



# A Platform for DRG development with seamless integration of medical decision trees and cost calculation

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## Agenda

- **Background: The SwissDRG System**
- An In-House Built DRG Development Platform
- Example of a Development Step

## Since 2012, Hospitals reimbursed based on DRG System

- DRG system categorizes patients into ~1000 DRGs.  
Hospitals reimbursed by DRG-based flat rate.
- DRG system should cover **average** yearly costs of all Swiss hospitals  
⇒ maximize R2 (proportion of cost variance explained by DRG grouping)
- DRG system should make **sense in medical terms**  
transparent and comprehensible

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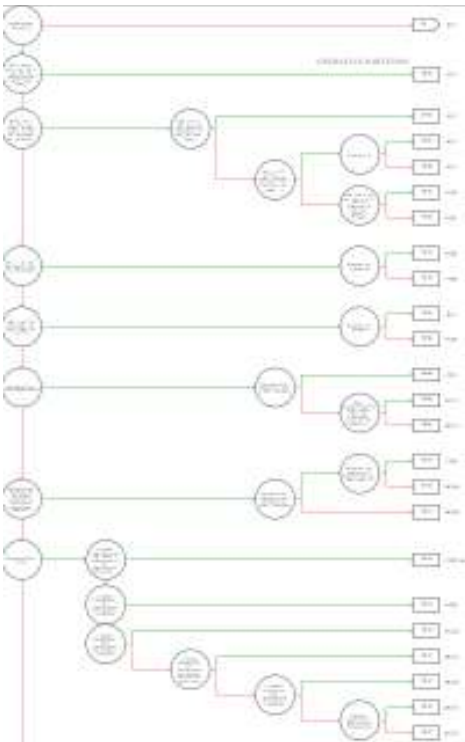
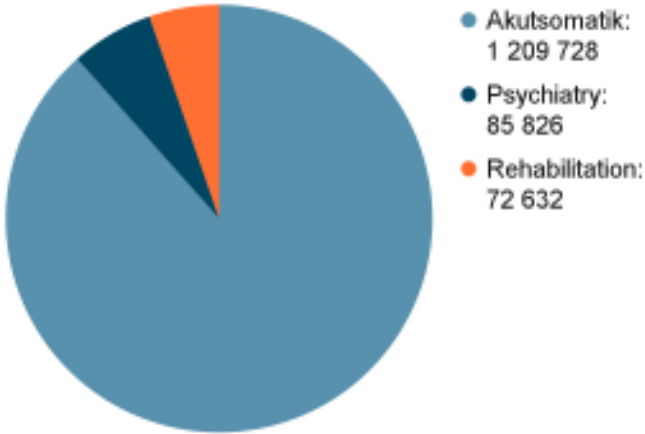
## DRG System Adapted Yearly

- ...to new diagnoses and procedures
- Change requests from the healthcare community must be evaluated and, if useful, integrated

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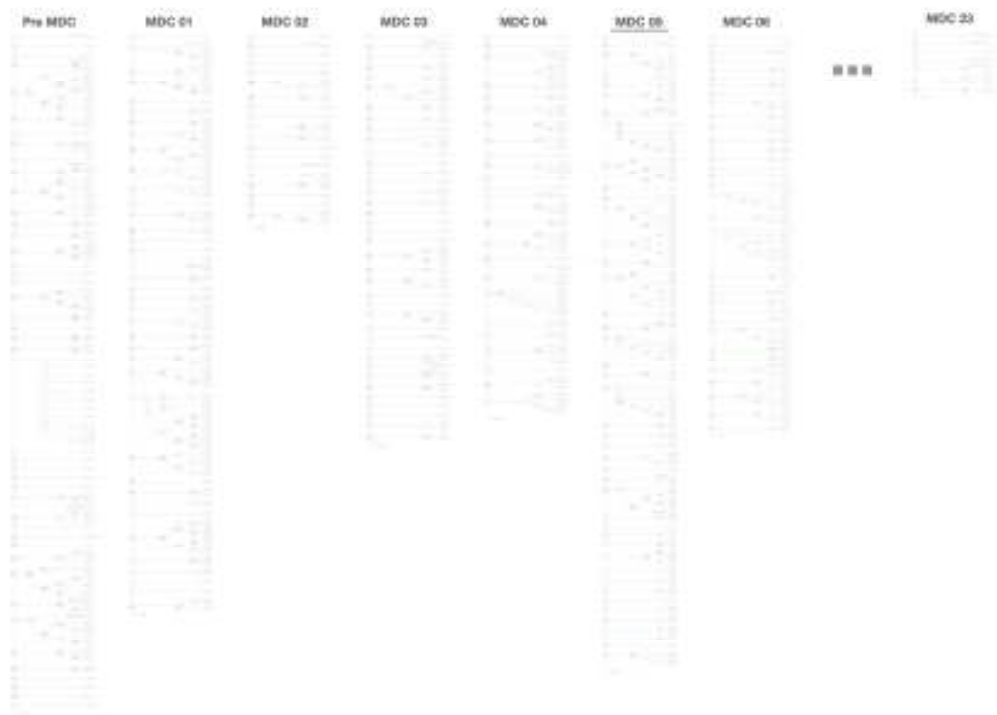
# SwissDRG System Based on all Hospitals' Patient Data

