



Direktoratet for  
e-helse

# SNOMED CT in a Dental EHR

By Peggy Hauge Moe and Jørn André Jørgensen

- Norway

# Participants

## Organizations

- Norwegian Directorate of e-health
- Norwegian Directorate of health
- Oral health centre of expertise in Mid-Norway
- Opus Systemer AS
- Vest-Agder County
- SNOMED International

# Clinic



Structured and unified registration  
(SNOMED CT, interfaceterminology and graphics)

Decision support  
Assertional knowledge

Structured and standardized storage  
(SNOMED CT)



# Authorities

Classifications for statistics and health monitoring

Reimbursement

# Research

Granular clinical data for practical research

High-level data for population research

# Clinical data with SNOMED CT in EHR Opus Dental

- Unique and unlimited reporting opportunities
- Solid source for research purposes with structured data directly from the EHR

The screenshot shows the 'SNOMED Statistics' window. On the left, there are search filters: Municipality, School, From - to (17.10.2019), Report year (2019), Gender (M&K), and Provider/Clinic/Company/Organization. A blue arrow points from the filter area to the data table. The table contains columns for SCTText\_Bodysite, SCTID\_Surface, SCTText\_Surface, SCTID, SCTText, SCTID\_Procedure, SCTText\_Procedure, SCTID\_Attribute, SCTText\_Attribute, Value, UO, ECLm, and ECLh. The data table is partially visible, showing various dental procedures and conditions.

SCTText_Bodysite	SCTID_Surface	SCTText_Surface	SCTID	SCTText	SCTID_Procedure	SCTText_Procedure	SCTID_Attribute	SCTText_Attribute	Value	UO	ECLm	ECLh
ISO designation 11	773310004	Structure of oral surface of tooth (body structure)	82212003	Erosion of tooth							82212003	82212003 Erosion of tooth
ISO designation 16	773310004	Structure of oral surface of tooth (body structure)	733941004	Primary active dental caries extending into outer third of dentin (disorder)							733941004	733941004 Primary active dental caries extending into out
ISO designation 46	90933009,83473006,8483002	Structure of distal surface of tooth (body structure)	234787002	Insertion of amalgam restoration into tooth	408730004	Procedure context	773277008	Previously performed			234787002 : 408730004 = 773277008	234787002 Insertion of amalgam restoration into tooth  : 40
ISO designation 46	773310004	Structure of oral surface of tooth (body structure)	48947008	Abnormal tooth attrition							48947008	48947008 Abnormal tooth attrition
ISO designation 15	83473006	Structure of occlusal surface of tooth (body structur	733941004	Primary active dental caries extending into outer third of dentin (disorder)							733941004	733941004 Primary active dental caries extending into out
ISO designation 15	62579006	Structure of vestibular surface of tooth (body struct	47222000	Abrasion of tooth							47222000	47222000 Abrasion of tooth
ISO designation 46	3262009	Structure of root canal of tooth (body structure)	39273001	Apical periodontitis							39273001	39273001 Apical periodontitis
ISO designation 37	83473006	Structure of occlusal surface of tooth (body structur	733941004	Primary active dental caries extending into outer third of dentin (disorder)							733941004	733941004 Primary active dental caries extending into out
ISO designation 35	83473006	Structure of occlusal surface of tooth (body structur	733941004	Primary active dental caries extending into outer third of dentin (disorder)							733941004	733941004 Primary active dental caries extending into out
ISO designation 43	8483002	Structure of mesial surface of tooth (body structure)	733940003	Primary active dental caries extending into inner half of enamel (disorder)							733940003	733940003 Primary active dental caries extending into inn
ISO designation 17	83473006	Structure of occlusal surface of tooth (body structur	234789004	Insertion of composite restoration into tooth (procedure)	408730004	Procedure context	398166005	Performed			234789004 : 408730004 = 398166005	234789004 Insertion of composite restoration into tooth (p
ISO designation 47	83473006	Structure of occlusal surface of tooth (body structur	733941004	Primary active dental caries extending into outer third of dentin (disorder)							733941004	733941004 Primary active dental caries extending into out
ISO designation 28			278661005	Tooth present							278661005	278661005 Tooth present
ISO designation 38			278661005	Tooth present							278661005	278661005 Tooth present
ISO designation 38			235104008	Impacted tooth							235104008	235104008 Impacted tooth
Mouth region structure			34043003	Dental consultation and report	408730004	Procedure context	398166005	Performed			34043003 : 408730004 = 398166005	34043003 Dental consultation and report  : 408730004 Pro
Mouth region structure			48450000	Radiography of head (procedure)	408730004	Procedure context	398166005	Performed			48450000 : 408730004 = 398166005	48450000 Radiography of head (procedure)  : 408730004
ISO designation 15	83473006	Structure of occlusal surface of tooth (body structur	234789004	Insertion of composite restoration into tooth (procedure)	408730004	Procedure context	398166005	Performed			234789004 : 408730004 = 398166005	234789004 Insertion of composite restoration into tooth (p

# Quality with structured data from the source: The dental record

Opus Dental 7.1.827.0 - <Test-Tannlege Jørn Andre Jørgensen> 17.10.2019

20003 Danser Line 13.11.1969-00216

Reg Health Record App.Bk Search Today Recall Appmts Cash Kort Invoice Paym W.Proc Update

In-/Outbox 0002 Tannlege Jørn Andre Jørgensen

**Record**

**Diagnosis**

- Caries
- Defect
- Fracture
- Overhang
- NB
- Endo.
- Perio.
- Trauma
- Ortho.
- TMD
- Aplasia
- Retained
- Supernum.
- Root rem.
- Oral m.
- Surgery
- Misc.

