

A pilot improvement project in hospital-based oral healthcare: improving caries risk assessment documentation

A. J. Keightley,¹ S. M. Lucey,² J. Leitch,³ R. C. Lloyd⁴ and C. Campbell⁵

IN BRIEF

- A direct clinical example of translation of evidence into practice using contemporary improvement methodologies.
- By regular monitoring and feedback on performance, barriers to improvement can be identified and addressed.
- Targeting documentation of a caries risk assessment delivered subsequent improvement in documentation of delivery of caries prevention interventions.

Objective To evaluate the impact of a continuous improvement project to improve completion of a caries risk assessment (CRA) and to assess its impact on delivery of dental caries prevention. **Design** Single centre clinical improvement project. **Setting** A paediatric dental department within a UK dental hospital over the course of 2008–2009. **Subjects (materials and methods)** Continuous monitoring of documentation of a CRA was instigated and results fed back to clinicians. Tools were developed to structure the process of CRA. After six months of intervention, a comparison of preventive care to a pre-intervention sample was undertaken. **Main outcome measures** The main outcome measure was completion of a CRA. Comparison was also made with pre-intervention data on levels of preventive care received. **Results** Over the 12 month project the mean rate of CRA completion improved from 30% over the first 6 months to 73% in the second 6 months. Compared to the pre-intervention sample, all items of the caries prevention package had improved, with delivery of tooth-paste strength advice (16% vs 60%, $p = 0.001$) and diet advice (32% vs 70%, $p = 0.004$) improving significantly. **Conclusion** By targeting and improving CRA completion the quality of preventive care delivered has also significantly improved.

INTRODUCTION

The white paper 'The new NHS: modern, dependable' (1997) stated '*...that quality is at the core*' of the future of the National Health Service (NHS).¹ This position reflected a shift in the NHS policy, to emphasise that quality improvement throughout the UK should be occurring as it had been witnessed elsewhere in the world.² Since then, the literature on improving the quality of healthcare has expanded rapidly, but as of yet the literature concerning quality improvement in oral healthcare remains limited.

Oral diseases are endemic throughout the world, with dental caries being the

most prevalent, yet dental caries is highly preventable.³ Among children in Scotland epidemiological studies have found that the distribution of dental caries appears to be concentrated in particular 'high risk' sections of the population. The 2010 National Dental Inspection Programme found 64% of 5–6-year-old children in Scotland being caries free, however, 8% of the children had 50% of the dental caries.⁴ Within Scotland 'operations on teeth including simple extraction' were the largest single reason for an elective hospital admission for children under the age of 15 in 2007/2008, accounting for 23.4% of the total.⁵

The department of paediatric dentistry in Glasgow Dental Hospital and School is a secondary referral centre, which accepts patients from the whole of the west of Scotland. This area covers a diverse range of patients, from the most deprived urban areas in the UK, to the most isolated rural island communities. Patients are treated up to the age of 16 years on referral. Reasons for referral include complex oral and/or general health conditions, dental trauma, and dental anxiety/phobia. Patients may require treatment under inhalational or

IV sedation, or general anaesthesia. In the period from October 2008 to October 2009, 8,794 patients attended the department for consultations or treatment on an outpatient basis, with 2,625 requiring treatment under general anaesthetic.

The evidence base to show there are effective interventions for preventing dental caries is well established and several clinical guidelines have been published in the UK on the subject.^{6–9} These guidelines recommend dentists perform a caries risk assessment (CRA) for every patient and personalise preventive care appropriately. Results published by another unit in Scotland have shown poor levels of documentation of CRA.¹⁰ These results supported the need to monitor and if needed undertake an improvement project to increase the level of documented CRA and to ensure that effective preventive care was delivered.

