



TIME SERIES FORECASTING OF POSTPONEMENT RATES IN OPERATION THEATRES OF ADVANCED CARDIAC CENTRE - AN OPTIMIZATION STRATEGY

Management

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ABSTRACT

Introduction Hospital contributes significant Tangible and Intangible resources on a concurred plan by the scheduling of surgery in OT List. Postponement decreases efficiency by declining throughput leads to wastage of resources hence burden to the nation. Patients and their family face economic and emotional implication due to the postponement. Postponement Rate being a quality indicator, control check mechanism could be developed from the results. Postponement of elective scheduled operations results in inefficient use of operating room (OR) time on the day of surgery. Inconvenience to patients and families also caused by postponements. Moreover, a day of surgery (DOS) postponement creates logistic and financial burden associated with extended hospital stay and repetitions of pre-operative preparations to an extent of repetition of investigations in some cases causing escalated costs, wastage of time and reduced income.

Methodology A cross-sectional study was done in the operation theaters of a tertiary care hospital in which total ten operation theaters of General Surgery Data of scheduled, performed and postponed surgeries was collected from all the operation theater with effect from March 1st to September 30th, 2018. A questionnaire was developed to find out the reasons for the postponement for all hospital's stakeholders (Surgeons, Anesthetist, Nursing officer) and they were further evaluated Time series analysis of scheduling of Operation Theater for Moving average Technique.

Results Total 958 surgeries were scheduled and 772 surgeries performed were and 186 surgeries were postponed with a postponement rate of 19.42% in the cardiac surgery department during the study period during the study period. Month-wise postponement Rate exponential smoothing of time series data shows the dynamic of operating suits. To test the throughput Postponement Rate was plotted the postponed surgeries and on regression analysis are in a perfect linear relationship.

KEYWORDS

Moving Average, Exponential Smoothing, Regression Analysis, ARIMA, DES, Operation Research, Forecasting, Optimization, Postponement Rates, Time Series analysis, Operation theater

Introduction

Hospital contributes significant Tangible and Intangible resources on a concurred plan by the scheduling of surgery in OT List. Postponement decreases efficiency by declining throughput leads to wastage of resources hence burden to the nation. Patients and their family face economic and emotional implication due to the postponement. Postponement Rate being a quality indicator, control check mechanism could be developed from the results. Postponement of elective scheduled operations results in inefficient use of operating room (OR) time on the day of surgery. The efficiency of Operation Theater depends on the constant flow of the patients to fulfill its capacity. The throughput of the theater is declined due to the delay in the postponement of surgery resulting in wastage of resources. Level and reason of postponement can be established through a study. Implementation strategy (action plan) to minimize the postponement of surgery may be formulated through this information. The late postponement is a waste of, material, money, time and Human resources hence is a burden to the Nation.

Postponement of scheduled surgeries Increments costs Diminishes Efficiency Duplicates workload Squanders Operating Room Time. Increases patient's out of pocket expenditure due to Overstay Redundancy in perioperative course of action and Management. Numerous Deliberates have proposed many ways of making strides of proficiency by guarantying Maximum Utilization, Minimizing Over-running, Minimizing Postponement Patients and their families face economic and emotional implications for a postponement if the case is canceled. When the cases are postponed more than half of family members of patients miss at least 1 day at work. Operating room utilization is defined as the measure of the use of an operating room that is properly staffed with people needed to successfully deliver a surgical procedure⁷ to a patient. Many postponements are often due to non-medical problems such as a full ICU, surgeon unavailability, or bad weather and postponement rates can be monitored statistically. Elective surgery cancellations always lead to insufficient utilization of manpower and hospital resources and can also lead to an increase in

