Wolfram Fischer

Base-DRGs, Fractionation Coefficient and Treemaps for the Assessment of the Relative Clinical Homogeneity of DRG Systems

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Contents

1 Abstract

This study complements the customary statistical homogeneity analyses (i. e. the computation of achievable variance reduction and the remaining dispersion within DRGs) by means of a comparison of DRG systems on the level of base DRGs. Introduction

The study is based on 900,000 records from Swiss hospitals from the years 2000 to 2003. The records were selected according to quality criteria. Data

Pair comparisons were conducted to try to compute the divergence in the assignment of base DRGs of the AP-DRG, APR-DRG, AR-DRG, IR-DRG systems among each other, and for individual evaluations also according to SQLape, LDF and CCS, and to represent the results graphically. For this purpose, a so-called "fractionation coefficient" was developed. Visualisation was effected on the basis of treemaps. Method

The study yielded the following results: the actual DRG systems (AP, APR, AR, IR) partially display similar grouping concepts in the medical sphere. In this respect, the greatest similarities exist between AP and APR, and between IR and APR. In the surgical sphere, AP and, to a lesser extent, AR were found to have some common features with APR; apart from this, it became apparent that the surgical base DRGs are more diverse in their make-up than medical base DRGs. The most conspicuous differences were discovered between the surgical base IR DRGs and the surgical base DRGs of the other DRG systems. Results

In order to be able to compare the SQLape categories with the base DRGs in spite of the differing construction approach, the SQLape code of the main treatment was established for each individual hospital case. In addition, some analyses were also conducted with the help of the primary SQLape codes computed by the manufacturer. Correspondence with the other systems was relatively low. However, the different perspective also can serve to detect deficiencies in the DRG systems.

In comparison with the CCS classification, which is also based on a diverging concept, all the systems showed great differences, with the surgical SQLape main treatment categories being the exception.

The definitions of a great number of base DRGs are distinctly different in the systems under scrutiny. With regard to the choice of a DRG system, this means that it is not merely a licenser and a cooperation model that are chosen, but at the same time also a certain way of viewing clinical treatment. Conclusions

2 Introduction

2.1 Starting point

A DRG system for Switzerland

One of the tasks of the SwissDRG project[1] is to select a national DRG system for Switzerland. It is to be expected that the first step will consist in making an existing system compatible with the coding systems used in Switzerland. Subsequently, the system will be subjected to adaptation and corrections with a view to making it usable in Switzerland.

System assessment

It is necessary that both the selection of, and any later modifications to, such a system should be based not only on economic calculations but also on substantial clinical analyses.

Commission

In view of the system selection, SwissDRG commissioned the Zentrum für Informatik und wirtschaftliche Medizin (ZIM) to compare selected DRG systems (APR-DRG, AR-DRG, IR-DRG; SQLape) on the basis of the base DRGs. The study thus conducted[2] was then extended by ZIM. This paper presents the state of the work done to date.

2.2 Relative clinical homogeneity

Economic homogeneity

Examinations of DRG systems usually apply statistical homogeneity analyses, such as the computation of variance reduction in respect of length of stay or of costs, or the calculation of the remaining dispersion of these variables within DRGs. Calculations of this type serve to examine economic homogeneity: the dependent variable that is meant to be explained by the DRG classification is a variable that can be or has been valued in monetary terms. A DRG is economically homogeneous if the costs of the cases assigned to this DRG are similar.

Clinical homogeneity

The assessment of clinical homogeneity focuses on the question as to whether syndromes and/or treatments of patients that are assigned to the same DRG, are similar. This question is less easy to answer by means of statistical methods. The measure of correspondence between existing diagnosis and/or procedure codes might be able to provide a pointer but will remain unreliable since some codes differentiate more strongly than others and also since hospital cases of a similar type may be represented equally correctly with differing code combinations.

Relative clinical homogeneity

As a way out of this situation, an attempt was now made, not to assess clinical homogeneity as such, but to compare the classification of hospital cases in different DRG systems with each other. The more concordant the concentration of hospital cases in individual DRGs, the greater the "relative clinical homogeneity".

[1] http:// www.swissdrg.org /.
[2] Fischer [Basis-DRG-Vergleiche, 2005].

3 Data

3.1 DRG systems taken into account

The following patient classification systems[3] were examined: DRG systems

- AP-DRG-CH: All Patient Diagnosis Related Groups (Hersteller: 3M, USA).[4]
- APR-DRG 15: All Patient Refined Diagnosis Related Groups (3M, USA).[5]
- AR-DRG 5: Australian Refined Diagnosis Related Groups (Australien).[6]
- IR-DRG 2005: International Refined Diagnosis Related Groups (3M, USA).[7]

In a number of evaluations, the following additional reference systems were used: Additional systems

- SQLape 2005: Striving for Quality Level and Analysis of Patient Expenditures (Sqlape, Schweiz).[8]
- LDF 2005: Leistungsbezogene Diagnosen-Fallgruppen (Österreich).[9]
- CCS: Clinical Classification Software (USA).[10]

Compared to established DRG systems, the SQLape system uses a different classification concept. As in DRG systems, only one cost weight results for each hospital case. Yet the SQLape system functions with a number of patient groups which is clearly lower than the number of DRGs in DRG systems, that is to say with only about 350 SQLape groups compared with 640 to more than 1200 DRGs. This is possible because only treatments and diseases are represented by SQLape groups but not severity degrees. Instead of severity categories (e. g. DRGs with or without CC) more than one SQLape group can be assigned to one hospital case. Furthermore, the main diagnosis does not decide the primary attribution of a DRG, but it is used the same way as all secondary diagnoses. SQLape

All the hospital cases in the database were grouped according to the mentioned patient classification systems by Hervé Guillain and Dung Duong of the CHUV (Centre hospitalier universitaire vaudois, Lausanne). Grouping

3.2 Database

The database that was used contains just over 900,000 cases from the years 2000 to 2003. There are data from the Swiss APDRG Association[11] as well as the data sets additionally made available to the SwissDRG project[12] by the Swiss Federal Statistical Office (SFSO). Data base
▶ Table 1

The data from the Swiss APDRG Association come from the hospitals of the CHUV and individual hospitals in the Cantons of Ticino, Valais and Neuchâtel from the years 2000 to 2003. AP-DRG-CH data

The SFSO data come from hospitals all over Switzerland from the years 2002 and 2003, with the SFSO selecting the data of those hospitals in the survey of medical statistics[13] which satisfied the following quality criteria:[14] SFSO data

[3] Vgl. Fischer [PCS, 1997].
[4] APDRG-CH [CW 4.1, 2003]; 3M [AP-DRG-CH, 1998].
[5] http:// www.3m.com / us / healthcare / his / products / coding / refined_drg.jhtml.
[6] http:// www.health.gov.au / casemix /.
[7] Vgl. Mullin et al. [IR-DRG, 2002].
[8] http:// www.sqlape.com /.
[9] BMGF-A [LKF05-Modell, 2004]; http:// www.bmgf.gv.at / cms / site / themen.htm ? channel=CH0005.
[10] http:// www.ahrq.gov / data / hcup / ccsicd10.htm. Vgl. auch Zahnd [CCS, 2004]; Zahnd [CCS, 2003].
[11] http:// www.apdrgsuisse.ch /.
[12] http:// www.swissdrg.org /.
[13] BFS-CH [Medizinische Statistik, 1997].
[14] Schwab/Meister [CMI, 2004]: 15.

Table 1:
Data according to years and hospital types

Hospital type	2000	2001	2002	2003	SUMME	in %
From AP-DRG-CH survey	70319	56949	68593		195861	21.75
K111 University hospitals			89971	95417	185388	20.59
K112 Central hospitals			84790	87744	172534	19.16
K121 Regional hospitals level 3			68738	81796	150534	16.72
K122 Regional hospitals level 4			76776	87833	164609	18.28
K123 Regional hospitals level 5			12705	12928	25633	2.85
K232 Special gyn./neonat. clinics			2874	3039	5913	0.66
sum	70319	56949	404447	368757	900472	100.00
in %	7.81	6.32	44.92	40.95	100.00	

- The case figures between medical and administrative statistics differ by no more than 5 %.
- More than an average of 2.2 diagnoses per case are available.

The number of hospitals involved cannot be detected from the data supplied.

The mean length of stay was 8.2 days. The median was located at 6 days, the first quartile at 3, the third quartile at 10 days.[15]

Selection of the main procedure

In the SFSO data, the main procedure was already encoded as such. Since this was not the case with the data from the Swiss APDRG Association, Guillain and Doung from the CHUV determined the hospital cases for the main procedure as follows:[16]

1. That code was selected from among the procedure codes which would be recognised as an surgical code by the DRG grouper and which influences DRG assignment.
2. Failing that, that code was selected from the procedure codes which influences DRG assignment.
3. Failing that, that code was selected from the procedure codes which would be recognised as an surgical code by the DRG grouper.
4. Failing that, the first existing procedure code was selected.

[15] In Switzerland, length of stay is calculated by counting both the day of admission and the day of discharge.

[16] According to an e-mail from Hervé Guillain, CHUV, dated 20 April 2005.

4 Methods

4.1 The Definition of "base DRGs"

Base DRGs (base groups, adjacent DRGs) result from the combination of the adjacent DRGs without splits by complications and comorbidities and/or age groups.[17]

Proposed definition

The following definition would be more differentiated: in a DRG system, those patient groups are labelled "base DRGs" which can be distinguished according to main diagnoses and procedures but not according to any of the following split criteria:

- CC (comorbidities and complications).
- Age.
- Type "complicating diagnosis".
- Type "complicating procedure".
- With/without death during hospital stay.
- Reason for discharge: against medical advice.
- Transfer within a given period of time.
- Possibly certain procedures (such as AP-DRG 411/422 with/without endoscopy).
- AP-MDC 15: possibly birth weight and/or significant procedures.
- AP-MDC 24: possibly with/without tuberculosis (DRGs for HIV patients).
- AP-MDC 24: possibly type of associated diagnoses.

Annotations:

- In the AR-DRG system, the base DRGs are known and can be encoded. (The first three characters of the code designate the base AR-DRG.) In the RDRG, APR-DRG, IR-DRG, LDF, EfP (from GHM), as well as in SQLape, the base DRGs are also designated and encoded. In these systems, it would have to be examined whether and to what extent the predefined base DRGs fit the above definition.
- In the G-DRG system 2005, the concept of base DRGs initially taken over from the AR-DRG system was broken up for the purpose of avoiding a conflict with procedure hierarchy.[18] The base G-DRGs can still be determined; however, this is no longer done on the strength of the G-DRG codes but on the basis of an analysis of the G-DRG label.
- Draft lists of AP-DRGs and base AR-DRGs can be found in Fischer [DRG+Pflege, 2002].[19]

For this study: adoption of the manufacturers' base DRG definitions

With one single exception, the DRG systems analysed in this study already had base groups labelled by the manufacturer. For financial reasons, these base groups were adopted without any further analysis.

Only the AP-DRG system was not equipped with a labelled list of base groups. For the determination of the base AP-DRGs, the data were only grouped according to main diagnosis and main procedure. To identify the base AP-DRGs, the AP-DRG codes were preceded by an "A-" (for "adjacent").

Determination of the SQLape category of the main treatment: "SQp"

In order to be able to conduct 1:1 comparisons between SQLape categories and DRGs, the SQLape procedure category that the system returned when only the main diagnosis and the main procedure were grouped, was used as the base group; if no SQLape

[17] Fischer [DRG-Systeme, 2000]: 27, on the basis of the "adjacent DRGs" ("ADRGs") defined in the RDRG and APR-DRG systems. – Cf. Freeman JL et al. [1991]: 63 ff.
[18] Cf. among others the example in Roeder et al. [G-DRG 2005 (II), 2004]: 1022 f.
[19] AP-DRG: Fischer [DRG+Pflege, 2002]: 327-367. AR-DRG: Fischer [DRG+Pflege, 2002]: 368-423.

procedure category existed, use was made of the SQLape diagnosis category returned. This patient category was called "SQLape main treatment category". The abbreviation "SQp" was used.

Primary SQLape category: "SQ1"

In the course of the work done on the study, the manufacturer defined the first SQLape category as the primary SQLape category, which also increased comparability with DRG systems. It must be borne in mind, however, that in approximately 20 % of all hospital cases[20], further SQLape categories are assigned besides this primary SQLape category. (DRG systems utilise a ranking according to degrees of severity [CC categories], which is less differentiated.)

4.2 Standardisation of the major diagnostic categories

Common base of MDCs
▶ Table 2

In order to have a common classification for the system comparisons, the major diagnostic categories of the individual patient classification systems were numbered and designated in a standardised manner. The major AP-DRG diagnostic categories served

[20] In the data used, 18.7 % of the hospital cases were grouped with more than one SQLape category: 13.4 % of the cases were encoded with two SQLape categories, 3.1 % with three, and the remaining 1.1 % with more than three.

