

Real-time Monitoring of Patient Safety in Victorian Public Hospitals

Implementation of the VAED and the COPE Model
to Monitor Intensive Care Services



Acknowledgments

- Department of Health, Victoria:

- Safety & Quality Branch, VHRS.



- Northern Clinical Research Centre

- Dr Anna Barker, Marnie Graco, Anastasia Hutchinson, Tshepo Rasekaba.

- Victorian Intensive Care Data Review Committee

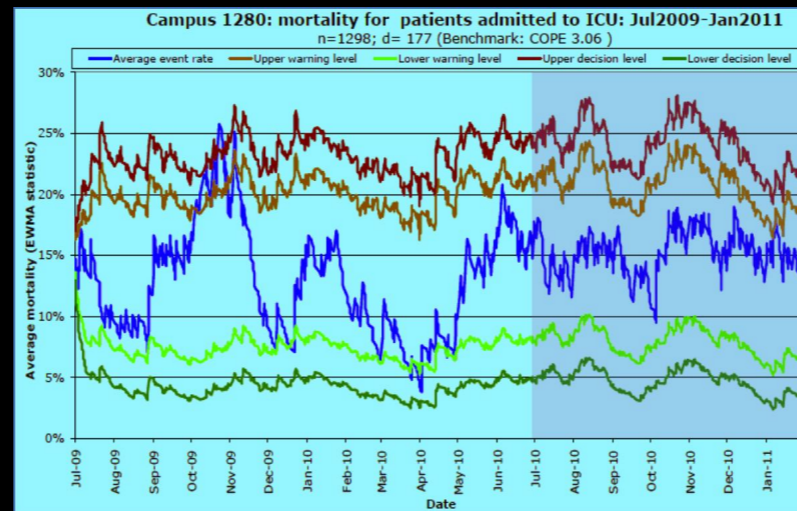
- John Santamaria.



Conclusion

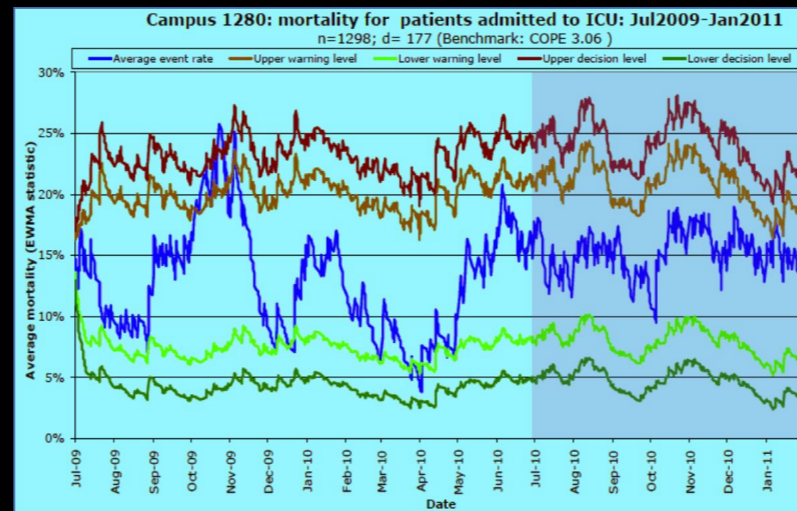
- Real-time system monitoring: feasible
- Comprehensive & timely data: VAED
- Stable & reliable risk-adjustment: COPE_{v6}
- Display methods:
 - EWMA: real-time, external benchmarking
 - SMR: retrospective, internal benchmarking
 - Funnel plot: retrospective, weak model

