



Unlocking a national adult cardiac surgery audit registry with

The R User Conference 2013
University of Castilla-La Mancha, Albacete, Spain

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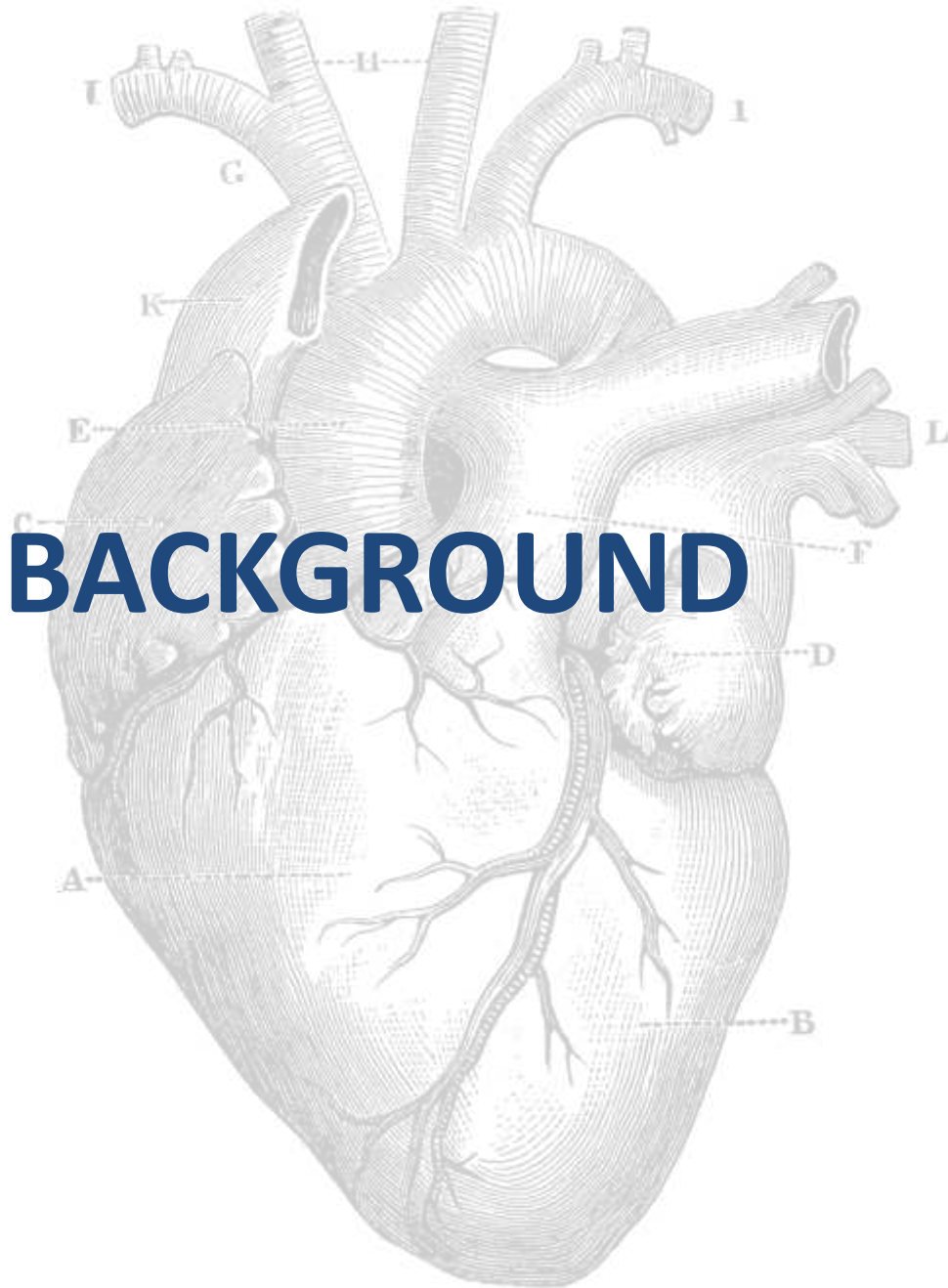
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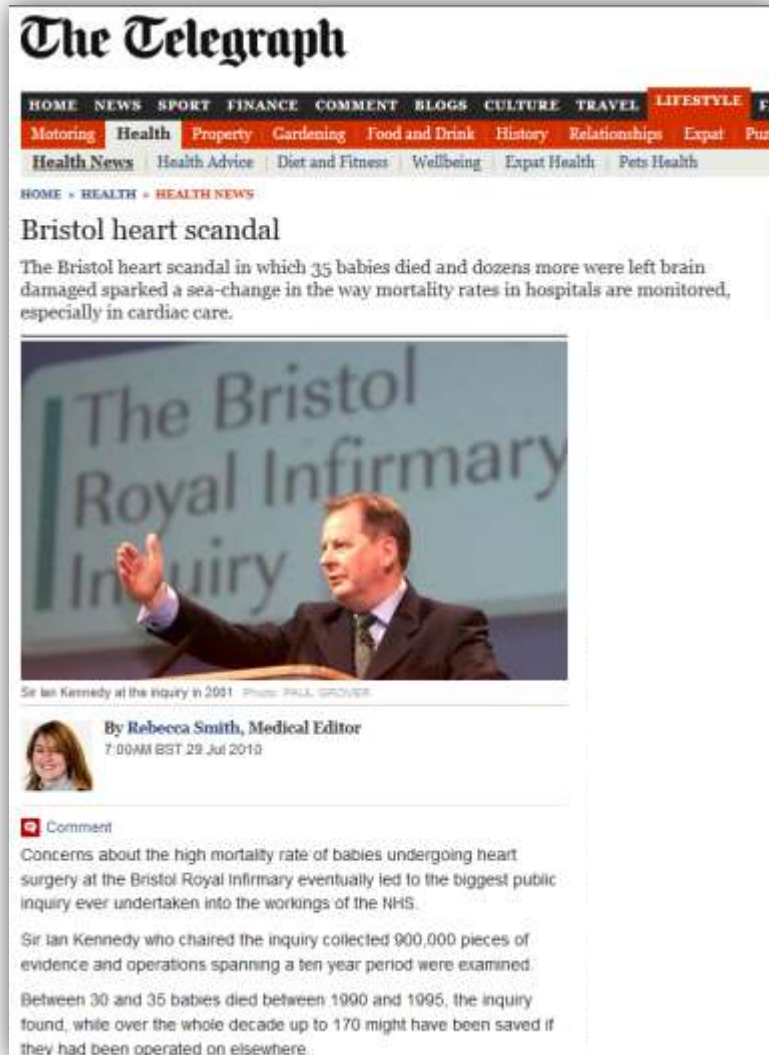


Fig. 37.



BACKGROUND

Bristol Inquiry




The Telegraph

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Motoring Health Property Gardening Food and Drink History Relationships Expat Puzz
Health News Health Advice Diet and Fitness Wellbeing Expat Health Pets Health

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Bristol heart scandal

The Bristol heart scandal in which 35 babies died and dozens more were left brain damaged sparked a sea-change in the way mortality rates in hospitals are monitored, especially in cardiac care.



