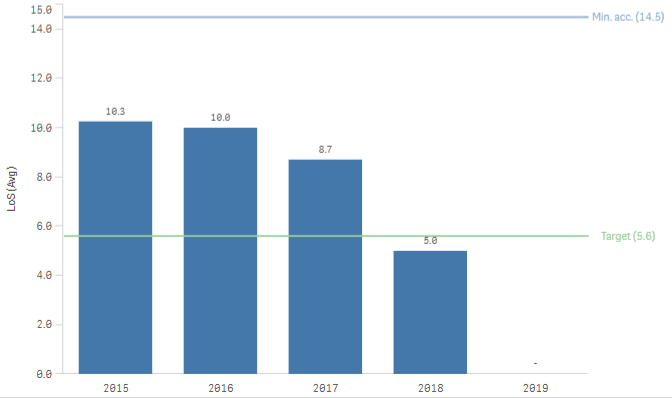
Target-MA (Current): Tele. < 1-6 (1.8) | MD action < 3-8 (3.0) | F2F < 7-30 (6.2)



Time from request (alert or appointment) to initiation of contact (nurse phone call, medical action, or face-to-face consultation. Tele. and MD action times in hours; F2F in days.

HF-related length of stay

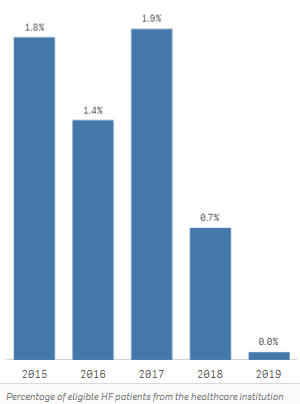
Target (MA): Avg < 6 (14.5) | Current: 9.3



Average length of stay, in days, due to HF-related causes before discharge or death.

% Eligible patients followed

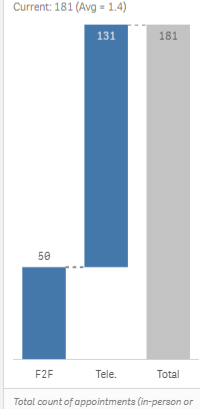
125 patients from 2147 eligible



Percentage of eligible HF patients from the healthcare institution who are enrolled in the telemonitoring program.

Consultations

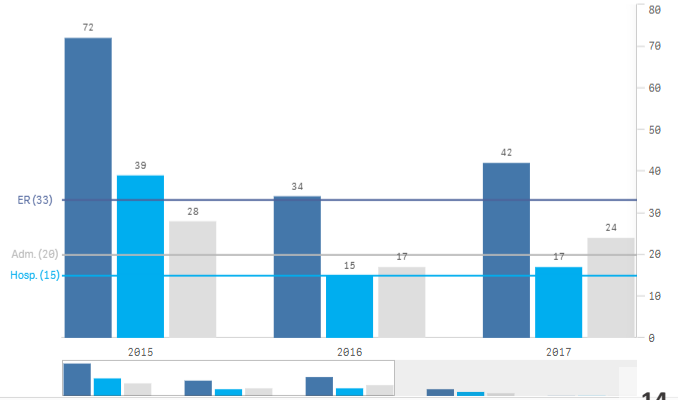
Target (MA): Count < 500 (1000) | Current: 181 (Avg = 1.4)



Total count of appointments (in-person or virtual) within the program duration.

HF-related hospital activity

Target-MA (Current): ER < 163-245 (163) | Hosp. < 75-225 (80) | Adm. < 100-225 (75)



Total count of healthcare events (ER, hospitalization, inpatient admissions) due to HF-related causes.

