Proceedings of the 8th Annual World Conference
of the Society for Industrial and Systems Engineering,
Baltimore, MD, USA
October 17-18, 2019

Root Cause Analysis of No Shows at a Diagnostics Center and Methods to Reduce Them

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Author Note: Ajay Goyal recently completed the Master of Science in Industrial and Systems Engineering at Binghamton University, a.k.a., the State University of New York at Binghamton. Daryl Santos is a Professor in the SSIE Department and advised Ajay on his master's project, upon which this paper is based.

Abstract: The aim of this effort is to conduct a root cause analysis to find reasons for missed appointments at a diagnostic center. The analysis is completed using control charts, Pareto analysis, cause and effect diagrams, and ANOVA to determine the relationship between time, procedures and reasons for no shows. Once the root causes are determined, methods are devised to eliminate them. A PDSA cycle for each method is attached to act as a standard operating procedure. We thank the entire staff of STAR Imaging and Research Center for all the help they have provided in the course of this project. STAR Imaging and Research Center (STAR) is a premier diagnostic imaging clinic located in Pune, India. It is focused on providing specialized diagnostic imaging and basic blood tests to patients and physicians. It is one of the only imaging centers in Pune that operates on all days of the week. Despite its smooth day-to-day business operation, the imaging center is facing revenue loss due to daily missed appointments by clients. This project will analyze the root causes of these 'no shows' and help reduce them. In June 2018, for example, the imaging center has had a missed-appointment rate of 20.11%. On an average, the imaging center loses $70 per missed appointment. Based on their data from January 2018 to June 2018 these no shows accounted for an approximate revenue loss of $103,110. The goal here is to bring down the missed appointment rate by at least 5% which will save approximately $25,777 for the imaging center. Primarily, the reasons responsible for these missed appointments were statistically organized and analyzed. A literature research was then conducted to study the causes which typically led to the highest number of no shows. Solutions were then constructed to help mitigate the rate of these no-shows.

Keywords: Root Cause Analysis, Imaging, Missed Appointments

1. Introduction

This document will explain the no-show's problem experienced by STAR Imaging and Research Center (STAR) at their facility in Pune, India. It is focused on providing specialized diagnostic imaging and basic blood tests to patients and physicians from the city. It's one of the only imaging centers in the city that operates on all days of the week. Any patient that did not show up after taking an appointment is considered as a missed appointment. As mentioned in the Abstract, this facility had a 20.11% missed appointment rate in the month of June 2018. These missed appointments are a hurdle as they cause a loss in revenue for the facility. The basic ideology behind a missed appointment is that it could have been replaced with an appointment which would have showed up and generated income. The data shows that there are some tests in peculiar that have a higher rate of missed appointments than the others. These tests are the Ultrasound Test, Complete Blood Count Test, 3 Tesla Magnetic Resonance Imaging, Position Emission Tomography, and the Computer Tomography Tests. In this report, these tests are referred to as US, CBC, 3T MRI, PET, and CT. The missed appointments mentioned above generated a revenue loss of $103,110 altogether in the first half of 2018. Thus, the goal of this project was to bring down the missed appointment rate by 5% which will save at least $25,777 for this facility. The focus of this project however is only appointments missed on the same day. It will not be dealing with the data of rescheduled appointments. The first step towards providing methods to reduce these missed appointments was to analyze the data of no-show at the facility from January 2018 to June 2018 and the reasons provided by the patients for not showing up during the same time period.

ISBN: 97819384961-7-2

2. Literature Review

To provide a significant system of solutions, it was necessary to conduct an extensive research on the diagnostics test process as well as the healthcare system. Documents and research papers related to missed appointments, overbooking appointments and efficient ways to schedule tests were studied. Although the facility focused in this report is in India, similar problems of missed appointments are also observed in North America. According to a paper submitted to the National Center for Biotechnology Information (NCBI), the average no-show rate in North America is close to 27% (Mohammadi et al., 2018). The paper shows that a significant amount of healthcare providers see revenue losses due to unreliable patients. It also points out some of the reasons why patients bail on appointments. They include transportation issues, little or no knowledge of the scheduling system, patients feeling neglected by the healthcare providers, lack of understanding of the scheduling system, patients not feeling respected by healthcare providers, timeliness, and severity of patient sickness/illness. According to their research, 55% of the appointments missed are by females. The average age of the population that contribute the most to missed appointments is 33 (Ullah et al., 2018). There are teams that are also working towards predicting missed appointments using regression analysis (Harvey et al., 2017). A similar research also observed that the distance of a patient from the facility, or their work status, are significant reasons that have an effect on predicting no shows (Lorenz and Hawkins, 2018).

