ORIGINAL RESEARCH

A Study On Optimization Of Chair Side Time (CST) - A Lean Six Sigma Approach In A Dental Hospital

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ABSTRACT

Introduction: Efficient use of professional's time is very important in healthcare industry in general and particularly in India as there is a greater demand for healthcare service. In case of dental care, 'Chair Side Time (CST)' is very important and one of the crucial parameters in patient's turnaround time that strongly influences 'patient and staff' satisfaction and is the key determinant of a dentist's productivity. The main objective of the present paper is to identify the causes that affect CST so that healthcare service delivery time can be optimized. This in turn can lead to increased customer satisfaction.

Material and methods: Lean six sigma methodology is employed to identify CTQ (Critical to Quality) factors and the prime focus is on chair side time of the define phase of DMAIC. In the measure phase baseline and target of chair side time is identified. In analyze phase, causes for increase in CST is identified using Ishikawa diagram. Two sample t-test and one way ANOVA are applied to statistically infer various factors affecting CST. In the improve phase suggestions for improvement are identified and recommended according to the inference of the analyze phase. In control phase control plan was suggested with the help of control charts and analysis was carried out to find the improvement in the reduction of CST by comparing the data before and after the improve phase.

Results: The average time for patient CST is (30.5±10.0) minutes and post improvement phase the same is reduced to (25.96±7.26) minutes, i.e., estimated reduction in CST is 4.500 minutes.

Conclusion: Lean Six Sigma methodology aims to improve the process performance resulting in better utilization of resources. In the present competitive era, if patients are inconvenienced or unhappy, they can very easily move onto another hospital without any personal costs. Thus it is important to implement such processes to improve the relationship between the patient and hospital.

Keywords: Lean Six Sigma; turnaround time; dentistry; chair side time; DMAIC

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INTRODUCTION

Long waiting times from registration to treatment, chair side operational time and patient treatment, low level of customer satisfaction are some of the critical aspects that require the attention of managements to boost the efficiency of 'OP' departments of dental hospitals. Lack of: i) skilled clinical persons, ii) trained administrators, iii) adequate number of trained staff and iv) strong performance monitoring systems are the hurdles in efficiency related issues in dental care.[1]

Quality in healthcare can be defined as the degree to which health services for individuals and population increase the likelihood of desired health outcomes and are consistent with current professional knowledge.[2] Adhering to a comprehensive philosophy of quality management is vital for today's hospitals to compete with other hospitals and healthcare providers.[3] The Six Sigma quality improvement model as applied by Robert Galvin at Motorola, Inc. refers to the five step problem solving approach known as DMAIC (**D**efine, **M**easure, **A**nalyze**, I**mprove and **C**ontrol).[4] Motorola developed Six Sigma Quality Management to include financial considerations.[5]

DMAIC is a structured problem solving method.[6] Six Sigma quality standard is at most 3.4 defects per million opportunities. The Sigma metric allows the comparison in terms of the number of defects generated by the process per one million opportunities.[7]

Six Sigma provides a general analytic framework for problem solving. Lean reduces the wastes of a process and increases the speed. Wastes in lean methodology are known as MUDA which includes transportation, inventory, motion, waiting time, over-processing, over-production and defects. The ideal solution is to

combine the two approaches.[8] Lean Six Sigma is a combination of two powerful methods. Lean and Six Sigma complement each other. Combining these two methods gives improvement team a comprehensive tool set to increase the speed, effectiveness of any process within the organization and reduces waste by streamlining the project – resulting in increased revenue, reduced costs and improved collaboration.[9]
The reasonable Turnaround Time for a patient on appointment for dental treatment should be about 1.5hrs to 2hrs approximately, which includes time at registration desk, waiting time and CST. The importance or rationale of the present study is to study the effect of different factors in managing the CST to improve health service delivery and increase patient satisfaction.

