Rapid Decision Support

A product of the Contextualized Health Research Synthesis Program
Newfoundland & Labrador Centre for Applied Health Research

Improving Operating Room Performance to Address Joint Surgery Backlog

An Evidence Scan for Multiple Strategies and Approaches

This evidence scan focuses on a range of strategies to improve operating room performance, including capacity, utilization, efficiency, and patient flow with the goal of treating the backlog of patients waiting for joint surgeries. The summary consists mainly of research-based evidence syntheses, but also includes primary research, best practices, and gray literature. The results are categorized by type of strategy, based, in part, on a living evidence synthesis [1] produced by New South Wales Government's Critical Intelligence Unit, cited below.

This report provides information relative to the following categories:

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[1] Living evidence synthesis or living evidence systematic reviews are high quality, continuously updated, online summaries of research-based evidence. They are intended to be used by health system administrators and decision makers, and adhere to high standards of scientific practice and communication. For more information, see: Elliott JH, et al. (2014) **Living Systematic Reviews: An Emerging Opportunity to Narrow the Evidence-Practice Gap**. PLoS Med 11(2): e1001603. LINK

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Reviews of Multiple Strategies

Living Evidence Synthesis

Agency for Clinical Innovation. **Approaches to reduce surgical waiting time and waitlist**. New South Wales Government, Critical Intelligence Unit. Last updated on 20 Nov 2023 ([LINK](#))

- "**This living table lists strategies identified in the peer-reviewed and grey-literature with evidence of feasibility and an association with a reduction in waiting times and hospital procedure waiting lists**. Literature on surgery waiting time management comprises mostly observational or descriptive studies and lacks robust randomized controlled trials or rigorous comparative studies. However, within the context of health policy research, observational studies are often considered to provide acceptable evidence of effectiveness."

- **The table includes**: Strategies, Evidence on effect, Levers for and influencing factors on effectiveness

- **Strategies discussed in the table include**: increasing supply, managing demand, waitlist management, perioperative management, treatment space management, operating theatre efficiency, postoperative management, performance management

- **Defining policy and intervention effectiveness**: an association with an improvement (either as a standalone or bundled intervention) in direct indicators of waiting time and waitlist, i.e. time to surgery and size of the waiting list; or indirect indicators such as referral rates, cancellation rates, no-show rates, operating room efficiency, bed occupancy, length of hospital stay and early discharge. Policy effectiveness can also be defined as "**the extent to which a policy is able to give affect to its stated goals**", quoted from: Azad Singh Bali, Giliberto Capano & M. Ramesh (2019) Anticipating and designing for policy effectiveness, Policy and Society, 38:1, 1-13 [LINK](#)
  - Abstract: "The new design orientation in the policy sciences has placed renewed emphasis on problem-solving and developing effective public policies. In this paper, we contribute to this scholarship by presenting a policy framework on anticipating effective policies. **We argue that anticipation – that is, foreseeing the future and preparing for it – must be central to how a policy is designed, executed and assessed. Anticipating policy effectiveness requires a careful understanding of the problem and its root causes, as well as selection and utilization of the most 'appropriate' policy instrument(s) to solve it**. We consider 'appropriateness' along three dimensions – analytical, political and operational – in two different respects: choice of policy tools and the capacity of the implementing agency."

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Overviews

Kreindler SA. **Policy strategies to reduce waits for elective care: a synthesis of international evidence**. Br Med Bull. 2010;95:7-32. ([LINK](#))

- Synthesis (103 reports), older but seems to be the basis for more recent evidence), **waits for elective care**
- "This synthesis seeks to assess and explain the effectiveness of wait-related policies. It considers the available evidence on each intervention's efficacy in reducing wait times/lists, ease of implementation, costs, harms and implications for equity."
- **Sections include:**
  - **Supply-side strategies**
    - Increasing activity directly
    - Increasing capacity (increasing capacity within the public system, obtaining capacity from abroad, obtaining capacity from the private sector, encouraging private capacity that is privately financed)
    - Using existing capacity more efficiently
    - Redistributing patients through choice
  - **Demand-side strategies**
    - replace rationing by queuing with rationing by prioritization
    - prioritization without rationing
    - eliminating inappropriate care
  - **Global strategies to influence local organizations**
    - Targets and guarantees
    - Targets versus internal markets
    - Refining target policies
    - Information and reporting
- **Discussion:**
  - "**The available evidence suggests that more direct strategies are more effective**. Paying for treatment activity, buying capacity locally to support increased treatment and providing strong incentives for organizations to meet wait-time targets are demonstrated strategies for reducing wait times. There is **also evidence that the use of existing capacity can often be greatly improved,** and further research is urgently needed to determine how best to accomplish this. **Limiting demand by expelling lower-priority patients from the wait list can also be an impactful strategy; however, it is ethically problematic.**"
  - "Direct approaches to wait-reduction are not easy; they may require significant financial investment (e.g. paying for activity, developing local capacity), strong regulation to prevent adverse effects (e.g. targets and incentives, buying capacity from the private sector), and/or tireless efforts to disseminate and support best practices (e.g. promoting efficient service design). **However, indirect approaches, because of their limited effectiveness, often cost more than they save**."

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Waddell, Bhuiya et al. **Rapid evidence profile #45: What is known from evidence and from experiences in other jurisdictions about how to effectively and efficiently improve wait times for scheduled (elective) surgical services?** Hamilton: McMaster Health Forum, 22 December 2022. (LINK)

- "Question **What is known from evidence and from experiences in other jurisdictions about how to effectively and efficiently improve wait times for scheduled (elective) surgical services?**"
- "**What we found** …we identified evidence, as well as experiences from five countries (Australia, Denmark, Ireland, New Zealand, and the U.K.) and all Canadian provinces and territories".
- "We organized our findings using the framework below, which was adapted from a rapid evidence profile completed earlier this year on increasing out-of-hospital capacity for elective surgeries. **Note that the health human resource crisis that has contributed to the problem and the policy solutions that are being put in place to address the crisis were considered out-of-scope for this rapid evidence profile**."
- Organizing framework:
    - **Changes to how elective surgeries are financed by adjusting**:
        - what organizations can be commissioned to provide elective surgeries (or services required before or after)
        - funding to organizations
        - provider remuneration
    - **Changes to how elective surgeries are delivered (or to the services needed before or after) by adjusting**:
        - referral requirements for the surgery
        - who is prioritized for the surgery and how this prioritization is determined
        - by whom the surgery (or the services needed before or after) is provided
        - where the surgery (or the services needed before or after) is provided
        - when the surgery (or the services needed before or after) is provided
        - with what supports the surgery (or the services needed before or after) is provided
- "**A detailed summary of the evidence is provided in Table 1, while experiences from other countries and from Canadian provinces and territories are provided in Table 2 and 3, respectively.**"

Scoping Reviews

Bachelet et al. **Policy strategies to reduce waiting times for elective surgery: A scoping review and evidence synthesis**. Int J Health Plann Manage. 2019 Apr. (LINK)

- "**Objectives**: …to identify and describe the interventions that have been implemented to reduce waiting times for major elective surgery."
- **Research Question**: "Which are the most effective interventions for reducing the waiting times of adult patients on waiting lists for major elective surgeries"

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- "Of the included studies, 83% refers to interventions on the supply side and concern the public health system. **The clinical specialties reported were heart surgery, obstetrics and gynecology, neurosurgery, ophthalmology, orthopedics, and pediatrics (Table 1)**"
- "**The included studies show significant variability regarding elective procedures, population, and type of provider, as well as in the characteristics of the interventions and the settings. All the studies had methodological limitations. We graded the certainty of the evidence as very low**."
- **Options to approach the problem of wait times**
    - "**We found no studies evaluating the effectiveness of several interventions of interest to the commissioning officers, such as mechanisms of payments to professionals, regulation of dual practice, or regulation of the work schedules of health personnel. We did find studies that assessed interventions such as supplemental funding to crank up capacity, management of surgical pathways, and prioritization of patients on waiting lists**"
    - "The remit for this evidence synthesis was focused on finding studies that included interventions of interest to our commissioning officers and that would include specified outcomes assessed with a scientific methodology. **In discussion with our counterpart, four options were defined:**
        - **Option 1: Increased funding.**
        - **Option 2: Surgical pathways and restructuring of the referral process.**
        - **Option 3: Score-based prioritization strategies.**
        - **Option 4: Policies to induce the take-up of private health insurance**
- **Discussion**
    - "The interventions described in the different studies that we included for this report are heavily dependent upon country context. It was not possible to summarize them in general categories without losing information on the different components that were deployed with the purpose of reducing waiting times and waiting lists. Ultimately, they were all interventions of a compound nature with multiple components, and it was not possible to extract from the papers' reports specific characteristics that explain the success or the failure of what was done"
    - "**To implement specific mitigation measures of the waiting time problem of patients scheduled for major elective surgery procedures, it is fundamentally necessary for the waiting lists to reliably reflect the reality**"
    - "According to the evidence found for this review and according to the international experience that is reported in the literature on the attempts to reduce and manage the problem of waiting times of patients scheduled for major elective surgery, **the interventions must most likely be multidimensional, with prioritization strategies on the waiting lists to incorporate equity criteria, together with quality management improvements of the surgical pathways and the use of operating rooms, as well as improvements in the planning of the surgical schedule**."
- **Recommendations:**

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- o "above actions must be coupled with **supplemental funds** to bolster an increased hospital productive capacity, including not only infrastructure but also human resources"
- o "Some of the interventions also included **setting up hospital annexes or special wards devoted exclusively to resolving low complexity surgeries**. These additional facilities should be located within the same hospital."
- o "have a **dedicated operating room for emergency or semi-emergency surgeries** to ensure that the operating rooms dedicated to the elective procedures can carry out their workload unhindered. In countries in which access guarantees have been incorporated, this macroregulatory measure has been associated with reduced waiting times for the patients covered by prioritized conditions, but only to the extent that additional funds have been allocated"
- o "further studies should be conducted to explore the potential implementation barriers in our national context regarding interventions to reduce the waiting times of patients who require major elective surgery, with a focus on the local considerations and engaging the different actors involved, including the viewpoint of the patients and the organized communities"

