D.C. Fire and EMS NEMSQA Key Performance Indicator Report

Office of the Medical Director - CQI Division

2022-07-11

Introduction

How to use this report

This report utilizes statistical process control charts, specifically the use of *run charts*. A run chart is a specific type of graph used to understand how a process or system is operating. Each data point can be thought of as an output or outcome of system and is generally plotted over time. Because all systems and processes have variation in them, we can then generally expect the next data point to be different from the previous one. Thus, we begin to see and understand how outputs and outcomes vary. See Appendix for in-depth explanation

National EMS Quality Alliance Measures

Hypoglycemia

Definition:

Numerator:

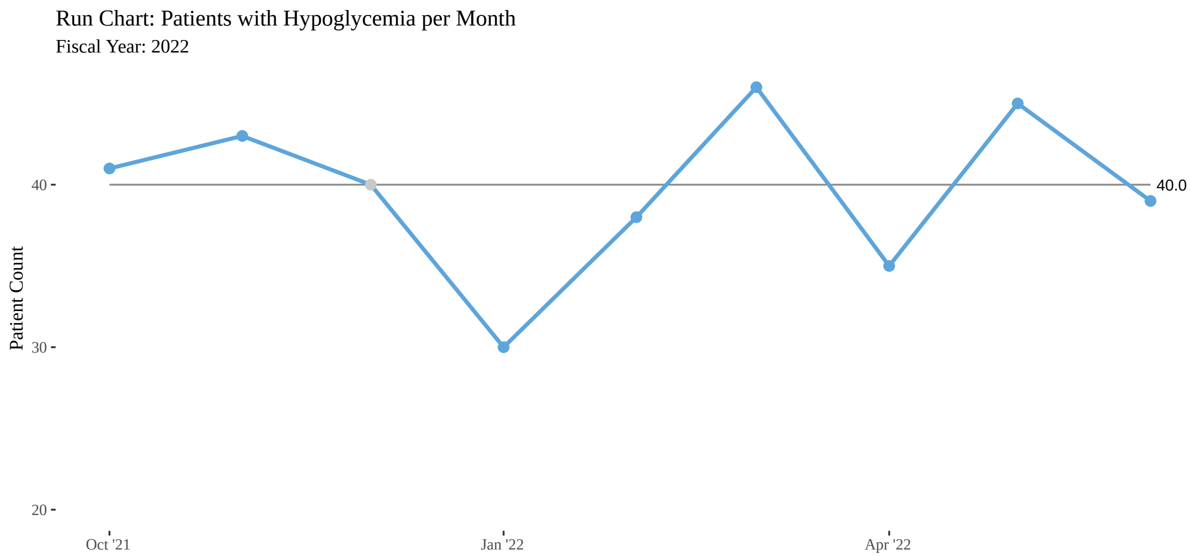
Denominator:

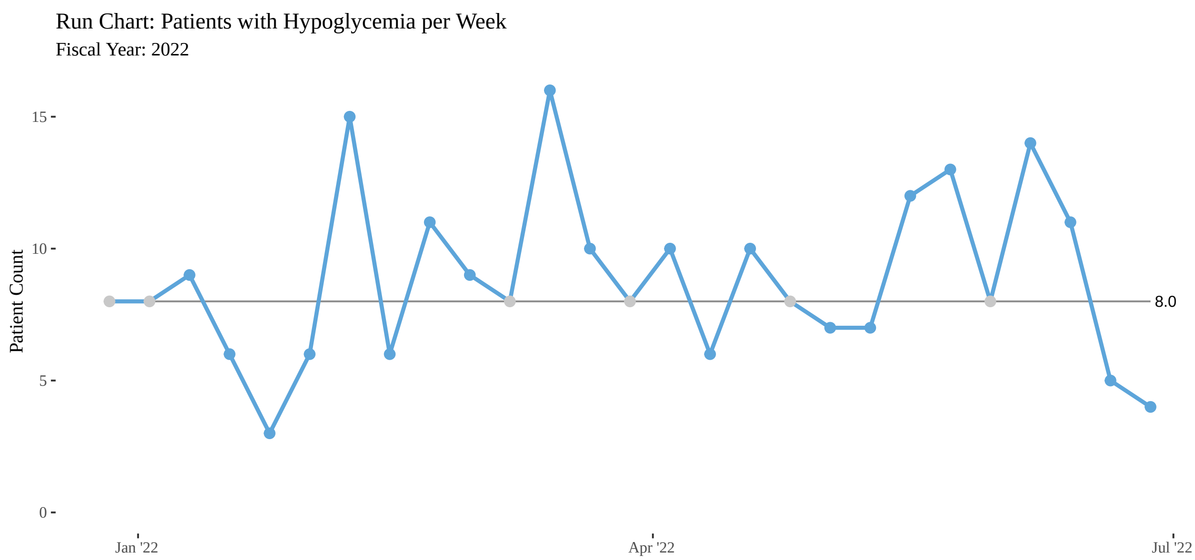
Rationale:

Hypoglycemic emergencies are one of the few types of cases EMS has a demonstrable positive impact on the outcome of a patient. Furthermore, because hypoglycemic emergencies can mimic other etiologies (i.e., intoxication, seizure) it is imperative EMS use good judgement and assessment skills to draw upon in order to make a sound clinical decision - namely, assessing blood glucose with a glucometer for all patients with an altered level of consciousness.

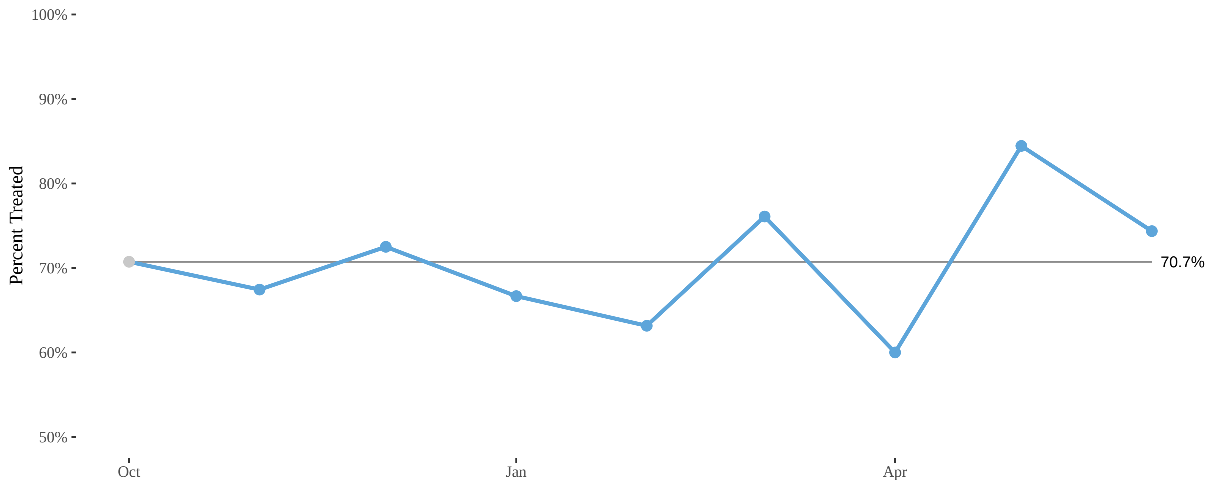
While there are likely many cases where it is known prior to arriving on scene a crew is responding for a diabetic emergency, there are instances where this is the case - and good clinical judgement is vital.