Real-time monitoring



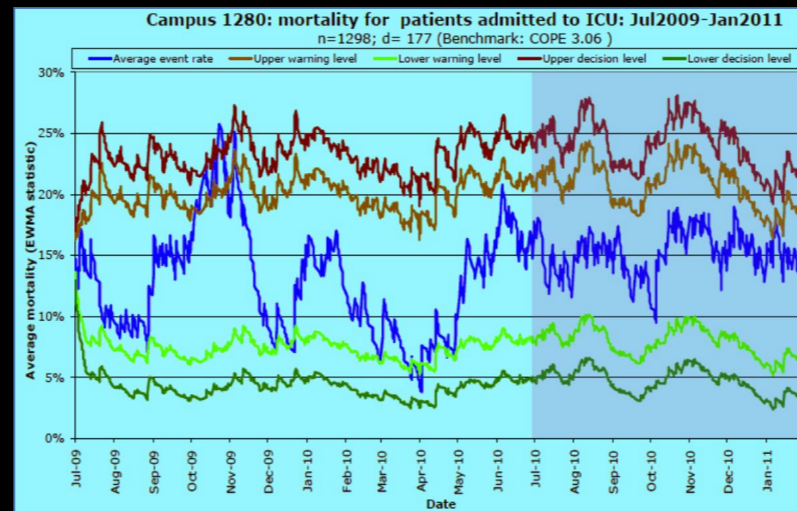
- Definition?

Real-time monitoring



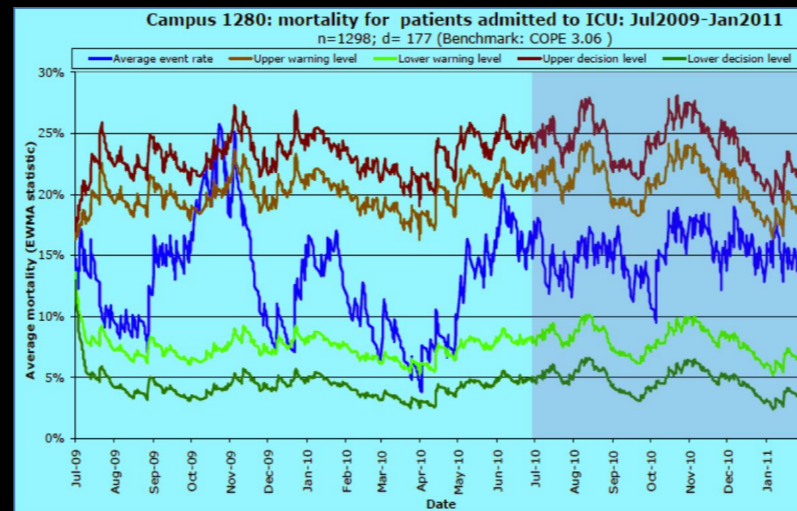
Why?

Real-time monitoring



Which outcome(s)?

