Quality Assurance in Healthcare with R

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Central institution for the quality assurance in the German public healthcare system

Founded in 2015
What we do - an example

In-hospital mortality due to community-acquired pneumonia
What we do - an example

In-hospital mortality due to community-acquired pneumonia

Software specification
For data collection in the hospitals

Patient Data
≥ 250,000 cases annually

medical, statistical, and IT experts
What we do - an example

In-hospital mortality due to community-acquired pneumonia

Software specification for data collection in the hospitals

Patient Data
\[ \geq 250,000 \] cases annually

Quality indicator specification

Computational rule

\textit{Software specification and computational rules are publicly available on our website}
What we do - an example

In-hospital mortality due to community-acquired pneumonia

Software specification for data collection in the hospitals

Patient Data
≥ 250,000 cases annually

Quality indicator specification
Computational rule

Results

Structured dialogue with providers for quality assessment and improvement
How we use R

At the Medical Biometry and Statistics Unit, we use R

- for ad hoc analysis of data
- for the development of new statistical methodologies
- for internal reporting tools (e.g. shiny)

- in production: packages for automatic computation of results
  - e.g. 21 million numbers for our standard routine report
How we use R

Funnelplots

Anzahl Fälle/ Prozeduren

Indikatorergebnis (Rate)

Auffällig

Anzahl Standorte

Grenze für

rechnerische Auffälligkeit

statistische Auffälligkeit

Referenzbereich

Nein

Rechnerisch

Statistisch

1

2
Internal infrastructure

- Statistical analysis is a team effort!
- Code review and automatic tests
- Independent proof-calculation of results
- Aim: Maintain high quality of analyses and published results
Internal infrastructure

- Internal package repository (~10 actively used packages)
- Shiny server:
### External transparency

**Computation rules for our ~280 quality indicators**

- Definition of the relevant sets from the data
- Specification on how to count
- Will be published as R code
External transparency

- Mostly simple Boolean expressions in base R:
  
  \[
  \text{age} \geq 18 \ \& \ \text{blood\_pressure} \geq 140
  \]

- Special abstractions to make code more compact:
  
  \[
  \text{diagnosis\_code} \%\text{isAnyLike}\% \text{ICD}\$\text{ICD\_Infection}
  \]
  
  \[
  \text{all(postoperative\_infect} = 0) \%\text{group\_by}\% \text{patient\_id}
  \]
R package IQTIGpvci

- We recently published our first R package: IQTIGpvci
- Reference implementation illustrating methodologies for performing hospital classification in the context of uncertainty
External transparency

R package IQTIGpvci

- Available on our website:

  Downloads (R-Paket)

  - IQTIG – R functions for hospital profiling
    2018 / 09.04.2018 / PDF / 143 KB

  - IQTIG – R functions for hospital profiling (Package "IQTIGpvci")
    2018 / 09.04.2018 / GZ / 60 KB

  - IQTIG – R functions for hospital profiling (Package "IQTIGpvci" description)
    2018 / 09.04.2018 / HTML / 78 KB
    https://iqtig.org/das-iqtig/grundlagen/biometrische-methoden/

- Licensed under GPL Version 3
External transparency

<table>
<thead>
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<th>Ermittlung statistischer Auffälligkeit</th>
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<td><strong>Statistischer Test</strong></td>
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<td><strong>Signifikanzniveau</strong></td>
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Example of R code (using IQTIGpvci) published in a juristic document (plan. QI directive, G-BA 2016)

Summing up

- R supports us in our mission to improve healthcare quality in Germany
- R enables us to be more transparent, because it’s open source