This report documents our experiences of introducing a health improvement project to the department, under the title of Caries Assessment Risk Evaluation (CARE). This project incorporated the introduction of a CARE toolset, to aid in implementing a CRA and preventive

¹Specialist Registrar, ²Consultant in Paediatric Dentistry, Department of Paediatric Dentistry, Glasgow Dental Hospital and School, 378 Sauchiehall Street, Glasgow; ³Senior House Officer, Glasgow Dental Hospital and School, NHS Greater Glasgow and Clyde, Glasgow; ⁴National Clinical Lead for Quality, Scottish Government Health Directorate, Edinburgh; ⁵Executive Director Performance Improvement, The Institute for Healthcare Improvement, Boston, USA

*Correspondence to: Alexander J. Keightley
Email: a.keightley@nhs.net; Tel: 01412119638

Caries Risk Assessment and Prevention Plan

Patient Name: _____ Date of Assessment: _____ Date for Re-assessment: _____

Caries Risk Assessment

Clinical Evidence	Dietary Habits	Social History	Fluoride Use	Plaque Control	Saliva	Medical History	Caries Risk
L H	L H	L H	L H	L H	L H	L H	L H

Height: _____ Weight: _____

Prevention Plan

Radiographs	Toothbrushing Instruction	F. Toothpaste	F. Mouthwash	F. Supplements	Diet Advice	F. Sugar Free Medicines

_____ Date of Assessment: _____ Date for Re-assessment: _____

Longitudinal Record of Prevention

Prevention Method	Carb. Discovered / Treatment Carried Out
Radiographs	
Toothbrushing Instruction	
F. Toothpaste	
F. Mouthwash	
F. Supplements	
Diet Advice	
F. Sugar Free Medicines	

Fig. 1 The caries risk assessment and prevention planning pro forma

DEPARTMENT OF PAEDIATRIC DENTISTRY

GEP Information: _____ Patient Information: _____

Dear _____

The above patient was seen in the Department of Paediatric Dentistry at Glasgow Dental Hospital on the following date: _____ regarding: **CARIES** **TRAUMA** **OTHER**

Examination revealed: **CARIES** _____

Treatment will be as follows (Please circle)

1. Comprehensive Care under GA at RDC	2. Management of trauma within GEDS
3. Extractions only under GA at RDC	4. All treatment and care within GEDS Paediatric Clinic

(Unless noted in box 4 above, the responsibility for the patient's routine examination, routine treatment and pain management remains with the primary care provider)

PREVENTION ADVICE

This patient's caries risk is currently: **LOW** **MEDIUM** **HIGH** (This risk should be regularly reviewed)

The following Prevention Plan is recommended to be carried out in the Primary Care setting as per current SIGN guidelines:

Prevention Plan	Recall Period
RADIOGRAPHIC PERIOD	4 months 6 months 12 months 18 months 24 months
FLUORIDE VARNISH (Duraflor)	4 months 6 months 12 months 18 months 24 months
TOOTHBRUSHING INSTRUCTION	YES NO
DIETARY COUNSELLING	YES NO
FINISSE SEALANTS TO BE APPLIED (Note teeth to be sealed)	

Thank you for your collaboration in improving this patient's oral health

(SIGN AND DATE): _____

Fig. 3 Primary care provider communication sheet

plan. The primary aim was to have at least 80% of the patients attending the department have a fully documented CRA by June 2009. The secondary aim was to evaluate whether improving CRA documentation improved the preventive care patients received. The project began in August 2008.