- Yearly data collection from most Swiss hospitals (**285** in 2021)



## Set of Rules as a Hierarchical Decision Tree

- Nodes with If-Then decisions with refined medical logics
- Leafs with DRGs



### Example DRG “F98A”

“Endovascular heart valve surgery, with aortocoronary bypass or intensive care complex treatment with > 196 /360 cost points.”



## Decision Nodes Contain Logical Expressions

“aortoconoral bypass *or* intensive care complex treatment with > 196/360 points”

**Aortokoronarer Bypass od. IntK > 196 / 360 Pkt.**

```
1 SRG IN TABLE(A02870RA)
2 OR SRG IN TABLES ((C02798N0, C02801N0))
```

SRG = “surgery”  
= any procedure

Logics can be nested or refer to functions which encapsulate other logic.

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## Motivation: New Medical Requirements

- Before 2020 SwissDRG Inc. has worked for almost 10 years with standalone Windows based system.
- To facilitate collaboration and cover new needs and gain flexibility to adapt to future needs of the medical development team, SwissDRG developed a tool in-house

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## Faster System Development

- Changes in the DRG system are evaluated immediately *within* the tool:
  - ⇒ integrated...
    - system development **and**
    - calculation with patient data

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## Higher Quality through Immediate Feedback

- A set of validations runs concurrently while editing; e.g.
  - table with invalid diagnosis codes
  - invalid logic expressions
  - invalid DRG names
- Users can tick off validations and comment on them.

Before: validation only at the end of a development cycle  
=> over 1000 warnings, many of them irrelevant

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## Validations: List Links to Problem Position

The screenshot displays a software development environment with a validation error. On the left, a project tree shows a folder structure for 'MDC 04' and 'MDC 05', with a sub-folder 'Eusdiagramm' containing a list of tables. The main area shows a diagram with nodes and arrows, including a red node with the text 'IstIK = 100 / Ist PRG. OD. kompl. Gefäße' and a green node with 'IstIK = 704 / Ist PRG. OD. Netz (kompl. OD.)'. A green arrow points from the red node to a box labeled 'F04Z' under the heading 'OPERATIVE PARTITION'. Another green arrow points from the green node to a box labeled 'F36A'. At the bottom, a validation error message is displayed: 'Fehler in Logikausdruck in MDC 05: Table <CO30210RSKIG> does not exist.' Below this message, a list of validation messages is shown, including 'Tabellen mit ungültigen Codes', 'Fehler in Logikausdrücken', 'Ungültige DRG oder MDC Namen', and 'Ungültige Fehleraktion für Variablen'. The error message is highlighted with a red background and a red icon, while the other messages have green backgrounds and icons.