Sir Ian Kennedy at the inquiry in 2001. Photo: PAUL GUNOVER

By Rebecca Smith, Medical Editor
7:00AM BST 29 Jul 2010

Comment

Concerns about the high mortality rate of babies undergoing heart surgery at the Bristol Royal Infirmary eventually led to the biggest public inquiry ever undertaken into the workings of the NHS.

Sir Ian Kennedy who chaired the inquiry collected 900,000 pieces of evidence and operations spanning a ten year period were examined.

Between 30 and 35 babies died between 1990 and 1995, the inquiry found, while over the whole decade up to 170 might have been saved if they had been operated on elsewhere.

Contributory factors that led to the failings included:

1. Inadequate collection of data
2. Inadequate monitoring of data

National Adult Cardiac Surgery Audit registry

- Up to 166 clinical variables collected on each patient: administrative, demographics, comorbidities, operative factors, outcomes
- 15 years of data
- 465,000 records
- 44 hospitals + >400 consultant surgeons

Flow of data

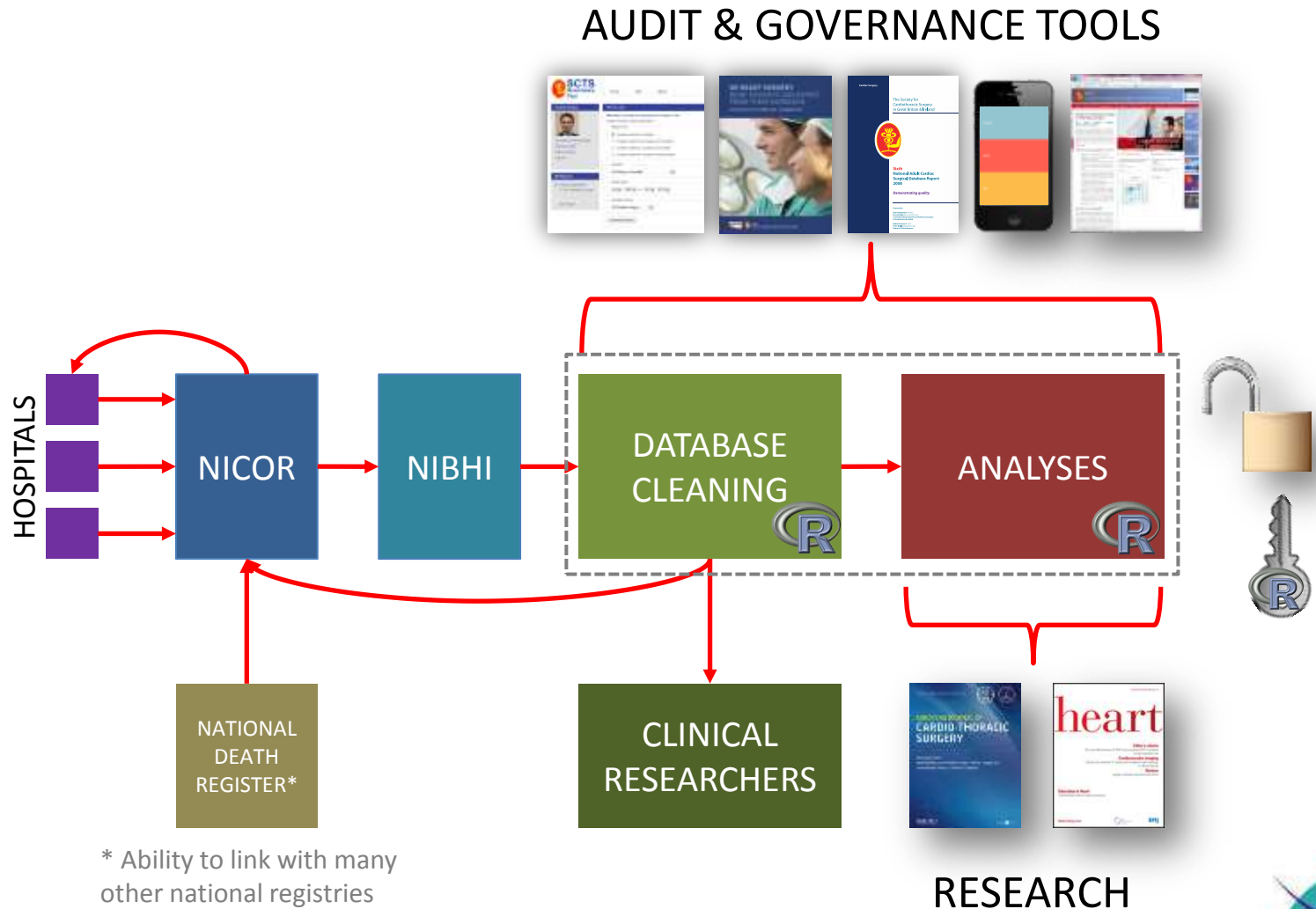
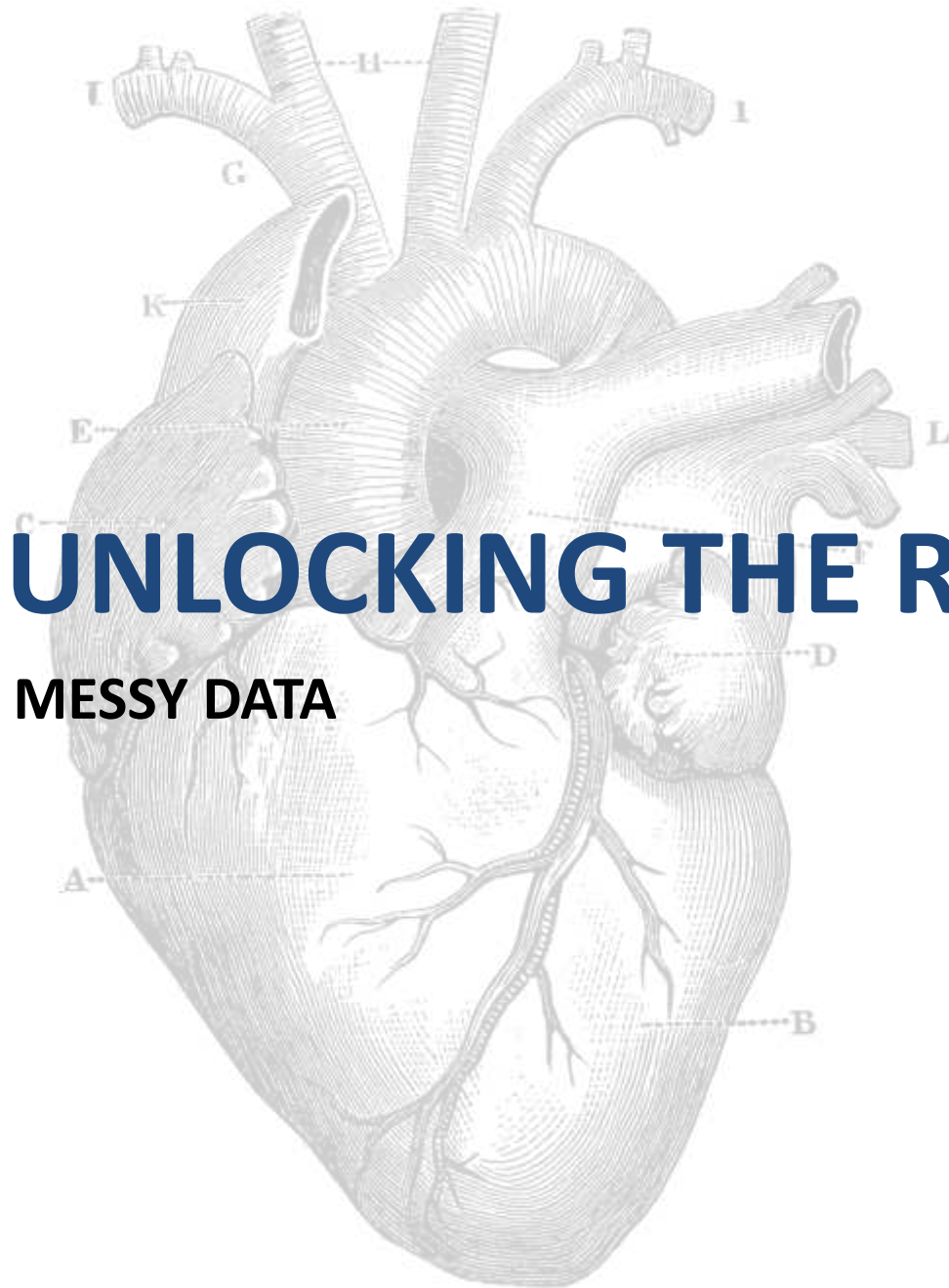


