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REDUCING SAME-DAY SURGICAL CANCELLATIONS TO IMPROVE OPERATING ROOM UTILIZATION: A LEAN SIX SIGMA PERSPECTIVE

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ABSTRACT

Background: The operating room stands among the most resource-intensive units within any hospital, and the way its time is used carries a direct weight on institutional revenue and on the flow of patients waiting for surgery. Same-day cancellation of scheduled procedures wastes a slot that has already been reserved, leaves costly staff and consumables on standby, and pushes other patients further down an already long waiting list. Because a cancelled case is difficult to replace at short notice, hospitals treat the cancellation rate as a sensitive marker of theatre efficiency and patient experience. Lean thinking and Six Sigma methodology, joined together as Lean Six Sigma, offer a structured and data-driven route for identifying the true reasons behind these cancellations and for building corrective measures that hold over time.

KEYWORDS: operating room utilization; same-day surgical cancellation; Lean Six Sigma; DMAIC; process capability; root cause analysis.

INTRODUCTION

The operating theatre is widely regarded as the financial and clinical heart of a modern hospital, since it draws together surgeons, nurses, anaesthetists, expensive equipment, and a steady supply of consumables into a single high-cost environment where every minute must be accounted for. When a case that has been booked is cancelled on the very morning it should have proceeded, the reserved time cannot easily be filled by another patient, because surgical preparation, admission, and pre-operative assessment all take considerable lead time. The result is idle capacity that still carries its full running cost, staff who remain on standby without a patient to serve, and a waiting list that grows longer for everyone else. [1]

Facilities that have studied this problem often describe cancellation rates in the range of several percentage points, a figure that translates into a substantial loss when theatre time is valued at a high cost per minute and when patients may wait many months for their appointment. For these reasons the reduction of avoidable cancellations has become a recurring priority for quality teams who wish to protect both the hospital budget and the trust of the people it serves. Against this background, the discipline known as Lean Six Sigma has gained a firm place in health services as a way of examining stubborn operational problems in a systematic manner rather than through guesswork or blame. The method invites teams to look at a process through the eyes of the patient, to gather evidence before proposing change, and to hold on to any gains they achieve by embedding them into daily routine. [2]

The Foundations of Six Sigma and Lean Thinking

Six Sigma began as a collection of techniques for improving industrial processes, first shaped by an engineer at Motorola during the early nineteen-eighties and later placed at the centre of corporate strategy by leaders at General Electric. At its core the philosophy seeks a level of quality so high that almost every opportunity to produce a feature is expected to be free of defects, an ambition captured by the statistical notion of holding the process mean six standard deviations away from the nearest limit of acceptability. The approach relies heavily on measurement, on statistical reasoning, and on a trained group of practitioners within the organisation who guide each project through a defined sequence of steps toward a clear target, whether that target is a shorter cycle time, lower cost, or greater satisfaction among the people the process is meant to serve. [3]

The sigma rating attached to a process describes how well it performs, and the guiding idea is to keep raising that rating over time; even a shift from a modest level toward a higher one lowers cost and lifts satisfaction long before the ideal is reached. Alongside this statistical tradition sits the Lean school of thought, which concerns itself above all with the removal of waste from any chain of production. The reasoning is direct: when waste is stripped away, more of the process delivers genuine value, output rises, and the benefit to the organisation grows accordingly. Lean

therefore trains attention on the many forms that waste can take and on the practical ways in which each form may be reduced or eliminated. [4]

Practitioners of Lean commonly speak of a set of distinct wastes that drain value from a process. Overproduction occurs when more is made than is needed, tying up raw material and storage. Defects force scrapping or rework at a cost in time and money. Waiting describes the idle periods when material, authorisation, or equipment is not ready. The waste of unused talent arises when the knowledge and judgement of staff are ignored by managers who work apart from them. Unnecessary transport and motion move materials or people without adding value and invite damage or injury. Excess inventory ages and risks obsolescence, while over-processing means doing more work than the task truly requires. Naming these categories gives a team a shared vocabulary for spotting inefficiency wherever it hides. [5]

When Lean and Six Sigma are brought together they form a balanced method that trims cost while sharpening quality, drawing the reduction of variation from one tradition and the elimination of waste from the other. The two share important common ground: both insist that the customer defines what counts as value, both lean on process maps to understand the flow of work, and both rely on data to decide where improvement is needed and to confirm that it has been achieved. Their differences are complementary rather than contradictory, since Lean brings a rich set of visual tools while Six Sigma contributes numerical and analytical strength, and a team that commands both has a wide instrument set at its disposal. [6]

The DMAIC Framework as a Roadmap

The most widely used structure within the Lean Six Sigma toolkit is the cycle known by the letters Define, Measure, Analyze, Improve, and Control. In the first stage the team sets out the system under study, listens to what the customer needs, and fixes the goals of the project in concrete terms. The measuring stage then captures the important features of the current process and gathers the data required to describe how it behaves at present. Analysis follows, during which the team investigates cause and effect, tests the relationships it suspects, and searches for the root of the defect under study. The improving stage turns findings into a redesigned process, often through piloting and mistake-proofing, and the controlling stage guards the new state so that any drift away from the target is caught and corrected before it can produce fresh defects. [7]