MATERIALS AND METHODS

This study is conducted on 300 patients visiting a corporate dental hospital in Hyderabad city during the month of April - July 2015 by selecting 3 patients per day on a systematic basis for a period of 100 hospital working days. The study was planned and carried out in a dental hospital by a black belt and green belt certified professional in order to analytically improve CST by application of lean six sigma methodology. Ethical clearance is taken for the commencement of the study from the ethical committee of the institute. The DMIAC process is employed beginning with the identification of factors which are CTQ (Critical to Quality) and the prime focus is on reduction of CST. A relationship between the input factors and the output factors is established by using Ishikawa (fish bone) diagram as shown in figure 1.
In the analyze phase two sample t- test was used to statistically find the relation of assistant experience and fatigue, doctor fatigue and skill, equipment break down, instrument arrangement, availability and breakdown, material arrangement, stock and location, patient-cooperation, patient-medical condition, patient-technical difficulties, power cuts, quality of material used and shared assistant. One way ANOVA test is applied to statistically find the significant relation between number of assistants and number of parallel treatments. p value <0.05 was considered as significant value. In the improve phase improvement suggestions are recommended according to the inference of the analyze phase. In the fifth phase, namely, control phase, analysis is carried out to find the improvement in the reduction of CST by comparing the data before and after the improve phase.

RESULT

At the intervention of the study, during the first phase **D**efine, CTQ factor was identified. CST is one of the CTQ factors. In the **M**easure phase, baseline and targets for CST are identified. In **A**nalyze phase, Ishikawa (fish bone) diagram is developed to identify the factors affecting CST. The factors identified include: i) Assistant related (experience and fatigue, shared assistant), ii) Number of assistants, iii) Equipment break down, iv) Instrument related (arrangement, availability and breakdown), v) Material related (arrangement, quality, stock and location), vi) Doctor fatigue and skill, vii) Number of parallel treatments, viii) Patient parameters (cooperation, medical condition, technical difficulties) and x) power cuts.
The average patient CST is (30.5±10.0) minutes. From the data collected, in the third phase, namely, analyze phase, it is found that the assistants professional experience (present or not present), assistants fatigue levels, doctors fatigue levels, unanticipated breakdown of instruments, arrangement of materials (bad or good), availability of material stock (absent or present), patients medical condition, technical difficulties encountered with regard to a patient, power failures, quality of materials and sharing of assistants do not cause a significant difference in the CST expended per patient. The doctors skill levels (high, low), equipment breakdown, arrangement of instruments (bad or good), availability of instruments (available or unavailable), location of materials (far or near), number of assistants (1,2,3), number of parallel treatments (2, 3 treatments) and level of patients cooperation (table I , II) increases the CST, which indirectly effect the patient satisfaction level.
Wastes in this study identified are: unnecessary movement of assistants increased waiting time due to the above mentioned factors; transportation is another type of wastes which shows the irrational movement of material.
In the **I**mprove phase, following improvements are recommended:
a) Equipment breakdown: i) Preventive/ Scheduled maintenance and ii) Daily Routine checks and training
b) Material Stocks: i) Classify the material according to usage (similar to surgical kits) and ii) Maintain appropriate stock of material.
Data revealed from the **C**ontrol phase indicates a significant difference in the pre and post improvement CST (Figure 3). The post improvement average CST per patient is (25.96± 7.26) minutes. Estimate for difference is 4.5min and 95% lower bound for

S.No.	Factors		N	Mean	S. D.	S. E.	P. Value
1	Experienced Assistant	Absent (0) vs Present (1)	254	30.1	10.2	0.64	0.879
			46	32	10.1	1.5	
2	Assistant's Fatigue	No (0) Vs Yes (1)	259	30.6	10.3	0.64	0.812
			41	29.12	9.41	1.5	
3	Doctor's Fatigue	No (0) Vs Yes (1)	275	30.5	10	0.61	0.609
			24	29.92	9.93	2	
4	Doctor's Skill	High Vs Low	170	25.56	8.36	0.64	0
			129	36.91	8.24	0.73	
5	Equipment Breakdown	Absent (0) Vs Present (1)	263	29.76	9.97	0.61	0
			36	35.56	9.02	1.5	
6	Instrument Arrangement	Bad Vs Good	87	38.03	8.44	0.91	0
			212	27.35	8.91	0.61	
7	Instrument Availability	Available Vs Un-available	256	2.78	9.95	0.62	0.002
			43	34.51	9.58	1.5	
8	Instrument Breakdown	Absent (0) Vs Present (1)	267	30.62	9.97	0.61	0.781
			32	29.1	10.5	1.9	
9	Material Arrangement	Bad Vs Good	21	28.7	12.9	2.8	0.261
			278	30.59	9.79	0.59	
10	Material Stock	Absent Vs Present	45	33.36	9.14	1.4	0.987
			254	29.9	10.1	0.63	
11	Material Location	Far Vs Near	86	36.57	9.33	1	0
			213	27.99	9.22	0.63	
12	Patient Cooperation	Un-Coop.(0) Vs Coop.(1)	98	20.26	5.29	0.53	0
			201	35.43	7.76	9.55	
13	Patient Medical Condition	Bad Vs Good	40	29.5	9.51	1.5	0.25
			259	30.6	10.1	0.63	
14	Patient Technical Difficulties	Absent (0) Vs Present (1)	269	30.2	10	0.61	
			30	32.57	9.72	1.8	0.11
15	Power Cuts	Absent (0) Vs Present((1)	276	30.3	10	0.6	0.185
			23	32.26	9.83	2	
16	Quality of Material Used	Bad Vs Good	33	34.5	10.4	1.8	0.988
			266	29.96	9.88	0.61	
17	Shared Assistant	No (0) Vs Yes (1)	249	29.4	9.65	0.61	0.999
			50	35.1	11.5	1.6	