Stafinski et al. **Reducing wait times to surgery—an international review**. Journal of Hospital Management and Health Policy. September 2022. (LINK)
- Interviews with key informants across Canada (32 interviews) and Scoping Review (92 articles + 242 grey literature documents) on **approaches implemented to reduce wait times** from the decision to perform surgery to the actual surgical service (wait time 2)
- **Aim**: "to describe approaches used in Canada and internationally, targeting wait times from the decision to treat to surgery (wait time 2)."
  - o "wait times were defined as the time from decision to perform surgery to when the surgery takes place"
- 33 approaches targeting wait time plus 2 identified in interviews and the literature
  - o "24 were supply-side strategies, 5 were demand-side strategies and 4 targeted both supply and demand. Fifteen approaches had consistent or limited but promising evidence supporting their effectiveness."
- **Strategies listed by strength of evidence** (please see article for further detail)
  - o **Strategies with consistent positive evidence of effectiveness:**
    - ▪ *Supply Side Approaches:* Expanded roles for non-physicians, Process improvement methodology (e.g., LEAN, Six Sigma or both), Publically funded, privately delivered services, Same-day surgery and discharge, Standardized treatment pathways, Streamlined pre-admission process, Targeted funding
    - ▪ *Demand-side approaches:* Prioritization of patients, Regular validation of wait lists
  - o **Strategies with limited but promising evidence of effectiveness:**

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- - **Supply Side Approaches:** Centralization of elective surgeries, Centralized surgical scheduling, Efficient use of ORs, Family doctors-led surgeries, Fast-track programs, Patient choice
  - **Strategies with mixed evidence of effectiveness:**
    - **Supply side approaches:** Mobile surgical clinics, Organization incentives
    - **Supply and demand approaches:** Wait time targets
  - **Strategies where no information on impact was found at this time:**
    - **Supply side approaches:** Appointment reminders for surgeries, Cancellation lists, Flex days, Innovative surgical approaches, No-show policies, Procedure rooms
    - **Demand-side approaches:** Subsidies for private health insurance or privately funded health insurance, Wait list management policies
    - **Supply and demand approaches:** Operations research and resources planning tools, Public reporting of wait times
  - **Strategies that were implemented alongside other approaches so not possible to determine if they had an impact:**
    - **Supply side approaches:** Pre-habilitation clinics, Provider incentives
    - **Supply and demand approaches:** Ongoing monitoring, analysis, and reporting of wait times and other outcomes data
  - **Strategies with consistent negative evidence of effectiveness**
    - **Supply side approaches:** Privately funded, privately delivered services
    - **Demand-side approaches:** Patient-targeted appropriateness initiatives
- **Discussion: "The most effective policies were those comprising multiple supply and demand strategies targeting the whole patient pathway**. They required collaboration between policymakers and healthcare providers, investment and even regulation changes"
- **Conclusions: "**This study identified eight different strategies with consistent positive evidence of effectiveness in reducing the wait time for elective surgeries and an additional six strategies with more limited but promising evidence of effectiveness. The approaches reviewed reduced referral times by affecting supply, demand, or both."

Systematic Reviews

Okolie et al. **A rapid review into innovations to address the surgical backlog as a result of the COVID-19 pandemic**. RR_00008. RR_00008. Wales COVID-19 Evidence Centre. November 2021. (LINK)

- **Aim:** "Following discussion with stakeholders regarding the Welsh context, we chose to focus on evidence for supply-side service delivery innovations to help reduce the backlog that would be relevant to adult orthopaedic patients on a surgical waiting list."
- **"Evidence of effectiveness**
  - There is evidence to suggest that supply-side interventions including **Lean and Six Sigma** methodologies, redesigning of elective surgery pathways, and allocation of additional resources are effective at improving waiting times, throughput, and other operating theatre performance outcomes Lean and Six Sigma methodologies could decrease

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waiting times, turnaround times and turnover times, they may also improve patient satisfaction (n=4 studies, all serious risk of bias)

- o The content of pathway/service reconfigurations varied across studies, but they appeared to improve throughput and other operating theatre performance outcomes. They may also improve patient 'acceptability' of waiting time (n=8 studies, all serious risk of bias)
- o Allocation of additional resources was effective at reducing wait time and increasing frequency of surgical procedures including additional funding or staff and equipment (n=4, two serious and two moderate risk of bias) Structured surgical registrar-based interventions to improve operating room efficiency may reduce changeover times and minimise delays (n=1, moderate risk of bias)"

- **"Policy Implications** Potential changes to reduce wait times to address the surgical backlog should consider a multi-component approach acknowledging local context Lean and Six Sigma methodologies, reconfiguration of the surgical pathway and the provision of additional resources could be considered as part of the multicomponent approach Further research and evaluation of strategies introduced to address the backlog from the Covid-19 pandemic is needed to inform ongoing policy decision-making in this area."

- **"Strength of Evidence** Most of the evidence identified was derived from non-randomised uncontrolled before and after studies with serious methodological limitations and risk of bias. Complex interventions make it hard to distinguish individual component effects. **Evidence identified in this rapid review is from studies conducted before the COVID-19 pandemic, and it is uncertain if interventions that were effective in relatively 'normal' circumstances will be as successful during/post pandemic.**"

Rothstein & Raval. **Operating room efficiency**. Semin Pediatr Surg. 2018 Apr;27. ([LINK](#))

- "This review will examine the major industry lessons that have been applied to healthcare, look at some successful approaches to increasing efficiency, discuss some of the challenges particular to pediatric surgery, and make some recommendations for consideration by individuals interested in improving any aspect of OR efficiency."

- **Includes sections on:** Operating room complexity, Metrics of OR efficiency (**off-hours surgery, same-day cancellation rate, first case start-time accuracy, or use, percentage of unplanned closures, case duration accuracy, turnover time, excess staffing cost**), Approaches to evaluating the OR process, the preoperative phase, the intraoperative phase, the postoperative phase, Industry streamlining processes (**Lean, Six sigma, Lean six sigma, theory of constraints, TeamSTEPPS** (Team Strategies and Tools to Enhance Performance and Patient Safety)

- Give a list of Recommendations for -
  - o 1. **Pre-operative phase** (pre-operative process, OR scheduling, admission process for outpatients, inpatients)
  - o 2. **Operative phase** (case carts and preference cards, supply chain/storage, OR)
  - o 3. **Post-operative phase** (turnover time, parallel processing, discharge pathways)

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- o 4. **OR general** (OR management, OR staff engagement, incentives)
- **"Conclusions: In the end, all OR efficiency has a local component, and while many strategies discussed in this manuscript are generalizable, each institution must review its particulars and adapt these strategies. It is helpful to foster a team attitude through active engagement of all relevant stakeholders – at least including surgery, anesthesia, nursing, OR management, and other administration. – Regularly scheduled release of data can maintain transparency and encourage participation of key stakeholders**. More work remains to prove the value and sustainability of any of the multiple business methodologies currently being applied in healthcare."

Other Reviews

Nagase FN, Stafinski T, Brindle ME, White J, Young A, Beesoon S, Cleary S, Menon D. **Reducing the wait for surgical consultation—what works and what doesn't?—a review of selected countries in North America, Europe and Australasia**. Journal of Hospital Management and Health Policy. 2022 Sep 25;6. LINK

- From abstract: "The purpose of this study was to present and discuss approaches implemented in several countries targeting wait times from referral to first appointment with a surgeon (wait time 1). This was part of a health evidence review to identify approaches used to reduce elective surgical wait times."
- "The 9 approaches with consistent evidence of effectiveness were: Central intake, Expanded role for non-physicians, Patient choice, Standardized referral forms, Specialist advice requests, Expanded role for family doctors, Process improvement methodology, Remote consultations, and Fast track programs."

Lee et al. **Improving Operating Room Efficiency**. Curr Urol Rep. 2019 (LINK)

- Review, OR costs, metrics, efficiency, value of surgical care
- "In this article, we will evaluate operating room costs, define some of the metrics used to evaluate operating room efficiency, and examine some innovative techniques to improve the value of surgical care."
- **Includes sections on:**
  - o **Costs of care in the operating room**,
    - "is essential to identify areas to improve efficiency and decrease unnecessary costs throughout the continuum of surgical care, from the preoperative, intraoperative, and postoperative management."
  - o **Operating room efficiency metrics**,
    - "**There is no single metric or series of measures that have been standardized and tested to best evaluate efficiency in surgical care.** However, there are several multiple proposed metrics that have been frequently reported and measured. Common measures include Procedure cancelation rate, First case start time, Operating room utilization, Percentage of unplanned closure, Case duration accuracy, Operating room turnover time, Off hours surgery.

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- o **Unexpected surgical cancelations**,
  - ▪ "Cancelations are generally placed into three categories: representing hospital-related causes, patient factors, or surgeon/staff factors"
  - ▪ **Interventions in literature addressing root causes of surgical cancelation**: "establishing a formalized preoperative anesthesia clinic, to phone calls from nursing staff, to machine learning algorithms to identify patients that are high risk for cancelations."
- o **First case start time**
  - ▪ "The most common causes for delays in the first case include surgeon/staff unavailability, delayed patient registration, congestion in the preoperative areas, and transportation issues"
  - ▪ **Interventions**: "Multimodal approaches using methodology from industry, such as **Six sigma and Lean, and financial incentives** with improved communication can significantly reduce delayed first case starts."
- o **Case duration accuracy**,
  - ▪ "One novel innovation to address this problem is the use of machine learning and artificial intelligence. By leveraging the available patient demographic data, pre-surgical milestones, and hospital logistics available through the electronic health records, a machine learning algorithm can reduce overall scheduling inaccuracy by 70%"
- o **Operating room turnover**,
  - ▪ "In order to improve operating room turnover time, it is essential to involve all the relevant stakeholders, align the proper incentives, and eliminate wasteful steps as much as possible."
- o **Intraoperative interventions**.
  - ▪ "Process mapping of surgical procedures can improve intraoperative efficiency by outlining every step of the procedure with the whole surgical team to decrease staff uncertainty and improve anticipatory involvement"

Meneghini RM. **Techniques and Strategies to Optimize Efficiencies in the Office and Operating Room: Getting Through the Patient Backlog and Preserving Hospital Resources**. J Arthroplasty. 2021. ([LINK](#))
- • Review, techniques and strategies to optimize efficiencies in the office and OR
- • **Aim**: "article outlines multiple strategies and techniques to develop and optimize efficiency in the hip and knee arthroplasty practice."
- • Includes sections on:
  - o Strategies for Efficiency in Practice and Within the Office
  - o Strategies to Optimize Surgical Efficiency
- • **Conclusion**: "Future considerations to enhance efficiency should critically evaluate whether surgical improvements and technology truly add value or decrease efficiency by introducing wasteful time or expense. There are a number of technologies or procedural efficiencies that must be critically assessed in the COVID era. Is the well-documented increase in surgical time

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associated with robotic assistance during partial and total knee arthroplasty offset with any true clinical value? Is performing a total hip arthroplasty through a direct anterior approach worth the well-documented increased surgical time and inefficiency? Can certain patients undergo total knee arthroplasty with uncemented fixation and obviate the need to "waste" ten minutes per procedure allowing cement to cure? Does every patient require the additional resources and time required to resurface their patella in a routine primary total knee arthroplasty if the native patella tracks perfectly and has intact cartilage with minimal damage? These issues should continue to be studied and evaluated for their true value and may further enhance efficiency in the care of the hip and knee arthroplasty patient."