A project of this kind begins with the careful assembly of a team, since the people chosen must combine knowledge of the process with the authority to carry change through to completion. In a theatre cancellation project the team would typically include staff who understand booking, admission, anaesthetic assessment, and surgical scheduling, each of whom brings a distinct view of where the process falters. An opening meeting, often called a kick-off, distributes the roles clearly and sets the time frame for each assignment, so that every member leaves knowing precisely what is expected of them. Where the relevant records already exist within the hospital information system, as is usually the case with cancelled procedures, the team can move quickly to retrieve a year of history and begin shaping a precise statement of the problem. [8]

Framing the Process with the SIPOC Model

Early in the defining stage a team commonly builds a high-level map known as SIPOC, a title formed from the words Suppliers, Inputs, Process, Outputs, and Customers. The map traces a process from the suppliers who provide its inputs, through the steps that transform those inputs, to the outputs delivered to the customers who receive them. Because it deliberately avoids fine detail, the diagram gives everyone involved a shared and agreed picture of where the work begins and ends, and it lays the groundwork for the more detailed analysis that follows. It is often completed by naming the process and its outputs and customers first, and only then working backward to the inputs and their suppliers. [9]

The value of this simple tool becomes clear when a team is uncertain who supplies the inputs to a process, what those inputs must meet, who the real customers are, and what those customers genuinely require. By setting these elements down in an easily read format the team records its shared understanding, communicates it concisely to others, and agrees on the boundaries of what it will tackle. Practitioners frequently build the map during a brainstorming session, keeping the central list of process steps short and expressing each step as a plain action upon a subject, so that the diagram remains a clear overview rather than a tangle of detail. In this way SIPOC marks the point at which the defining stage of a cancellation project can be considered complete. [10]

Measurement and the Assessment of Process Capability

Once the boundaries of the process are agreed, the team turns to measurement, and here the process map is drawn in greater detail to show the true sequence of events without any attempt to correct or improve them at this point. A well-made map identifies the loops where work is repeated, the bottlenecks where flow is choked, and the inputs that feed each step, and it sorts activities according to whether they add value, add value only to the business, or add no value at all. Because several steps may unfold at the same time and may cross the boundaries of more than one unit, the map

must capture every contributor honestly, since the changes proposed later will rest upon this faithful description of what actually happens. [11]

With the process mapped, the team examines its statistical behaviour through the idea of process capability, a measure of the ability of a process to produce results within stated limits on a consistent basis. Indices such as the capability index and the centred capability index compare the natural spread of the process against the limits set for it, telling the team both whether the process can meet its specification and whether it sits comfortably in the middle of the allowed range. A memorable way to picture this is a vehicle crossing a bridge, where the width of the vehicle stands for the spread of the data and the guardrails stand for the specification limits; the narrower the vehicle relative to the bridge, the safer the crossing and the more capable the process. [12]

These capability calculations rest on a few assumptions that a careful team must respect, namely that no special causes of variation remain uncontrolled, that the data follow a reasonably normal distribution, and that the sample truly represents the wider population from which it is drawn. When these conditions hold, the indices give a trustworthy reading of how the process is performing and how much room exists for improvement, and monitoring them over time allows the team to adjust the process so that its output continues to meet the requirements placed upon it. In this sense capability analysis is not merely a single calculation but one instrument within the broader practice of statistical process control, through which waste is reduced and quality is protected. [13]

To carry out these statistics many teams rely on dedicated software, and a widely used package of this kind automates the calculations and the drawing of charts so that the user can concentrate on interpreting the results rather than on arithmetic. Among the displays such software produces is the proportion chart, which monitors the share of nonconforming units in a sample and suits a simple pass-or-fail judgement of the kind that a cancelled or completed case represents. By plotting the monthly proportion of cancellations against control limits, a team can see at a glance whether the process is stable, whether it is drifting, and whether the changes it later introduces have moved the figure in the desired direction. [14]

Setting Priorities through Pareto Analysis

When the reasons behind a problem are numerous and varied, a team cannot sensibly attack all of them at once, and it must find a way to concentrate its effort where the return will be greatest. The principle that guides this choice traces back to the observation that a small share of causes tends to account for a large share of effects, a pattern first noticed in the distribution of wealth and later found to hold across many fields of quality. Expressed as a rule of thumb, roughly one fifth of the sources give rise to about four fifths of the problems, so the task of the team is to separate the vital few causes from the trivial many and to direct its energy toward the former. [15]

The chart that displays this principle arranges the causes in order of their frequency so that the most important stand out immediately, and it is a natural companion to a quality improvement project because it turns a long and discouraging list into a clear set of priorities. In a theatre cancellation study such a chart might reveal that a handful of services account for the majority of cancelled cases, or that a small number of reasons, such as medical unfitness, cancellation by the patient or family, rescheduling, failure to attend, and breach of fasting instructions, together make up the bulk of the total. Once these dominant causes are identified the team knows exactly where to dig deeper, confident that success against them will move the overall rate substantially. [16]