Table - 1: Two - Sample t-Test for Factors Affecting CST

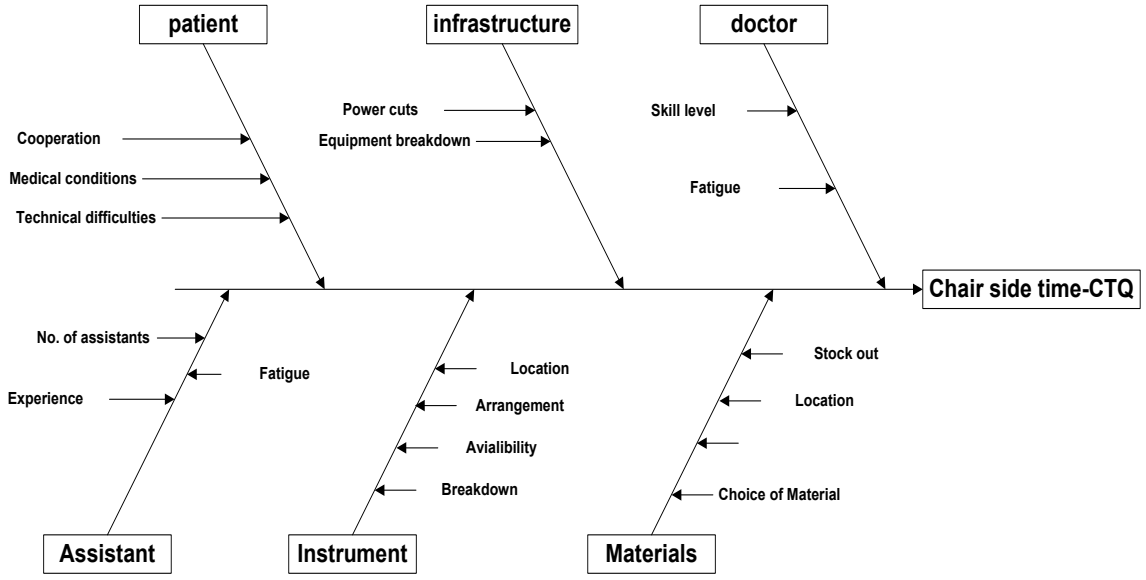

Figure-1: Ishikawa (Fish Bone) Diagram

S.No.	Factors		N	Mean	S. D.	P. Value
1	Number of Assistants	O	140	32.993	11.926	0
		1	118	28.686	7.431	
		2	42	26.262	8.006	
2	Number of Parallel Treatments	0	226	30.257	11.021	0
		2	45	26.711	5.949	
		3	29	36.793	2.513	