3. Methodology

The first step to providing solutions for reducing the missed appointments was to analyze the data provided by STAR. The data were then reorganized, chronologically. The data also were bifurcated to represent the missed appointments for the 5 procedures previously mentioned. After the data were organized, they were used in the implementation of process improvement tools such as Ishikawa (fishbone or cause-and-effect) diagrams, Pareto analysis, and control charts. Additionally, a single way ANOVA was performed to check if there was significant variation between the missed appointments and analyzed by days and by months. Minitab 18 was used to carry out all the data analysis. The reason behind this analysis was to recognize a trend that would lead to the causes of missed appointments at this specific facility. The facility's appointment scheduler was consulted about the process and asked if, according to them, there are any areas in the flow which have a scope of improvement. It was observed that the scheduler has a problem sending out reminders to patients and could use a more efficient way to do it. Also, the scheduler mentioned that they offer a ride to their facilities, but do so only with patients they thought would need them. Consequently, a fishbone diagram was constructed to list and represent the possible causes of no-shows on a typical day as shown in Figure 1. Observing the diagram, four areas were chosen to focus on.

The four areas that were focused on are the following: no fool-proof system for reminders, clarity in scheduling of an appointment, transportation, and miscommunication with patients. Transportation was given priority as it was already available for patients. The no show data for 5 procedures from January 2018 to June 2018 was provided by the facility. The dataset included a number of parameters, including the dates for which the facility was operational, patient gender, patient age, and the actual appointments made for all the 5 procedures. Further, the data also included the defaulted appointments for each of the 5 procedures. The facility schedules tests and appointments on all days of the week including Saturdays and Sundays. According to the data, STAR averages approximately 41 scheduled appointments per day and is well above it targets. Although it promises good revenues for the facility, it also increases the probability of the defaulted appointments. The data of missed appointments was used to create a control chart for 6 months. An I-MR chart for these data appear as Figure 2. A dataset of 179 data points was used to determine the average default appointments per day. There were no out-of-control indicators found in the I-MR chart and hence it can be concluded that the number of missed appointments per day are quite consistent. The control chart shows that the facility has, on average, 8 defaulted appointments in a day. If we compare this against the operational hours, the facility has about one missed appointment every 1.5 hours.

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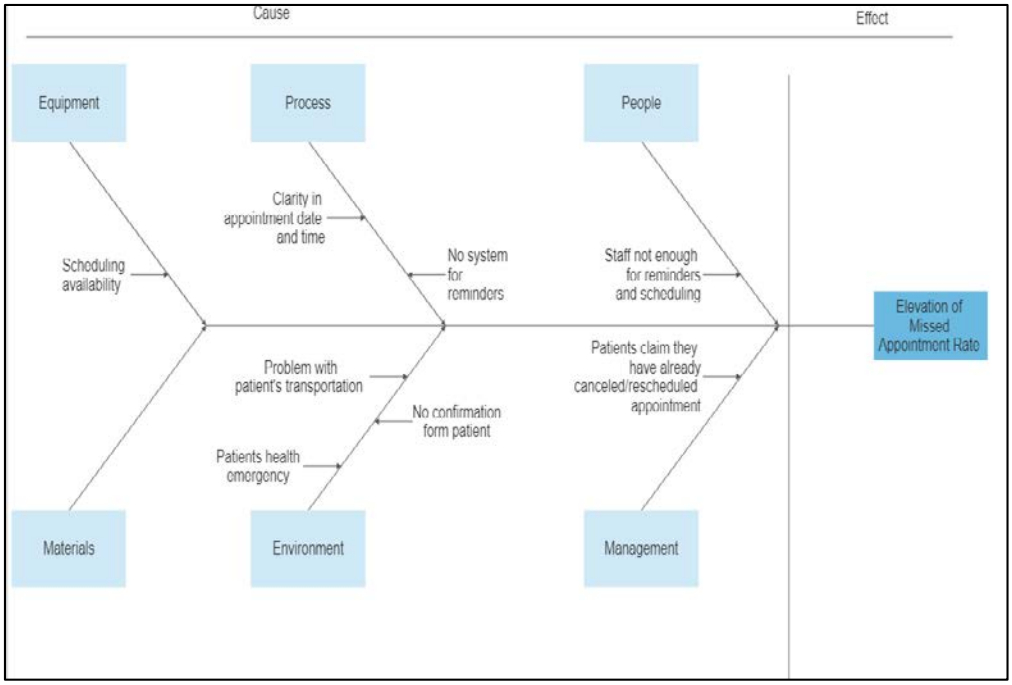

