Quality improvement in lost specimen metric through process improvements and automated process optimization: a retrospective analysis.

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Introduction

Pre-analytical errors comprise 44-61.9 percent of all laboratory errors that occur in the total testing process [1]. Lost specimens are a form of pre-analytical error that could occur at any point upon specimen collection and can result in poor patient outcomes [2].

The lost specimen metric has been identified as a pre-analytic quality measure in clinical laboratories despite the sparse literature quantifying the problem and assessing mitigation efforts. A Six-Sigma approach has been employed to analyse laboratory lost specimen metrics in the literature [2,3].

Upon operationalisation, our laboratory initiated proactive quality improvement (QI) measures to evaluate and intervene to reduce lost specimen rates. In this poster, we present the approach and results of a retrospective analysis of QI measures.

Aim

To evaluate the effectiveness of proactive QI efforts related to lost specimen metrics based on our experience at a tertiary care clinical laboratory in Singapore.

Methodology

- This retrospective analysis was conducted at a tertiary care clinical laboratory in Singapore from 01 Jan 2016 to 31 December 2018 – a period of three years.
- For the purpose of this analysis, a lost specimen was defined as a "specimen that is reported to have been misplaced and undiscoverable for analysis upon a comprehensive search conducted according to current workflow and checklists within a period of 24 hours from the time of dispatch."
- Laboratory lost specimen data were collected systematically and examined/investigated using methods for root cause analysis (RCA) by the Incident Management Committee.
- Patterns identified and the insights generated by RCA were used in planning interventions based on published evidence and professional expertise. Interventions were analysed and categorised into domains.
- Frequency of lost specimens was expressed in Six-Sigma performance levels using the Westgard Six-Sigma calculator on a monthly basis. Six-Sigma performance is understood as ≤ 3.4 defects per million opportunities (DPMO) or 99.99966% defect-free work [2].

Results

All QI interventions were categorised into a) automation and automated process optimisation, and b) managing human behaviour through process improvements (Table1).

Automation and automated process optimisation	Managing human behaviour through process improvements
1. Nov 2016: Corrective maintenance on clinical chemistry automation track.	1. April 2016: Workbench de-cluttering using 5S productivity improvement tool.
2. Jan 2017: Introducing a banner on Epic System to enhance visibility upon specimen receipt.	2. Sep 2016: Introducing lost specimen checklist.
3. Aug 2017: Replacing slider on PTS (Phase 1).	3. Oct 2016: Retraining for specimen reception staff.
4. Aug 2017: Replacing PTS velco (Phase 1).	4. Jan 2017: Training nurses for proper use of PTS.
5. Oct 2017: Replacing slider on PTS (Phase 2).	5. Jan 2017: Revising checklist to expand areas for manual searches.
6. Oct 2017: Replacing PTS velco (Phase 2).	

Table 1: The classification of QI interventions in a chronological order.

We observed positive and stable trends in Six-Sigma levels of the lost specimen metric over the last 12 months of the study period, demonstrating levels of 5.3-5.9 with an average of 5.5. This overall positive trend is likely achieved as a cumulative result of the interventions.