Hypoglycemia-01

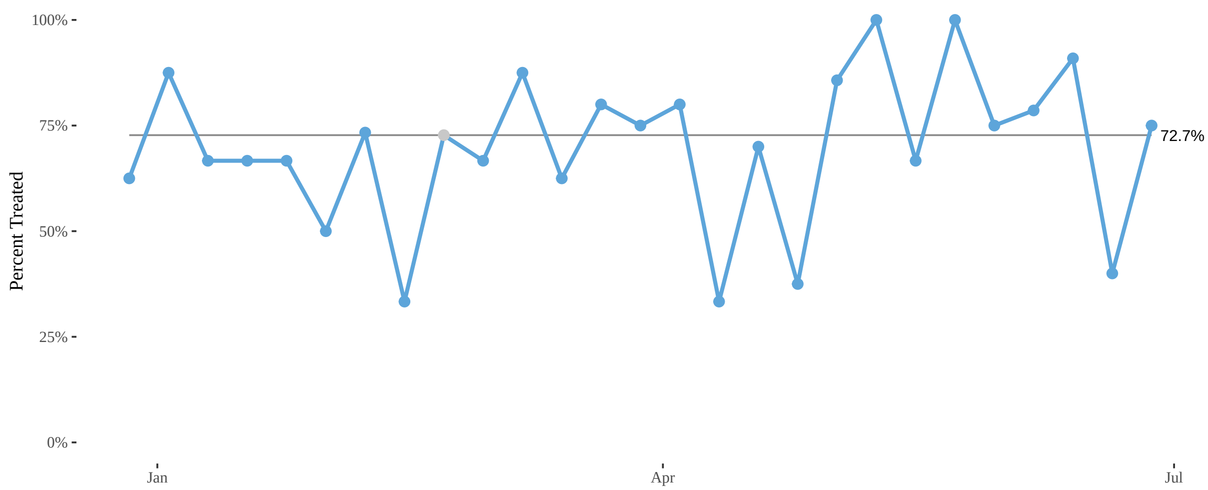




Run Chart: Percent of Hypoglycemia Patients Treated per Month
Fiscal Year: 2022



Run Chart: Percent of Hypoglycemia Patients Treated per Week
Fiscal Year: 2022



Discussion:

Pediatrics

Peds-01

Peds-02

Peds-03

Seizure

Seizure-01

Stroke

Stroke-01

Trauma

Trauma-01

Trauma-03

Trauma-04

Appendix

Understanding Run Charts and Shewhart Charts

Statistical Process Control Charts, also known as 'Shewhart Charts', are set of graphical depictions of how processes or systems performs by displaying valuable information about their inherent variation. Value is further amplified by the ability to detect shifts or anomalies within a process as well. Detecting these shifts has implications for understanding how applied changes, intended or unintended, affect outcomes (or lack thereof).

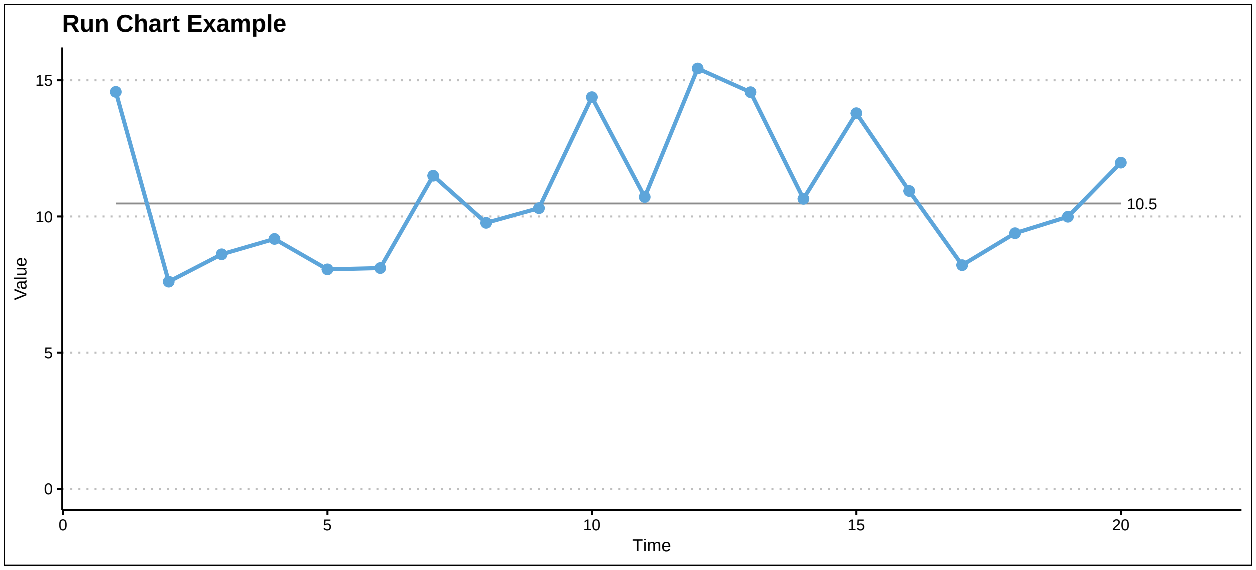
Variation in a process can be classified as two types: Common Cause Variation and Special Cause Variation. Common Cause Variation is variation that is inherent of the system. Examples 1.1-1.3 show the application of a Run Chart, Individuals Chart, and Moving Range Chart to describe what a stable process produces with common cause variation.

Special Cause Variation is variation that falls outside of the expected range or any data point that exceed 3 Standard Deviations from the mean (above or below).