**Completed**

- Exam.
- X-ray
- Proph.
- Hygiene
- Anaest.
- Amalgam
- Comp.
- Glass
- Temp. fill.
- Gold
- Porc.
- Façade
- Dental tech.
- Epidem
- Sales
- Finance
- Crown
- Temp. crown
- Bridge a.
- Bridge p.
- Prost.
- Impl.
- Pillar
- Endo.
- Ortho.
- TMD
- Oral m.
- Extr.
- Surgery
- Root sep.
- Misc.

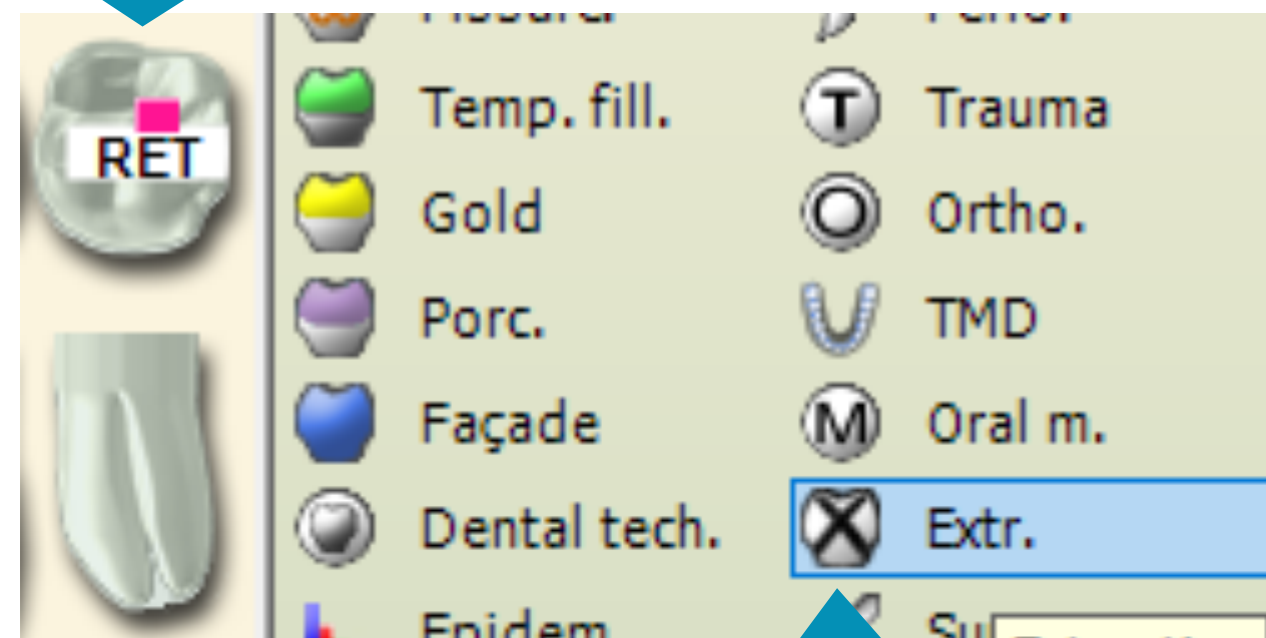
Structured data

#	ID	Logi	Date	Group	To	Srvc	Prod. no.	T	Min	Text	Dekn.type	S	T	Off.hon	Direkte	Pasient	Lab	Fee	S	Sign	F
u	0002	Pe...	05.03.2019	MISC				M		Pasienten har vondt i tannen 27 og dette skyldes caries								0,00	Y		
u	0002	Pe...	05.03.2019	PREV. ...	26	MOB				Amalgamfylling											
u	0002	Pe...	05.03.2019	PREV. ...	25	OBP				Amalgamfylling											
u	0002	Pe...	05.03.2019	PREV. ...	23	B				Porselensfasade											
u	0002	Pe...	05.03.2019	MISC	24	P				Tilbakeført 17.10.2019: Tannfarget								0,00	Y		
u	0002	Pe...	21.03.2019	PROSTH	36		304-1	M		Helkrone						1935,00	1000	1 935,00	Y		
u	0002	Pe...	21.03.2019	SALES				M		tannbørste						200,00		200,00	Y		
u	0002	Pe...	21.03.2019	PAYM						Betaling - kontant, spesifisert kvitt. nr. 1						-20265,00		-20 265,00	Y		
u	0002	Pe...	17.10.2019	MISC	24	P				Tilbakeføring av: 05.03.2019 Tannfarget								0,00	Y		
u	0002	Pe...	17.10.2019	MISC			1-2	M		Moved: Undersøkelse, recall						300,00		300,00	N		
u	0002	Pe...	17.10.2019	X-RAY			802-1	M		Moved: Tannrøntgen, pr bilde (2 å kr 55)						110,00		110,00	N		
d	0002	Pe...	17.10.2019		11	P				Erosjon											
d	0002	Pe...	17.10.2019	CARIES	16	P				Karies 3											
u	0002	Pe...	17.10.2019	PREV. ...	46	MOD				Amalgamfylling											
d	0002	Pe...	17.10.2019		46	L				Attrisjon											
d	0002	Pe...	17.10.2019	CARIES	15	O				Karies 3											
d	0002	Pe...	17.10.2019		15	B				Abrasjon											
d	0002	Pe...	17.10.2019	ENDO	46	r.				Apikal											
d	0002	Pe...	17.10.2019	CARIES	37	O				Karies 3											
d	0002	Pe...	17.10.2019	CARIES	35	O				Karies 3											
d	0002	Pe...	17.10.2019	CARIES	43	M				Karies 2											
u	0002	Pe...	17.10.2019	REST	17	O	201	M		Preparering og fylling med kompositt						240,00		240,00	N		
d	0002	Pe...	17.10.2019	CARIES	47	O				Karies 3											
d	0002	Pe...	17.10.2019	MISC	38					Retinert tann											
u	0002	Pe...	17.10.2019	REST	15	O	201	M		Preparering og fylling med kompositt, 1 flate						240,00		240,00	N		

