

Use of rational subgrouping to identify areas for improving time to ultrasound performance

Keon Ma, Erin Pols, Jennifer Thull-Freedman

Background: Safe, high-quality care within emergency departments includes the provision of efficient diagnostic and testing. At the Alberta Children's Hospital, emergency department (ED) and radiology staff have anecdotally noted delays for some patients in the completion of abdominal and pelvic ultrasounds. Rational subgrouping is an approach that stratifies data into multiple groups for display in control charts to minimize in-group variability and maximize between-group variability. The aim of this project was to identify subgroups based on demographic factors, shift type, and disposition status that experience longer time to completion, in order to identify targeted areas for improvement.

Methods: A working group of interprofessional stakeholders was formed, including emergency physicians, an emergency QI nurse, a radiologist and a sonographer. Existing protocols were reviewed. These included recent changes that had been implemented but not yet systemically evaluated, including specifying ultrasound indications that require bladder filling, revising bladder filling protocols, specifying requirements for radiologist approval, and clarifying flow and communication processes.

Abdominal and pelvic ultrasounds conducted in the Alberta Children's Hospital ED from May 2019 to April 2021 were included. This range encapsulated data points both before and after the declaration of the COVID-19 pandemic on Mar 11, 2020, which notably reduced ED volumes. Time stamps were obtained from the electronic health record for the time of physician assessment, time of study request and the time of study result. Data was subdivided based on rational subgroups for (1) sex, (2) age (3) shift time availability, and (4) disposition status. Cases with excessive delay were identified and a chart review was conducted to confirm time stamp validity and to identify unique circumstances contributing to delay. An exemption for ethics board review was obtained from the Conjoint Health Research Ethics Board at the University of Calgary due to the primary purpose of the project being quality improvement.

Evaluation Methods: Statistical process control charts (X-bar and S-chart) were used to establish mean and variation in time from ultrasound order to study result in the total population and each subgroup, measured in minutes. Scrotal ultrasounds were analyzed as a comparator to understand the most efficient time expected from ultrasound order to completion, given that they are typically highly prioritized. Rules to detect special causes were applied, including: (1) Single point outside control limits, defined as 3-sigma (2) Eight or more points above or below the centre line (mean) (3) Six consecutive points that are increasing (trend up) or decreasing (trend down) (4) Two out of three consecutive points near the outer third of a control limit (5) 15 consecutive points in the inner third nearest the centre line (mean).

Results: The mean time from ordering an abdominal/pelvic ultrasound to having reported findings was 203 minutes, compared to 103 minutes for scrotal ultrasounds. The mean time from physician assessment to having a reported study was 279 minutes, compared to 135 minutes for scrotal ultrasounds. Using subgrouping by sex for abdominal/pelvic ultrasounds, females had an

mean order to result time of 226 minutes, versus 178 minutes for males. For the 0 to 3 year age group, the mean order to result time was 167 minutes, which increased for ages 4 to 11 to 193 minutes and for children greater than 12 years old, it was 223 minutes. By shift type, day shifts had a mean order to result time of 157 minutes, evening shifts 142 minutes and night shifts 317 minutes. Using rational subgrouping for disposition status, the order to result time for admitted patients was shorter at 190 minutes compared to discharged patients, which was 214 minutes.

Advice and Lessons Learned:

1. This initiative highlights the benefits of using rational subgrouping for emergency department quality improvement projects. By separating our data based on sex, age, time of care, and disposition status, considerable variability was revealed between subgroups that would have otherwise been hidden.
2. Groups more likely to experience longer wait times for abdominal or pelvic ultrasounds included females, patients arriving at night, and adolescents.
3. Rational subgrouping with baseline data enables a targeted approach when designing plan-do-study-act cycles.