Primary Research

Quercioli et al. **Reducing waiting times of elective surgical procedures: effectiveness evaluation of a multi-interventions approach**. Ann Ig. 2022 Nov-Dec. ([LINK](#))

- Primary study, pre-post approach evaluation, **reducing waiting times of elective surgery**
- **Aim:** "to evaluate the effectiveness of a multidimensional intervention in reducing waiting times for elective surgery."
- "**Methods**: In a district general hospital (Italy) with three elective surgery operating rooms open 6 hours/day, 5 days/week (surgery specialties: general surgery, orthopaedics, gynaecology and urology), a project for reducing surgery waiting times was implemented in October 2018. The project focused on three aspects: i) separation of the flow of day surgery from that of ordinary surgery; ii) increasing available operating time by reorganizing the staff; iii) allocation of operating sessions flexibly in proportion to the waiting list."
- "**Results**: Waiting times for non-high-priority cases shortened significantly for all specialities (p<0.01), except for urology. **For general surgery, orthopaedics and gynaecology, mean waiting times for day surgery decreased from 198 to 100 days (-50%) and for ordinary operations from 213 to 134 days (-37%). Waiting times for high-priority cases also shortened**."
- "**Conclusions:** Our multidimensional project based on reorganization of staff and facilities and on improved scheduling proved effective in reducing waiting times for elective surgery."

Gray Literature

British Columbia Government. **Surgical Renewal Year-End Progress Report: April 1, 2022 – March 31, 2023**. BC Gov Department of Health, May 2023. [LINK](#)

- Report reviewing the initiatives to address surgical backlog caused by the pandemic. The BC Minister of Health notes that: "B.C. delivered over 350,000 surgeries – the most surgeries ever recorded in our province in a single year. This on top of 2021-22, when we delivered over 337,000 surgeries, itself a record. We have not only delivered on our commitment to deliver postponed surgeries, but we have completed more surgeries overall than we did prior to surgical renewal. What this means is clear: Innovation works. Finding new methods, approaches, and facilities works. Individual and collective action works. All these are critical parts of surgical renewal and, put simply, surgical renewal works."
- Categories of innovation:

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- o Prioritizing and Completing Postponed Surgeries
- o Performing More Surgeries
- o Decreasing the Waitlist Size
- o Increasing Surgeries
- o Extending Operating Room Hours
- o Increasing Essential Personnel
- o Training/Recruitment
- "In this report, the surgeries postponed between March 16 and May 18, 2020, are referred to as "Patient Cohort 1", the surgeries postponed between November 20, 2020 and June 11, 2021 are referred to as "Patient Cohort 2", and the surgeries postponed between June 12, 2021 and February 4, 2022 are referred to as "Patient Cohort 3".

Blythe & Ross. **Strategies to reduce waiting times for elective care: Full literature review findings. National Institute for Health and Care Research Programme**. Dec 2022. LINK
- Non-systematic literature review and interviews with 14 key experts, **reduce waiting times for elective care**
- "The study aimed to explore the following
  - o What approaches have been used in England and elsewhere to reduce wait for elective care?
  - o What were the short and longer-term impacts of these approaches?
  - o What learning has there been from those approaches about how to maximize impact and value for money?
- **Supply-side factors**
  - o "Factors within this category are mainly affected by funding and investment in health and social care services to ensure there is sufficient capacity to meet demand. This capacity takes account of the size and composition of the health and care workforce as well as the number of available beds, equipment, facilities and technology to deliver health care."
- **Demand-side factors**
  - o "Demand for health care is influenced and mediated by a range of factors: on the one hand, the health care needs of a population and their propensity to seek treatment to meet these needs; on the other hand, the availability of treatments for patients, the thresholds/criteria for administering these treatments, and attitudes and approaches of health care professionals to make referrals for onward treatment."
- **Factors impacting the management of waiting lists and waiting times**
  - o Operational and practical factors: " that help or hamper the smooth running of the processes in place to deliver health care. This includes: the arrangement and composition of patient treatment pathways, including the interconnections and 'hand-off' points between different services and parts of the system; the collection and use of waiting times data to understand potential 'pinch-points' and minimise waste; the processes in place to process referrals, book appointments, prioritise patients and issue

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reminders; and the allocation of roles and responsibilities across different members in the health care workforce"

- **Caveats of the evidence**
  - o "Evidence base is overall is weak"
  - o "Commonly it was not possible for studies to make any causal links or claims between design/implementation and outcomes – only to draw associations"
  - o "**bulk of the evidence focused on initiatives to reduce waiting times rather than waiting lists** – as waiting times are deemed to be the more reliable measure of the size of excess demand in relation to the available supply"
- **See individual sections the review evidence on**
  - o **Increasing supply** (additional funding, use of the private/independent sector, expanding the workforce, treating patients overseas)
  - o **Managing demand** (changing the categories/thresholds for adding patients to a waiting list for elective care, review/standardization of referral criteria, active waiting)
  - o **Activities affecting the culture and environment of a health system** (max waiting time guarantee for patients/targets for providers, remuneration of providers and/or staff for activity to reduce waiting lists/waiting times, patient choice of provider, workforce engagement)
  - o **Operational and practice actions** (granular collection and analysis of waiting list/waiting times data, validation of waiting lists, quality improvement and pathway/process efficiencies, changes to the referral process, one stop shops/pooled waiting lists, patient reminders, expanded/extended use of existing facilities, separating elective and urgent/emergency activity, automated booking of appointments, waiting list prioritization, expanding roles/multidisciplinary treatment, different models of care

Campbell G, Speer S. **Surge capacity: how to address Ontario's medical backlog.** Ontario: ON360; 2022. LINK
- "Ontario 360 collaborates with senior Ontario policymakers to identify issues of importance to the government. It then commissions independent policy experts and practitioners to produce research, analysis, and policy recommendations to contribute to the government's internal policy planning and development. The goal is to facilitate productive engagement and to contribute to evidence-based policy-making in the Province of Ontario."
- Summarizes the then-current situation of backlogs, the steps taken by the Ontario government already, and additional steps that could be taken based on an environmental scan of other provinces.
- Steps Ontario had already taken:
  - o "More dedicated funding for hospitals to increase surgical volumes, diagnostic imaging, and capacity, including extending operating room hours for surgeries during evenings and weekends and more hours for MRI and CT scanning.
  - o "Grants through the Surgical Innovation Fund that are intended to increase surgical capacity in specific regions by overcoming unique local bottlenecks such as operating

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room nurse training, lease costs for new locations, dedicated specialized operating facilities, and acquiring surgical equipment and technological supports.

- o "Additional funding, engagement, and licensing of Independent Health Facilities[29] to leverage their capacity for increased volumes of low-risk, publicly-funded services such as cataract surgery, MRI/CT scans, and insured plastic surgeries.
- o "Centralized surgical wait list management to reduce wait times by using technology and more efficient administration.
- o "Measures to increase cancer screening, streamline referrals, and improve virtual post-surgical care and transitions to rehab/home care."
- The report goes on to include private sector capacity in the following provinces: British Columbia, Alberta, Quebec, Saskatchewan.
- Conclusion:
  - o "These other provincial examples (which span the political spectrum) also suggest that drawing on private resources (including facilities and personnel) can provide a "surge capacity" to help patients get the care that they need in a timely and cost-effective way."
  - o "Partnering with the private sector to deliver more publicly-funded surgeries is a means for the Ontario government to reduce the current backlog both faster and at lower cost. It would also help to address the systemic wait lists and wait times that existed well before the pandemic. Such surge capacity could, in other words, have short- and long-term benefits for Ontario's health-care system and the overall health and well-being of Ontarians."

Department of Health, Government of Ireland. **2023 Waiting List Action Plan**. Government of Ireland, 2023. LINK

- Mentions short term strategies to address wait list but focuses on multi-annual strategies to address wait lists (see Section 2.2 A Multi-Annual Approach to Addressing Wait Lists)
- Has a brief jurisdictional scan of other European countries' approaches (see 2.3 International Approaches to Reducing Waiting Lists), as well as an appendix providing more details to those countries' strategies (see Appendix (II): International Research).
- Section 5 2023 Waiting List Projections, Targets and Funding, includes information on:
  - o 5.1 Waiting List Additions and Removals in 2023
  - o 5.2 Projected Action Plan Activity and Expenditure in 2023
  - o 5.3 Reform Funding and Activity in 2023
- Section 6 2023 Actions to Reduce and Reform Waiting Lists and Times, includes information on:
  - o 6.1 Delivering Capacity in 2023
  - o 6.2 Reforming Scheduled Care
  - o 6.3 Enabling Scheduled Care Reform

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Reed S, Schlepper L, Edwards N. **Health system recovery from Covid-19: International lessons for the NHS**. Nuffield Trust: Research report March 2022. LINK

- "This report uses interviews with medical directors, academics and policy-makers across 16 different countries alongside a structured policy analysis of each of those countries to understand how each has approached system recovery."
- "Health systems are pursuing a range of common strategies to quickly catch up on care backlogs and reform services to better prepare for future shocks. These include outsourcing care to private hospitals, extending clinical hours of care, scaling up remote and home-based services, separating planned and unplanned care, and implementing new staffing models to make best use of the available workforce."
- "The extent of the recovery challenge varies between and within countries and is a product of multiple factors, many of which are outside the health system's direct control."
- See Table 3: International measures and strategies to clear elective backlogs (pp 35-38) for summary of interventions.
- "Lesson 4: Better separation of scheduled and unscheduled care has been an asset in recovery, which has been made easier in countries with more flexible estates."
- "Lesson 5: Recovery can be aided by empowering staff and facilitating bottom-up approaches"
    - See "Box 4: Country examples: staff engagement in Canada and Spain" (p42)