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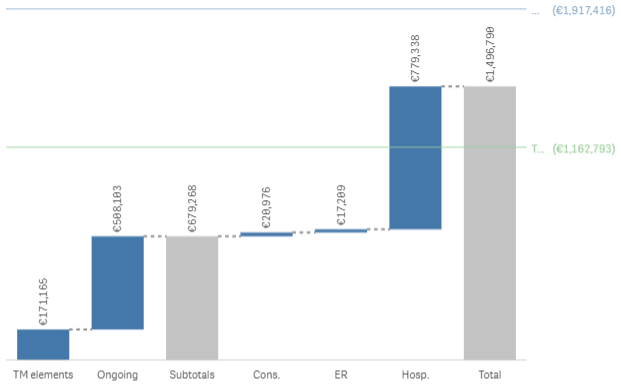
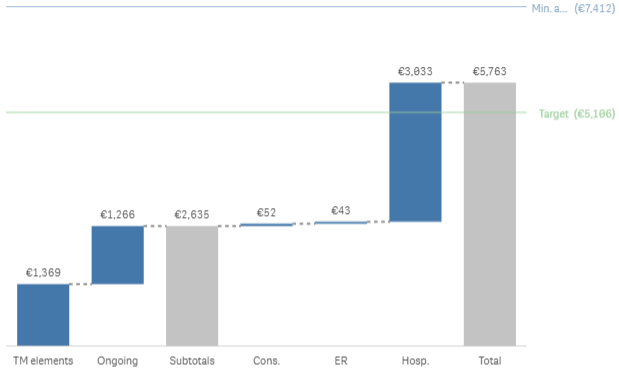
Monitoring (Costs dimension)

Program cost



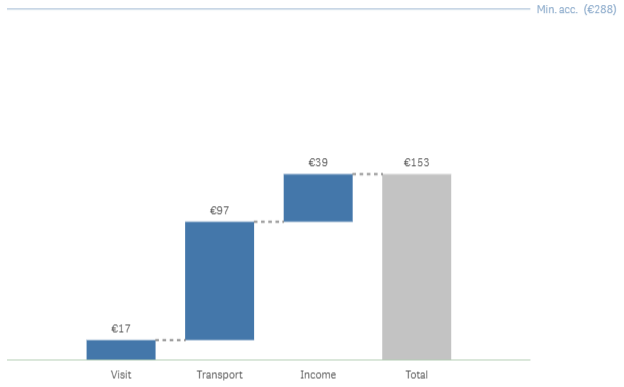
Total program cost, including telemonitoring elements (i.e., setup, devices) and activities, external consultations, emergency service admissions and hospitalizations.

Program cost per patient



Total cost (on average) associated with a patient's clinical pathway within one year of program duration. Cost components: telemonitoring (TM) elements; telemonitoring activities (Ongoing); external consultations (Cons.); emergency service admissions (ER); hospitalizations

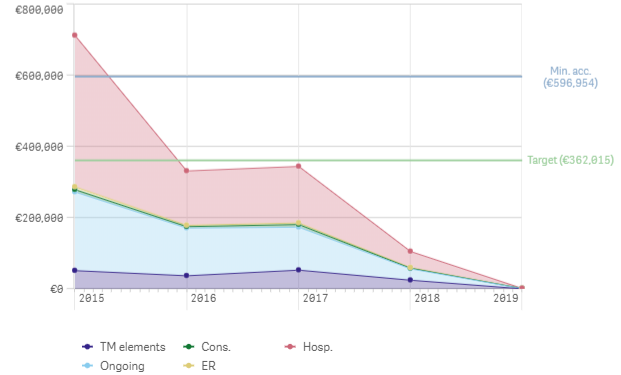
Costs for the patient



Total expenses (on average) directly incurred by the patient within one year of program duration. Cost components (Caló et al. [2013]): visit; transportation; lost income.

Program cost

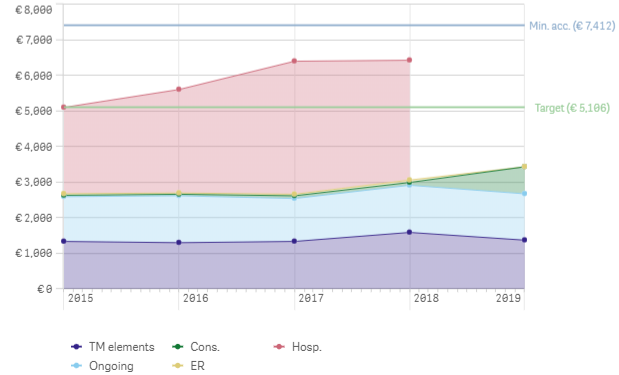
Target (MA): Cost < €1.16M (€1.92M) | Current: €1.58M



Total program cost, including telemonitoring elements (i.e., setup, devices) and activities, external consultations, emergency service admissions and hospitalizations.