## Monitoring: Machine Load; Automatic Replication



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## Example Overview

1. extend a rule system by adding a conditional split
2. group the patient data with the changed rule system
3. compare the differences between current and new grouping
4. calculate the new catalog
5. compare the catalog between current and new catalog

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## Extend a System by Adding a Conditional Split

Start: base DRG **F04**:

“Elaborate multi-stage procedures or complex vacuum treatment with existing intervention or tissue transplantation with microvascular anastomosis for diseases and disorders of the circulatory system”



## Adding the split



insert a new decision node  
and a new DRG

**Red:** missing logic, missing DRG name

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## Editor assists in writing correct logic expressions

Neue Entscheidung

Kommentar

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AGEYEARS

AGEYEARS  
AGEYEARS  
C023810R

Variablen	Operatoren	Tabellen	Funktionen
ADM_MODE Alphabetsgrund	ADRG () OHG ()	A0221NOB Anastomie karotidlogische Diagnostik	Bestimme_OR_Prozeduren EGWP
ADM_WT Alphabetsgewicht	IN TABLE () IN TABLES ()	A0226GRS Andere kardiothorakale Prozeduren	Clasise CNAL
ADT Antrittskosten	NOT IN TABLES ()	A0228ORA Grosse rekonstruktive Gefaessgefue	Eingriff_Mehrere_Lok FAL
AGEDAYS Alter	OR	A0231ORA Innere Gefaessgefue	Fruehstuf_14 FR 14
AGEYEARS Alter	EMPTY ()	A0233ORA Amputation ausser obere Extremitaet und Zehen	Fruehstuf_7 FR 7
ATE ATC Code	OPD2 IN ()	A0234ORA Amputation obere Extremitaet und Zehen	Geriatris_14 GR 14
BEWAERTUNG	MIN ()		
	MAX ()		
	MINUS		

Schliessen

Toggle Control Elements

The editor suggests existing function or variable or table names.

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## Editor checks syntax and semantics

```
1 AGEYEARS > 130
```

⚠ 3 1 of 1 problem

Value <130> is invalid for variable <AGEYEARS>. Valid values are: (0, 124)

Check happens *while* writing logical expressions.

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## Adding the split logic

### Neue Entscheidung

Kommentar

Kommentar

```
1 AGEYEARS > 96|
```

“age older than 96 (years)”

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## Name the new DRG



All elements affected by the change are marked.

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## Changes in Fitness Criteria

### Vergleiche

Neuer Vergleich...

▼ Vergleichsrechnung: swiss v130 kv v001 auf swiss v120 pv1\_2 v012 neue Egin Daten 2021 mit egln\_data2021\_mitANK\_20220701\_mitFZF.csv

Direkter Vorgänger

Rechnung öffnen

Modus	Delta R2 alle	Delta R2 inlier	Anzeige	Erstelldatum
<span style="background-color: #007bff; color: white; padding: 2px;">DYN</span>	0.00003786	0.00003804	<span style="color: #007bff;">DYN</span> <span style="color: #007bff;">DYN</span> <span style="color: #007bff;">🔗</span> <span style="color: #007bff;">⇌</span> (112)	09.09.2022 15:29

Difference in fitness criterion R2 (variance explained by the DRG grouping specified by this changed set of grouping rules)

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## Statistics of the Differences between the two Groupings

Rang	DRG	Fall- anzahl alle	Kosten Mw alle	Kosten Str alle	Kosten HK alle	Tagesk. MW alle	VWD Mw alle	Diffk. Mw alle	Fall- anzahl inlier	Kosten Mw inlier	Kosten Str inlier	Kosten HK inlier	Tagesk. MW inlier	VWD Mw inlier	VWD Str inlier	VWD HK inlier	Diffk. Mw inlier	O V M V	L- TP	H- TP
0	F04A	0	0	0	0.0%	0	0.00		0	0	0	0.0%	0	0.00	0.00	0.00		0	0	0
5	F04A	112	94000	40670	69.8%	2351	42.29		87	81639	30704	72.7%	2449	34.56	9.78	77.94		V	12	53
5	F04A	112	94000	40670	69.8%	2351	42.29	94000	87	81639	30704	72.7%	2449	34.56	9.78	77.94	81639			
5	F04Z	124	90973	40734	69.1%	2338	41.32		95	79083	30872	71.9%	2424	33.78	10.00	77.15		V	11	52
6	F04Z	12	62713	29971	67.7%	2215	32.25		8	53798	21267	71.7%	2161	26.50	12.13	68.60		A	10	47
1	F04Z	-112	-28260	-10763	-1.4%	-123	-9.07	94000	-87	-25285	-9605	-0.3%	-263	-7.28	2.13	-8.55	81408		-1	-5

Shows statistics of differences in number of patients, cost and length of stay:

- average
- standard deviation

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## Evaluate shifted patient cases

DRG-Verschiebungen: 112



Which patients  
"moved" into  
new DRG  
"F04A"?