Table - II: One-Way ANOVA Test for Factors Affecting CST

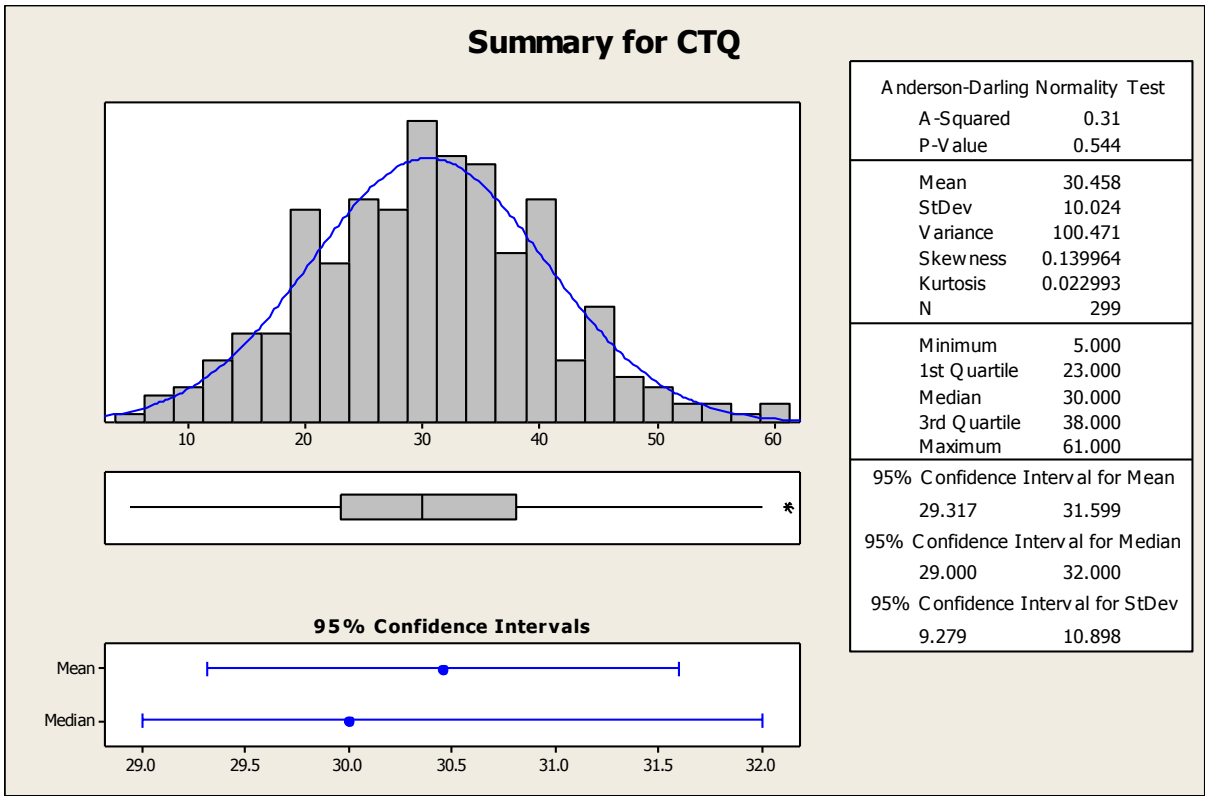

Figure-3: Pre Improvement data

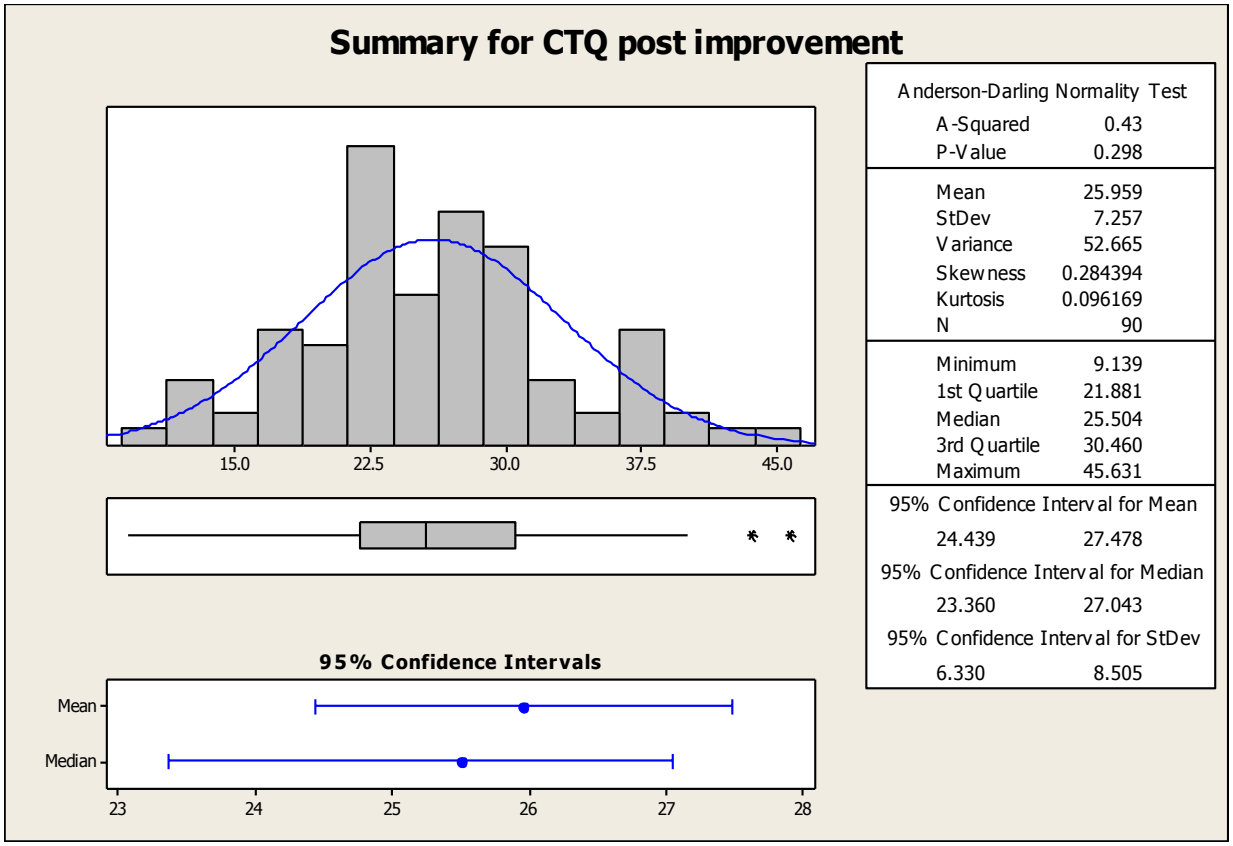

Figure-4: Post Improvement data

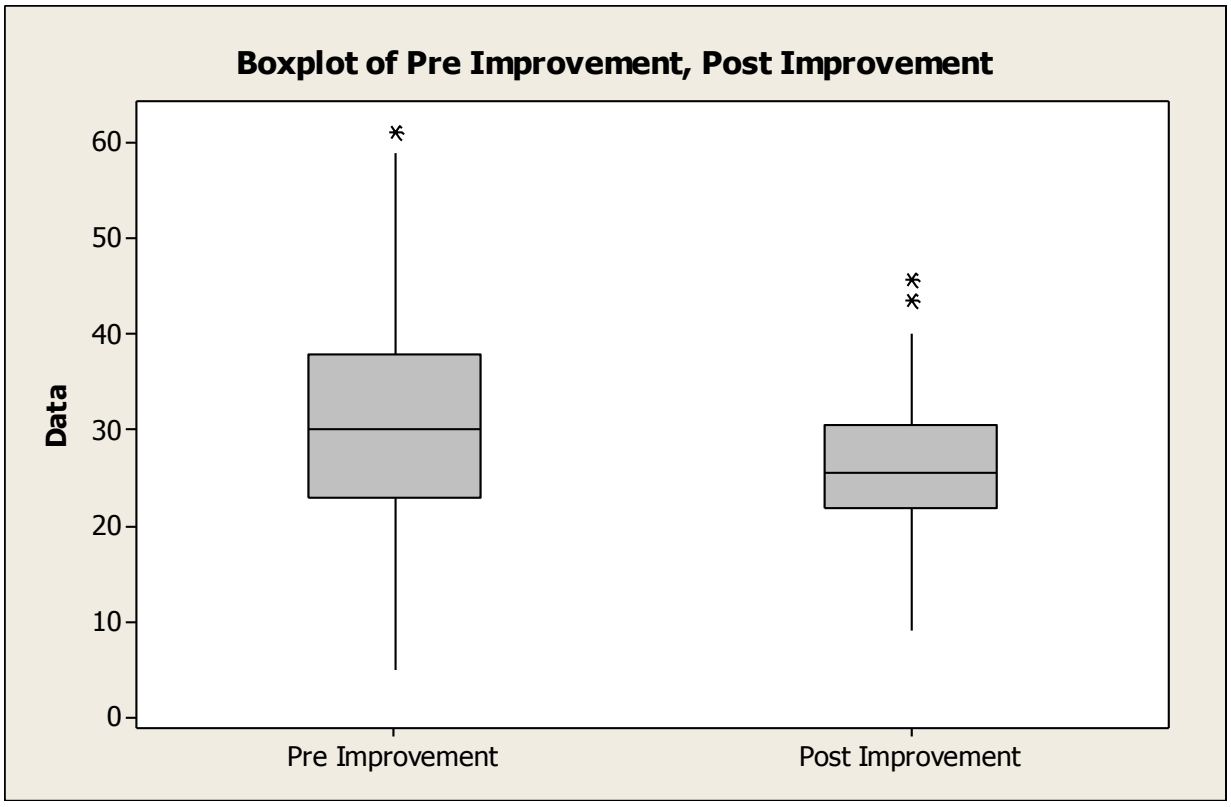

Figure-2: Box plot - Pre Improvement and Post Improvement

difference was 2.914. P-Value was found to be highly significant with p= 0.000

DISCUSSION

The DMAIC methodology is considered both as a philosophy and a methodology that improves quality by analyzing data to find root cause of quality improvements in its processes, products and services. It is a scientific method to improve any aspect of a business, organization process. DMAIC is a methodology to identify improvement opportunities, define and solve problems and establish measures to sustain the improvement.[10]

In the present study, lean six sigma (DMAIC) methodology was utilized to determine the effect ofvarious factors affecting the CST. The average CST per patient is (30.5±10.0) minutes and post improvement phase it reduced to (25.96± 7.26) minutes, i.e., estimate for difference was 4.500 minutes. CST is a crucial parameter of patient turnaround time that strongly influences patients and staff satisfaction level. Conrad DA et al[11] carried out a study to estimate determinants of dentist productivity and suggested that the dentist's own CST is the key determinant of dentist productivity.