Common Cause Variation

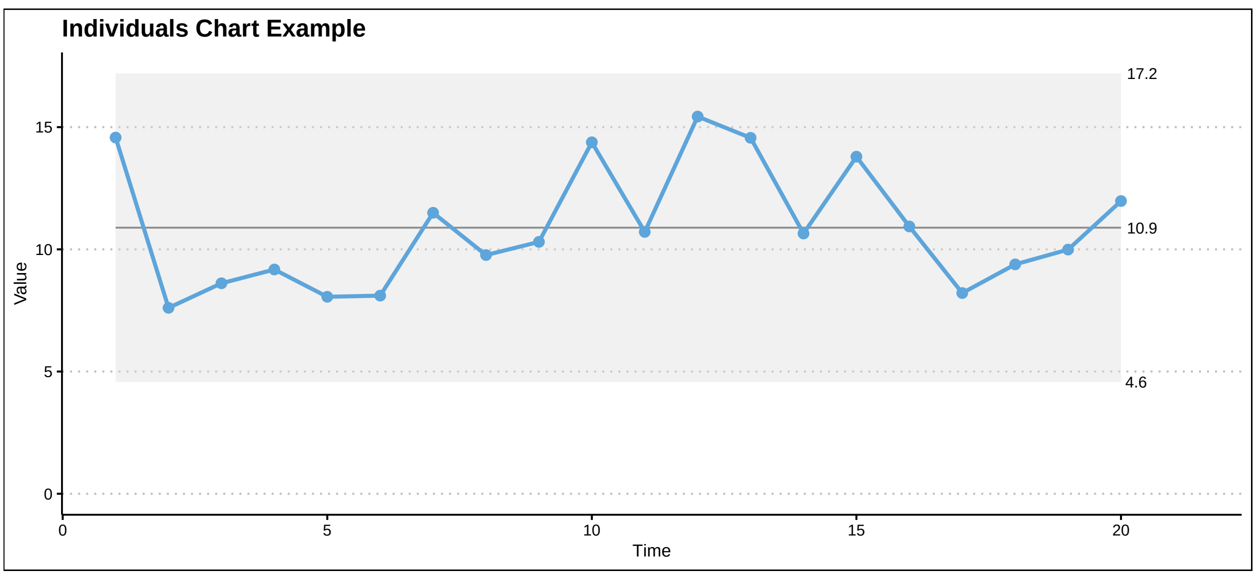
The run chart in Ex. 1.1 shows the output of a random process, represented as the blue line. The center line (solid black line) denotes the median - and describes the 'middle' of the data. In this case, the median for this particular case is 10.5, with 50% of the data above the line, and 50% below the line. What we see here is a process with what appears to be normal variation.

Ex. 1.1



To confirm this, we can use two additional charts: Individuals and Moving Range. These charts help us determine if a process has issues with "Special Cause Variation"; or more succinctly - variation outside of the expected range.

