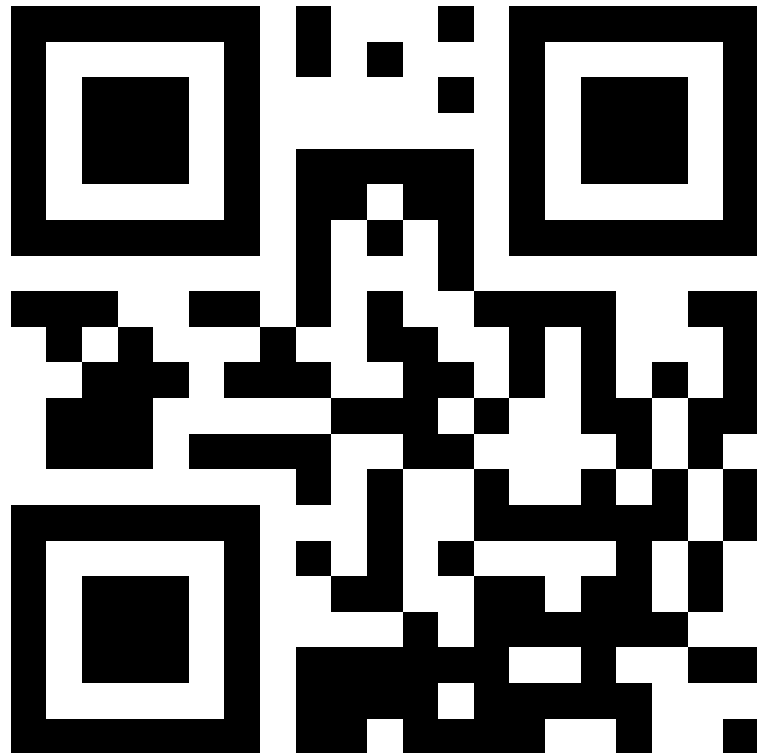


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with your own device



Semi-automatic classification of intensive care APACHE IV diagnoses based on SNOMED CT

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¹Dept Medical Informatics, University of Amsterdam, The Netherlands

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Patient data reuse



Patient data reuse



Intensive Care Quality registries



Scale 1:134,000,000

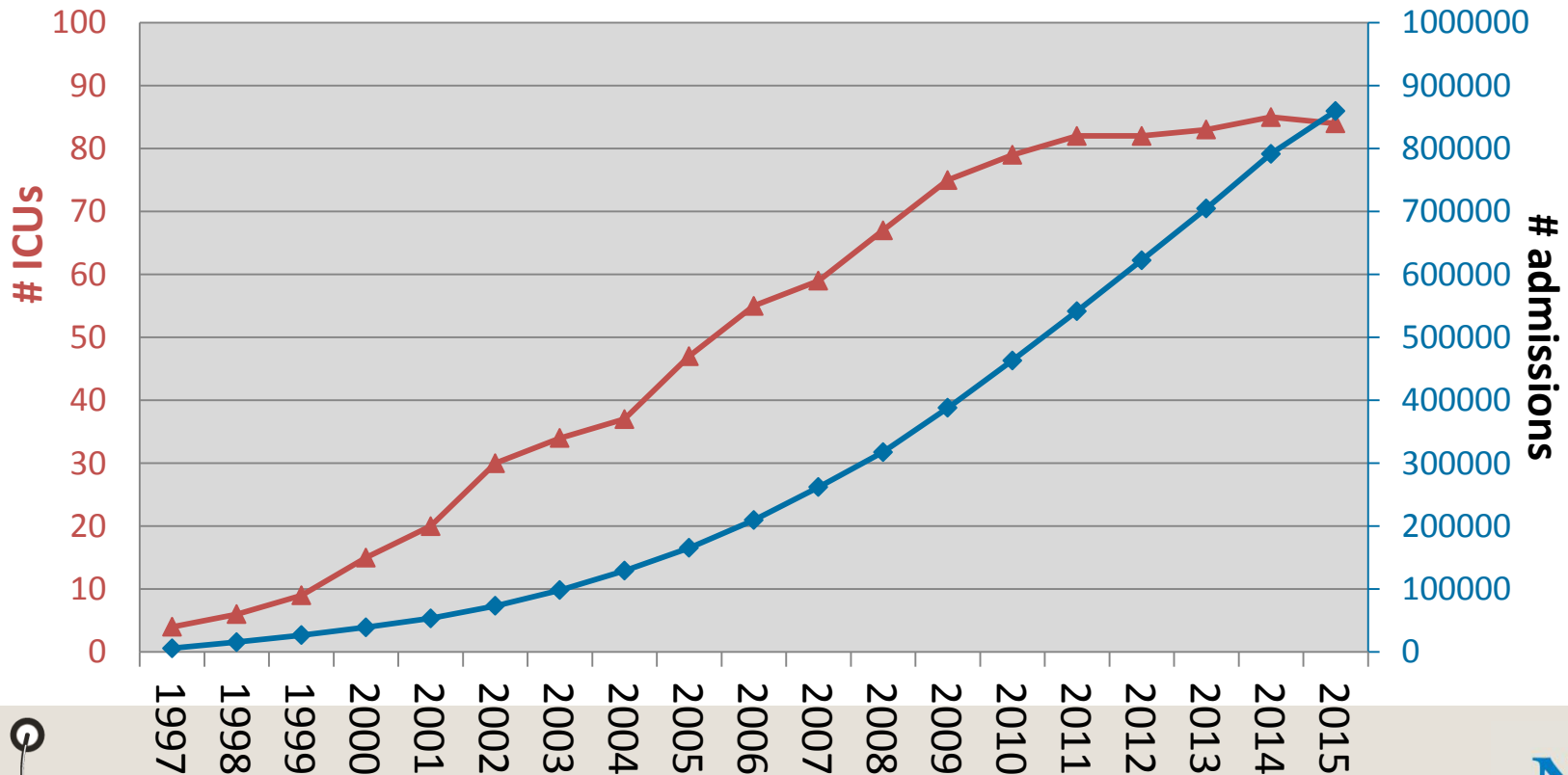
Robinson Projection
standard parallels 38° N and 38° S