patients treatment expenses due to a prolonged hospital stay and in many cases, repetitions of pre-operative preparations and management¹. The delays and postponements specifically lower the morale among the staff, patients, and relatives and may reflect as a decreased productivity in their workplaces.⁴ There is a need for the healthcare teams to encourage cost-effectiveness in every aspect of patient care. Therefore, avoidance of unnecessary cancellation of elective surgery should lead to a reduction in the overall cost of the treatment.⁷ Cancellation is a major problem in most hospitals.⁸ It is an inconvenience, which has a significant ripple effect.¹⁵ Cancellation of cases on the scheduled day of surgery leads to inefficient utilization of manpower and scarce resources.²¹ Cancellation of elective operations is a parameter to assess the quality of patient care and quality of management system.¹⁸ Hence, this is one criterion for evaluating the efficiency of surgical service which has the low rate of cancellation of operations, which compels the hospital management to demonstrate the good performance.¹⁰

RESEARCH METHODOLOGY

RESEARCH SETTING: The study of postponement of scheduled surgeries was done in Main OT located at Nehru Hospital, Cardiac OT located in the Advance cardiac center (ACC), Pediatric Operation Theater complex located in Advance Pediatric center (APC), and an Eye Operation theater located in Advance Eye Center (AEC). Bed compliment of Nehru hospital is 949, Advance Pediatric Centre is 243 and Advance Cardiac Centre is 208, and advance eye center is 101 respectively. Main Operation theatre complex situated on 4th and 5th floor of Nehru Hospital, Pediatric, Cardiac operation theater complex and Eye OT. General Surgery department has 25 Senior Resident Doctors and 9 consultant surgeons.

RESEARCH DESIGN: This study was conducted between March 1st to September 30th, 2017. It was a cross-sectional study. Study tools: Questionnaire/opinion sheet was used. It included a semi-structured Performa by which information and data were obtained through the communication with the Doctors and Nursing officer.

SAMPLING TECHNIQUE DATA COLLECTION: Observation was done only for the scheduled cases enlisted for the specific day. The List of surgeries was generated before 8 pm on a previous day. Data for scheduled, performed and postponed surgeries were collected for seven months. The observation was not made during holidays, as routine cases were not scheduled on those days. A universal sampling technique³⁴ was adopted to select the one surgical specialty for each day since there are ten surgical specialties (twelve working days for each department thus data from the various stakeholder was taken for total 120 days). The opinion regarding the postponement was taken from various stakeholders (anesthetist, surgeon and staff nurse) was done by using a questionnaire/ opinion sheet³⁹, after obtaining the informed consent. In case of different opinion regarding the postponement of the same case, consensus was arrived by the discussion among surgeon, anesthetist, staff nurse and Hospital administrator and final opinion was entered in Annexure B. Postponement rate was calculated by dividing total number of surgeries postponed on day of surgery by the total no. of scheduled surgeries on that day multiplied by hundred.

Data were compiled into two major groups that are Hospital related and patient-related causes of postponement and they were further classified into avoidable and non-avoidable causes of postponement. Statistical analysis was done with the help of SPSS version 22, and stat pus application.

Table 1 Abbreviation

NAN	Not Actual Number
MAPE	Mean Absolute Percentage Error
MAD	Mean Absolute Deviation
MS	Mean Squared Deviation
d.f.	Degree of Freedom
SS	Sum of Square
MS	Mean Square

EXCLUSION CRITERIA: All the cases posted as unlisted cases or emergency cases.

DATA ANALYSIS TECHNIQUE:

The data collected was analyzed by using, a descriptive statistical method to describe sample characteristics in terms of frequency, mode, and percentage, moving average, exponential smoothing, Regression analysis and modeling techniques were used to interpret the data. Following abbreviations were used to interoperate the data.

