European Commission

Directorate General for Communications Networks, Content and Technology
Sustainable and Secure Society - Health and Well-being

H2020 PHC-30-2015 689617
Research and Innovation Action

Work Package: WP4

Digital Patient Definition, Data Collection

Deliverable: 4.1

Digital Patient Definition

Version: 1v2

Date: 30-Apr-16

DOCUMENT INFORMATION

Project Num	H2020 PHC-30-2015 689617	**Acronym**	EurValve
Full title	Personalised Decision Support for Heart Valve Disease		
Project URL	http://www.eurvalve.eu		
EU Project officer	Carmen LAPLAZA SANTOS (CNECT/H/01)		

Work package	**Number**	4	**Title**	Digital Patient Definition, Data Collection
Deliverable	**Number**	4.1	**Title**	Digital Patient Definition

Date of delivery	**Contractual**	30-Apr-16	**Actual**	30-Apr-16
Status	Version 1v2		Final ☑	
Nature	Prototype ☐ Report ☑ Dissemination ☐ Other ☐			
Dissemination Level	Public (PU) ☑	Restricted to other Programme Participants (PP) ☐		
	Consortium (CO) ☐	Restricted to specified group (RE) ☐		

Authors (Partner)	T Kuehne (DHZB) M Kelm A Meyer			
Responsible Author	T Kuehne		**Email**	titus.kuehne@dhzb.de
	Partner	DHZB	**Phone**	+49 30 45 93 20 78

Abstract (for dissemination)	The concept underpinning EurValve is that of the Digital Patient, in which all available data on a patient is combined, and interpreted through the operation of computational models. The outputs, novel disease characterisations and ranked intervention alternatives, are provided to the physicians to support their decision. This document provides a specification for the content of the Digital Patient definition.
Keywords	Aortic Stenosis, Mitral Regurgitation, Decision Support, Digital Patient, Predictive Modelling, Simulation

Version Log			
Issue Date	**Version**	**Author**	**Change**
22-Apr-2016	0v1	Marcus Kelm, Alexander Meyer	Initial version
28-Apr-2016	0v2	Alexander Meyer	Revision
29-Apr-2016	0v3	Marcus Kelm	Revision
30-Apr-2016	1v0	Rod Hose	Analysis parameters
30-Apr-2016	1v1	PMO	Release candidate
30-Apr-2016	1v2	Leonid Goubergrits & PMO	Release version

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EXECUTIVE SUMMARY

SCOPE

EurValve will develop a clinically-compliant Decision Support System for the management of Valvular Heart Disease. The concept underpinning the project is that of the Digital Patient, in which we combine all available data on a patient, and interpret it through the operation of computational models. The outputs, novel disease characterisations and ranked intervention alternatives, are provided to the physicians to support their decision.

OBJECTIVES

The amalgamated dataset must allow for information from current patient pathways (including imaging by CT and Echo, laboratory testing, and other clinical data) and also from anticipated future pathways, in particular MR imaging which drives the EurValve haemodynamic modelling process and is expected to enter clinical guidelines in due course. This task will therefore identify all patient-specific data that might be important to support the decision process for patients presenting with aortic stenosis or mitral regurgitation, and will define the operations on these data to underpin the decision support mechanism.

CONCLUSIONS

Together with clinical and technical partners an amalgamated set of data was defined allowing the storage of clinical parameters in conjunction with analyses performed and modelling output. The integration of data will facilitate a series of activities:

i) Characterisation of valve anatomy and valve haemodynamics
ii) Characterisation of the anatomical and physiological envelope and quantification of the effect on cardiac physiology of valve disease and of potential interventions,
iii) Sensitivity analysis,
iv) Improvement of computational efficiency and
v) Validation.

A key concept is that the Digital Patient data on any particular individual evolves over time, becoming an increasingly accurate representation of the individual, as new data is available (whether from new measurements on the patient or from new relevant population data).

It is also the case that the amalgamated Digital Patient definition included in this document is itself likely to evolve as the EurValve project progresses and the modelling process is refined.

1 INTRODUCTION

The aim of EurValve is to improve clinical diagnosis and interventional planning for valve disease by interpreting and exploiting all available information, from personal clinical data, population data, clinical guidelines, imaging and other sources. The mechanism that will provide this improvement is the operation of a computational model that is capable both of offering more effective quantitative characterisation of the disease state and of predicting the effect of intervention. At the highest level, each model operates on a series of inputs to produce outputs that are descriptive of the patient status and/or the potential changes under intervention. The overall work flow is illustrated in Figure 1. This document focuses on the definition and the consolidation process of different data sources in order to obtain a Digital Patient representation.

