Changes to HED SHMI and CUSUM modules

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Overview

- Standardised Mortality Ratios
- SHMI
  - NHS Digital's changes
  - HED module changes
  - Outstanding methodological issues
- SHMI Q&A
- CUSUM overview
  - Different CUSUM methods
  - New HED CUSUM module
- CUSUM Q&A

Please type any questions into the chat box, and we will address them at Q&A

Standardised Mortality Ratios (SMRs)

- Difference in case-mix between hospitals hinder mortality comparisons
  - Patient population / demographics
  - Referral patterns / service provision

- Indirectly-standardised: using regression models
  - Individual Probability of death calculated per patient:

$$SMR = \frac{\Sigma(\text{Number of Observed deaths})}{\Sigma(\text{Predicted Probability of death})}$$

Common SMRs:

- **SHMI:** Summary Hospital-level Mortality Indicator, NHS indicator for death in hospitals or within 30-days
- **HSMR**: Hospital Standardised Mortality Ratio, Dr Foster-based indicator of ~80% in-hospital deaths

SHMI development

Number of criticisms remain:

- Model quality was poor in certain groups (and in general)
- No deprivation, ethnicity, or palliative information
- Apparent South-East bias
- Distinct seasonal patterns
- Out-of-date
- Inconsistent across large / integrated providers

NHS Digital Changes:

- Regrouped: Hodgkin/non-Hodgkin lymphoma, birth and obs/maternity.
- Added Birth-weight predictor to neonatal groups
- Seasonality now included as admission month
- Publication now monthly(mostly...)
- Site-level now published*

Site-level SHMI

Many of you may have filled in an NHS Digital survey about site in recent weeks. Site is inconsistently recorded, coded and submitted to HES.

NHSD techniques developed:

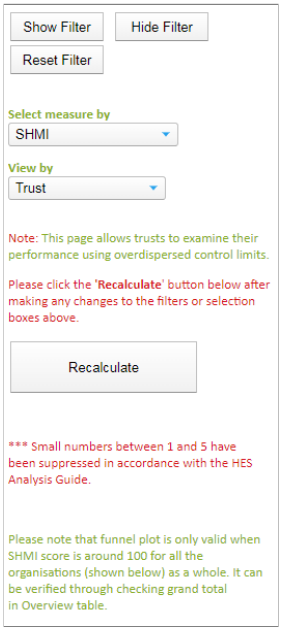
- Using CQC registered sites/providers
- Merging with ODS data and HES
- Using their own remapping
- Manual correction likely in subsequent publications

HED using look-up tables supplied by NHSD, and applying remapping to SITETRET.

HED module changes

- Renaming modules in due course
- All model parameters now provided:
  - NHSD added more predictors, but not in co-ordination with DARS team
  - NHSD did not provide other predictors to subscribers
  - Fit SHMI from NHSD coefficients, calculate in/out hospital and palliative models
- 'Monthly' SHMI
  - Subject to Type-2 opt-outs, but has patient details
  - Fitted using correct model from NHS, but numbers may differ
  - HES sites not mapped like SHMI, manual remapping

Module changes



- In portal, little has changed for user, mostly in underlying system
- Additional drop-down menu on Funnel Plot (Random Effects Model)
- Adjusts aggregation level and recalculates
- Censoring and Overdispersion issues in NHSD method

Outstanding Issues

Site-level mapping

- This is inconsistent and inaccessible for other organisations.
- In our view, it is not fit for analysis, but we have provided to match NHSD.

Overdispersion

Overdispersion (more variation than we expect in our data from theory alone) is present in SHMI. It is adjusted for in the random-effects funnel plot by inflating the limits by the overdispersion factor.

- OD is usually worse in smaller unit
- Site and diagnosis groupings increase OD due to smaller units
- NHSD censors ***before*** calculating OD, underestimating it
- HED adjusts for OD, then applies censoring ***after*** adjustment

Summary

- SHMI has moved to monthly publication, with improved division of diagnosis groups, and additions of birth-weight and seasonality predictors. This has improved the quality of SHMI.
- Reporting at site and diagnosis group level is not yet sound due to combination of censoring and overdispersion adjustments.
- HED is reporting data as provided by NHS Digital, using their methods and site-lookup tables. We are in regular contact with NHSD about SHMI developments and will keep up with any changes.
- The only noticeable change for users is the ability to select site or diagnosis grouping in the random-effects funnel plot.
- SHMI seasonal pattern will change, but annual figures the same.

