

Utilisation of Lean Six Sigma Tools to Optimise Patient-Prep, Bed Occupancy, Cost and Throughput in a Busy IR Department

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- Our QI project focused on improving patient-preparation (prep) for IR procedures in a tertiary referral inner-city hospital in Dublin, Ireland
- Prep Definition: A prepped patient has no outstanding practical or safety issues that need to be addressed by IR staff prior to commencing the procedure
- July 2019: We carried out a 5-day pilot study and found that 55% (24/44) of patients were not prepped for their procedure on arrival to IR which led to room down-time and cessation of throughput



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Lean and Six Sigma are process improvement methodologies that aim to reduce waste and decrease variation in process outcomes and are widely applied in private industry

There have been several studies that applied Lean-Six Sigma tools to radiology, however, methodological flaws and lack of statistical rigor have prevented robust quantitative assessment of the utility of Lean-Six Sigma in clinical radiology



- *To avoid the reported pitfalls in the Radiology Lean-Six Sigma literature highlighted in the article below, we adapted several recommendations to our study design...*
 - We clearly documented our study protocol to reduce the likelihood of selective outcome reporting
 - We measured a diverse set of outcomes
 - We trained staff members in data collection during a pilot study
 - We utilized on-going prospective data collection to assess the sustainability of improvements
 - We used a time-series study design for the throughput analysis. Time-series data sampling is particularly effective at determining whether an intervention has had an effect significantly greater than the underlying trend, providing a greater degree of internal validity compared to an uncontrolled before-and-after study

Review > [J Am Coll Radiol. 2016 Sep;13\(9\):1088-1095.e7. doi: 10.1016/j.jacr.2016.02.033.](#)

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Systematic Review of the Application of Lean and Six Sigma Quality Improvement Methodologies in Radiology

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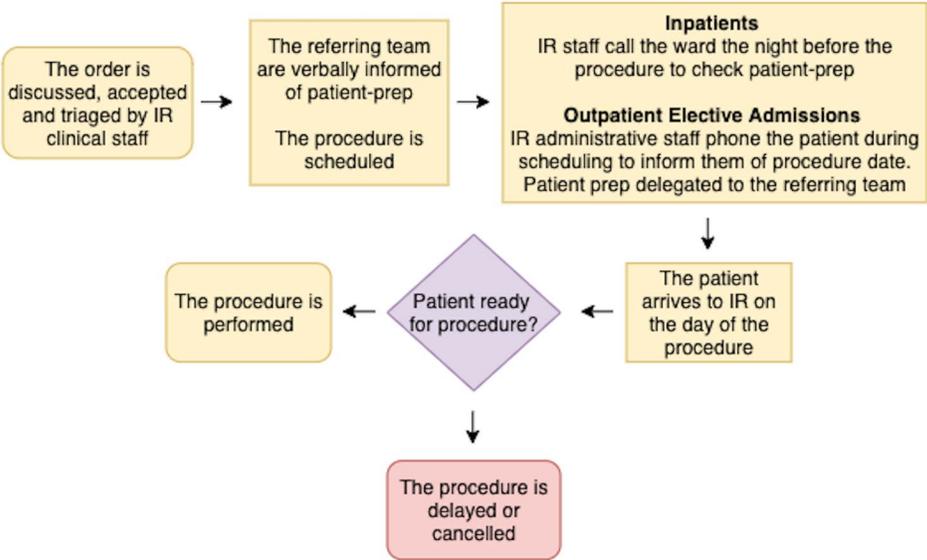
Affiliations + expand

PMID: 27209599 DOI: [10.1016/j.jacr.2016.02.033](#)

First, we created a process map to examine and dissect our 2019 IR patient-prep pathway