- Yellow Middle E
- Light Green N. Africa
- Light Blue Africa
- Pink Near East
- Light Yellow Asia
- Cyan S. East A
- Blue N. Ameri
- Brown Lat. Amer
- Light Cyan E. Europ
- Orange W. Europ
- Purple Australia

National Intensive Care Evaluation (NICE)

History

- 1996 initiative by and for intensivists
- EHR/ICIS -> national registry



Core principle: Benchmarking



Mortality

20%

17%

Age

68

63

Comorbidity

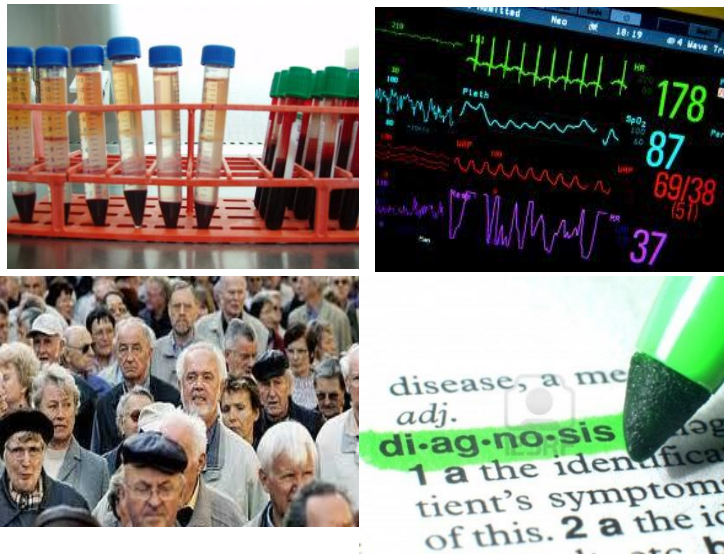
40%

5%

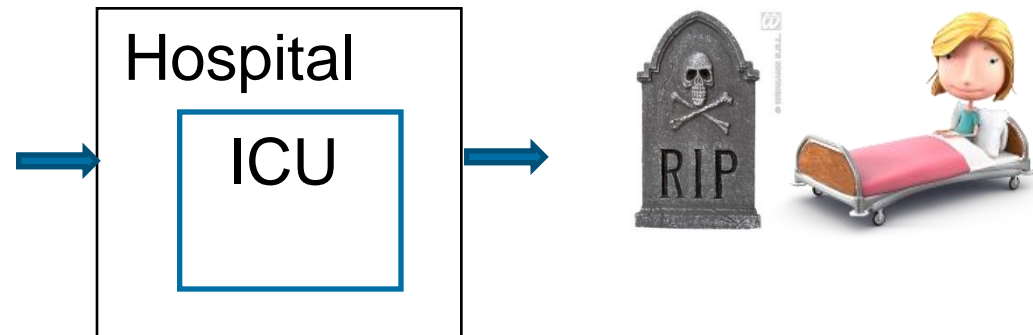