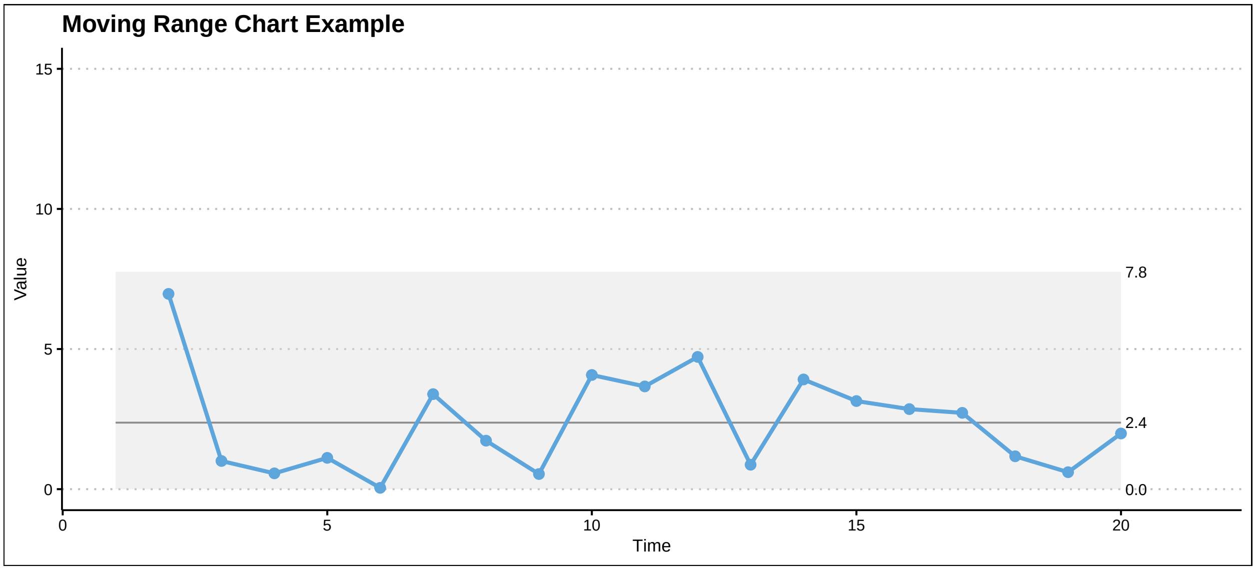
Ex. 1.2



In this case, the individuals chart changes. We have 4 additional pieces of information: a gray area box, a new center line number, and two additional numbers above and below the center line. The gray area is the expected range of outputs from the system, with an **average** output of 10.9 and upper and lower control limit of 4.6 and 4.6 respectively.

This chart confirms that our process is stable and in 'control'. It has some level of predictability.

Ex. 1.3

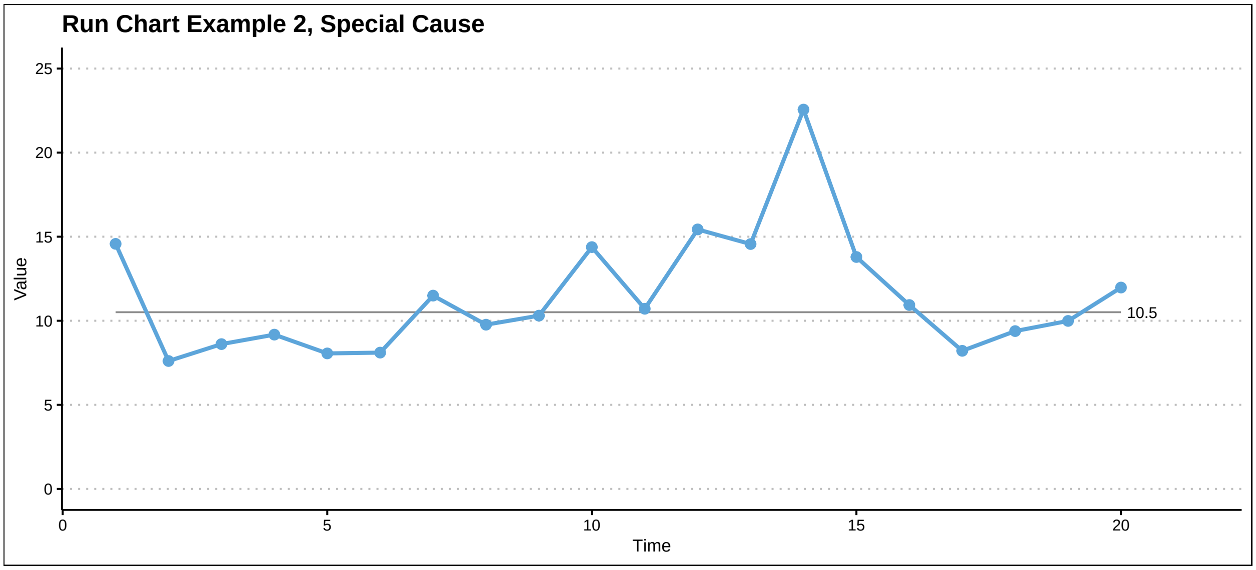


Further confirmation of a stable process, in conjunction with the individuals chart is the moving range chart. This graph reveals how much the data moves from point to point; and is also an important component in calculating the control limits in the individuals chart. Our moving range chart reveals an average change of 2.4 units with an expected change in the range of 0 and 7.8 units.