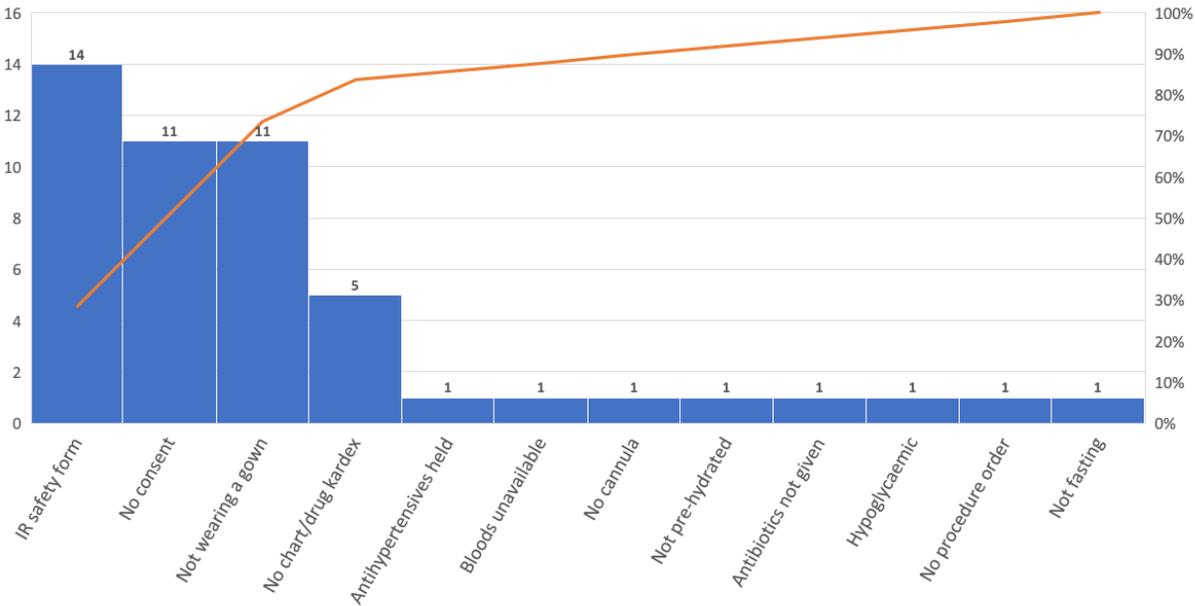
IR Patient-Prep Process Map

Pre-intervention



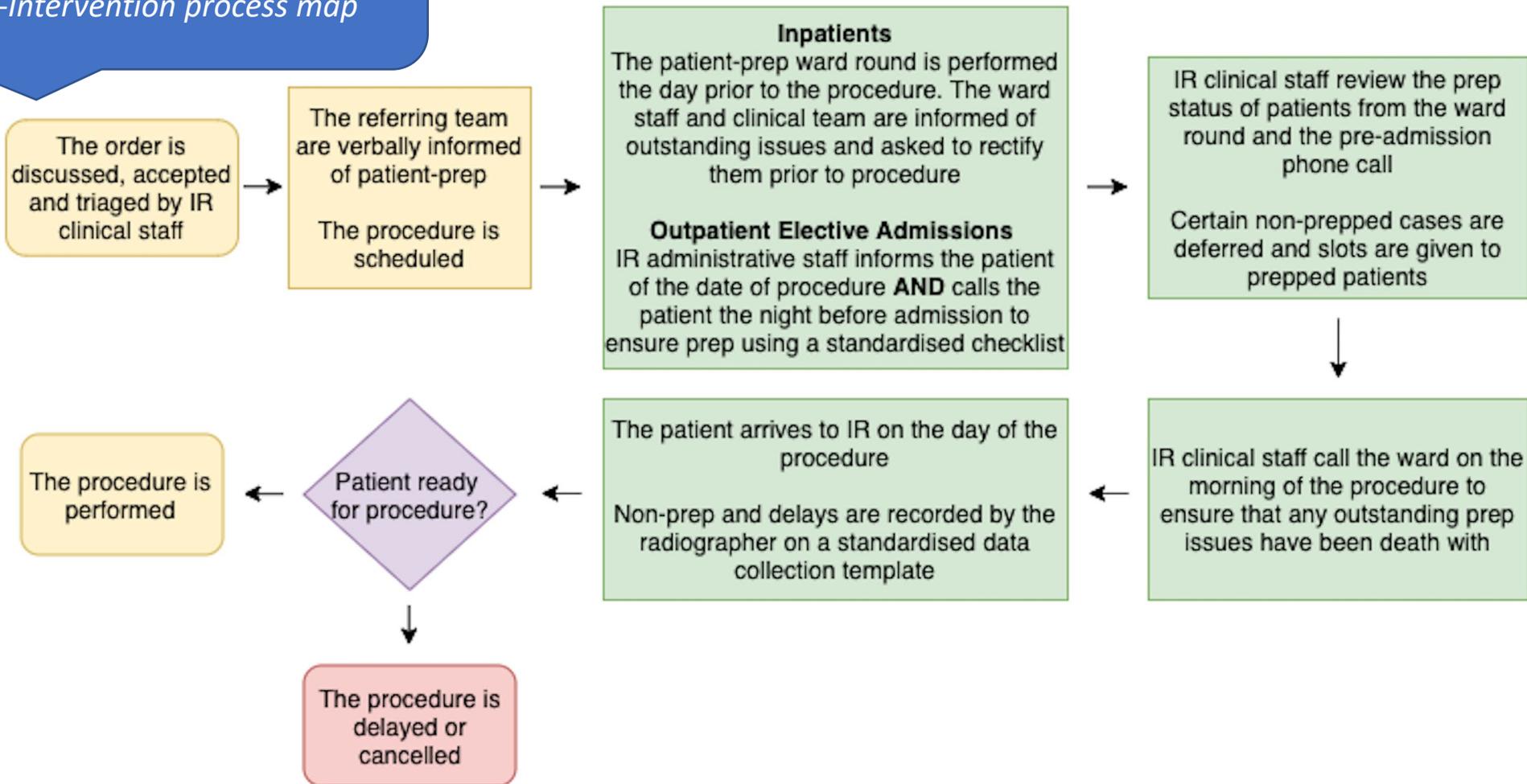
- Next,
1. We used a Power-Interest Grid Stakeholder Analysis to help identify influential groups and individuals that were important to project success. Key stakeholders were informed of the project early on and updated as the project progressed
 2. We performed a Critical to Quality Analysis to identify key performance metrics to accurately compare pre and post-intervention process outcomes
 3. We constructed Pareto Charts highlighting common prep issues amongst patients. Pareto Charts are useful tools when identifying areas, teams and individuals to prioritise for intervention