Program cost per patient

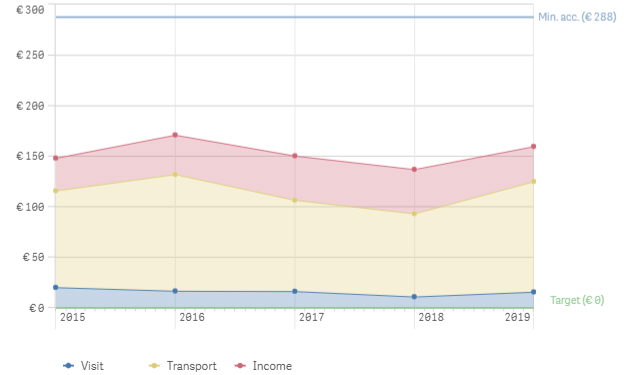
Target (MA): Cost < €5.11k (€7.41k) | Current: €5.76k



Total cost (on average) associated with a patient's clinical pathway within one year of program duration. Cost components: telemonitoring (TM) elements; telemonitoring activities (Ongoing); external consultations (Cons.); emergency service admissions (ER); hospitalizations

Costs for the patient

Target (MA): Cost < €0 (€288) | Current: €153



Total expenses (on average) directly incurred by the patient within one year of program duration. Cost components (Caló et al. [2013]): visit; transportation; lost income.

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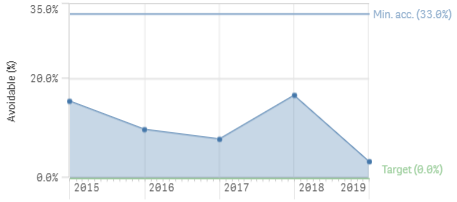
Monitoring (Clinical aspects dimension)

Avoidable hospital admissions due to HF

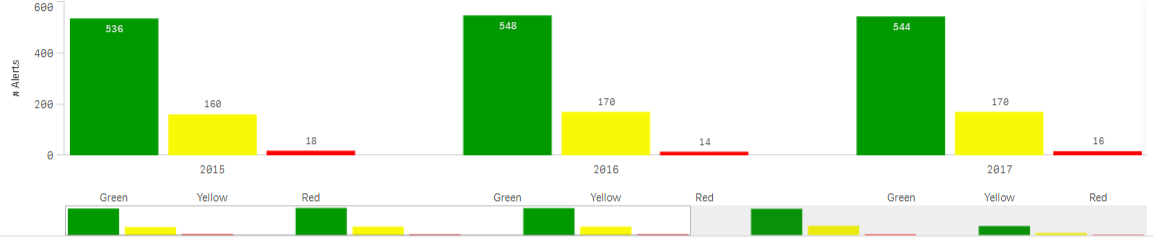
Target (MA): Rate = 0% (33%) | Current: 12%



Percentage of preventable (i.e., clinical alert is not responded to) hospital admissions related to HF within the program duration.

Number of alerts generated and severity of alerts

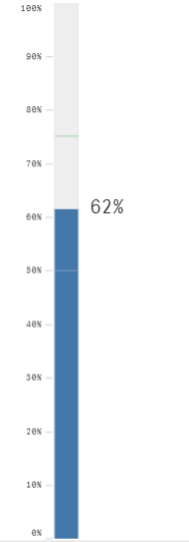
Target (MA): Alerts < 3168 (4752) | Current: 3138



Count and severity of alerts related to patient deterioration or decompensation for timely intervention and monitoring.

Patients with ΔNT-ProBNP < +30% (%)

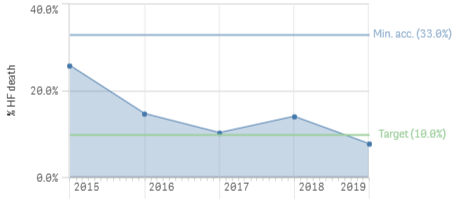
Target (MA): Rate > 75% (50%) | Current: 62%



Percentage of HF patients exhibiting a decrease or less than 30% increase in N-terminal pro-B-type natriuretic