Table 2: Standardised major diagnostic categories

Code	Short Label	Label
00’	Outpat.	Outpatient Treatments
01’	Nerves	Nervous System
02’	Eye	Eye
03’	ENT	Ear, Nose, Mouth, and Throat
04’	Respir.	Respiratory System
05’	Circul.	Circulatory System
06’	Digest.	Digestive System
07’	Hep+P	Hepatobiliary System and Pancreas
08’	MuscTs	Musculoskeletal System and Connective Tissue
09’	Skin	Skin, Subcutaneous Tissue, and Breast
10’	Endocr.	Endocrine, Nutritional, and Metabolic Diseases and Disorders
11’	Kidney	Kidney and Urinary Tract
12’	Male	Male Reproductive System
13’	Female	Female Reproductive System
14’	Birth	Pregnancy, Childbirth, and Puerperium
15’	Neonat.	Newborns and Other Neonates
16’	Blood	Blood and Blood Forming Organs and Immunological Disorders
17’	Neopl.	Myeloproliferative Diseases and Disorders, and Poorly Diffenerentiatad Neoplasms
18’	Infect.	Infectious and Parasitic Diseases
19’	Mental	Mental Diseases and Disorders
20’	Drug	Alcohol/Drug Use and Alcohol/Drug Induced Organic Mental Disorders
21’	Trauma	Injuries, Poisoning, and Toxic Effect of Drugs
22’	Burns	Burns
23’	Div.Fac	Factors Influencing Health Status and Other Contacts with Health Services
24’	HIV	Human Immunodeficiency Virus (HIV) Infections
25’	Polytr.	Multiple Significant Trauma
91’	Trp+Trc	Transplantations and Tracheostomies
92’	Day1	Death and Transfer Within One Day
99’	Error	Unclassifiable

for the reference classification. The groups additionally defined by the Swiss APDRG Association and the groups of exceptional and unclassifiable cases were renumbered. For purposes of identification, an apostrophe (’) was placed behind each code number of the standardised system.

AR subcategory types

In the AR-DRG system, three major diagnostic subcategory types are defined: "surgical", "medical" and "others". The subcategory type "others" contains the AR-DRGs which are derived from non operating room procedures. With regard to the common analysis, these AR-DRGs have been merged with the "surgical" subcategory type.

4.3 Fractionation coefficient

Assessment of the fragmentation of a base DRG

By way of measurement for the assessment of the fragmentation of the base groups within a DRG system, a so-called "fractionation coefficient" was developed. The higher the fractionation coefficient, the more strongly a base DRG of the "original" system to be assessed is divided up among different base groups of the reference system. To compute the fractionation coefficient for each base DRG_g of the original system, the proportional distribution of the cases among the base $DRGs_h$ of the reference system is determined. The greater these proportions, the less they contribute towards the fragmentation. For this reason, the differences between these proportions and 1 were calculated. These differences were then weighted and summed up. The weights used were the proportions themselves since the more cases were assigned to an identical base DRG_h, the higher the relative influence of these cases on the measure of fragmentation.

f_g : fractionation coefficient per base DRG

In mathematical terms, this looks as follows: A base DRG_g from the original system G is represented in the h-indexed base DRGs of the reference system H. p_{gh} designates the proportion of the cases from base DRG_g which were classed in base $DRGs_h$ of the reference system. The fractionation coefficient is calculated as follows:

$$f_{g|H} = \sum_{h \in H} (1 - p_{gh}) p_{gh} \qquad \text{with} \qquad \sum_{h \in H} p_{gh} = 1$$

or more simply:

$$f_{g|H} = 1 - \sum_{h \in H} (p_{gh})^2$$

Examples

▶ Table 3

A few examples may serve as explanations:

- First example: all the cases that have been assigned to a certain base DRG_g of the original system are represented in one single base DRG_h in the reference system. Such a 1:1 representation results in a fractionation coefficient of:
  $f = 1 - 1^2 = 0$.
- Second example: the cases that have been assigned to a base DRG_g are represented in two different base $DRGs_h$ in the reference system in proportions of 90 % and 10 %. This results in a fractionation coefficient of:
  $f = 1 - (0.9^2 + 0.1^2) = 0.18$.

Table 3: Calculation examples for fractionation coefficients

Distribution	Nb. of groups	Result	Distribution	Nb. of groups	Result
100 %	1	0.000	67, 22, 11 %	3	0.490
99, 1 %	2	0.020	50, 50 %	2	0.500
98, 1, 1 %	3	0.039	50, 33, 17 %	3	0.612
90, 10 %	2	0.180	33, 33, 33 %	3	0.667
80, 20 %	2	0.320	10, . . ., 10 %	10	0.900
80, 13, 7 %	3	0.338	1, . . ., 1 %	100	0.990
67, 33 %	2	0.442	0.1, . . ., 0.1 %	1000	0.999

- Third example: the cases that have been assigned to a base DRG_g are represented in three different base $DRGs_h$ in the reference system in proportions of 80 %, 13 % and 7 %. This results in a fractionation coefficient of:
  $f = 1 - (0.8^2 + 0.13^2 + 0.07^2) = 0.34$.
- Fourth example: the cases that have been assigned to a base DRG_g are represented in two different base $DRGs_h$ in the reference at a ratio of 50:50. This results in a fractionation coefficient of:
  $f = 1 - (0.5^2 + 0.5^2) = 0.5$.

F_G : Average fractionation coefficient of a DRG system

To assess the correspondence between the representation of all the cases from a original system G and in a reference system H, a weighted average fractionation coefficient was computed. The case numbers n per base DRG_g served as weights:

$$F_{G|H} = \frac{\sum_{g \in G}(n_g f_{g|H})}{\sum_{g \in G} n_g}$$

4.4 Treemaps

Treemaps for the representation of entire DRG systems

By means of the treemaps[21] generated in this study, all the base DRGs of a DRG system are printed on one single page. Each box represents one base DRG. The size of the boxes reflects the proportion of cases it represents. In this way, it points out the quantitative relevance of the base DRGs depicted.

↑ Example: Table 13 (p. 22)

The first treemap variant shows the fractionation coefficient of the representation of each base DRG of the original system in the reference system by means of the values indicated and the colours of the boxes.

↑ Example: Table 15 (p. 25)

A second treemap variant was developed which has higher degree of differentiation: In the case of each base DRG, it can be seen now to which alternative base DRGs of a reference classification system it has been assigned.

[21] Cf. Fischer [KH-Vergleiche, 2005]: 113 ff; Shneiderman [Treemaps, 1992].

5 Results

5.1 Number of base groups and number of case groups

To compare the number of groups, the major diagnostic categories of the individual DRG systems were numbered and labelled in a standardised manner.

Standardisation of the major diagnostic categories of DRGs
↑ p. 7

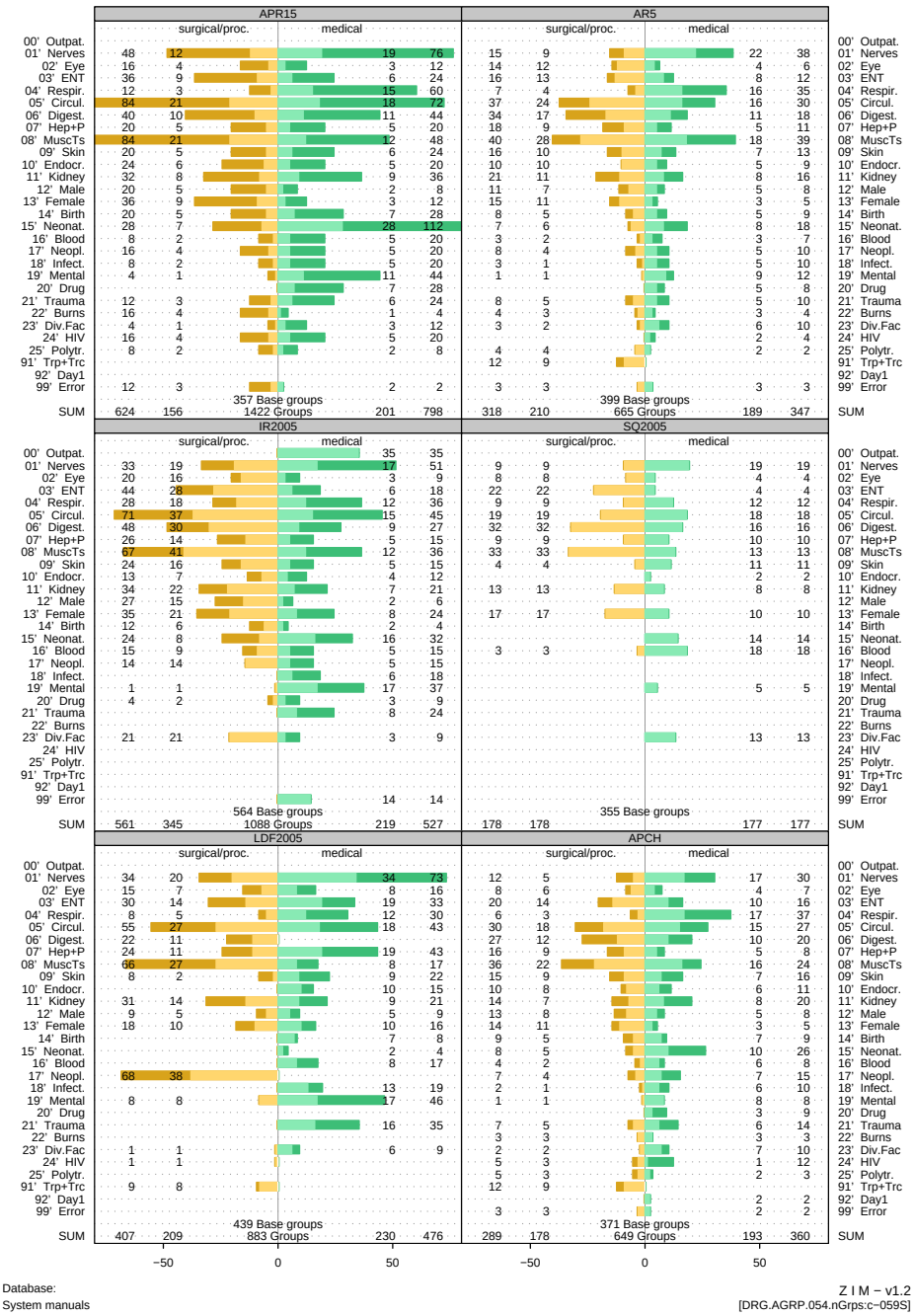


Table 4: Number of DRGs and base DRGs according to major diagnostic categories and subcategory types

Table 5: Number of DRGs and base DRGs of each major diagnostic category according to the DRG system and subcategory types

	00' Outpat.				01' Nerves				02' Eye				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15					48	12	19	76	16	4	3	12	APR15
AR5					15	9	22	38	14	12	4	6	AR5
IR2005			35	35	33	19	17	51	20	16	3	9	IR2005
SQ2005					9	9	19	19	8	8	4	4	SQ2005
LDF2005					34	20	34	73	15	7	8	16	LDF2005
APCH					12	5	17	30	8	6	4	7	APCH

	03' ENT				04' Respir.				05' Circul.				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	36	9	6	24	12	3	15	60	84	21	18	72	APR15
AR5	16	13	8	12	7	4	16	35	37	24	16	30	AR5
IR2005	44	28	6	18	28	18	12	36	71	37	15	45	IR2005
SQ2005	22	22	4	4	9	9	12	12	19	19	18	18	SQ2005
LDF2005	30	14	19	33	8	5	12	30	55	27	18	43	LDF2005
APCH	20	14	10	16	6	3	17	37	30	18	15	27	APCH

	06' Digest.				07' Hep+P				08' MuscTs				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	40	10	11	44	20	5	5	20	84	21	12	48	APR15
AR5	34	17	11	18	18	9	5	11	40	28	18	39	AR5
IR2005	48	30	9	27	26	14	5	15	67	41	12	36	IR2005
SQ2005	32	32	16	16	9	9	10	10	33	33	13	13	SQ2005
LDF2005	22	11			24	11	19	43	66	27	8	17	LDF2005
APCH	27	12	10	20	16	9	5	8	36	22	16	24	APCH

	09' Skin				10' Endocr.				11' Kidney				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	20	5	6	24	24	6	5	20	32	8	9	36	APR15
AR5	16	10	7	13	10	10	5	9	21	11	8	16	AR5
IR2005	24	16	5	15	13	7	4	12	34	22	7	21	IR2005
SQ2005	4	4	11	11			2	2	13	13	8	8	SQ2005
LDF2005	8	2	9	22			10	15	31	14	9	21	LDF2005
APCH	15	9	7	16	10	8	6	11	14	7	8	20	APCH

	12' Male				13' Female				14' Birth				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	20	5	2	8	36	9	3	12	20	5	7	28	APR15
AR5	11	7	5	8	15	11	3	5	8	5	5	9	AR5
IR2005	27	15	2	6	35	21	8	24	12	6	2	4	IR2005
SQ2005					17	17	10	10					SQ2005
LDF2005	9	5	5	9	18	10	10	16			7	8	LDF2005
APCH	13	8	5	8	14	11	3	5	9	5	7	9	APCH