Figure 1. Cause and Effect Diagram for Missed Appointments

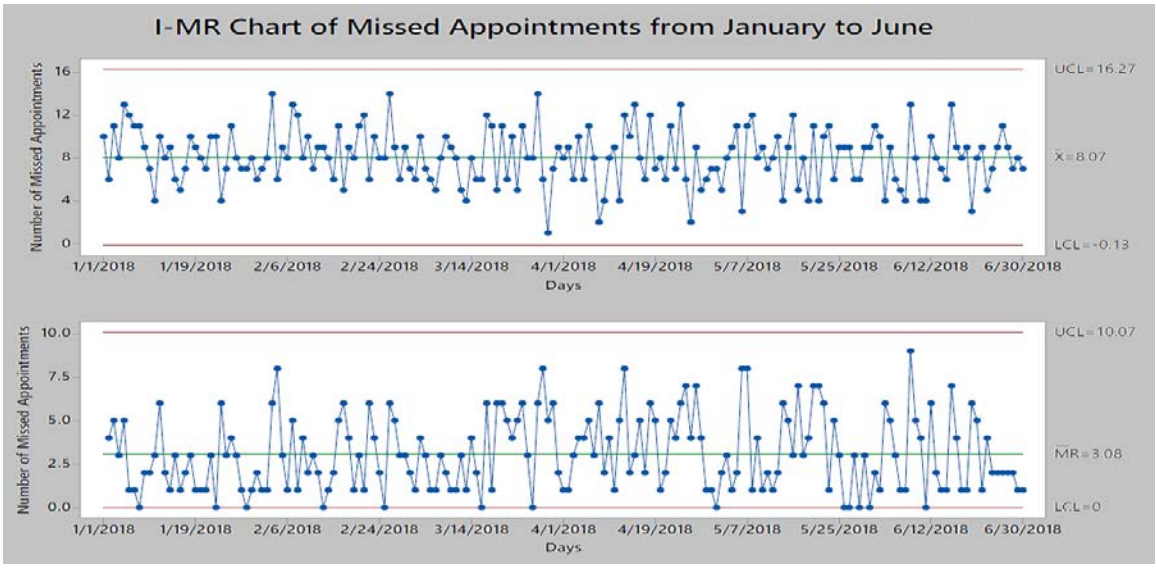

Figure 2. I-MR Chart of Missed Appointments

Multiple value sets were mined for comparison. The next analysis was done to observe the trend of defaulted appointments based on the procedure type. Pareto analysis done for these tests indicated that 3T MRI, CT and PET accounted for 88 percent of the defaulted appointments. The results of the analysis are shown in Figure 3.

ISBN: 97819384961-7-2

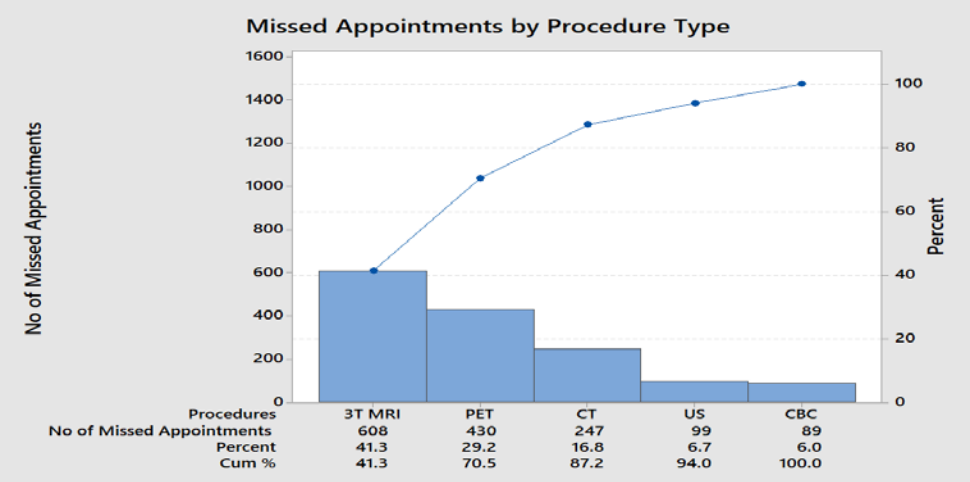

Figure 3. Missed appointment by Procedure Type

To further analyze the irregularity between the missed appointments by months, a single way ANOVA was performed for defaulted appointments. The results of the analysis are represented in Figure 4.