HF-related/All-cause mortality ratio

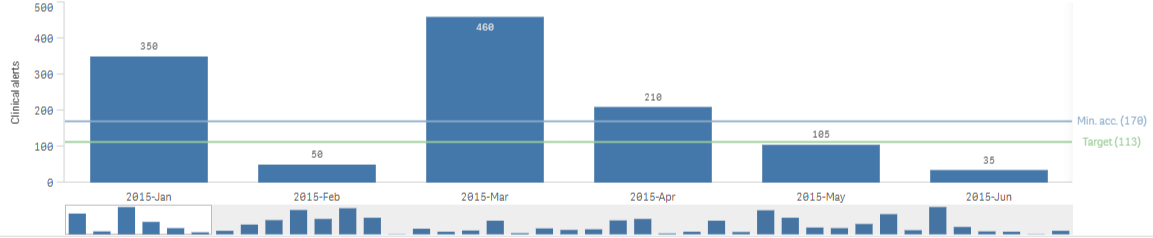
Target (MA): Rate < 10% (33%) | Current: 17%



Ratio between the number of deaths directly linked to HF and all occurring deaths within the program duration.

Biosignals

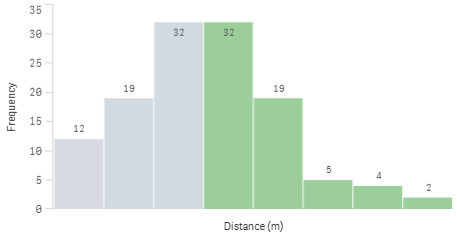
Target (MA): Total < 6800 (10200) | Current: 6845



Average monthly count of clinical alerts i.e., when a patient exhibits two or more vital sign measurements outside their defined normal range.

Level of physical activity

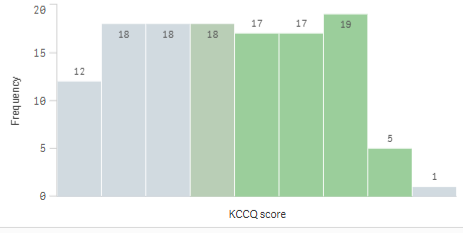
Target (MA): Avg > 417 (316) | Current: 420 (49.6% >= 417)



Measurement of patients' physical activity levels through the Six Minute Walk Test (6MWT).

Quality of life self-perception

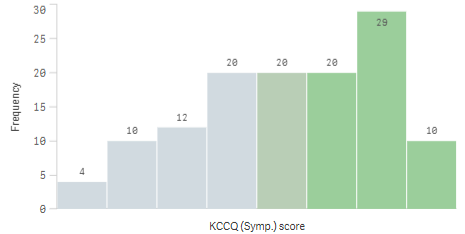
Target (MA): Avg > 77 (60) | Current: 77 (50.4% >= 77)



Measurement of patients' perception of overall well-being and ability to participate in or enjoy everyday life moments through the Kansas City Cardiomyopathy Questionnaire (KCCQ).

HF symptoms self-perception

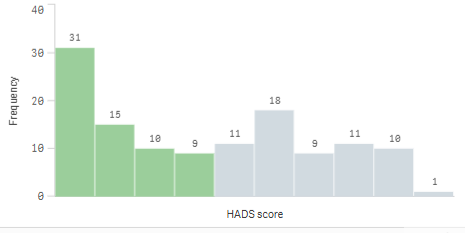
Target (MA): Avg > 89 (67) | Current: 88 (53.6% >= 89)



Measurement of patients' perception of HF symptoms e.g., oedema, through the KCCQ (Symp.) scale.