	15' Neonat.				16' Blood				17' Neopl.				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	28	7	28	112	8	2	5	20	16	4	5	20	APR15
AR5	7	6	8	18	3	2	3	7	8	4	5	10	AR5
IR2005	24	8	16	32	15	9	5	15	14	14	5	15	IR2005
SQ2005			14	14	3	3	18	18					SQ2005
LDF2005			2	4			8	17	68	38			LDF2005
APCH	8	5	10	26	4	2	6	8	7	4	7	15	APCH

	18' Infect.				19' Mental				20' Drug				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	8	2	5	20	4	1	11	44			7	28	APR15
AR5	3	1	5	10	1	1	9	12			5	8	AR5
IR2005			6	18	1	1	17	37	4	2	3	9	IR2005
SQ2005							5	5					SQ2005
LDF2005			13	19	8	8	17	46					LDF2005
APCH	2	1	6	10	1	1	8	8			3	9	APCH

	21' Trauma				22' Burns				23' Div.Fac				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	12	3	6	24	16	4	1	4	4	1	3	12	APR15
AR5	8	5	5	10	4	3	3	4	3	2	6	10	AR5
IR2005			8	24					21	21	3	9	IR2005
SQ2005											13	13	SQ2005
LDF2005			16	35					1	1	6	9	LDF2005
APCH	7	5	6	14	3	3	3	3	2	2	7	10	APCH

	24' HIV				25' Polytr.				91' Trp+Trc				
	surgical/proc.		medical		surgical/proc.		medical		surgical/proc.		medical		
APR15	16	4	5	20	8	2	2	8					APR15
AR5			2	4	4	4	2	2	12	9			AR5
IR2005													IR2005
SQ2005													SQ2005
LDF2005	1	1							9	8			LDF2005
APCH	5	3	1	12	5	3	2	3	12	9			APCH

	92' Day1				99' Error				
	surgical/proc.		medical		surgical/proc.		medical		
APR15					12	3	2	2	APR15
AR5					3	3	3	3	AR5
IR2005							14	14	IR2005
SQ2005									SQ2005
LDF2005									LDF2005
APCH			2	2	3	3	2	2	APCH

−50 0 50 −50 0 50

Database:
System manuals

Z I M − v1.2
[DRG.AGRP.054.nGrps:s−059S]

Key to the graphs

▶ Tables 4 and 5

The graphic representation of the count of DRGs and base DRGs was effected in two different ways: once according to DRG systems, and once according to the DRG's major diagnostic categories. For the rest, both graphs have the same structure: the left half of the graph – i. e. that half in which the yellow bars are located – refers to surgical/procedural DRGs, whilst the right half – that with the green bars – refers to medical DRGs. The outer figures indicate the number of DRGs per major diagnostic subcategory, the inner figures the number of base DRGs. The four figures per line have been visualised by the bars.

Commentary

A scrutiny of the graphs reveals the following striking features:

- The number of base groups differs. It ranges from approximately 360 base groups in APR and SQLape to approximately 560 base groups in IR. ▶ Table 4
- Both the surgical and the medical subcategories within one system contain very different numbers of patient categories.
- The number of patient categories per major diagnostic category varies greatly among DRG systems. At least at first sight, hardly any regularities can be made out. (One such observation would be, for instance, that: all DRG systems have more medical than surgical DRGs within the respiratory system [04']. But even when we look at the number of base DRGs in this major diagnostic category, the IR-DRG system proves to be an exception of this rule . . . At any rate, concerning the musculoskeletal system [08'] there are more surgical DRGs and also more base DRGs throughout this major diagnostic category.) ▶ Table 5

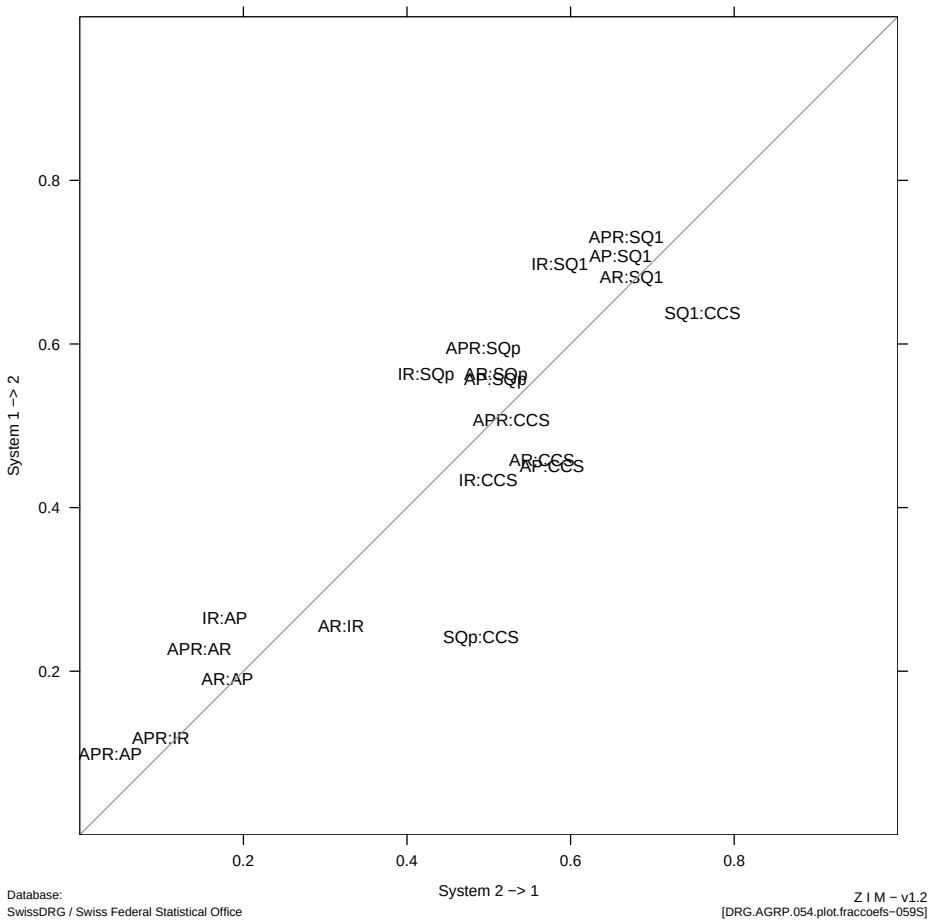


Table 6:
Map of the weighted average fractionation coefficients of pair comparisons of DRG systems

5.2 Fractionation coefficients in pair comparisons of DRG systems

Fractionation coefficient
↑ p. 8

The "fractionation coefficient" was developed in order to measure the extent of fragmentation that occurs when hospital stays are classed according to two different DRGs. In short: a fractionation coefficient of 0 indicates a 1:1 representation. The coefficient increases with the number of different base DRGs of the reference system that are used to represent the cases of a base DRG of the original system to be assessed. However, it never exceeds 1.

▶ Table 6

Table 6 illustrates fractionation coefficients for pairs of DRG systems. A value of 0.23 for "APR:AR" on the vertical axis, which is labelled "System 1 -> 2", means that when the original system 1 (here: APR) was represented in the reference system 2 (here: AR), a fractionation coefficient of 0.23 was calculated for the cases contained in the database. The assignment of DRGs corresponds better, the further to the bottom left a pair of patient classification systems is placed.

▶ Table 7

An alternative depiction of these values is represented in Table 7, where the values of the fractionation coefficients are actually printed out. In addition, these values were coloured according to their height: blue points to low (corresponding) values, orange to high (diverging) values. The size of the rectangles is proportionate to the fractionation coefficient: the smaller the symbol, the better the value.

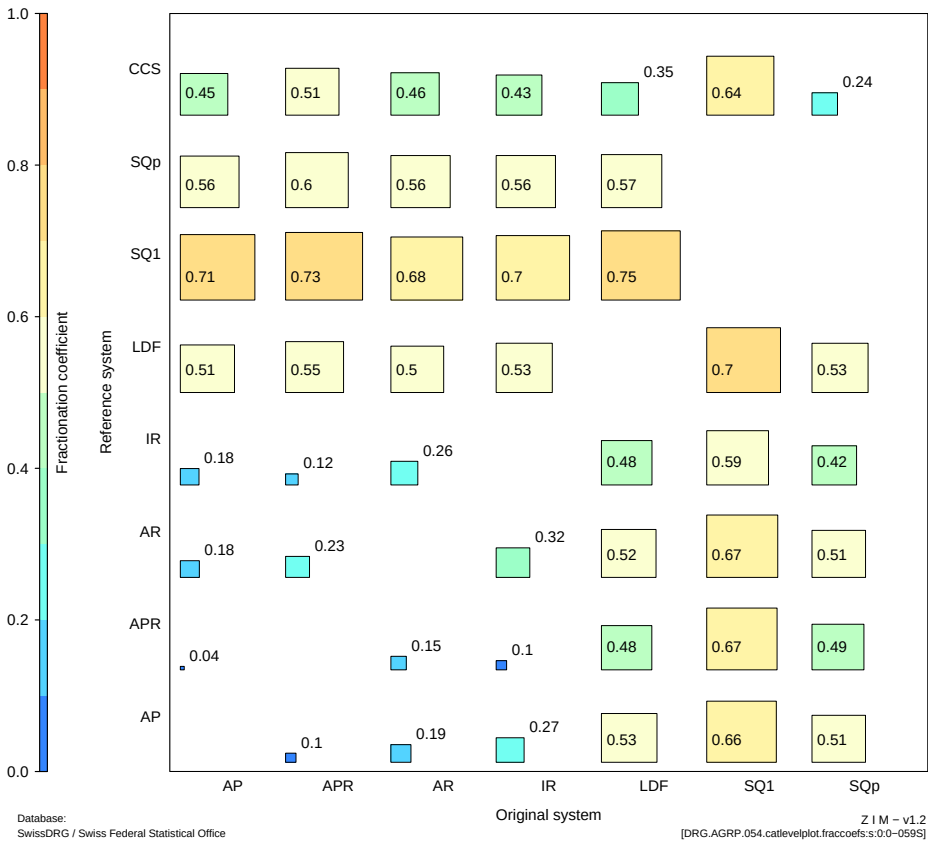
APR and AP

The evaluation of the fractionation coefficients reveals that the APR and AP systems display the highest degree of correspondence; in Table 6, the pair is placed bottom left. The comparison resulted in average fractionation coefficients of 0.1 or less. This means that there are many cases in DRGs that have a similar concept in both cases.

APR and IR

The comparison between APR and IR also yielded low fractionation coefficients.

Table 7:
Weighted average fractionation coefficient of pair comparisons of DRG systems



The average fractionation coefficients are below 0.12. This means that here, too, there are many cases with similar concepts in both the APR and the IR system.

AR compared with APR and IR

The next pairs we look at are APR and AR, and AR and IR. Both entries are at a distinctive distance from the diagonal. This means that fractionation weighs differently depending on the direction of the representation. In concrete terms, for instance, the representation of APR in AR (with a value of 0.23) is worse than the representation of AR in APR (with a value of 0.15). It is striking that the representation of IR in AR, with a value of 0.32, is the most problematic of the representations within the DRG pairs. This figure makes it evident that IR and AR are based on quite different concepts.

SQLape

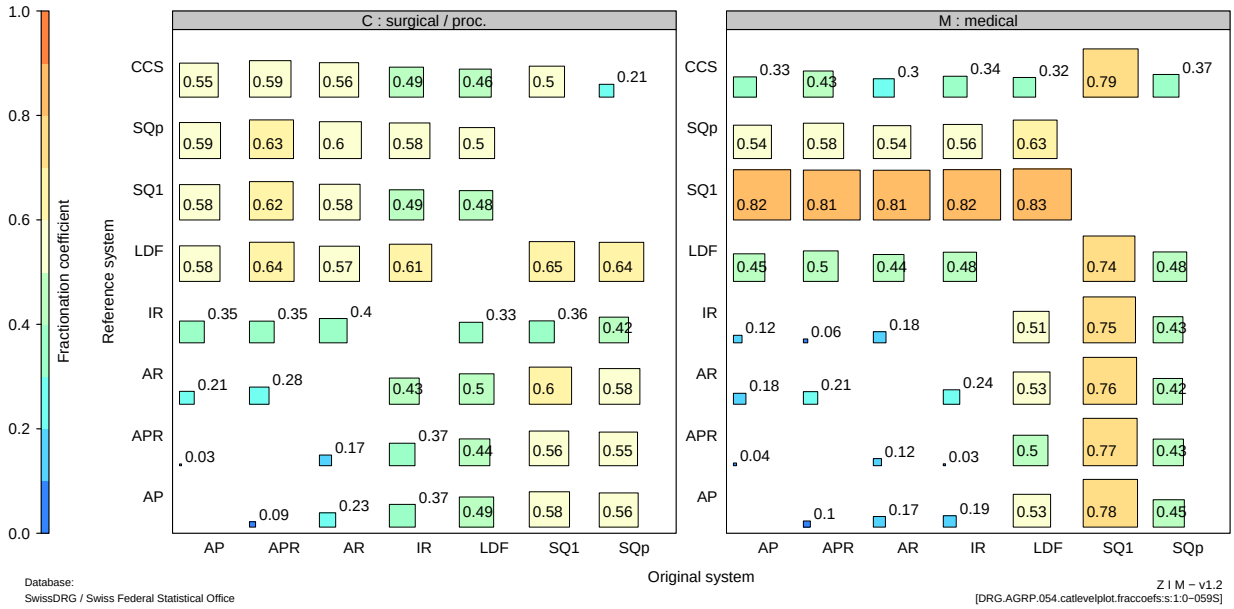
In the comparisons with the SQLape system, which is based on a different concept, the SQLape procedure category that the system returned when only the main diagnosis and the main procedure were grouped, was used as the base group; if no SQLape procedure category existed, use was made of the SQLape diagnosis category returned. This code was called "SQp". The different classification approach of the SQLape system is reflected in relatively high fractionation coefficients. They all exceed 0.42. This shows that correspondence with conventional DRG systems is relatively small.