Real-time monitoring



- Data + Risk-adjustor + Display + Governance

Methodology

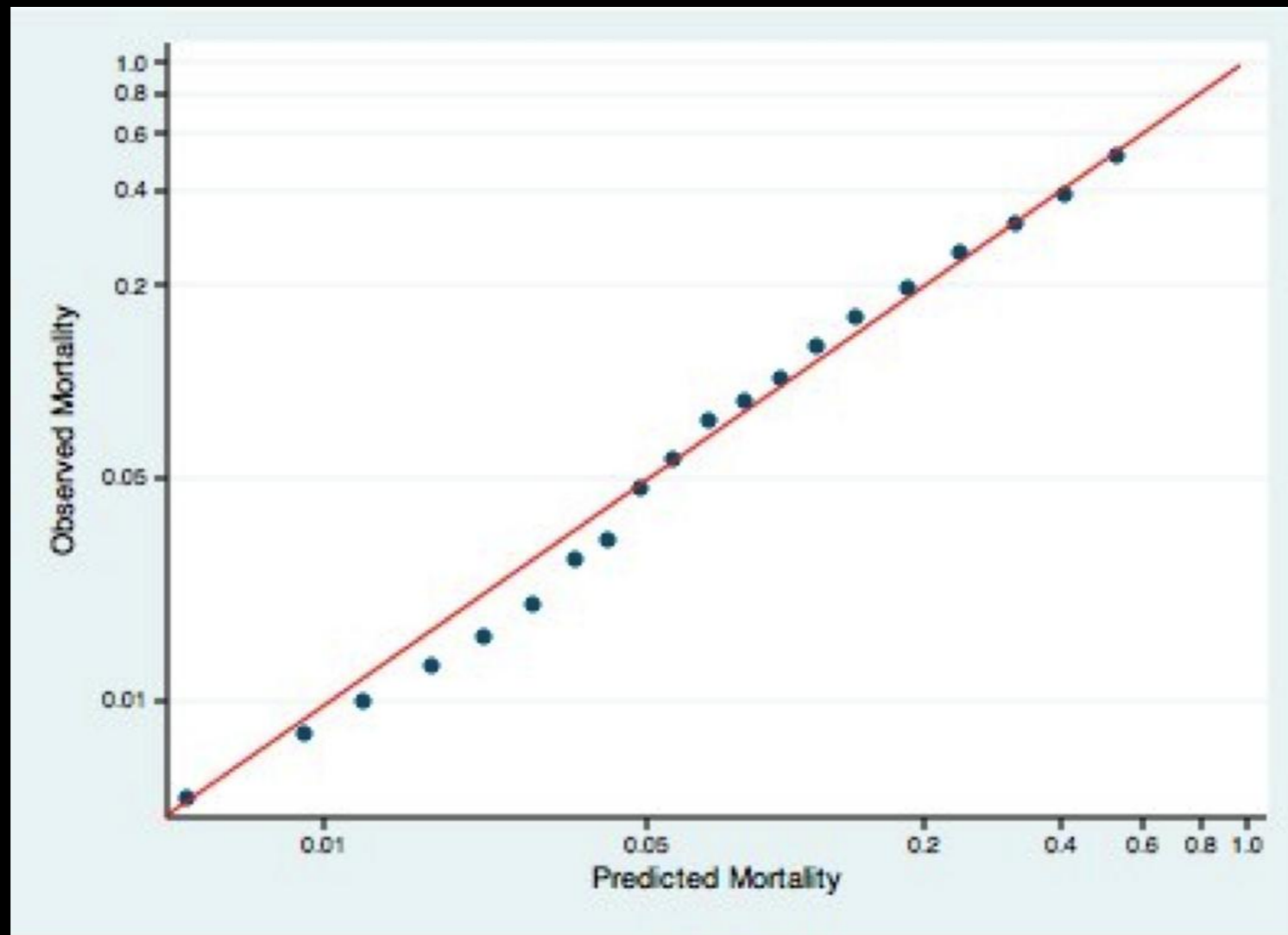
1. Hospital data acquisition (VHIRS)
2. Data cleaning & quality testing
3. Recalibrate risk-adjustor (COPE_{v6})
4. Control chart (EWMA) production
5. EWMA signal analysis/interpretation
6. Governance process



Is the VAED a reliable data-source?

- Coding quality
- Data extraction
- Data security & transfer
- Timely <6wks

Is the risk-adjustor stable?