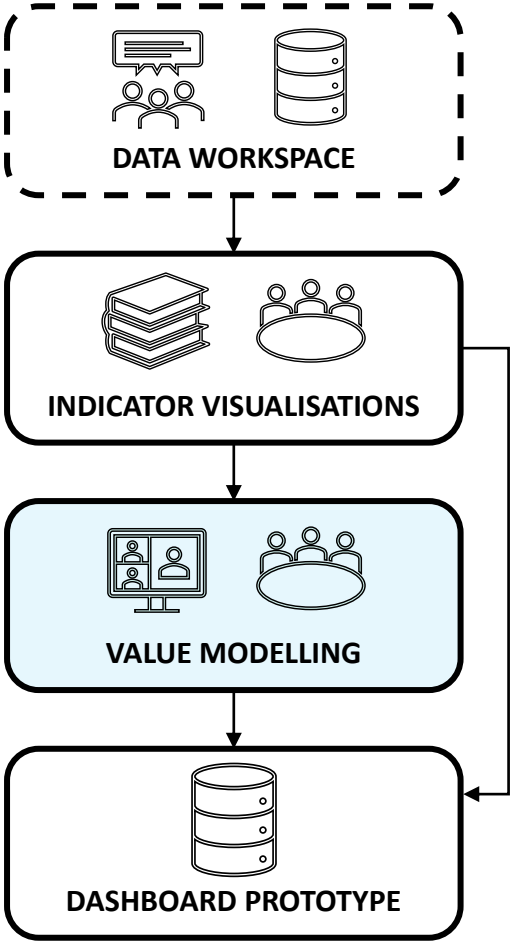
Mental health self-perception

Target (MA): Avg < 8 (11) | Current: 7 (52.0% < 8)

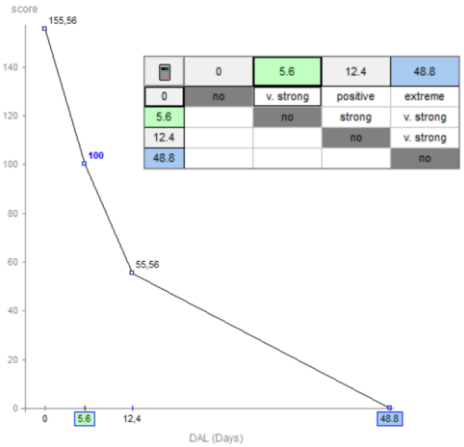


Measurement of patients' perception of their mental health status through the Hospital Anxiety and Depression Scale (HADS).

Phase 2: Build MMD



	Descriptor of performance	Performance levels
Patient's activity loss [DAL]	Average yearly number of days lost due to unplanned hospital admissions or all-cause death.	0 days 5.6 days 12.4 days 48.8 days
HF-related hospital activity [Activity]	Qualitative performance levels combining HF-related hospitalization rate and the number of yearly face-to-face consultations.	hc: The HF hosp. rate is <=12% and the avg. yearly number of cons. is <4. hC: The HF hosp. rate is <=12% and the avg. yearly number of cons. is >=4. Hc: The HF hosp. rate is >12% and the avg. yearly number of cons. is <4. HC: The HF hosp. rate is >12% and the avg. yearly number of cons. is >=4.



Criterion	Rank				Judgements							Avg.	MD
	P1	P2	P3	P4	No	VW	W	M	S	VS	E		
% HF death	1st	3rd	1st	5th					1	2	1	16,22	4,55
Activity	3rd	2nd	4th	3rd					1	2	1	14,33	0,74
DAL	4th	1st	3rd	6th					1	1	2	14,22	2,22
Avoidable	2nd	4th	2nd	8th				1		2	1	13,18	4,50
Health	5th	5th	6th	1st					2	2		11,57	3,53
QoL	6th	6th	5th	7th					3	1		9,21	0,62
Adherence	7th	9th	8th	4th					4			6,82	2,97
Self-eff.	11th	7th	9th	2nd				2	1	1		6,91	5,32
Waiting	8th	11th	7th	9th			2	1		1		2,70	0,95
Trust	9th	8th	11th	10th		1		2	1			2,80	1,73
Stk. satisf.	10th	10th	10th	11th		1		3				2,06	1,06