Direkte: 0,00 Pasient 890,00 Provider 890,00 Total 890,00

# The key – easy to get reliable data

1) Mark tooth/surface



2) Select category of treatment

A screenshot of the 'New record entry' form in a dental software. The form shows a text field with 'Ukomplisert ekstraksjon', a list of predefined record texts, and a 'Spec. cause' section with radio buttons for (caries), (periodontitis), (orthodontics), (trauma), (exfoliated), and (other cause). The 'Spec. cause' section is highlighted with a blue callout box.

Code	Description	Price
401	Ukomplisert ex av ytterligere tann eller rot i samme kjeve-region	175,00
401	Ukomplisert ekstraksjon	300,00
405-1	Komplisert ex	1165,00
405-2	Fjerning av retinert tann / rot	1165,00

Fee

Hourly  
 High  
 Middle 300,00  
 Low  
 Own

Code 401  
Pricecode 601  
Ins. code

Dental labshare VAT Ref.hon Ref.andel Pas.andel Amount  
0 300 300,00

Treatmentdate 17.10.2019 21:10

Attach file(s) OK Cancel

3) Select predefined record text

4) Select the cause

**No changes for the provider.**

**The provider performs normal workflow and procedure in the EHR.**

**It is easy for the providers to start using SNOMED CT in their**

**documentation.**

# The key – easy to get reliable data

5) Result: automatic coding with SNOMED CT

SCTText_Bodysite	SCTID	SCTText	SCTID_Due to	SCTText_Due to	SCTID_Due to Attribute	SCTText_Due to Attribute	SCTID_Procedure	SCTText_Procedure	SCTID_Attribute	SCTText_Attribute
ISO designation 38	55162003	Tooth extraction	42752001	Due to	80967001	Dental caries	408730004	Procedure context	398166005	Performed

ECLm

55162003 : 42752001 = 80967001, 408730004 = 398166005

ECLh

55162003 |Tooth extraction| : 42752001 |Due to| = 80967001 |Dental caries|, 408730004 |Procedure context| = 398166005 |Performed

- **SNOMED CT generated automatically from a normal EHR workflow.**
- **No requirements of knowledge of the terminology SNOMED CT for the users of EHR.**
- **The SNOMED CT mapping behind the user interface of the EHR results in reliable data.**

# Periodontal charting – values included in SNOMED report

Mapped all fields in the Periodontal charting with six-area per tooth focus (procedure) to SNOMED CT, implemented using of ECL to expresses the values

OrgNo	Firmanavn	Pasientnr	Personnr	Etternavn	Fornavn	Dato	HPRNr	SCTID_Bodysite	SCTText_Bodysite	SCTID_Surface	SCTText_Surface	SCTID	SCTText
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		22120004	ISO designation 11	289913003	Mesiopalatal surface of tooth root (body structure)	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	289912008	Distobuccal surface of tooth root (body structure)	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	773297003	Vestibular surface of tooth root	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	289911001	Mesiobuccal surface of tooth root (body structure)	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	289914009	Distopalatal surface of tooth root (body structure)	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	773309009	Structure of oral surface of tooth root	286546002	Depth of periodontal pocket (observable entity)
987999587	Test-Tannlege Jørn Andre Jørgensen	20001	210164-00952	Dottno	Finn	01.01.2018 00:10:00		57826002	ISO designation 14	289913003	Mesiopalatal surface of tooth root (body structure)	286546002	Depth of periodontal pocket (observable entity)

ECLm	ECLh
782631009 : 408730004 = 398166005	782631009  Periodontal charting with six-area per tooth focus (procedure)  : 408730004  Procedure context  = 398166005  Performed
286546002 : 83568003 = #4, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #4, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #6, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #6, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #3, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #3, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #4, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #4, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #5, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #5, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #5, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #5, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)
286546002 : 83568003 = #2, 73298004 = 258673006	286546002  Depth of periodontal pocket (observable entity)  : 83568003  Has value (qualifier value)  = #2, 73298004  Has units (qualifier value)  = 258673006  Millimeter (qualifier value)