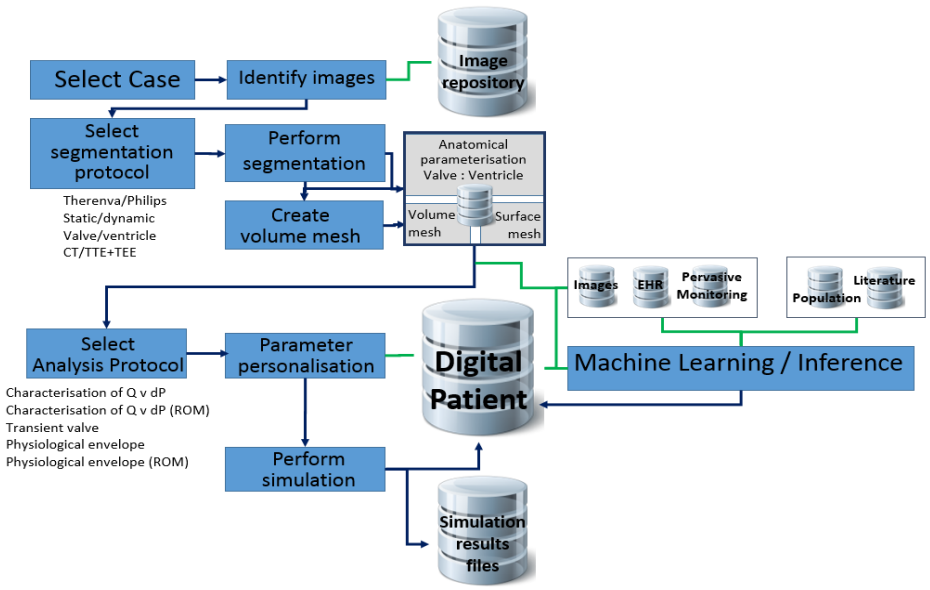

Figure 1 Overall EurValve work flow illustrating sequence of analysis operations and communication with data repositories

2 CONSOLIDATED DATA

In EurValve, data from different multi-national clinical sites (Eindhoven, Sheffield, and Berlin) will be integrated in a shared repository. Based on experience from previous European projects the project will re-use the TrialConnect technology (Telekom, Germany) to anonymise and store relevant DICOM image data. This image repository will offer technical partners seamless access to medical imaging information from the time when each patient is enrolled.

A Digital Patient database at the University of Sheffield will be used to keep information gathered in electronic case report forms (eCRF). In addition to demographic data, many patient-specific measurements will be included.

After the performance of technical and modelling operations, such as anatomical parameterisation, EurValve technical partners will be able to integrate their computed results with the clinical dataset of the patient. This amalgamated repository will facilitate the novel approach being taken to the combined data analysis being undertaken within the EurValve project, which has been divided into five processes, namely:

i) Characterisation of valve anatomy and valve haemodynamics
ii) Characterisation of the physiological envelope and quantification of the effect on cardiac physiology of valve disease and of potential interventions
iii) Sensitivity analysis
iv) Improvement of computational efficiency and
v) Validation

The first two of these are the core elements of the operation of the Decision Support System for assessment of the individual patient, the third is needed to underpin the development of the details of the operational analysis protocols, the fourth will optimise the clinical utility of the DSS by providing reduced execution times, and the fifth is needed to demonstrate that the selected protocols are appropriate.

The Digital Patient initiative will develop new ways of combining rich patient information in a highly visual, coherent and meaningful way. In the short-term, this will enable new clinical information to be generated by the blending and fusing of existing data but, ultimately, it will lead to the creation of a powerful “patient avatar” capable of supporting the medical professional by producing the new clinical knowledge which will emerge from the integration of patient-specific and population-specific information. These innovative information technologies will impact how medical professionals can access simulations of the progression, treatment, and outcome of a disease to support diagnosis, prognosis, and choice of treatment. They will further be of help when developing evidence-based explanations in complex clinical cases.