Data collection

Input (1st 24 hours)



Output



Prognostic models: APACHE IV, SAPSII...



Standardized Mortality Ratio (SMR)

$$\text{SMR} = \frac{\text{Observed in-hospital mortality}}{\text{Expected mortality}}$$

SMR < 1 better performance than expected based on case-mix

SMR > 1 poor performance than expected based on case-mix



From data collection to audit and feedback

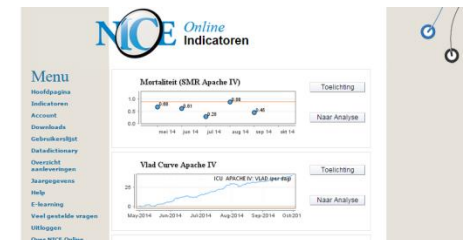
Dataset



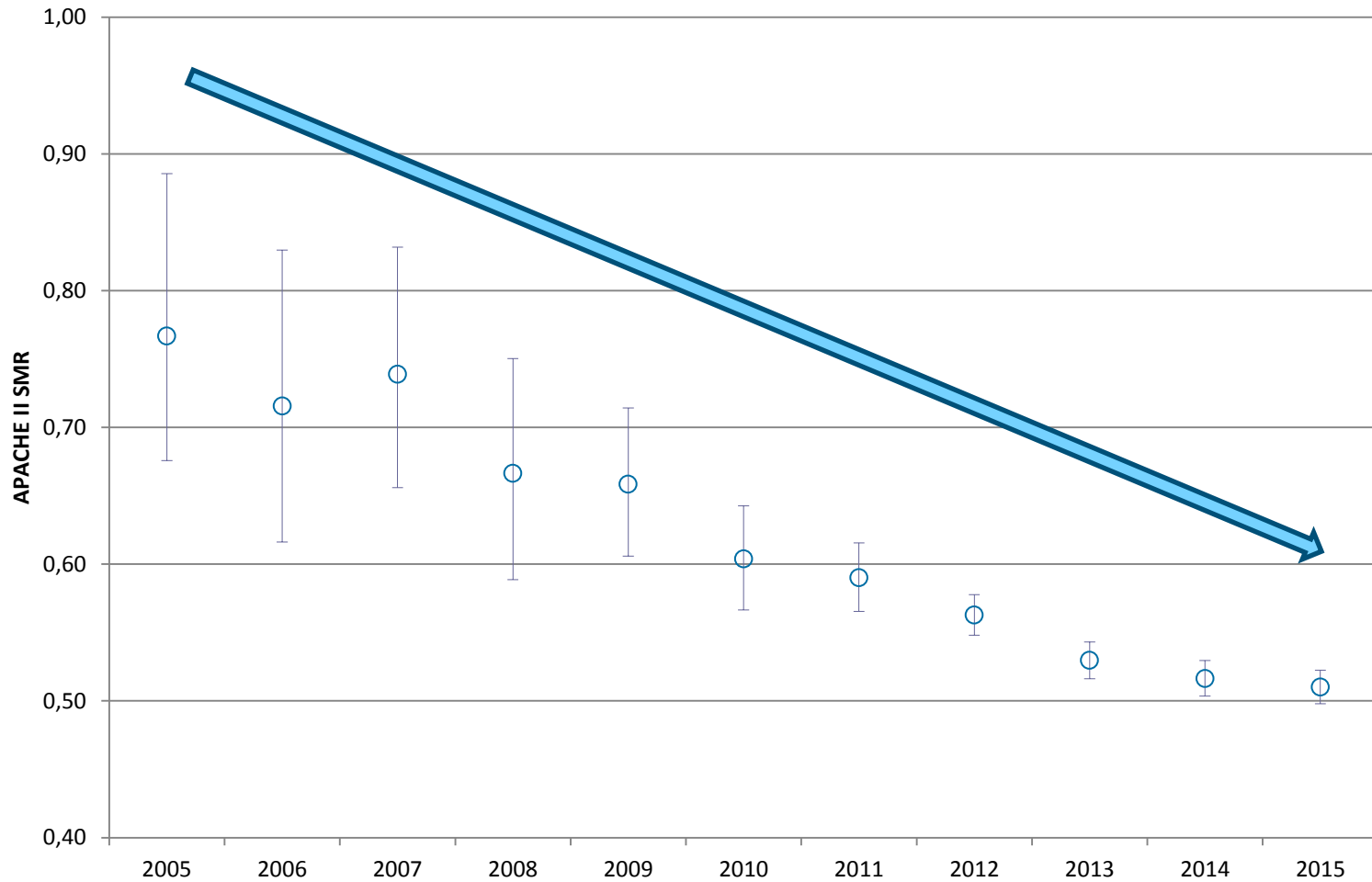
Benchmark information:

- Annual report
- NICE Online dashboard

| Year | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|------|------|------|------|------|------|------|------|------|------|
| Recalibrated Standardized Mortality Ratio | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |



Standardized Mortality Ratio (SMR)

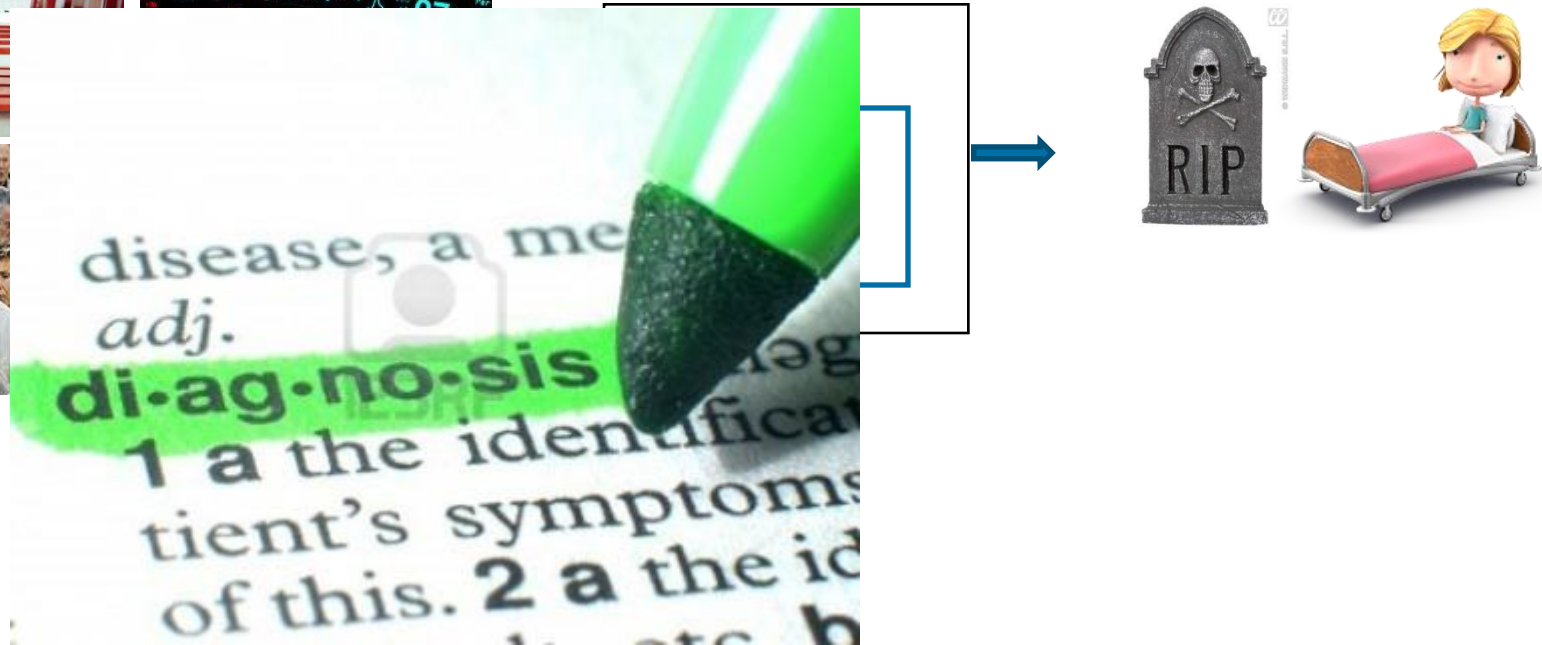


Automatic data collection

Input (1st 24 hours)