Pareto Chart: Reasons for Inpatient Non-Prep: Pre-Intervention



Interventions commenced January 2020 and are described here on the post-Intervention process map

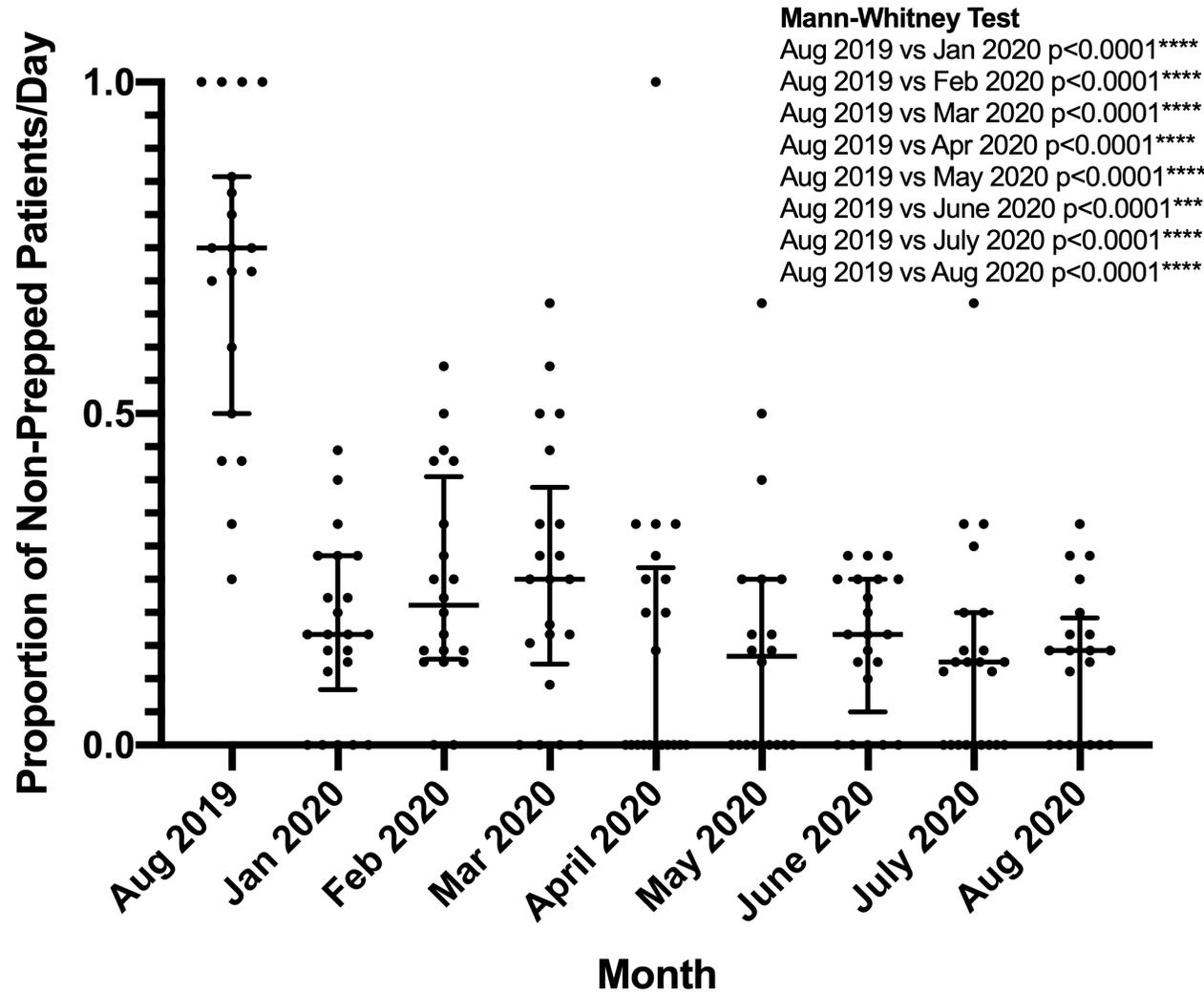
Post-intervention
(changes highlighted in green)