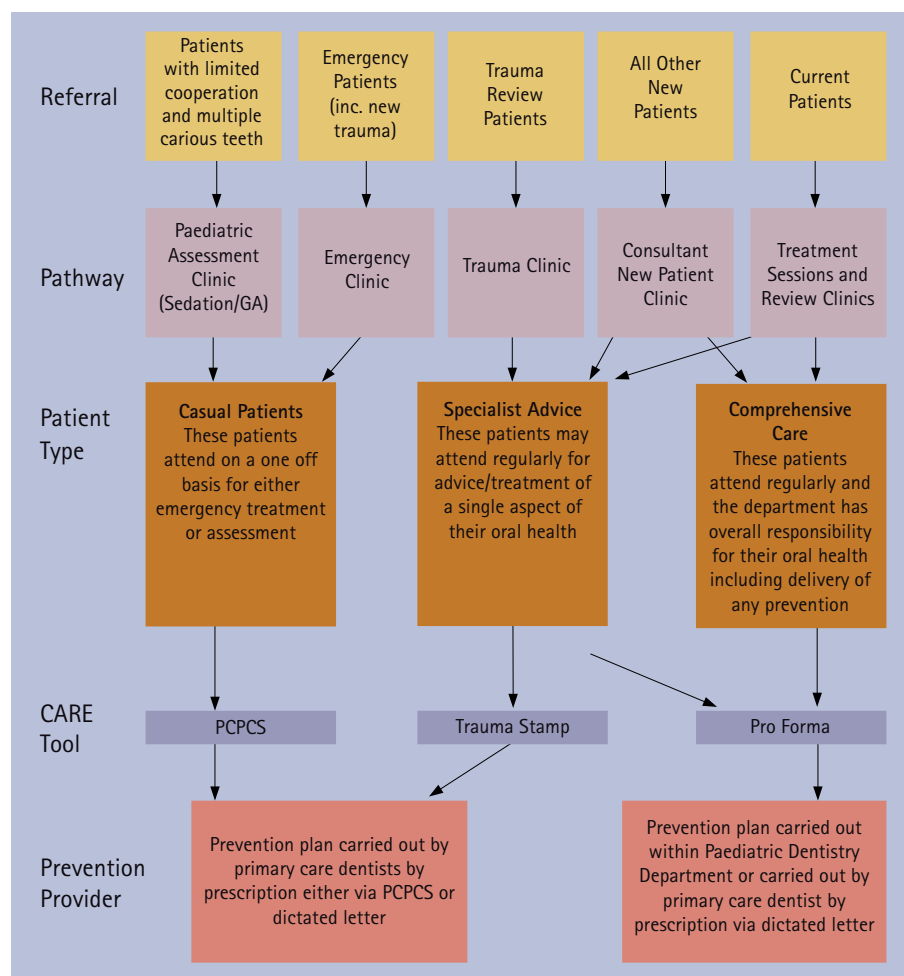


Fig. 2 Final patient flow through CARE project process

TOOTH				
SINUS				
COLOUR				
TTP				
MOBILITY				
EPT				
ECL				
P. NOTE				
RADIOGRAPH				
CARIES RISK				

Fig. 4 Updated trauma stamp

METHODS

Study design and initial intervention

Following the results of a 2007 departmental audit (baseline), which found an unacceptably low level of documentation of CRA and subsequent delivery of prevention, a working group was formed. The aim of this working group was to lead a quality

improvement project to improve documentation of delivery of both CRA and prevention. This working group oversaw the project, led by a consultant in paediatric dentistry and involving postgraduate dental trainees. The working group met regularly during the course of the project, and structured its work around the PDSA (Plan-Do-Study-Act) improvement model.¹¹ The initial improvement aim was

to target the documented completion of a CRA. Once the patient's caries risk status is determined, an evidence-based dental caries prevention package can be devised.^{12–15}

The first intervention was revising a pre-existing CRA and prevention planning pro forma that was already in use on the undergraduate teaching clinics. This involved consultation with all clinical staff, before a revised pro forma was launched in September 2008 (Fig. 1). To increase uptake, the medical records department agreed to place this pro forma into all new paediatric patient case notes. For patients already attending the department, the pro forma was to be completed and added to the notes by the dentist at their next appointment.

Data collection

A judgement sample was collected by an investigator who would select two patient charts at the end of every morning and afternoon session. A cross section of all clinics within the department was represented. The notes were examined and for a positive result to be recorded an overall CRA level had to be noted. This gave a total of 20 samples over the course of a week, and the process was carried out every second week. This data collection was carried out from September 2008 until July 2009.

Statistical methods

The primary statistical method used to analyse the data relating to CRA completion rates was statistical process control (SPC).¹⁶ SPC comes from the work of Walter Shewhart in the 1920s in relation to manufacturing, as a method for detecting whether a system was acting under common or special cause variation. Shewhart identified that even a stable system will produce a range of results purely due to random chance and should therefore be considered acting under common cause variation. In contrast, if a system is producing results beyond those attributable to random effect, these systems should be considered to be acting under the influence of special cause. The specific SPC tool used was a type of control chart called the p-chart (percentage chart), which determined if the interventions produced significant changes in the measures. The control chart was annotated as the project progressed to indicate