Output



APACHE IV classification

○ 445 Reasons for ICU admission

Opnamereden APACHE IV

| | |
|------------------------------------|--|
| Non-Operative | <input type="checkbox"/> Apnea, sleep |
| Cardiovascular Non-Operative | <input type="checkbox"/> ARDS-adult respiratory distress syndrome, non-cardiogenic pulmonary edema |
| Gastrointestinal Non-Operative | <input type="checkbox"/> Arrest, respiratory (without cardiac arrest) |
| Genitourinary Non-Operative | <input type="checkbox"/> Asthma |
| Hematology Non-Operative | <input type="checkbox"/> Atelectasis |
| Metabolic/Endocrine Non-Operative | <input type="checkbox"/> Cancer, laryngeal |
| Musculoskeletal/Skin Non-Operative | <input type="checkbox"/> Cancer, lung |
| Neurologic Non-Operative | <input type="checkbox"/> Cancer, oral |
| Respiratory Non-Operative | <input type="checkbox"/> Cancer, tracheal |
| Transplant Non-Operative | <input type="checkbox"/> Effusions, pleural |
| Trauma Non-Operative | <input type="checkbox"/> Embolus, pulmonary |
| | <input type="checkbox"/> Emphysema/bronchitis |
| | <input type="checkbox"/> Hemorrhage/hemoptysis, pulmonary |
| | <input type="checkbox"/> Hemothorax |
| | <input type="checkbox"/> Hypertension-pulmonary, primary/idiopathic |
| | <input type="checkbox"/> Near drowning accident |
| | <input type="checkbox"/> Obstruction-airway (i.e. acute epiglottitis, post-extubation edema, foreign body, etc.) |
| Operative | <input type="checkbox"/> Pneumonia, aspiration |
| Cardiovascular Non-Operative | <input type="checkbox"/> Pneumonia, bacterial |
| Gastrointestinal Non-Operative | <input type="checkbox"/> Pneumonia, fungal |
| Genitourinary Non-Operative | <input type="checkbox"/> Pneumonia, other |