ETHICAL JUSTIFICATION

This was a cross-sectional study to study the causes of postponement of scheduled surgeries. The confidentiality of any patient or the institution was not breached evolving any ethical issue. Treatment did not be altered delayed deprived when the study was undertaken. The study did not affect the procedure, process, and outcome of the ongoing treatment of the patient. The study in no way involves and experimentation on human no intervention procedure was carried out as apart of study. The ethical issues in the study had been paid due attention and study did not delay any patient of required investigation or treatment. Freedom of expression and un-indentured use of information generated victimization of participants and threats were taken care with special attention and due regards as per recommendation during the approval from Institutional Ethics committee.

OBSERVATION AND RESULTS

Postponement cause study for the scheduled surgeries was conducted in the operation theaters of PGIMER Chandigarh. Data from the operation theaters was collected w.e.f 1st March to 30 September 2017. During this period there were total 174 working days and total ten surgical departments hence 1740 observations were recorded for scheduled performed and postponed surgeries. During this period 26,662 surgeries were scheduled 21,805 surgeries were performed and 4837 surgeries were postponed and postponement Rate was 18.22% all over the institute. However Total 958 surgeries were scheduled and 772 surgeries performed were and 186 surgeries were postponed with a postponement rate of 19.42% in the cardiac surgery department during the study period. Postponement rate was calculated by using the formula as under.

$$\text{Postponement Rate} = \frac{\text{Postponed Surgeries}}{\text{Scheduled Surgeries}} * 100$$

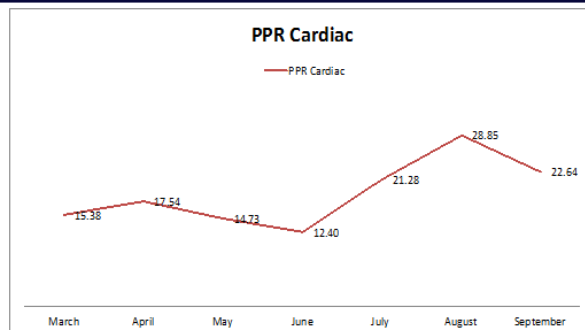


Fig.1 Time Trend Chart of Postponement Rates In Percentage of Cardiac Surgeries

Month-wise postponement rate of scheduled surgeries in Cardiac surgeries Department is graphically represented on time trend in Fig 1. Postponement rate increases from 15.38% to 17.54% from the month of March to April 2017 then decreases to 14.73% in the month of May and further to 12.4% in the month of June. Postponement rate increases to 21.28% in the month of July, and then further increases to 25.85% and then decreases to 22.64% in the month of August and September respectively.

Moving Average Forecasting of Cardiac Surgeries

On the ground of data for the month of March, April May and June the forecasted value for the postponement rate during the month of **July was 15.88 %**, for the **August it was 14.89%**, and for the **September 16.13%**. Forecasted postponement Rate decreased from July to August and then increased from August to September in contrast to Actual that is increased from **21.28% in July to 28.85% in August** and then decreased to **22.64% in September 2017**.

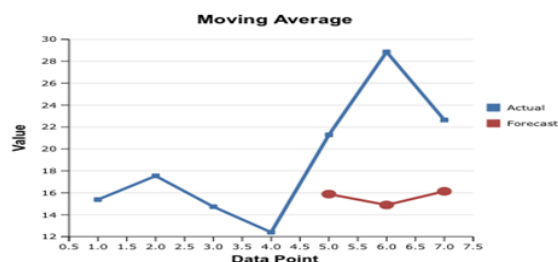


Fig 2 Moving Average graph of postponement Rate of Cardiac Surgeries

Table 2 Moving Average results of Forecasting of Cardiac Surgeries

Month	Actual Value	Forecast	Standard Error
March	15.38		
April	17.54		
May	14.73	NaN	NaN
June	12.40	NaN	NaN
July	21.28	15.8833	NaN
August	28.85	14.89	NaN
September	22.64	16.13	3.36572
October		20.8433	5.67922
November		24.25667	5.57298

On the ground of data for the month of March, April May and June the forecasted value for the postponement rate during the month of **July was 11.33 %**, for the **August it was 12.12%**, and for the **September 12.36%**. Forecasted postponement Rate increased from July to August and then also from August to September as seen in actual that is increased from **12.35% in July to 14.65% in August** but in contrast to increasing in forecasted it actually decreased to **12.49% in September 2017**.