So what effect did these process changes have?

This is a frequency distribution curve illustrating the proportion of non-prepped patients/day on the y-axis vs. month on the x-axis. As you can see, there has been a statistically significant improvement in patient-prep for each month post-intervention

IR Patient Non-Prep Analysis



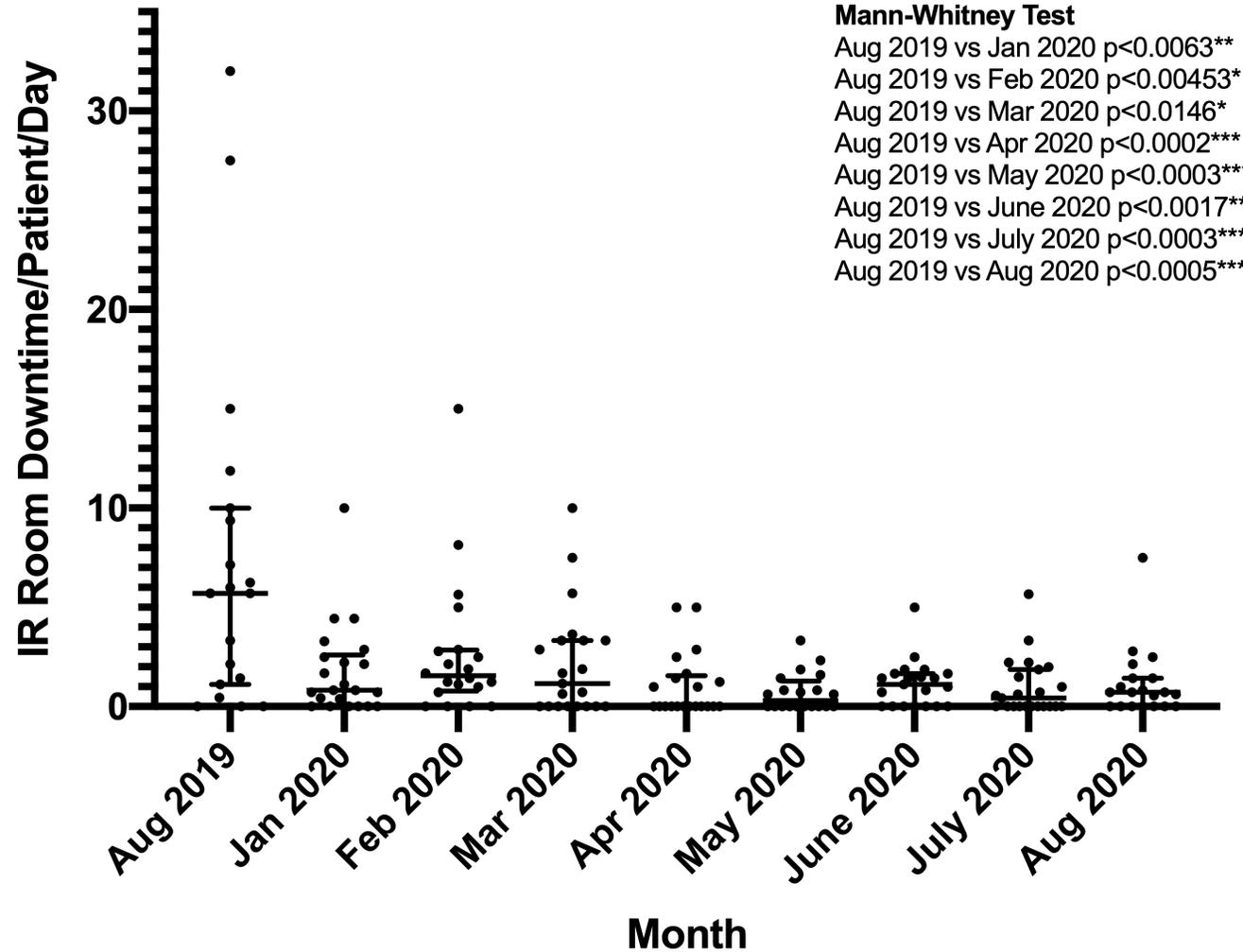
Pre-intervention patient-prep data sample: August 2019 (132 patients)

