NICHQ National Institute for Children's Health Quality

Insights

A New Study Reveals a Breakthrough in Examining Rare Events

In the United States, six of every 1,000 babies do not live to celebrate their first birthday. This translates to approximately 23,000 babies dying every year.

Although more babies are reaching this milestone today than in the past, the U.S. infant mortality rate (IMR) is relatively high when compared to Japan, Canada, and many European countries. Moreover, clear IMR race and ethnicity disparities persist: as an example, black babies are more than twice as likely to die in their first year of life compared to white babies.

Reflecting its commitment to reducing infant mortality and disparities across the country, NICHQ led the Collaborative Improvement and Innovation Network to Reduce Infant Mortality (Infant Mortality CoIIN) from 2012-2017 with the U.S. Maternal and Child Health Bureau. Starting as a regional initiative, the Infant Mortality CoIIN expanded nationally to engage federal, state, and local leaders; public and private agencies; professionals; and communities to reduce infant mortality and improve other birth outcomes with a focus on continuous quality improvement.

A cornerstone aim of this multi-year program was to produce **measurable** improvements in infant mortality rates, and identify the cause of those improvements. However, challenges inherent in infant mortality data make it difficult to measure improvement and assess impact because:

1. **Timing of data collection**. It takes multiple years for official birth and death certificate data to become available.
2. **Finding appropriate analytic techniques**. Since infant mortality is considered a relatively rare occurrence, not all analytical techniques can be applied to these data. For example, techniques used to analyze heart disease deaths, which average over 600,000 a year, will not be as effective for analyzing infant deaths, which occur far less frequently.
3. **Even smaller numbers when looking at disparities**. Limited data is compounded when attempting to assess changes in infant mortality among subpopulations, such as racial and ethnic groups, which is critical to assessing progress toward addressing health equity.

These limitations make it challenging for states to evaluate the impact of their work in real time and to use that data to guide future changes in programming.

To combat these challenges, NICHQ leveraged a quality improvement approach novel to the field of maternal child health: the use of statistical process control (SPC) charts. Findings from this approach were recently published in the Maternal and Child Health Journal. Below, NICHQ Senior Analyst Emily O'Donnell, ScD, MS, one of the authors of the article, provides an overview of their findings and expands on how certain SPC charts, in particular, can improve maternal and child health programs by helping them analyze and respond to rare events.

NICHQ Senior Analyst Emily O'Donnell, ScD, MS

What do SPC charts tell us?

SPC charts examine data chronologically and identify fluctuations in data that signify improvements in a system. By identifying when true improvements occur relative to programmatic efforts or interventions, public health practitioners are empowered to respond to lessons gleaned from data in real-time.

Specifically, SPC charts differentiate between:

- **Common cause variation**: data that fluctuates for predictable reasons, such as random variation; and,
- **Special cause variation**: data fluctuations that result from external forces, such as public health programs to reduce infant mortality, which are important to identify and act upon.

Interested in learning more about SPC charts? Read this NICHQ insight on using special cause variation to inform action.

How can SPC charts help maternal and child health professionals examine rare data?

For rare events, like infant mortality, it can be difficult to understand fluctuations in data over time. And without seeing those fluctuations, it can be hard to determine whether changes made to reduce infant mortality are having an impact.

To put it another way, because infant deaths happen infrequently, there aren't enough data to analyze infant mortality using traditional methods.

Fortunately, a subset of SPC charts are meant to handle these challenges with sparse data. For example, these charts can focus on the time between the infant deaths instead of the number of actual deaths. When the time between deaths go up, it signifies improvements in infant mortality. When these SPC charts were used in the Infant Mortality CoIIN for Kansas and Alaska, they showed an increase in the number of babies born in the states between infant deaths. This suggests that efforts undertaken in Kansas and Alaska may have resulted in these improvements.

SPC charts were also found to be a valuable tool to track progress in addressing gaps in health equity. Using SPC charts, Kansas was able to identify IMR improvements among non-Hispanic Black babies, which may have otherwise been missed.

Moreover, SPC charts utilize real-time data, such as provisional birth and death data, which are subject to revision before final vital statistics data are released. These data have the potential for helping maternal and child health programs take informed action to improve public health outcomes, without having to wait the months and even years that it takes to get final and complete data.

Ultimately, SPC charts have significant capacity for helping maternal and child health practitioners interpret sparse data in real-time as programs and policies are tested, and then successes are spread and scaled. By incorporating SPC charts into existing data systems, local departments of public health gain a powerful tool in helping more babies celebrate their first birthdays.