Exponential Smoothing of Cardiac Surgeries

On the application of exponential smoothing with alfa value, 0.5 shows operation theater remained well optimized and smoothed in the month of April and September generating Residual less the 1 %. During the month of May due to the Summer Vacation of Consultants Residual is -

2.6 and further be smoothened by appropriate planning with reallocation of Human Resources and List of operation theater can be formulated with respect to the availability of surgeons and time.

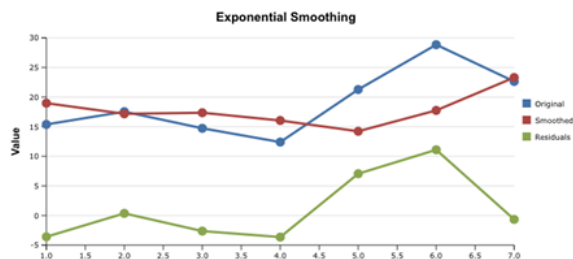


Fig 3 Exponential Smoothing of Postponement Rate of Cardiac Surgery Operation Theater

Table 3 Exponential Smoothing of Postponement Rate of Cardiac Surgery Operation Theater

Month	Original	Smoothed	Residuals
March	15.38	18.97429	-3.59429
April	17.54	17.17714	0.36286
May	14.73	17.35857	-2.62857
June	12.40	16.04429	-3.64429
July	21.28	14.22214	7.05786
August	28.85	17.75107	11.09893
September	22.64	23.30054	-0.66054

Maximum residual (11.09893%) was in the month of August with maximum postponement rate 28.85 followed by July (7.06%) was due to the rainy season.

by appropriate planning with reallocation of Human Resources and List of operation theater can be formulated with respect to the availability of surgeons and time.

On the perusal of the formula for calculating the Postponement Rate.

$$\text{Postponement Rate} = \frac{\text{Postponed Surgeries}}{\text{Scheduled Surgeries}} * 100 \dots\dots\dots 1$$

$$\text{Postponement Rate} = \frac{(\text{Scheduled-Performed})}{\text{Scheduled Surgeries}} * 100$$

Postponement rate is directly proportioned to the postponed surgeries in equation 1 And inversely proportional to the scheduled surgeries in standard performance.

Scheduling is an input indicator, Performed surgeries is an output indicator then throughput is tested through postponed surgeries plotted against Postponement rate in a scatter diagram by simple regression methods.

- **Throughput Indicators**
- Postponed surgeries (Independent Variable)
- Postponement Rate (Dependable Variable)

Table 4 ANOVA for Regression of plotted Postponed surgeries with Postponement Rate of Cardiac Surgeries.

		ANOVA					
	d.f.	SS		F	p-level		
Regression	1.00	185.40	130.61	76.41	0.0009		
Residual	5.00	7.10	1.42				
Total	6.00	192.49					
Intercept	Coefficient	Std. Error	LCL	UCL	t Stat	p-level	H0 (5%) Rejected
	5.26	1.28	1.96	8.55	4.10	0.00934	

Postponed Surgeries	0.30	0.03	0.21	0.39	8.74138	0.00032	Rejected
T (5%)	2.57						
LCL- Lower Value of Reliable interval							
UCL- Upper Value of Reliable Interval							

- **Hypothesis:** Postponement Rates has perfect Linear Relationship with the postponed surgeries.
- **Null Hypothesis (H0):** Postponement Rates does not have the perfect linear relationship with the postponed Surgeries