# What is already performed?

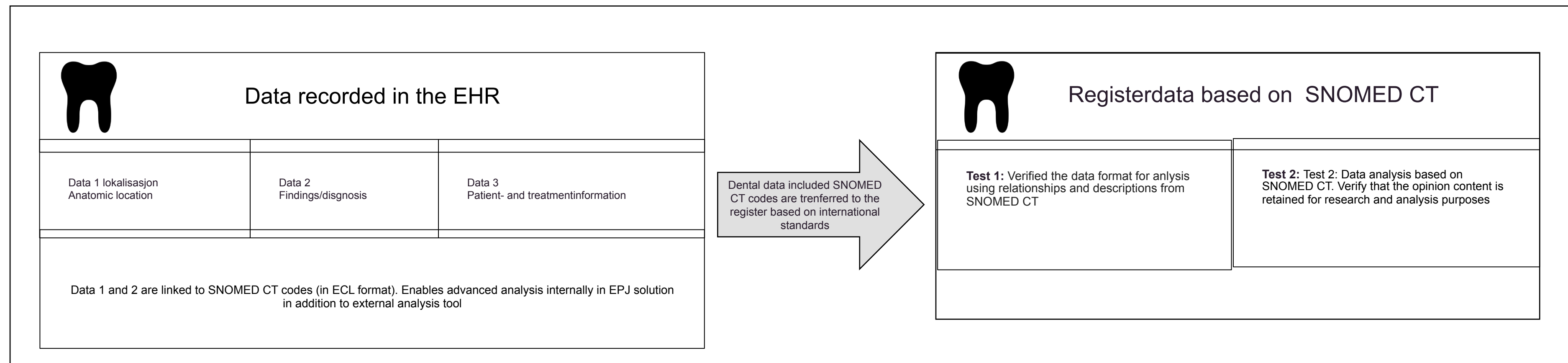
- 1) Defined the standard set of data needed for the description message – analyzed the existing data
- 2) Mapped all body sites to SNOMED CT – tooth, surfaces, root surfaces, root canals, mouth region
- 3) Mapped all opportunities of registration within status, diagnosis, findings, therapy, previously performed, performed from Opus internal codes to SNOMED CT, and using ECL to express context
- 4) Mapped all fields in the Periodontal charting with six-area per tooth focus (procedure) from Opus internal codes to SNOMED CT, and using Expression Constraint Language to express values
- 5) Converted all historical data
- 6) Enabled advanced analysis internally in EPJ in addition to external analysis tool
- 7) Made a selection of data to be transferred to a central dental registry