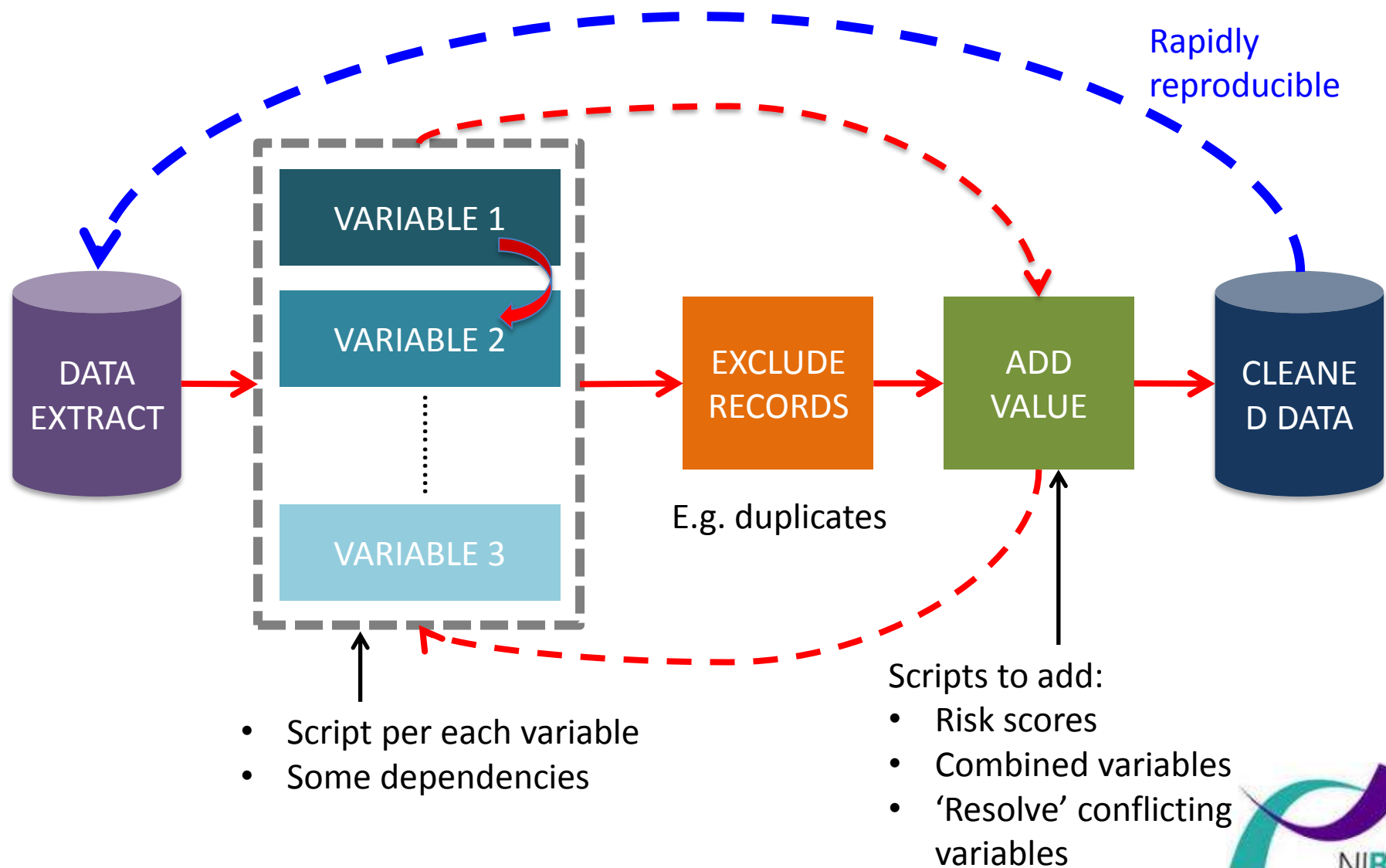
Fig. 37.



UNLOCKING THE REGISTRY

MESSY DATA

Cleaning the registry in



> with(SCTS, table(X4.04.Discharge.Destination, X4.05.Status.at.Discharge))

X4.04.Discharge.Destination

X4.05.Status.at.Discharge

0. Alive 1. Dead

```

. Another dept within the trust
0
0. Not applicable - patient deceased
1 Home
1. Home
2 Convalescence
2. Convalescence
2. Convalescence (Non acute Hospital)
3 Other hospital
3 Other Hospital
3 Other Hospital - wd 6
3 Other Hospital wd 2
3 Other ward
3. Other Acute hospital
3. Other hospital
4 Patient deceased
4. Not applicable - patient deceased
4. Patient Deceased
5
5. Transferred to different Consultant - NGH
7
8
9
Second op

```

3 Other hospital
3 Other Hospital
3 Other Hospital - wd 6
3 Other Hospital wd 2
3 Other ward
3. Other Acute hospital
3. Other hospital

Transcriptional
discrepancies

7
8
9
Second op

Illegal options

	0. Alive	1. Dead
828	48296	2453
0	57	0
1	1	0
0	0	1
0	4104	0
674	370763	374
0	63	0
8	7347	4
2	2164	0
0	1	0
0	151	0
0	1	0
0	1	0
0	1	0
1	7680	1
115	22935	37
0	0	173
51	412	13286
0	0	19
0	7	0
0	42	0
0	2	0
0	38	4
114	3820	518
0	2	6

Conflicts

Missing data



Cleaning the registry in

- Errors are **difficult to find** and not all can be resolved
- Excluding all imperfect data not an option
- Balance between a ‘research ready’ dataset and robust audit capability
- Needs to be **reproducible**
- It is **locked** to clinicians & researchers without being cleaned