Smith et al. **Reducing surgical waitlist times in Australia**. Sydney: Australian Institute of Health Innovation and NHRMC Partnership Centre for Health System Sustainability, 2020. (LINK)

- "Conducted four literature reviews, focused on the following areas: eliminating the backlog of patients; successful waitlist management and prioritisation strategies; and strategies to reduce low-value care in the peer-reviewed and grey literature."
    - Report reviewed by experienced health services researcher and a senior clinician for feasibility and additional comments
- "This document provides key information on managing elective surgery waitlists, which have grown as a result of restrictions on operating theatre use due to the COVID-19 pandemic"
- "Through our examination of the literature, **we identified three priority areas in which improvements are most likely to yield significant outcomes for the Australian healthcare system:**
    - **1) Streamlining processes and patient journeys to address the surgical waitlist backlog;**
    - **2) Improving waitlist management and prioritisation strategies; and**
    - **3) Reducing low-value, high-cost care"**
- **Evidence-based list of strategies for improving patient journeys and increasing efficiency**
    - "Auditing the current waitlist to prioritise patients most in need, including re-assessing the need for, and effectiveness of, scheduled low-value, high-cost surgeries
    - Postponing surgeries for high-risk patients, where ethically feasible
    - Harnessing the capacity of the private sector through sub-contracting of surgeries
    - Increasing capacity through extra clinics, additional fractional appointments, and supporting higher clinician caseloads, and

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- o Streamlining organisations and processes, such as enhanced pre-operative patient care and postoperative innovations, aiming to reduce patient harm, length of stays, and costs."
- **Evidenced-based list of strategies for improving waitlist management and prioritisation**
  - o "Longer-term strategies have been identified in the literature for preventing growth in surgical waitlists, including pooled waitlists, advanced methods for prioritising patients, and seeking to implement alternative models of care."
    - Examples of alternative models of care include: "non-surgical interventions, virtual care (such as remote-monitoring and telemedicine) and hospital-in-the-home systems"
  - o "…identified several **recommendations for systemic changes to support evidence-based surgical referrals**. These include improving the referral pathway for patients by:
    - Developing education programs for general practitioners (GPs) and patients to support appropriate referral and decision making
    - Implementing decision-support tools to ensure compliance with surgical guidelines
    - Establishing a triage referral system with allied health professionals and
    - Improving diagnostic processes to speed diagnosis."
- **Evidence-based list of strategies for reducing low-value, high-cost care:**
  - o "To reduce low-value surgery, the system needs to become more transparent and have increased accountability. Monitoring known low-value procedures across public and private settings using established guidelines could be a step towards minimising waste and variation. This could be accomplished by developing central monitoring systems that mobilise multidisciplinary teams to provide second opinions and encouraging adherence to guidelines"
  - o "Incentives to promote the provision of more appropriate, high-value care"
  - o "consider limiting the volume of low-value surgery of each Medical Benefits Schedule item"
- "**See figure 1 for a summary of evidence-based strategies to immediately reduce waitlist length, temporarily increase capacity, and to reset for high-value care (Figure 1).**"

Policy Scans

Wennberg et al. **Elective surgery wait time reduction in Canada: A synthesis of provincial initiatives.** Healthc Manage Forum. 2020 May. ([LINK](#))
- Review of elective surgery wait time reduction initiatives
- **Aim**: "to provide an overview of elective surgery wait time reduction initiatives across the Canadian provinces from 2000 to 2018."
- "Each of the 10 provincial government web sites were searched. A theoretical framework for elective surgery wait time reduction policies was developed. The final framework is broadly organized into a supply-demand-performance management model."

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- See Table. 1. Framework for categorization of elective surgery wait time reduction initiatives in the Canadian provinces
- **Discussion**:
  - "The **majority were categorized as supply-oriented initiatives**, which have been implemented by all the provinces in some form. These initiatives aim to increase the number of surgeries performed through such strategies as providing funding, increasing capacity, and improving efficiencies in the surgical journey."
  - "**Demand-oriented initiatives**, which aim to decrease the number of surgeries needed, **have been implemented the least**. Examples of these are more limited and include triage and prevention strategies."
  - "**performance management-oriented initiatives** support improvements in performance through wait times monitoring or by setting performance targets. Wait time monitoring systems have been implemented or are in development in all the provinces."
  - "**We did not determine the relative efficacy of these initiatives at reducing wait times or their effects on quality of life, safety outcomes, and economic cost, and there is little evidence in this regard**. To date, there have been only 12 studies assessing these initiatives, 4 of which took place in Canada. Most of these studies were observational, and the overall quality of the evidence was deemed in a recent review to be "very low," with a high risk of bias."
  - "Three strategies with evidence for effectiveness were identified in Kreindler's study: investing in capacity, directly paying for activity, and creating targets and strong incentives for wait time reduction. Kreindler makes the broad conclusion that such strategies, which are more "direct" in their approach, are more effective at reducing wait times than "indirect" strategies, such as public reporting of wait time information or unenforced guarantees. However, indirect strategies may be more attractive to governments as their implementation requires less effort and financial investment."

Increasing Supply

Expanding capacity in the form of human and material resources to increase surgical activities.

Systematic Reviews

Rathnayake D, Clarke M, Jayasinghe V. **Improving access to surgery during and after the COVID-19 pandemic: A systematic review of the effects of outsourcing elective surgeries to private-sector health service providers to shorten waiting times**. Research Square; 2022. LINK

- From abstract: "this review assesses the evidence on the effects on waiting times of outsourcing elective surgical services to private sector service providers"
- "The evidence from this review suggests that for certain types of elective surgeries, such as hip and knee replacement, outsourcing to private sector providers is likely to shorten waiting times and increase access for patients. This may be especially important given the impact of COVID-19 on elective surgery waiting lists."

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- "Mackinnon ([see here for full report](#)) reported on the strategic approaches implemented in Saskatchewan Surgical Initiative (SSI) in Canada. The interventions were intended to increase surgical capacity in private-for-profit clinics to perform 34-day elective surgery procedures. These improved private clinics helped to reduce waiting times and reduced the total cost of performance by 26% compared with the public sector hospitals and almost cleared the patients waited more than a year period."

Primary Research

Chen, H., Qian, Q. and Zhang, A. (2015), **Would Allowing Privately Funded Health Care Reduce Public Waiting Time? Theory and Empirical Evidence from Canadian Joint Replacement Surgery Data**. Prod Oper Manag, 24: 605-618. [LINK](#)

- Abstract: "This study develops a theoretical model and then, using Canadian joint replacement surgery data, empirically tests the relationship between government policies that promote privately funded health care and patients' waiting time in the public health care system. Two policies are tested: one policy allows opt-out physicians to extra-bill private patients, and the other provides public subsidies to private patients. We find that both policies are associated with shorter public waiting time, and that the subsidy policy appears to be more effective in waiting time reduction than the extra-billing policy. Our findings are consistent with a dominant demand-side effect in that these policies would provide patients an option, and some incentive, to opt out of the public health system, shifting the demand from the public health system to the private care market."
- **Related**: Johar, M. and Savage, E. (2010), **Do Private Patients have Shorter Waiting Times for Elective Surgery? Evidence from New South Wales Public Hospitals**. Economic Papers: A journal of applied economics and policy, 29: 128-142. [LINK](#)
    - "We find that private patients have substantially shorter waiting times, and tend to be admitted ahead of their listing rank, especially for procedures that have low urgency levels. We also explore the benefits and costs of this preferential treatment on waiting times."

Yang O, Yong J, Zhang Y. **Effects of private health insurance on waiting time in public hospitals**. Melbourne: Melbourne Institute Applied Economic and Social Research; 2023 [cited 5 Sep 2023]. Available from: [LINK](#)

- From abstract: "We use an instrumental variable approach to study the causal effects of higher PHI takeup on waiting times in public hospitals. We use 2014-2018 hospital admission and elective surgery waiting list data linked at the patient level from the Victorian Centre for Data Linkage. These data cover all Victorian residents who had any inpatient admissions in all hospitals in Victoria (both public and private hospitals) and those registered on the waiting list for elective surgeries in public hospitals in Victoria. We find that one percentage point increase in the PHI take-up leads to about 0.34 days (or 0.5%) reduction in waiting times in public hospitals on average."

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- From abstract: "The small effect suggests that raising PHI coverage with the aim to taking the pressure off the public system is not an effective and practical strategy in reducing waiting times in public hospitals. Alternative policies aiming at improving the efficiency of public hospitals and advancing equitable access to care should be a priority for policymakers"

Gray Literature

Yanick Labrie. **Lessons from the Public-Private Partnerships in Surgical Care in Quebec**. Fraser Institute, 2023. LINK

- "This essay documents Quebec's relatively unique approach to health care in the Canadian landscape in order to show the compatibility—and potential benefits—of public-private partnerships within the framework of a universal health care system."
- Reviews "The Chaoulli Ruling and the Creation of Specialized Medical Centres in Quebec"
- Reviews "The Increasing Role of Specialized Medical Centres in Ambulatory Surgery"
- From Discussion:
  - "public funding given to Specialized Medical Centres must be the same as that granted to public hospitals for the same procedure and adjusted for case mix, so that all care providers operate on a level playing field"
  - "it is crucial to allow diversification of revenue sources for Specialized Medical Centres if we are to consolidate their contribution to the health network"
  - "increased private sector participation in the field of elective surgery will only be fully beneficial if it is accompanied by mechanisms promoting competition between institutions"
  - "the government should eventually introduce a policy of free choice whereby patients can decide where they wish to receive their treatment, among various options in the public or private sectors"

Managing Demand

Includes strategies to reduce patient waiting times for surgery, as well as adding and managing patients who are currently on the waitlist. Please note, however, that strategies based on revising patient selection criteria for joint arthroplasty have been summarized in a previous CHRSP RDS available here.

Systematic Reviews

Ballini et al. **Interventions to reduce waiting times for elective procedures.** Cochrane Database Syst Rev. 2015. (LINK)
- Cochrane review (8 studies), **reducing wait times elective procedures**
- **"Objectives:** To assess the effectiveness of interventions aimed at reducing waiting times for elective care, both diagnostic and therapeutic."
- **Study selection criteria**: "We considered studies reporting one or more of the following outcomes: number or proportion of participants whose waiting times were above or below a specific time threshold, or participants' mean or median waiting times. Comparators could include any type of active intervention or standard practice."