From ICU specific to hospital wide EHR



Central problem list &
Terminology service



Terminology in the Netherlands



DHD
diagnoses/
procedure
thesaurus

SNOMED CT

ICD-10
DBC/DRG
APACHE IV

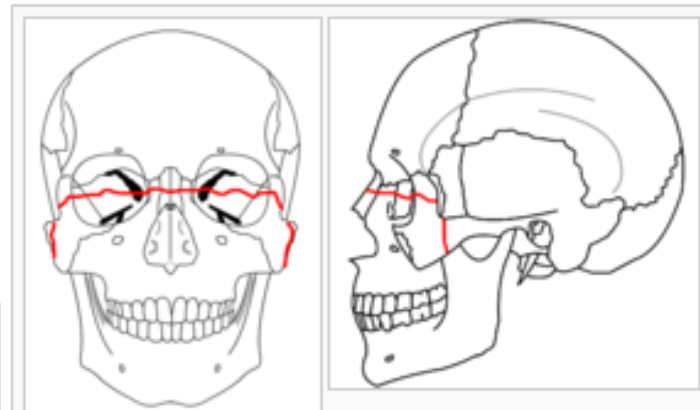
Terminology in the Netherlands



Le-Fort III fractuur
Craniofaciale dissociatie

37027003 -
Le-Fort III

Face trauma



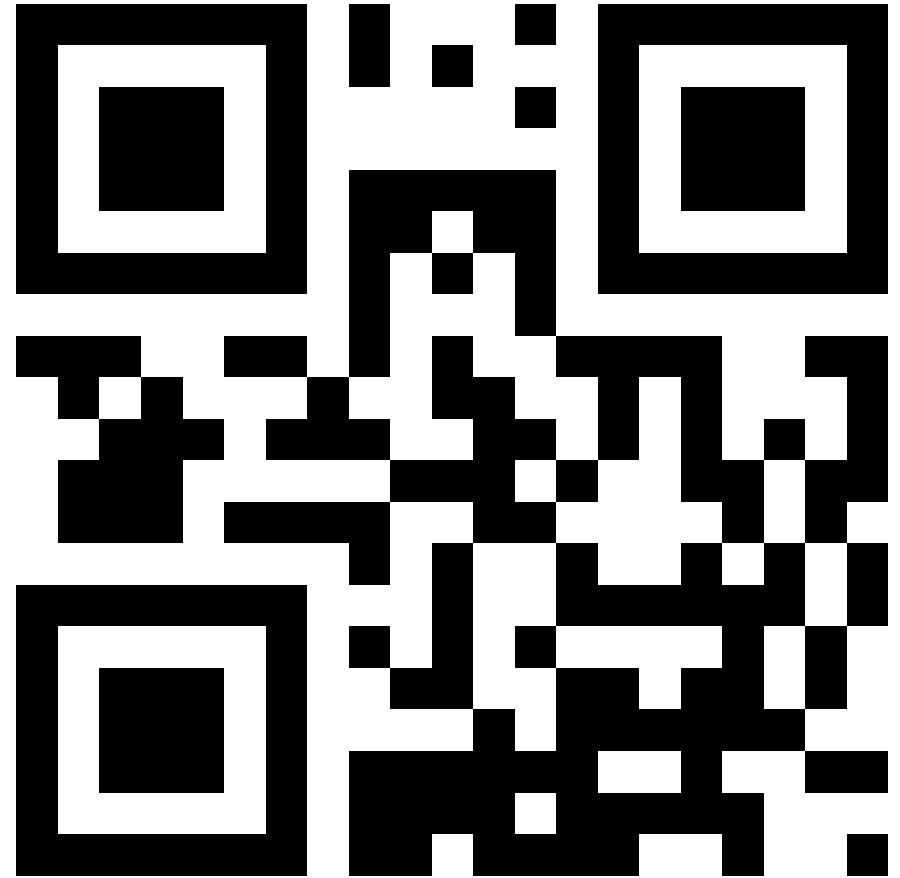
Aim of this study

- Reduce registration burden of ICU physicians
- Semi-automatic classification of APACHE IV diagnoses from point-of-care data in EHR
 - Develop a mapping from SNOMED CT to APACHE IV
 - Develop classification rules



Please go with your own device to....

- kahoot.it



Approach

- For each APACHE IV category, determine appropriate SNOMED CT concept(s) (twice, independent)
- Conflict resolution
- Assessment of relevance of descendants
- Create Dutch interface terminology for concepts
- Implementation of classification rules



Classification challenges

- Fuzzy classes in APACHE IV
- Classification depends on presence or absence of other findings
- Irrelevant SNOMED CT descendants in the ICU
- Distinction between “problems” and “reasons for admission”