3 FRAMING CONDITIONS

EurValve includes a multi-centre clinical study design in which a consistent patient definition is required to ensure that a critical criterion is met: completeness of data. The data acquired in the Digital Patient definition must be coded in a unified way and, in a multi-institutional effort, data availability was checked and a unified set of parameters was defined. There are many sources of data and many potential analysis protocols, each of which can provide important information or insights into the patient's condition. EurValve must strike a balance between provision of a coherent and easy-to-operate diagnostic and prognostic analysis process and exploitation of state-of-the-art computational analysis tools.

4 CONTENT

In agreement with all clinical partners the common parameters of an eCRF were defined, and common standards of medical information parameters for risk quantification were added. Those include parameters that allow the calculation of commonly used risk scores, namely the European System for Cardiac Operative Risk Evaluation "EuroSCORE II" and the Society of Thoracic Surgeons – STS- Score[1,2].

The TrialConnect platform already provides the ability to store segmentation results and geometrical processing in a standard DICOM or STL file format, allowing the re-use of segmentations.

The Digital Patient database will also store computed information derived from segmented anatomy, performed by technical partners in other WPs, to allow further use in disease specific models as well as comparison and optimisation of methods.

All parameters included to date are listed in the ANNEX of this document.

5 EXTENSIBILITY

A key concept is that the Digital Patient evolves over time, becoming an increasingly accurate representation of the individual, as new data is available (whether from new measurements on the patient or from new relevant population data). An open data concept with the ability to add new database fields from calculations, measurements or modelling output will be essential to adapt Digital Patient data stored to new methods and techniques.

6 REFERENCES

1. Hemmann K, Sirotina M, De Rosa S, et al. The STS score is the strongest predictor of long-term survival following transcatheter aortic valve implantation, whereas access route (transapical versus transfemoral) has no predictive value beyond the periprocedural phase. *Interactive cardiovascular and thoracic surgery.* 2013;17(2):359-364.

2. Holinski S, Jessen S, Neumann K, Konertz W. Predictive Power and Implication of EuroSCORE, EuroSCORE II and STS Score for Isolated Repeated Aortic Valve Replacement. *Ann Thorac Cardiovasc Surg.* 2015;21(3):242-246.

7 List of Abbreviations

BMI	Body Mass Index
BSA	Body Surface Area
CABG	Coronary artery bypass grafting
CCS	Canadian Cardiovascular Society grading of Angina
COPD	Chronic obstructive pulmonary disease
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine Standard
dPmax	Max Pressure Drop
dPmean	Mean Pressure Drop
DSS	Decision Support System
eCRF	electronic case report forms
ED	End diastole
EF	Ejection fraction
ES	End systole
FS	Fractional shortening
ICD	International classification of disease
JSON	Javascript object notation
LV	Left ventricle
LVEDD	Left ventricle end diastolic diameter
LVOT	Left ventricular outflow tract
LVPWD	Left ventricle posterior wall diameter
MR(I)	Magnetic Resonance (Imaging)
NYHA	New York Heart Association Heart Failure Classification
RV	Right ventricle
s/p	status post
STL	Stereolithography
STS	Society of Thoracic Surgeons Risk Score
TAVI	Transcatheter aortic valve implantation
WP	Working plan

8 ANNEX

The annex lists a current definition of the data characterising a Digital Patient. Since a key concept is that the digital patient definition evolves over time and therefor becomes an increasingly accurate representation of the individual, as new data is available (whether from new measurements on the patient or from new relevant population data) the following data definition tables might be subject to change.

8.1 Meta-Data

In addition to time-independent information the Digital Patient can store information from at least two distinct states, pre-operative and post-operative, and can include the results of computations at each of these time points.

Table 1: Meta-Data

Field Label	Field Name	Data Type	Code/Unit/Comment
Patient State	state	Character	{pre-op, post-op, modelled, [rest/exercise/characterisation, input/output, measured/ inferred]}
Date of patient record creation	creation_date	Date	YYYY-MM-DD

8.2 Demographics

Table 2: Demographics

Field Label	Field Name	Data Type	Code/Unit/Comment
Gender	gender	Character	{Male, Female}
Birth Date	dob	Date	YYYY-MM-DD
Age	age	Integer	[Years]
Height	height	Integer	[cm]
Weight	weight	Integer	[kg]
BSA	bsa	Double	Derived (Mosteller)
BMI	bmi	Double	Derived
Pregnancy	pregnancy	Boolean	{TRUE, FALSE}