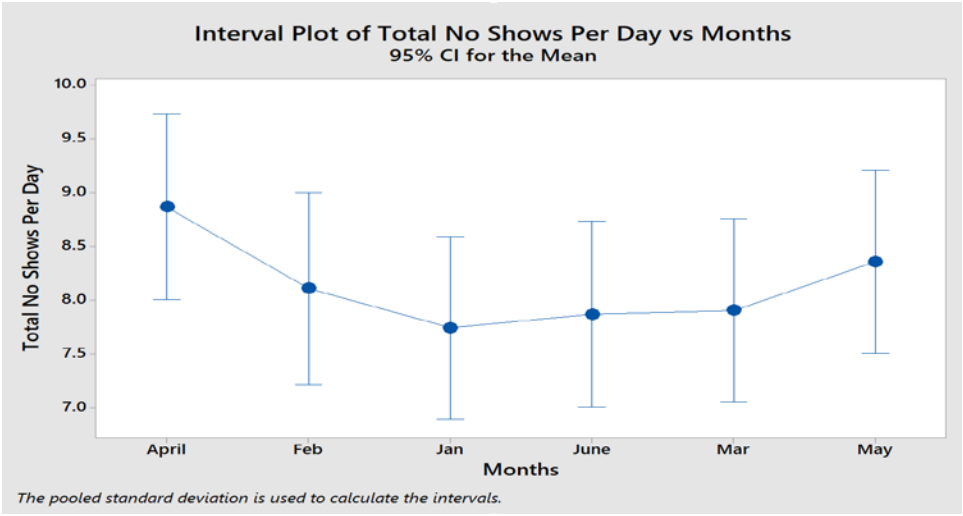

Figure 4. ANOVA for Missed Appointments by Months

The p-value concluded for the one-way ANOVA is 0.47. The detailed ANOVA analysis, not shown herein, and even with the overlapping intervals in Figure 4, suggests some statistical significance of the months of January and May on no-shows.

In addition to the earlier discussed fishbone diagram, a root cause analysis was conducted to help pin down the specific reasons for no-shows. The root cause analysis approach was made a little simpler as the facility sends out surveys to patients who did not show up for their appointments. This survey basically included details like time and date of the appointments, details of the receptionist who scheduled the appointments, whether the patient received a reminder, and the patient's reason of not showing up. A Pareto analysis was conducted to check which of the reasons were used most by patients and which are used least. The results of this analysis are provided in Figure 5. This chart includes those that answered the survey but did not do a follow-up discussion after the survey.