# Completed pilot project

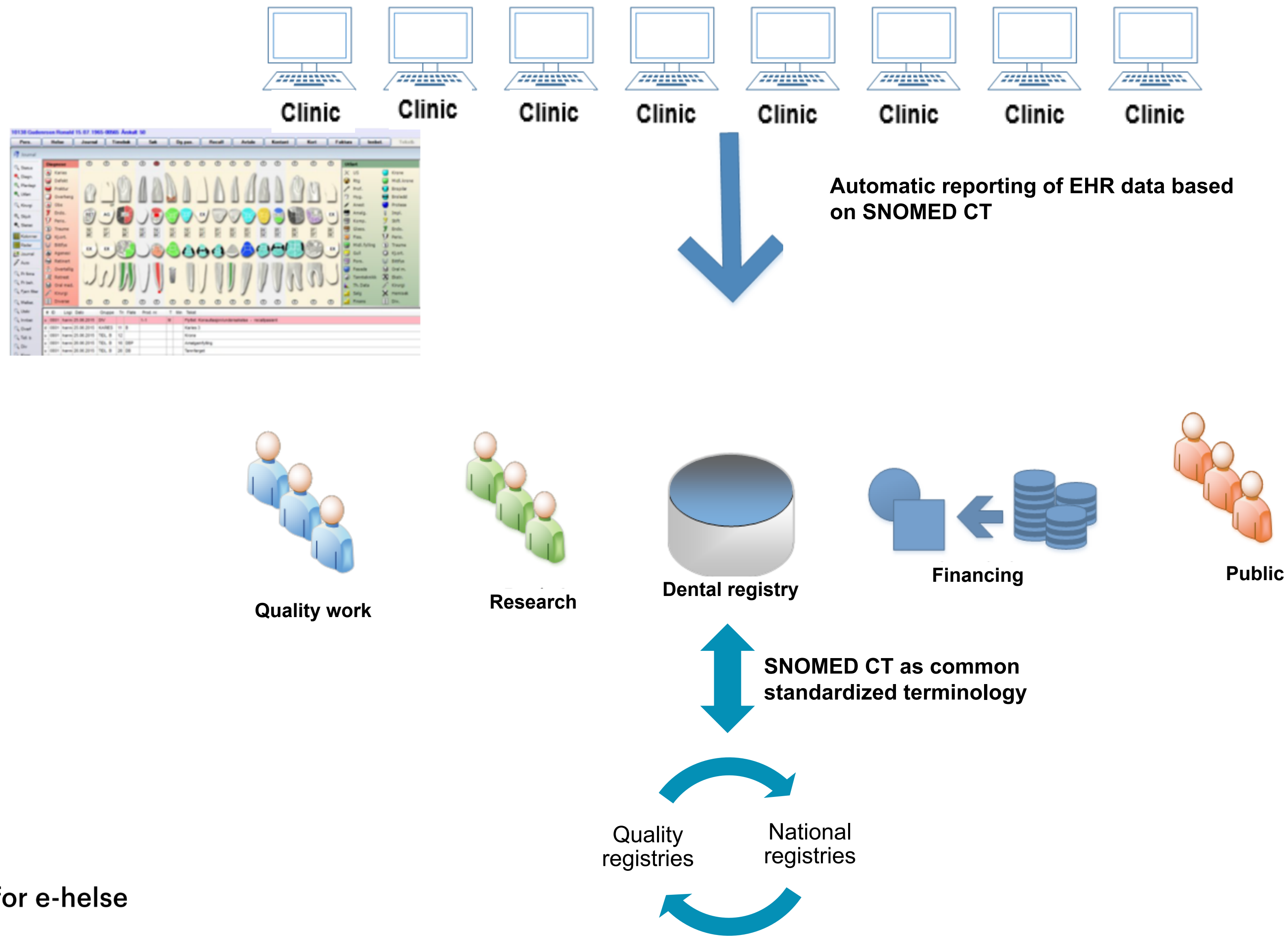
Production of data  
in EHR

Transferred  
to register

Analysis



# Advanced analysis made possible, both internally in EHR and in external analysis tools



# Building the use-case (- and a small disclaimer...)

- The project aims at demonstrating the potential for data collection and analysis using SNOMED CT
- Analysis of data for dental research is out of scope
- We have used a simple method of analysis – so far

# Material

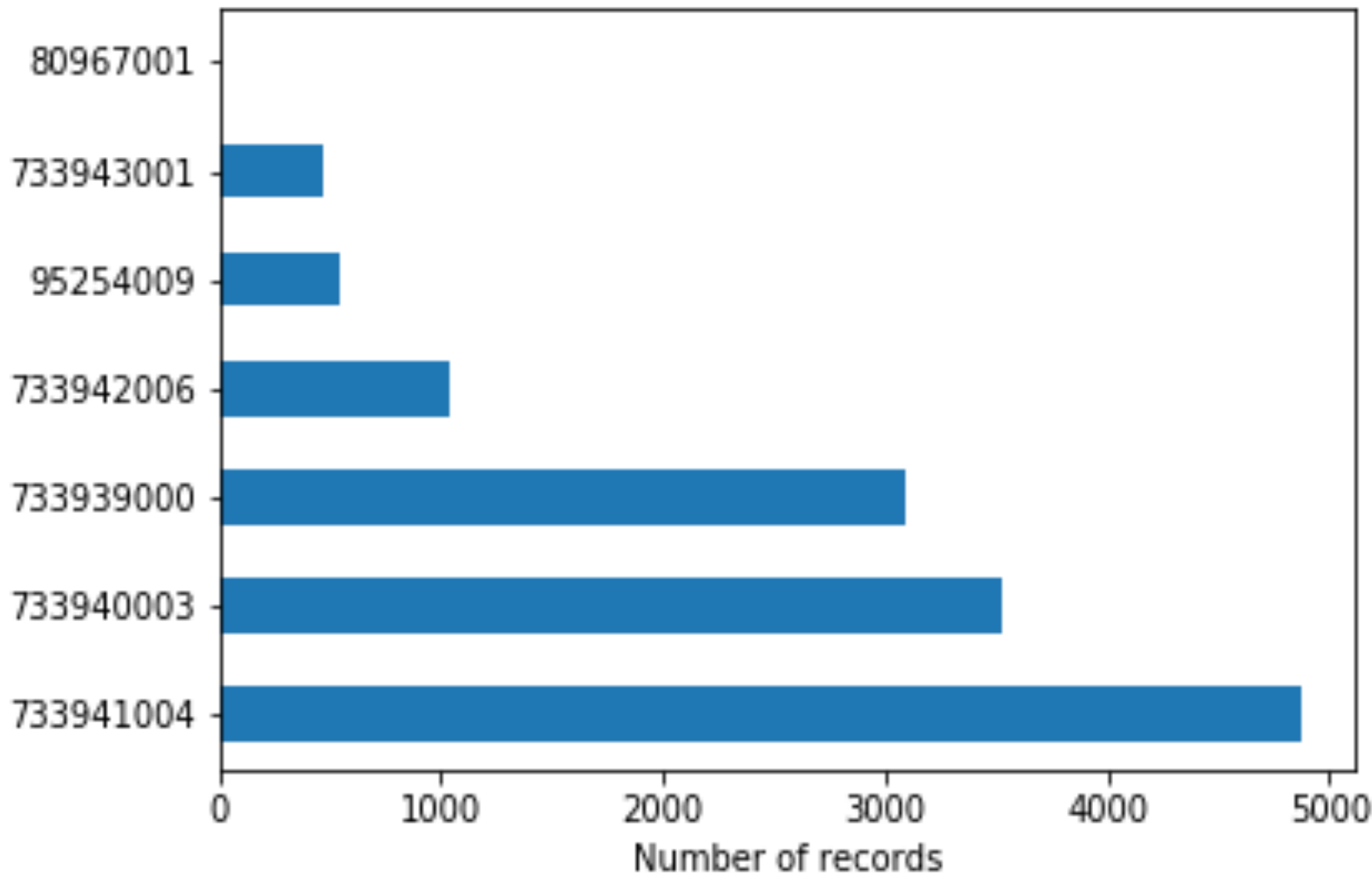
- 10 377 879 registrations in the dental records with Snomed CT codes
- Population: 136 324 patients
- Historical data extending over a period of 25 years back to October 1994

