



# **e-Charting in Epidemiological Surveys: The Way Forward**

## **Data Analysis Using Cloud-based e-Charting in Epidemiological Surveys**

**Wouter Put**  
**President DentalCharting**

**IADR** Asia Pacific Region

**Brisbane**

**28.11.2019**



**4th Meeting of the International Association for Dental Research**  
Asia Pacific Region 2019

**28-30 November 2019**

Brisbane Convention & Exhibition Centre, Queensland, Australia

**DentalCharting**  
Clinic Management

India



Netherlands



**DentalCharting**  
Clinic Management



**Radboud  
Universiteit  
Nijmegen**



Philippines



Indonesia



Will  
**e-Charting**  
in combination with  
**statistical analysis**  
help make the world a  
healthier place ?



## Definition

e-Charting is the process of marking the digital dental chart on a laptop/tablet/smartphone screen, which automatically generates instantaneous

- individual patient oral health indicators
- statistics and trends of such indicators for the total patient group/population



# History

**standard**

Classical epidemiological surveys ————— **DMFT**

- Send paper forms to the field and collect data
- Gather collected data centrally
- Process data



**modern**

e-Charting epidemiological surveys — **DMFT/ICDAS + CAST**

- Collect electronic data in the field + Process data



**future ?**

e-Charting epidemiological surveys ————— **CAST**

- Collect electronic data in the field + Process data



# Individual oral health indicators

**Rodriguez, Leo** Smile Dental Clinics Print entire record

**General** Status: Regular patient **History** Add Medical history **Charting** Baseline chart **Finance** Balance: ₱ 0.00 **Scheduler** Next app.: 2016-05-26  
 Birthday: January 1 **Dental history** **Work done chart** Last treated: 2016-05-20

DMFT			CAST	
D	M	F	Overall	
2	0	3	2	5

**i** The DMF overall score is calculated with the following formula:  $D + M + F = \text{overall score}$ .

DMFT			CAST	
D	M	F	Overall	
2	0	3	2	5

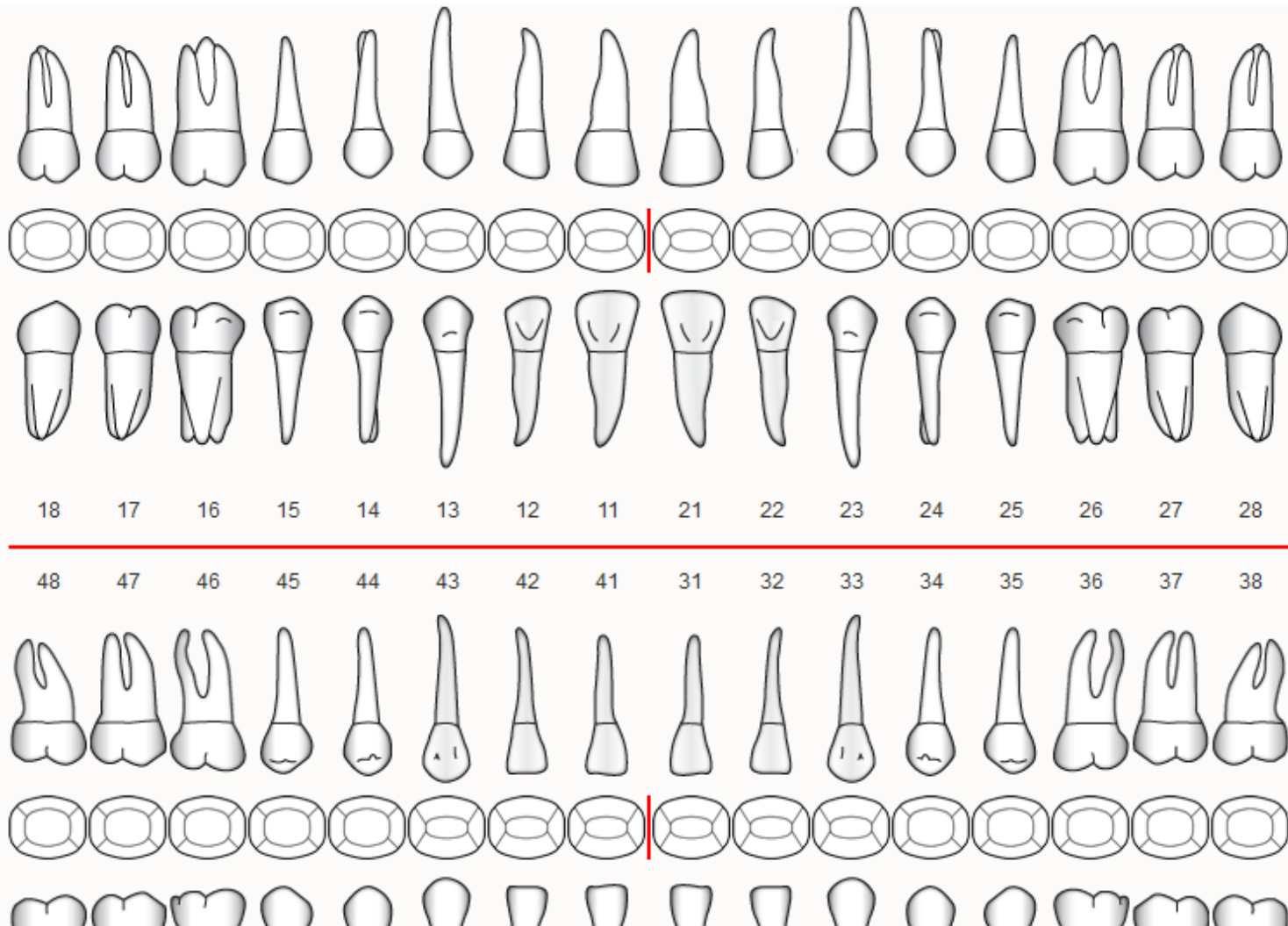
**i** The Cast severity score is calculated as follows:  $\text{Severity} = \text{Pre-morbid} + \text{Morbid} + \text{Mortal}$