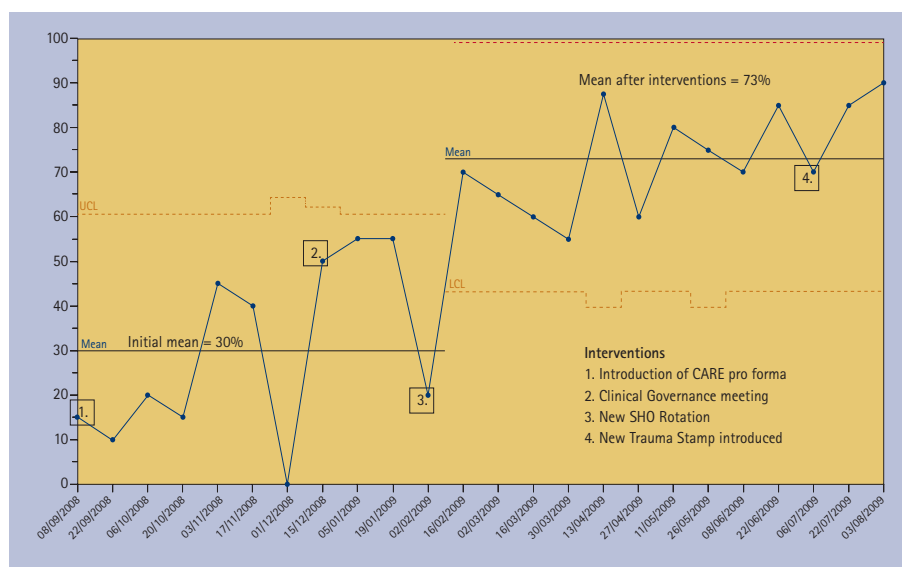


Fig. 5 CARE tool uptake data

where the interventions (or changes) were implemented and if they had the intended impact. The working group would regularly disseminate the results by displaying charts on the clinic, emailing them to all staff and by regularly reporting to departmental meetings.

In January 2009, a comparison was made with the 2007 audit data to determine if the project had statistically significant impacts on preventive care received by patients. Case notes of 40 patients were reviewed in two groups; 20 patients, who were known to have a completed pro forma in October 2008, compared with 20 patients known not to have a completed pro forma. It was expected that by reviewing the case notes for patients who had attended four months previously, any preventive care planned would have then been delivered. The results were then tabulated in Minitab 15 (Minitab Inc., State College, Pennsylvania, USA) and analysed using a two-sample t-test. No power calculation was carried out for this analysis due to the pilot nature of this project.

RESULTS

PDSA cycles and change concepts

PDSA cycles were carried out on a regular basis to test the effectiveness of the interventions. The major changes instigated by this approach are shown in Table 1. The process developed for ensuring patients had a CRA and that prevention was carried out in the most appropriate setting is demonstrated in Figure 2, while examples

of the tools developed to assist in documenting a CRA in each setting are given in Figures 3 and 4.

Uptake of CRA

Over the course of the project 464 patient charts were reviewed and the key measure, percentage with a completed CRA, was plotted on a SPC p-chart (Fig. 5). The left side of Figure 5 displays the baseline period with a mean of only 30% of the patients seen in the department having a completed CRA. Even though the baseline period reflects considerable variation in the data, there are no special causes detectable in the data and it is therefore likely that the system is acting under common cause variation. This means that the baseline period is stable and predictable within limits (that is, the process on the average would continue to produce about 30% of the patients having a completed caries risk assessment tool and utilisation of the tool could range from zero to around 60%). Since the target was to have 80% or more utilising the CRA tool, this performance was considered stable and predictable, but unacceptable.

The annotations on Figure 5 highlight the points of the key interventions during the project. Point 1 is the first measurement taken the week after the introduction of the revised CRA pro forma at the beginning of September 2008. With continued feedback and encouragement this produced an improvement from the initial 30% to around 40%. Unfortunately at point 2 significant fall was detected at the

beginning of December 2008. This was discussed at the departmental clinical governance meeting the following week, with the main reason identified for the fall being the multiple staff absences that week due to illness and annual leave. At the meeting it was suggested that nursing staff prepare the pro forma to improve work flow. At point 3, at the beginning of February, the junior trainees complete their six month rotation and change department. A fall in CRA completion was reflected in the results coinciding with this. It was found that the new trainees were not familiar with the CARE project, and so a training session was held. Between points 3 and 4 the other CRA tools (Figs 3 and 4) were developed as detailed in Table 1.

The right side of Figure 5 shows the performance of the key measure as the change concepts (Table 1) were introduced. While there are numerous tests to determine statistically significant movement on a control chart,¹⁶ the one that is shown in Figure 5 is a shift in the process performance. A shift in process is determined by detecting a run of eight or more data points above the baseline mean. In our case the evidence of a shift is very strong since 13 data points are all above the baseline mean of 30%. The probability of this happening by chance would be extremely rare. The new uptake of CRA process average is 73% with the control limits predicting that the variation in the new process could be between roughly 45% and 100%.