SHMI Questions

HED

CUSUM

- SMRs are usually compared in a 'cross-sectional' manner: a snapshot at point in time.
- Question is are we higher or lower than expected?

What if I want to compare over time?

- We can't use monthly relative risk figures, as it's the wrong comparison.
- We can use control charts to monitor change over time.
- Risk-adjustment in SMRs makes them more complicated
  - i.e. ***don't use an XmR (#plotthedots) chart!***
- Risk-adjusted **CU**mulative **SUM** log-likelihood ratio test charts can be used
- Sequential probability test, usually to checking if rate is twice england rate.
- General monitoring method by CQC, and by Dr Foster Unit @ Imperial

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Methods

Essentially:

$$C_t = max(C_{t-1} + w_t, 0)$$

- C CUSUM value at time-point t (e.g. a monthly at a trust)
- w is a weighting, in this case the log-likelihood ratio (observation v.s. england)

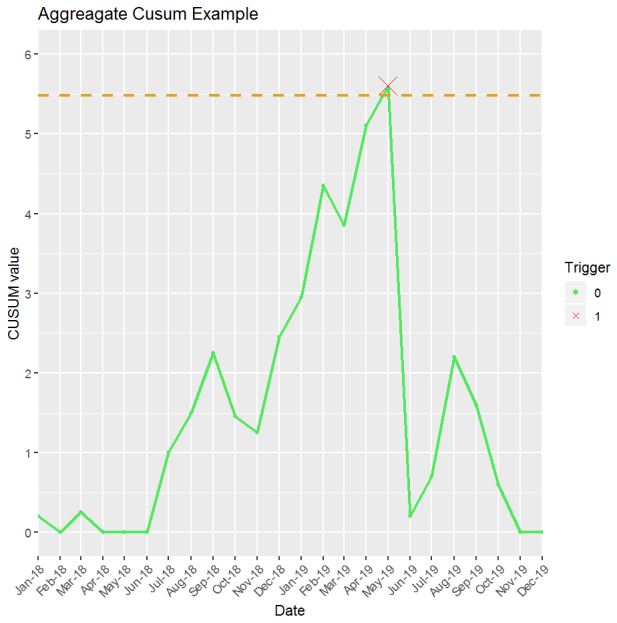
Two common methods:

- **Aggregated:** transforms to 'standard score', overdisperison adjustment like SHMI. CQC method, per month. ((CQC), 2014; Spiegelhalter, SherlawJohnson, Bardsley, Blunt, Wood, and Grigg, 2012)
- **Patient-level:** Individual patient risk/outcome scored against expected. (Steiner, Cook, Farewell, and Treasure, 2000; Bottle and Aylin, 2011; Steiner, Cook, and Farewell, 2001)

Aggregated Cusum

- Starts at zero
- Accumulates with deaths
- Threshold of 0.5 of sd before accumulating
- Trigger value based on normal distribution approximation (Grigg and Spiegelhalter, 2008)
- Trigger = 5.48, (0.1% - False Discovery Rate)
- Reset to zero

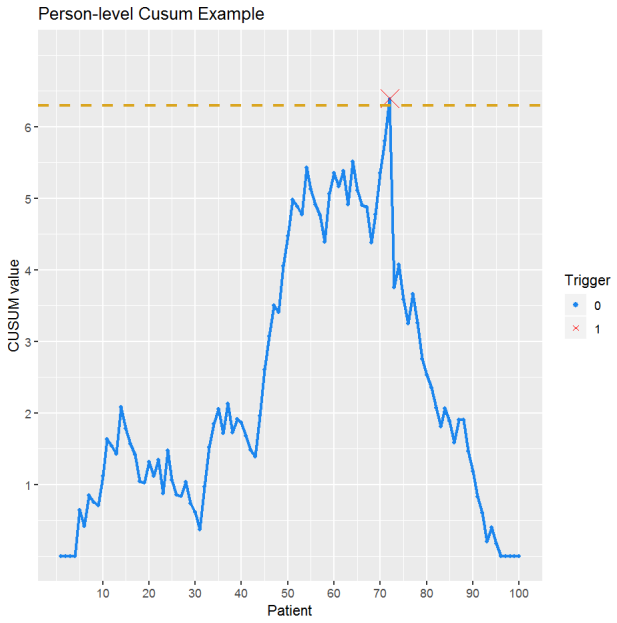
Based on CQC / Cambridge papers on comparing Healthcare Indicators