DMFT		CAST	
Pre-morbid	Morbid	Sev. morbid	Mortal
0	4	0	0
CAST severity			
4			





# e-Charting



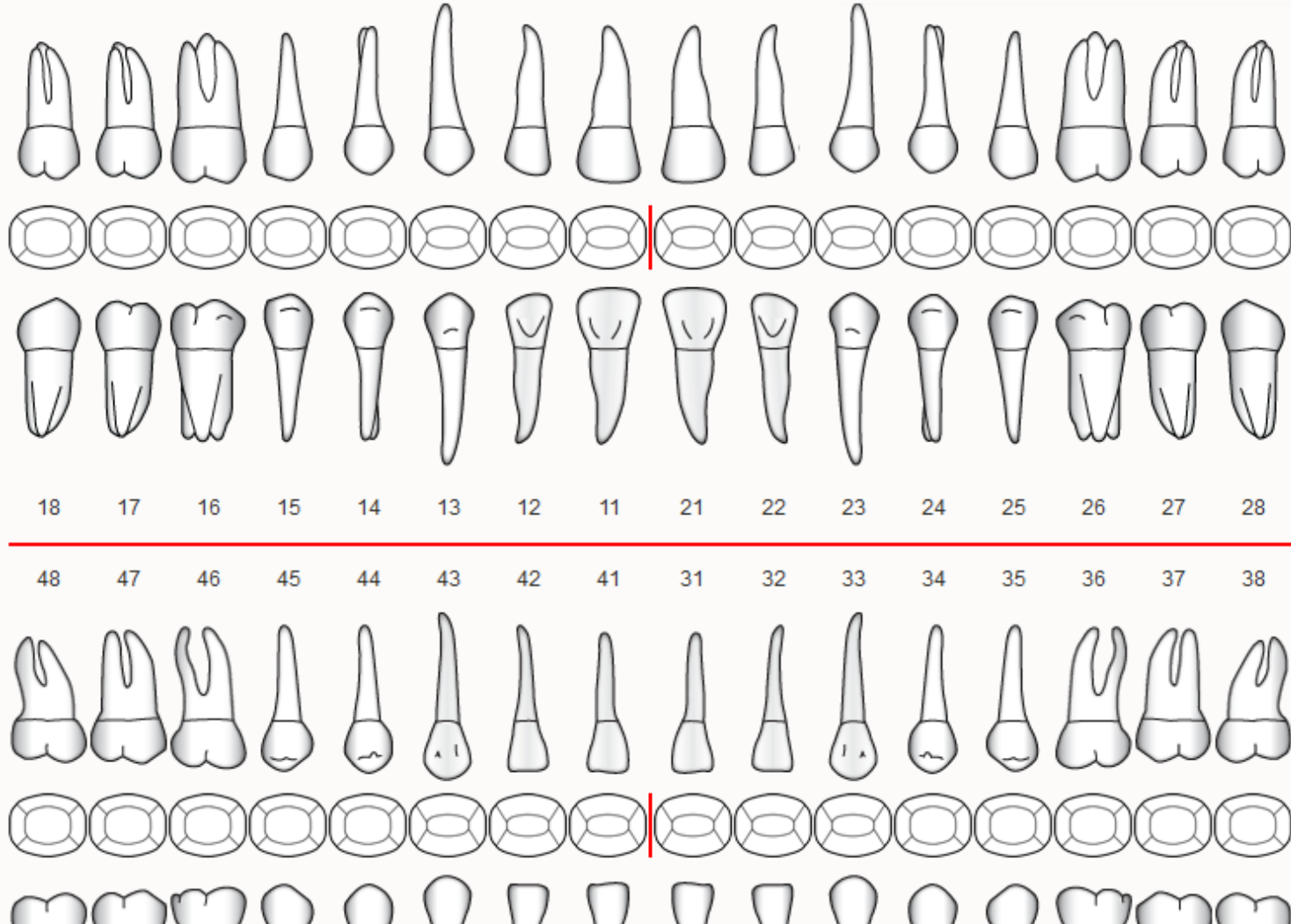
Pick status, drag and drop

- Caries (click to close)	
2ndCar Secondary ...	C1Li Dental Car...
C10 Dental Car...	C2D Dental Car...
C2DO Dental Car...	C2DOB Dental Car...
C2DOLi Dental Car...	C2M Dental Car...
C2MO Dental Car...	C2MOB Dental Car...
C2MOD Dental Car...	C2MOLi Dental C...
C3D Dental Car...	C3M Dental Car...
C3MD Dental Car...	C4DI Dental Car...
C4MDI Dental Car...	C4MI Dental Car...
C5CB Dental C...	C5CLa Dental Car...
C5CLi Dental Car...	C6BC Dental Car...
C6Lic Dental Car...	