# SNOMED CT based analysis (limited to 100.000 lines)

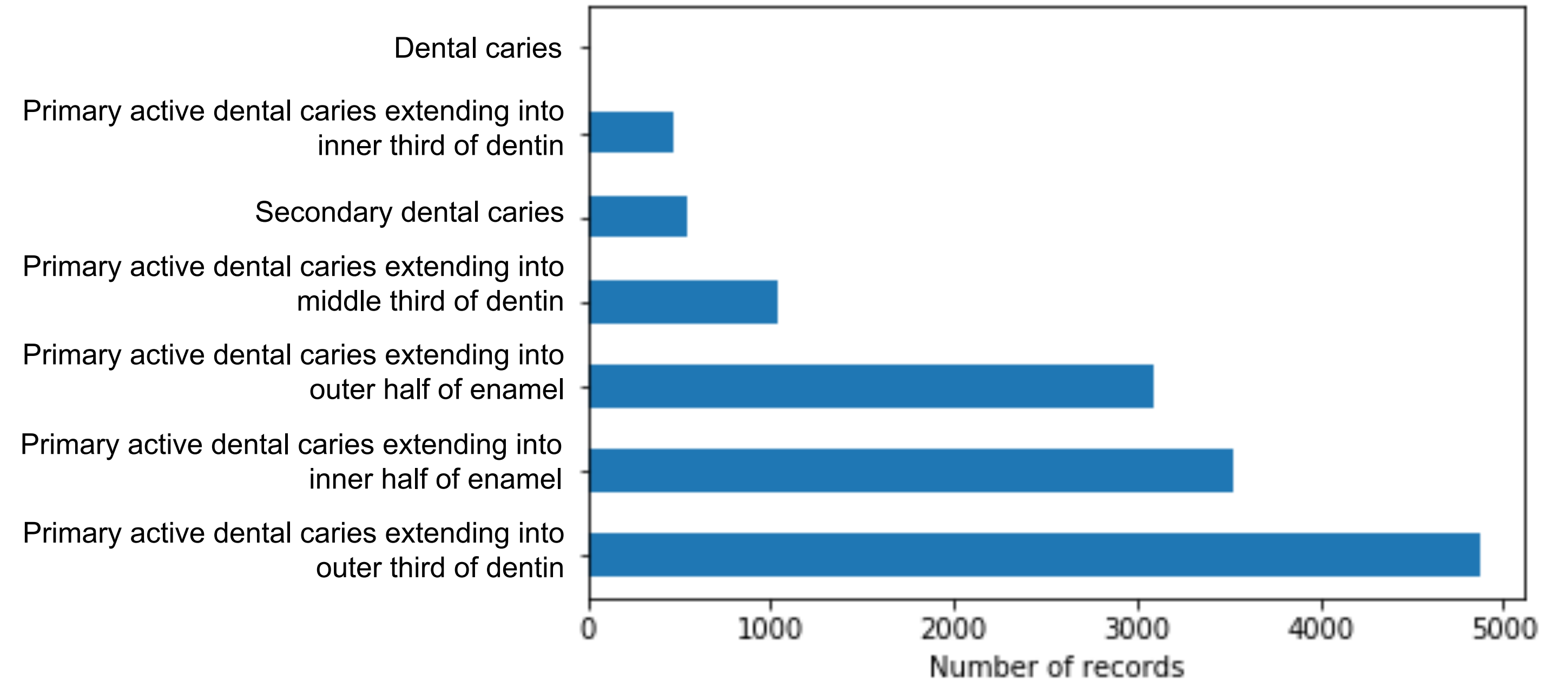
## «Is-a» subsumption

## Causative agent = Bacteria

Snomed counts of caries



Diagnosis caused by bacterias



**Caries is the only disease with a causative agent of bacteria in the refset**

# Reason for tooth extraction – first permanent premolar

SCTtext_DueToAttribute	Antall
Disturbance of tooth eruption or exfoliation	25
Dental trauma	15
Orthodontic procedure	7669
NULL	486
Periodontitis	754
Dental caries	1907

## Caries, outer third of dentin:

	SCTID	antall
1	733941004	497995

	Pro Text	antall
1	Fissure seal tooth (procedure)	31220
2	Fit post core to tooth	12
3	Fit veneer to tooth	8
4	Insertion of amalgam restoration into tooth	1734
5	Insertion of composite restoration into tooth (p...	91976
6	Insertion of dental bridge abutment (procedure)	136
7	Insertion of dental bridge pontic (procedure)	24
8	Insertion of glass-ionomer restoration into toot...	42680
9	Insertion of temporary dental crown	32
10	Insertion of temporary dental filling in tooth	27129
11	Procedure on mouth (procedure)	33
12	Prosthetic dental implant	4
13	Replacement of tooth with removable denture	164
14	Restoration, crown, single (procedure)	420
15	Restoration, inlay, metallic (procedure)	8
16	Root canal therapy, comprehensive (procedure)	8940
17	Tooth extraction	2064