Simple Linear Regression Advance Cardiac Center

igram (Predicted Y, Postponement Rate Cardiac Surgery vs. Postponemen

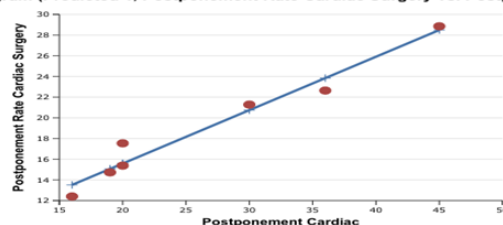


Fig 4 Regression Line Plot Postponed surgeries with Postponement Rate of Cardiac surgeries

- On the perusal of the **p-Value 0.00934** of intercept and postponed surgeries **0.0032** which is less than 0.005 we are able to reject the null hypothesis that is Postponement Rates does not have the perfect linear relationship with the postponed Surgeries.
- Meaning thereby Postponement Rates has perfect Linear Relationship with the postponed surgeries hence throughput factors are responsible for the postponement rate efficiency of surgeons to access the time of surgery and delay in previous surgeries contribute the major factor for the increased postponement rates and non availability of surgeon during the leave period (Summer Vacations) or occupancy of available surgeons in scheduling emergency operation is contributed another throughput factor for the increasing postponement rates during vacation period of other consultants. Incomplete preoperative workup and changing Health status was another throughput factors responsible for the high postponement rate during the post-rainy seasons like in the month of August as suggested by the multiple stakeholders.

Discussion

Postponement of scheduled surgeries results in increased consumption of various tangible resources like Financial Resources, Organizational Resources, Physical Resources, Technological Resources, The organization's borrowing capacity, ability to generate internal funds, formal reporting structure and its formal planning, controlling, and coordinating systems. In addition to this Sophistication and location of a hospital's plant and equipment, Access to raw materials; Stock of technology; such as patents; trademarks; copyrights, and trade secrets; take a toll. The postponement not only impact tangible resources but also to intangible resources like Human resources, Innovation, Knowledge, Trust, Managerial capabilities, Organizational routines, Ideas, Scientific capabilities; Capacity to innovate; Reputation with beneficiaries; Brand name, Perceptions of quality; durability and reliability; Reputation with stakeholder for efficient; effective; supportive; and mutually beneficial interactions which causes depreciation of institute. These factors seem unnecessary in public sector hospital however corporate hospitals have deemed necessary for formulating different strategies to minimize postponement in constrained recourse in developing nations. During analysis of postponement causes it appears that in 80% postponements of scheduled surgeries were due to delay in previous surgery, changing patient health state, not contactable, failure to arrive, scheduling Emergency operation, were responsible. It was also observed that among the postponed surgeries 63.67 % of cases were due to avoidable reasons as also suggested by Hanna et al that elective procedure were potentially avoidable and may be prevented using quality improvement techniques. Maximum postponements rates are observed during the month of May that may be due to the vacation of the faculty.

CONCLUSION

- It was evident from our study that surgical postponement rate is relatively lower than other studies conducted in India and abroad.
- Our study also concluded that only five reasons that are Delay in Previous Surgery, Scheduling Emergency Operation, Changing patient health status, Incomplete preoperative Diagnosis and Patient absent are responsible for the 80% postponement of scheduled surgeries.
- Among all postponement of scheduled surgical cases, sixty-three percent was avoidable.

RECOMMENDATION

- Pediatric surgery Operation Theater has predictable postponement rates and can be further well optimized by taking appropriate operation research techniques like Linear Programming, Discrete Event Simulation Modeling with Network Analysis.
- Auto Regression Integrated With Moving Average (ARIMA)** models are also very useful to eliminate the residue by streamlining internal processes after the process flow analysis of department. Residuals in exponential smoothing can be eliminated by the algebraic equations through the linear programming on the result of Data Envelopment Analysis of suggestions from various stakeholders.
- Value Stream Mapping** (flow chart) of the processes of the surgical department in integration with diagnostic and support services.
- Time Value analysis** will further help to identify the bottlenecks and waste can be eliminated accordingly.