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## Examine individual shifted patients

Patienten pro Seite: 100 | Update

AMN	NR	Verfahrsnr	Medikationstypologie	Geschlecht	Alter in Tagen	Alter in Jahren	Aufnahmegrund	Geräte-ADR in %	Intensivstation	ICU	Erstattung der Aufnahmepflicht für DRG	Internist. Care	HNW	Aufnahmestufe	Klassierungsart	LOS	MDC	DRG	Kosten	PCLL	GEF	Standardkosten	Tagekosten	Hauptdiagnose
3000480	Karlsruhe	K112	Male	38			0						Normal	Normal	31.00	05	FD2	1110	4	7.525	4815.90	208.79	E1175	
3000481	Klinik	K112	Male	73			00	304				0	Normal	Normal	30.00	05	FD2	1110	3	7.525	11300.05	2272.14	E1174	
3000482	Schulmer	K112	Female	32			0		8	8	0	0	Normal	Normal	18.00	05	FD2	1110	3	7.525	2801.88	2042.11	E1220	
3000483	Schulmer	K112	Male	62			0		8	8	0	0	Normal	Normal	31.00	05	FD2	1110	4	7.525	5892.80	1029.10	E1175	
3000484	Hirtenberg	K112	Male	78			0						Normal	Normal	33.00	05	FD2	1110	3	7.525	6301.84	1020.00	E1174	
3000485	Perle	K112	Female	32			48	189				18	Normal	Normal	21.00	05	FD2	1110	5	7.525	6006.71	3180.00	E1175	

Drill down into database to examine individual shifted patient cases

## Catalog: Statistics per DRG

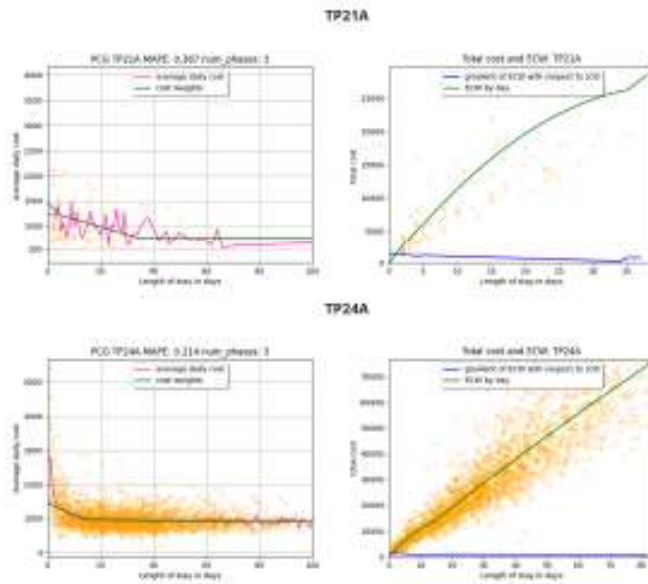
### Katalog

Kennzahlen							Katalog							Grafiken						
PCG	nr_cases	n_cases_tr_out	n_hosp	avg_costs	med_costs	std_costs	DMI	CM	r2	IG	MAPS	MRI	KMI	med_KI						
Egln	63075	3487	62	25333	18093	26870	1.800	32.945	0.575	798.947	0.215	4688	5499	0.178						
TP21A	135	10	27	17793	13277	15363	1.786	23.148	0.776	873.487	0.367	5098	7302	0.080						
TP21B	6940	501	46	17322	12197	17530	0.967	23.526	0.882	743.472	0.302	2958	6016	0.080						

DMI: Day Mix Index  
 CM: Case Mix Index

Based on the changed rule system, a catalog with new cost-weight was calculated. Using this new catalog, cost and demographic statistics were calculated.

## Catalog diagrams



Diagrams show average cost and compensation, given this catalog.

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## Conclusion

We developed an infrastructure that allows...