## Caries, outer third of dentin, deciduous teeth:

	SCTID	antall
1	733941004	114319

	Pro Text	antall
1	Procedure on mouth (procedure)	8
2	Insertion of amalgam restoration into tooth	86
3	Fissure seal tooth (procedure)	2052
4	Root canal therapy, comprehensive (procedure)	595
5	Tooth extraction	792
6	Insertion of temporary dental filling in tooth	10515
7	Insertion of composite restoration into tooth (pr...	1624
8	Insertion of glass-ionomer restoration into tooth...	18810



# Free Text in Oral Medicine and Surgery

Number of registrations

	SCTID	antall
1	423066003	9618
2	107100119107	7849

- Oral Medicine
- Oral Surgery

# Why is SNOMED CT important?

- Structured documentation using an international standard
- Interoperability
- Analytics

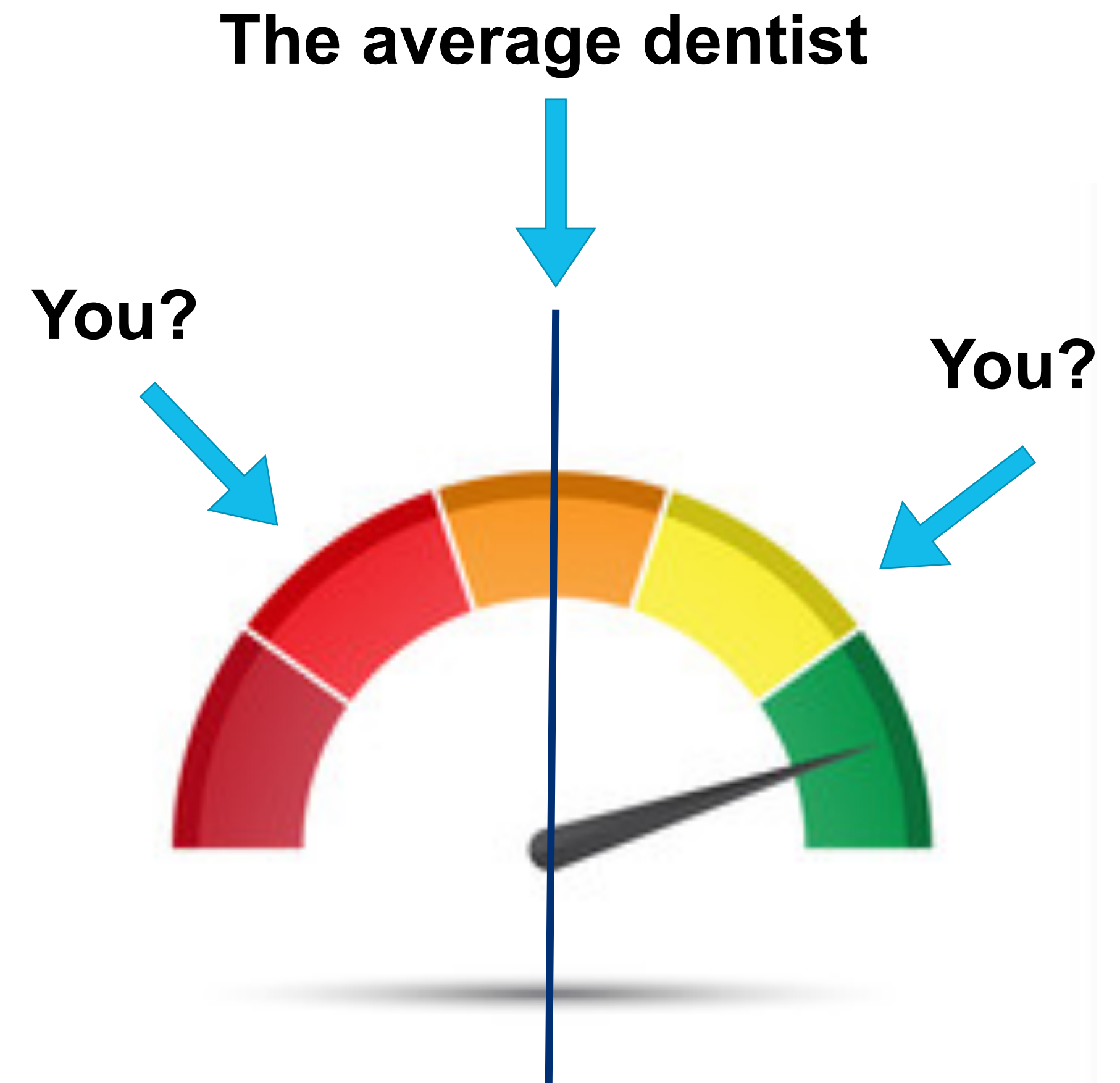
SO WHAT?



WHO CARES?