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- **Main results**:
  - "The studies were heterogeneous in terms of types of interventions, elective procedures and clinical conditions; this made meta-analysis unfeasible. One ITS study evaluating prioritisation of demand through a system for streamlining elective surgery services reduced the number of semi-urgent participants waiting longer than the recommended time (< 90 days) by 28 participants/mo, while no effects were found for urgent (< 30 days) versus non-urgent participants (< 365 days)"
  - "Most of the evaluated interventions were aimed at improving the organisational management of waiting lists or restructuring the intake assessment/referral process. These studies however, did not cover all possible interventions, for example, resource sharing strategies or remuneration schemes."
- **"Implications for practice:** Decision-makers should be aware that **for interventions aimed at prioritising demand (e.g. co-payment, explicit referral criteria or practice guidelines, clinical priority scores), evidence is incomplete, and for those aimed at rationing demand or expanding capacity (e.g. providing additional funding to the public sector, subsidising or facilitating access to the private sector), evidence is lacking**. Thus, implementation of such interventions should be monitored for both effectiveness and possible drawbacks."
- **See a summary of this review here:**
  - Mansilla C. **What are the effects of interventions to reduce waiting times for elective procedures? A SUPPORT Summary of a systematic review**. April 2017. ([LINK])

Primary Research

Damani et al. **Improving the quality of care with a single-entry model of referral for total joint replacement: a preimplementation/postimplementation evaluation**. BMJ Open. 2019 Dec. ([LINK])
- Preimplementation/postimplementation cross-sectional design comparing historical and prospective cohorts, **single-entry model of referral joint replacement**
- "**Objectives**: We assessed: (1) waiting time variation among surgeons; (2) proportion of patients receiving surgery within benchmark and (3) influence of the Winnipeg Central Intake Service (WCIS) across five dimensions of quality: accessibility, acceptability, appropriateness, effectiveness, safety."
- "**Interventions:** The WCIS is a single-entry model (SEM) to improve access to total hip replacement (THR) or total knee replacement (TKR) surgery, implemented to minimise variation in total waiting time (TW) across orthopaedic surgeons and increase the proportion of surgeries within 26 weeks (benchmark). Impact of SEMs on quality of care is poorly understood."
- "**Primary and secondary outcome measures**: Primary outcomes related to **'accessibility'**: waiting time variation across surgeons, waiting times (Waiting Time 2 (WT2)=decision to treat until surgery and TW=total waiting time) and surgeries within benchmark."
- "**Results:** Variability in TW among surgeons was reduced by 3.7 (hip) and 4.3 (knee) weeks. Mean waiting was reduced for TKR (WT2/TW); TKR within benchmark increased by 5.9%. Accessibility and safety were the only quality dimensions that changed (post-WCIS THR and TKR). Shorter WT2 was associated with post-WCIS (knee), worse Oxford score (hip and knee)

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and having medical comorbidities (hip). Meeting benchmark was associated with post-WCIS (knee), lower Body Mass Index (BMI) (hip) and worse Oxford score (hip and knee).”

- **“Conclusion**: **SEMs used for scheduled clinical services have shown promise for improvements in quality of care**. In our study, **use of the WCIS reduced variability in waiting times among surgeons, reduced patient waiting times and facilitated a greater proportion of TKRs within benchmark without adversely influencing other quality indicators**. While our evaluation considered all dimensions of quality, the observation period was limited, and results indicate positive impact on some but not all dimensions.”

Souza et al. **Surgery remember@: an innovation to reduce surgical cancellations**. Rev Col Bras Cir. 2022 Jan 5. ([LINK](#))

- Study of technical production, communication tool named Surgery Remember@ includes an integrative review (11 articles)
- **Aim:** “to develop a communication tool named Surgery Remember@ to mitigate surgical suspensions due to patient absenteeism.”
  - ○ “Surgery Remember@ endeavours to reduce surgery cancellations, improving efficiency and reducing costs. It is known that sending messages three days before the surgical procedure makes it possible to replace patients in the event of cancellations, optimizing the human and material resources in the operating room.”
- **Article contains 4 sections**:
  - ○ literature review; analysis of the hospital administrative profile; software development; and process mapping for software implementation.
- **Conclusions**:
  - ○ “Messages sent three days before the surgical procedure will enable the replacement of patients in case of patient withdrawal, optimizing the use of human and material resources.
  - ○ The confirmation of the pre-anesthetic consultation will be positively impacted on the verification of the perioperative assistance improvement. Therefore, Surgery Remember@, besides being viable and easy to implement, will also allow the inclusion of other functionalities according to existing requirements, proving to be a feasible tool to deal with the problems discussed in the current article.
  - ○ Lastly, it is expected that the catalogued data will allow identifying patterns and patients' clinical profile as well as guiding the quality management processes of perioperative care.”

Policy Scans

Segall et al. **Wait-time reporting systems for elective surgery in Canada: a content analysis of provincial and territorial initiatives**. CMAJ Open. 2020 Dec 10. ([LINK](#))

- “searched all Canadian provincial and territorial ministry of health websites to identify the wait-time reporting systems in place. We conducted content analysis and used a qualitative descriptive approach to compare the variables of interest across the provinces and territories.”

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- **"Results**: There were websites available for assessment in all 13 provinces and territories. Seven provinces have comprehensive, centralized wait-time reporting systems. The rest of the provinces have highly decentralized wait-time reporting, and the territories do not have wait-time reporting systems in place. There is substantial variation in the comprehensiveness, purpose, data sources and data collection methods among the wait-time reporting systems across the provinces and territories."
    - "There was a website for the health ministries of each province and territory (**Appendix 1, Supplemental Table S1).** Nine provinces had a website specifically reporting surgical wait times. **Newfoundland Labrador and the 3 territories did not have surgical wait-time reporting websites (Appendix 1, Supplemental Table S2)."**
    - **"Table 1 presents an overview of the wait-time reporting systems in the provinces and territories."**
- "**Interpretation**:
    - "**All provinces except Newfoundland and Labrador have websites to publicly report wait-time information for elective surgeries.** Seven provinces have comprehensive, centralized wait-time reporting systems. Many provinces have gone beyond the national reporting standards in terms of procedures reported, and all provinces with reporting systems have standardized diagnostic prioritization systems in place. The territories do not report or publish wait-time data for elective surgeries."
    - "**Although Wait 1 times represent an important part of the wait for surgery, these times are not consistently reported across Canada**. In general, Wait 1 data are more difficult and expensive to collect, because they require obtaining information directly from referring primary care physicians as well as specialists. While Wait 2 times are generally well reported, the definition of Wait 2 is not consistent across Canada"
- "**It is unclear who is using reported wait-time information and for what purpose**. Understanding the extent of use of wait-time data and ways to increase awareness of these data among patients and health care providers is an important future research direction. Further research is needed to understand how physicians, the public and other stakeholders use this information when making health care decisions. **If data are not extensively used to help reduce wait times, other strategies, such as central referral systems and single-entry models, would be helpful**."

Preoperative Management

Includes strategies for optimising patient clinical conditions, preparing patients for what to expect before, during and after the surgery.

Overviews

Okolie et al. **Wales COVID-19 Evidence Centre. Rapid review of the effectiveness of innovations to support patients on elective surgical waiting lists**. April 2022. ([LINK](#))
- Rapid Review (40 reviews of which 17 reviews were prioritized for inclusion in the synthesis), **innovations to support patients on elective surgical waiting lists**

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- **"Who is this summary for?** Health Boards and others involved in planning, monitoring, managing waiting lists for surgery."
- **Aim**: "to identify innovations to support patients on surgical waiting lists to inform policy and strategy to address the elective surgical backlog in Wales. The review is based on the findings of existing reviews with priority given to robust evidence synthesis using minimum standards (systematic search, study selection, quality assessment, and appropriate synthesis)."
  - "Most reviews (n=23) focused on orthopaedic surgical procedures."
- "Evidence of effectiveness
  - **Preoperative exercise interventions** (n=9; 6 were orthopaedic) could help improve preoperative and postoperative outcomes such as pain, muscle strength and function, and reduced incidence of postoperative complications, in people awaiting elective surgery.
  - **Educational interventions** (n=3; 1 was orthopaedic) were effective at improving knowledge in patients awaiting elective surgery. However, the evidence about these interventions improving pre- and postoperative pain and physical functioning in orthopaedic patients is limited. There were mixed findings for the effectiveness of preoperative educational interventions on psychological outcomes.
  - **Psychological interventions** (n=2; 1 was orthopaedic) evidence is limited but indicates it may have a positive effect on anxiety and mental health components of quality of life postoperatively. The evidence in support of such interventions in reducing postoperative pain is inconclusive.
  - **Smoking cessation interventions** (n=1) providing behavioural support and offering nicotine replacement therapy increased short-term smoking cessation and may reduce postoperative morbidity. Intensive preoperative smoking cessation interventions appear to reduce the incidence of postoperative complications, but not brief interventions.
  - **Multicomponent interventions** (n=2; 1 was orthopaedic) consisting of both exercise and education components could shorten the length of hospital stay and improve postoperative pain, function, and muscle strength."
- "**Strength of Evidence** The primary studies included in the reviews were mainly randomised controlled trials, but most had small sample size, varied by surgical type, and often had issues regarding blinding."
- "**Implications for policy and practice This report has highlighted the benefits of preoperative interventions for patients awaiting elective surgery. The current evidence supports the use of exercise, education, smoking cessation, and psychological interventions to support and improve the outcomes of waitlisted patients.** Policymakers and clinicians should consider incorporating such interventions into health professionals' curriculums. The effect of social prescribing interventions in supporting patients awaiting surgery needs to be established. In addition, further research is required to understand how various patient subgroups respond to preoperative interventions, including those from underserved and minority ethnic groups."