# e-Charting

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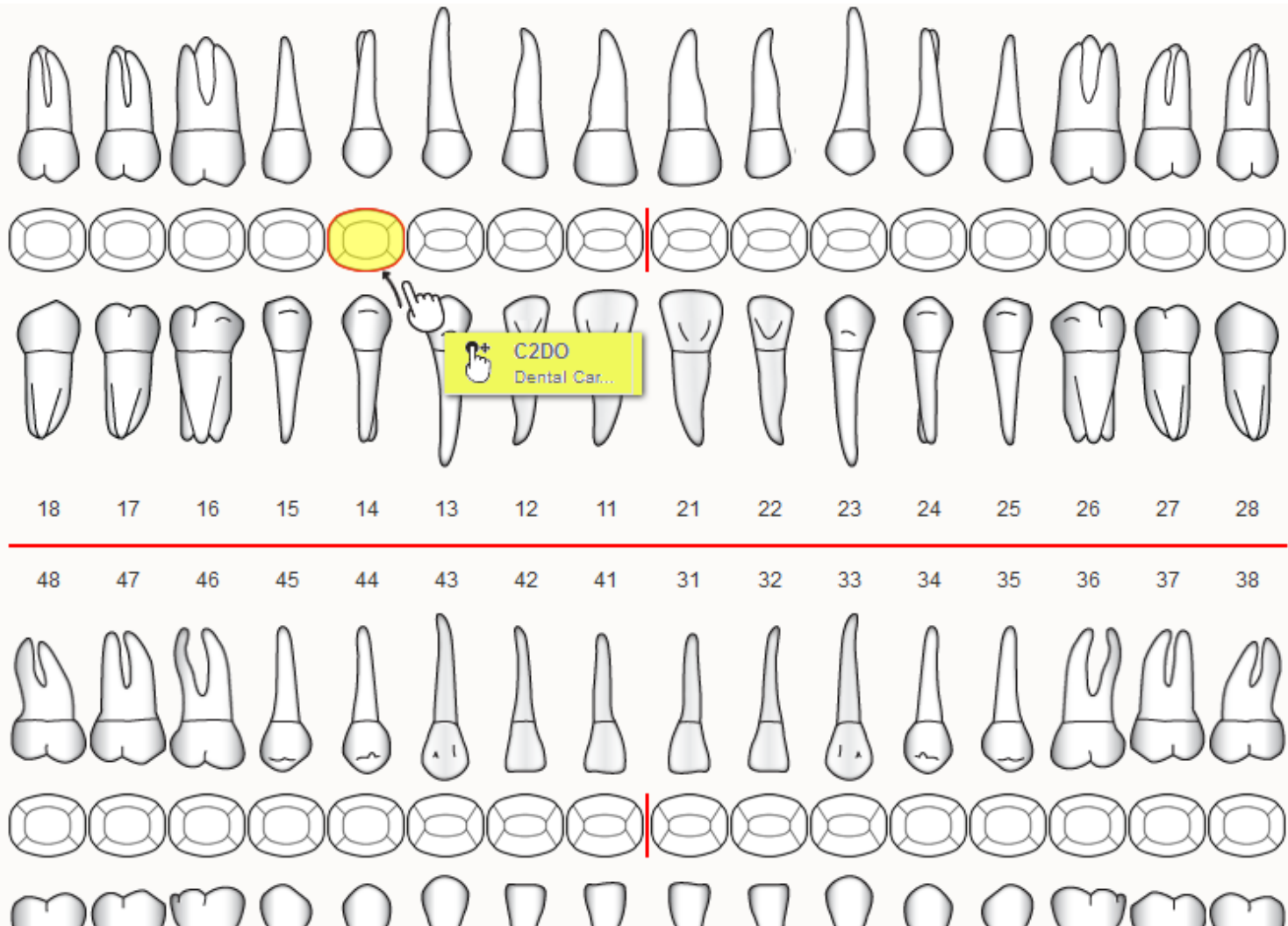
Pick status, drag and drop

Caries (click to close)	
<b>2ndCar</b> Secondary ...	<b>C1Li</b> Dental Car...
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<b>C2MOD</b> Dental Car...	<b>C2MOLi</b> Dental C...
<b>C3D</b> Dental Car...	<b>C3M</b> Dental Car...
<b>C3MD</b> Dental Car...	<b>C4DI</b> Dental Car...
<b>C4MDI</b> Dental Car...	<b>C4MI</b> Dental Car...
<b>C5CB</b> Dental C...	<b>C5CLa</b> Dental Car...
<b>C5CLi</b> Dental Car...	<b>C6BC</b> Dental Car...
<b>C6LiC</b> Dental Car...	