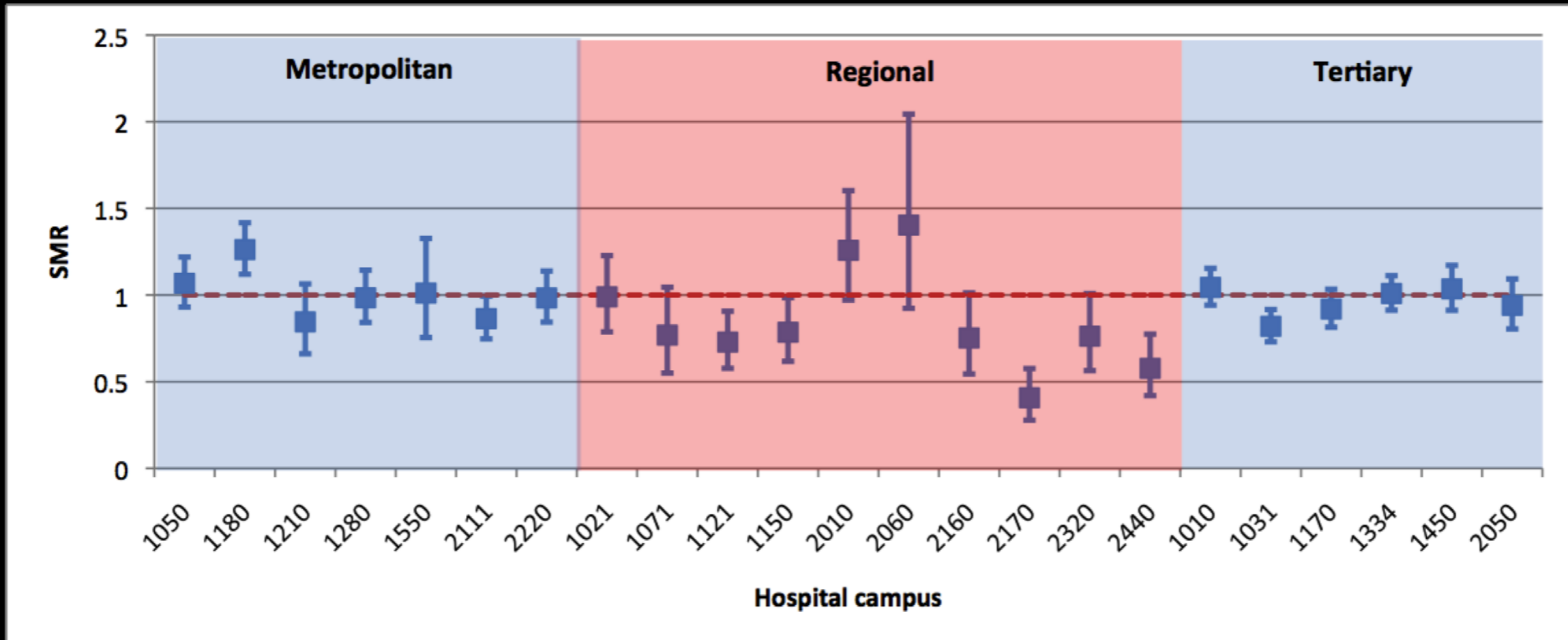


- Critical Care outcome Prediction Equation (COPE_{v6})

Is the COPE model stable?

Fiscal Year	Ideal	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
n=		16,107	16,474	16,620	17,147	17,961	17,949	18,670	18,167	18,179	18,499
COPE model (contemporary) recalibrated to each fiscal year											
ROC	>0.80	0.833	0.838	0.829	0.818	0.826	0.834	0.824	0.817	0.811	0.815
X ² , df=8	<15.5	13.23	12.10	10.97	12.96	11.07	15.67	11.12	16.58	11.23	15.51
p-value	<0.05	0.10	0.15	0.20	0.11	0.20	0.05	0.20	0.04	0.20	0.05
Slope*, β	1.0	0.980	0.988	0.985	0.985	0.990	0.972	0.980	0.970	0.984	0.969
Intercept*, α	0	0.002	0.002	0.002	0.002	0.001	0.004	0.003	0.004	0.002	0.004
COPE model (historical) calibrated to 2003-05 then applied to each fiscal year											
ROC	>0.80	0.830	0.836	0.827	0.790	0.825	0.833	0.788	0.814	0.808	0.812
X ² , df=10	<18.3	56.4	33.7	34.1	35.5	10.6	16.7	38.6	25.6	16.4	22.5
p-value	<0.05	0.000	0.000	0.000	0.000	0.387	0.080	0.000	0.004	0.088	0.013