Special Cause Variation

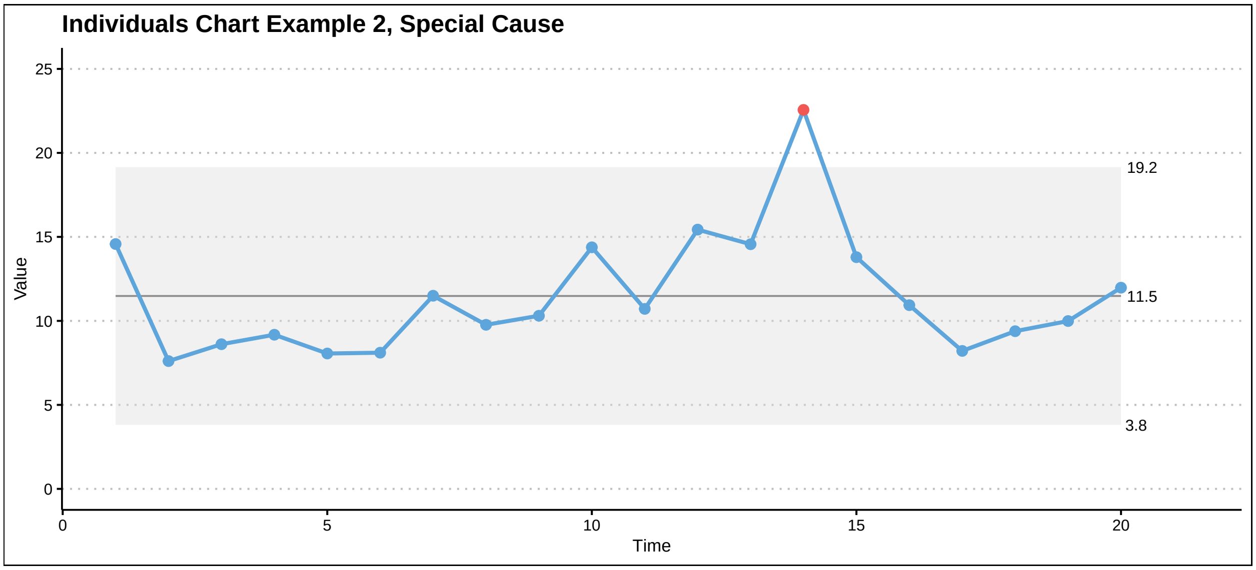
At times, special cause variation can be difficult to detect. Example 2.1 reveals what may be an 'astronomical point' or point that is considered on the extreme end of what a process or system could produce. But because a run chart is designed to detect systematic shifts, it will not identify data outside the expected range. Hence, we use an Individuals Chart.

Ex. 2.1



The chart in Ex. 2.2 reveals a single data point outside the expected range of outputs from our process or system and is indeed a 'Special Cause' data point. The question becomes, what is to be done about this point?

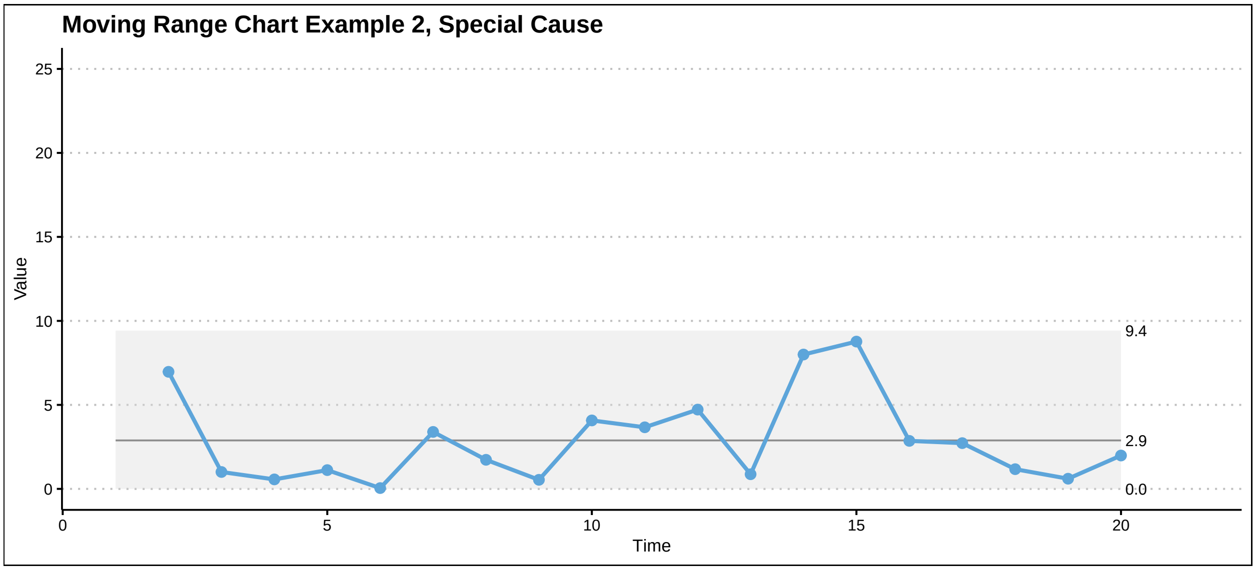
Ex. 2.2



Special Cause variation requires some research as to the potential cause, which can lead to a determination on what the action (if any) should be to prevent future issues.