Post-intervention patient-prep data sample: Jan-Aug 2020 (1113 patients)

Similarly, this graph illustrates IR room downtime due to non-prep vs. month. Again, there has been a significant decrease in room downtime for each month post-intervention

Of note, improvements in prep-rates and room downtime were sustained in July and August 2020 during the yearly junior physician changeover as new interns begin work in hospitals. This is an important observation as it provides a like for like comparison with August 2019 baseline data, removing the confounding variable of increasing junior physician experience as the academic year progresses.

IR Room Downtime due to Non-Prep

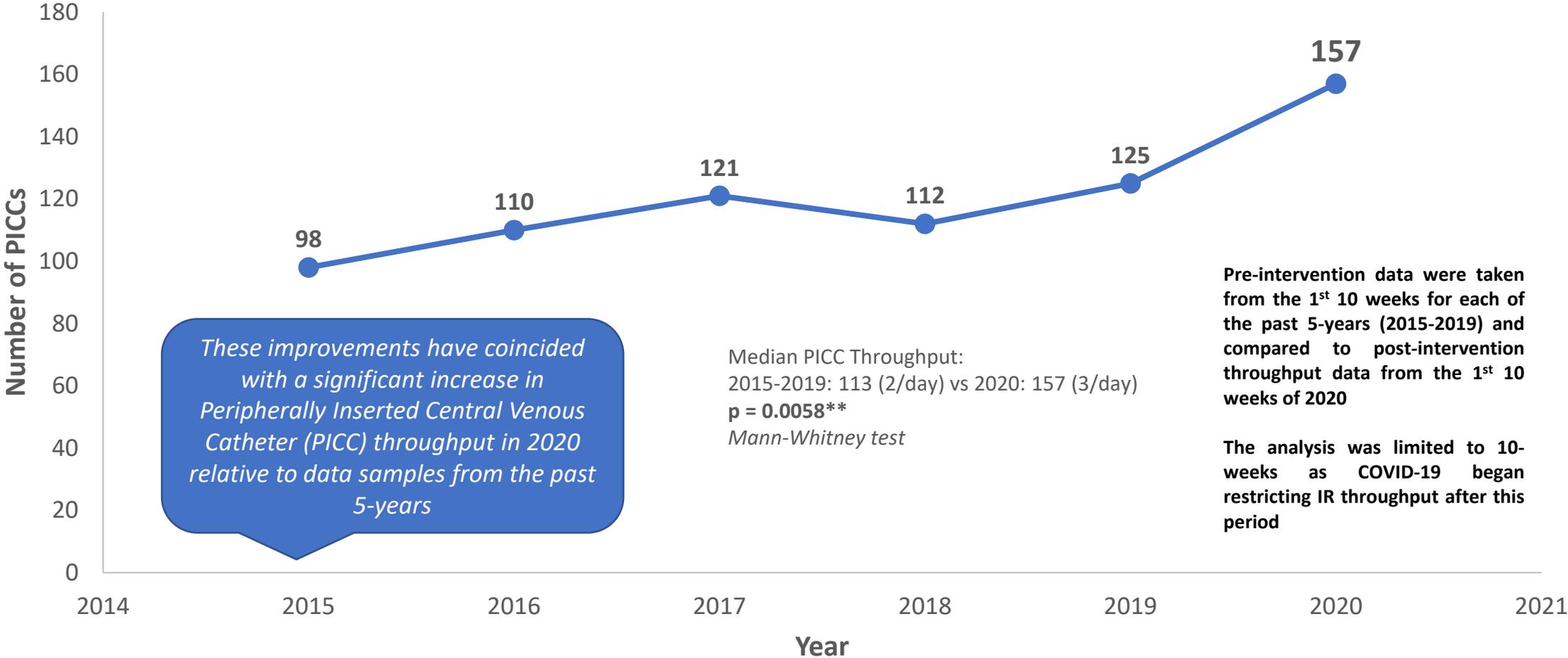


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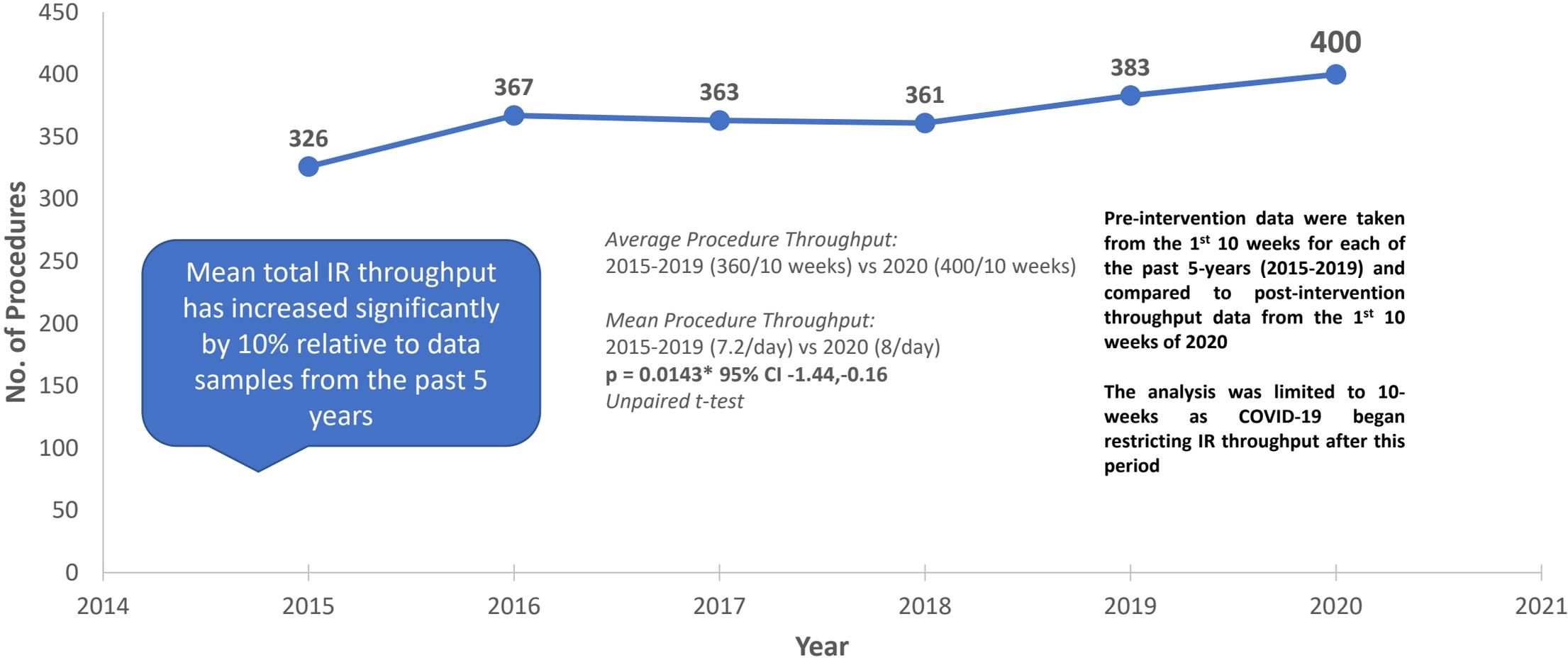
PICC Throughput vs. Year