# e-Charting

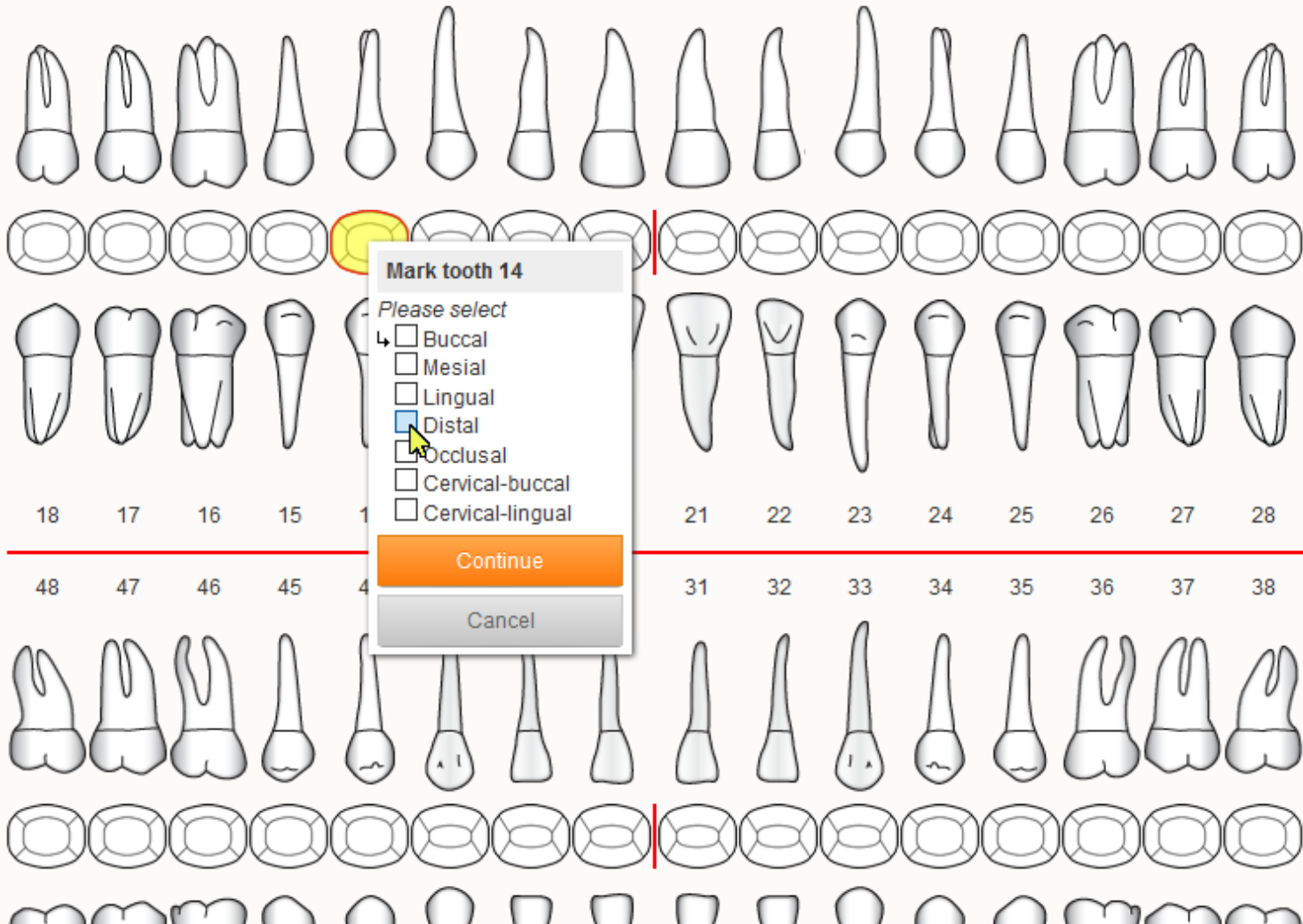


Pick status, drag and drop

Caries (click to close)	
2ndCar Secondary ...	C1Li Dental Car...
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# e-Charting