Warning: cleaning clinical registries without experts is dangerous*



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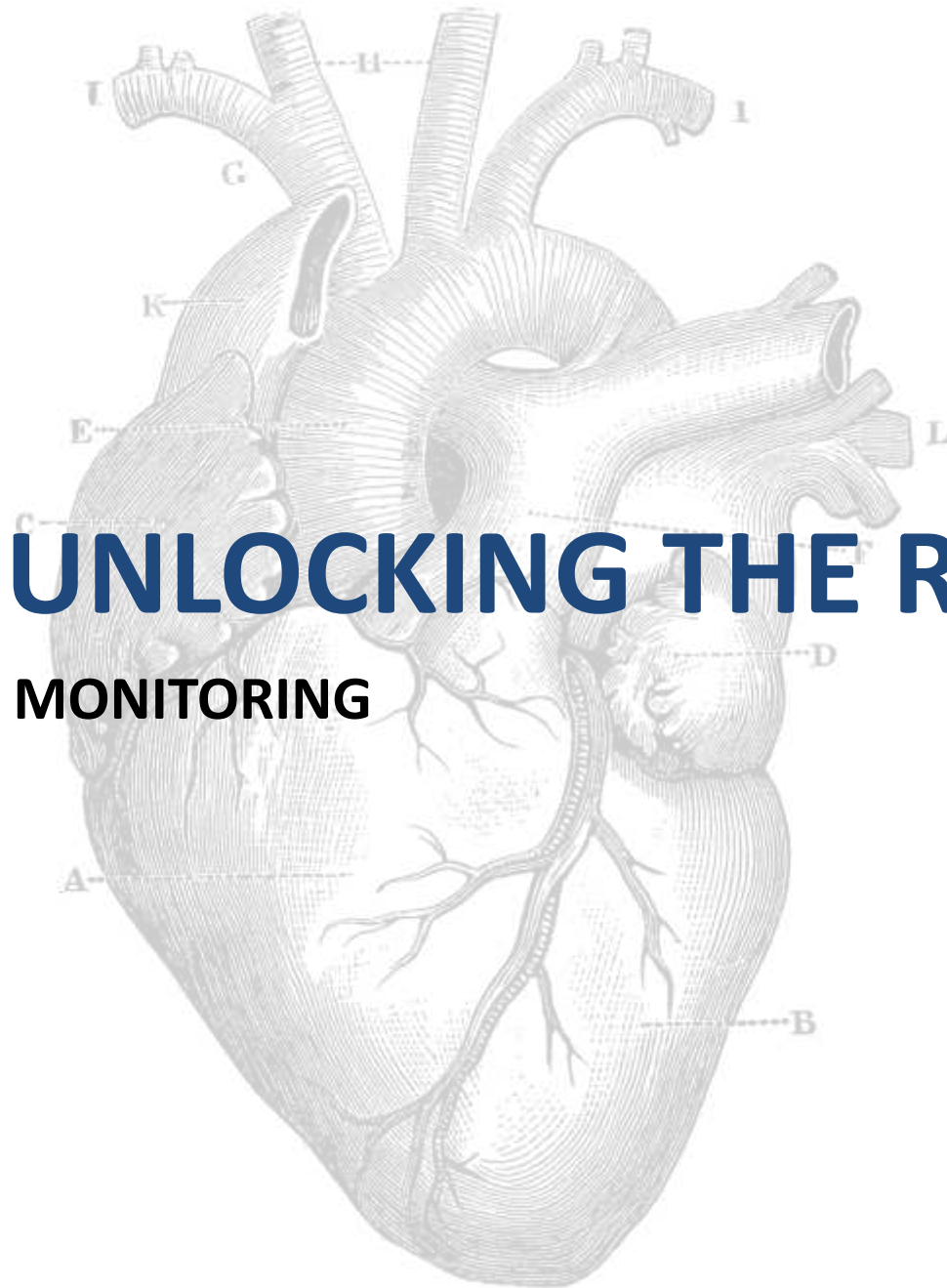


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* Applies to analysing healthcare data also

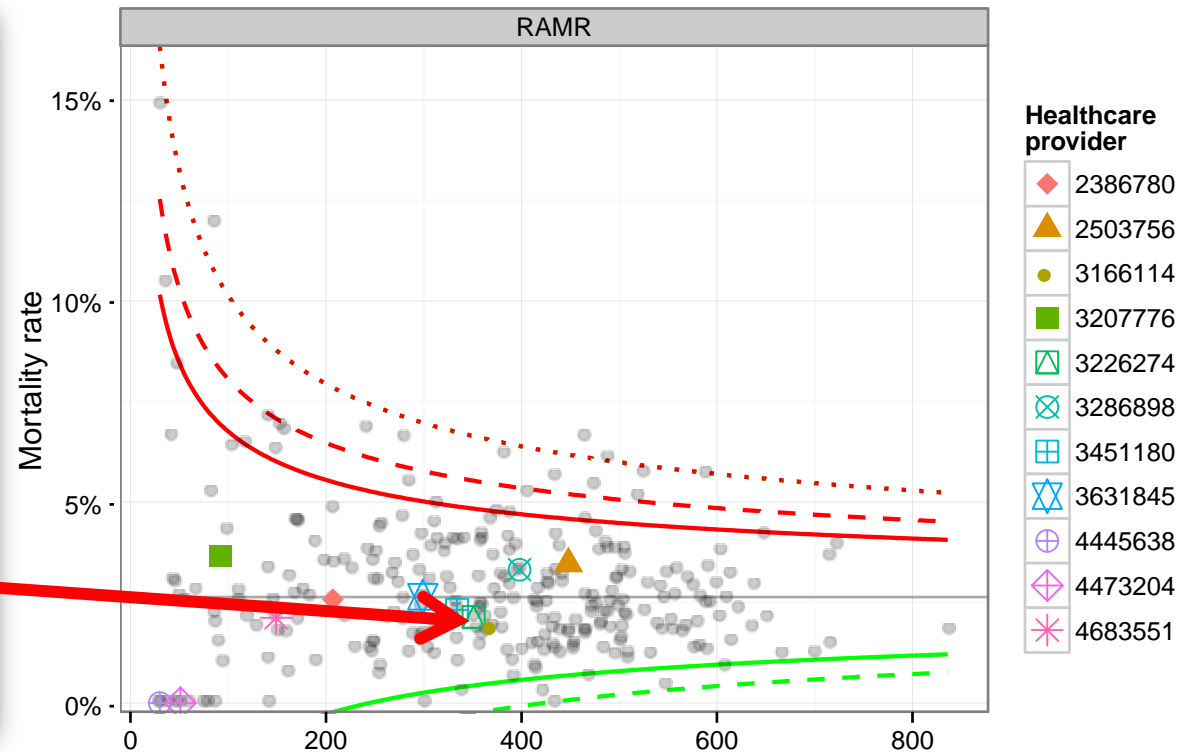
Fig. 37.