Even greater divergences occur when the primary SQLape categories ("SQ1") are compared with the base DRGs of the various DRG systems. Here, the fractionation coefficients even exceed 0.59.

CCS

The fractionation coefficients of the representation of the medical base DRGs in the CCS diagnosis categories, and of the surgical base DRGs in the CCS procedure categories appear in the line labelled "CCS" in Table 7. The values are high throughout; they range from 0.43 to 0.51, i. e. all the DRG systems are relatively inhomogeneous with regard to the CCS categories. With 0.35, the LDF system does not possess a substantially better value. The conspicuous exception is the representation of SQp in CCS, where the fractionation coefficient is only 0.24.

Table 8: Weighted average fractionation coefficient of pair comparisons of DRG systems according to major diagnostic subcategory types



5.3 Fractionation coefficients according to major diagnosic subcategory types

The fractionation coefficients can also be computed for subsystems of DRG systems. Below, the fractionation coefficients for surgical and medical base DRGs will be considered separately since it is known that the representation quality for medical cases in DRG systems is markedly worse than that for surgical cases.

Medical DRGs show a higher degree of correspondence than surgical DRGs

▶ Table 8

When we look at Table 8, it is immediately apparent that the DRG systems differ more strongly from each other in the surgical field than they do in the medical field. A very high degree of correspondence occurs for the medical cases grouped according to APR-DRG when the IR-DRG system is used as the reference classification ($F.med_{APR|IR}$ = 0.06). On the other hand, he high values of the representation of the surgical base IR-DRGs both in AR and in APR are particularly striking ($F.chir_{IR|AR}$ = 0.43; $F.chir_{IR|APR}$ = 0.37).

SQLape

The representation of the DRG systems in the SQLape code for main procedure or main diagnosis (SQp) results in poor fractionation coefficients for both major diagnostic subcategory types. In the medical sphere they are slightly better than in the surgical sphere, unless they are compared with the base IR-DRGs. What is interesting is the fact that SQp and SQ1 differ only slightly in relation to the surgical base DRGs. In the medical sphere, however, the primary SQLape categories "SQ1" differ much more strongly from the medical base DRGs than the SQLape main treatment categories "SQp".

It is striking that the fractionation coefficient of the representation of the surgical SQp in the CCS procedures is comparably low: $F.chir_{SQp|CCS}$ is 0.21.

CCS

All in all, it appears that the medical base DRGs come somewhat closer to the CCS diagnosis classification than the surgical base DRGs come to the CCS procedure classification; however, fragmentation is high in both areas. The representation of APR in CCS is distinctly worse that the representation of IR in CCS, with regard to both diagnoses and procedures ($F.chir_{APR|CCS}$ = 0.59 in comparison with $F.chir_{IR|CCS}$ = 0.49 and $F.med_{APR|CCS}$ = 0.43 in comparison with $F.med_{IR|CCS}$ = 0.34).

5.4 Fractionation coefficients according to major diagnosic subcategories

▶ Tables 9 and 10

In the next step of the analysis, the fractionation coefficients are computed for each major diagnosis subcategory.

Here: DRG systems only

In this instance, comparisons were limited to DRG systems proper. Naturally, a comparison with SQLape, LDF and CCS would also be of interest since it would reveal the areas in which similarities might be found despite the overall great divergences noted in the last chapter. In the basic study[22], these comparisons were made. For reasons of space and clarity, they will not be repeated here.

Large symbols = great divergence

Large and yellowy-orange symbols indicate great discrepancies between the systems concerned. Columns with a majority of small rectangles show that the cases from the major diagnosis subcategory type described above them (C: "surgical/procedural" or M: "medical") of the original system were grouped into relatively similar base groups of the reference system named below the column.

AP

Areas with high degrees of correspondence exist, for example, between AP and APR in the surgical subcategories Eyes [02’C], Circulatory system [05’C], Digestive system [06’C], Hepatobiliary system and pancreas [07’C], Skin [09’C], Glands, metabolism [10’C], Male [12’C], Female [13’C], Birth [14’C] and HIV [24’C]. For all these surgical subcategories, the fractionation coefficient is below 0.05. The Respiratory System [04’C] is a striking exception to this rule.

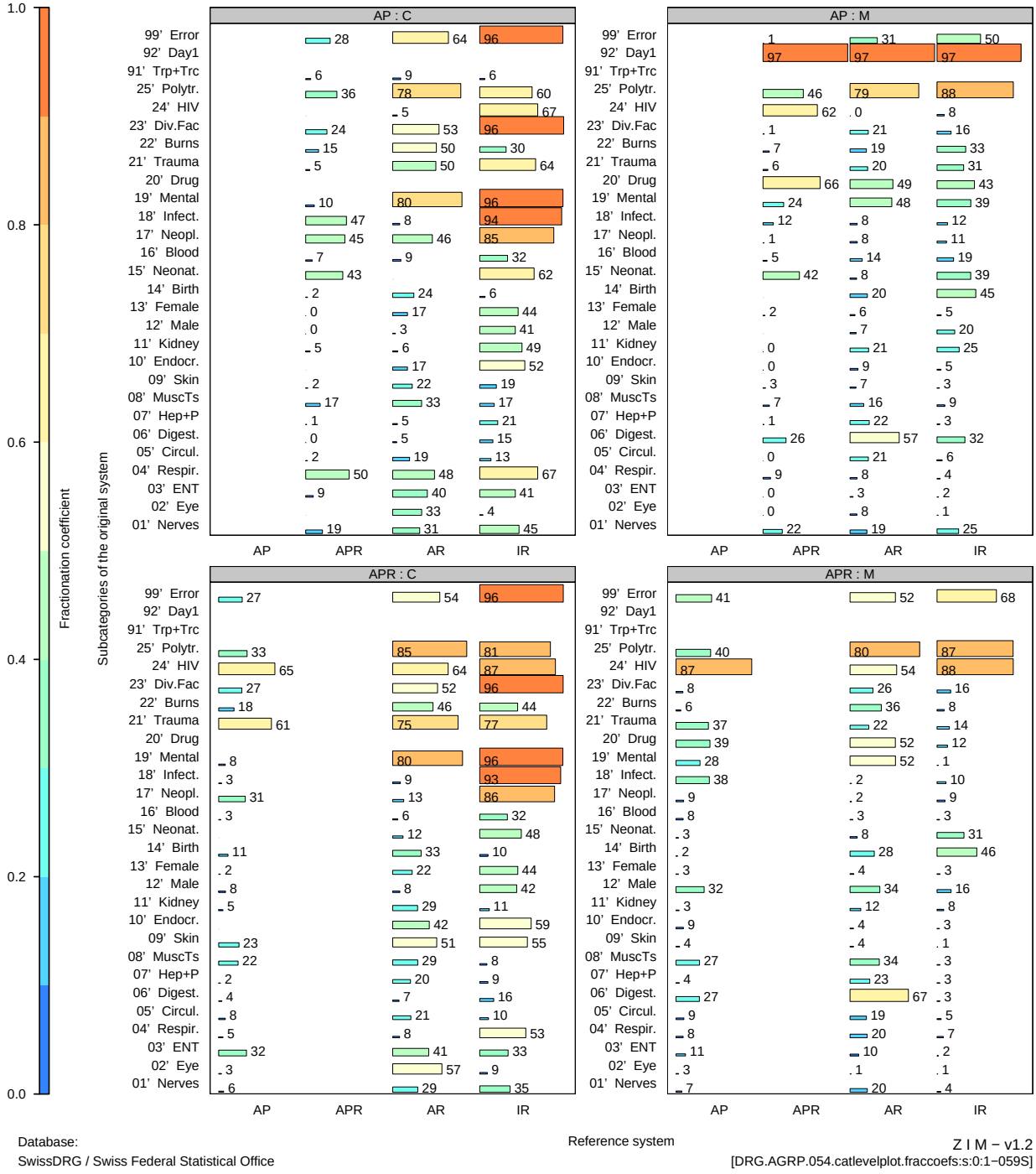
IR

It is striking in the comparison of the IR system with the other DRG systems, that there is distinctly more similarity in the medical sphere than in the surgical sphere. It

[22] Fischer [Basis-DRG-Vergleiche, 2005].

must be assumed that this is linked to the fact that a new concept was developed for the surgical sphere and that hospital cases – unlike in the other DRG systems – are assigned to a surgical IR-DRG independently of the main diagnosis.

Table 9: Weighted average fractionation coefficient of pair comparisons of DRG systems per system according to major diagnosis subcategories (Part 1)

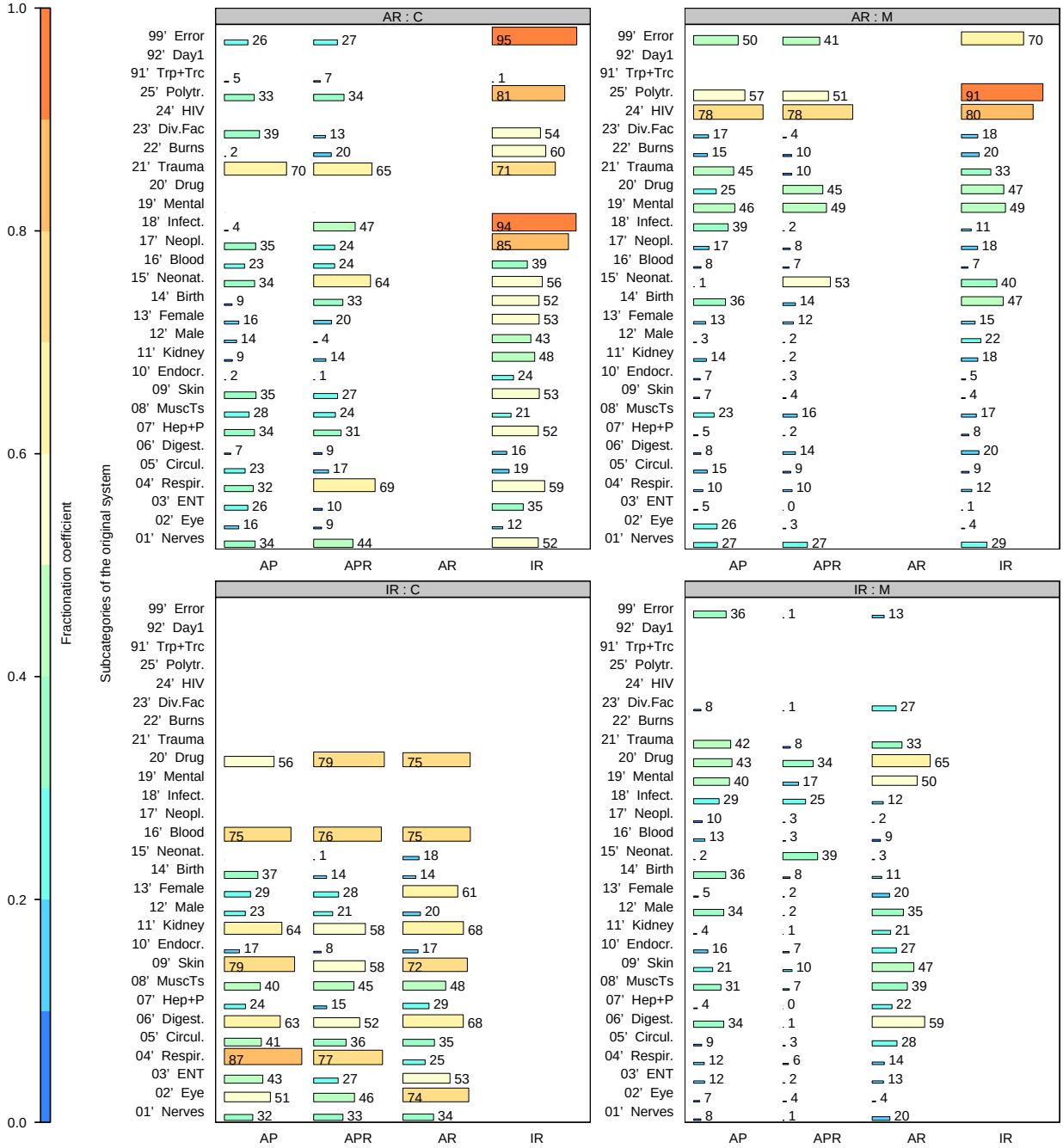


Database:
SwissDRG / Swiss Federal Statistical Office

Reference system

Z I M – v1.2
[DRG.AGRP.054.catlevelplot.fraccoefs:s:0:1–059S]