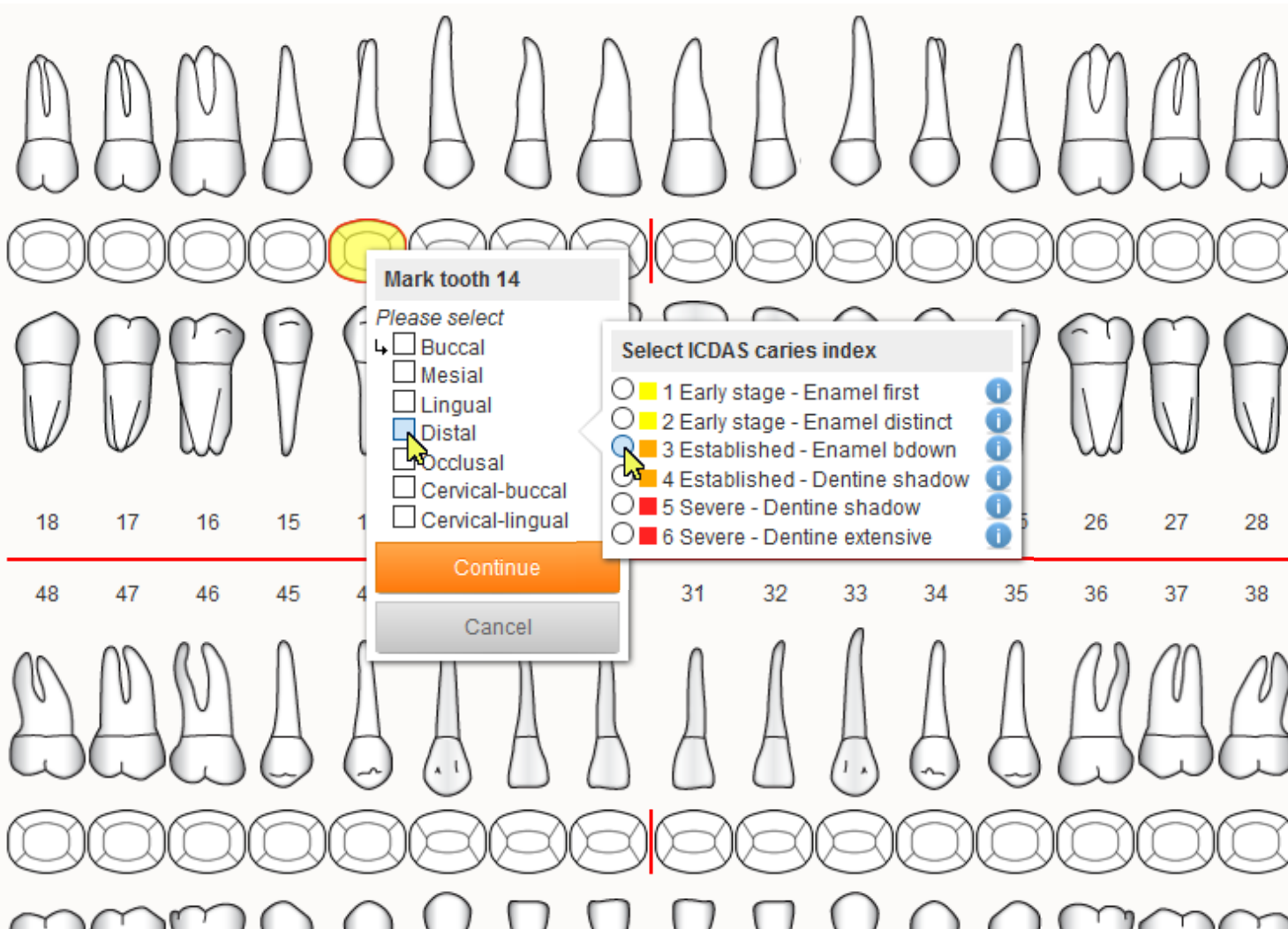
Pick status, drag and drop

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# e-Charting

DentalCharting  
Clinic Management



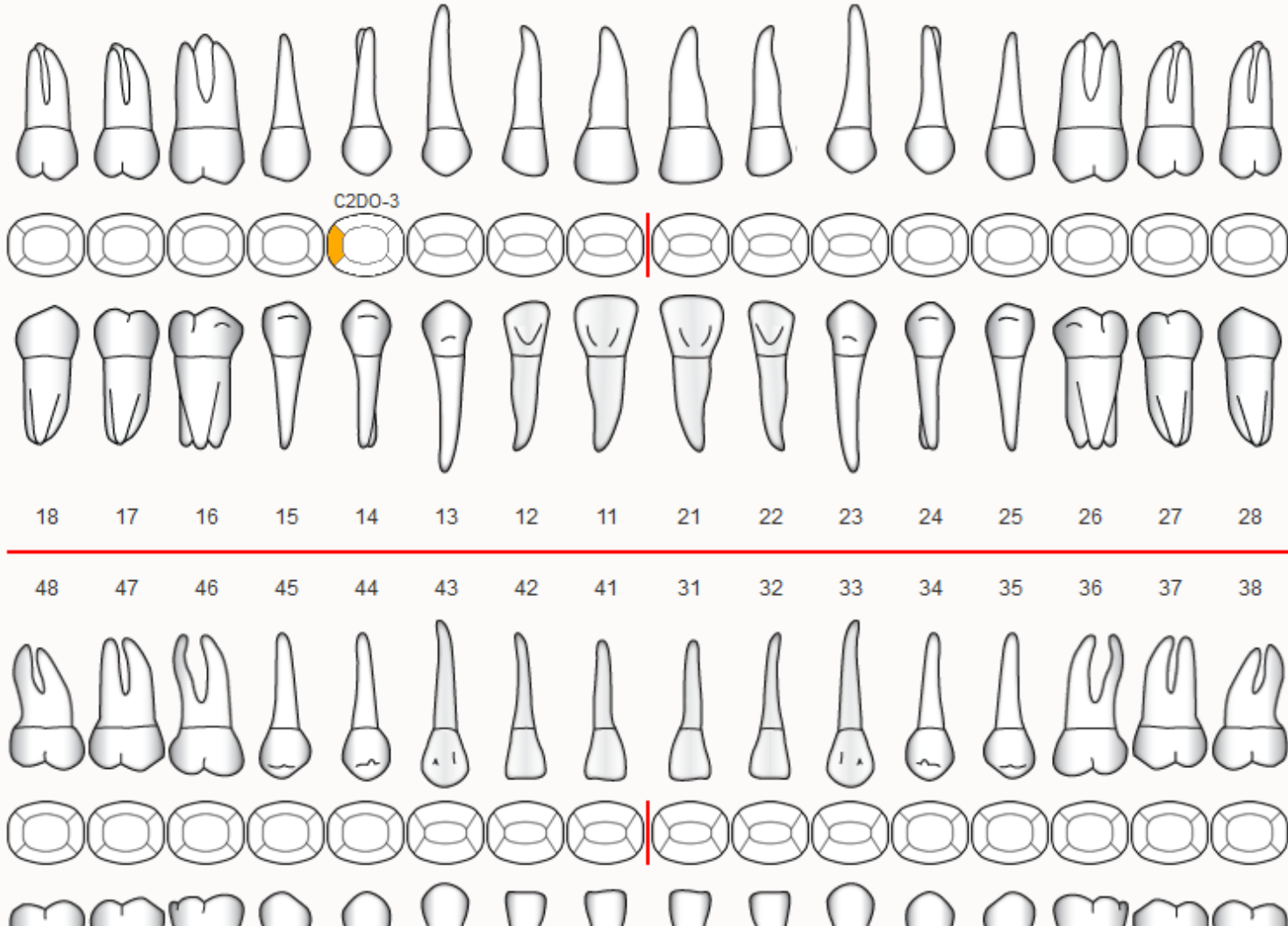
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Caries (click to close)	
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# e-Charting

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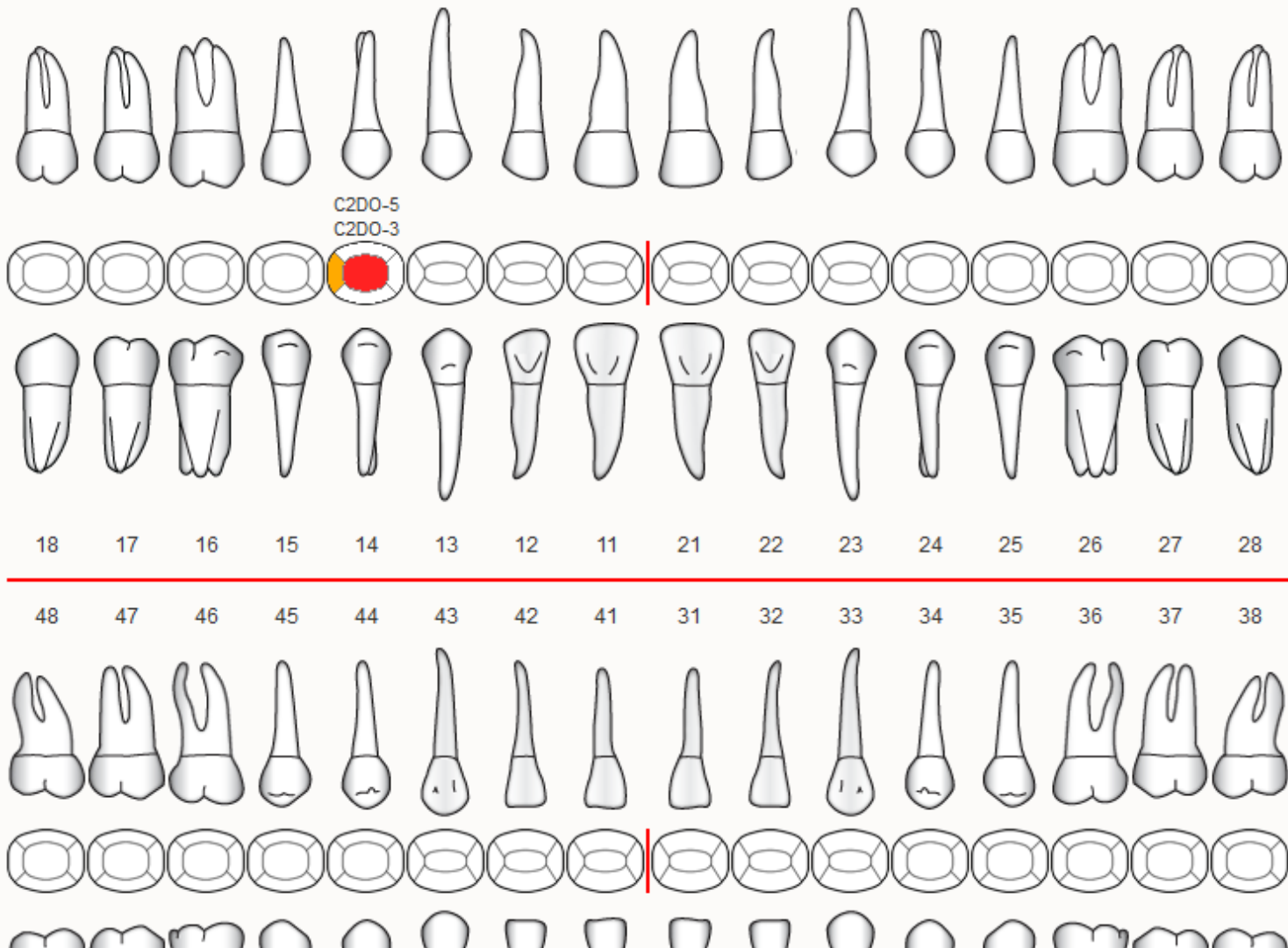
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# e-Charting