8.3 Medication

Table 3: Medication

Field Label	Field Name	Data Type	Code/Unit/Comment
Beta Blocker	med_bb	Boolean	{TRUE, FALSE}
ACE-Inhibitors	med_ace	Boolean	{TRUE, FALSE}
ARB-Inhibitors	med_arb	Boolean	{TRUE, FALSE}
Statins	med_statin	Boolean	{TRUE, FALSE}
Loop Diuretics	med_diuretics_loop	Boolean	{TRUE, FALSE}
Diuretics others	med_diuretics_other	Boolean	{TRUE, FALSE}
Nitrate	med_nitrate	Boolean	{TRUE, FALSE}
Calcium Antagonists	med_ca_ant	Boolean	{TRUE, FALSE}
L-Thyroxine	Med_thyrocine	Boolean	{TRUE, FALSE}

8.4 Risk Factors

Table 4: Risk Factors

Field Label	Field Name	Data Type	Code/Unit/Comment
Extracardiac Arteriopathy	risk_paod	Boolean	{TRUE, FALSE}
Previous cardiac surgery	risk_reop	Boolean	{TRUE, FALSE}
COPD	risk_copd	Boolean	{TRUE, FALSE}
Active Endocarditis	risk_endocarditis	Boolean	{TRUE, FALSE}
Critical preoperative state	risk_critical	Boolean	{TRUE, FALSE}
Diabetes on Insulin	risk_iddm	Boolean	{TRUE, FALSE}
NYHA	risk_nyha	Integer	{1, 2, 3, 4}
CCS class 4	risk_ccs4	Boolean	{TRUE, FALSE}
Recent myocardial infarction	risk_recent_mi	Boolean	{TRUE, FALSE}
Previous myocardial infarction	risk_prev_mi	Boolean	{TRUE, FALSE}
Pulmonary Hypertension systolic > 60mmHg	risk_pht	Boolean	{TRUE, FALSE}
Urgency of Indication	risk_urgency	Character	{elective, urgent, emergency, salvage}
Surgery on Thoracic aorta	risk_aortic	Boolean	{TRUE, FALSE}
Frail	risk_frail	Boolean	{TRUE, FALSE}
s/p Coronary Bypass Surgery	risk_cabg	Boolean	{TRUE, FALSE}
s/p aortic valve replacement	risk_savr	Boolean	{TRUE, FALSE}

8.5 Diagnoses

A maximum of 20 main diagnoses will be allowed. Besides primary diagnoses this should allow coverage of all relevant co-morbidities

Table 5: Diagnoses

Field Label	Field Name	Data Type	Code/Unit/Comment
ICD Main Diagnosis	icd_main	Character	ICD10 code
ICD 2	icd_2	Character	ICD10 code
ICD 3	icd_3	Character	ICD10 code
ICD 4	icd_4	Character	ICD10 code
ICD 5	icd_5	Character	ICD10 code
ICD 6	icd_6	Character	ICD10 code
ICD 7	icd_7	Character	ICD10 code
ICD 8	icd_8	Character	ICD10 code
ICD 9	icd_9	Character	ICD10 code
ICD 2	icd_10	Character	ICD10 code
ICD 3	icd_11	Character	ICD10 code
ICD 4	icd_12	Character	ICD10 code
ICD 5	icd_13	Character	ICD10 code
ICD 6	icd_14	Character	ICD10 code
ICD 7	icd_15	Character	ICD10 code
ICD 8	icd_16	Character	ICD10 code
ICD 9	icd_17	Character	ICD10 code
ICD 2	icd_18	Character	ICD10 code
ICD 3	icd_19	Character	ICD10 code

8.6 Physiological and Laboratory Measurements

All pertinent laboratory measurements will be gathered. Data will be stored in a field "lab_values" encoded in a JSON format, specifying for each parameter the name, the unit and the measured value. The following list reflects the set of routinely measured values. As these might be given in differing units depending on clinical site, the unit will also be stored:

- Sodium
- Potassium
- Urea
- Estimated Glomerular Filtration Rate
- Glucose
- Cholesterol
- Haemoglobin
- Red Cell Count
- White Cell Count
- Platelets
- Haematocrit
- Mean Cell Volume
- Cystatin C
- Creatinine
- y-Gamma Transferase
- Glutamic-Oxalacetic Transaminase
- C-Reactive Protein
- Albumin
- Creatine Kinase
- Creatine Kinase MB
- Troponin T
- NT-proBNP
- Lactat-Dehydrogenase
- Thyroid stimulating hormone
- Renin concentration
- Angiotensin concentration
- Aldosterone concentration
- Estradiol concentration
- Dihydrotestosterone
- Blood group
- Rhesus factor