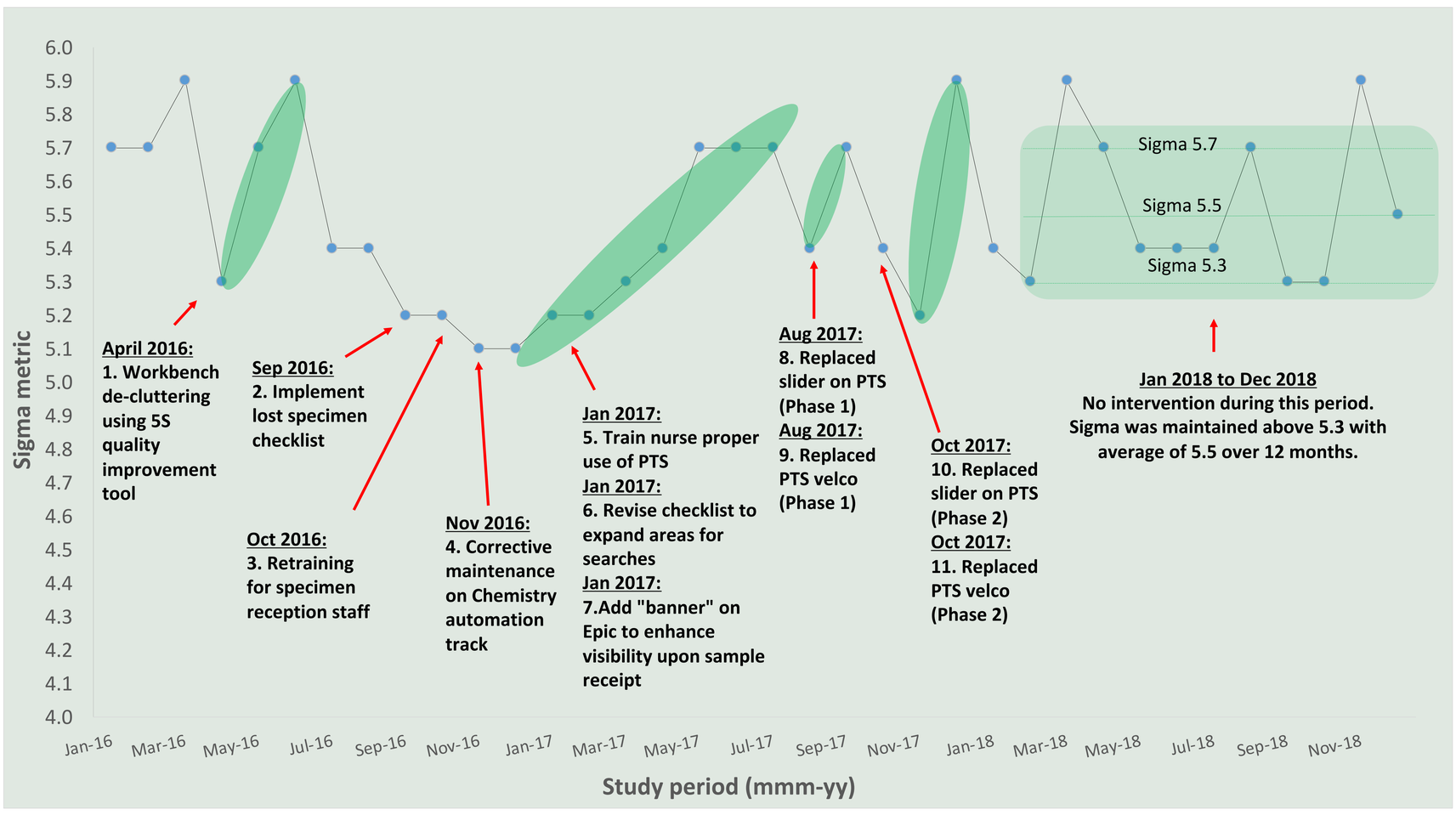

Figure 1: Monthly lost specimens per million tests performed and interventions implemented during the 3-year study period.

Based on our analysis, workbench de-cluttering using the 5S* method was observed as a possible standalone high-impact intervention. Furthermore, introducing a checklist, retraining laboratory staff to familiarise themselves with after-hours storage, and training for nursing staff regarding pneumatic tube system (PTS) canisters also displayed positive outcomes. Interventions targeting human behaviour appear to yield better results than automated process optimisation (Figure 1).

Conclusion

This retrospective analysis demonstrates the utility of proactive QI in a newly established clinical laboratory. We observed that the overall influence of these activities is compounding, with each building on the success of the last. Proactive QI accompanied by evidence-informed targeted interventions and its regular maintenance should be considered to address the burden of lost specimens. Furthermore, automated process improvements and behavioural controls are instrumental in addressing lost specimen metrics. An important limitation of this analysis is the absence of an experimental design due to pragmatic concerns. Further longitudinal and experimental studies are necessary to assess the effectiveness of individual interventions.

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References

1. *Carraro P, Plebani M. Errors in a Stat Laboratory: Types and Frequencies 10 Years Later. Clinical Chemistry 2007; 53(7):1338–42.*
2. *Hawker C, Messinger B. Achieving six sigma quality for lost samples: a success story. Utah (US): ARUP laboratories; 2011 [cited 2020 June 22].*
3. *Messinger BL, Rogers DN, Hawker CD. Use of Automation and Process Improvement to Achieve a Six Sigma Level of Nonanalytic Quality. JALM 2017;2(1):86–91.*

Footnote

**5S stands for "Sort, Set in order (or Systematic arrangement), Shine (or Sweep), Standardise, Sustain".*