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Pick status, drag and drop

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# Automatic Analytics

- For permanent teeth
  - D, M, F
- For temporary teeth
  - D, f
- ICDAS 1-6 for permanent and for temporary teeth
- CAST for permanent and for temporary teeth
  - Caries severity
  - Spectrum
- Preventive therapies for permanent and for temporary teeth
  - Sealant
  - Varnish



## Automatic Analytics (2)

- Miscellaneous oral disease conditions for permanent and for temporary teeth
  - Decubital ulcer
  - Periodontal problem
  - Gingivitis
  - Abscess
- Behavioral ?
- Nutritional ?
- ...



# Individual oral health indicators

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example

**Rodriguez, Leo** Smile Dental Clinics [Print entire record](#)

**General** Status: Regular patient Birthday: January 1

**History** Add Medical history Dental history

**Charting** Baseline chart Work done chart

**Finance** Balance: ₱ 0.00

**Scheduler** Next app.: 2016-05-26 Last treated: 2016-05-20

DMFT <i>i</i>		CAST <i>i</i>	
D	M	F	Overall
2	0	3	5



The DMF overall score is calculated with the following formula:  $D + M + F = \text{overall score}$ .





# Individual oral health indicators

example



## Rodriguez, Leo

Smile Dental Clinics

Print entire record

### General

Status: Regular patient  
Birthday: January 1

### History

Add Medical history  
Dental history

### Charting

Baseline chart  
Work done chart

### Finance

Balance: ₱ 0.00

### Scheduler

Next app.: 2016-05-26  
Last treated: 2016-05-20

DMFT <i>i</i>		CAST <i>i</i>	
D	M	F	Overall
2	0	3	5

DMFT <i>i</i>	CAST <i>i</i>
Pre-morbid 0	Morbid 4
Sev. morbid 0	Mortal 0
CAST severity 4	



# CAST

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## CAST

### Caries Assessment Spectrum and Treatment

- developed and validated by dental researchers around the globe
- led by Prof. Jo Frencken
  - Department of Oral Function and Prosthetic Dentistry
  - Radboud University Medical Centre, Nijmegen, Netherlands





RADBOUD UNIVERSITY NIJMEGEN MEDICAL CENTRE  
UNIVERSITY OF BRASÍLIA

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# MANUAL

## CAST

### CARIES ASSESSMENT SPECTRUM AND TREATMENT

---

JO E. FRENCKEN

ANA LUIZA DE SOUZA HILGERT

EWALD M. BRONKHORST

SORAYA COELHO LEAL

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DEPARTMENT OF GLOBAL ORAL HEALTH



Cast Manual 011115  
Adobe Acrobat Document  
4,71 MB



# Measurement instrument

## CAST

### w. factors

0 = Sound	0	Healthy
1 = Sealant	0	
2 = Restoration	0	
3 = Enamel	0.25	Pre-morbid
4 = Dentine discoloration	1	Morbid
5 = Dentine cavitation	2	
6 = Pulp involvement	4	Severely morbid
7 = Abscess / Fistula	5	Mortal
8 = Lost	6	

Caries

Cast severity = Pre-morbid + Morbid + Sev. morbid + Mortal



# CAST vs DMFT

## CAST

- 0 = Sound
- 1 = Sealant
- 2 = Restoration
- 3 = Enamel
- 4 = Dentine discoloration
- 5 = Dentine cavitation
- 6 = Pulp involvement
- 7 = Abscess / Fistula
- 8 = Lost

Caries



## DMF

- F (illing)
- D (ecay)
- M (issing)



# Example 1

		CAST #	w.f.	# occur.	CAST severity
Healthy		0 Sound	0		
		1 Sealant	0		
		2 Restoration	0	1	0
Caries	Pre-morbid	3 Enamel	0,25		
	Morbid	4 Dentine discoloration	1	1	1
		5 Dentine cavitation	2		
	6 Pulp	4			
Sev. morbid	7 Abcess / Fistula	5			
	8 Lost	6	1	6	

		w.f.	# occur.	DMF score
F	Filling	1	1	1
D	Caries	1	1	1
M	Missing	1	1	1

7

3

Add CAST Pulp / DMF Caries :

		CAST #	w.f.	# occur.	CAST severity
Healthy		0 Sound	0		
		1 Sealant	0		
		2 Restoration	0	1	0
Caries	Pre-morbid	3 Enamel	0,25		
	Morbid	4 Dentine discoloration	1	1	1
		5 Dentine cavitation	2		
	6 Pulp	4	1	4	
Sev. morbid	7 Abcess / Fistula	5			
	8 Lost	6	1	6	

		w.f.	# occur.	DMF score
F	Filling	1	1	1
D	Caries	1	2	2
M	Missing	1	1	1

11

4



# Example 2

		CAST #	w.f.	# occur.	CAST severity
<b>Healthy</b>		0 Sound	0		
		1 Sealant	0		
		2 Restoration	0	1	0
<b>Caries</b>	<b>Pre-morbid</b>	3 Enamel	0,25		
	<b>Morbid</b>	4 Dentine discoloration	1	1	1
		5 Dentine cavitation	2		
	<b>Sev. morbid</b>	6 Pulp	4		
		7 Abcess / Fistula	5		
<b>Lost</b>		8 Lost	6	1	6

		w.f.	# occur.	DMF score
<b>F</b>	<b>Filling</b>	1	1	1
<b>D</b>	<b>Caries</b>	1	1	1
<b>M</b>	<b>Missing</b>	1	1	1