Impact on preventive care

The result of the comparison of preventive care received by 2009 patients with and without a completed CARE tool, compared to the data from the 2007 audit is shown in Figure 6. Within all categories, the 2009 patients with a completed CARE tool received more elements of the prevention package. The 2009 patients who did not have a CARE tool actually received less prevention than the 2007 sample.

The results from the 2009 patients who did have a CARE tool completed were compared to the 2007 patients using a two-sample t-test using Minitab 15 (Minitab Inc., State College, Pennsylvania, USA). The results of this analysis (Table 2) show that the levels of provision of toothpaste strength advice (estimate for difference = 44%, $p = 0.001$) and diet advice

Table 1 Summary of PDSA cycles and change concepts tested

Date	Problem	Identified cause	Change implemented
December 2008	Monitoring identified a fall in pro forma uptake to 0%	Particular week had staffing difficulties due to multiple staff absences	Issues discussed at subsequent departmental clinical governance meeting
February 2009	Fall in completion of pro forma	Junior postgraduate trainees rotate departments on 01 February, new trainees had not received training relating to the project in their departmental induction	Training needs for new trainees addressed and CARE project training manual created to be used in subsequent staff inductions
February 2009 – May 2009	Identified low completion of CRA along with poor communication for patients attending for assessment for extractions under general anaesthesia and for patients attending as one off emergencies on the casual clinic	The working practices on these clinics along with type of patients made pro forma unsuitable	Primary care provider communication sheet (PCPCS) was designed in the SBAR style (Fig. 3). ¹⁷ A pilot study was carried out before being formally introduced in May 2009.
June 2009	Identified trauma patients as a group with low rate of completion of pro forma	Staff working with these patients felt that pro forma was unnecessarily detailed for this group of patients.	As a trauma stamp was already in use to aid in trauma patient management, this was modified to include a caries risk assessment (Fig. 4).

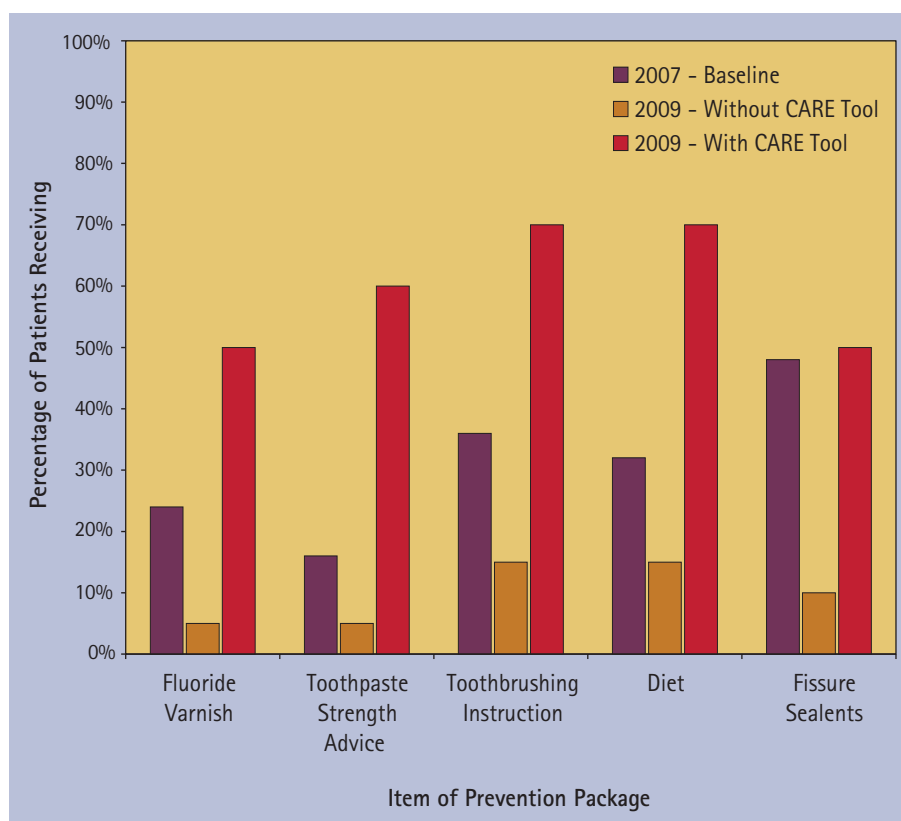


Fig. 6 Percentage of patients who received elements of preventive treatment in 2007 and 2009

(estimate for difference = 38%, $p = 0.004$) appear to have improved significantly.