UNLOCKING THE REGISTRY

MONITORING

Publication of named healthcare provider outcomes



<http://www.scts.org/patients/>

Publication of named healthcare provider outcomes

FILTER DATA

```
subset
```

RISK ADJUSTMENT

```
glm, glmer {lme4}, mfp  
{mfp}, predict, auc {pROC},
```

CLASSIFICATION & PRESENTATION

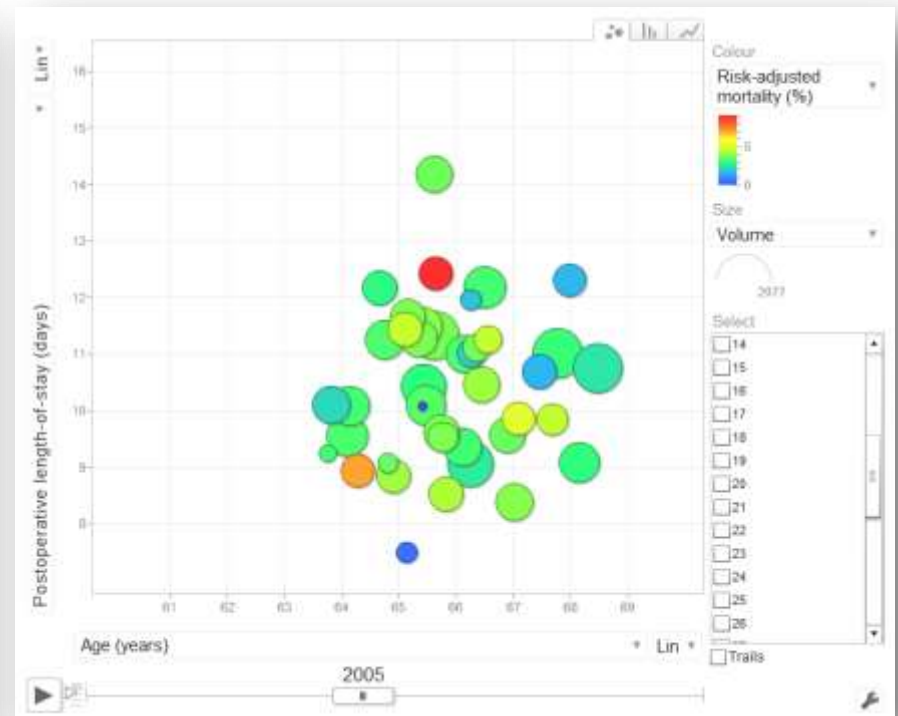
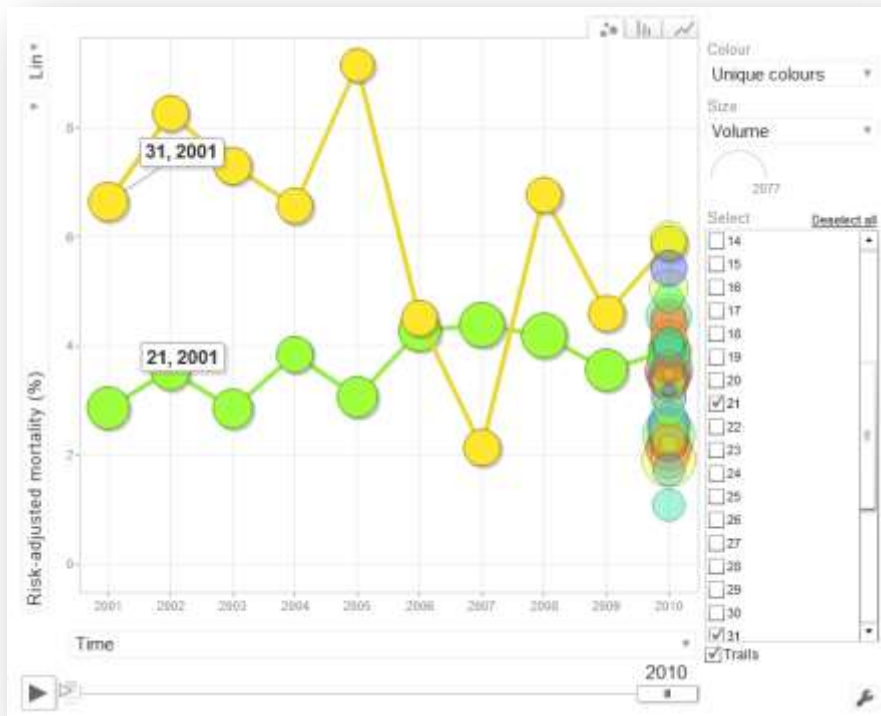
```
ggplot {ggplot2}, write.csv
```