**7**

**3**

**Remove CAST Dent. discol. / DMF Caries + Add CAST/DMF Fill. :**

		CAST #	w.f.	# occur.	CAST severity
<b>Healthy</b>		0 Sound	0		
		1 Sealant	0		
		2 Restoration	0	2	0
<b>Caries</b>	<b>Pre-morbid</b>	3 Enamel	0,25		
	<b>Morbid</b>	4 Dentine discoloration	1	0	0
		5 Dentine cavitation	2		
	<b>Sev. morbid</b>	6 Pulp	4		
		7 Abcess / Fistula	5		
<b>Lost</b>		8 Lost	6	1	6

		w.f.	# occur.	DMF score
<b>F</b>	<b>Filling</b>	1	2	2
<b>D</b>	<b>Caries</b>	1	0	0
<b>M</b>	<b>Missing</b>	1	1	1

**6**

**3**



## Observation + potential

### Observation CAST / DMF comparison

- CAST is a spectrum; distinguishes healthy vs unhealthy
- CAST “finer grain” / greater resolution
  - Penalizes unhealthy
  - Rewards healthy

### Potential: e-Charting in combination with CAST enables

- Logging trends: regular tracking oral health performance
  - Any population
    - Classical “dental census” surveys
    - Dental clinics patient population
    - Individual patients
- Data-driven budgeting for treatment





# Tracking oral health performance

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*example*

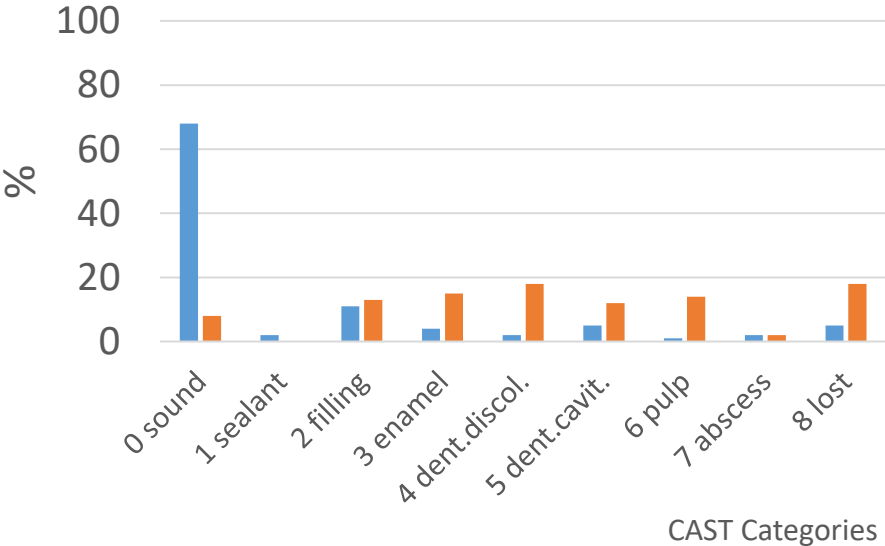
Quantifying oral health status



# Oral health baseline

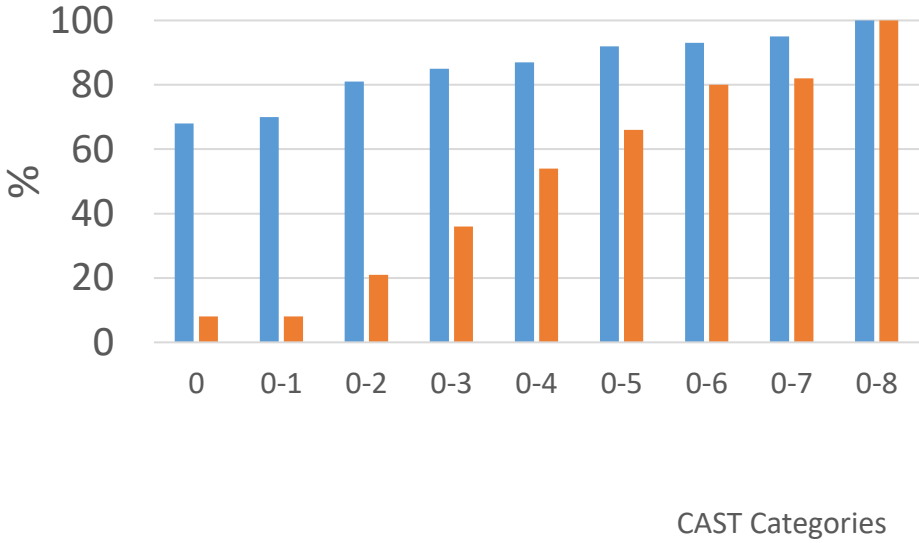
## Statistics: CAST, cumulative CAST % occurrence in a given population