DISCUSSION

This pilot project demonstrated this methodology was associated with delivering improvements in the documentation of

CRA and delivery of preventive care. The project's continuous nature allowed the identification of barriers to improvement and changes devised to address them, for example, the introduction of the PCPCS for casual patients who required their own CARE tool. This project encouraged

Table 2 Levels of preventive care in 2007 compared to 2009 with CARE tool

Preventive measure	2007 (n = 50)	2009 with CARE tool (n = 20)	Estimate for difference	95% CI for difference	p-value
Fluoride varnish	24% (12)	50% (10)	21%	47.4%, -5.4%	0.115
Toothpaste strength advice	16% (8)	60% (12)	44%	69.4%, 18.6%	0.001
Toothbrushing instruction	36% (18)	70% (14)	24%	50.8%, -2.8%	0.077
Diet advice	32% (16)	70% (14)	38%	63.3%, 12.7%	0.004
Fissure sealants	48% (24)	50% (10)	20%	29.5%, -25.5%	0.883

improvements beyond the areas originally envisaged; for example, the PCPCS also improved communication with the referring dentist. The project also motivated staff to improve the quality of health promotion literature within the department.

The sampling system was designed to cause minimal disruption to clinic working, while providing contemporaneous results. The sample size of 20 case notes every second week was judged as adequate to reflect the general patient patterns within the department. This method of data collection was highly visible, which in itself acted as a reminder to complete a CARE tool. However, some limitations were that: results were subject to selection bias by the investigator; notes from some clinics were not available to the investigators; and results had to be collected before case notes left the clinic, which may prejudice results against members of staff who may have later completed a CARE tool. However, to provide contemporaneous feedback to facilitate improvement, it was elected to accept these shortcomings.

The main change concepts introduced by this project revolved around development of new working processes in an endeavour to improve patient care, along with continuous monitoring and feedback as advocated by the PDSA model.¹¹ Some of the more notable changes are noted in Table 1 and Figure 5. Overall our changes revolved around regular monitoring, regular feedback and engaging with all members of the team. This meant the working group not only regularly measured the uptake of the CARE tools but also regularly took opportunities to both give and receive feedback from the staff within the

department. Feedback might be given formally at a departmental meeting or via an email, but equally constructive comments may arise during brief conversations during the working day. Overall the feedback received from staff was positive with regard to the improved patient care being provided. Staff did note that completing the CARE tools does generate some extra work but this was not felt to be excessive and worth the perceived benefit to patient care and working processes. It has since been decided to continue the project to build upon the success of the pilot, the aim being to continue to develop work flows which place appropriate dental caries prevention at the heart of the treatment received by every patient.

As this project progressed, the desirability of an outcome measure for the effects of improving preventive care was discussed. The obvious measure of this would be the incidence of new carious lesions. Unfortunately, as dental caries is a multifactorial and relatively slow developing disease, evaluation of incidence of new carious lesions as an outcome measure would be outside the scope of an improvement project with no additional funding. However, given the strength of the evidence supporting the effectiveness of the preventive interventions, we are confident that ensuring their effective application should have a net patient benefit in terms of reduction of future dental caries.¹²⁻¹⁵

This project demonstrates a successful model for improving delivery of preventive care for patients. By targeting CRA, the first key step in delivery of prevention, we have demonstrated improved delivery of a range of preventive interventions.

We did achieve our 80% target for CRA completion on five occasions by the end of the project. However, our aim for the future will be not only to achieve 95% plus CRA completion, but to achieve our target consistently, potentially a significant challenge of its own. While this project was hospital-based, the quality improvement principles involved could be translated into a system suitable for use in primary dental care.

Thank you to J. Thompson, and everyone within the paediatric and medical records departments at Glasgow Dental Hospital and School for their assistance with this project. Appreciation is extended to Mr William Peters, an Improvement Advisor with the IHI, for preparing the SPC charts in this analysis.

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