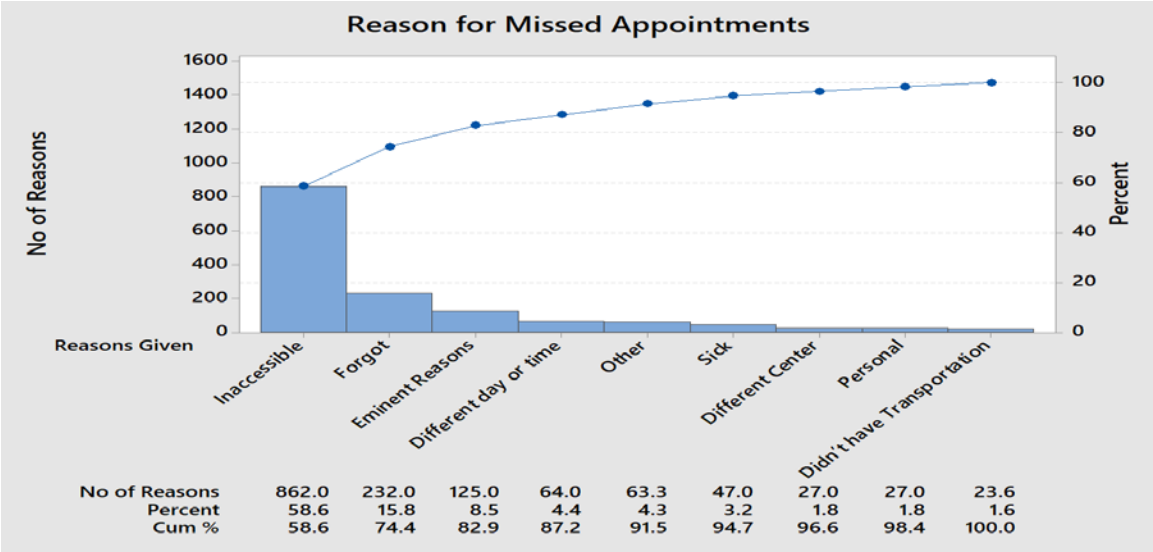

Figure 5. Reasons for Missed Appointments

Similarly, a Pareto analysis of the reasons given by patients who answered the survey was also conducted. In this group, these patients followed up after the survey with some additional explanations. This analysis shows that 5 of the 9 reasons constituted 79% of the missed appointments at this facility. This Pareto diagram in shown in Figure 6.

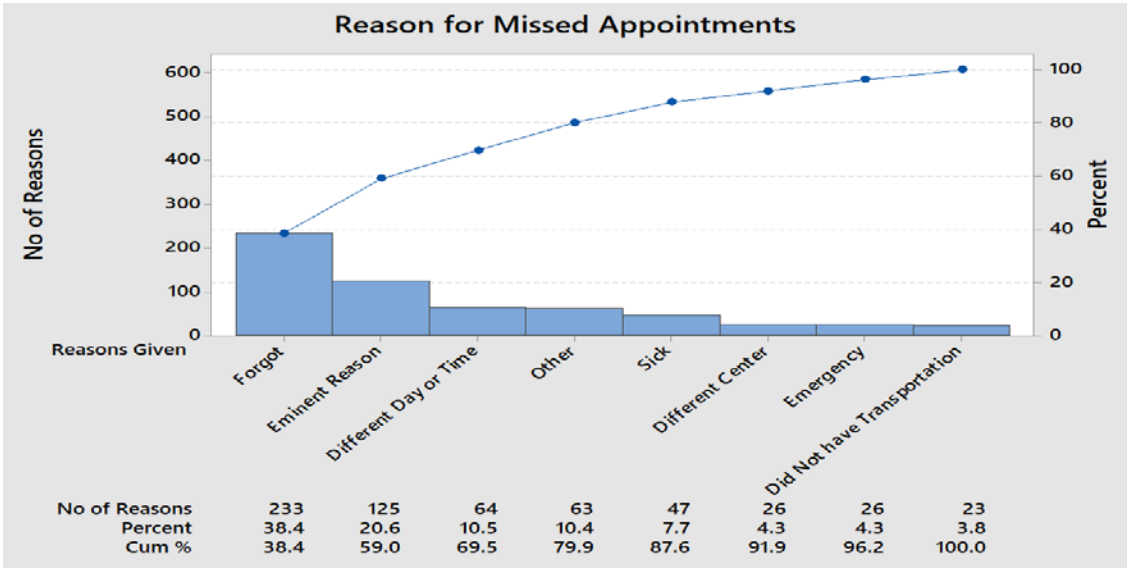

Figure 6. Reasons for Missed Appointments by Contacted Patients

The miscellaneous eminent reason as seen in the graph are the some of the reasons given to the facility for example, arrived at the location more than half an hour late for the procedure, thought the procedure cost was high, unable to clear off the remaining balance and the patient couldn't locate the facility. Patient forgetting about their appointment or misunderstanding the date and time constituted almost 50 % of the no shows. Now that the reasons behind the missed appointed were pinned down, in the next section of this report ideas to reduce these missed appointments are discussed.

ISBN: 97819384961-7-2

4. Findings and Action Items

The analysis was concluded in the previous section of the report and a total of 6 ideas will be suggested in this section to curb the rate of missed appointments. These ideas have been discussed below. Although not detailed in this paper, a Plan-Do-Study-Act methodology was also created and suggested with every solution.

4.1 Transportation Services

This solution is relatively easier to apply and could prove most effective. The recommendation here is to hire a third-party transportation service which can pick patients up from their homes and bring them to the facility as well as take them back. The advantage of this solution is that if the patient's previous mode of transportation fails, they can always opt for the transportation services. However, the details of this transportation services should be provided to each patient while scheduling the appointments. This will obviously make the appointment scheduling longer and is a disadvantage of this process. The fact that the facility cares enough for its patient to provide transportation services, its assumed that it would increase customer satisfaction. Of course, a cost analysis of the cost of this service as compared to the losses of missed appointments would need to be thoroughly conducted, but transportation costs are relatively low in Pune and thus likely to not outweigh the benefit of the made appointment.