Caterpillar plot of SMR

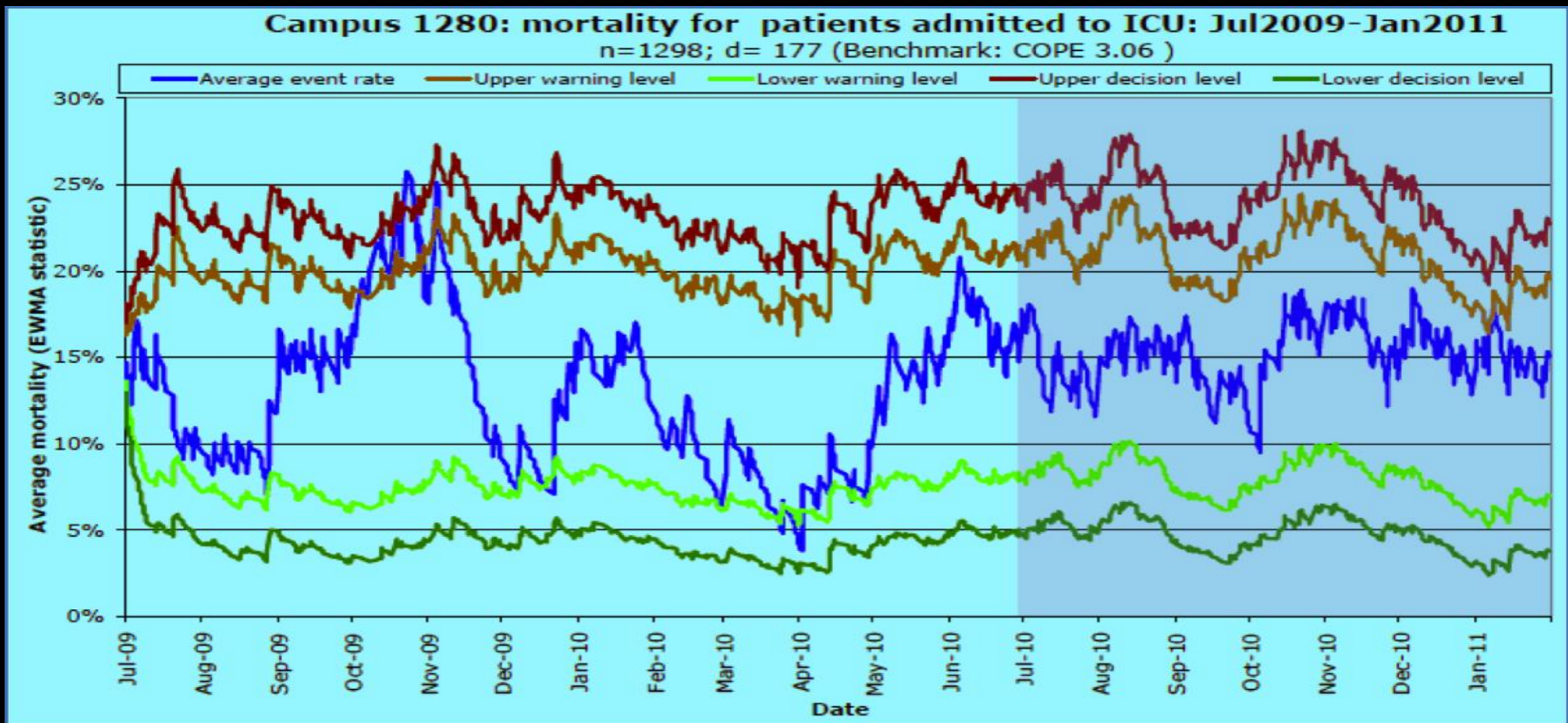


*Caterpillar plot of campus SMR, 95% CI. Jul2009-Jan2011
Benchmark = COPE model (2006-2009)*