Systematic Reviews

Khan et al. **The Golden Patient Initiative: A Systematic Review**. Cureus. 2023 May 30. ([LINK])
- Systematic Review (14), **Golden patient initiative**

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- "In this systematic review, we discuss the Golden Patient Initiative (GPI), in which the first patient on the operating list is pre-assessed the day prior to surgery, and we aim to assess its impact and overall efficacy."
- **Discussion**: "Our review indicates that the **GPI can improve theatre efficiency and provides favourable results when implemented across several different specialities and hospitals**. Importantly, improvement was seen in theatre start time in all studies, and this was statistically significant in most cases across a range of metrics representing theatre start time. Furthermore, case cancellations also decreased in all studies that measured this variable."
- **Limitations of the Golden Patient Initiative (GPI):**
  - "Selection of the GPI patient relies upon members of the surgical team assessing the urgency and the length of time of surgery before the list starts. This can vary and predictions may often be incorrect. In such cases, this impacts the remaining available theatre time, and thus may negatively impact theatre efficiency despite the selection of a Golden Patient"
  - "Adherence is also an important factor in the long-term efficacy of the GPI. As seen by Key et al., arrival in the suite, procedure end time, and time out of theatre all showed greater improvements in the first month after the GPI, as compared to four months after the GPI…. importance of regular auditing in order to keep the GPI effective over a longer period."
- **Conclusions**: "**Outcomes included delay in theatre start time, number of surgical case cancellations, and changes to total case numbers**. Across the studies, a **19-30-minute improvement in theatre start time was reported (p<0.05)**, as well as a **statistically significant decrease in case cancellations**. Our analysis provides encouraging conclusions with regard to greater theatre efficiency following the application of GPI, a low-cost solution that can easily be implemented to help improve patient safety and lead to cost savings. However, at present, it is largely implemented among local trusts, and hence larger multi-centre studies are required to gather conclusive evidence about the efficacy of the initiative."

Kristoffersen et al. **Effectiveness of pre-anaesthetic assessment clinic: a systematic review of randomised and non-randomised prospective controlled studies**. BMJ Open. 2022 May. ([LINK](#))
- Systematic review (7 studies), **effectiveness of pre-anaesthetic assessment clinic**
- **Objectives**: "to examine the effectiveness of pre-anaesthesia assessment clinics (PACs) in improving the quality and safety of perioperative patient care."
- **"The two review questions were:**
  - **Is PAC effective in improving patient satisfaction and safety, while reducing anxiety?**
  - **Is PAC effective in reducing cancellation rate and cost of surgery, and improving the efficiency of perioperative patient care?"**
- **Intervention characteristics**: "the **PACs in all studies comprised an outpatient service whereby patients were examined for medical conditions important for anaesthesia and informed regarding expectations on the day of surgery**. Nevertheless, the terminology used for PACs

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varied, as they served different surgical specialties and conducted pre-anaesthesia consultation from ≥48 hours to ≤3 months before the surgery. The settings included a university hospital (n=3), teaching hospital (n=1), medical centre (n=1) and general hospital (n=1); one study did not specify the context. The **staff conducting the pre-anaesthetic consultation also varied**: in five studies, it was the **anaesthesiologists**; in the other studies, it was (also) the **orthopaedic senior house officer**, **consultant or resident, or physician**. In three studies, **nurses** were part of the team."

- **Results**:
  - "the main findings were reduction in the length of stay and surgery cancellation rate in hospitals. However, **the studies were of low quality, making it difficult to draw any conclusion. The evidence from our systematic review is insufficient to conclude whether patients have reduced anxiety because of PAC**. This is because the included studies used different instruments for measuring anxiety levels, and the results could not be pooled."
  - "**Three studies reported a significant reduction in the length of hospital stay and two studies reported a significant reduction in cancellation of surgery for medical reasons when patients were seen in the PAC**. In addition, the included studies presented mixed results regarding anxiety in patients. Most studies had a high risk of bias."
- **"Conclusion:** This systematic review **demonstrated a reduction in the length of hospital stay and cancellation of surgery when the patients had been assessed in the PAC**. There is a need for high-quality prospective studies to gain a deeper understanding of the effectiveness of PACs.**"

Treatment Space Management

Arrangement and management of physical infrastructure where the care is delivered.

Overviews

Emode & Severn. **Case Carts in Surgical Settings** [Internet]. Ottawa, Ontario: CADTH; 2023 Nov [cited 2023 Nov 20] p. 13. Report No.: RC1512-000. ([LINK)](#)

- Health Technology Review, case carts in surgical settings
- Aim: "to summarize the evidence identified from medical databases and grey literature searching regarding the comparative clinical effectiveness of open versus closed case carts in managing infection control and prevention and personnel safety. We also aimed to identify evidence-based guidelines regarding the use of case carts in surgical settings."
- Zero publications met the inclusion criteria.
- "Without any comparative effectiveness evidence, decision-makers may want to consider the organizational features (e.g., sterile processing workflow systems, transport distance to the operating room) to inform the choice of either open or closed case carts. Measures to promote personnel safety when using any case cart may include training for use as well as cart inspection and monitoring processes"

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Primary Research

Farrokhi et al. **Application of Lean Methodology for Improved Quality and Efficiency in Operating Room Instrument Availability**. J Healthc Qual. 2015 Sep-Oct. (LINK)

- Primary research, focus on spine surgeries, DBS, and craniotomies
- **Aim**: "This project was considered to be a quality improvement effort by our institutional review board, and therefore exempt from formal review."
- Value Stream Map for Surgical Tray Processing can be seen here
- **Planning the intervention**: "Problems identified included (1) no mechanism existed for tracking the actual usage of instruments, (2) the operating room, with a century-long history, had mechanisms for adding instruments to the trays, but not for removing instruments as their utility dwindled, and (3) OR growth and the expansion of specialties led to diminished OR personnel content expertise on what instruments were actually needed."
- **Discussion**: "developed and validated a Lean 5S approach consisting of sort (determining instrument usage and waste), simplify (removing unnecessary instruments), sweep (confirm availability of needed instruments), standardize (all trays the same for a given procedure), and self-discipline (monitor success)"
- **Conclusions:** "We report greater than 70% decrease in the number of instruments required, with no adverse effect on surgery times. As recent national data shed light on the substantial waste present within our healthcare system, implementation of quality and efficiency improvement efforts must become a part of the everyday work of all those working within this system."

Operating Theatre Efficiency

Optimising operating theatre room capacity to process an optimum number of procedures without compromising safety and quality

Systematic Reviews

Bellini et al. **Artificial Intelligence: A New Tool in Operating Room Management. Role of Machine Learning Models in Operating Room Optimization**. J Med Syst. 2019 Dec 10. (LINK)

- Systematic Review (19 articles), AI for OR Optimization
- **Aim**: "an analysis of how ML[machine learning] is applied in perioperative medicine was made, with the goal to understand if and how these technologies, can improve the OR management, reducing the costs and maximizing revenue and care quality"
- **Discussion** has sections on uses and examples for ML for:
    - **Estimation of Surgical Case Duration**
    - **Post-Anesthesia Care Unit**
    - **Surgical Cases Cancellation Detection**
    - **Other Variables**
- **Limitations**: "If certifications of healthcare professionals using these systems have already been mentioned, another limit is their use in the event of new procedures. As shown in the table, the ML requires a sufficient number of data to have valid results; if on one side this means that it is

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able to analyze an immense number of variables and data, on the other side if this number is not reached the results may erroneously not be significant, as it could be in the case of estimates made on a few cases."

- **"Conclusion:** ML models have a huge potential to improve hospital medical services. Thanks to them, we can perform a precise perioperative risk assessment or be more aware of the need for Recovery Time of each patient, allowing medical staff to develop different and personalized services for patients, increasing security and quality of perioperative period. In an administrative and managerial perspective, ML systems allow an accurate prediction of the time of use of the most expensive structures, such as OR and PACU, on which most of the profits depend. However, **further studies are needed to assess the effective role of these new technologies in the perioperative medicine and OR management**."

Cortegiani et al. **Association between night/after-hours surgery and mortality: a systematic review and meta-analysis**. Br J Anaesth. 2020 May. ([LINK](#))

- Systematic review and meta-analysis, association between nigh/after-hours surgery and mortality
- **Aim**: "of finding in adult patients undergoing elective or non-elective surgery whether interventions performed during night or after-hours compared with daytime were associated with an increased risk of 30 day or in-hospital mortality.
- **Results**: "Overall, surgery performed during night/after-hours was associated with higher unadjusted mortality than surgery performed during the day (OR=1.47; 95% CI, 1.19–1.83, P=0.0005; I2=97%; low certainty)"
- **Discussion:** "…data from nearly 3 million patients suggest that surgery performed at night/after-hours is associated with a higher postoperative risk of death than surgery performed during the day. This effect was consistent in both adjusted and unadjusted analysis and across subgroups of interest. The adjusted odds of death were 16% higher in nighttime/after hour surgery than in daytime surgery (true population effect between 6% and 28%). Neither the number of centres per study nor the urgency of surgery had a credible subgroup effect on this association. This finding carries important implications for both scheduling of surgery and perioperative risk management**.**"
- **Conclusion**: "Night/after-hours surgery may be associated with a higher risk of mortality. Patients' and surgical characteristics seem not to completely explain this finding. However, the certainty of the evidence was low."

Entezari et al. **Improving Resource Utilization for Arthroplasty Care by Leveraging Machine Learning and Optimization: A Systematic Review**. Arthroplast Today. 2023 Mar. ([LINK](#))

- Systematic Review (18 articles), resource utilization for arthroplasty using machine learning
- **Aim**: "to evaluate strategies using advances in analytics and computational modeling that may improve planning and the overall efficiency of TJA [total joint arthroplasty] care"

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- **Artificial intelligence prediction**: "Studies were included if they used any type of ML model to predict 1 of 3 outcomes following TJA; LOS, DOS, or postoperative readmission. Studies evaluating patients undergoing primary or revision TKA, THA, partial knee arthroplasty, or hip resurfacing were included"
- **Includes sections on**: length of stay, duration of surgery, hospital readmission, optimization
- **Discussion**
  - **"Generally, the findings of this study support the use of ML for prediction modelling and surgical optimization in TJA**. In the prediction of LOS, the ML models evaluated in this study performed superior to or at the same level as matched control models. With only 3 studies generating ML models for the prediction of DOS and 2 for hospital readmissions, further research is required to assess the performance of ML models for the prediction of these outcomes in particular. Preliminary models, however, show promising outputs and encourage further investigation."
  - **"**As for **surgical scheduling**, a majority of optimization research for surgical scheduling has been targeted at the operational level. This is likely due to the complex and multifactorial nature of the problem, presenting as an ideal target for optimization compared to the distribution of yearly or weekly OR time among specialties. Various optimization strategies have been utilized to improve the efficiency of surgical scheduling, all of which improved the outcome of interest compared to traditional manual scheduling practices."
  - "Potential clinical uses of these algorithms include the automation of surgical scheduling and improved utilization of hospital resources."
  - "Most models were generated to optimize total OR utilization and minimize overtime and/or idle time, which may be the best metric when trying to maximize the utility of a finite resource. However, **one ideal metric cannot be defined, as the solution to each OR optimization problem depends on the specific goals of the institution**."
- **Conclusions**: "While there remains work to be done in refining these tools, there exists considerable opportunities for improved efficiency in resource utilization surrounding TJA, especially when considering the combined utilization of predictive modelling with optimization strategies.
- **Related reference**: Lex JR. *Machine Learning to Predict and Optimize Lower Extremity Arthroplasty Resource Utilization* (Doctoral dissertation, University of Toronto (Canada)). (LINK)

Fong et al. **Efficiency improvement in the operating room**. J Surg Res. 2016 Aug. (LINK)
- Systematic review (39 studies), **improving efficiency in OR**
- "this article summarizes currently published studies of intraoperative efficacy improvement, examines the outcomes of these efforts, and proposes standardization of reporting future efforts in the surgical literature"
- "Efficiency" is a widely used word in health care with multiple definitions; **for this study, we focused on efforts to produce improvements in time, costs, or their proxies**. We defined our inclusion criteria as any article describing a method to improve intraoperative efficiency and

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reporting results of an outcome measure. We defined the intraoperative time period to be that when the patient is in the operating room, including anesthesia time but not patient transport or room changeover time ("interoperative" time)."