Person-level Cusum

- Starts at zero
- Accumulates with deaths
- Trigger value based published approximation (Bottle and Aylin, 2011)
- Trigger unique to each trust and diagnosis group
- Reset to half, partly (Lucas and Crosier, 1982)

Based on (Steiner Cook, et al., 2000; Bottle and Aylin, 2008)



Replacing the HED CUSUM modules:

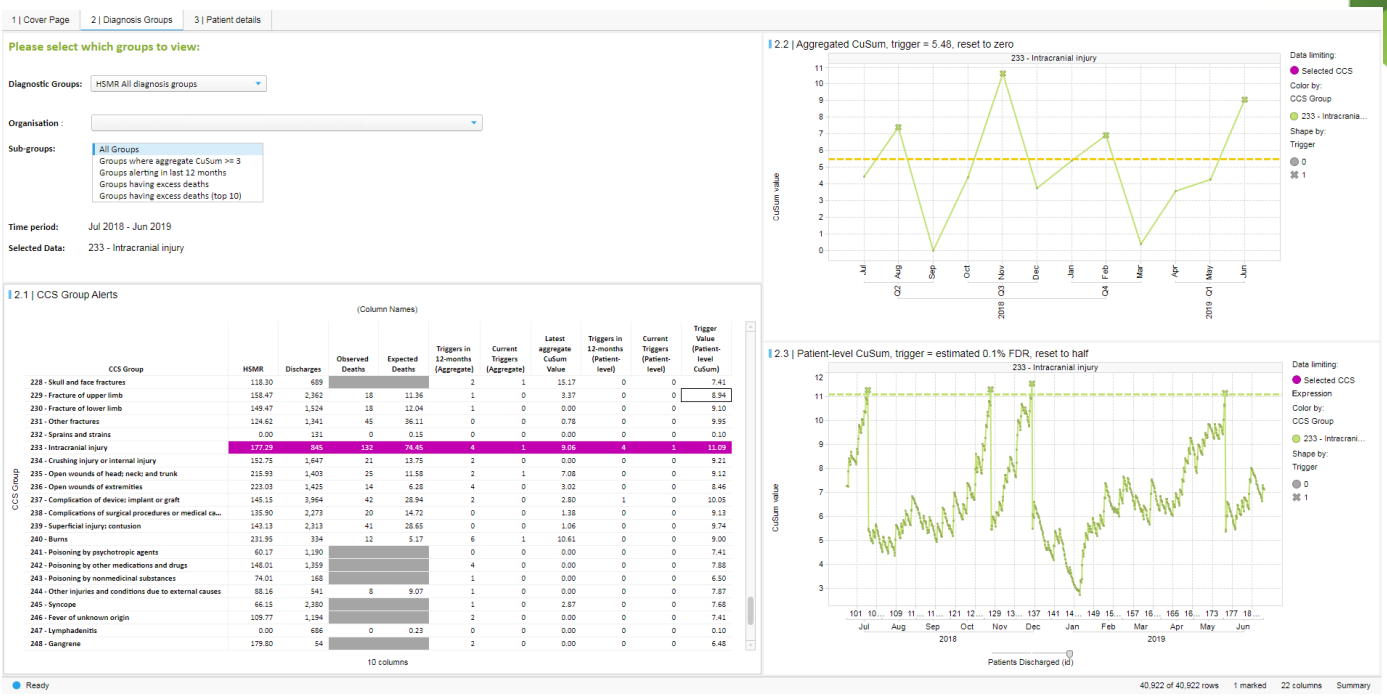
Current modules:

- Clinical Quality > Mortality > CUSUM - Mortality Analytics
- Pre-release: Person-level > Mortality Overview and Cusum Alerts

New single module:

- Summarises current alerts and prior 12-months
- Both aggregated and person-level methods
- Aggreagate trigger remains 5.48 (0.1%FDR)
- Applied Aylin & Bottle CUSUM limit approximation to persons

Layout



Summary

- CUSUMs monitor mortality over time
- Applied to HSMR, VLAD will be added for SHMI over the Christmas period
- Replacing two current modules with single new one:
  - Aggregated method (CQC-style)
  - Person-level (Imperial/DFI-style)
- Simpler interface showing table of alerts first

CUSUM Questions

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