AGGREGATION

```
summaryBy {doBy}, merge,  
arrange {plyr}
```

Exploratory analyses

```
summaryBy {doBy} + gvisMotionChart {googleVis}
```



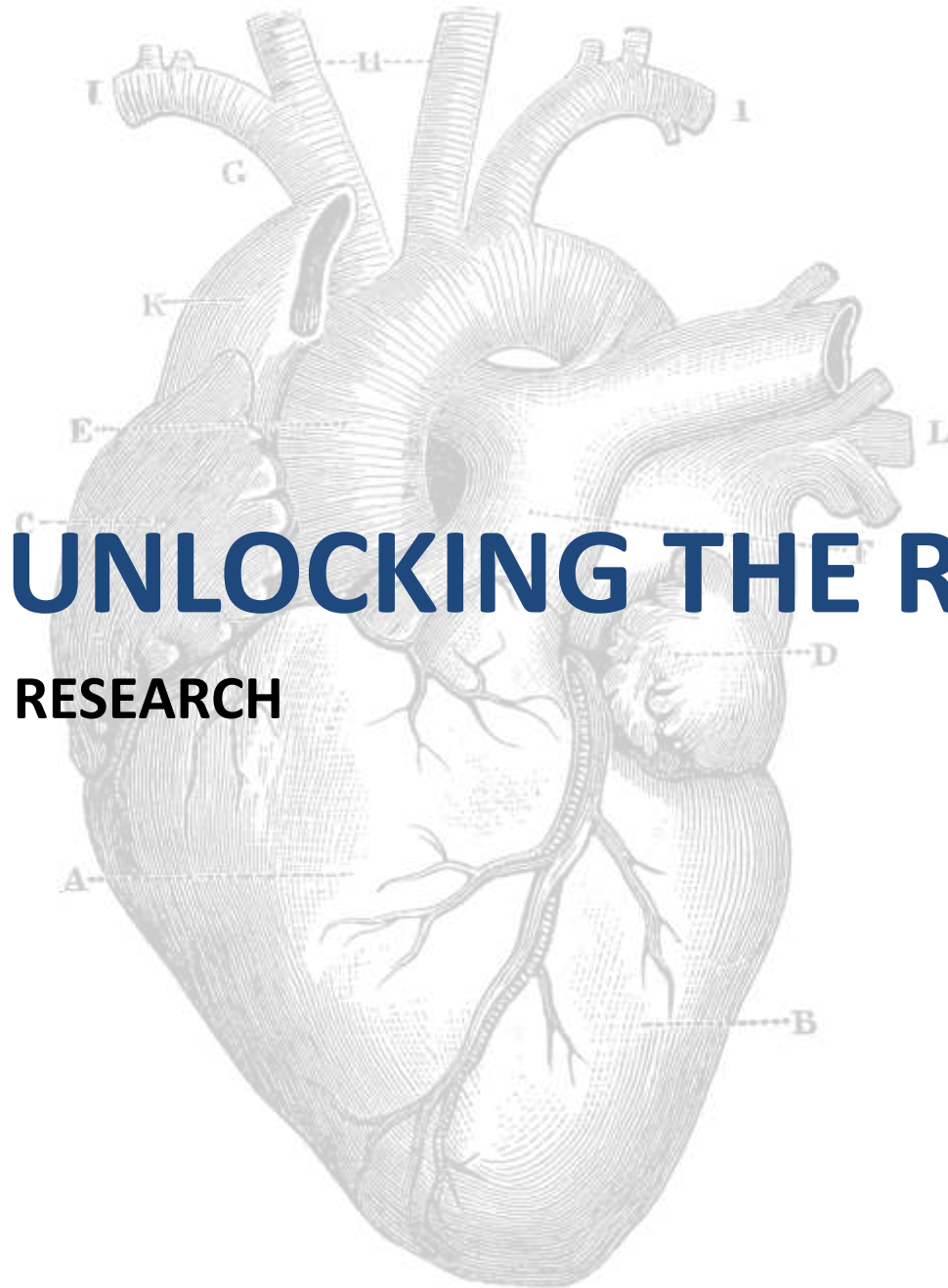
<http://www.scts.org/DynamicCharts/>

Monitoring medical devices

- Currently does not happen in UK
- Data: **200** valve types entered **13,000** ways (free text)
- But R is good with **regular expressions**



Fig. 37.

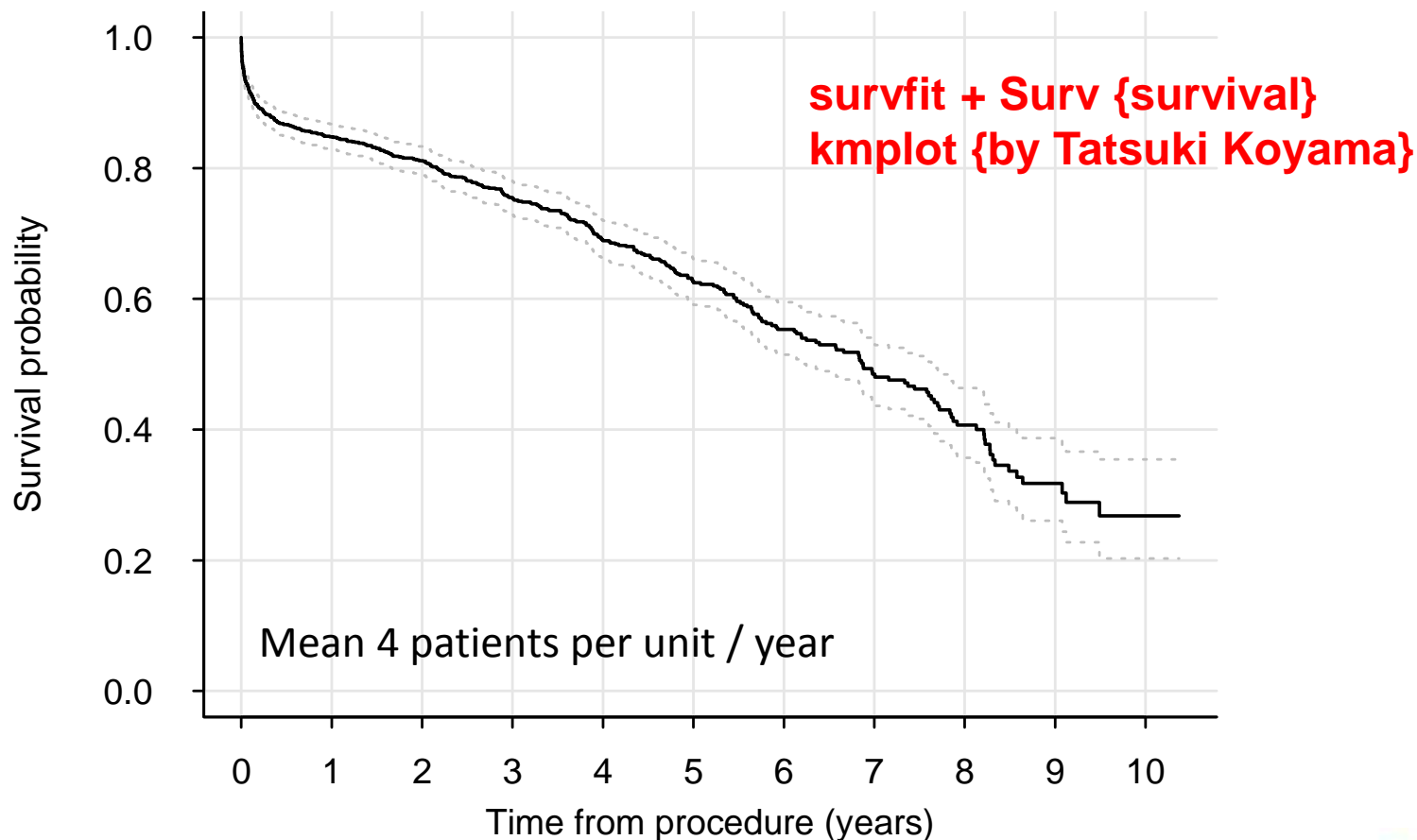


UNLOCKING THE REGISTRY

RESEARCH

Evidence based medicine

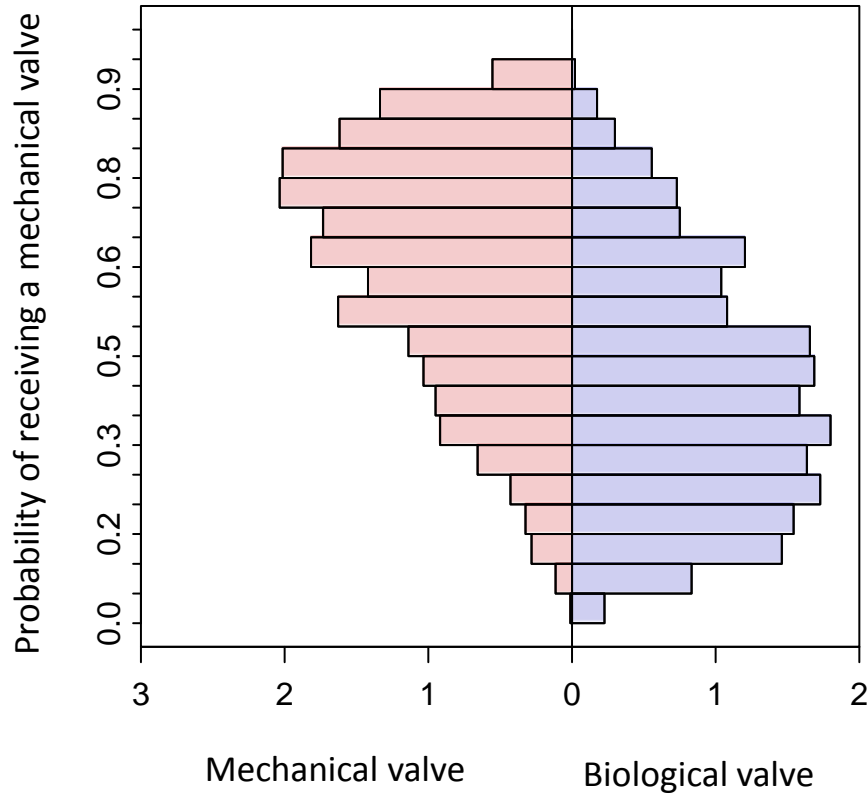
Octogenarians having Mitral Valve Surgery ± CABG ± TV repair
over 10-year window