Finally, we use the moving range, Ex. 2.3, to better understand how much the data are moving from point to point. In this special cause example, our data do not drastically change from point to point - even though we have a 'special cause' data point.

Ex. 2.3



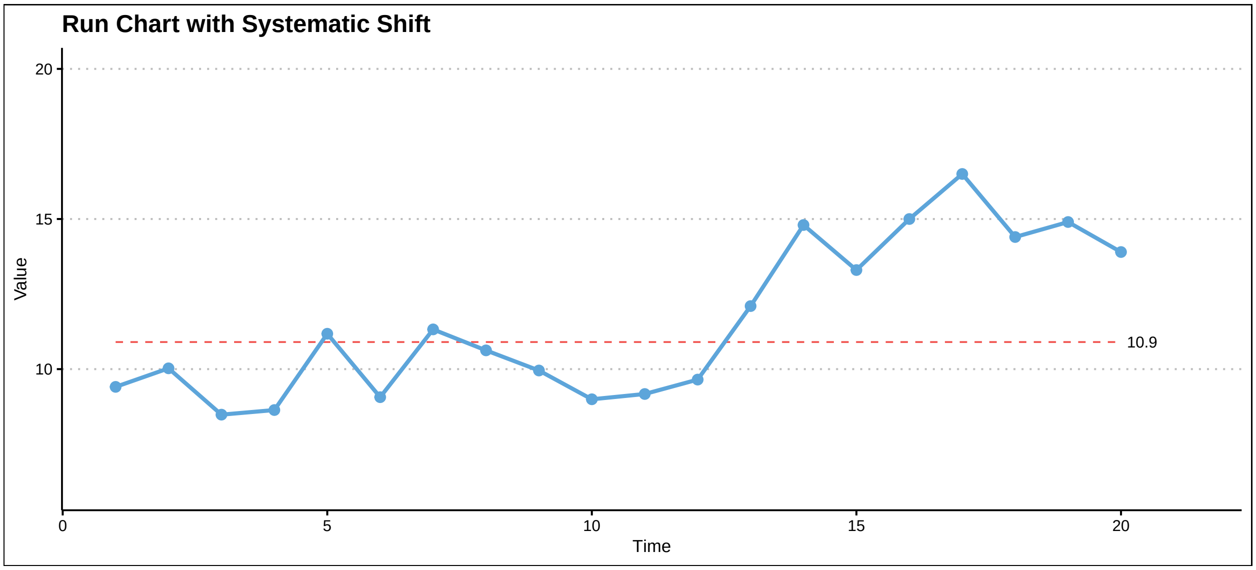
This may indicate a number of things about our process. First, it may indicate a gradual deviance away from our standard process output. For example, a manufacturing plant saw increasing numbers of employees taking sick days each day. The accumulated number of employees sick resulted in a higher than expected number out of work. The return to normal then where the employees returning from sick leave.

Systematic Shift

Finally, we come to understanding systematic shifts in process and system outputs. Often times we look for systematic changes when we know some external or internal system/process change has occurred. A salient real life example is the COVID-19 pandemic. During the initial months of the pandemic, much of the world was shut down and massive shifts in systems were apparent.

Ex. 3.1 shows what a systematic shift may look like on a run chart.