Reaching the Root Cause with the Five Whys

Having chosen the causes worth pursuing, the team seeks to understand why each one arises, and a favoured instrument for this purpose is the repeated questioning technique in which the word why is asked again and again until the underlying reason surfaces. Each answer becomes the basis of the next question, and the name of the method reflects an observation that around five such iterations often suffice, though the true number depends on the problem rather than on any fixed rule. The technique was developed within a major motor manufacturer and has since spread far beyond its origin into wider quality practice, where it is valued for its simplicity and for the way it discourages a team from settling for a superficial explanation. [17]

It is worth noting that a problem need not always yield to a full five rounds of questioning, and a team may reach the root after only one or two, just as it may sometimes need to follow more than one line of enquiry because a single problem can have several roots. In a cancellation project the questioning might reveal, for a category such as medical unfitness, that patients arrived with fever or respiratory infection, that cardiology clearance had not been obtained in time, or that laboratory results were unready, and each of these findings points toward a different corrective action. Because the method offers no rigid rules about which questions to pursue or how long to continue, its success depends greatly on the knowledge and persistence of the people who apply it. [18]

Designing and Testing Improvements

The improving stage converts the understanding gained from analysis into concrete recommendations, each assigned to a named member of the team together with a time frame and a duty to report back when the action is complete. For causes rooted in the hospital system, such as gaps in anaesthetic assessment or the late request of specialist clearance,

the remedies tend to be procedural: capturing a patient health check during a telephone call made a day before surgery, tightening pre-admission review, clarifying the handling of medication that affects bleeding, and ensuring that necessary results are addressed before the day of operation. Such measures speak directly to the mechanisms that generate the defect and can therefore be expected to move the rate once they are reliably in place. [19]

For causes that lie with the patient or the family, such as cancellation on the day, failure to attend, or arrival without proper fasting, the remedies lean toward communication and policy, including a requirement that cancellations be notified well in advance and the consistent application of a policy addressing non-attendance. Experience shows that system-related causes often respond quickly and visibly to well-designed action, whereas causes rooted in patient behaviour prove more stubborn and may even resist the first attempt, obliging the team to revisit its recommendations and place greater emphasis on engaging patients and their families in keeping their appointments. This willingness to adjust the plan in the light of early results is itself a mark of a disciplined improvement effort rather than a sign of failure. [20]

Holding the Gains through a Control Plan

No improvement project can be considered finished until the team has secured its gains against the natural tendency of a process to drift back toward its former state, and this is the purpose of the control plan prepared during the closing stage of the cycle. The plan is a written summary that lays out each step of the process, names the parameters that must be kept within bounds, and describes the corrective action to be taken should a measure stray outside its limits. It assigns responsibility for each activity, provides a single point of reference for the standard operating procedure, and is kept up to date as the process evolves, so that the specialist overseeing quality can tell at any moment whether the process remains on track and can intervene promptly if it does not. [21]

The closing stage carries a number of practical obligations that a careful team will not neglect, among them the naming of a process owner, the involvement of the whole team in shaping the plan, the preparation of fresh work instructions, and the training of the staff whom the changes affect. In a cancellation project the control plan might set a threshold on the cancellation rate to be reviewed at regular intervals, require a root cause analysis whenever the figure exceeds that threshold, and demand full compliance with the new steps introduced into the process, with any lapse reported to the head of the department concerned. By tying responsibility to measurable indicators in this way, the team ensures that the improvement it worked to achieve becomes part of the ordinary running of the theatre rather than a temporary success that fades once attention moves elsewhere. [22]

The Wider Context of Quality and Equity

Projects of this nature do not stand apart from the broader mission of a health service, since the efficient use of theatre time is ultimately a matter of serving patients well and fairly. A health system worthy of the name provides care that is safe, effective, and equitable, delivered to the patient at the right time and centred upon that patient rather than upon the convenience of the institution. When a hospital reduces avoidable cancellations it does more than protect its budget: it shortens the wait for those who need surgery, honours the effort that staff invest in preparing each appointment, and reduces the frustration that a cancelled operation inflicts on patients and families alike. In this light a quality project becomes an expression of the same values that guide good clinical care, and the discipline it demands serves the patient as surely as it serves the balance sheet. [23]

CONCLUSION

Same-day cancellation of surgery is a familiar and costly drain on operating room utilisation, yet the experience gathered here suggests that it is far from an intractable one, since a structured Lean Six Sigma approach can expose its true causes and guide practical remedies that hold over time. By defining the problem clearly, measuring the current process honestly, analysing the dominant reasons through tools such as Pareto ranking and repeated questioning, improving the process with targeted and accountable actions, and controlling the result through a well-kept plan, a team can turn a discouraging cancellation rate into a manageable and measurable target. The lessons that emerge extend beyond the numbers, for they show that many cancellations rest on nothing more than a failure of communication and commitment that a thoughtful process can correct, and that the success of any such effort depends above all on teamwork, on the closeness of management to frontline staff, and on the willingness to adjust a plan in the light of what the evidence reveals; taken together these lessons offer a hopeful message to any hospital that wishes to make better use of its most valuable clinical resource while serving its patients more fairly and more promptly. [24]

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