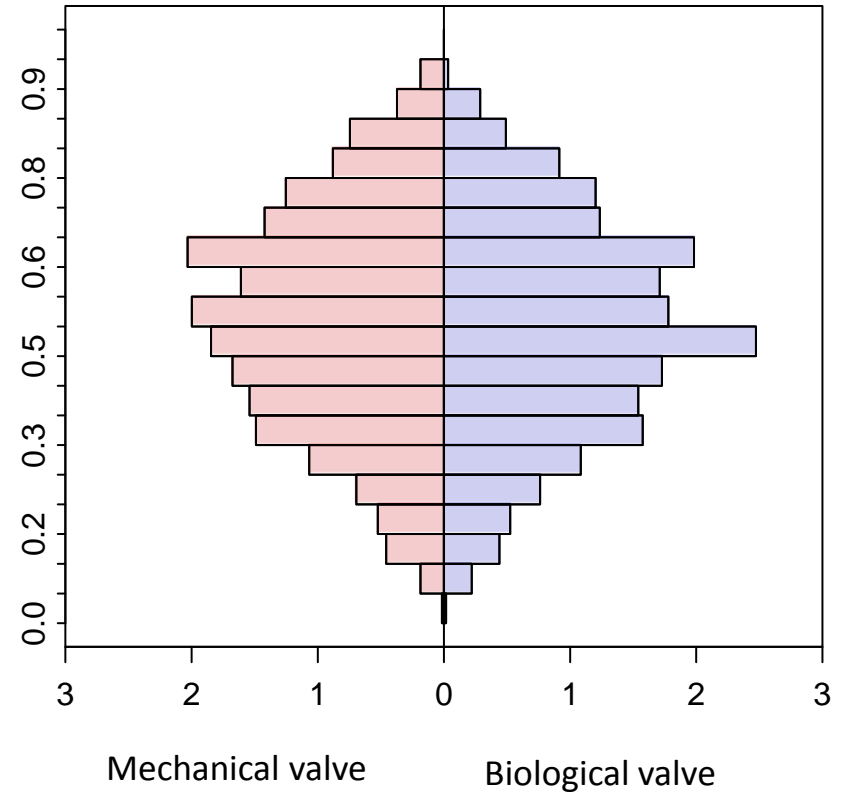
No. at risk	1415	991	779	559	398	276	180	114	64	23	6
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Contemporary statistical methodology for retrospective data