CAST - YR 1



Population A Population B

CUMULATIVE CAST – YR 1



Population A Population B

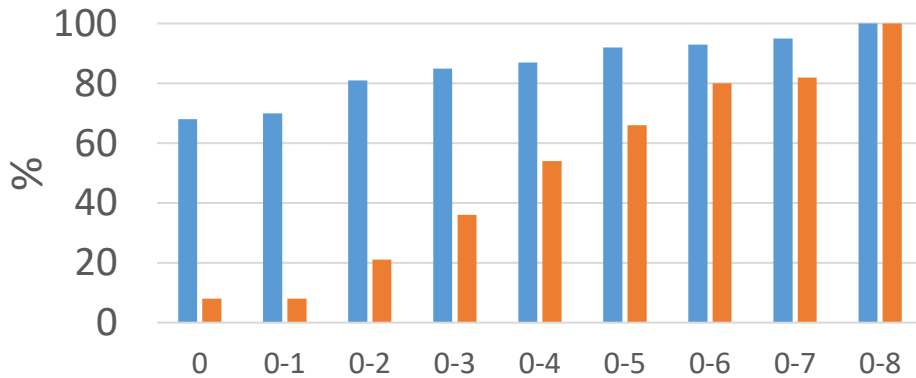


# Oral health performance

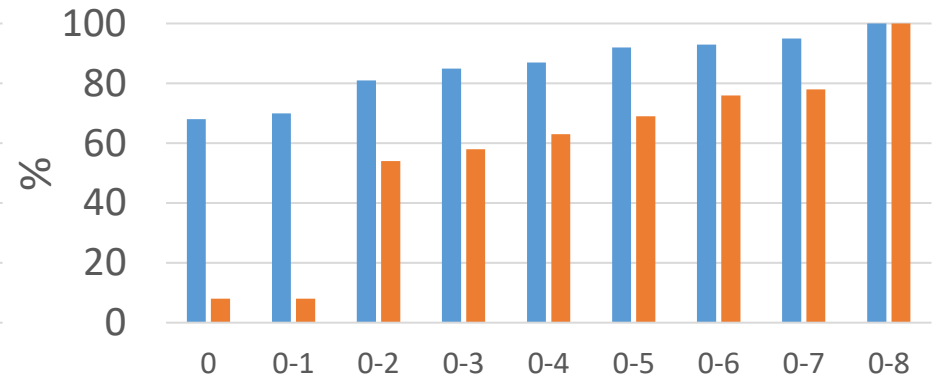
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## Performance: Compare changes in CAST year-on-year

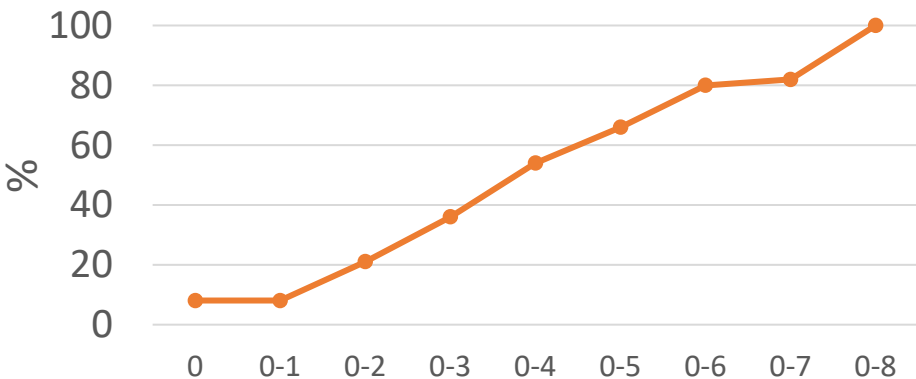
CUMULATIVE CAST – YR 1



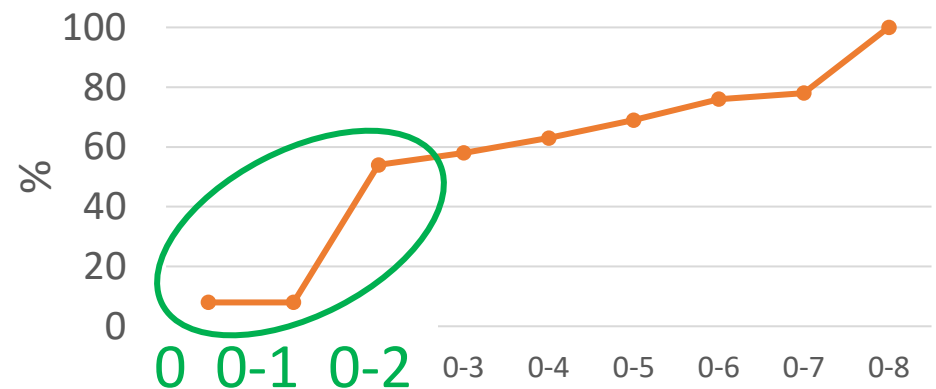
CUMULATIVE CAST - YR 2



CUMULATIVE CAST - YR 1



CUMULATIVE CAST - YR 2

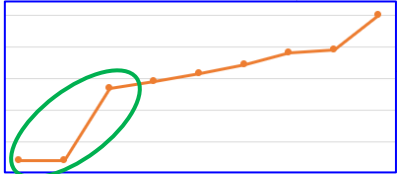
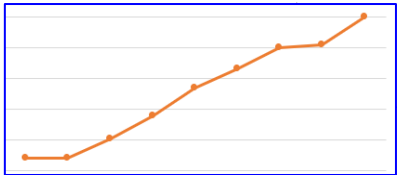




# Treatment

## Changes YR 1 – YR 2

Population B



	0 sound	1 sealant	2 filling	3 enamel	4 dent. discol.	5 dent. cavit.	6 pulp	7 abscess	8 lost
YR 1	8	0	13	15	18	12	14	2	18
YR 2	8	0	46	4	5	6	7	2	22

caries

37 % drop

33 % of carious teeth treated / filled

4 % of teeth extracted

**Conclusion: % healthy teeth up from 21 % to 54 %**



# Data-driven budgeting

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*example*

Data-driven annual policy cycle



# Annual budget

## High

Based on ***measured population data*** the treatment budget for YR 1 was calculated as a function of CAST 3 – 7

				YR 1					
YR 1	8	0	13	15	18	12	14	2	18
YR 2	8	0	46	4	5	6	7	2	22
				YR 2					

## Moderate

For YR 2 the budget was calculated again, it dropped



# A healthier place ?

(Preliminary?) Conclusions

**e-Charting** in combination with **CAST** (or comparable indicators) promises to enable

- Logging trends: regular tracking oral health performance
  - Any population
    - Classical “dental census” surveys
    - Dental clinics patient population
    - Individual patients
- Data-driven budgeting

Further steps .....



## A healthier place ...

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### Further steps

- Invite oral / dental health practitioners and researchers to think along towards even greater digital opportunities
- Utilize scalability (no population too large, too small)
- Manpower limitations alleviated (tele dentistry)
- Peer-to-peer data collection
- Standardization (gold standard, patient consent, ...)
- Education
  - Dental students (clinic management, diagnosis)
  - Patient participation (co-diagnosis, co-treatment)

*What is it you want to know ?*





**Thank you !**

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## Remember ...

Dental caries is the most widespread global disease

- Review study from 2016 shows that across 187 countries
  - Caries ranks # 1
  - Among 291 non-oral and oral diseases surveyed
  - Caries currently affects 2.4 billion people (31%)
- Economic and social impact
  - Adults miss work
  - Children miss school
  - Study from 2010: \$ 144 bln negative economic impact
- Poor oral health also impacts general health by causing
  - malnutrition
  - illnesses such as heart disease