Table 10: Weighted average fractionation coefficient of pair comparisons of DRG systems per system according to major diagnosis subcategories (Part 2)

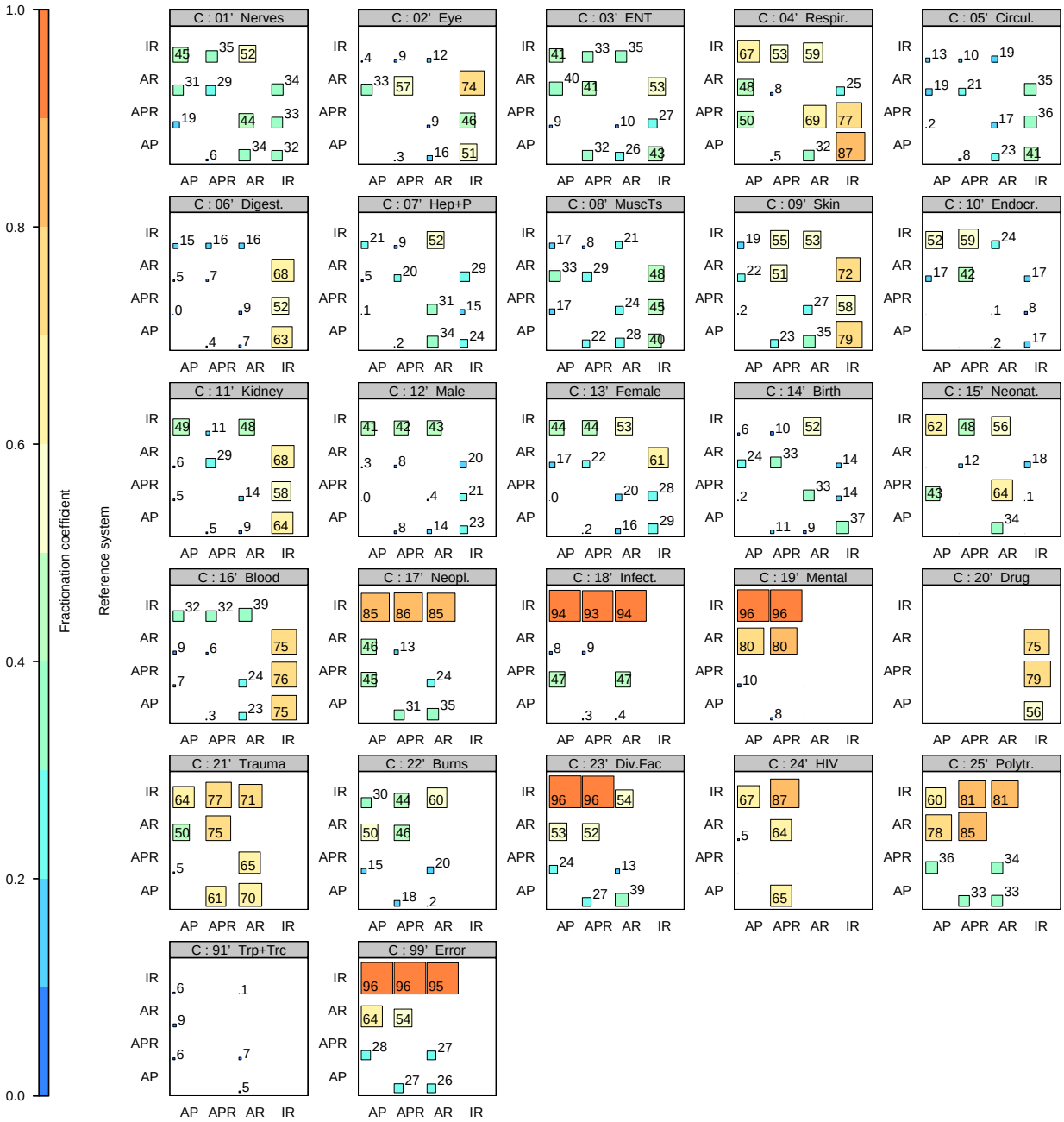


Database:
SwissDRG / Swiss Federal Statistical Office

Reference system

Z I M − v1.2
[DRG.AGRP.054.catlevelplot.fraccoefs:s:0:1−059S]

Table 11: Weighted average fractionation coefficient of pair comparisons of DRG systems according to surgical subcategories

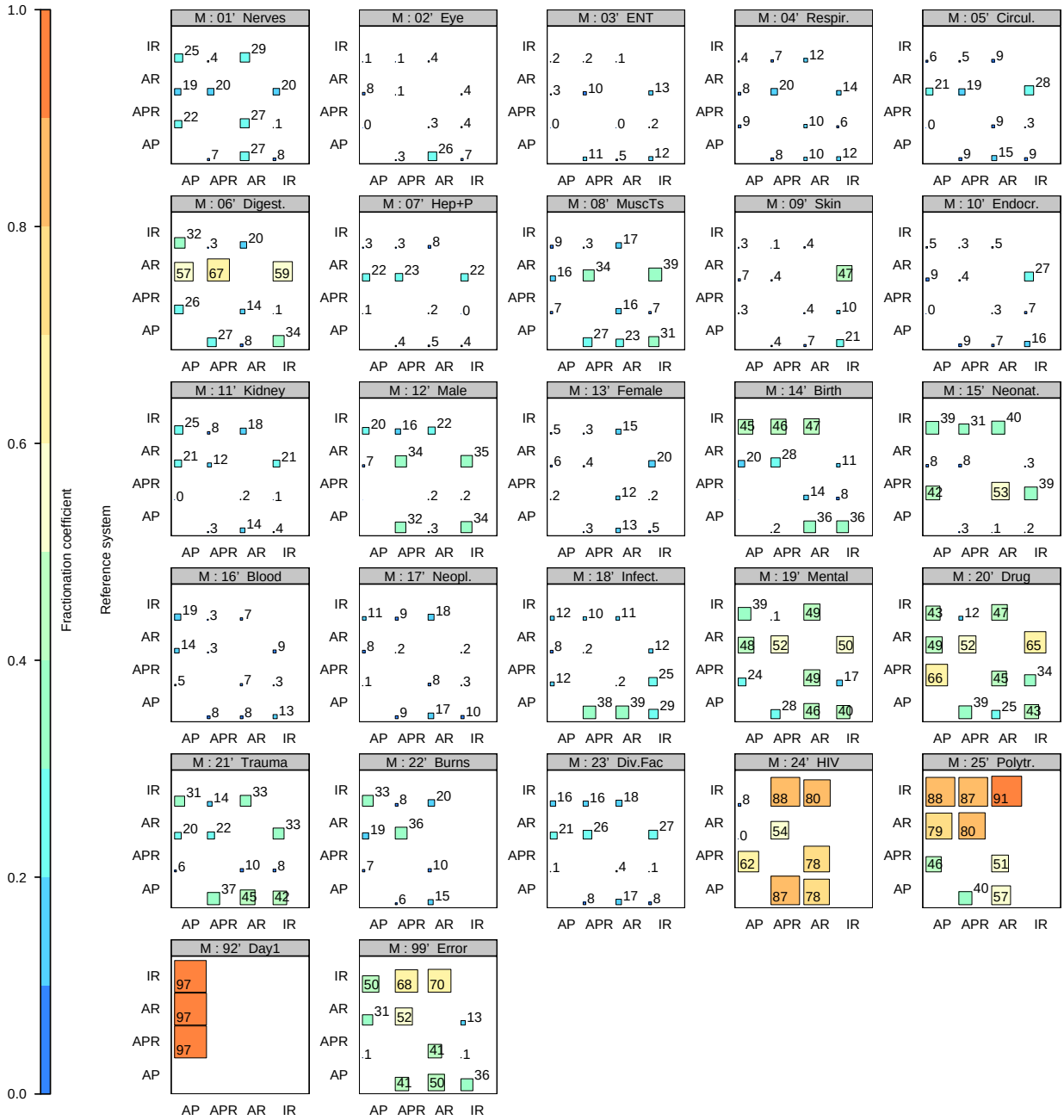


Database:
SwissDRG / Swiss Federal Statistical Office

Original system

Z I M – v1.2 / 1
[DRG.AGRP.054.catlevelplot.fraccoefs:c:0:1–059S]

Table 12: Weighted average fractionation coefficient of pair comparisons of DRG systems according to medical subcategories



Database:
SwissDRG / Swiss Federal Statistical Office

Original system

Z I M – v1.2 / 2
[DRG.AGRP.054.catlevelplot.fraccoefs:c:0:1–059S]

5.5 Major diagnostic subcategories with more problems and with fewer problems

Tables 11 and 12 help find those subcategories which categorise hospital cases in a relatively similar manner and those with greatly different grouping concepts.

▶ Tables 11 and 12

In the following, those subcategories for which all the representations in other DRG systems resulted in fractionation coefficients of less than 0.15 will be regarded as presenting "no problems" (at first sight).

"no problems"

In the following, those subcategories for which at least one of the representations in another DRG system among all the DRG systems under scrutiny resulted in an average fractionation coefficient of more than 0.5 will be considered to be (potentially) "problematic".

"problematic"

Among the surgical subcategories, there is only one single subcategory for which all the comparisons yielded low fractionation coefficients, namely the category with the transplantations and tracheostomies [91'C].

Surgical subcategories

↑ Table 11 (p. 18)

All the other subcategories have fractionation coefficients in excess of 0.4. Only in three of these subcategories does none of the fractionation coefficients exceed 0.5.[23]

Among the medical subcategories, too, there is only one subcategory for which all the comparisons resulted in low fractionation coefficients: ENT [03'M].

Medical subcategories

↑ Table 12 (p. 19)

The following medical subcategories display problematic differences:

- 06'M: Digestive system
- 15'M: Newborns
- 19'M: Mental diseases
- 20'M: Drugs
- 24'M: HIV
- 25'M: Multiple significant trauma
- 99'M: Not groupable

Commentary

There is an amazing number of subcategories with differing grouping concepts. In all these cases, a closer look is necessary to find the base DRGs that have been subjected to particularly different treatment.

[23] At least one fractionation coefficient is above 0.4 but below 0.5 in the subcategories Circulary system [05'C]; Musculoskeletal system [08'C]; Male reproductive system [12'C].

5.6 Example of a treemap for the display of fractionation coefficients

↑ Treemaps: p. 9

Each of the following treemaps contains all the base DRGs of a DRG system. The colours represent the values of the fractionation coefficients per base DRG of the original system mapped to the reference system.

Hierarchical structuring

The graphs are hierarchically divided up according to:

1. major diagnostic subcategory types (vertical main subdivision according to "surgical/procedural" and "medical";
2. standardised major diagnostic subcategories (such as "01'M Nerves"; horizontal fields with black frames);
3. base DRGs of the original classification with a white frame, sorted by the values of the fractionation coefficient.

Codes

The codes for the original classification have been entered at the centre of each white-framed cell. Possibly it is followed by the label of the base DRG (or a short version of it) and the fractionation coefficient if space is available. The major diagnostic subcategories have been entered in italics on the left of each black-framed cell, turned around 90° counter-clockwise.

Surface division

The size of the rectangles reflects the proportion of cases they represents. With the help of the vertical subdivision, which separates the cases according to major diagnostic subcategory types, it can be seen that all in all, the database used contains fewer surgical/procedural cases (on the left) than medical cases (on the right).

Colours

The colours correspond to the values of the fractionation coefficients. Low coefficients are shown in a bluish colour, high coefficients in a reddish colour.

The bluer a white-framed cell, the less fragmentated the representation of the displayed base DRGs of the original system in the base DRGs of the reference system.

Number of cases in the database

The overall number of cases represented from the database is indicated in the centre below the graph.

IR -> APR

▶ Table 13

The first of the two following treemaps displays the fractionation coefficients of all base IR-DRGs split into base APR-DRGs. It is striking immediatly that there are much more reddish and red boxes on the left with the surgical base IR-DRGs than on the right with the medical base IR-DRGs. A quite great number of medical base IR-DRGs with fractionation coefficients of zero or nearly zero can be seen on the right half. (They are coloured in a bluish colour.) This means that this graphic tells us, too, that the medical base IR-DRGs are less fragmentated into APR-DRGs than the surgical base IR-DRGs: the fractionation coefficient ($F.med_{IR|APR}$) of the medical base IR-DRGs only amounts to 0.03, whilst the fractionation coefficient of the surgical base IR-DRGs ($F.chir_{IR|APR}$) is at 0.37.