- graphical manipulation of system rules AND quick simulation of the effects - all the way to generating cost weights per DRG and calculating case mix indices for all patients.
- quick adaptation of the system, e.g. in case of pandemics
- implementation of new features based on user requirements within 2-4 weeks

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## Join us for the **Live Demo**

Join us for a demo (and a drink):  
**today 17:30 in Room “D”**

**We are happy to answer your questions:**

Lukas Nick: [lukas.nick@swissdrg.org](mailto:lukas.nick@swissdrg.org)

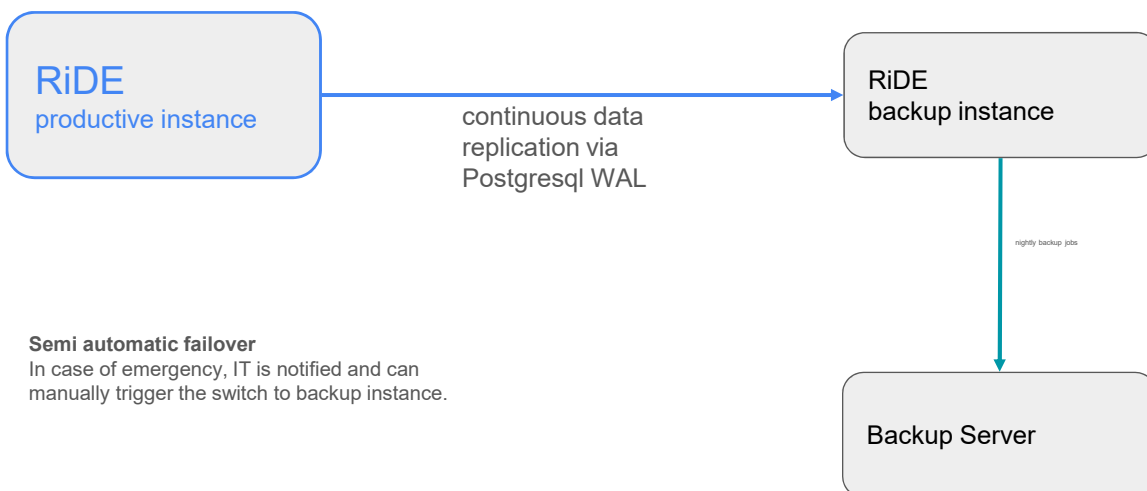
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- Since 2012: patients categorized (grouped) into DRGs
- Comprehensive flat rate as an objective: DRG valuation (cost weights) includes operating costs as well as costs for infrastructure
- Reimbursement mechanism:  
Individual baserate x Cost weight (of DRG catalogue) + additional payments = payment per hospitalized patient (inpatient case) = flat rate
- Hospital financing mechanism: sum of flat rates (of inpatient cases) + payment for community services

## Continuous Mirroring and Backup





Monitoring:  
Application  
Performance

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Group patient set  
with updated rules,  
calculate statistics

“Egin”: patient data set

**Arbeitsbereich SaHä v50 kv v001 auf tarpsy v50 kv v015 rechnen**

**EGIN:**  
 egin\_tarpsy2021-withAnk-20220712109\_36\_18Z.csv

**Erweiterte Optionen (R2)**

**Inlier Filter:** inlier\_filter\_config\_nullr2conf  
**OVMV Konfiguration:** ovmv\_config\_nullr2conf  
**High Tripoint Konstante:** 17

**Arbeitsbereich abschliessend anpassen:**

**Titel:**  
 neu TP70A für LOS>90

**Beschreibung:**  
 TP70 gesplittet aufgrund LOS>90 => TP70A

**Festgelegte Grupperversion:**  
 1.4.1

**Katalog-Berechnung anpassen:**  
 Katalog berechnen

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# Catalog with fitness statistics

## Katalog

Kennzahlen **Katalog** Grafiken

MAPE	RMSE	Correlation Coefficient	Bezugsgrösse
0.2139406614411579	9443.942641463724	0.9363332071383937	768.9465195139311

PCG	mape	num_cases	num_phases	norm_factor	regpt_1	regpt_2	regpt_3
TP21A	0.318	215	3	1	1	7	62
TP21B	0.201	5913	3	1	1	8	80

- Overall fitness statistics (for entire patient set)
- Fitness statistics per DRG

# Technology