Ex. 3.1

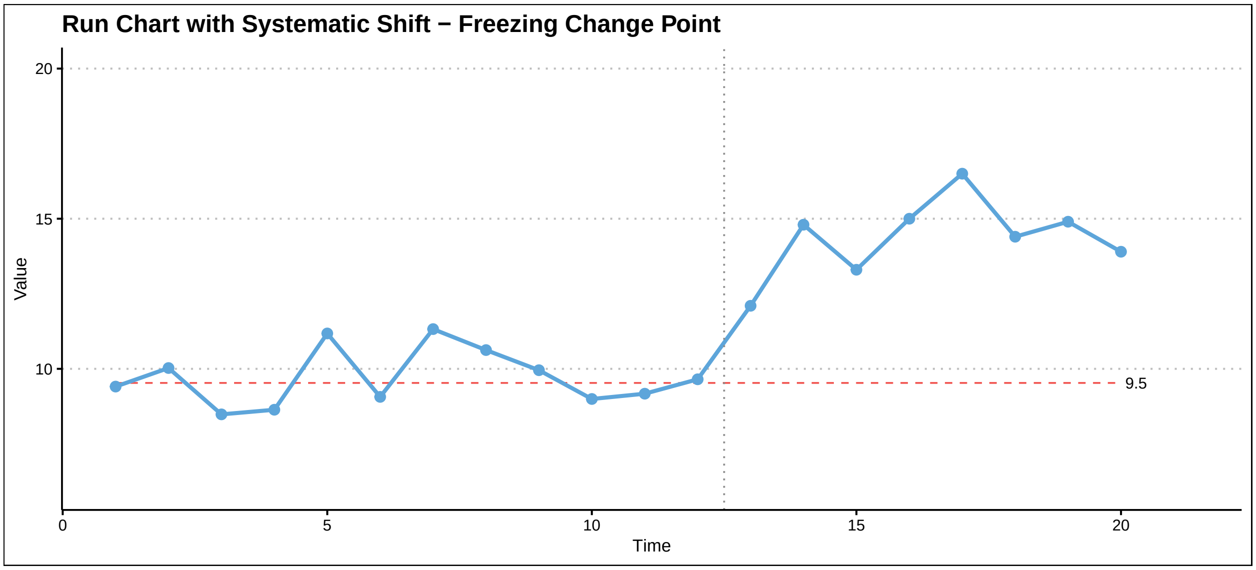


Here we a dotted line which indicates a shift in the system. Visual inspection reveals an apparent increase later in time, starting around the 13th data point. We could reason this is the result of some intervention developed by an improvement team - essentially showing the impact of what they implemented.

Because we are interested in a systematic shift, our run chart will be sufficient.

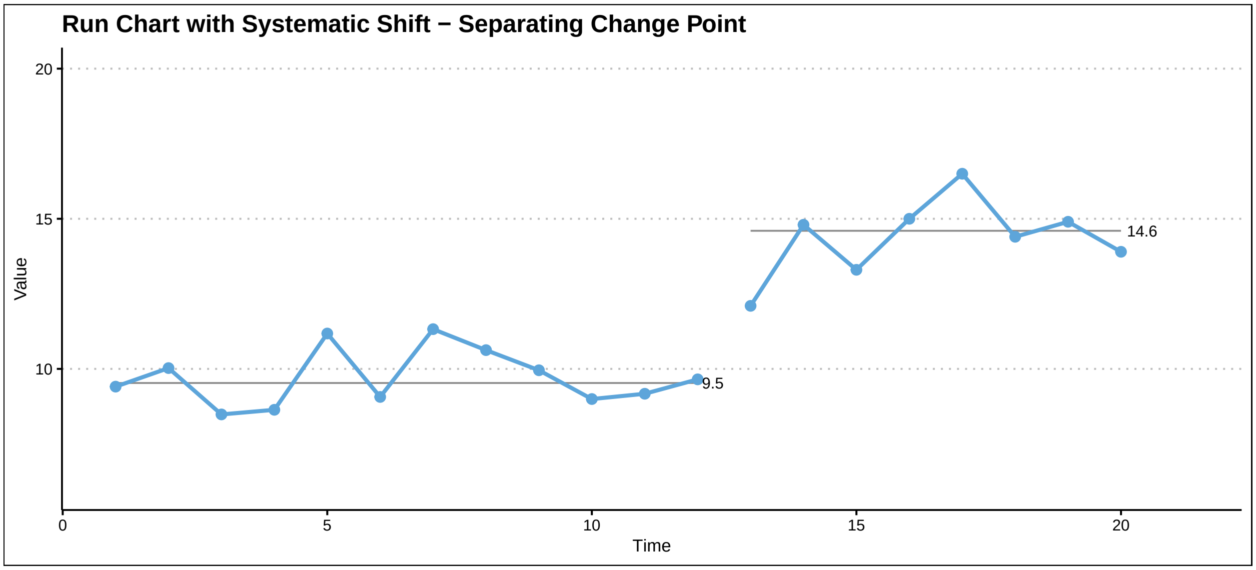
To understand what the difference of our pre-intervention to our post intervention, we “freeze” the median at point 12; therefore only calculating the data based on the initial 12 data points, Ex. 2.2.

Ex. 3.2



Then finally,, once we have determined that a shift had indeed occurred - we ‘reset’ the data to the new norm. Ex. 3.3

Ex. 3.3



Here we see the median output move from 9.5 to 14.6. However, context for this case must be taken into consideration. A change like this may not actually be an improvement, but negative effect of direct change or *indirect* change to other systems or processes.