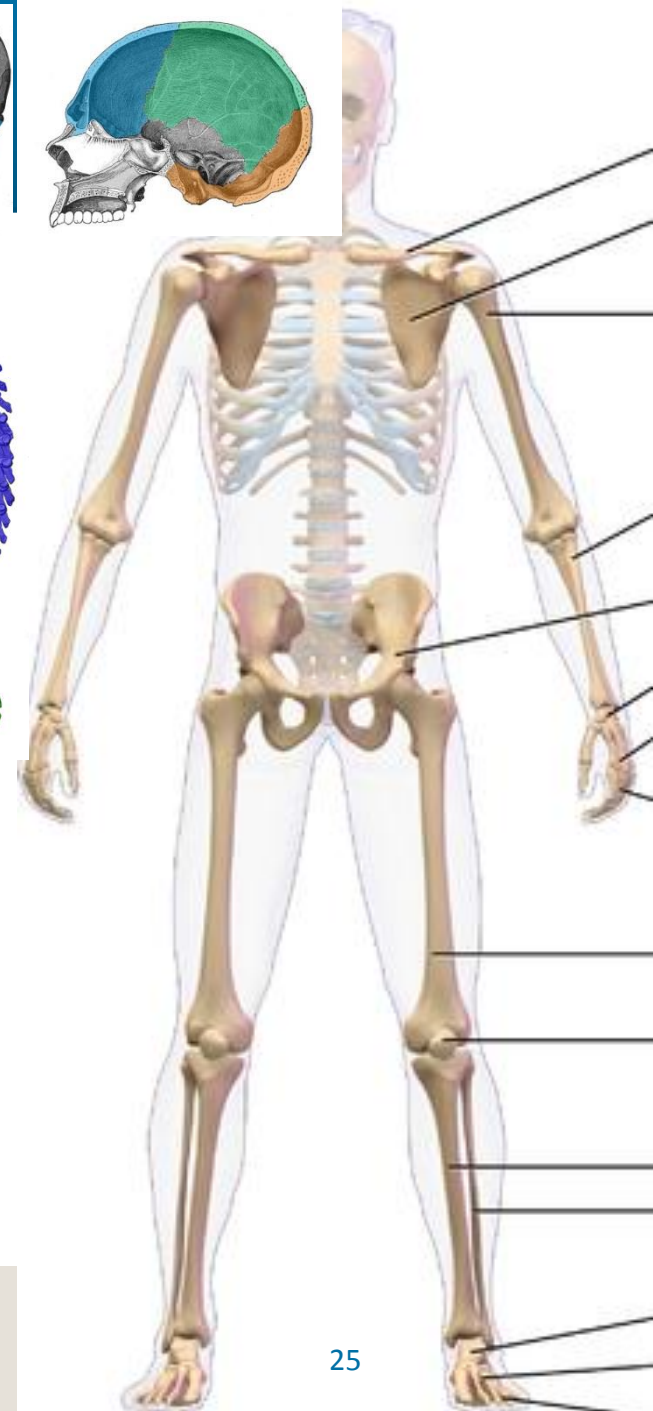
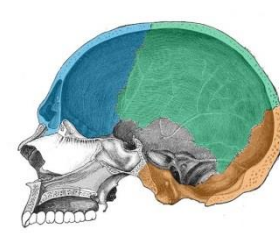
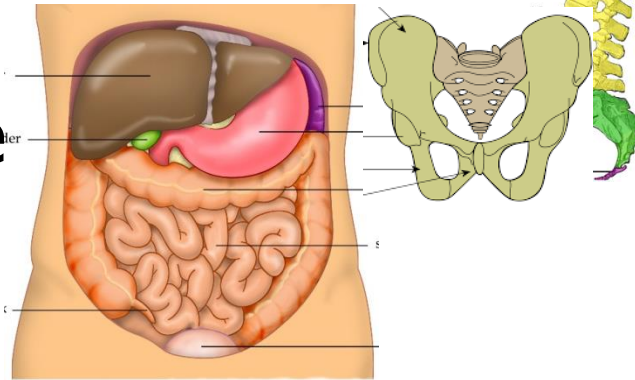
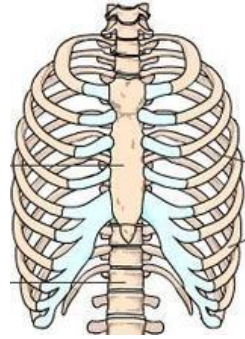
Fuzzy classes in APACHE IV

- APACHE categories are not “URU”
 - What are street drugs?



Combining findings

- Traumata
 - 1
 - 2
 - multiple



“Irrelevant” SNOMED CT descendants

- In SNOMED CT, Rupture of ear lobe is a head trauma
- Not sufficiently severe for ICU admission



Distinction between “problems” and “reasons for admission”

- Not just a SNOMED CT – APACHE mapping problem...
- Identification of reason for admission on problem list



Resulting Reference Set

- Reasons for admission
 - 213 non-operative APACHE categories; 223 operative; 9 both
 - 230 SNOMED CT clinical findings mapped
 - 24 concepts to be added to SNOMED CT
 - # Mapped clinical findings + children: 46473
 - Selection results in < 11000 clinical findings
 - Interface terminology under development
- After implementation (to do)
 - Generate APACHE codes from SNOMED-encoded record
 - Clinician evaluates generated codes

Conclusion

- Clinical expertise and SNOMED CT expertise required
- Cognitive burden moved from clinical practice to mapping project
- Clinical judgement remains needed to select reason for ICU admission from problem list



- It's one small step for man but a giant leap for the ICU