Lean six sigma approach is an integrated and balanced combination of the speed with variation reduction power of both Lean and Six Sigma to achieve business management process full optimization.[5] Six Sigma, a quality initiative tool, is based on rigorous statistical process control, it a systematic problem solving approach. It targets the root cause for the variation and redefines the process for long term results. Lean Six Sigma decreases organization's costs by removing **"waste"** from a process and solving problems caused by a process. Waste is any activity within a process that is not required to manufacture a product or provide a service that is up to specification. Problems are defects in a product or service that affects organization economically. Basically, Lean Six Sigma enables to fix processes that cost organization valuable resources.[9] In lean methodology, materials are classified according to usage and to eliminate waste, i.e., to reduce the time required to search the material to increase the speed of the process in the present study.

Six Sigma's methodology has been applied in the business world from all variations and types of business which includes the health industry also. It has helped the health care organizations in developing higher standards by improving their defects towards efficiency.[12] Khatoon FK et al[13] carried out a study using six sigma approach to identify the causes, practice and conditions related needle stick injuries and the post improvement results showed 50% reduction of the incidences. Khan V[12] applied this strategy to reduce outpatient waiting time, patient satisfaction and recommended method d to be effective towards minimizing long wait time. Similarly Baddour AA et al,[6] Karen R et al[14] Bucci RV et al,[15] Kuo AM et al[16] applied Six Sigma in various areas of healthcare and found the method to effective to meet patient's needs and expectations.

CONCLUSIONS

It is obvious that long CST affect patient`s satisfaction towards services they receive. Through Lean Six Sigma approach, main factors leading to long CST are identified as doctor's skill, equipment breakdown, instrument arrangement, instrument availability, material location, number of assistants, number of parallel treatments, patient co operation. Improvements has to be made to fulfill patient`s satisfaction. lean Six Sigma gives improvement team a comprehensive tool set to increase the speed and reduces waste by streamlining the project – resulting in increased revenue, reduced costs and improved collaboration. In the present competitive era if patients are inconvenienced or unhappy they can very easily move onto another location without any personal costs. Thus it is important to implement such processes to improve the relationship between the patient and hospital.

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