- **Conclusions:** "There is substantial opportunity to enhance operating room efficiency during the intraoperative period. **Surgeons may have a particular role in procedural efficiency, which has been relatively unstudied. Common themes were standardizing tasks, collecting and using actionable data, and maintaining effective team communication**."

Halim et al. **Strategies to Improve Start Time in the Operating Theatre: a Systematic Review**. J Med Syst. 2018 Jul 20. ([LINK](#))

- Systematic review (14), **improving start time in OR**
- "We conducted a systematic review of bibliographic databases to identify primary research papers assessing the effect of interventions on theatre start time"
- "The population considered were patients undergoing surgery who were listed first on a scheduled theatre list, with no restriction on demographics or geographical location. The primary outcome was theatre start time for the first case of the day. Papers included were those that made a comparison between theatre start time before and after a specified intervention."
- **See Table 2: Summary of interventions and key unanswered questions**
    - Financial Incentives
    - Education: Teaching programs, Awareness based programs
    - Systems based approaches: **Lean and Six Sigma,** Protocols e.g., e.g. ensuring consenting and marking is completed 30 min before the start of the list, Operating room managers and charters
    - Communication: Briefings and debriefings, Morning huddles
    - Golden patient
    - The productive operating theatre
- **Conclusions:** "The studies in the literature which have sought to improve theatre start times offer several different potential strategies. Since each hospital functions differently **there is no 'one-size-fits-all' approach that can be recommended**. **Instead, the literature supports the idea that individuals carry out a thorough analysis of the causes of delays in their own hospital and then implement tailored solutions**. **Lean and Six Sigma techniques provide useful frameworks with which hospital staff can identify causes of delays in their own institutions.** Several techniques exist to improve theatre start times, with the 'golden patient' initiative seeming to offer the biggest time savings. However, **questions exist surrounding the long-term efficacy of this approach, and indeed the long-term efficacy of other approaches**. This is an area that future studies must seek to address. Future work will be more informative and useful to the surgical community if a unified definition of first case on time starts is agreed upon."

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Oliveira et al. **A systematic literature review on the utilization of extended operating room hours to reduce surgical backlogs**. Front Public Health. 2023 Apr 13. (LINK)

- Systematic review (12 articles), **extended OR hours**
- **"Two research questions are raised**:
    - (1) which are the scientific literature's insights related to the use of extended operating room hours to help reduce surgery backlogs? and
    - (2) provided that a hospital decides to extend its operating room opening time, what are the main challenges and the key aspects to consider in the design and implementation of policies to manage extended operating room hours?"
- "Among the 12 papers, we observed a variety of propositions that we grouped into three families of strategies:
    - (1) strategies that seek to **increase the opening hours of the corresponding service, including weekend and after-hour clinics**;
    - (2) strategies to better **manage demand, including prioritization and triage, treatment postponement, and patient transfer**; and
    - (3) strategies to **increase productivity**, such as specific fee-for-services to reward physicians and reduced protocols.
    - It is worth noting that several of the papers were published after March 2020, therefore after the beginning of the COVID-19 pandemic."
- "**Discussion**: **The review suggests that extended operating room hours might be problematic if current staff is used and that a careful choice of patients should be made**. **However, its potential to reduce waiting times and its implications are discussed only superficially**. Therefore, we analyze the implications of extending operating room hours from four different perspectives (management, staff, patients, and strategy deployment) and define some recommendations for policy makers and healthcare managers when implementing it in practice."
- **Recommendations**
    - 1) "extended OR hours, as defined in this paper (i.e., using existing human resources), **should only be used in the short term or, if used in medium to long terms, its intensity should be limited to prevent exhaustion of the OR staff and the post-surgical services, which might be overloaded**."
    - 2) "**the need for a shared understanding and agreement of all the stakeholders on the goals pursued by this strategy**: is it to broaden access to services?, is it to cope with emergency surgeries?, is it to perform more surgeries of a particular type?, or is it to treat specific patients under specific situations? Only after all the stakeholders (managers, staff, and patients) have agreed on the objectives, it is possible to start framing and planning how to make the best use of extended OR hours.
    - 3) "The third recommendation concerns **communication and transparency**. **Decisions should be clear and communicated to all stakeholders.** This level of transparency allows decisions to be revised in light of information held by different people. Indeed, if

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decision-makers share the knowledge about the strategic goal of extended OR hours, it should be easier to guarantee an efficient and fair use of resources."

Primary Research

Al Zoubi F, Gold R, Poitras S, Kreviazuk C, Brillinger J, Fallavollita P, Beaulé PE. **Artificial intelligence-driven prescriptive model to optimize team efficiency in a high-volume primary arthroplasty practice**. International Orthopaedics. 2023 Feb;47(2):343-50. LINK

- Model, AI driven prescriptive model team optimization arthroplasty
- **Aim**: "aimed to improve OR efficiency using machine learning (ML) to find relevant metrics influencing surgery time success and team performance on efficiency to create a model which incorporated team, patient, and surgery-related factors."
- **"Methods**: From 2012 to 2020, five surgeons, 44 nurses, and 152 anesthesiologists participated in 1199 four joint days (4796 cases): 1461 THA, 1496 TKA, 652 HR, 242 UKA, and 945 others. Patients were 2461f:2335 m; age, 64.1; BMI, 29.93; and ASA, 2.45. **Surgical Success was defined as completing four joints within an eight hour shift using one OR**. Time data was recorded prospectively using Surgical Information Management Systems. Hospital records provided team, patient demographics, adverse events, and anesthetic. Data mining identified patterns and relationships in higher dimensions. Predictive analytics used ML ranking algorithm to identify important metrics and created decision tree models for benchmarks and success probability".
- **Results**: "**Five variables predicted success**: anaesthesia preparation time, surgical preparation time, time of procedure, anesthesia finish time, and type of joint replacement. The model determined success rate with accuracy of 72% and AUC = 0.72. Probability of success based on mean performance was 77-89% (mean-median) if APT 14-15 minutes, PT 68-70 minutes, AFT four to five minutes, and turnover 25-27 minutes. With the above benchmarks maintained, success rate was 59% if surgeon exceeded 71.5-minutes PT or 89% if 64-minutes procedure time or 66% when anesthesiologist spent 17-19.5 minutes on APT."
- **"Conclusion:** AI-ML predicted OR success without increasing resources. Benchmarks track OR performance, demonstrate effects of strategic changes, guide decisions, and provide teamwork improvement opportunities"

Chohan et al. **Evaluation of a tiered operating room strategy at an academic centre: comparing high-efficiency and conventional operating rooms**. Can J Surg. 2022 Nov. (LINK)
- Primary research, evaluation of tiered OR strategy
- **Aim**: "to test a novel, resource-saving redesign of outpatient operating room (OR) services, based on tiered grouping of surgical cases, to maximize health benefits for patients while improving efficiency and decreasing wait times."
- **Results**: "The costs associated with the high-efficiency OR were 60% lower than those associated with the conventional OR (this was primarily due to the streamlining of OR care and elimination of the need to use a postanesthetic care unit), with the same or equivalent patient

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health outcomes. No differences in patient and staff satisfaction were found between the 2 setups."

- o "The turnover time per case fell from an average of 23.5 minutes in the conventional OR group to just 8.75 minutes in the high-efficiency OR group"
- o "The most substantial savings were associated with bypassing the PACU and decreasing OR-associated labour and materials costs."

Elliott-Dawe et al. **Case-Mix Moderation of the Relationship Between OR Performance Metrics and Utilization**. AORN J. 2022 Dec. (LINK)

- Archival research design, **relationship between OR performance metrics and OR utilization**
- **Aims**: "to identify the **relative effect of OR performance metrics on OR utilization** in an academic medical center in the southeastern region of the United States, and to delineate the moderating effect that case mix may have on the relationship between performance metrics and OR utilization. **The research questions were as follows.**
  - o Which OR metrics have the greatest impact on OR utilization?
  - o Does case mix affect the relationship between performance metrics and OR utilization?
  - o "We included an average of 16 scheduled ORs for each day in the data analysis with a range of 6 to 19 ORs scheduled on any particular day. The study data comprised information from 1,161 scheduled surgical days (ie, beginning at either 7:30 AM or 8:30 AM depending on the day and ending at 5 PM); **we excluded 11 holidays each year**. The resulting data set included 51,338 procedures."
- "After extracting 55 months of data from the surgical repository, we used simple and multiple linear regression models to analyze the data and determine the strength and direction of the relationships among the variables. We compared models comprising proportionally more inpatients to models comprising proportionally more outpatients for each metric to ascertain the effects of case mix on OR utilization. **Idle time had the greatest effect on OR utilization, followed by late starts and turnover time**. Case mix moderated the relationship between OR utilization and the metrics of cancellations and turnover time. **Perioperative leaders may enhance OR utilization by monitoring and addressing idle time and late starts and scheduling an appropriate mix of inpatients and outpatients**."
- "Perioperative managers should be aware that **the relative representation of surgical inpatients and outpatients on any given day can affect OR utilization** and seek to set an optimal case mix based on known performance metrics such as average turnover time and cancellation rates. For researchers, case mix is a relevant variable that can account for seemingly contradictory findings across studies of cancellations and turnover time."
- **Conclusion:** "**The results of this study indicate that addressing idle time at the end of the day and late start at the beginning of the day may have the greatest effects on OR utilization**. Further, the **daily case mix of inpatients and outpatients moderated the effect of performance metrics on OR utilization**. The negative effect of a cancellation was greater when there were more inpatients than outpatients, up to cancellation rates of approximately 20%"