Sample Period: 1st 10 weeks of each year

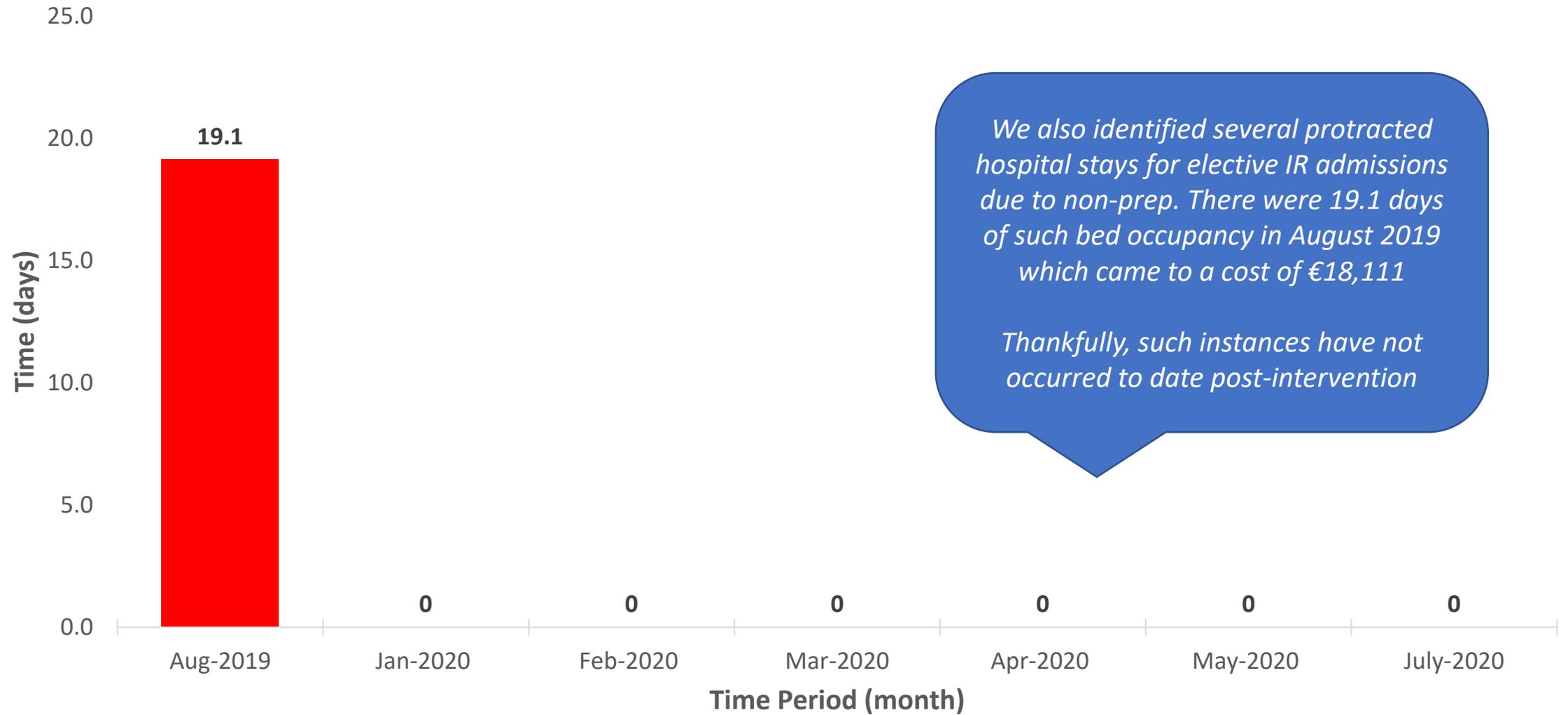


IR Throughput vs. Year

Sample Period: 1st 10 weeks of each year



Elective Admission Overnight/Multi-Day Bed Occupancy Time due to Non-Prep



Finally, an IR Process Improvement Committee was established in Jan 2020 to monitor and sustain improvements



To date the committee has...

Drafted and distributed an IR patient-prep manual for junior physicians

Developed and implemented a standardised IR interhospital patient transfer policy

Completed SOPs for Tech-led prep ward rounds and PICC insertions

In Summary...

- *Use of Lean Six Sigma methodology in our clinical radiology process was associated with significant waste reduction, decreased variance and a consistent improvement in patient-prep, IR room downtime and inappropriate bed occupancy sustained up to 8-months post-intervention*
- *Comparison of pre-intervention time-series data samples from the preceding 5 years (2015-2019) to 2020 revealed a 10% increase in IR throughput post-intervention despite consistent staffing levels and capacity*
- *Data collection is ongoing to assess the long-term sustainability of improvements*