↑ Table 8 (p. 14)

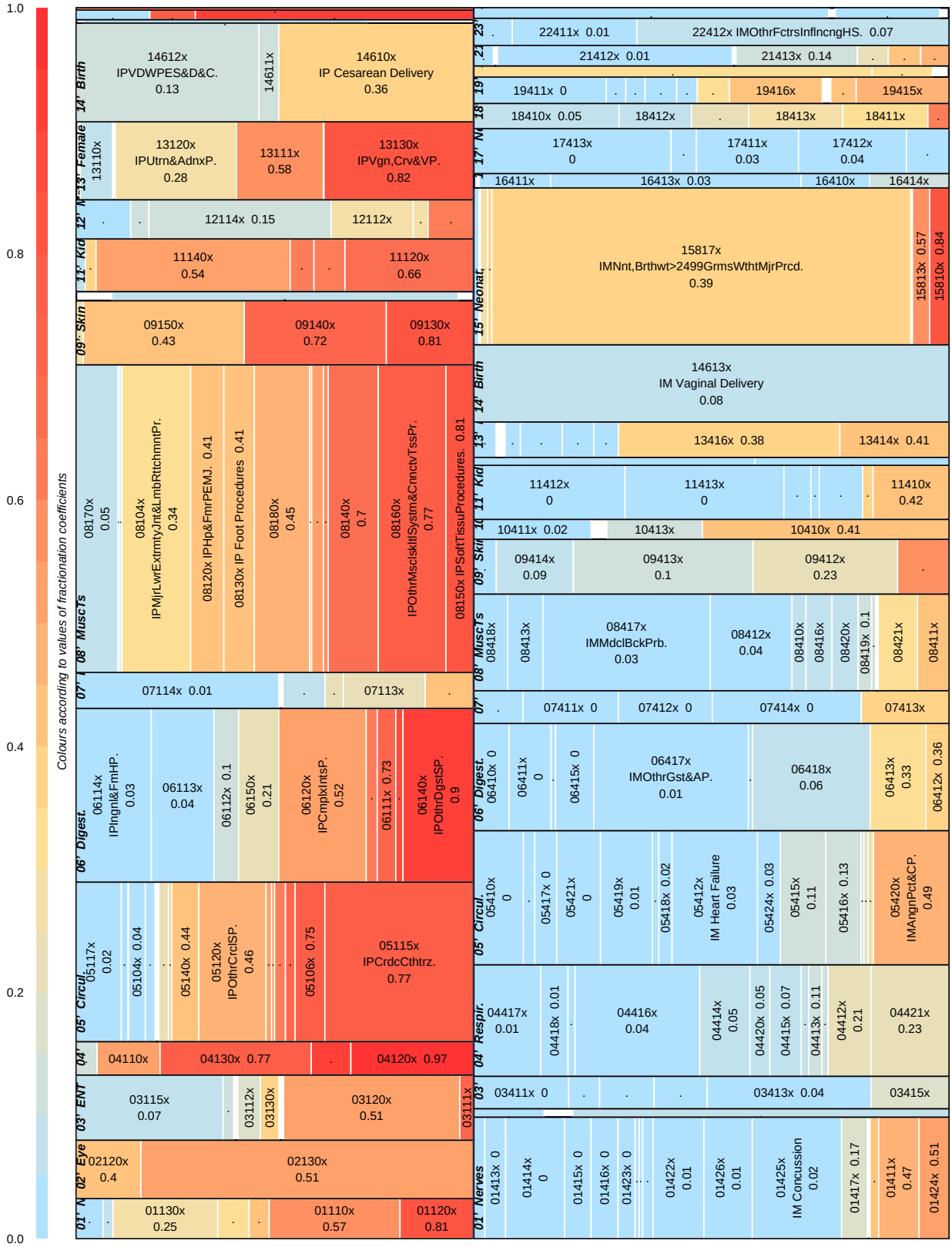
IR -> AR

▶ Table 14

In the next graphic, also the medical field is now coloured with a more intensive red, but it is still less red than the surgical field. Yet the latter appears to be even more fragmentated than in the previous graph for IR to APR. A look at the fractionation coefficients of both fields shows likewise that, though they are higher, they differ less: $F.med_{IR|AR} = 0.24$, $F.chir_{IR|AR} = 0.43$.

↑ Table 8 (p. 14)

Table 13: Fractionation coefficients of base IR2005-DRGs divided according to base APR15-DRGs

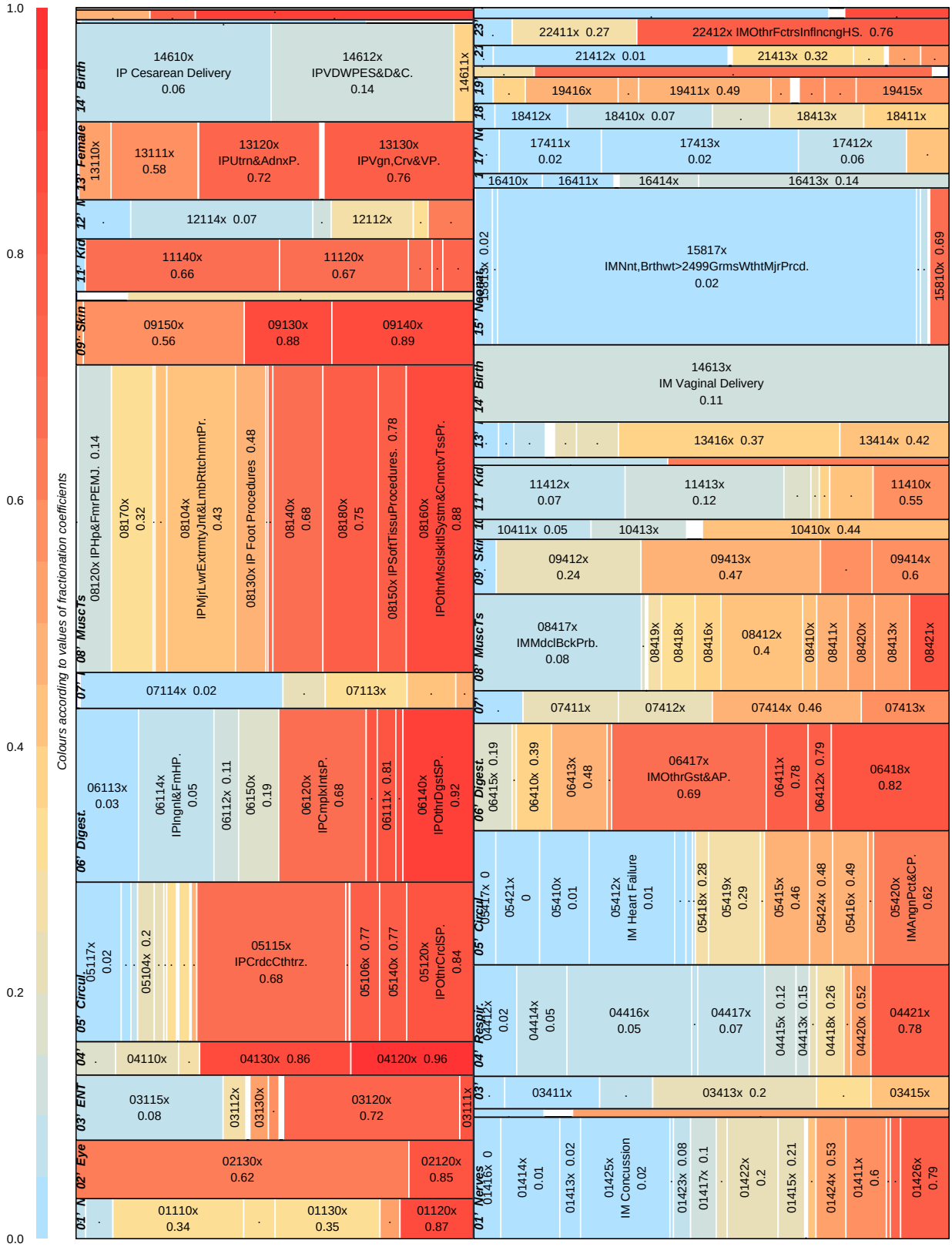


The size of the boxes corresponds to the number of cases (n_total = 900472).
Main division according to subcategory types: C, M (from left to right).

Database:
SwissDRG / Swiss Federal Statistical Office

Z I M − v1.2
[DRG.AGRP.059.treemap.fc:IR2005:APR15−059S]

Table 14: Fractionation coefficients of base IR2005-DRGs divided according to base AR5-DRGs



The size of the boxes corresponds to the number of cases (n_total = 900472).
Main division according to subcategory types: C, M (from left to right).

Database:
SwissDRG / Swiss Federal Statistical Office

Z I M − v1.2
[DRG.AGRP.059.treemap.fc:IR2005:AR5−059S]

5.7 Example of a treemap for the comparison of two DRG systems

The next treemap below shows all the base DRGs of the original system again (black-framed), yet this time divided up into the base DRGs of the reference system (white-framed).

↑ Treemaps: p. 9

These treemaps are hierarchically divided up according to:

Hierarchical structuring

1. major diagnostic subcategory types (main subdivision according to "surgical/procedural" and "medical");
2. standardised major diagnostic subcategories (such as "01'M Nerves"; with a fine grey frame at a right angle to the main subdivision);
3. base DRGs of the original classification (with a black frame);
4. base DRGs of the reference classification (with a white frame).

The codes for the original classification have been entered in italics at the bottom of each black-framed cell, while the codes for the reference classification occupy the centre of the white-framed cells. The major diagnostic subcategories have also been entered in italics, but the letters have been turned around 90° counter-clockwise.

Codes

The size of the rectangles reflects the proportion of cases they represents. The main subdivision distinguishes between the surgical/procedural cases and the medical cases.

Surface division

The colours were determined on the basis of the (sequential) code numbers of the reference classification. White rectangles indicate a combination of base DRGs and reference base DRGs with fewer than three cases.

Colours

The fewer stripes and the fewer colours the field of a base DRG contains, the better the base DRG in question corresponds to the group structure of the reference classification.

Correspondence of classifications

The overall number of cases represented from the database is indicated in the centre below the graph (or, in the portrait format print-out, to the left of the graph).

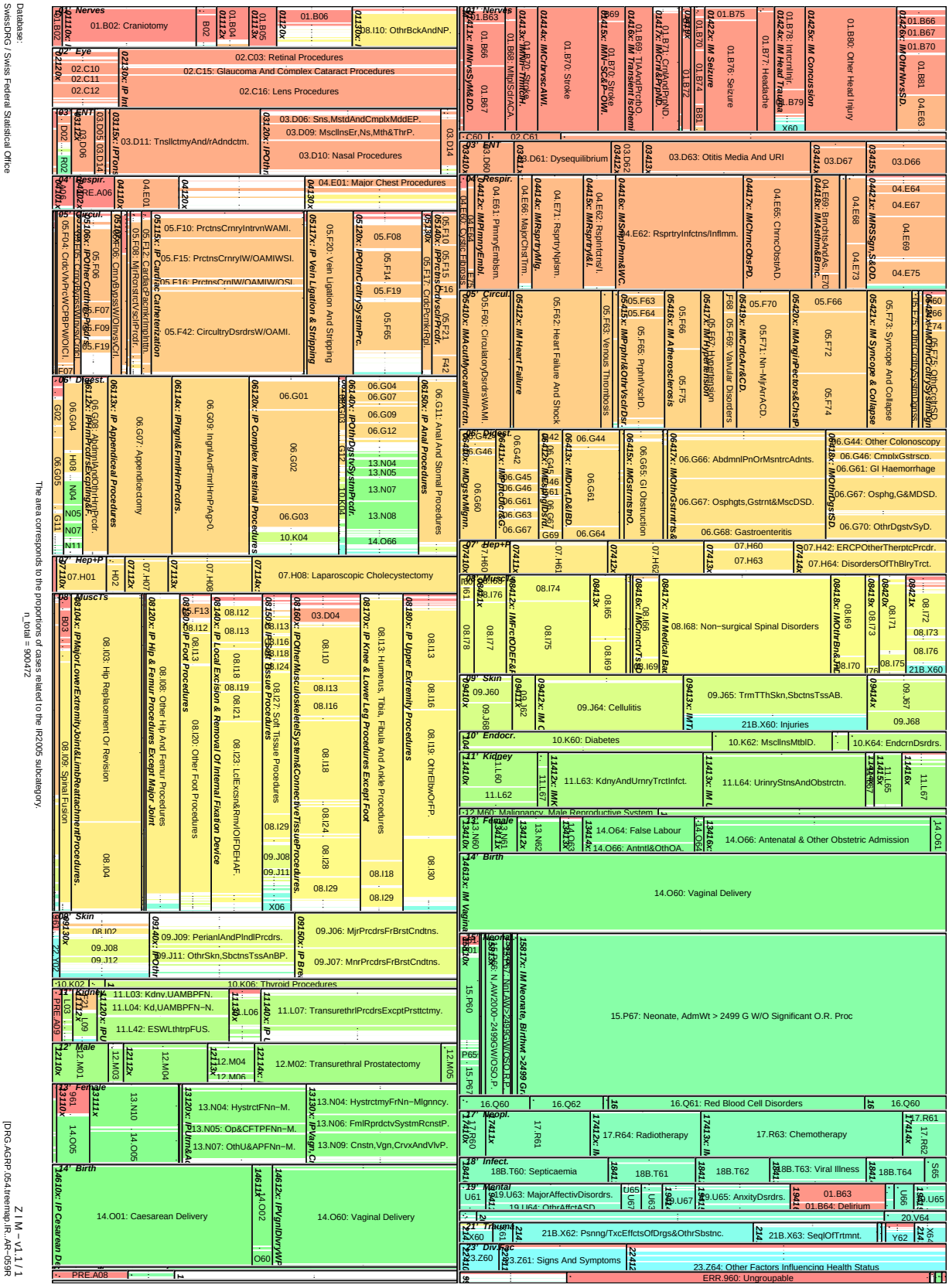
Number of cases in the database

The treemaps below can be interpreted as follows:

Notes concerning interpretation

- *Large rectangles* refer to frequent codings or coding combinations.
- The smaller the *number* of white-framed base DRGs of the reference system within a base DRG of the original system, the more similar the grouping concept used for these base DRGs in both systems.
- The more uniform the *colour gradient*, the more base DRGs of the original system are represented in base DRGs of the reference system whose codes are assigned to similar thematic areas.
- *Conspicuous colours* point to the fact that the same hospital cases are encoded in different thematic areas.
- An in-depth analysis should not only compare the colours but also the *labels* of the base DRGs of the original system and the assigned base DRGs of the reference system.
- If the reference classification has a good *clinical homogeneity*, then the graph may serve as a basis for an estimate of the clinical homogeneity of the original classification.

Table 15: Base IR2005-DRGs divided according to base AR5-DRGs



IR -> AR
▶ Table 15

Basically, the colour pattern looks rather calm. This means that the classifications have a similar overall structure: the hospital cases are classified into similar "coding zones" by both DRG systems.

A detailed observation reveals that there is a considerable number of base IR-DRGs that are represented in several base AR-DRGs: this is the case wherever a black-framed field is divided up into several white-framed subsections.

The most striking are base IR-DRG fields that bear several colours: in this case, the base AR-DRGs into which this base IR-DRG is divided also belong to subcategories that are "further distant". The most conspicuous example of this kind is base IR-DRG 06140x (IP Other Digestive System Procedures) almost in the centre of the graph. The size of the field shows that a relatively high number of hospital cases have been assigned to this collective base IR-DRG. In the AR-DRG system, the same cases can be found both in the subcategory "Digestive system" [06’C] and under "Female reproductive system" [13’C].

Another example that is plain to see is provided by the strong fragmentation of the base IR-DRGs of procedures on the musculoskeletal system [subcategory 08’C]. The prevalent yellow colour shows that the base AR-DRGs according to which these cases were grouped are frequently to be found in the same subcategory.

5.8 Examples of individual DRG-related evaluations

In the following, the fragmentation of the base APR-DRG 313 (Knee & lower leg procedures except foot) will be shown through its representation in the AR-DRG system, in the IR-DRG system and in the AP-DRG system. The fractionation coefficient is relatively high for all three representations, namely approximately f = 0.6.

APR 313 -> AR
▶ Table 16

When the hospital cases from base APR-DRG 313 are represented in the AR-DRG system, it becomes evident that these cases are mainly assigned to three base AR-DRGs, namely: base AR-DRG I13 (Humerus, Tibia, Fibula and Ankle Procedures), base AR-DRG I18 (Other Knee Procedures) and base AR-DRG I29 (Knee Reconstruction Or Revision). As in APR, foot procedures are also represented in a separate DRG.[24] Nev-

[24] Foot procedures : base APR-DRG 314 (Foot procedures); base AR-DRG I20 (Other Foot Procedures).

Table 16: Example: APR 313 according to AR (f=0.61, n=21378): Knee & lower leg procedures except foot

APR	Cases	%APR	%AR	Type	MDC	AR	AR-DRG label
313	11204	52.4	74.7	C	08	I13	Humerus, Tibia, Fibula and Ankle Procedures
313	6804	31.8	99.5	C	08	I18	Other Knee Procedures
313	2549	11.9	98.9	C	08	I29	Knee Reconstruction Or Revision
313	254	1.2	16.8	C	08	I12	Infect/Inflam Bone & Joint
313	90	0.4	7.4	C	08	I21	Local Excision & Removal of Internal Fixation Devices of Hip and Femur
313	88	0.4	1.5	M	ERR	961	Unacceptable Principal Diagnosis
313	74	0.3	1.3	M	08	I75	Injury to Shoulder, Arm, Elbow, Knee, Leg or Ankle
313	47	0.2	1.5	C	08	I28	Other Connective Tissue Procedures
313	43	0.2	0.8	C	08	I20	Other Foot Procedures
313	35	0.2	1.0	M	08	I69	Bone Diseases & Spec Arthropathies
313	25	0.1	0.3	C	08	I08	Other Hip and Femur Procedures
313	23	0.1	4.2	C	21B	X04	Other Procedures for Injuries to Lower Limb
313	21	0.1	42.0	C	08	I11	Limb Lengthening Procedures
313	18	0.1	0.4	C	08	I04	Knee Replacement and Reattachment
313	17	0.1	0.5	C	08	I30	Hand Procedures
313	16	0.1	1.0	M	08	I76	Other Musculoskeletal Disorders
313	11	0.1	0.5	M	01	B60	Established Paraplegia/Quadriplegia

ertheless, only half of the APR-313 cases come into the nominally comparable base AR-DRG I13 (cf. column marked "%APR"). On the strength of the label of AR-DRG I13 it becomes clear that this also includes procedures on the humerus (i. e. not only on the lower but also on the upper extremity). This explains why only three quarters of this base AR-DRG contains cases from base APR-DRG 313 (cf. column marked "%AR"). Evidently, the APR-DRGs in this context are less differentiated at the level of base DRGs than AR-DRGs; part of this might be compensated for by the four severity categories that are systematically available in the APR-DRG system. However, it turns out that in the AR-DRG system, I13, too, has three severity categories whereas I18 and I20 have no further subdivisions.[25]

APR 313 -> IR

▶ Table 17

When the hospital cases from base APR-DRG 313 were represented in the IR-DRG system, they were mainly positioned in five base IR-DRGs, namely: base IR-DRG 08170x (IP Knee & Lower Leg Procedures Except Foot), base IR-DRG 08160x (IP Other Musculoskeletel System & Connective Tissue Procedures), base IR-DRG 08140x (IP Local Excision & Removal Of Internal Fixation Device), base IR-DRG 08150x (IP Soft Tissue Procedures) and, interestingly, 3.9 % of the cases also in base IR-DRG 08130x (IP Foot Procedures), even though the label of APR-DRG 313 should really exclude any procedures on the foot. What is particularly confusing, however, is the fact that the labels of base APR-DRG 313 and base IR-DRG 08170x are identical[26], and yet not even half of the APR-313 cases are assigned to base IR-DRG 08170x (cf. column marked "%APR"). At any rate, almost all the cases to be found in base IR-DRG 08170x, namely 97.6 %, are assigned to base APR-DRG 313 (cf. column marked "%IR").

APR 313 -> AP

▶ Table 18

When the hospital cases from base APR-DRG 313 were represented in the AP-DRG

[25] There are separate DRGs in both systems for replantations and prostheses: base APR-DRG 301 (Major joint & limb reattach proc of lower extremity for trauma) und base APR-DRG 302 (Major joint & limb reattach proc of lower extrem exc for trauma); base AR-DRG I04 (Knee Replacement and Reattachment).

[26] Base IR-DRG 08170x is solely preceded by "IP". In the IR-DRG system, "IP" identifies all stationary procedures (I = inpatient, P = procedure).

Table 17: Example: APR 313 according to IR (f=0.65, n=21378): Knee & lower leg procedures except foot

APR	Cases	%APR	%IR	Type	MDC	IR	IR-DRG label
313	10484	49.0	97.6	C	08	08170x	IP Knee & Lower Leg Procedures Except Foot
313	6364	29.8	36.5	C	08	08160x	IP Other Musculoskeletel System & Connective Tissue Procedures
313	2482	11.6	19.2	C	08	08140x	IP Local Excision & Removal Of Internal Fixation Device
313	1100	5.1	15.2	C	08	08150x	IP Soft Tissue Procedures
313	831	3.9	10.6	C	08	08130x	IP Foot Procedures
313	46	0.2	1.9	C	01	01120x	IP Cranial & Peripheral Nerve Procedures
313	18	0.1	0.4	C	04	04130x	IP Moderately Complex Respiratory System Procedures
313	13	0.1	0.1	C	05	05120x	IP Other Circulatory System Procedures
313	12	0.1	0.3	C	05	05106x	IP Other Cardiothoracic Procedures

Table 18: Example: APR 313 according to AP (f=0.59, n=21378): Knee & lower leg procedures except foot

APR	Cases	%APR	%AP	Type	MDC	AP	AP-DRG label
313	11486	53.7	76.0	C	08	A-218	Lower Extremity & Humerus Procedures Except Hip, Foot, Femur
313	7306	34.2	99.4	C	08	A-221	Knee Procedures
313	1510	7.1	13.3	C	08	A-231	Local Excision & Removal Of Int Fix Devices Except Hip & Femur
313	814	3.8	14.4	C	08	A-226	Soft Tissue Procedures
313	110	0.5	8.3	C	08	A-230	Local Excision & Removal Of Int Fix Devices Of Hip & Femur
313	63	0.3	2.4	C	23	A-461	O.R. Procedures W Diagnoses Of Other Contact W Health Services
313	62	0.3	6.2	C	25	A-732	Other O.R. Procedures For Multiple Significant Trauma
313	15	0.1	0.1	M	27	A-901	Transfer Within One Day

system, they were mainly positioned in five base AP-DRGs, namely base AP-DRG A-218 (Lower Extremity & Humerus Procedures Except Hip, Foot, Femur), base AP-DRG A-221 (Knee Procedures), base AP-DRG A-231 (Local Excision & Removal Of Int Fix Devices Except Hip & Femur) and base AP-DRG A-226 (Soft Tissue Procedures). This last base AP-DRG has a counterpart in the APR-DRG system, namely base APR-DRG 317 (Soft tissue procedures). This raises the question as to whether it is a positioning in APR-DRG 313 or an assignment to base AP-DRG A-226 that fits the situation better.

AR I13 -> AP

▶ Table 19

A complementary example to be shown is the representation of the hospital cases from base AR-DRG I13 (Humerus, Tibia, Fibula and Ankle Procedures) in the AP-DRG system. This is a relatively homogeneous representation: 96.9 % of the hospital cases in AR-DRG I13 will be found again in base AP-DRG A-218 (Lower Extremity & Humerus Procedures Except Hip, Foot, Femur). The representation also works well in the opposite direction: 96.2 % of the hospital cases in base AP-DRG A-218 are assigned to base AR-DRG I13. This relatively good correspondence is also indicated by the fractionation coefficients of f = 0.06 and f = 0.07, respectively.

▶ Table 20

In this case, the different natures of AR and AP become evident only at the next lower level. Base AR-DRG I13 is divided up into three severity categories: I13A applies to cases with severe or catastrophic comorbidities or complications; all other cases are assigned to I13B if patients are over 59 years of age, whilst I13C is for patients under 60. In contrast, there is AP-DRG 218 for "Lower Extremity & Humerus Procedures Except Hip, Foot, Femur, Age > 17, with CC"; AP-DRG 219, the same, but without CC; and AP-DRG 220 for patients below 18 years.