REFERENCES

- Chalya PL, Gilyoma JM, Mabula JB, Simbila S, Ngayomela IH, Chandika AB, Mahalu W. Incidence, causes and pattern of cancellation of elective surgical operations in a university teaching hospital in the Lake Zone, Tanzania. *Afr Health Sci*. 2011; 11:438-430. Aguntola AS, Agodrin S.O. Cancellation Of Elective Surgical Gases In A Teaching Hospital, South- Western Nigeria *The Tropical Journal Of Health Sciences* 2009; 16(1): 39-43.
- González-Arévalo A, Gómez-Armau JI, DelaCruz FJ, Marzal JM, Ramírez S, Corral EM. Causes for cancellation of elective surgical procedures in a Spanish general hospital. *Anaesthesia*. 2009;64(5):487-93.
- Jonnalagadda R, Walrond ER, Hariharan S, Walrond M, Prasad C. Evaluation of the reasons for cancellations and delays of surgical procedures in a developing country. *Int J Clin Pract*. 2005;59(6):716-20.
- Garg R, Bhalotra AR, Bhadoria P, Gupta N, Anand R. Reasons for cancellation of cases on the day of surgery-a prospective study. *Indian J Anaesth* [Internet]. 2009;53(1):35-9.
- Boker A. Causes of Last Minute Cancellation of Operative Procedures at King Abdulaziz University Hospital. *Journal of King Abdulaziz University-Medical Sciences*. 2008;15(4):31-9.
- Kolawole I, Bolaji B. Reasons for cancellation of elective surgery in Ilorin [Internet]. Vol. 4, *Nigerian Journal of Surgical Research*. 2002. p. 28 a 33.
- Mesmar M, Shatnawi NJ, Faori I, Khader YS. Reasons for cancellation of elective operations at a major teaching referral hospital in Jordan. *East Mediterr Heal J* [Internet]. 2011;17(8):651-5.
- McIntosh B, Cookson G, Jones S. Cancelled Surgeries and Payment by Results in the English National Health Service. *Journal of Health Services Research & Policy*. 2012;17(2):79-86.
- Jokhio AJ, Hussain S. Reasons for cancellation of elective surgical procedures at Chandka Medical college hospital, Larkana, Pakistan" *Rawai medical journal* 2014, 39(1): 61.
- Dawlaty E, Turkistani A, Reasons Of Cancellation Of Elective Surgery In A Teaching Hospital. *The Internet Journal of Anesthesiology*. 2008;15(2).
- Mahmood M, Akhter N, Cancellations of elective operations-causes in the pediatric patient, *Rawal Medical Journal* 2011; 36(3).
- Hovlid E, Bukve O. A new pathway for elective surgery to reduce cancellation rate *BMC Health Services Research* 2012;12(12): 154.
- Zafar A, Mufti TS, Griffin S, Ahmed S, Ansari JA. Canceled elective general surgical operations in Ayub Teaching Hospital. *J Ayub Med Coll Abbottabad*. 2007;19(3):64-6.
- Lopez PN, Jowett S, Mark S. The reasons for cancellation of urological surgery: A retrospective analysis. *NZ Med J*. 2012; 124:1339
- Caesar U, Karlsson J, Olsson LE, Samuelsson K, Hansson-Olofsson E. Incidence and root causes of cancellations for elective orthopedic procedures: A single center experience of 17,625 consecutive cases. *Patient Saf Surg*. 2014;8(1):1-7.
- Keller A, Ashrafi A, Ali A. Causes of elective surgery cancellation and theatre throughput efficiency in an Australian urology unit. *F1000Research* [Internet]. 2014;3(0):197.
- Kumar R, Gandhi R. Reasons for cancellation of operation on the day of intended surgery in a multidisciplinary 500 bedded hospital. *Journal of Anaesthesiology Clinical Pharmacology*. 2012;28(1):66.