4 DINTS, 4 MODELS -> RECONCILE

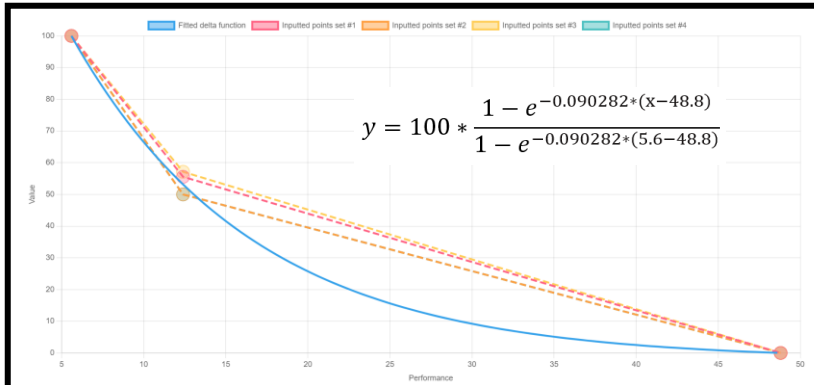
Phase 2: Build MMD

DATA WORKSPACE

INDICATOR VISUALISATIONS

VALUE MODELLING

DASHBOARD PROTOTYPE

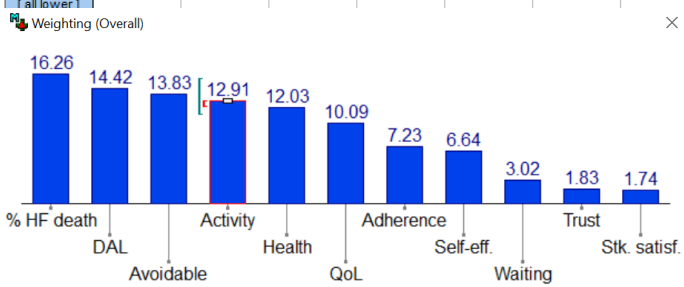


RECONCILIATION

- ***Value functions***: "delta" function fit
- ***Value scales***: ranking, avg, max, min, MD
- ***Weights***: reconciled ranking, mode judgement, avg weight

A UNIFIED VALUE MODEL

PKs validated reconciled functions/scales, discussed a criteria ranking, provided new judgements to adjust weights and defined achievement classes.



	Alert	Acceptable	Good	Excellent
% HF death	100,00	33,00	20,00	0,00
DAL	48,80	48,80	12,40	0,00
Avoidable	100,00	33,00	15,00	0,00
Activity	HC	HC	hC	hc
Health	Bad	pm	pM	PM
QoL	0,00	50,00	66,67	100,00
Adherence	Bad	Dmc	dMc	dMC
Self-eff.	0,00	50,00	66,67	100,00
Waiting	MC	MC	mC	mc
Trust	0,00	50,00	66,67	100,00
Stk. Satisf.	Bad	php	Php	PHP

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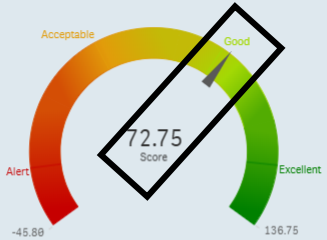
MACBETH Assessment

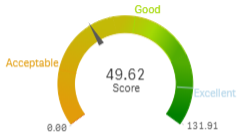
Overall model score



An achievement class considers both the model score and conditional rules for classification.

Access (Score)

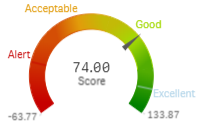
HTA weight: 30.35%



Score concerning the Access value dimension. Included criteria are DAL, Activity and Waiting.

Clinical asp. (Score)

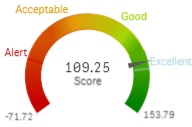
HTA weight: 52.21%



Score concerning the Clinical aspects value dimension. Included criteria are % HF death, Avoidable, Health and QoL.

Acceptability (Score)

HTA weight: 17.44%



Score concerning the Acceptability value dimension. Included criteria are Adherence, Self-eff., Trust and Stk. satisf.

Access (Class)

DAL: 11.4 | % HF Hosp.: 17% | MD action: 2.9

ACCEPTABLE

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0 or DAL, % HF Hosp. or MD action above MA; ACCEPTABLE: Score < 60.59, or

Clinical asp. (Class)

HF death: 14% | Avoid.: 17% | QoL: 81% | 6MWT: 81% | HADS: 69%

GOOD

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0; ACCEPTABLE: Score < 49.17, or Avoidable, % HF death above MA, or QoL and

Acceptability (Score)

Self-eff: 81% | MMAS: 81% | Compliance: 94% | Patients: 81%

EXCELLENT

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0 or MMAS and Compliance below MA; ACCEPTABLE

Achievement class

GOOD

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0, or Access or Clinical asp. in ALERT; ACCEPTABLE: Score < 54.22, or Acceptability in ALERT, or Clinical asp. and Access (or Acceptability) in