SMR

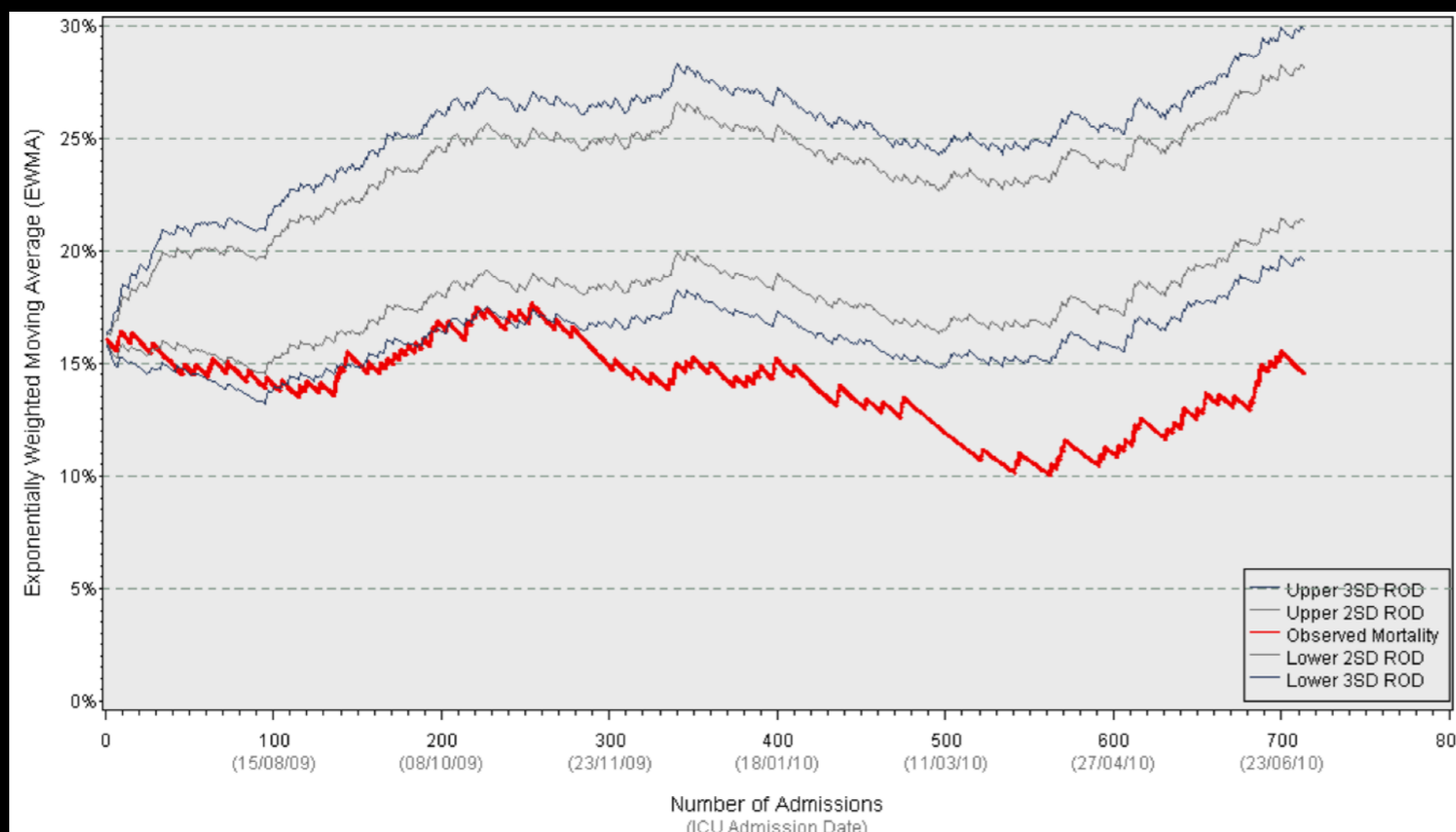
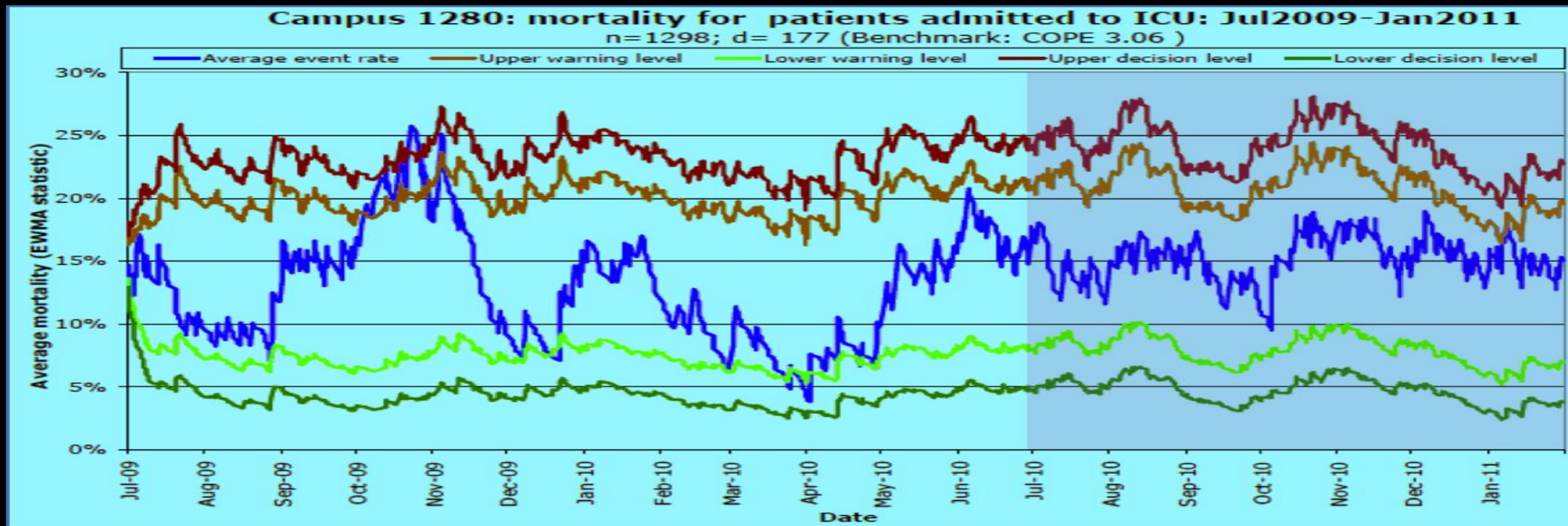
- retrospective and internal benchmarking*
- less useful for real-time monitoring.*