Table 19: Example: AR I13 according to AP (f=0.06, n=14999): Humerus, Tibia, Fibula and Ankle Procedures

AR	Cases	%AR	%AP	Type	MDC	AP	AP-DRG label
I13	14538	96.9	96.2	C	08	A-218	Lower Extremity & Humerus Procedures Except Hip, Foot, Femur
I13	220	1.5	22.0	C	25	A-732	Other O.R. Procedures For Multiple Significant Trauma
I13	101	0.7	7.0	C	08	A-217	Wound Debridements & Skin Grafts
I13	75	0.5	2.8	C	23	A-461	O.R. Procedures W Diagnoses Of Other Contact W Health Services
I13	27	0.2	1.1	C	21	A-442	Other O.R. Procedures For Injuries
I13	15	0.1	0.1	M	27	A-901	Transfer Within One Day

Table 20: Example: AP A-218 according to AR (f=0.07, n=15115): Lower Extremity & Humerus Procedures Except Hip, Foot, Femur

AP	Cases	%AP	%AR	Type	MDC	AR	AR-DRG label
A-218	14538	96.2	96.9	C	08	I13	Humerus, Tibia, Fibula and Ankle Procedures
A-218	155	1.0	10.3	C	08	I12	Infect/Inflam Bone & Joint
A-218	82	0.5	2.6	C	08	I28	Other Connective Tissue Procedures
A-218	59	0.4	1.1	M	08	I75	Injury to Shoulder, Arm, Elbow, Knee, Leg or Ankle
A-218	51	0.3	0.8	M	ERR	961	Unacceptable Principal Diagnosis
A-218	33	0.2	0.4	C	08	I08	Other Hip and Femur Procedures
A-218	31	0.2	1.7	M	08	I74	Injury to Forearm, Wrist, Hand or Foot
A-218	24	0.2	48.0	C	08	I11	Limb Lengthening Procedures
A-218	21	0.1	0.6	M	08	I69	Bone Diseases & Spec Arthropathies
A-218	20	0.1	1.2	M	08	I76	Other Musculoskeletal Disorders
A-218	15	0.1	0.3	C	08	I10	Other Back and Neck Procedures
A-218	11	0.1	0.5	M	01	B60	Established Paraplegia/Quadriplegia

APR 313 -> SQp

▶ Table 21

The representation of the hospital cases of base APR-DRG 313 within the reference classification of SQLape main treatment categories (SQp) reveals that main treatments comprise mainly procedures on the leg ("CRU"), especially on the knee ("GEN") and also – inspite of the exclusion done by the APR-DRG label – on the foot ("PED2" and "PED3").

APR 313 -> SQ1

▶ Table 22

The representation of the hospital cases of base APR-DRG 313 within the reference classification of primary SQLape categories (SQ1) is even more interesting. They mirror the main treatments or diagnoses determined by the SQLape system based on the evaluation of all diagnoses and procedure codes. The fragmentation is slightly smaller. The first three SQ1 categories cover approximately 80 % of the hospital cases. The first seven SQ1 categories concern the legs ("CRU"), the knees ("GEN") and the foots ("PED"). It would be worthwhile to take a look at the case data in order to judge if SQLape or APR did the groupings of the "PED" cases and of the hospital cases left over in a more adequate manner.

Table 21: Example: APR 313 according to SQp (f=0.77, n=21378): Knee & lower leg procedures except foot

APR	Cases	%APR	%SQp	Type	MDC	SQp	SQp label
313	8372	39.2	96.4	C	L	CRU3	Major operation on leg
313	4279	20.0	89.6	C	L	GEN2	Excision of knee structures
313	2590	12.1	33.9	C	L	GEN4	Open operation on knee
313	2350	11.0	41.4	C	L	ART1	Arthroscopy or traction
313	1133	5.3	65.3	C	L	CRU2	Minor operation on leg
313	697	3.3	14.6	C	L	PED2	Minor operation on foot
313	512	2.4	86.9	C	L	GEN3	Other arthroscopic operation on knee
313	425	2.0	21.4	C	L	PED3	Major operation on foot
313	225	1.1	2.5	C	L	OSS2	Removal of internal fixation device
313	109	0.5	3.7	C	L	OSS4	Other operation on unspecified bone
313	101	0.5	6.6	M	L	L-tZ	Other severe injury
313	93	0.4	13.9	C	L	ART3	Major operation on joint
313	64	0.3	3.4	M	L	L-iO	Musculoskeletal system inflammation
313	53	0.2	1.8	C	L	MUS3	Other operation on muscle
313	47	0.2	7.9	M	L	L-dG	Degenerative disease of knee
313	43	0.2	10.1	C	L	OSS3	Excision of unspecified bone
313	40	0.2	1.0	M	L	L-tC	Fracture of pelvis
313	37	0.2	2.2	M	L	L-tJ	Leg injury
313	37	0.2	1.2	M	L	L-tL	Other musculoskeletal injury
313	30	0.1	0.1	M	Z	Z-zZ	Other disorders
313	20	0.1	1.3	C	L	ART2	Minor operation on joint
313	19	0.1	1.2	C	L	MUS2	Excision or suture of muscle
313	17	0.1	0.1	C	T	CUT1	Minor operation on tegument
313	15	0.1	0.3	C	L	BRA4	Forearm minor operation

Table 22: Example: APR 313 according to SQ1 (f=0.74, n=21378): Knee & lower leg procedures except foot

APR	Cases	%APR	%SQ1	Type	MDC	SQ1	SQ1 label
313	9003	42.1	94.7	C	L	CRU3	Major operation on leg
313	4647	21.7	88.1	C	L	GEN2	Excision of knee structures
313	3803	17.8	42.6	C	L	GEN4	Open operation on knee
313	713	3.3	91.2	C	L	GEN3	Other arthroscopic operation on knee
313	621	2.9	59.3	C	L	CRU2	Minor operation on leg
313	608	2.8	23.0	C	L	PED3	Major operation on foot
313	591	2.8	14.5	C	L	PED2	Minor operation on foot
313	177	0.8	3.6	M	Z	Z-zM	Without valid information
313	161	0.8	4.3	C	L	MUS3	Other operation on muscle
313	148	0.7	1.8	C	L	OSS2	Removal of internal fixation device
313	146	0.7	15.4	C	L	ART3	Major operation on joint
313	113	0.5	6.8	C	L	ART2	Minor operation on joint
313	62	0.3	11.4	C	L	OSS3	Excision of unspecified bone
313	48	0.2	1.3	M	L	L-iO	Musculoskeletal system inflammation
313	39	0.2	0.5	C	L	COX4	Other major operation on hip
313	38	0.2	1.3	C	L	OSS4	Other operation on unspecified bone
313	33	0.2	0.4	M	N	N-fC	Epilepsy
313	32	0.1	12.5	C	L	COX3	Minor operation on hip
313	24	0.1	1.3	C	N	NER3	Operation on nerves
313	23	0.1	0.2	M	U	U-iU	Urinary infection
313	22	0.1	2.1	M	L	L-tZ	Other severe injury
313	21	0.1	0.6	C	L	SCA3	Other major operation of shoulder
313	15	0.1	0.2	C	C	COR2	Heart operation without circulatory assistance
313	15	0.1	0.1	M	S	S-mS	Lymphoma, other leukemia or hematopoetic malignat neoplasm without complication
313	13	0.1	0.1	C	D	ABD3	Unilateral repair other hernia
313	12	0.1	0.4	M	P	P+xS	Chronic substance abuse
313	11	0.1	0.5	M	C	C-zC	Other cardiac disease
313	11	0.1	0.3	M	L	L-tC	Fracture of pelvis
313	10	0.0	0.2	C	C	VAS2	Operation on varicose limb veins

6 Discussion and prospects

It has been revealed that the fractionation coefficient is basically an interesting measure to describe the relative difference in the nature of patient classification systems.

In the following, a number of discussion points are listed, which at the same time serve as suggestions for further work.

↑ p. 7

Standardisation of the major diagnostic categories:

- Following the example of the IR-DRG system, major diagnostic categories with few groups and hospital cases could be subsumed. This would concern HIV, for instance, which would be assigned to infections, or polytraumata, which would be divided up among various major diagnostic categories.
- The DRGs of the former major diagnostic category of transplantations and tracheostomies was dispersed within the IR-DRG system. In analogy, the base DRGs in other DRG systems could be removed from this major diagnostic category and assigned to the main categories of the organ systems concerned.
- Besides major diagnostic categories, "DRG-Klassen" could be introduced as an additional hierarchical level, which would serve to unite similar base DRGs in a tighter structure.[27]

↑ p. 6

Base DRGs:

- The definition of base DRGs could be made more precise. In this manner, additional individual DRGs could be subsumed even though the manufacturer defined them as separate DRGs.

↑ p. 8

fractionation coefficient:

- In the weighting process, a distinction could be introduced between groups of the reference system that are positioned within the same DRG subcategory (or within the same DRG-Klasse; cf. above) and others.
- In the aggregation of the fractionation coefficients at the level of subcategory types and at system level, the error groups could be excluded or given special treatment. (In particular, this is necessary where the nature of the system results in many false classifications, as for instance with LDF, where transcoding obviously still has many deficiencies.)

↑ p. **??**

Treemaps:

- At present, the colouring of the base DRGs of the reference system is based directly on their code numbers. This will yield acceptable results particularly if the system under scrutiny is structured according to a hierarchy that is similar to that of the reference system. It would be better, however, to colour base DRGs on the basis of a common logical order that would still have to be defined.

↑ p. 24

Pair analysis of patient classification systems:

- So far, a detailed view of individual base DRGs of a original system and their breakdown according to basic case groups of the reference classification has only been provided by means of examples. This should be systematised.

[27] Base DRGs can be subsumed in a "DRG-Klassen", i. e. a kind of "product group" or "product line", according to thematic resemblance. Cf. among others Krüger/Lenz [2004]; http:// www.adimehp.com / G-GHM.htm; Buronfosse et al. [OAP manuel 3.0, 2003]; Buronfosse et al. [OAP court séjour, 2002]; Ruiz [GA+GF, 1999], as well as the "product lines" in the PMC system: PRI [PMC-Rel.5, 1993].

- Some information could be added about the proportions of the cost weights.
- A way of representing the breakdown of a base DRG into several selected reference classifications should be developed.
- Comparisons between DRGs and SQLape categories still require further development.

Thematic comparisons: ↑ p. 26

- DRG systems could be compared with each other in thematic terms, as some examples adduced in this text have shown.

Further fields of application:

- The fractionation coefficient can be used to analyse the correspondence between a DRG system and an alternative patient classification system (such as the »mipp› system[28] used by individual hospitals in the Swiss Canton of Aargau).
- The fractionation coefficient and treemaps in particular could be used to detect coding differences within individual DRGs.
- The fractionation coefficient and treemaps could be used to visualise differences of versions of a single DRG system from year to year.

[28] Cf. Rieben et al. [Pfadkostenrechnung, 2003]: 29 ff.

7 Appendix

7.1 Table of abbreviations

Table 23: Abbreviations and Links

Abbreviation	Designation	Links and references
AP-DRG	All Patient Diagnosis Related Groups	http:// www.fischer-zim.ch / text-pcssa / t-ga-E4-System-AP-0003.htm
APR-DRG	All Patient Refined Diagnosis Related Groups	http:// www.fischer-zim.ch / text-pcssa / t-ga-E5-System-APR-0003.htm
AR-DRG	Australian Refined Diagnosis Related Groups	http:// www.fischer-zim.ch / artikel / ARDRG-0105-SGMI.htm
CCS	Clinical Classification Software	http:// www.ahrq.gov / data / hcup / ccsicd10.htm
CC	Comorbidity or Complication	
CHUV	Centre hospitalier universitaire vaudois	http:// www.hospvd.ch / public / chuv /
DRG	Diagnosis Related Groups	http:// www.fischer-zim.ch / streiflicht / DRG-Familie-9512.htm
D.S.	Disease Staging	http:// www.fischer-zim.ch / streiflicht / Disease-Staging-9603.htm
EfP	Effeuillage Progressif	http:// www.fischer-zim.ch / text-pcssa / t-ga-E8-System-GHM-0003.htm#zimEfP
G-DRG	German Diagnosis Related Groups	http:// www.g-drg.de /
G-GHM	Groupements de Groupes Homogènes de Malades	http:// www.adimehp.com / G-GHM.htm
GHM	Groupes homogènes de malades	http:// www.atih.sante.fr /
LDF	Leistungsbezogene Diagnosen-Fallgruppen	http:// www.bmgf.gv.at / cms / site / themen.htm ? channel=CH0005
IR-DRG	International Refined Diagnosis Related Groups	http:// www.3m.com / us / healthcare / his / pdf / reports / ir_drg_whitepaper_09_02.pdf
MCC	Major Comorbidity or Complication	
MDC	Major Diagnostic Category	
»mipp›	Modell integrierter Patientenpfade	http:// www.mipp.ch /
OAP	Outil d'Analyse PMSI	http:// membres.lycos.fr / pradeau / PMSI / telechargements / OAP_acceuil.htm
PMC	Patient Management Categories	http:// www.fischer-zim.ch / streiflicht / PMC-9511.htm
PMSI	Programme de médicalisation des systèmes d'information	http:// www.le-pmsi.org / index.html
RDRG	Refined Diagnosis Related Groups	http:// www.fischer-zim.ch / text-pcssa / t-ga-E3-System-RDRG-0003.htm
SFSO	Swiss Federal Statistical Office	http:// www.bfs.admin.ch /
SQ1	Primary SQLape category	(For this study only)
SQLape	Striving for Quality Level and Analysis of Patient Expenditures	http:// www.sqlape.com /
SQp	SQLape main treatment category	(For this study only)
SwissDRG	Swiss Diagnosis Related Groups	http:// www.swissdrg.org /
ZIM	Zentrum für Informatik und wirtschaftliche Medizin	http:// www.fischer-zim.ch /

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