Unmatched

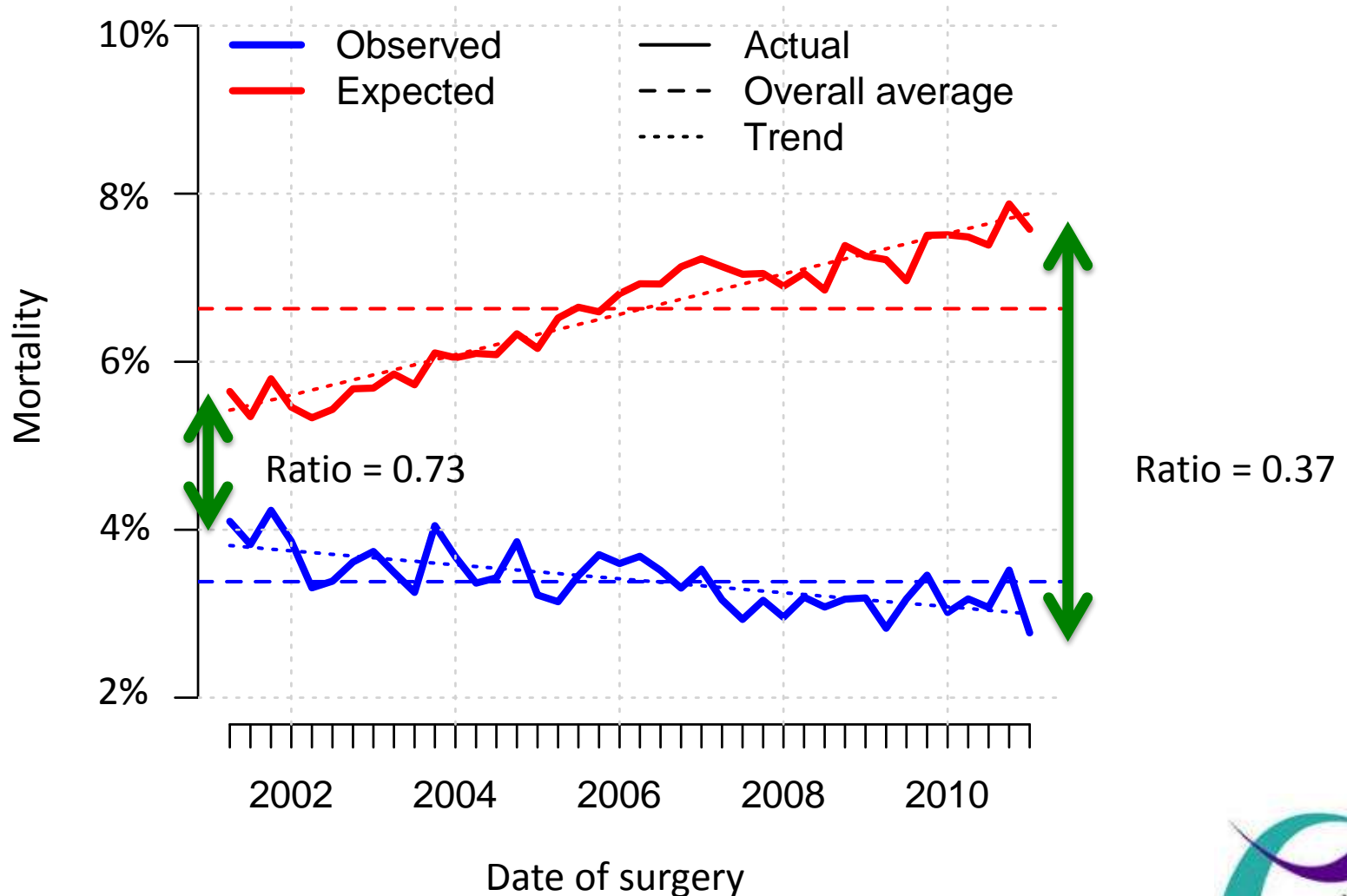


Matched

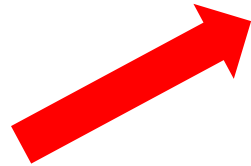


matchit {MatchIt}

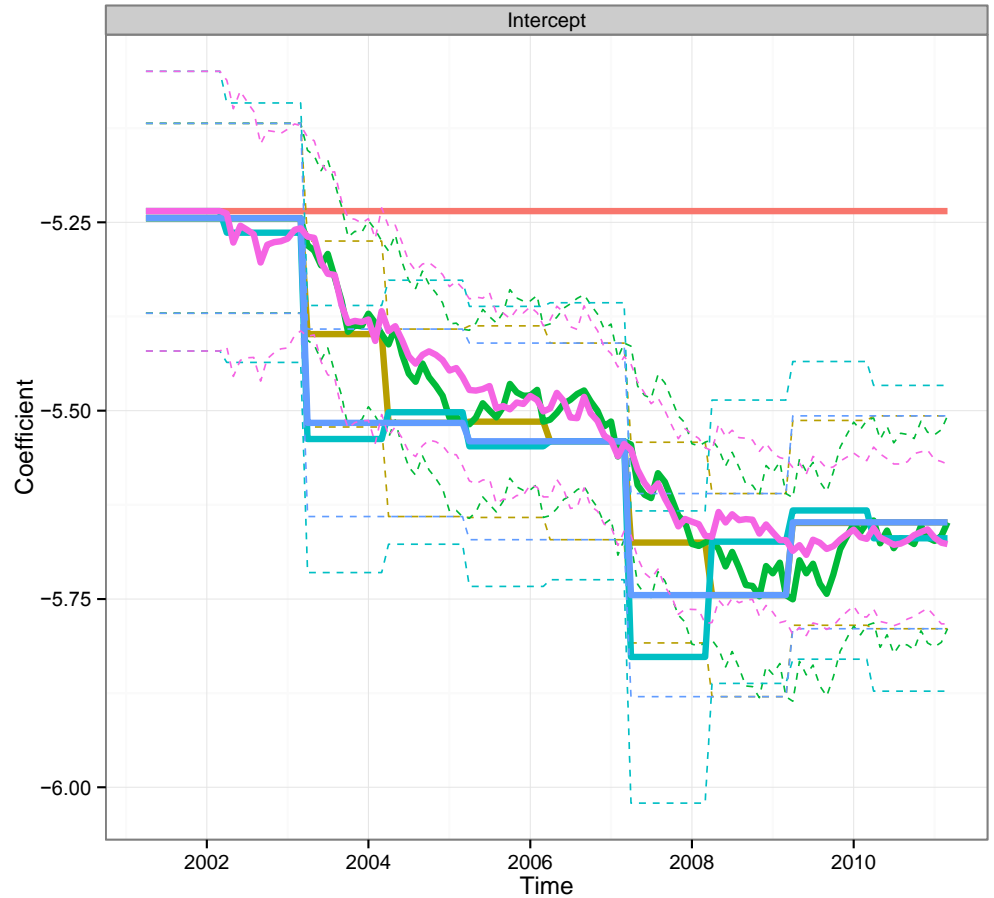
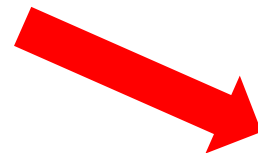
Risk prediction: *status quo*



Risk prediction: with R



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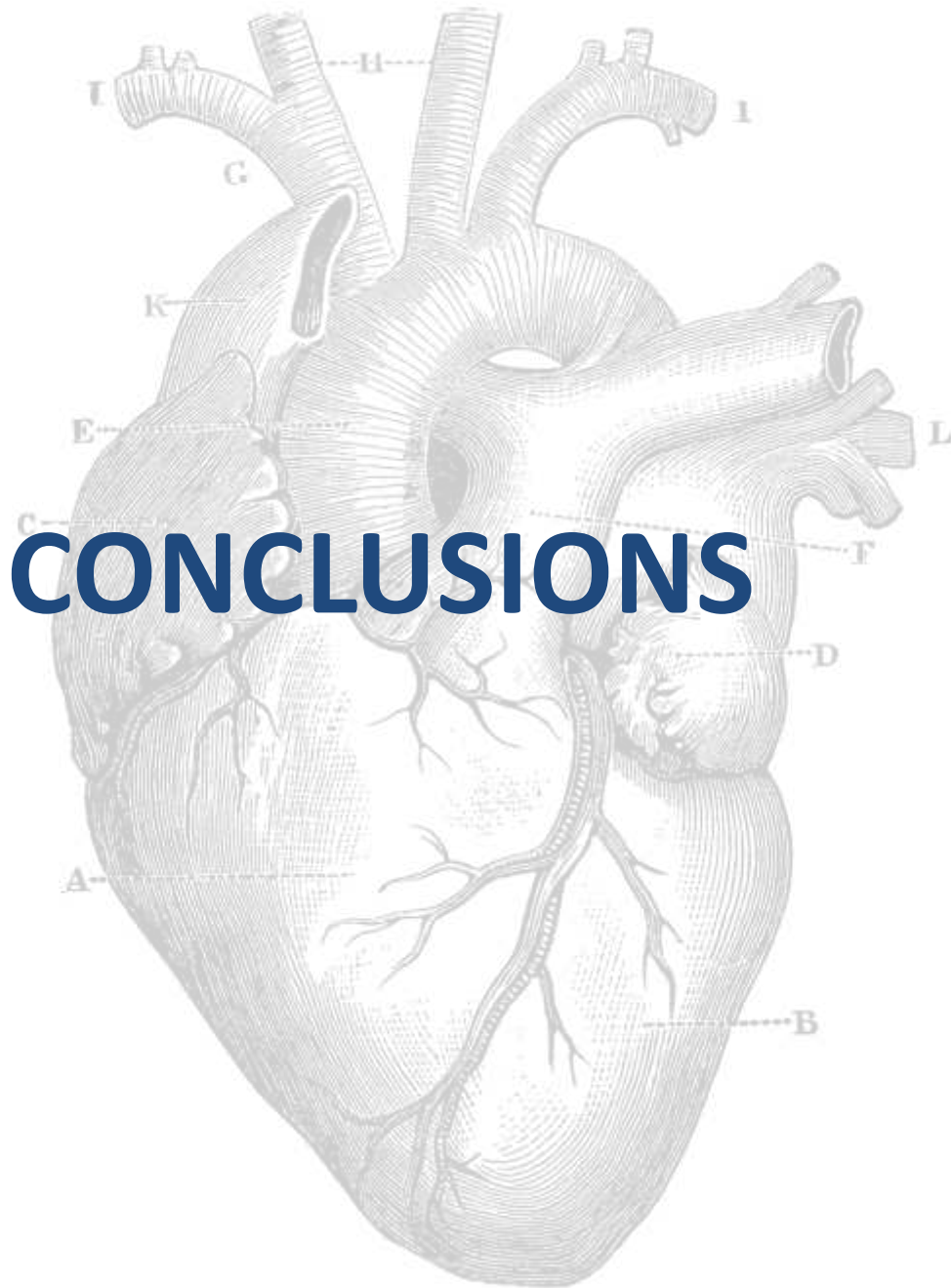


— Estimate - - 95% CI

- No update
- Rolling 24-month window (12-months)
- Rolling 24-month window (1-month)
- Piecewise recalibration (12-months)
- Piecewise recalibration (24-months)
- Dynamic logistic regression

logistic.dma {dma}

Fig. 37.



CONCLUSIONS

Conclusions

- We need to **unlock** healthcare registries to:
 - Monitor quality & avoid a repeat of Bristol
 - Revalidation of professional credentials
 - Facilitate patient choice
 - Develop & validate evidence based medicine
 - Increase in demand
- We can do it all in R!



Acknowledgements

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Comments & suggestions

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