- Sultan N, Rashid A, Abbas SM. Reasons for cancellation of elective cardiac surgery at Prince Sultan Cardiac Centre, Saudi Arabia. *Journal of the Saudi Heart Association*. 2012;24(1):29-34.
- Ebirim LN, Buowari DY. WI Causes of cancellation of elective surgical operations at a University Teaching Hospital *Journal of Medicine and Medical Sciences* 2012;3(5):297-301.
- Hewawasam GC, Maduwanthi A. Cancellation of elective surgical procedures in the Genito-Urinary section of National Hospital of Sri Lanka - can we do better? *Sri Lankan Journal of Anaesthesiology*. 2013;21(2):68.
- Schofield WN, Rubin GL, Piza M, Lai YY, Sindhusake D, Fearnside MR. Cancellation of operations on the day of intended surgery at a major Australian referral hospital. *Med J Aust*. 2005;182(12):612-5.
- Jiménez A, Artigas C. Cancellations In Ambulatory Day Surgery: An Observational Study 2005;3.
- Chiu CH, Lee A, Chui PT. Cancellation of elective operations on the day of intended surgery in a Hong Kong hospital: Point prevalence and reasons. *Hong Kong Med J*. 2012;18(1):5-10.
- Trentman TL, Mueller JT, Fassett SL, Dormer CL, Weinmeister KP. Day of Surgery Cancellations in a Tertiary Care Hospital: A One Year Review. *J Anesth Clin Res*. 2010;1(3):1-4.
- Afzal F, Asad N, Ali K. Causes of postponement of elective surgery in Mayo Hospital Lahore Biomedica. 2010;26:148-51.
- Sung W-C, Chou A-H, Liao C-C, Yang M-W, Chang C-J. Operation cancellation at Chang Gung Memorial Hospital. *Chang Gung Med J* [Internet]. 2010;33(5):568-75.
- Dadaş S, Eti-Aslan F. The causes and consequences of cancellations in planned orthopedic surgery: the reactions of patients and their families. *Journal of Orthopedic Nursing*. 2004;8(1):11-9.
- Xue W, Yan Z, Barnett R, Lee F, Liu R. Different dynamics of elective case cancellation for inpatient and outpatient in an academic center. *J Anesth Clin Res*. 2013;4(5).
- Talati S, Gupta A, Malhotra S, Jain A. An analysis of time utilization and cancellations of scheduled cases in the main operation theater complex of a tertiary care teaching institute of North India. *Journal of Postgraduate Medicine*. 2017;61(1):3-8.
- Dawlaty A, Turkistani A, Aldohayan A, Zubaidi A. Reasons Of Cancellation Of Elective Surgery In A Teaching Hospital. *the Internet Journal of Anesthesiology*. 2007;15(2):1-5.
- Haana V, Sethuraman K, Stephens L, Rosen H, Meara J. Case cancellations on the day of surgery: an investigation in an Australian pediatric hospital. *ANZ Journal of Surgery*. 2009;79(9):636-640.
- Mesmar M, Satnawi N, Faori I, Khader Y. Reasons for cancellation of elective operations at a major teaching referral hospital in Jordan. *EMHJ*. 2011;17(8).
- Kaddour R, Fadlallah R, Hitti E, EL-Jardali F, El Eid G. Causes of cancellations on the day of surgery at a Tertiary Teaching Hospital. *BMC Health Services*. 2016;16(259).
- Moataza M, Wahab A, Nagwa Y, El-Enein A. Statistical Process Control for Cancelled Operations at the Paediatric Surgery Department of a University Hospital in Alexandria. *Egypt Public Health Assoc*. 2009;84(5&6).
- Bento Vaz C. Methodology to reduce cancellations of scheduled surgeries [Internet]. 1st ed. Portugal: School of Technology and Management, Polytechnic Institute of Bragança.; [cited 18 November 2016]. Available from: <http://apolo.dps.uminho.pt/icqem/2014/abstracts/D2.2.pdf>.