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Herron et al. **Extended operating times are more efficient, save money and maintain a high staff and patient satisfaction**. J Perioper Pract. 2018 Sep;28. (LINK)

- Pilot study, **extending operating times**
- "A pilot period of four months of extended operating times (4.5 hour sessions) was completed and included all theatre surgical specialties. **Outcome measures included: the number of cases completed, late starts, early finishes, cancelled operations, theatre overruns, preoperative assessment and 18-week targets**. The outcomes were then compared to pre-existing normal working day operating lists (0900-1700). Theatre staff, patient and surgical trainee satisfaction with the system were also considered by use of an anonymous questionnaire."
- **Findings**: The study showed that in-session utilisation time was unchanged by extended operating hours 88.7% (vs 89.2%). The service was rated as 'good' or 'excellent' by 87.5% of patients. Over £345,000 was saved by reducing premium payments. Savings of £225,000 were made by reducing privately outsourced operation and a further £63,000 by reviewing staff hours. Day case procedures increased from 2.8 to 3.2 cases/day with extended operating. There was no significant increase in late starts (5.1% vs 6.8%) or cancellation rates (0.75% vs 1.02%). Theatre over-runs reduced from 5% to 3.4%. The 18 weeks target for surgery was achieved in 93.7% of cases (vs 88.3%). The number of elective procedures increased from 4.1 to 4.89 cases/day. Only 13.33% of trainees (n = 33) surveyed felt that extended operating had a negative impact on training."
- **Conclusions**: "The study **concludes that extended operating increased productivity from 2.8 patients per session to 3.2 patients per session with potential savings of just over £2.4 million per financial year**. Extrapolating this to the other 155 trusts in England could be a potential saving of £372 million per year. Staff, trainee and patient satisfaction was unaffected. An improved 18 weeks target position was achieved with a significant reduction in private sector work. However, some staff had difficulty with arranging childcare and taking public transport and this may prevent full implementation."

Jreije et al. **Rewarding On Time Start Times in Operating Rooms Improves Efficiency**. Am Surg. 2020 Oct. (LINK)

- Primary Study, "star system" was implemented to improve compliance with **timely start times**.
- **Aim**: "to see if we could incentivize all members of the OR staff to start on time. We created an interventional study, in which we would **compare OR start times before and after implementation of the star system**."
  - "study was conducted at a county "safety net" hospital, where both general surgery and family medicine residencies exist. Our hospital has 8 ORs, with one dedicated to trauma. We are a level 2 trauma center and have a wide range of cases."
- "**significant improvement in timely starts was made after implementation of the program.** No surveys were conducted during the implementation of the star system; however, anecdotally, we noticed OR staff members were more excited to get cases started on time and a casual level of competition became apparent between different members of the team. In our star system, each individual is held accountable for their part in ensuring other participants receive a star.

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We have continued to use this system, and so far, our data show continued improvement in OR start times. Some enthusiasm was lost after the first couple of months, prompting realization that in order for programs like ours to thrive, a champion is needed to ensure the staff stays motivated. Being delegated to the task of encouraging on time starts can be quite strenuous, especially in the high stress environment, so moving forward, we are planning on having the chief surgery resident be in charge of the star system updates. This is helpful because it will teach our surgical residents how to talk to their peers, both surgeons and ancillary staff, and chiefs who are at the county institution 3 months at a time. This will likely decrease the chance of burnout or loss of interest in the project. The gift, although modest, was well received by participants. In the future, we hope to expand the gifts to include cards from retailers such as Target or Amazon."

Ong BS, Thomas R, Jenkins S. **Introducing the "Twilight" operating room concept: a feasibility study to improve operating room utilization**. Patient Saf Surg. 2022 Jul 27;16(1):23. ([LINK)](#)
- Feasibility study using retrospective audit, 'Twilight' operating room concept
- "We introduced a new concept of 'Twilight' operating room, where elective cases were performed after hours between 5 pm and 8.30 pm."
- **Aim**: "to analyse the cost-effectiveness of "Twilight" operating room as well as its impact on elective surgery waiting period"
- Based on a retrospective chart audit when a hospital in Australia did them for a period while another hospital in the same region was closed for renovations, included orthopedics but not arthroplasty (see Table 1).
- **Data collection**: "There was no session overutilization in 102 of the sessions (70.8%). The average operating room underutilisation time was between 0 and 192 min whereas the average over utilization time was between 2 and 152 min. The common reasons for overrun were overrunning of afternoon list, delay in obtaining operating equipment and radiology staffs."
- **Discussion**: "Our study demonstrated the feasibility of conducting elective surgeries after hours with the advantage of clearing hospital waiting list. The waiting list in our institution was completely cleared for July 2020 to April 2021 with no overdue elective surgeries. Importantly, no post-operative complications were reported. This model is a feasible and safe strategy to restore surgical activity impacted by COVID-19 pandemic."

Postoperative Management
Supporting patient's early recovery and early discharge home

Systematic Reviews
Skegg et al. **Debriefing to improve interprofessional teamwork in the operating room: A systematic review**. J Nurs Scholarsh. 2023 Nov. ([LINK)](#)
- Systematic review (19 articles), debriefing to improve interprofessional teamwork in OR

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- **Aim:** "We reviewed the literature on routine surgical debriefing with special reference to its implementation, barriers, and effectiveness."
  - "In the present review, we emphasize the value of a comprehensive team discussion, that is, debriefing, over and above the previously established value of the sign-out checklist"
- **Findings**:
  - "On synthesis, **we identified five topics**: explanations of how debriefing had been implemented; the value of coaching and audit; the learning dimensions of debriefing, both team learning and quality improvement at the organizational level; the effect of debriefing on patient safety or the organization's culture; and barriers to debriefing.
  - Reports (briefly) on impact on culture, safety and efficiency: "In two papers (Porta et al., 2013; Rose & Rose, 2018), debriefing improved efficiency as measured by a reduction in delay to the operating room, increased utilization, more accurate scheduling of operations (Porta et al., 2013), and reduced staff working hours per case (Rose & Rose, 2018)."
- "**Clinical Relevance**: Debriefing can improve teamwork, learning, and psychological safety but is difficult to practice in the operating room environment. It is relevant to review the benefits and barriers to debriefing, and to learn from the experience of others, in order to run better debriefing models in our own hospitals."

Primary Research

Fairley et al. **Improving the efficiency of the operating room environment with an optimization and machine learning model**. Health Care Manag Sci. 2019 Dec;22. ([LINK](#))

- Machine learning model, efficiency of OR
- "We develop a generalizable optimization and machine learning approach to sequence operating room procedures to minimize delays caused by PACU [post-anesthesia care unit] unavailability. Specifically, we **use machine learning to estimate the required PACU time for each type of surgical procedure, we develop and solve two integer programming models to schedule procedures in the operating rooms to minimize maximum PACU occupancy, and we use discrete event simulation to compare our optimized schedule to the existing schedule**"
- **Discussion:** "We addressed several practical challenges using a combination of machine learning and integer programming. **We validated our model and estimated its performance with historical data from Lucile Packard Children's Hospital Stanford**. The model incorporates many constraints involved in scheduling surgical procedures and finds an optimal sequence from among many permutations within an average of 2.3 minutes. We showed that we are able to achieve a significant improvement over historical scheduling strategies despite the presence of uncertainty in procedure and recovery durations. **By level loading the PACU, the improved schedule increases the effective capacity of the PACU. This reduces the frequency of PACU holds, thereby reducing costs and improving patient and staff satisfaction**."

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Lyons et al. **Surgery Scheduling and Perioperative Care: Smoothing and Visualizing Elective Surgery and Recovery Patient Flow**. *Analytics.* 2023.

- Scheduling model, scheduling perioperative care
- **Aim**: "addresses the practical problem of scheduling operating room (OR) elective surgeries to minimize the likelihood of surgical delays caused by the unavailability of capacity for patient recovery in a central post-anesthesia care unit (PACU).
- **Setting and Context:** "Working with a hospital in which 50+ procedures are performed in 15+ ORs most weekdays, we develop a constraint programming (CP) model that takes the hospital's elective surgery pre-schedule as input and produces a recommended alternate schedule designed to minimize the expected peak number of patients in the PACU over the course of the day.
- **Model description:** "Our model was developed from the hospital's data and evaluated through its application to daily schedules during a testing period. **Schedules generated by our model indicated the potential to reduce the peak PACU load substantially, 20-30% during most days in our study period, or alternatively reduce average patient flow time by up to 15% given the same PACU peak load**. We also developed tools for schedule visualization that can be used to aid management both before and after surgery day; plan PACU resources; propose critical schedule changes; identify the timing, location, and root causes of delay; and to discern the differences in surgical specialty case mixes and their potential impacts on the system."
- **Conclusions: "**In this paper, we have extended the view of the perioperative process to distinguish between patients according to a variety of paths they follow, as in-patients, one-day surgeries, and same-day admissions. We have also introduced a constraint program to develop coordinated OR schedules aimed at minimizing peak patient loads in the PACU, to better ensure that OR delays will not be incurred due to the PACU reaching full capacity and being unable to accept new patients from the ORs."

Performance Management

Improving efficiency and productivity by increasing accountability and using financial incentives. For articles relating to this section, please see the following in the first section, Reviews of Multiple Strategies:

- British Columbia Government. **Surgical Renewal Year-End Progress Report: April 1, 2022 – March 31, 2023**. BC Gov Department of Health, May 2023. LINK
- Department of Health, Government of Ireland. **2023 Waiting List Action Plan**. Government of Ireland, 2023. LINK
- Kreindler SA. **Policy strategies to reduce waits for elective care: a synthesis of international evidence**. Br Med Bull. 2010;95:7-32. (LINK)
- Reed S, Schlepper L, Edwards N. **Health system recovery from Covid-19: International lessons for the NHS**. Nuffield Trust: Research report March 2022. LINK

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