30.35

(Slide to update Access weight)

52.21

(Slide to update Clinical asp. weight)

Acceptability weight

17.44%

Reset

Table of performances, partial values and MACBETH score

Score (HTA)	Data_início....	DAL (Avg)	DAL (VF)	Activity (% HF Hosp.)	Activity (F2F)	Activity (VF)	Waiting (MD action)	Waiting (F2F)	Waiting (VF)	Avoida... (%	Avoida... (VF)	% HF death	% HF death (VF)	Health (6MWT)	Health (HADS)	Health (VF)	QoL (%)	QoL (VF)	Adhere... (MMAS)	Adherence (Complia...	Adheren... (Dropout)	Adheren... (VF)	Stk. satisf. (Patients)	Stk. satisf. (HP)	Stk. satisf. (VF)	Self-eff. (%)	Self-eff. (VF)	Trust (%)	Trust (VF)
72.75		11.5	58.12	16.8%	1.3	28.33	2.9	6.1	100.00	16.7	34.15	14.1%	80.25	81.3%	68.8%	70.00	81.3%	123.31	81.3%	93.8%	0.0%	100.00	81.3%	56.3%	62.13	81.3%	127.31	81.3%	125.08
90.39	Jan	3.2	124.69	4.3%	1.0	100.00	3.1	6.4	29.02	3.4%	82.94	7.8%	111.15	0.0%	100.0...	-50.00	100.0...	189.47	0.0%	100.0%	0.0%	-50.00	100.0%	100.0%	100.00	100.0...	215.36	100.0...	194.05
61.59	Apr	18.8	28.86	29.3%	1.4	28.33	3.5	7.3	0.00	22.2%	20.06	20.3%	51.67	87.5%	75.0%	100.00	75.0%...	100.00	87.5%	100.0%	0.0%	100.00	75.0%	62.5%	62.13	87.5%	155.62	75.0%...	100.00
102.08	Jul	4.2	113.75	4.3%	1.3	100.00	2.8	5.9	100.00	0.0%	100.00	7.8%	111.15	66.7%	66.7%	0.00	100.0...	189.47	66.7%	100.0%	0.0%	24.77	66.7%	33.3%	-52.80	100.0%...	215.36	100.0...	194.05
116.62	Aug	3.2	124.69	4.3%	1.0	100.00	3.1	6.4	29.02	3.4%	82.94	7.8%	111.15	100.0%...	100.0%...	100.00	100.0...	189.47	100.0%	100.0%	0.0%	100.00	100.0%	0.0%	-52.80	100.0%...	215.36	100.0...	194.05
83.07	Sep	7.2	86.27	4.3%	2.0	100.00	2.4	4.9	100.00	11.1%	51.61	7.8%	111.15	100.0%...	100.0%...	100.00	100.0...	189.47	100.0%	100.0%	0.0%	100.00	100.0%	0.0%	-52.80	0.0%	-97.62	0.0%	-81.55
59.12	Dec	3.2	124.69	4.3%	1.0	100.00	2.8	5.9	100.00	3.4%	82.94	7.8%	111.15	100.0%...	0.0%	-50.00	50.0%	0.00	100.0%	50.0%	0.0%	-50.00	100.0%	100.0%	100.00	50.0%	0.00	100.0...	194.05

The table details value model inputs and partial values (as scaled by value functions [VF]). Text colors indicate if the KPI meets Target (green) or is worse than Minimally acceptable (red). Background colors indicate the defined achievement classes for each VF (Excellent, Good, Acceptable, Alert).

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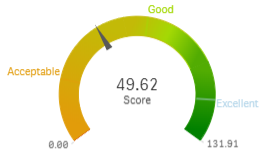
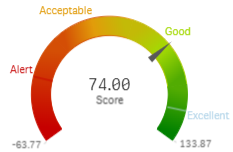
MACBETH Call-for-action

Access (Score)



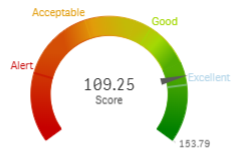
Score concerning the Access value dimension. Included criteria are DAL, Activity and Waiting.

Clinical asp. (Score)



Score concerning the Clinical aspects value dimension. Included criteria are % HF death, Avoidable, Health and QoL.