Table 6: Physiological and Laboratory Measurements

Field Label	Field Name	Data Type	Code/Unit/Comment
Arterial Blood pressure Systolic	rr_sys	Integer	[mmHg]
Arterial Blood pressure RR Diastolic	rr_dia	Integer	[mmHg]
Arterial Blood pressure RR Mean	rr_mean	Integer	[mmHg]
Forced inspiratory Vital Capacity	spiro_fvc	Integer	[mL]
Forced Expiratory 1 sec volume	spiro_fev1	Integer	[mL]
Tiffeneau Index	spiro_tiff	Integer	[%]
Sinus Rhythm	ecg_rhythm	Character	{Sinus, Atrial Fibrillation, Paced}
Conduction Branch Block	ecg_branch_block	Character	{none, lbbb, rbbb}
Conduction AV Block	ecg_av_block	Character	{none, AVBI, AVBIIa, AVBIIb, AVBIII}
Heart Rate	ecg_hr	Integer	[beats/minutes]
QRS Time	ecg_qrs	Integer	[msec]
QT Time	ecg_qt	Integer	[msec]
QTc Time	ecg_qtc	Integer	[msec]
Lab Values	lab_values	JSON	

8.7 Echocardiographic Measurements

Echocardiographic data is not available electronically in all centres in a structured data record, and it might be necessary to complete these data by individual file research in some cases.

Table 7: Echocardiographic Measurements

Field Label	Field Name	Data Type	Code/Unit/Comment
LV-EF	echo_lvef	Integer	[%]
RV-EF	echo_rvef	Integer	[%]
Tricuspid anular plane systolic excursion	echo_tapse	Integer	[mm]
LV-FS	echo_lvfs	Integer	[%]
LVEDD	echo_lvedd	Integer	[mm]
LVPWD	echo_lvpwd	Integer	[mm]
Aortic Valve dPmean	echo_dpmean	Integer	[mmHg]
Aortic Valve dPmax	echo_dpmax	Integer	[mmHg]
Aortic Valve Area	echo_ava	Double	[cm^2]
Aortic Valve Regurg.	echo_ai	Integer	{0,1,2,3,4}
Mitral Valve Regurg.	echo_mi	Integer	{0,1,2,3,4}
Mitral Valve Regurg. Pathology	echo_mi_class	Character	{degenerative, functional}
Mitral Valve Morphology	echo_mitral_morph	Character	{normal, prolapse, flail leaflet, ruptured papillary muscle}
Pulmonary Vein Flow	echo_pulmonary	Character	{systolic dominance, blunting, flow reversal}
Mitral Valve Vena contracta	echo_mi_vc	Integer	[mm]
Mitral Valve Pressure Half Time	echo_mi_pht	Integer	[msec]
Mitral Valve Effective Regurgitant Orifice Area	echo_mi_eroa	Integer	[mm^2]
Mitral Valve Regurgitation Volume	echo_mi_rvol	Integer	[mL/beat]
Left Atrial Area	echo_la_area	Integer	[cm^2]
Right Atrial Area	echo_ra_area	Integer	[cm^2]
Right Ventricular Systolic Pressure	echo_rvsp	Integer	[mmHg]
Doppler E-Wave	echo_pw_e	Double	[cm/sec]
Doppler A-Wave	echo_pw_a	Double	[cm/sec]
Tissue Doppler E-Wave	echo_td_e	Double	[cm/sec]
Tissue Doppler A-Wave	echo_td_a	Double	[cm/sec]
Tricuspid Valve Regurg.	echo_ti	Integer	{0,1,2,3,4}
Ascending Aorta Diameter	echo_asc_aorta	Integer	[mm]

8.8 CT Measurements

CT data is not available electronically in all centres in a structured data record, and it might be necessary to complete these data by individual file research in some cases.