EWMA process control chart



EWMA chart of average mortality (blue line) compared to the benchmark (between red and green lines)

Benchmark = COPE model (2006-2009)



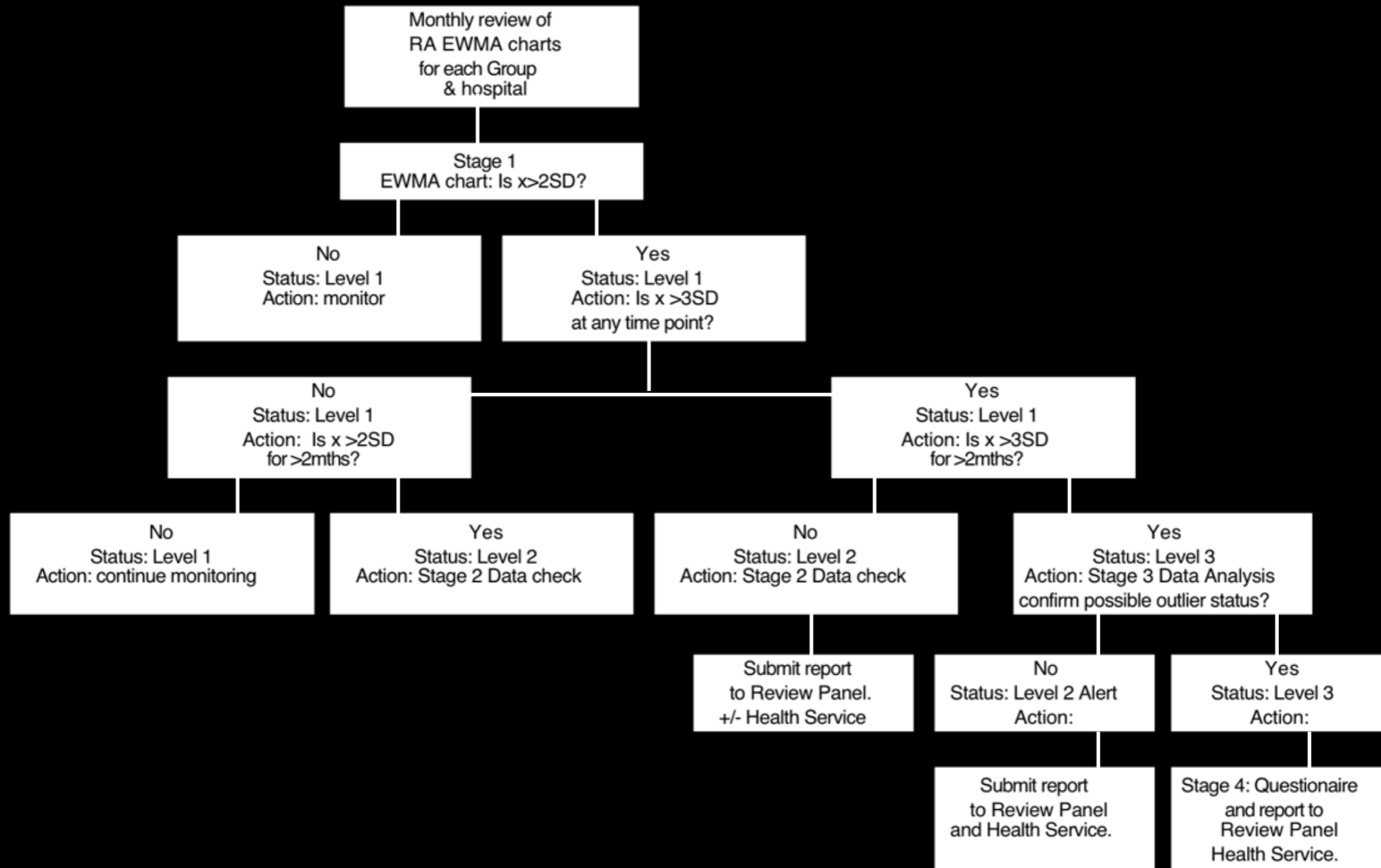
EWMA observations:

1. Mortality
2. Severity/casemix
3. Chronology
4. Calibration
5. Population size

EWMA Comparison

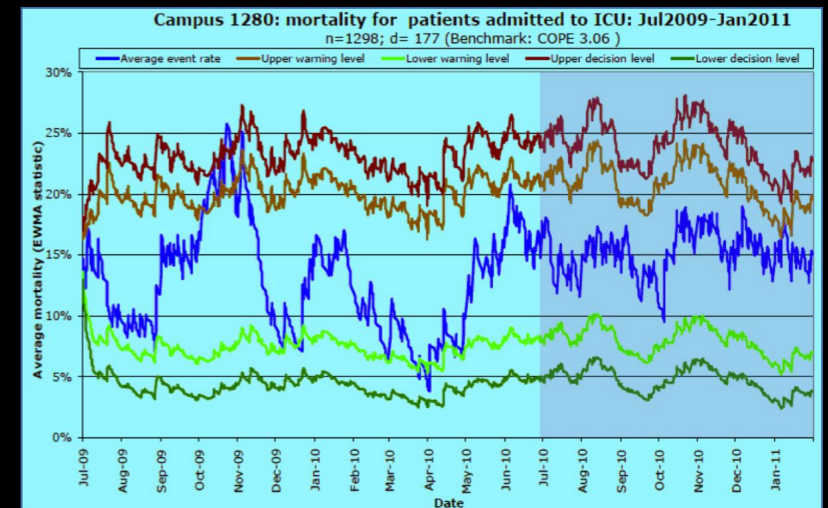
1. Calibration
2. Data excluded

Governance model



Real-time monitoring

- Flag early trends
- Identify 'good' performers (best practice?)
- Focus on subgroups eg high-risk diagnoses
- Direct resources
- Monitor system innovations
- Reassure stakeholders



Conclusion

- Real-time monitoring: feasible
- Administrative data adequate
- Stable & reliable risk-adjustment: COPE_{v6}
- Display methods: EWMA
- Governance model
- Broad application (monitoring, research, safety)

Questions?

1. What evidence is there that RTM identifies true outliers?
2. Can RTM be applied hospital-wide (using HOPE model)?
3. Can RTM be applied in a single hospital?
4. Does RTM & COPE apply outside Victoria?
5. Does RTM & COPE replace APACHE?
6. What are the limitations of RTM?
7. How often is COPE model recalibrated?
8. Is there a minimum population size for RTM?
9. How can RTM be used as Quality & Safety initiative?
10. Can this method replace clinical peer review?
11. Why is EWMA preferred over caterpillar & funnel plots?
12. What does the governance process involve?
13. How much of the methodology can be automated?
14. Isn't administrative data now passe? Is the SMR passe?