Acceptability (Score)



Score concerning the Acceptability value dimension. Included criteria are Adherence, Self-eff., Trust and Stk. satisf.

ACCEPTABLE

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0 or DAL, % HF Hosp. or MD action above MA; ACCEPTABLE: Score < 60.59, or DAL > 20 days, or % HF Hosp. and MD action above Target;

GOOD

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0; ACCEPTABLE: Score < 49.17, or Avoidable, % HF death above MA, or QoL and 6MWT (or HADS) < 67%; EXCELLENT: Score > 100 and QoL, 6MWT and HADS > 67%.

EXCELLENT

An achievement class considers both the model score and assignment rules for classification. ALERT: Score < 0 or MMAS and Compliance below MA; ACCEPTABLE: Score < 58.23, or Self-eff. below MA and MMAS below Target;

DAL (Avg)
Target (MA): Avg < 5.6 (48.8)

11.5

(Average) number of days of activity lost: Average days of absence or reduced activity due to health-related needs (e.g., emergency room admission, hospitalization, premature death).

% HF death
Target (MA): Rate < 10% (33%)

14.1%

HF-related/All-cause mortality ratio: Percentage of patients who died due to HF-related causes out of all deceased patients.

Adherence (Compliance)
Target (MA): Rate > 88% (67%)

93.8%

Compliance with biosignal transfer: Measurement of patient adherence to

Adherence (MMAS)
Target (MA): High > 75% (50%)

81.3%

(High) medication/therapy adherence: Percentage of patients whose adherence to medication intake and therapy is considered

Activity (% HF Hosp.)
Target (MA): Rate < 12% (36%)

16.8%

HF-related hospitalization rate: Percentage of patients who were hospitalized at least once in a year due to HF-related causes.

Activity (F2F)
Target (MA): Avg < 4 (8)

1.3

Yearly face-to-face consultations (per patient): Average count of in-person appointments per patient in a year.

Avoidable (%)
Target (MA): Rate = 0% (33%)

16.7%

Avoidable hospital admissions due to HF: Percentage of preventable (i.e., clinical alert is not responded to) hospital admissions related to HF.

Adherence (Dropout)
Target (MA): Rate = 0% (8%)

0.0%

Dropout rate: Percentage of patients who abandoned the program before

Self-eff. (%)
Target (MA): 75% (50%) >= 90

81.3%

(Good) disease management capacity: Percentage of patients whose score in the Kansas City Cardiomyopathy Questionnaire

Waiting (MD action)
Target (MA): Avg < 3 (8)

2.9

Average time to medical action: Average time, in hours, from an alert of patient decompensation to appropriate medical intervention and

Waiting (F2F)
Target (MA): Avg < 7 (30)

6.1

Average time to consultation: Average time, in days, from an appointment request to face-to-face

Health (6MWT)
Target (MA): 75% (50%) >= 417

81.3%

(Good) level of physical activity: Percentage of patients who walked at least 417m during the Six Minute Walk

Health (HADS)
Target (MA): 75% (50%) < 8

68.8%

(Good) mental health self-perception: Percentage of patients whose score in the

QoL (%)
Target (MA): 75% (50%) >= 77

81.3%

(Good) quality of life self-perception: Percentage of patients whose score in the Kansas City Cardiomyopathy Questionnaire (KCCQ) is

Trust (%)
Target (MA): 75% (50%) >= 20

81.3%

(High) patient's trust in the program: Percentage of patients whose score in the

Stk. satisf. (Patients)
Target (MA): 75% (50%) > 40.8

81.3%

Satisfied patients: Percentage of patients whose score in the

Stk. satisf. (HP)
Target (MA): Satisfied > 75% (50%)

56.3%

Satisfied health professionals (HPs): Percentage of HPs

Conclusions

Key Messages

- Processes must be clear and practical – crowded agendas and limited dedicated attention span
- During MMD development, stakeholders reflect about the program and may identify areas for improvement
- While developing KPIs, stakeholders refine measures and references, facilitating value modelling
- *Ex-ante* decision interviews are demanding for DAs, but streamline the decision conference
- User-adjusted weights provide a strong tool for fostering stakeholder discussion

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THANK YOU!
ANY QUESTIONS?

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