Table 8: CT Measurements

Field Label	Field Name	Data Type	Code/Unit/Comment
Direct Measurements			
LV-EF	ct_lvef	Integer	[%]
Diameter Descending Aorta	ct_dia_desc_aorta	Integer	[mm]
Diameter Ascending Aorta	ct_dia_asc_aorta	Integer	[mm]
Diameter Bulbus	ct_dia_bulbus	Integer	[mm]
Diameter Valve	ct_dia_valve	Integer	[mm]
Calcification of Aorta	ct_calc_aorta	Integer	{none, few, significant}
Calcification of Valve	ct_calc_av	Integer	{none, few, significant}
Extension of the calcifications in the LVOT	ct_calc_lvot	Boolean	{TRUE, FALSE}
End diastolic interventricular septum thickness	ct_ivst	Double	[mm]
Minimal diameter of the right iliac artery	ct_iliac_right	Double	[mm]
Minimal diameter of the left iliac artery	ct_iliac_left	Double	[mm]
Calcifications of the femoral arteries	ct_iliac_ca	Character	{none, few, significant}
Tortuosity of the femoral arteries – Integer	ct_iliac_tort	Character	{none, few, significant}

CT Measurements (cont'd)

Field Label	Field Name	Data Type	Code/Unit/Comment
Measurements derived from segmentation			
Aortic valve area	ct_seg_ava	Double	[cm²]
Annulus circumference	ct_seg_ann_circ	Integer	[mm]
Annulus diameter	ct_seg_ann_diam	Integer	[mm]
LVOT diameter	ct_seg_lvot_diam	Integer	[mm]
Mid-sinus diameter	ct_seg_mid_sinus_diam	Integer	[mm]
Sinutubular junction diameter	ct_seg_stj_diam	Integer	[mm]
Mitral valve open area	ct_seg_mva	Double	[cm²]
Mitral valve annulus circumference	ct_seg_mitral_ann_circ	Integer	[mm]
Left ventricle volume at ED	ct_seg_lvved	Integer	[mL]
Left ventricle volume at ES	ct_seg_lvves	Integer	[mL]
Volume curve left ventricle	ct_seg_vc_lv	OrderedMap <Integer,Double>	{*TimePoint*, *Measurement*}
Left ventricle Ejection fraction	ct_seg_lvef	Integer	[%]
Cardiac output	ct_seg_co	Integer	[mL/min]
Myocardial mass	ct_seg_mass	Integer	[g]
Left atrium volume at ED	ct_seg_laed	Integer	[mL]
Left atrium volume at ES	ct_seg_laes	Integer	[mL]
Volume curve left atrium	ct_seg_vc_la	OrderedMap <Integer,Double>	{*TimePoint*, *Measurement*}

8.9 Operative Data

Table 9: Operative Data

Field Label	Field Name	Data Type	Code/Unit/Comment
Surgery	op_proc	Character	{SAVR, TAVR,MVRepair, MVReplace}
Access	op_access	Character	{Sternotomy, Hemisternotomy, Right anterior Thoracotomy, transapical, transfermoral, transaortic, transsubclavian}
Additional operation	op_additional	Character	free text field
CABG operation	op_cabg	Boolean	{TRUE, FALSE}
Other Valve operation	op_other_valve	Boolean	{TRUE, FALSE}
aortic valve size, mm	op_av_size	Integer	[mm]
biological aortic valve	op_valve_type_bio	Boolean	{TRUE, FALSE}
Modell of aortic valve	op_avr_model	Character	free text field
Cardioplegia	op_cardioplegio	Character	{Blood, Crystalloid}
Crossclamp Time	op_xclamp	Integer	[min]
Cardio-Pulmonary Bypass Time	op_cpb	Integer	[min]
Reperfusions Time	op_reperfusion	Integer	[min]
Postoperative pacemaker	op_post_pacer	Boolean	{TRUE, FALSE}
Procedure summary text	op_summary	Character	free text field
Procedural Sucess	op_success	Boolean	{TRUE, FALSE}
TAVI Anulus Rupture	op_tavi_anulus_rup	Boolean	{TRUE, FALSE}
TAVI Coronary Occlusion	op_tavi_coronary	Boolean	{TRUE, FALSE}
Cause of Failure	op_failure	Character	free text field
Procedural Death	op_death	Boolean	{TRUE, FALSE}