4.2 In-house Test Services

In the survey, it was observed that 15.9% of missed appointments occurred due to either the patients being too sick to travel, a personal emergency, or they did not have a mode of transportation. For all these reasons, the patients could be provided services that allow them to take certain types of tests at home. Since there is a limitation of equipment portability for tests like 3T MRI, PET, and CT, the Ultrasound and Complete Blood Count can be the procedures that can be provided at the patient's residence. The at-home ultrasound procedure will specifically help pregnant females who are recommended not to travel during the final months of their pregnancy.

4.3 Reminders

The greatest number of defaulted appointments occurs because of patients forgetting their appointment. Almost 39% of the patients who answered the survey said that they forgot about the appointment. Therefore, a customized reminder call can significantly bring down this percentage of patients. If the patient knows that they have a tendency of forgetting, they can even set up a time for a reminder. However, when this idea was suggested, the facility disagreed on adding more work for the receptionist as they were already understaffed. Therefore, the suggestion of using a software based system, namely, Appointy was made. Appointy is an appointment management software. This software helps the patient to schedule their appointments and sends an SMS/notification reminder (such as that suggested by Lin et al. (2016)) on the time and date chosen by the patient. This software also integrates with Google calendar.

4.4 Food Services

The facility mentioned that for the 3T MRI, CAT, and PET they require the patients to fast before the test. For the same reason the facility tries to schedule these appointments as early as possible. However, they have records of scheduling appointments as late as 2 pm in the day. Therefore, the next solution for this problem is to provide light snack services after the procedure. The patients will be told about these procedures while they are scheduling the appointments as well as on the day of the test. Given that the 3 procedures constitute 88% of the no shows, then if this solution reduces the no shows for each test by 10%, it will still save the facility about $9,068 in revenue over a half-year period. Letting the patient know before the appointment that food will be available may act as optimistic reinforcement and can increase the show rate. The disadvantage of this solution is that it would increase the overhead cost of the facility, but after weighing it with benefits, the facility agreed that it was a good suggestion to implement.

4.5 Probability

This solution, although a little contentious, is crucial for the next solution appearing in Section 4.6. It was suggested that the receptionist is asked to note the likelihood of a patient showing up in the range of 1-5 while scheduling the appointments by asking the patients directly. In this case, 1 is most likely forgetting their appointment and 5 is showing up for the procedure

on time. Although it might sound a little rude to ask the patients how likely they are going to show up for an appointment, a another way was suggested to go about this. The facility, while asking this question, would mention that it is for a survey conducted by a university student associated with the facility. If some patients are honest enough, this method might also help the facility to track no-shows better.

4.6 On-Call Appointments

As mentioned earlier, the main reason for using the probability scale is to apply it in the on-call appointment solution. The facility was not in agreement with double-booking as it didn't want to stain its reputation if in fact both patients showed up for a procedure at the same time. Therefore, an on-call method was devised to use the concept of double booking without actually doing it. While making an appointment, if there are patients who are stubborn on having an appointment at a specific time, the receptionist could ask them if the patient would be okay with being on-call. If the patient agrees, the receptionist can then check the likelihood scale and if the likelihood of the other patient showing up at the same time is low, an on-call appointment for the same time can be booked. However, the on-call patient will be informed only 15 minutes before the actual procedure if their appointment is confirmed or not. This might act as a disadvantage to this solution.

5. Conclusions

The total revenue loss of the facility due to missed opportunity from January 2018 to May 2018 was $103,110. Reducing the no-show rate by 5% will save the facility $25,777 in revenue losses. It was found that the facility has 8 missed appointments on an average, every day. Just the 3 of the 5 procedures namely 3T MRI, PET and CT account for 88% of the defaulted appointments. One-way Anova was performed to observe any significance in missed appointments by days of the week as well as months, but no significance was found. Amongst the reasons provided by patient for not showing up, 38% were simply because patients forgot about their appointments. Almost 60% of the patients could not be contacted because the contact number or email provided during the scheduling was appointment was either wrong or no longer valid. Out of the 6 suggested solutions, the facility was skeptical about 2 of them and did not think that they are feasible. Human error is one the most critical issues at this facility that is leading to increase in the number of no shows. Other improvements are also being considered such as utilizing dynamic scheduling (Liu et al., 2010) and improving the modified overbooking procedure discussed herein but using concepts from others such as Parente et al. (2018).

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