- Schofield W, L Rubin G, Piza M, Lai Y, Sindhusake D, R Fearnside M et al. Cancellation of operations on the day of intended surgery at a major Australian referral hospital. *MJA*. 2005. 2005;182(12):612-615.
- González-Arévalo A, Gómez-Armau J, delaCruz F, Marzal J, Ramírez S, Corral E et al. Causes for cancellation of elective surgical procedures in a Spanish general hospital. *Anesthesiologia*. 2009;64(5):487-493.
- Keller A, Ashrafi A, Ali A. Causes of elective surgery cancellation and theatre throughput efficiency in an Australian urology unit. *F1000Research*. 2014;3(197):1-1.
- Ebrahimpour H, Shirdel A, Rahimi M, Meraji M, Hooshmand E, Pourtaieb A et al. A Study on the Frequency and the Reasons for Cancellation of Surgical Operations in Khatam Hospital (Mashhad, Iran) in 2013. *Patient Safety And Quality Improvement*. 2014;2(4):156-159.
- Ebrahim A, A Hamza A, A El-Haj M. Cancellation of Elective General Surgical Operations at the Day of Intended Surgery. *Global Journals Inc (USA)*. 2014;14(3).
- Ehrenfeld, J, Dexter F, Adrienne B, Rothman M, Johnson M, H. Epstein R. Case Cancellation Rates Measured by Surgical Service Differ Whether Based on the Number of Cases or the Number of Minutes Cancelled. 2013;117(3).
- Ebirim L, Buowari D, Ezike H. Causes of cancellation of elective surgical operations at a University Teaching Hospital. *Journal of Medicine and Medical Sciences*. 2017;3(5):297-301.
- Trentman T, Mueller J, Fassett S, Dormer C, Weinmeister K. Day of Surgery Cancellations in a Tertiary Care Hospital: A One Year Review. *Journal of Anesthesia & Clinical Research*. 2010;1(3).
- Kim K, Lee J. Reasons for cancellation of elective surgery in a 500-bed teaching hospital: a prospective study. *Korean Journal of Anesthesiology*. 2014;67(1):66.
- Epstein R, Dexter F. Management Implications for the Perioperative Surgical Home Related to Inpatient Case Cancellations and Add-On Case Scheduling on the Day of Surgery. *Anesthesia & Analgesia*. 2015;121(1):206-218.
- Rohini R, Mallikarjun J. Six Sigma: Improving the Quality of Operation Theatre. *Procedia Social and Behavioural Sciences*. 2011;25:273-280.
- Jones SS, Thomas A, Evans RS, Welch SJ, Haug PJ, Snow GL. Forecasting daily patient volumes in the emergency department. *Academic Emergency Medicine*. 2008 Feb; 15(2): 159-170.
- G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," *Phil. Trans. Roy. Soc. London*, vol. A247, pp. 529-551, April 1955. (references)
- J. Clerk Maxwell, *A Treatise on Electricity and Magnetism*, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
- I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in *Magnetism*, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
- K. Elissa, "Title of paper if known," unpublished.
- R. Nicole, "Title of paper with only first word capitalized," *J. Name Stand. Abbrev.*, in the press.
- Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," *IEEE Transl. J. Magn. Japan*, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetism Japan, p. 301, 1982].
- M. Young, *The Technical Writer's Handbook*. Mill Valley, CA: University Science, 1989.
- Momia YP, Talati S, Kaushal V, Bhagat H. Postponement Of Scheduled General Surgeries In A Tertiary Care Hospital - A Time Series Forecasting And Regression Analysis *International Journal of Technical Research and Applications* 2018; 6(3): 31-36
- Momia YP, Kaushal V, Talati S Bhagat H. Exponential smoothing of postponement rates of