# Why should the clinician care? (or: What's in it for me?)

- Dashboards measuring:
  - Variation in treatment
  - Lifespan of fillings
  - Lifespans of prosthetics
  - Post operative complications
- Comparisions with cohorts of dentists
- Decision support
- Predefined lists of diagnosis



# The next level – making text structured

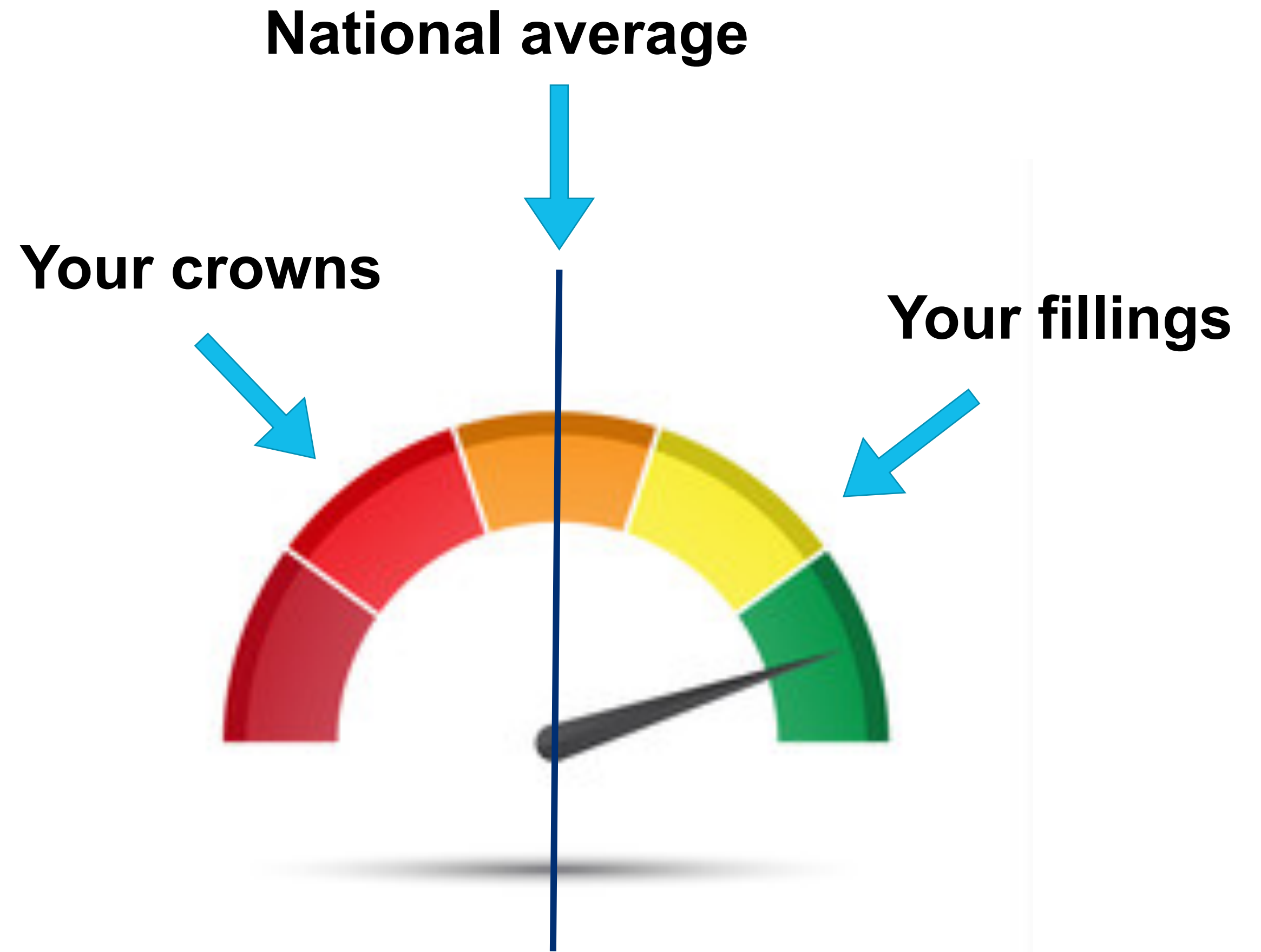
- <<404684003 |Clinical finding| : 363698007 |Finding site| = <<74336005 |Oral soft tissues structure (body structure)|

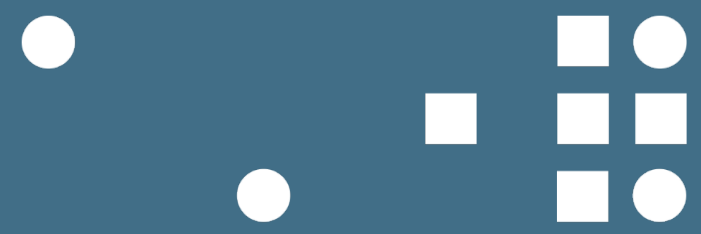
Results: Found 1504 concepts

Concept	Id
Mucous cyst of upper lip (disorder)	1092901000119107
Oral ulcerative mucositis due to antineoplastic therapy (disorder)	1089991000119109
Lesion of oral mucosa (disorder)	1089981000119106
Minimal keratinized residual ridge mucosa (finding)	1089881000119100
Excessive keratinized residual ridge mucosa (finding)	1086851000119100
Cleft of soft palate and cleft lip (disorder)	1085351000119101
Cleft of soft palate and bilateral cleft lip (disorder)	1085341000119103
Cleft palate and bilateral cleft lip (disorder)	1085331000119107
Cleft of hard palate and cleft lip (disorder)	1085301000119100
Uranostaphyloschisis with cleft lip (disorder)	1085291000119101
High attachment of labial frenum (disorder)	433981000124105
Cheilitis due to lupus erythematosus (disorder)	430961000124105
Posterior soft tissue impingement on teeth (disorder)	318161000119106

# Future goal

*Giving the power of analytics to the clinician.*





Direktoratet for  
e-helse

Thank you!