8.10 Computational Measures and Concepts

Table 10: Computational measures and concepts

Field Label	Field Name	Data Type	Code/Unit/Comment
Maximum LV Elastance	com_elvmax	Double	[mmHg/ml]
Minimum LV Elastance	com_elvmin	Double	[mmHg/ml]
LV Elastance Offset parameters	com_elvoff	OrderedMap < Double>	[p0 mmHg, V0 ml]
LV Elastance timing parameters	com_elvtimepar	OrderedMap < Double>	[Dimensionless, fraction]
Maximum Left Atrium Elastance	com_elamax	Double	[mmHg/ml]
Minimum Left Atrium Elastance	com_elamin	Double	[mmHg/ml]
Left Atrium Elastance timing parameters	com_elatimepar	OrderedMap < Double>	[Dimensionless, fraction]
Aortic Flow/dP characterisation	com_aQdP	OrderedMap < Double>	[Q l/min, dP mmHg]
Aortic Flow/dP characterisation coefficients	Com_aQdPcoeff	OrderedMap < Double>	[mixed]
Mitral Flow/dP characterisation	com_mQdP	OrderedMap < Double>	[Q l/min, dP mmHg]
Mitral Flow/dP characterisation coefficients	Com_mQdPcoeff	OrderedMap < Double>	[mixed]
Total Blood Volume	com_tbv	Integer	[ml]
Heart Rate	com_hr	Integer	[beats/minute]
Systemic resistance proximal	com_sysresprox	Double	[mmHg/ml]
Systemic resistance distal	com_sysresdis	Double	[mmHg/ml]
Systemic compliance	com_sysresdis	Double	[ml/mmHg]
Systemic Oxygen Consumption	com_O2_rate	Double	[ml/min]
Left ventricle volume at ED	com_lvved	Integer	[mL]
Left ventricle volume at ES	com_lvves	Integer	[mL]
Volume curve left ventricle	com_vc_lv	OrderedMap <Integer,Double>	{*TimePoint*, *Measurement*}
Left ventricle Ejection fraction	com_lvef	Integer	[%]
Cardiac output	com_co	Integer	[mL/min]
Barocontrol afferent signal parameters	com_baro_cp	OrderedMap <Double>	*{fmin [s^{-1}], fmax [s^{-1}], Pn [mmHg], kn [mmHg]}*
Barocontrol efferent sympathetic signal parameters	com_baro_es	OrderedMap <Double>	*{fes0 [s^{-1}], fesinf [s^{-1}], kes [s]}*

Field Label	Field Name	Data Type	Code/Unit/Comment
Barocontrol efferent vagal signal parameters	com_baro_ev	OrderedMap <Double>	*{fes0 [s^{-1}], fesinf [s^{-1}], kev [s]}*
Barocontrol regulation effectors	com_baro_reg	OrderedMap <Double>	*{gain, time constant and time delay for each effector: effectors to be determined (WP3)}*
LV-EF	com_lvef	Integer	[%]
RV-EF	com_lvef	Integer	[%]
Left atrium volume at ED	com_laed	Integer	[mL]
Left atrium volume at ES	com_laes	Integer	[mL]
Volume curve left atrium	com _la	OrderedMap <Integer,Double>	{*TimePoint*, *Measurement*}
Aortic Valve dPmean	com_dpmean	Integer	[mmHg]
Aortic Valve dPmax	com_dpmax	Integer	[mmHg]
Aortic Valve Regurg.	com_ai	Integer	{0,1,2,3,4}
Aortic Valve dPcurve	com_dp_curve	OrderedMap <Integer,Double>	{*TimePoint*, *Measurement*}
Mitral Valve Regurg.	com_mi	Integer	{0,1,2,3,4}
Mitral Valve Vena contracta	com_mi_vc	Integer	[mm]
Mitral Valve Pressure Half Time	com_mi_pht	Integer	[msec]
Mitral Valve Effective Regurgitant Orifice Area	com_mi_eroa	Integer	[mm^2]
Mitral Valve Regurgitation Volume	com_mi_rvol	Integer	[mL/beat]
Right Ventricular Systolic Pressure	com_rvsp	Integer	[mmHg]
Doppler E-Wave	com_pw_e	Double	[cm/sec]
Doppler A-Wave	com_echo_pw_a	Double	[cm/sec]
Left Ventricular Work	com_lvwork	Double	[Joules]
Left Ventricular Peak Power	com_lvwork	Double	[Watts]
Pulmonary Vein Flow	com_pulmonary	Character	{systolic dominance, blunting, flow reversal}
Tricuspid Valve Regurg.	com_ti	Integer	{0,1,2,3,4}

End