

## A Posterior Predictive Model-Based Control Chart for Monitoring Healthcare

**Authors :** Yi-Fan Lin, Peter P. Howley, Frank A. Tuyl

**Abstract :** Quality measurement and reporting systems are used in healthcare internationally. In Australia, the Australian Council on Healthcare Standards records and reports hundreds of clinical indicators (CIs) nationally across the healthcare system. These CIs are measures of performance in the clinical setting, and are used as a screening tool to help assess whether a standard of care is being met. Existing analysis and reporting of these CIs incorporate Bayesian methods to address sampling variation; however, such assessments are retrospective in nature, reporting upon the previous six or twelve months of data. The use of Bayesian methods within statistical process control for monitoring systems is an important pursuit to support more timely decision-making. Our research has developed and assessed a new graphical monitoring tool, similar to a control chart, based on the beta-binomial posterior predictive (BBPP) distribution to facilitate the real-time assessment of health care organizational performance via CIs. The BBPP charts have been compared with the traditional Bernoulli CUSUM (BC) chart by simulation. The more traditional “central” and “highest posterior density” (HPD) interval approaches were each considered to define the limits, and the multiple charts were compared via in-control and out-of-control average run lengths (ARLs), assuming that the parameter representing the underlying CI rate (proportion of cases with an event of interest) required estimation. Preliminary results have identified that the BBPP chart with HPD-based control limits provides better out-of-control run length performance than the central interval-based and BC charts. Further, the BC chart’s performance may be improved by using Bayesian parameter estimation of the underlying CI rate.

**Keywords :** average run length (ARL), bernoulli cusum (BC) chart, beta binomial posterior predictive (BBPP) distribution, clinical indicator (CI), healthcare organization (HCO), highest posterior density (HPD) interval

**Conference Title :** ICBCPO 2018 : International Conference on Bayesian Control and Process Optimization

**Conference Location :** Sydney, Australia

**Conference Dates :** October 04-05, 2018